PESTICIDE SAFETY TRAINING COURSE

PROFESSIONAL DEVELOPMENT CONTINUING EDUCATION COURSE

Technical Learning College

ISBN: 978-0-9799559-9-0

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TLC
P.O. Box 3060
Chino Valley, AZ 86323

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

Important Information about this Manual

This CEU course manual has been prepared to educate pesticide applicators and operators in general safety awareness of dealing with the often-complex and various pesticide treatment devices, methods, and applications.

This manual covers general laws, regulations, required procedures, and accepted policies relating to the use of pesticides. It should be noted, however, that the regulation of pesticides and hazardous materials is an ongoing process and subject to change over time. For this reason, a list of resources is provided to assist in obtaining the most up-to-date information on various subjects.

This manual is not a guidance document for applicators or operators who are involved with pesticides. It is not designed to meet the requirements of the United States Environmental Protection Agency or your local State environmental protection agency or health department.

This CEU course manual provides general pesticide safety awareness and should not be used as a basis for pesticide treatment method/device guidance. This document is not a detailed pesticide information resource or a source or remedy for poison control.

Technical Learning College or Technical Learning Consultants, Inc. make no warranty, guarantee or representation as to the absolute correctness or appropriateness of the information in this manual and assumes no responsibility in connection with the implementation of this information.

It cannot be assumed that this manual contains all measures and concepts required for specific conditions or circumstances. This document is to be used solely for educational purposes only and is not considered a legal document.

Pesticides are poisonous. Always read and carefully follow all precautions and safety recommendations given on the container label. Store all pesticides or chemicals in the original labeled containers in a locked cabinet or shed, away from food or feeds, and out of the reach of children, unauthorized persons, pets, and livestock.

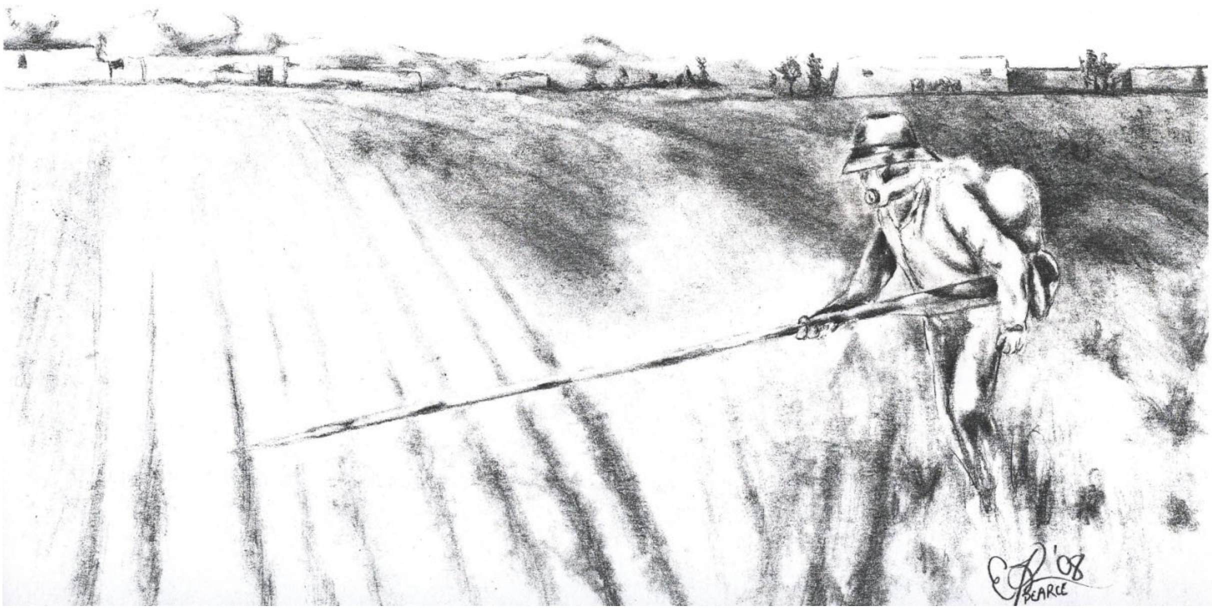
Confine pesticides or chemicals to the property being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables.

Dispose of empty containers carefully. Follow label instructions for disposal. Never reuse containers. Make sure empty containers are not accessible to children or animals.

Never dispose of containers where they may contaminate water supplies or natural waterways.

Do not pour down sink or toilet. Consult your county agricultural commissioner for correct ways of disposing of excess pesticides. Never burn pesticide containers.

Individuals who are responsible for pesticide storage, mixing, and application should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with the EPA and other appropriate federal, state, and local agencies.



Proper respiratory protection is essential to all pesticide applicators.

The handler employer must assure that:

- No pesticide is applied so as to contact any worker (directly or through drift) other than an appropriately trained and equipped handler.

- Workers handling highly toxic pesticides are monitored visually or by voice communication at least every 2 hours.

Any worker who handles a fumigant in a greenhouse, including a handler entering before acceptable safe entry criteria have been met, maintains continuous visual or voice contact with another handler who has immediate access to the required PPE if rescuing the handler in the greenhouse becomes necessary.

Responsibility

This course contains portions of EPA's WPS federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's or OSHA's regulations. Check with your state environmental/pesticide agency for more information. You are solely responsible in ensuring that you abide with your jurisdiction or agency's rules and regulations.

Technical Learning College's Scope and Function

Welcome to the Program,

Technical Learning College (TLC) offers affordable continuing education for today's working professionals who need to maintain licenses or certifications. TLC holds several different governmental agency approvals for granting of continuing education credit.

TLC's delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. TLC's distance-based or independent study courses are offered in a print - based distance educational format. We will beat any other training competitor's price for the same CEU material or classroom training.

Our courses are designed to be flexible and for you to finish the material at your convenience. Students can receive course materials through the mail or electronically. The CEU course or e-manual will contain all your lessons, activities and instruction to obtain the assignments. All of TLC's CEU courses allow students to submit assignments using e-mail or fax, or by postal mail. (See the course description for more information.)

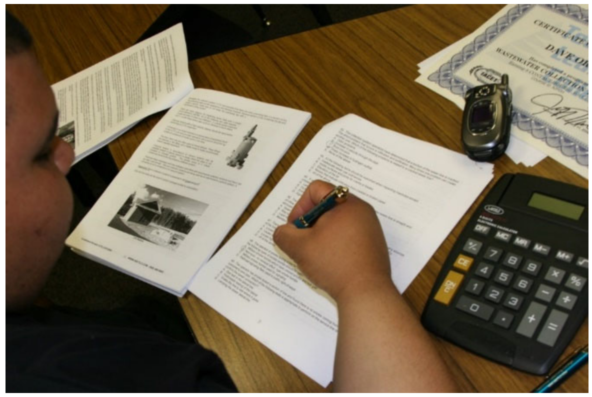
Students have direct contact with their instructor—primarily by e-mail or telephone. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling; i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored closed-book exams, depending upon your state or employer requirements.

Flexible Learning
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus - based student. You will work at your own pace, completing assignments in time frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

Course Structure
TLC's online courses combine the best of online delivery and traditional university textbooks. You can easily find the course syllabus, course content, assignments, and the post-exam (Assignment). This student-friendly course design allows you the most flexibility in choosing when and where you will study.

Classroom of One
TLC offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members (S.M.E.) are assigned at the beginning of each course providing the academic support you need to successfully complete each course. Please call or email us for assistance.

No Data Mining Policy
Unlike most online training providers, we do not use passwords or will upload intrusive data mining software onto your computer. We do not use any type of artificial intelligence in our program. Nor will we sell you any other product or sell your data to others as with many of our competitors. Unlike our training competitors, we have a telephone and we humanly answer.



We welcome you to do the electronic version of the assignment and submit the answer key and registration to us by either fax or e-mail. If you need this assignment graded and a certificate of completion within a 48-hour turn around, prepare to pay an additional rush charge of $50.

Contact Numbers
Fax (928) 468-0675
Email Info@tlch2o.com
Telephone (866) 557-1746

Precept-Based Training CEU Course
This training course is made of “micro-content” or “precepts”– small chunks of information that can be easily digested. Using bite-size pieces of technical information is considered to be one of the most effective ways of teaching people new information because it helps the student to retain knowledge easier.

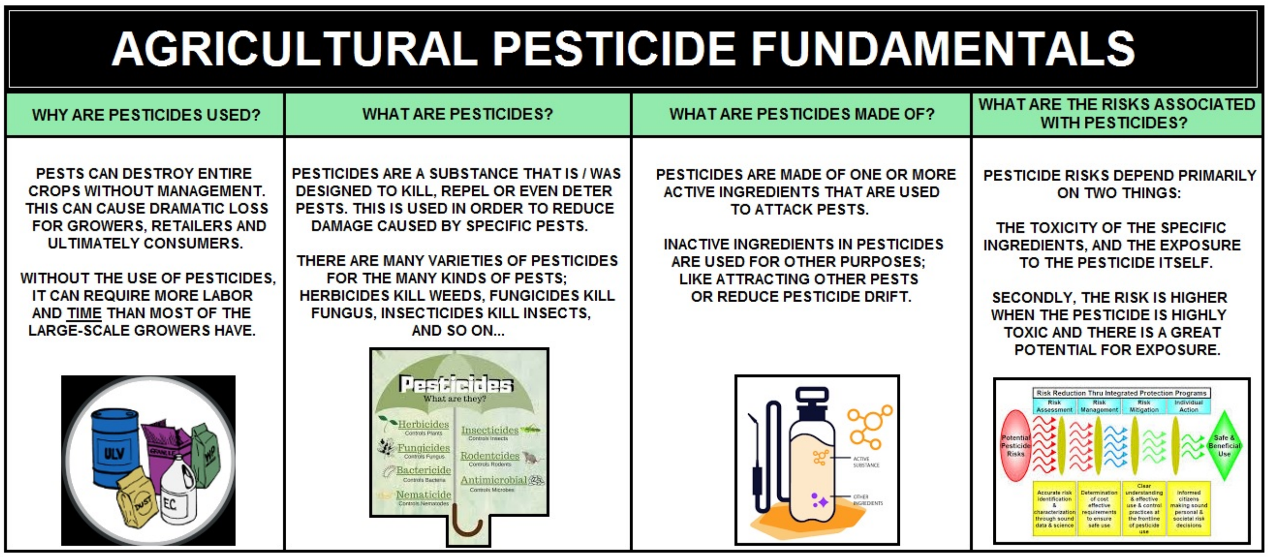
Micro-learning or precept-based training doesn’t rely on the student to process a large amount of information before breaking it down. Our method includes short modules with clearly defined learning goals for each section. This method allows a student to hone in on a particular skill, then demonstrate their knowledge in the final assessment.

Many States and employers require the final exam to be proctored.

CEU Course Description

Pesticide Safety Training CEU Course

This CEU course is a review of pesticide safety related training information, various pesticide application methods, pesticide classifications, types and trade names of commonly found pesticides. This course will cover basic pesticide handling, mixing, pesticide usages, first aid procedures, poisoning, environmental issues, pesticide resistance, spills, fate, toxicity, personal protective equipment and federal pesticide rules (hazard Communication and parts of the Worker Protection Standard. Much of this course information will come from OSHA and the USEPA. This course is general in nature and not state specific.



AGRICULTURAL PESTICIDE FUNDAMENTALS

Audience

Structural and Agricultural Pesticide Applicators (PCAs), and others who are not necessarily pesticide applicators but who possess a pesticide license for other needs, like in disinfection, wineries, nut, or meat production. The target audience for this course is the person interested in working in a pest control related position and/or wishing to maintain CEUs for certification license or to learn how to do the job safely and effectively, and/or to meet education needs for promotion.

Anyone involved in Structural Pest Control (PCAs) or Agricultural Pest Management (Workers and Handlers) also needs to be trained to identify the appropriate control measures and should have an awareness of how the chemicals used can affect others and the environment. This knowledge may require communication and notification to affected persons, or restricted access to areas that have been treated.

A very small portion of this course will come from the EPA's Agricultural Worker Protection Standard (WPS). The EPA's Worker Protection Standard is aimed at reducing the risk of pesticide poisoning and injury among agricultural workers and pesticide handlers. The standard requires employers to provide protection to workers from potential exposure, provide training on pesticide safety, and mitigate any pesticide exposures that may occur. The WPS is an excellent guideline for structural pesticide usage.

About a seventh part of this course is on Hazard Communication. OSHA requires all pesticide or related chemical employers must ensure that employees receive hazard communication protections in the workplace. Commercial pesticide employers shall make sure all SDS's are available to all employees and that all chemical products like mixed chemicals and fumigants have proper placards and labeling. Hazard communication is the practice of properly informing employees about pesticide/chemical dangers they might encounter.

You will not need any other materials for this course. Pesticide applicators both structural and agricultural may be exposed to pesticides by:

- Preparing pesticides for use, such as by mixing a concentrate with water or loading the pesticide into application equipment, dusting, spraying, etc.
- Dealing with environmental impact issues and chemic fates of pesticide chemicals.
- Understanding various pesticide and right-to-know laws related to pesticide usage.
- Proper pesticide applications, such as in an agricultural, structural or commercial setting
- Instruction for entering an area, or working where pesticides have been applied to perform allowed tasks, such as picking crops.

Final Examination for Credit
Opportunity to pass the final comprehensive examination is limited to three attempts per course enrollment.

Prerequisites: None

Course Procedures for Registration and Support
All of Technical Learning College correspondence courses have complete registration and support services offered. Delivery of services will include, e-mail, web site, telephone, fax and mail support. TLC will attempt to provide immediate and prompt service. When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date.

It is the student's responsibility to note dates for assignments and keep up with the course work. If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request. All students are tracked by a unique number assigned to the student.

Instructions for Written Assignments
The Pesticide Safety Training CEU Training course uses a multiple choice and a True/False style answer key. Complete course support is available on TLC's website under the Assignment Page. You can write your answers in this manual or type out your own answer key. TLC would prefer that you type out and e-mail the examination to TLC, but it is not required.

Feedback Mechanism (examination procedures)
Each student will receive a feedback form as part of his or her study packet. You will be able to find this form in the assignment packet.

Security and Integrity
All students are required to do their own work. All lesson sheets and final exams are not returned to the student to discourage the sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified.

Grading Criteria
TLC will offer the student either pass/fail or a standard letter grading assignment. If TLC is not notified, you will only receive a pass/fail notice.

Required Texts
The course will not require any other materials. This course comes complete. No other materials are needed.

Environmental Terms, Abbreviations, and Acronyms
TLC provides a glossary that defines in non-technical language commonly used environmental terms appearing in publications and materials. It also explains abbreviations and acronyms used throughout the EPA and other agencies. You can find the glossary in the rear of this manual.

Recordkeeping and Reporting Practices
TLC will keep all student records for a minimum of seven years. It is your responsibility to give the completion certificate to the appropriate agencies.

ADA Compliance
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs. Course content may vary from this outline to meet the needs of this particular group.

Continuing Education Units
You will have 90 days from receipt of this manual to complete it in order to receive your Continuing Education Units (**CEUs**) or Professional Development Hours (**PDHs**). A score of 70 % is necessary to pass this course.

If you should need any assistance, please email all concerns as well as the final test to info@tlch2o.com.

Note to students: Final course grades are based on the total number of possible points. The grading scale is administered equally to all students in the course. Do not expect to receive a grade higher than that merited by your total points. No point adjustments will be made for class participation or other subjective factors.

Credit/no credit option (P/Z) - None Available
Your assignments are due on time. Any assignment or mailed-in examination that is one to five days late will be marked down one letter grade. Any assignment or mailed-in examination that is turned in *later* than five days will not be accepted and will be recorded in my grade book as "***non-participating***" and you can be withdrawn from class. (See final grade options.)

Note to students: Keep a copy of everything that you submit. If your work is lost you can submit your copy for grading. If you do not receive your certificate of completion or results within two or three weeks after submitting it, please contact your instructor.

We expect every student to produce his/her original, independent work. Any student whose work indicates a violation of the Academic Misconduct Policy (cheating, plagiarism) can expect penalties as specified in the Student Handbook, which is available through Student Services; contact them at (928) 468-0665.

Course Objective: At the end of this course, the student will be able to understand and describe pesticides, pesticide safety techniques, safe pesticide application, proper pesticide safety equipment, various pesticide chemical treatments, the Hazard Communication rule and the Worker Protection Standard.

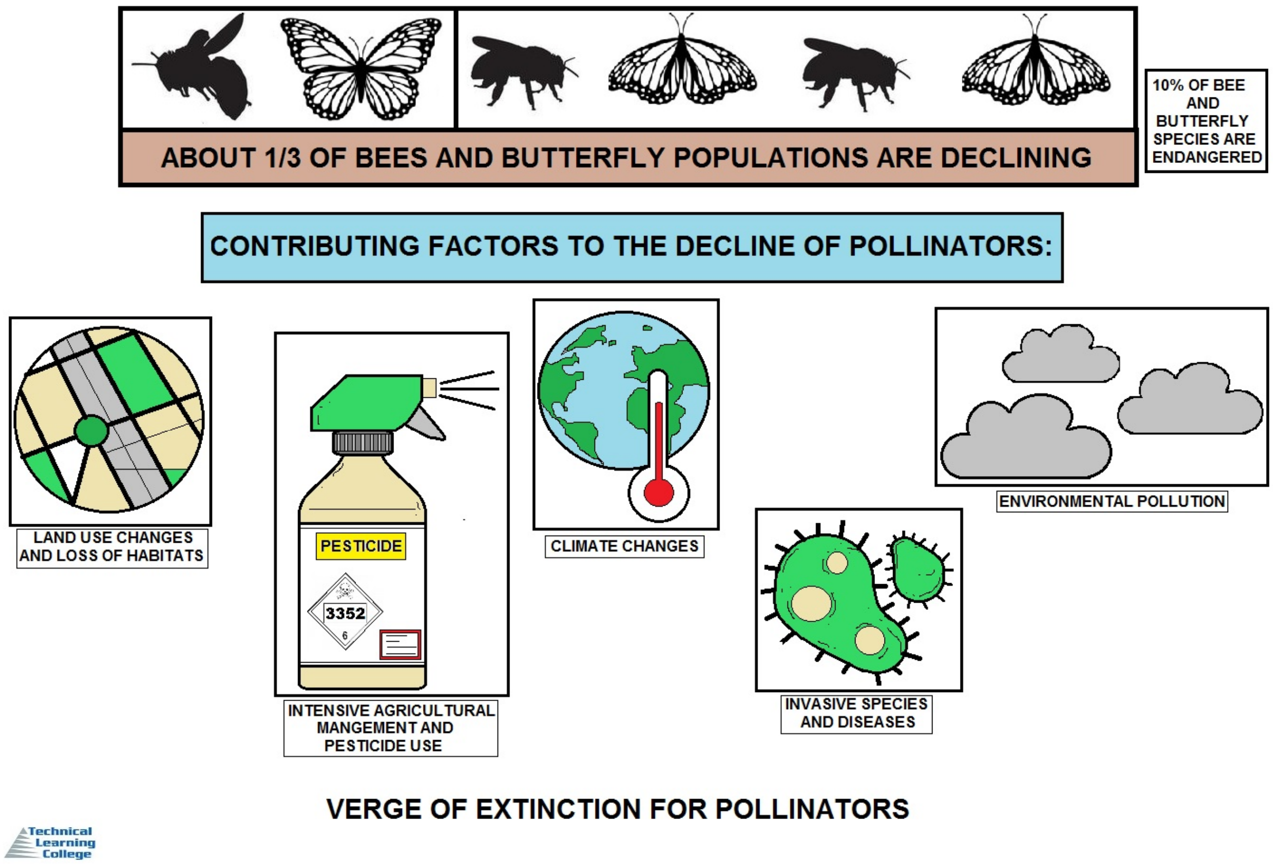
Educational Mission
The educational mission of TLC is:
To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the pesticide application field,

To provide TLC students opportunities to apply and understand the theory and skills needed for pesticide application certification,

To provide opportunities for TLC students to learn and practice pesticide application skills with members of the community for the purpose of sharing diverse perspectives and experience,

To provide a forum in which students can exchange experiences and ideas related to pesticide application,

To provide a forum for the collection and dissemination of current information related to pesticide application education, and to maintain an environment that nurtures academic and personal growth.



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Common Abbreviations for Pesticide Formulations

A= Aerosol
AF= Aqueous flowable
AS= Aqueous solution or aqueous suspension
B = Bait
C= Concentrate
CM= Concentrate mixture
CG = Concentrate granules
D= Dust
DF= Dry flowables
DS= Soluble dust
E= Emulsifiable concentrate
EC= Emulsifiable concentrate
F= Flowable (liquid)
G = Granules
GL= Gel
L= Liquid (flowable)
LC= Liquid concentrate or low concentrate
LV = Low volatile
M= Microencapsulated
MTF= Multiple temperature formulation
P = Pellets
PS= Pellets
RTU= Ready-to-use
S= Solution
SD= Soluble dust
SG = Soluble granule
SP = Soluble powder or soluble packet
ULV = Ultra low volume
ULW = Ultra low weight or ultra-low wettable
W = Wettable powder
WDG = Water-dispersible granules
WP = Wettable powder
WS= Water soluble
WSG = Water-soluble granules
WSL= Water-soluble liquid
WSP = Water-soluble powder or water-soluble packet

Acronyms/Abbreviations

The following list presents some acronyms and abbreviations used in this document.
*The **Glossary** contains a more complete list.*

ANSI: American National Standards Institute
APEC: Asia-Pacific Economic Cooperation
ASTM: American Society of Testing and Materials
CA: Competent Authority
CAS: Chemical Abstract Service
CBI: Confidential Business Information
CFR: Code of Federal Regulations
CG/HCCS: Coordinating Group for the Harmonization of Chemical Classification Systems
CPSC: Consumer Product Safety Commission
DOT: Department of Transportation
EINECS: European Inventory of Existing Commercial Chemical Substances
EPA: Environmental Protection Agency
EU: European Union
FIFRA: Federal Insecticide, Fungicide and Rodenticide Act
GHS: Globally Harmonized System of Classification and Labeling of Chemicals
HCS: Hazard Communication Standard
IARC: International Agency for the Research on Cancer
IFCS: International Forum on Chemical Safety
ILO: International Labor Organization
IOMC: Inter-organization Program on the Sound Management of Chemicals
ISO: International Standards Organization
IUPAC: International Union of Pure and Applied Chemistry
LD_{50} : Lethal dose 50mg/kg: Milligram per kilogram
MSDS: Material Safety Data Sheet
NAFTA: North American Free Trade Agreement
OSHA: Occupational Safety and Health Administration
OECD: The Organization for Economic Cooperation and Development
QSARs: Quantitative Structure-Activity Relationships
SDS: Safety Data Sheet
SME: Small and medium sized enterprises
TFHCL: Task Force on the Harmonization of Classification and Labeling
TSCA: Toxic Substances Control Act
UN: United Nations
UNCED: United Nations Conference on Environment and Development
UNCETDG: United Nations Committee of Experts on the Transport of Dangerous Goods
UNCETDG/GHS: United Nations Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and Labeling of Chemicals
UNITAR: United Nations Institute for Training and Research
WG: work group
WHMIS: Workplace Hazardous Materials Information System
WSSD: World Summit on Sustainable Development

Topic 1 - Pesticide Safety Introduction

Topic 1 - Section Focus: You will learn the basics of pesticides, pesticide classification and safety procedures. At the end of this section, the student will be able to understand and describe pesticide and pesticide safety techniques. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours

Topic Scope: Pesticides are chemicals that are used to eliminate pests and protect crops. The four most common pesticides are: insecticides to control insects, herbicides to control weeds, fungicides to control plant diseases, and rodenticides/pesticides to control other pests such as rodents and birds. Because pesticides are poisonous, they can be extremely dangerous to humans and the environment. Before applying commercial pesticides always consider your safety, the safety of others, and the safety of the environment.

Anyone involved in structural Pest Control (PCAs) or Agricultural Pest Management (Workers and Handlers) also needs to be trained to identify the appropriate control measures and should have an awareness of how the chemicals used can affect others and the environment. This knowledge may require communication and notification to affected persons, or restricted access to areas that have been treated. Much of this course will come from the EPA's Agricultural Worker Protection Standard (WPS) but it is an excellent standard for structural pesticide usage.

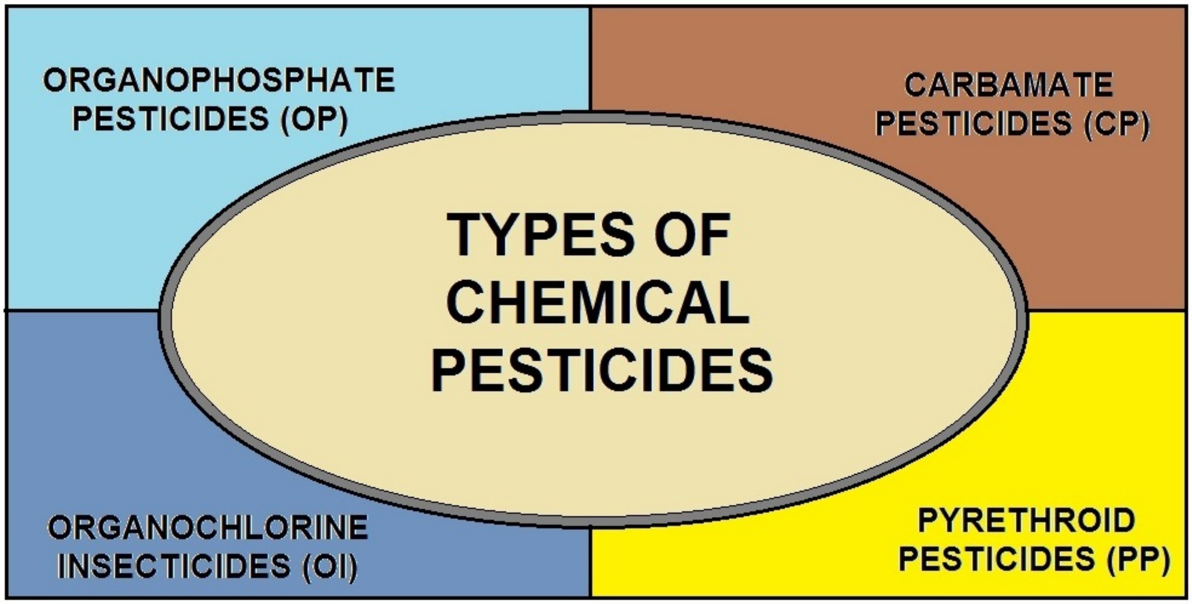
The EPA's Worker Protection Standard is aimed at reducing the risk of pesticide poisoning and injury among agricultural workers and pesticide handlers. The standard requires employers to provide protection to workers from potential exposure, provide training on pesticide safety, and mitigate any pesticide exposures that may occur.

Authors' Introduction

The authors' intent is to emphasize the importance of proper safety in dealing, handling or applying various pesticides and the dangers to the applicator and to the environment. The authors are pesticide applicators and will have an emphasis of the dangers of pesticides from a pesticide applicator's viewpoint. We have seen too many pesticide related injuries and illnesses because of a lack of safety training and proper personal protection equipment, especially respiratory protection and medical surveillance and fit testing. Many of these illnesses do not occur for several years or decades after the usage of the pesticides.

Our viewpoint on pesticide application is that in general, most applicators do not use proper pesticide safety procedures during application. Our focus is to emphasize the importance of properly dealing or applying these toxic chemicals in order to save the applicator's health in the long run of their career and to minimize environmental damage from not following the label's instruction or federal laws.

We will start with the basics of pesticides and move on to pesticide safety. There will be several areas of concern and the author will try to address many of these however, pesticides, application methods, laws and other complexities are too vast for one course to cover.   The authors will provide tradenames of many different pesticide products but does not endorse any of these products for sale. Do not follow the authors' suggestions or experiences but always follow the pesticide label's instruction and the federal and state rule regarding pesticide applications.



TYPES OF PESTICIDES DIAGRAM #1

Pesticide Definition

Pesticides are substances that are meant to control pests, including weeds. The term pesticide includes all of the following: herbicide, insecticides (which may include insect growth regulators, termiticides, etc.) nematicide, molluscicide, piscicide, avicide, rodenticide, bactericide, insect repellent, animal repellent, antimicrobial, fungicide and disinfectant (antimicrobial).

Most common of these products are herbicides that account for approximately 80% of all pesticide use. Most pesticides are intended to serve as plant protection products (also known as crop protection products), which in general, protect plants from weeds, fungi, or insects.

In general, a pesticide is a chemical or biological agent (such as a virus, bacterium, or fungus) that deters, incapacitates, kills, or otherwise discourages pests. Target pests can include insects, plant pathogens, weeds, mollusks, birds, mammals, fish, nematodes (roundworms), and microbes that destroy property, cause nuisance, or spread disease, or are disease vectors. Along with these benefits, pesticides also have drawbacks, such as potential toxicity to humans and other species.

Insecticide Definition

An insecticide is a pesticide used against insects. They include ovicides and larvicides used against the eggs and larvae of insects respectively. The use of insecticides is believed to be one of the major factors behind the increase in agricultural productivity in the 20th century. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans; and others are concentrated in the food chain.

Exposure Limits Introduction

Information on the pesticide chemical's exposure limits—how much of the chemical it is believed you can safely be exposed to over time--may be given as:

PEL—Permissible Exposure Limit set by OSHA. To explain it simply, it's the averaged maximum concentration of the chemical in the air to which OSHA believes a person can be exposed repeatedly without developing health problems. The PEL is generally expressed in parts per million (**ppm**). Concentrations at or above the PEL make respiratory protection mandatory.

TLV—Threshold Limit Value, recommended by the American Conference of Governmental Industrial Hygienists. To explain it simply, it's the average maximum air concentration of the chemical that a worker may be repeatedly exposed to without adverse effect. Unlike the PEL, this is a recommendation rather than a mandatory limit. The SDS may also provide other exposure limits used or recommended by the chemical manufacturer or importer.

Reading the Pesticide Label

The pesticide label is your best guide to using pesticides safely and effectively. The directions on the label are there primarily to help you achieve "maximum" benefits—the pest control that you desire—with "minimum" risk. Both depend on following label directions and correctly using the pesticide.

Read the label. Read the label before buying the pesticide. Read the label before mixing or using the pesticide each time, and read the label before storing or disposing of the pesticide. Do not trust your memory. You may have forgotten part of the label instructions or they may have changed. Use of any pesticide in any way that is not consistent with label directions and precautions is illegal. It may also be ineffective and, even worse, dangerous.

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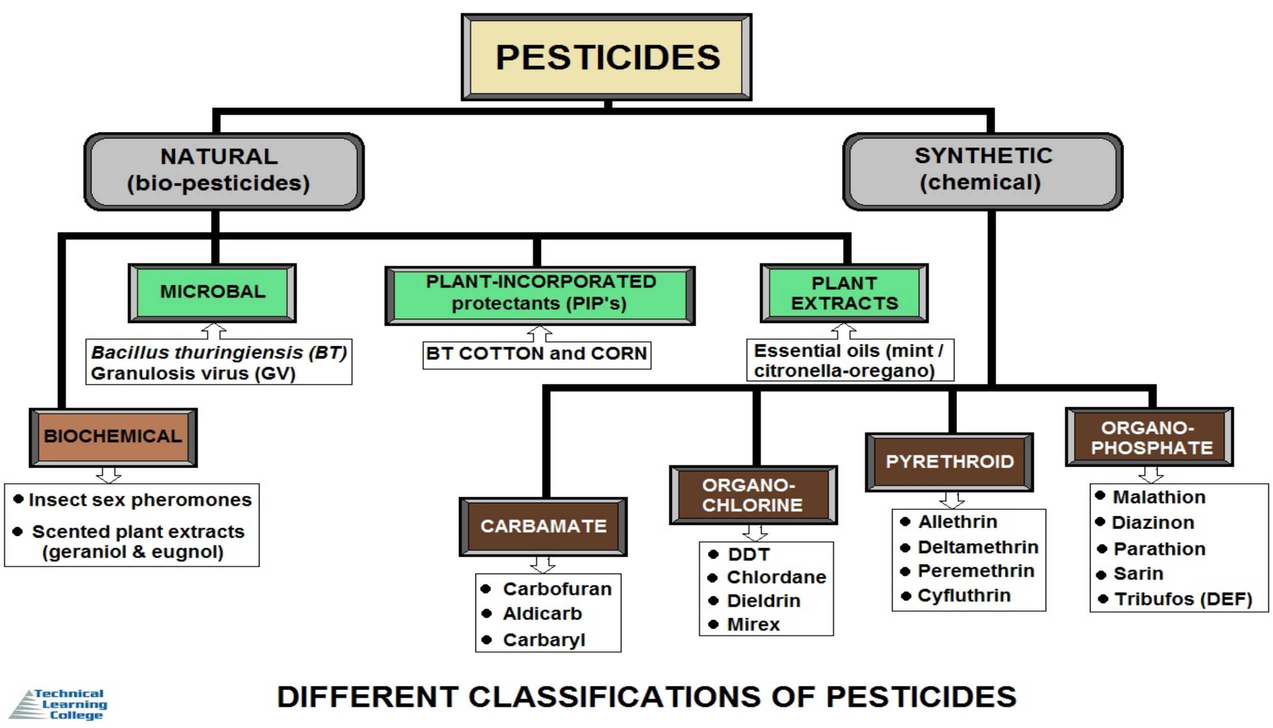


DIFFERENT CLASSIFICATIONS OF PESTICIDES

Common Kinds of Pesticides and their Function

Algaecides
Control algae in lakes, canals, swimming pools, water tanks, and other sites.

Antifouling agents
Kill or repel organisms that attach to underwater surfaces, such as boat bottoms.

Antimicrobials
Kill microorganisms (such as bacteria and viruses).

Attractants
Attract pests (for example, to lure an insect or rodent to a trap). (However, food is not considered a pesticide when used as an attractant.)

Biocides
Kill microorganisms.

Disinfectants and sanitizers
Kill or inactivate disease-producing microorganisms on inanimate objects.

Fungicides
Kill fungi (including blights, mildews, molds, and rusts).

Fumigants
Produce gas or vapor intended to destroy pests in buildings or soil.

Herbicides
Kill weeds and other plants that grow where they are not wanted.

Insecticides
Kill insects and other arthropods.

Miticides (also called acaricides)
Kill mites that feed on plants and animals.

Microbial pesticides
Microorganisms that kill, inhibit, or out compete pests, including insects or other microorganisms.

Molluscicides
Kill snails and slugs.

Nematicides
Kill nematodes (microscopic, worm-like organisms that feed on plant roots).

Ovicides
Kill eggs of insects and mites.

Pesticides and Functions

Pheromones
Biochemicals used to disrupt the mating behavior of insects.

Repellents
Repel pests, including insects (such as mosquitoes) and birds.

Rodenticides
Control mice and other rodents.

The term pesticide also includes these substances:

Defoliants
Cause leaves or other foliage to drop from a plant, usually to facilitate harvest.

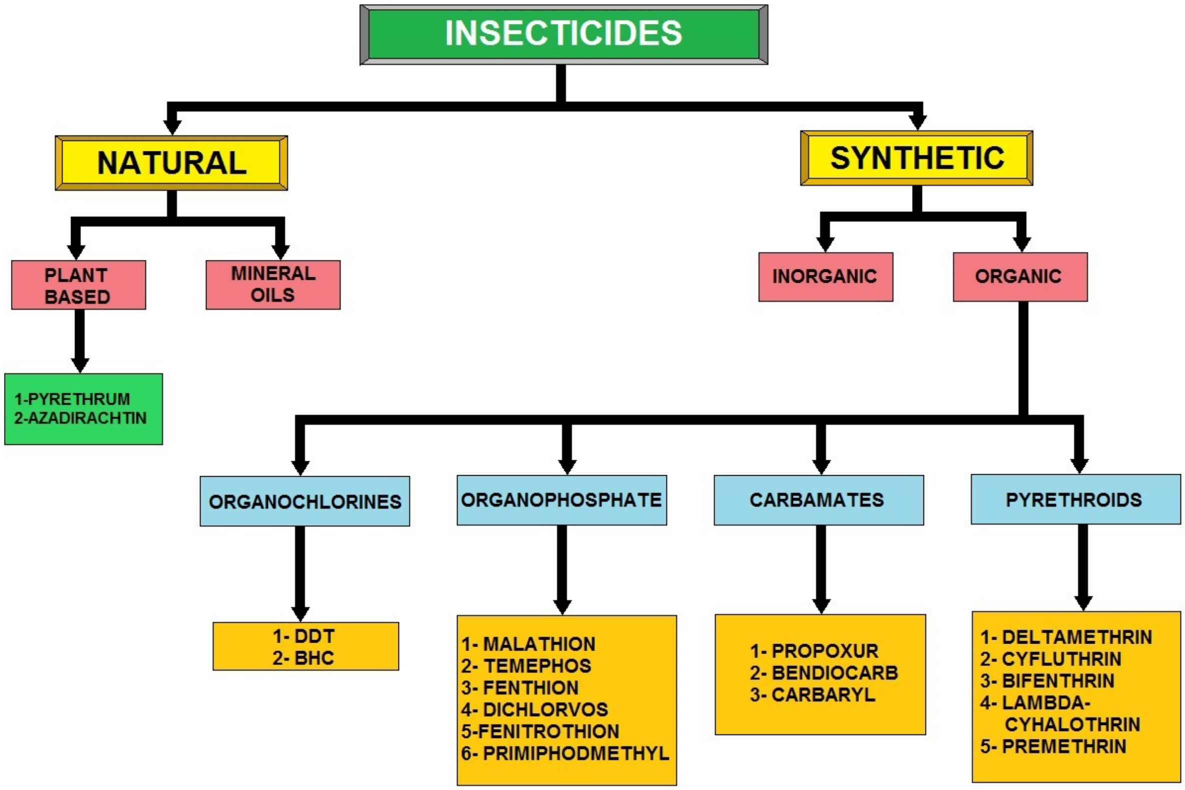
Desiccants
Promote drying of living tissues, such as unwanted plant tops.

Insect Growth Regulators
Disrupt the molting, maturity from pupal stage to adult or other life processes of insects.

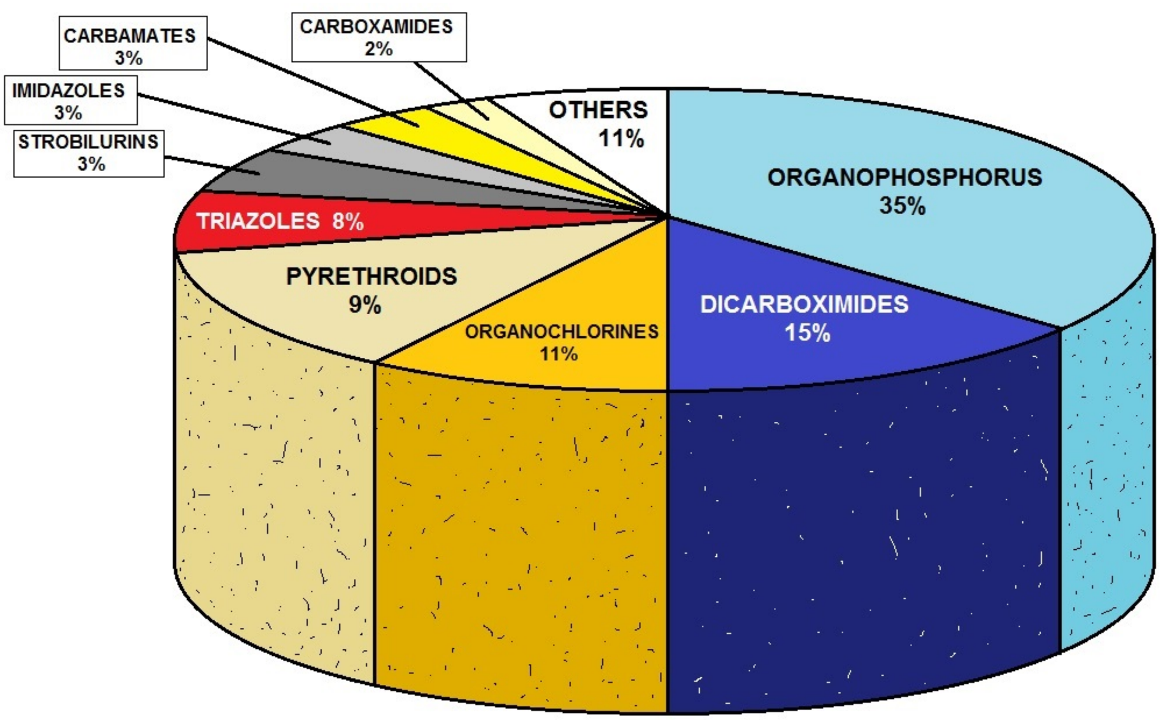
Plant Growth Regulators
Substances (excluding fertilizers or other plant nutrients) that alter the expected growth, flowering, or reproduction rate of plants.

These common products are considered pesticides.

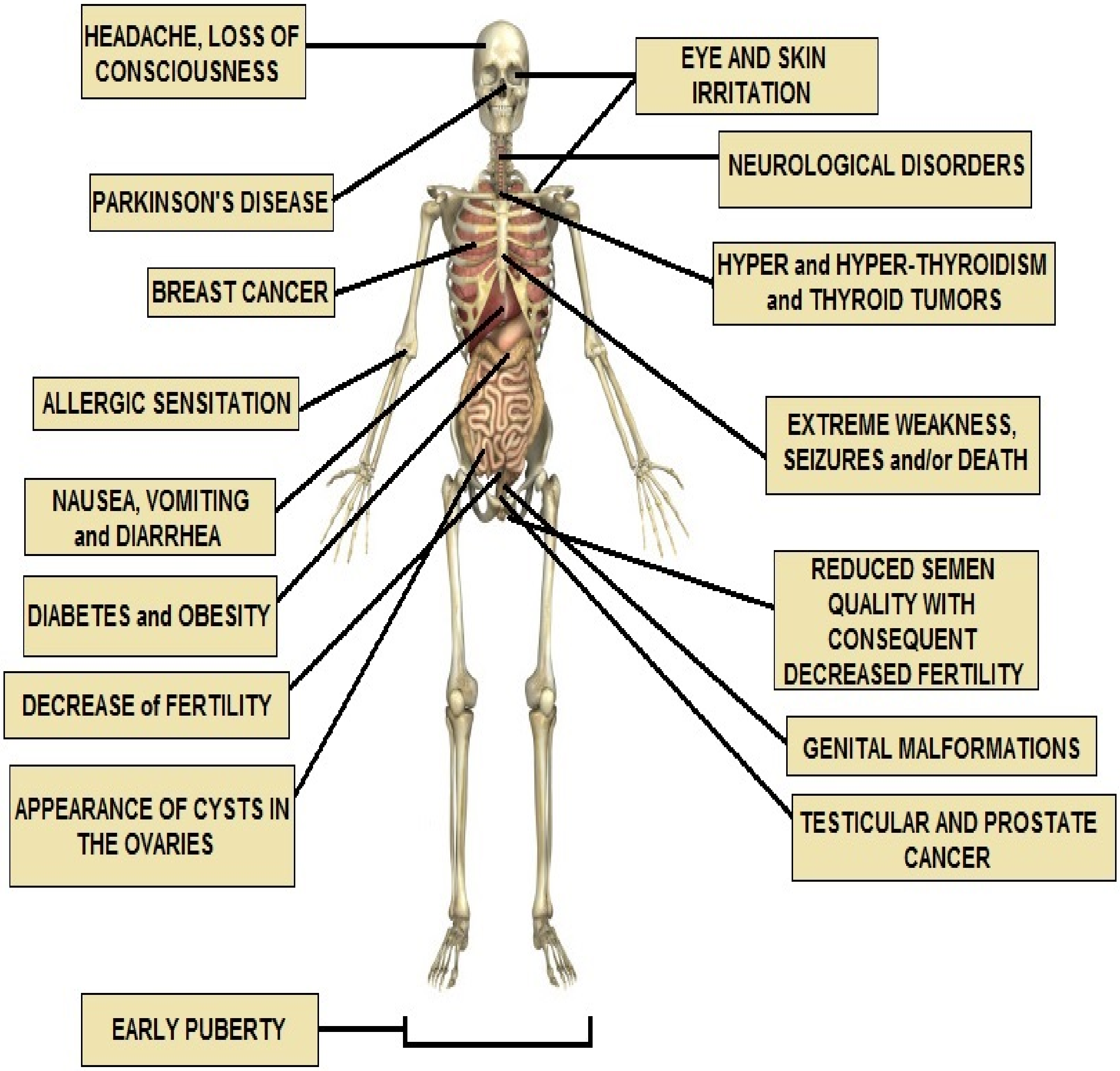
- Cockroach sprays and baits
- Flea and tick sprays, powders, and pet collars.
- Insect repellents for personal use.
- Kitchen, laundry, and bath disinfectants and sanitizers.
- Products that kill mold and mildew.
- Rat and other rodent poisons.
- Some lawn and garden products, such as weed killers.
- Some swimming pool chemicals like chlorine.



PESTICIDES BASED UPON CHEMICAL COMPOSITION



PERCENTAGE OF PESTICIDE BY CHEMICAL CLASSIFICATION



TOXIC IMPACT OF PESTICIDES ON HUMAN BODY

	GLOVES	HARD HAT	APRON	COVERALLS	RESPIRATOR	FOOTWEAR	PROTECTIVE EYEWEAR
MIXING / LOADING	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
ENCLOSED CAB	NO	NO	NO	NO	NO	SHOES + SOCKS	NO
OPEN CAB	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
CLEANOUT	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO

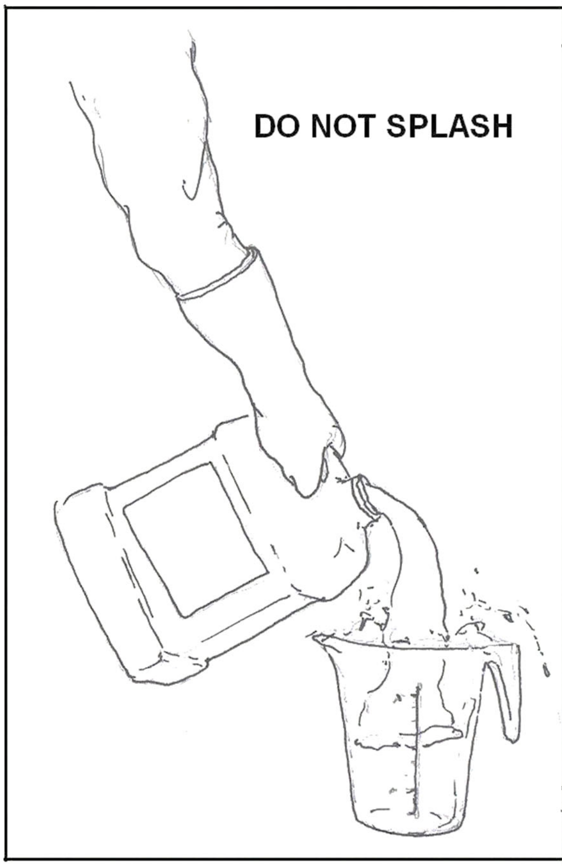
PESTICIDE HANDLING SAFETY REFERENCE (PPE)

Pesticide Posioning Signs and Symptoms

Acute Exposure for Insecticide Active Ingredients

Active Ingredient	Brand Name	Signs and Symptoms
Acephate (organophosphate)	Orthene	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Aldicarb (N-methyl carbamate)	Temik	Malaise, muscle weakness, dizziness, sweating. Headache, salivation, nausea, vomiting, abdominal pain, diarrhea. Nervous system depression, pulmonary edema in serious cases.
Carbaryl (N-methyl carbamate)	Sevin	Malaise, muscle weakness, dizziness, sweating. Headache, salivation, nausea, vomiting, abdominal pain, diarrhea. Nervous system depression, pulmonary edema in serious cases.
Chlorpyrifos (organophosphate)	Dursban	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Endosulfan (organochlorine)	Thiodan	Itching, burning, tingling of skin. Headache, dizziness, nausea, vomiting, lack of coordination, tremor, mental confusion. Seizures, respiratory depression, coma.
Malathion (organophosphate)	Cythion	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Methyl Parathion (organophosphate)	Penncap-M	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Phosmet (organophosphate)	Imidan	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Pyrethrins (natural origin)		Irritating to skin and upper respiratory tract. Contact dermatitis and allergic reactions--asthma.

Pyrethroids (synthetic pyrethrin)	Cypermethrin, permethrin	Abnormal facial sensation, dizziness, salivation, headache, fatigue, vomiting, diarrhea. Irritability to sounds or touch. Seizures, numbness.



Pesticide Applicators Must Think About These Concerns:

- Where will the pesticide go after it leaves its container or application equipment?
- What effects could it have on those non-target sites it may reach?
- What can I do to minimize harmful effects?

Types of Pesticide Spectrums

Broad-Spectrum
A pesticide that is effective against many pest. An example of a broad-spectrum pesticide is methyl bromide, which is designed to control pests ranging from small insects and pathogens to larger weeds and rodents. The pesticide can be injected into the ground to kill organisms in the soil that might harm the plant while it is growing. It can also be pumped into warehouses or barns to kill pests that could harm the plant during storage or transport for sale.

Narrow-Spectrum AKA Target-Spectrum
Developed to kill specific organism types. An example of a narrow-spectrum pesticide is chitin inhibitors, which are chemicals that interact with chitin, a component of the exoskeleton of insects. This pesticide inhibits the development of chitin and will eventually result in the death of the insect. The chitin inhibiting pesticide will only harm insects that have chitin in their exoskeletons and will not affect other insects.

Pesticide Formulation Breakdown

1. The pesticide active ingredient that controls the target pest

2. The **carrier**, such as an organic solvent or mineral clay

3. **Adjuvants**, such as stickers and spreaders

Other ingredients, such as stabilizers, safeners, dyes, and chemicals that improve or enhance pesticidal activity

Adjuvants - Primary Types

A pesticide adjuvant is broadly defined as any substance added to the spray tank, separate from the pesticide formulation, that will improve the performance of the pesticide.

Diluent: A substance used to dilute something.
Fillers: A diluent in Powder form.
Spreaders: A substance that is added to assist even distribution over the target.
Surfactants: Chemicals that physically alter the surface tension of a spray droplet.
Wetting Agent: A chemical added that can be added to a liquid to reduce its surface tension and make the chemical more effective in spreading over and penetrating surfaces.

Minor Purpose Adjuvants
A number of adjuvants for various special purposes exist for which there are only a few products available in each category. For some of these types, there is disagreement among researchers as to their effectiveness, circumstances under which they will be effective, and the concentrations that may be needed to be effective.

Categories of Agricultural Adjuvants

Activators	**Special Purpose**
Spreaders	Foliar nutrients
wetters	Compatibility agents
Stickers	Drift retardants
builders	Foam retardants
extenders	Buffers
Emulsifiers	Inverting agents
dispersants	Soil penetrants
suspending agents	Stabilizing agents (UV filters)
Plant Penetrants	Feeding stimulants
translocators	Washing agents
Emulsifiable oils	Sinking agents
activators	Protectant binders

Wetter Spreaders
A spray drop must be able to wet the foliage and spread out or cover an area of the leaf for the pesticide to perform its pest control function. In some situations, (very waxy or hairy leaves or insufficient surfactant in the pesticide concentrate formulation), additional adjuvant is needed for good coverage. Too much surfactant may permit runoff or loss of deposit rather than increasing coverage.

Stickers
A sticker can perform three types of functions. It can increase the adhesion or "stickiness" of solid particles that otherwise might be easily dislodged from a leaf surface, sort of glue them on as it were. It can also reduce evaporation of the pesticide.

Emulsifiable Oil Activators
Petroleum oils will enhance the penetration of some pesticides through the waxy layer of cuticle on a leaf surface and thus increase the rate of penetration. Most herbicide activators are emulsifiable light oils containing variable amounts of surfactants to emulsify the oil.

Buffers
Some water used for diluting pesticide formulations is alkaline (high pH). If the pH is sufficiently high and the pesticide is subject to degradation by alkaline hydrolysis, it may be necessary to lower the pH of the mix water. If the pesticide is alkaline labile but poorly water soluble, the formulation colloids will provide some protection from hydrolysis in the spray.

Inverting Agents
These are special emulsifiers that can invert an oil/water emulsion (the usual type in pesticide formulations) to a water/oil emulsion, or invert emulsion that is very viscous or "mayonnaise-like". This requires special application equipment and is effective in reducing drift.

Inert Ingredients
Pesticide products contain at least one active ingredient and other intentionally added inert ingredients. Called “inert ingredients” by the federal law, they are combined with active ingredients to make a pesticide product. Inerts are chemicals, compounds, and other substances, including common food commodities (e.g., certain edible oils, spices, herbs) and some natural materials (e.g., beeswax, cellulose).

Pesticide - Primary Characteristics

Solubility
Is a measure of the ability of a pesticide to dissolve in a solvent, usually water. Highly soluble pesticides dissolve easily in water. They are more likely to move with surface water in runoff or by leaching down through the soil than less soluble pesticides.

Adsorption
Measure how well a pesticide sticks to soil particles. It occurs because of the attraction between the chemical and soil particles. Typically, oil-soluble pesticides are more attracted to clay particles and organic matter in soil than water-soluble pesticides. Also, pesticide molecules with a positive (+) charge are tightly adsorbed to negatively (-) charged soil particles. A pesticide that adsorbs to soil particles is less likely to move from the spray site than one that does not adsorb tightly to soil.

Persistence
Is the ability of a pesticide to remain present and active in its original form for a long time before breaking down. Persistence is described in terms of half-life: the time needed for 50% of the chemical to break down (degrade). The longer the half-life, the more persistent the pesticide.

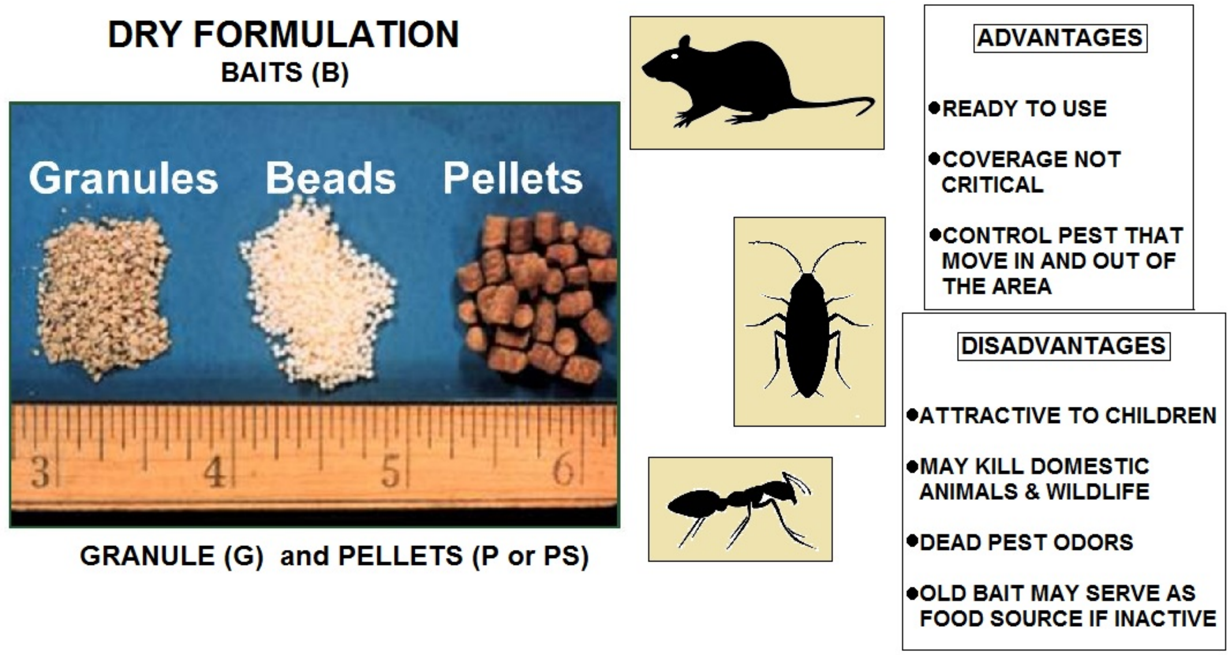
Residue
The amount of pesticide that remains in the environment after an application or a spill. A residue is desirable when it provides long-term pest control and reduces the need for repeated applications. However, some persistent pesticides can harm sensitive plants or animals, including humans. Therefore, it is especially important to prevent persistent pesticides from moving offsite through improper handling, application, drift, leaching, or runoff.

Pesticide Medias – Primary Delivery Systems

Liquid Formulations
Liquid formulations are generally mixed with water, but in some instances labels may permit the use of crop oil, diesel fuel, kerosene, or some other light oil as a carrier. This section will present more detailed information about the common liquid pesticide formulations.

Aerosols (A)
These formulations contain one or more active ingredients and a solvent. Most aerosols contain a low percentage of active ingredients. There are two types of aerosol formulations: the ready-to-use type commonly available in pressurized, sealed containers and those products used in electric- or gasoline-powered aerosol generators that release the formulation as a “smoke” or “fog.”

Liquid Baits
An increasing number of insecticides and rodenticides are being formulated as liquid baits. Liquid rodenticides are mixed with water and placed in bait stations designed for these products. They have two major benefits. Liquid rodenticides are effective in controlling rodents, especially rats, in areas where they cannot find water. They are also effective in areas of poor sanitation where readily available food renders traditional baits ineffective.



PESTICIDE DRY FORMULATIONS

Dry or Solid Formulations
Dry formulations can be divided into two types: ready-to-use and concentrates that must be mixed with water to be applied as a spray. This section will present more detailed information about the common dry or solid pesticide formulations. Dusts (D) Most dust formulations are ready to use and contain a low percentage of active ingredients (usually 10% or less by weight), plus a very fine, dry inert carrier made from talc, chalk, clay, nut hulls, or volcanic ash. The size of individual dust particles varies.

Granules (G)
Granular formulations are similar to dust formulations except granular particles are larger and heavier. The coarse particles are made from materials such as clay, corncobs, or walnut shells. The active ingredient either coats the outside of the granules or is absorbed into them. The amount of active ingredient is relatively low, usually ranging from less than 1 to 15 percent by weigh.

Wettable Powders (WP or W)
Wettable powders are dry, finely ground formulations that look like dusts. They usually must be mixed with water for application as a spray. A few products, however, may be applied either as a dust or as a wettable powder; the choice is left to the applicator. Wettable powders contain 5%–95% active ingredient by weight, usually 50% or more. The particles do not dissolve in water. They settle out quickly unless constantly agitated to keep them suspended.

Water-Dispersible Granules (WDG) or Dry Flowables (DF)
Water-dispersible granules, also known as dry flowables, are like wettable powders except instead of being dust-like; they are formulated as small, easily measured granules. Water-dispersible granules must be mixed with water to be applied. Once in water, the granules break apart into fine particles similar to wettable powders. The formulation requires constant agitation to keep them suspended in water. The percentage of active ingredient is high, often as much as 90 percent by weight.

Soluble Powders (SP or WSP)

Soluble powder formulations look like wettable powders. However, when mixed with water, soluble powders dissolve readily and form a true solution. After they are mixed thoroughly, no additional agitation is necessary. The amount of active ingredient in soluble powders ranges from 15% to 95% by weight; it usually is more than 50%. Soluble powders have all the advantages of wettable powders and none of the disadvantages except the inhalation hazard during mixing. Few pesticides are available in this formulation because few active ingredients are readily soluble in water.

Water-Soluble Packets (WSB or WSP)

Water-soluble packets reduce the mixing and handling hazards of some highly toxic pesticides. Manufacturers package precise amounts of wettable powder or soluble powder formulations in a special type of plastic bag. When you drop these bags into a filled spray tank, they dissolve and release their contents to mix with the water.

Fumigants

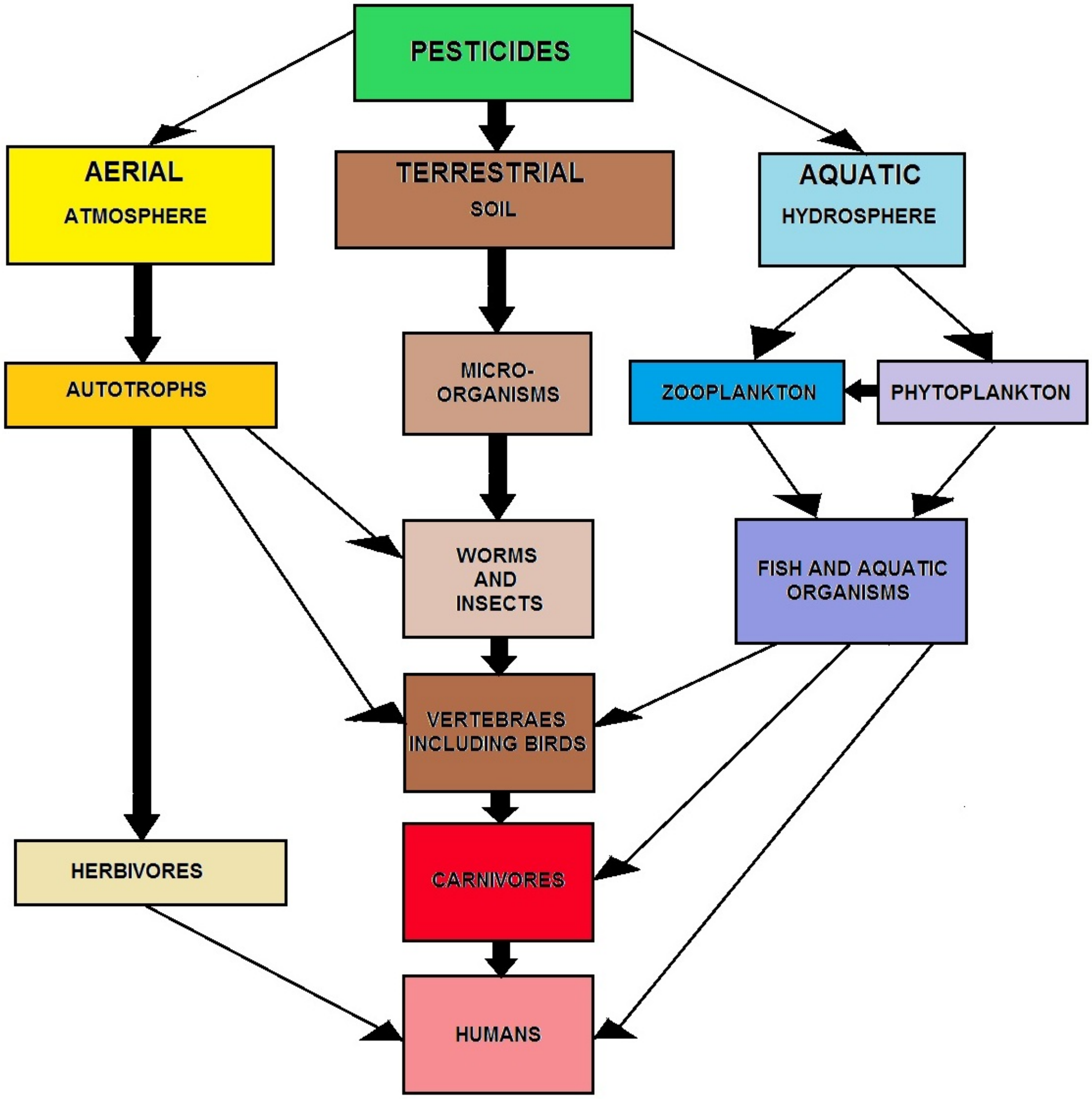
Fumigants are pesticides that form gases or vapors toxic to plants, animals, and microorganisms. Some active ingredients are formulated, packaged, and released as gases; others are liquids when packaged under high pressure and change to gases when they are released. Other active ingredients are volatile liquids when enclosed in an ordinary container and, therefore, are not formulated under pressure. Others are solids that release gases when applied under conditions of high humidity or in the presence of water vapor.

Ultra-Low Volume (ULV)

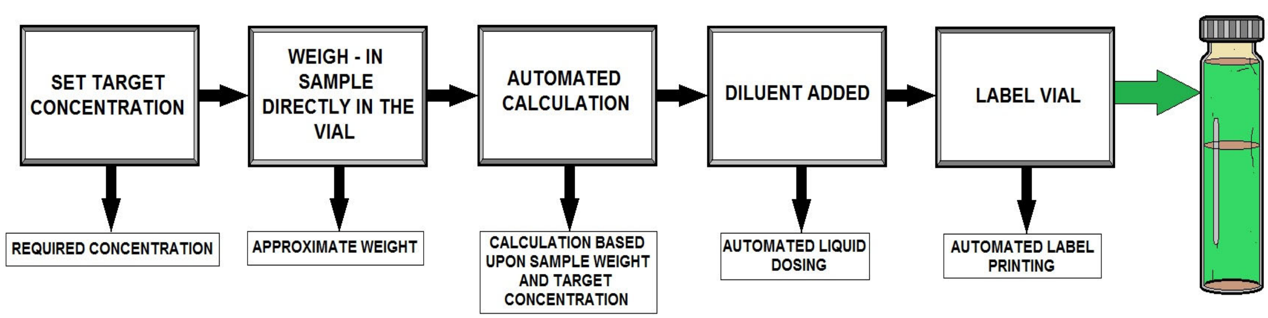
These concentrates may approach 100% active ingredient. They are designed to be used “as is” or to be diluted with only small quantities of a specified carrier. They are used at rates of no more than 1/2 gallon per acre. These special purpose formulations are used mostly in outdoor applications, such as in agricultural, forestry, ornamental, and mosquito control programs.

Pesticides are Broken Down or Degraded by:

1. **Chemical degradation** usually involves a chemical reaction with water; it does not involve living organisms.
2. **Microbial action** is the breakdown of chemicals by soil microorganisms, such as fungi or bacteria.
3. **Photodegradation** is the breakdown of chemicals in reaction to sunlight.
4. **Volatility** is the tendency of a pesticide to turn into a gas or vapor. Some are more volatile than others. The chance of volatilization increases as temperatures and wind increase. Also, volatility is more likely under conditions of low relative humidity because evaporation increases in drier conditions.

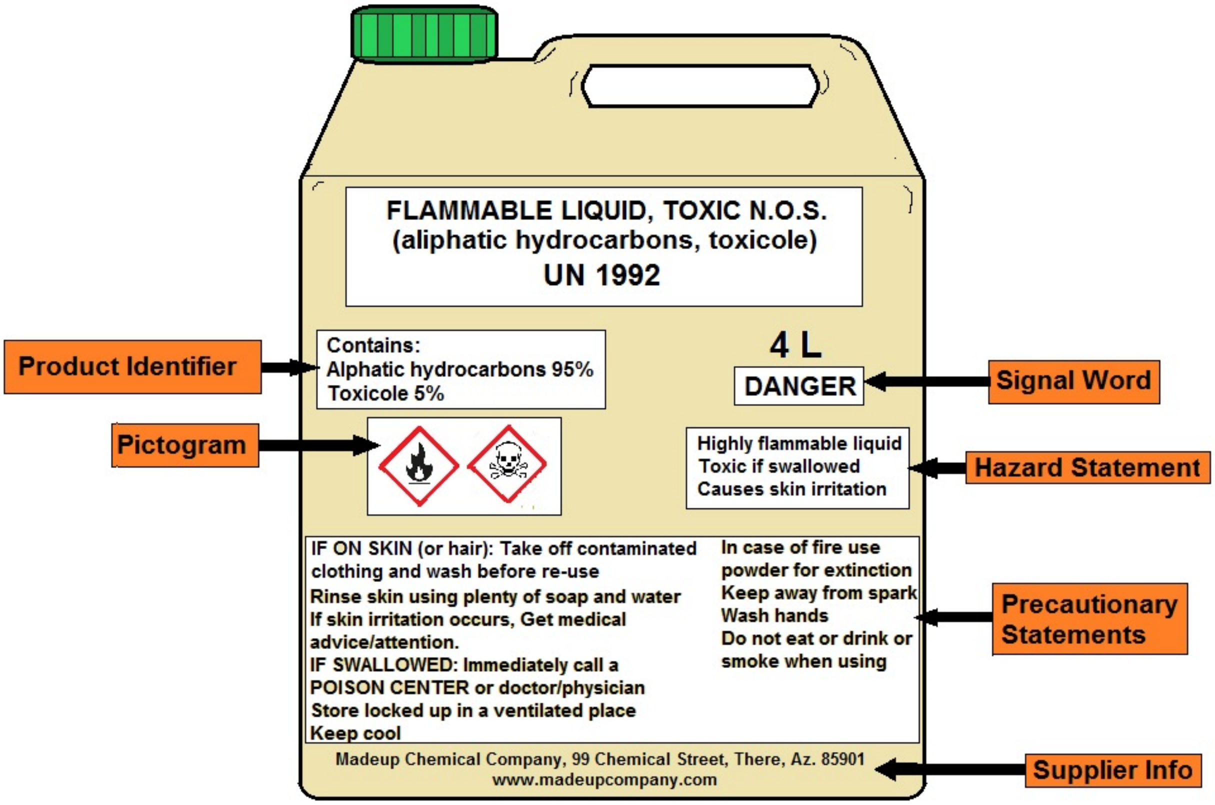


PESTICIDE RESIDUAL CHAIN DIAGRAM #1



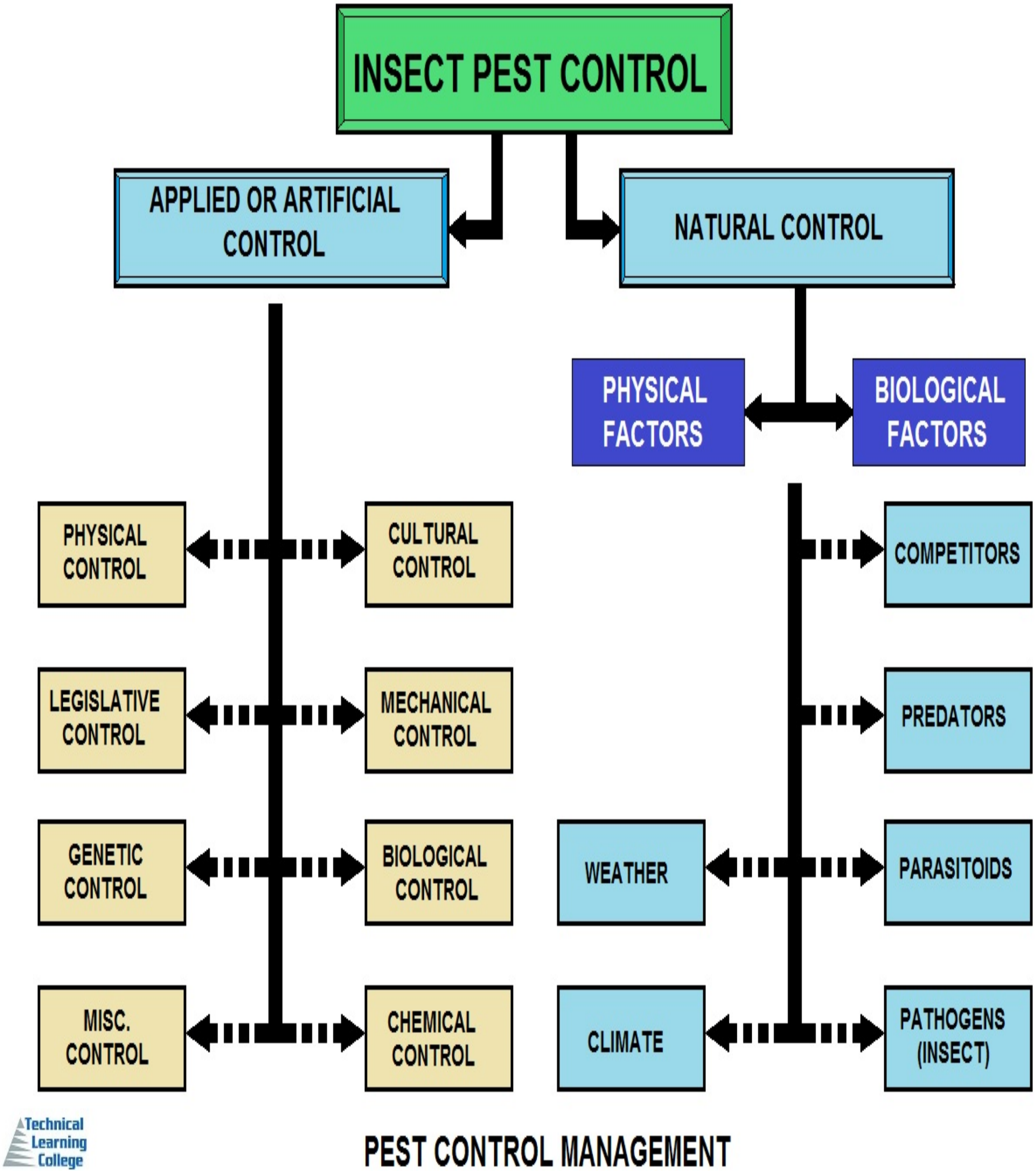
Technical Learning College

PESTICIDE RESIDUE TESTING



PESTICIDE LABEL DIAGRAM

CHEMICAL SPILL / EMERGENCY RESPONSE



PEST CONTROL MANAGEMENT
DIAGRAM #1

Pesticide Components Sub-Section

The conventional approach was probably the first to be employed, since it is comparatively easy to destroy weeds by burning them or plowing them under, and to kill larger competing herbivores, such as crows and other birds eating seeds. Techniques such as crop rotation, companion planting (also known as intercropping or mixed cropping), and the selective breeding of pest-resistant cultivars have a long history. Pest control is at least as old as agriculture, as there has always been a need to keep crops free from pests. In order to maximize food production, it is advantageous to protect crops from competing species of plants, as well as from herbivores competing with humans.

Chemical pesticides date back 4,500 years, when the Sumerians used sulfur compounds as insecticides. The Rig Veda, which is about 4,000 years old, also mentions the use of poisonous plants for pest control. It was only with the industrialization and mechanization of agriculture in the 18th and 19th century, and the introduction of the insecticides pyrethrum and derris that chemical pest control became widespread. In the 20th century, the discovery of several synthetic insecticides, such as DDT, and herbicides boosted this development.

Chemical pest control is still the predominant type of pest control today, although its long-term effects led to a renewed interest in traditional and biological pest control towards the end of the 20th century.

All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment. Because of advances in scientific knowledge, the law requires that pesticides which were first registered before November 1, 1984, be reregistered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that can be used without posing unreasonable risks to human health or the environment. When a pesticide is eligible for reregistration, EPA explains the basis for its decision in a Reregistration Eligibility Decision (RED) document.

Chemical Pesticides
Some examples of chemically-related pesticides follow. Other examples are available in sources such as Recognition and Management of Pesticide Poisonings.

Organophosphate Pesticides - These pesticides affect the nervous system by disrupting the enzyme that regulates acetylcholine, a neurotransmitter. Most organophosphates are insecticides. They were developed during the early 19th century, but their effects on insects, which are similar to their effects on humans, were discovered in 1932. Some are very poisonous (they were used in World War II as nerve agents). However, they usually are not persistent in the environment.

Carbamate Pesticides affect the nervous system by disrupting an enzyme that regulates acetylcholine, a neurotransmitter. The enzyme effects are usually reversible. There are several subgroups within the carbamates.

Organochlorine Insecticides were commonly used in the past, but many have been removed from the market due to their health and environmental effects and their persistence (e.g. DDT and chlordane).

Pyrethroid Pesticides were developed as a synthetic version of the naturally occurring pesticide pyrethrin, which is found in chrysanthemums. They have been modified to increase their stability in the environment. Some synthetic pyrethroids are toxic to the nervous system.

GROUP OF PESTICIDES	PURPOSE AND USES OF THESE PESTICIDE GROUPS
ALGAECIDES	USED TO KILL AND PREVENT GROWTH OF ALGAE (i.e: Common Use In Swimming Pools)
ANTIMICROBIALS	USED TO KILL MICROORGANISMS THAT PRODUCE DISEASES
ATTRACTANTS	THIS PESTICIDE IS USED TO ATTRACT SPECIFIC PESTS USING NATURAL INSECT CHEMICALS CALLED PHEROMONES TO CONFUSE INSECTS MATING BEHAVIOUR
AVICIDES	USED TO CONTROL PEST BIRDS
BIOPESTICIDES	THESE ARE NATURALLY OCCURING SUBSTANCES THAT HAVE PESTICIDAL PROPERTIES
DEFOLIANTS	THIS PESTICIDE GROUP CAUSES FOLIAGE TO DROP FROM A PLANT, TYPICALLY USED IN THE HARVESTING PROCESS
DESICCANTS	AIDS IN THE DRYING PROCESS OF INSECTS OR PLANTS, USUALLY IN LABRATORY PROCESS. PROMOTES DRYING OF LIVING TISSUE, SUCH AS TOPS OF UNWANTED PLANTS
FUMIGANTS	THESE PRODUCE VAPOURS OR GASES TO CONTROL AIR or SOIL BORNE INSECTS AND DISEASES.
FUNGICIDES	THIS GROUP DESTROYS FUNGI THAT INFECT ANIMALS, PLANTS or PEOPLE
HERBICIDES	THIS GROUP IS USED TO KILL WEEDS AND OTHER PLANTS THAT ARE GROWING or COMPETING WITH THE DESIRED SPECIES
INSECT GROWTH REGULATORS (IGR's)	THESE ACCELERATE or RETARD THE GROWTH RATE OF THE INSECTS
INSECTICIDES	USED TO CONTROL OR ELIMINATE INSECTS THAT AFFECT ANIMALS, PLANTS or PEOPLE
MITICIDES (Acaricides)	THESE KILL MITES THAT LIVE ON PLANTS, LIVESTOCK or EVEN PEOPLE
MOLLUSCICIDES	THESE ARE USED TO KILL SNAILS AND SLUGS
NEMATICIDES	USED TO KILL NEMATODES, WHICH ARE MICROSCOPIC WORMLIKE ORGANISMS THAT LIVE IN THE SOIL AND CAN CAUSE EXTENSIVE DAMAGE TO FOOD CROPS
OVICIDES	THESE ARE USED TO CONTROL THE INSECT'S EGGS
PISCICIDES	THESE ARE USED TO CONTROL PEST FISH
PLANT GROWTH REGULATORS (PGR's)	USED TO ACCELERATE or RETARD THE GROWTH RATE OF A SPECIFIC PLANT. SUBSTANCES (excluding Fertilizers or other plant nutrients) THAT ALTER THE EXPECTED GROWTH, FLOWERING, or THE REPRODUCTION RATE OF A PLANT
PREDACIDES	USED TO CONTROL VERTEBRATE PESTS (Birds, Mammals or Reptiles)
REPELLENTS	USED IN REPELLING PESTS SUCH AS MOSQUITOES, FLIES, TICKS and FLEAS
RODENTICIDES	USED TO KILL RATS, MICE or OTHER TYPES OF RODENTS

CHART SHOWING THE GROUPS OF PESTICIDES AND THEIR USES

Biopesticide Introduction

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. At the end of 2001, there were approximately 195 registered biopesticide active ingredients and 780 products. Biopesticides fall into three major classes:

(1) Microbial pesticides consist of a microorganism (e.g., a bacterium, fungus, virus or protozoan) as the active ingredient. Microbial pesticides can control many different kinds of pests, although each separate active ingredient is relatively specific for its target pest[s]. For example, there are fungi that control certain weeds, and other fungi that kill specific insects.

The most widely used microbial pesticides are subspecies and strains of *Bacillus thuringiensis*, or Bt. Each strain of this bacterium produces a different mix of proteins, and specifically kills one or a few related species of insect larvae. While some Bt's control moth larvae found on plants, other Bt's are specific for larvae of flies and mosquitoes. The target insect species are determined by whether the particular Bt produces a protein that can bind to a larval gut receptor, thereby causing the insect larvae to starve.

(2) Plant-Incorporated-Protectants (PIPs) are pesticidal substances that plants produce from genetic material that has been added to the plant. For example, scientists can take the gene for the Bt pesticidal protein, and introduce the gene into the plant's own genetic material. Then the plant, instead of the Bt bacterium, manufactures the substance that destroys the pest. The protein and its genetic material, but not the plant itself, are regulated by the EPA.

(3) Biochemical pesticides Biochemical pesticides are naturally occurring substances that control pests by non-toxic mechanisms. Conventional pesticides, by contrast, are generally synthetic materials that directly kill or inactivate the pest. Biochemical pesticides include substances, such as insect sex pheromones that interfere with mating as well as various scented plant extracts that attract insect pests to traps. Because it is sometimes difficult to determine whether a substance meets the criteria for classification as a biochemical pesticide, the EPA has established a special committee to make such decisions.

What are the advantages of using biopesticides?
Biopesticides are usually inherently less toxic than conventional pesticides. Biopesticides generally affect only the target pest and closely related organisms, in contrast to broad spectrum, conventional pesticides that may affect organisms as different as birds, insects, and mammals.

Biopesticides often are effective in very small quantities and often decompose quickly, thereby resulting in lower exposures and largely avoiding the pollution problems caused by conventional pesticides. When used as a component of Integrated Pest Management (IPM) programs, biopesticides can greatly decrease the use of conventional pesticides, while crop yields remain high. To use biopesticides effectively, however, users need to know a great deal about managing pests.

How does the EPA encourage the development and use of biopesticides?
In 1994, the Biopesticides and Pollution Prevention Division was established in the Office of Pesticide Programs to facilitate the registration of biopesticides. This Division promotes the use of safer pesticides, including biopesticides, as components of IPM programs. The Division also coordinates the Pesticide Environmental Stewardship Program (**PESP**). Since biopesticides tend to pose fewer risks than conventional pesticides, the EPA generally requires much less data to register a biopesticide than to register a conventional pesticide. In fact, new biopesticides are often registered in less than a year, compared with an average of more than 3 years for conventional pesticides.

While biopesticides require less data and are registered in less time than conventional pesticides, the EPA always conducts rigorous reviews to ensure that pesticides will not have adverse effects on human health or the environment. For the EPA to be sure that a pesticide is safe, the Agency requires that registrants submit a variety of data about the composition, toxicity, degradation, and other characteristics of the pesticide.

Pest Control Devices

What about pest control devices?
The EPA also has a role in regulating devices used to control pests. More specifically, a ***"device"*** is any instrument or contrivance (other than a firearm) intended for trapping, destroying, repelling, or mitigating any pest. A black light trap is an example of a device. Unlike pesticides, EPA does not require devices to be registered with the Agency. Devices are subject to certain labeling, packaging, record keeping, and import/export requirements, however.

What is <u>not</u> a pesticide? The U.S. definition of pesticides is quite broad, but it does have some exclusions:

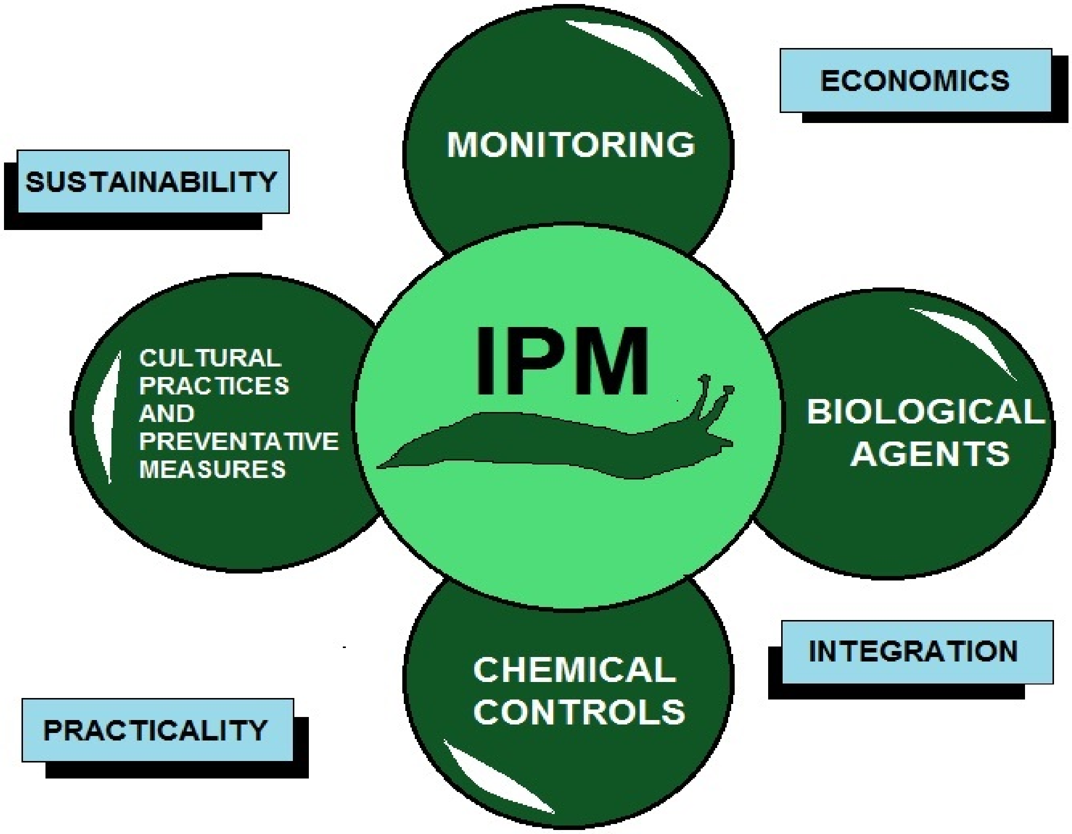
- Drugs used to control diseases of humans or animals (such as livestock and pets) are not considered pesticides; such drugs are regulated by the Food and Drug Administration.

- Fertilizers, nutrients, and other substances used to promote plant survival and health are not considered plant growth regulators and thus are not pesticides.

- Biological control agents, except for certain microorganisms, are exempted from regulation by the EPA. (Biological control agents include beneficial predators such as birds or ladybugs that eat insect pests.)

- Products which contain certain low-risk ingredients, such as garlic and mint oil, have been exempted from Federal registration requirements, although State regulatory requirements may still apply. For a list of ingredients which may be exempt, and a discussion of allowable label claims for such products, see the EPA's Pesticide Registration Notice 2000-6, *"Minimum Risk Pesticides Exempted under FIFRA Section 25(b)."*

IPM Methods (Types of Pest Control)



INTEGRATED PEST MANAGEMENT (IPM) DIAGRAM #1

Conventional Pest Control Verses Integrated Pest Management

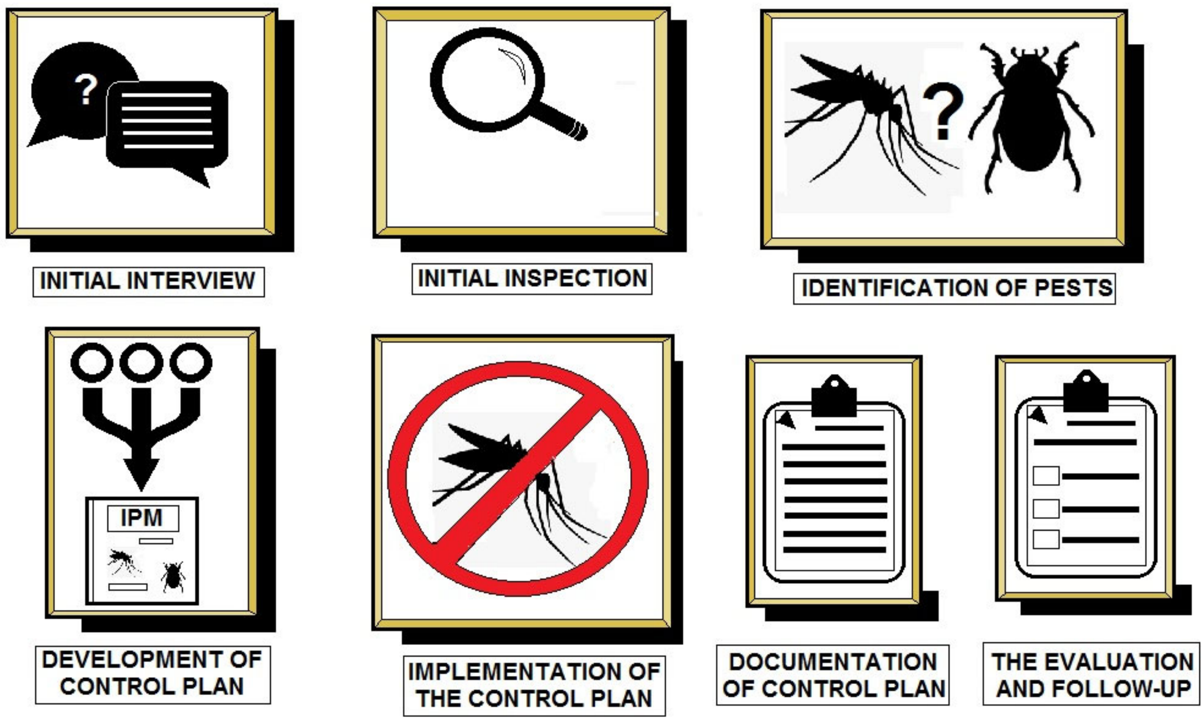
"Conventional" Pest Control

1. Chemical intensive
2. Emphasis on Killing pest directly
3. Largely reactive to pest outbreaks
4. Primary purpose of site visits is to apply more pesticide
5. General and overuse of pesticides
6. Less emphasis on prevention

Integrated Pest Management

1. Knowledge intensive
2. Emphasizes modification of conditions that favor pests
3. Systematic program of long-term pest control
4. Major purpose of most site visits is to inspect and monitor
5. Pesticide use is limited in terms of types, amounts and locations
6. Major emphasis on prevention of pest problems

Integrated Pest Management (IPM) is an effective and environmentally sensitive approach to pest management that relies on a combination of common-sense practices.



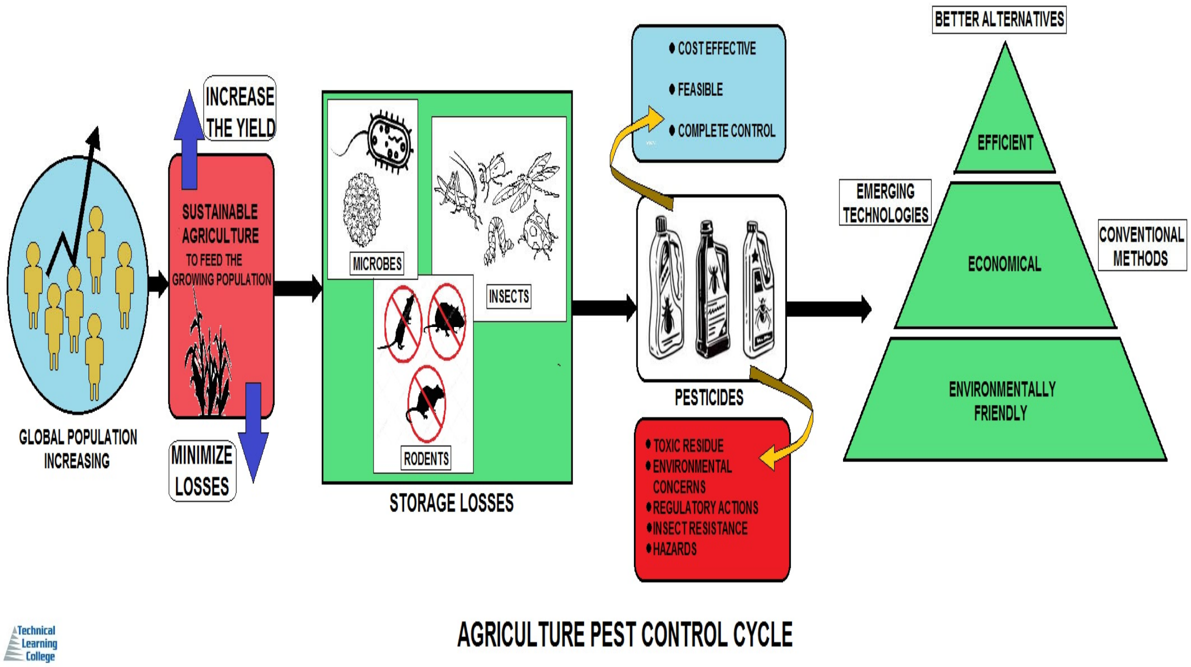
DEVELOPING AN INTEGRATED PESTICIDE MANAGEMENT PROGRAM (IPM)

IPM programs use current, comprehensive information on the life cycles of pests and their interaction with the environment. This information, in combination with available pest control methods, is used to manage pest damage by the most economical means, and with the least possible hazard to people, property, and the environment.

The IPM approach can be applied to both agricultural and non-agricultural settings, such as the home, garden, and workplace. IPM takes advantage of all appropriate pest management options including, but not limited to, the judicious use of pesticides. In contrast, organic food production applies many of the same concepts as IPM but limits the use of pesticides to those that are produced from natural sources, as opposed to synthetic chemicals.

IPM is not a single pest control method but, rather, a series of pest management evaluations, decisions and controls. In practicing IPM, growers who are aware of the potential for pest infestation follow a four-tiered approach.

The four steps include:
Set Action Thresholds
Before taking any pest control action, IPM first sets an action threshold, a point at which pest populations or environmental conditions indicate that pest control action must be taken. Sighting a single pest does not always mean control is needed. The level at which pests will either become an economic threat is critical to guide future pest control decisions.

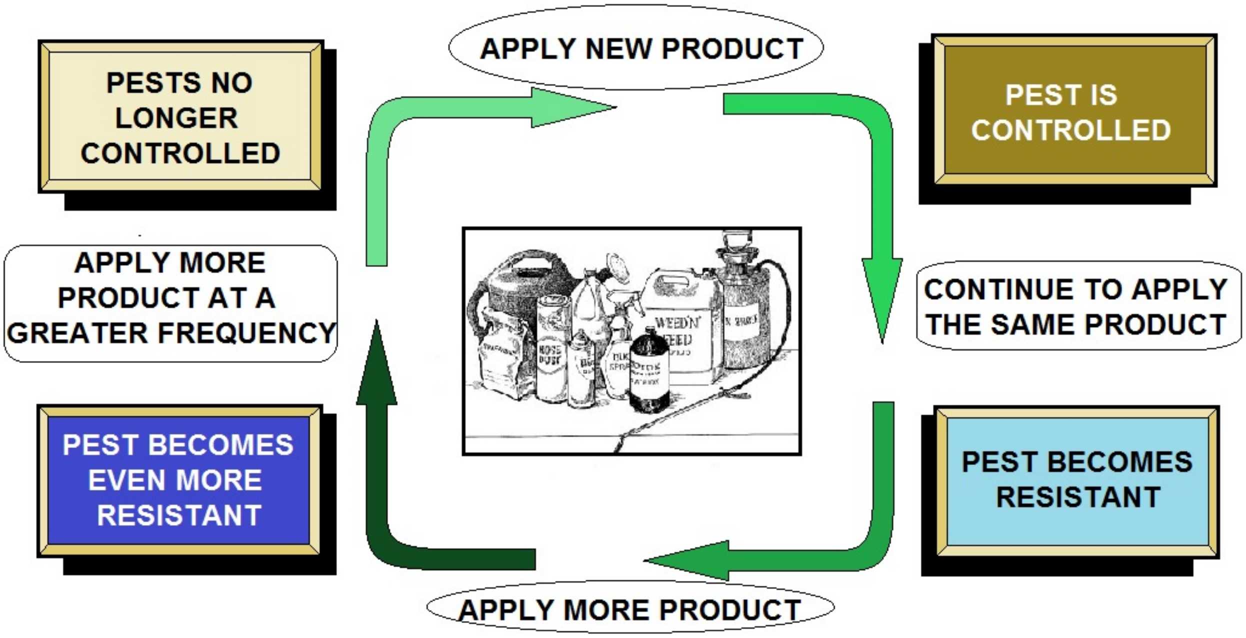


AGRICULTURE PEST CONTROL CYCLE

Monitor and Identify Pests
Not all insects, weeds, and other living organisms require control. Many organisms are innocuous, and some are even beneficial. IPM programs work to monitor for pests and identify them accurately, so that appropriate control decisions can be made in conjunction with action thresholds. This monitoring and identification removes the possibility that pesticides will be used when they are not really needed or that the wrong kind of pesticide will be used.

Prevention
As a first line of pest control, IPM programs work to manage the crop, lawn, or indoor space to prevent pests from becoming a threat. In an agricultural crop, this may mean using cultural methods, such as rotating between different crops, selecting pest-resistant varieties, and planting pest-free rootstock. These control methods can be very effective and cost-efficient and present little to no risk to people or the environment.

Control
Once monitoring, identification, and action thresholds indicate that pest control is required, and preventive methods are no longer effective or available, IPM programs then evaluate the proper control method both for effectiveness and risk. Effective, less risky pest controls are chosen first, including highly targeted chemicals, such as pheromones to disrupt pest mating, or mechanical control, such as trapping or weeding. If further monitoring, identifications and action thresholds indicate that less risky controls are not working, then additional pest control methods would be employed, such as targeted spraying of pesticides. Broadcast spraying of non-specific pesticides is a last resort.



PESTICIDE TREADMILL DIAGRAM

PESTICIDE POST TREATMENT WARNING SIGN EXAMPLES

Six Basic Components

An IPM system is designed around six basic components: The US Environmental Protection Agency has a useful set of IPM principles.
1. Acceptable Pest Levels: The emphasis is on control, not eradication. IPM holds that wiping out an entire pest population is often impossible, and the attempt can be economically expensive, environmentally unsafe, and frequently unachievable. IPM programs first work to establish acceptable pest levels, called action thresholds, and apply controls if those thresholds are crossed. These thresholds are pest and site specific, meaning that it may be acceptable at one site to have a weed such as white clover, but at another site it may not be acceptable. By allowing a pest population to survive at a reasonable threshold, selection pressure is reduced. This stops the pest gaining resistance to chemicals produced by the plant or applied to the crops. If many of the pests are killed then any that have resistance to the chemical will form the genetic basis of the future, more resistant, population. By not killing all the pests there are some un-resistant pests left that will dilute any resistant genes that appear.

2. Preventive Cultural Practices: Selecting varieties best for local growing conditions, and maintaining healthy crops, is the first line of defense, together with plant quarantine and 'cultural techniques' such as crop sanitation (e.g. removal of diseased plants to prevent spread of infection).

3. Monitoring: Regular observation is the cornerstone of IPM. Observation is broken into two steps, first; inspection and second; identification. Visual inspection, insect and spore traps, and other measurement methods and monitoring tools are used to monitor pest levels. Accurate pest identification is critical to a successful IPM program. Record-keeping is essential, as is a thorough knowledge of the behavior and reproductive cycles of target pests. Since insects are cold-blooded, their physical development is dependent on the temperature of their environment. Many insects have had their development cycles modeled in terms of degree days. Monitor the degree days of an environment to determine when is the optimal time for a specific insect's outbreak.

4. Mechanical Controls: Should a pest reach an unacceptable level, mechanical methods are the first options to consider. They include simple hand-picking, erecting insect barriers, using traps, vacuuming, and tillage to disrupt breeding.

5. Biological Controls: Natural biological processes and materials can provide control, with minimal environmental impact, and often at low cost. The main focus here is on promoting beneficial insects that eat target pests. Biological insecticides, derived from naturally occurring microorganisms (e.g.: Bt, entomopathogenic fungi and entomopathogenic nematodes), also fit in this category.

6. Responsible Pesticide Use: Synthetic pesticides are generally only used as required and often only at specific times in a pests life cycle. Many of the newer pesticide groups are derived from plants or naturally occurring substances (e.g.: nicotine, pyrethrum and insect juvenile hormone analogues), but the toxophore or active component may be altered to provide increased biological activity or stability. Further 'biology-based' or 'ecological' techniques are under evaluation.

Main Focus of IPM Programs

An IPM regime can be quite simple or sophisticated. Historically, the main focus of IPM programs was on agricultural insect pests. Although originally developed for agricultural pest management, IPM programs are now developed to encompass diseases, weeds, and other pests that interfere with the management objectives of sites such as residential and commercial structures, lawn and turf areas, and home and community gardens.

IPM is applicable to all types of agriculture and sites such as residential and commercial structures, lawn and turf areas, and home and community gardens.

Reliance on knowledge, experience, observation, and integration of multiple techniques makes IPM a perfect fit for organic farming (sans artificial pesticide application). For large-scale, chemical-based farms, IPM can reduce human and environmental exposure to hazardous chemicals, and potentially lower overall costs of pesticide application material and labor.

1. Proper identification of pest - What is it?
Cases of mistaken identity may result in ineffective actions. If plant damage due to over-watering is mistaken for fungal infection, spray costs can be incurred, and the plant is no better off.

2. **Learn pest and host life cycle and biology.**
At the time you see a pest, it may be too late to do much about it except maybe spray with a pesticide. Often, there is another stage of the life cycle that is susceptible to preventative actions. For example, weeds reproducing from last year's seed can be prevented with mulches. Also, learning what a pest needs to survive allows you to remove these.

3. Monitor or sample environment for pest population - How many are here?
Preventative actions must be taken at the correct time if they are to be effective. For this reason, once the pest is correctly identified, monitoring must begin before it becomes a problem. For example, in school cafeterias where roaches may be expected to appear, sticky traps are set out before school starts.

Traps are checked at regular intervals so populations can be monitored and controlled before they get out of hand. Some factors to consider and monitor include: Is the pest present/absent? What is the distribution - all over or only in certain spots? Is the pest population increasing or decreasing?

4. Establish action threshold (economic, health or aesthetic) - How many are too many?
In some cases, a certain number of pests can be tolerated. Soybeans are quite tolerant of defoliation, so if there are a few caterpillars in the field and their population is not increasing dramatically, there is not necessarily any action necessary.

Conversely, there is a point at which action must be taken to control cost. For the farmer, that point is the one at which the cost of damage by the pest is more than the cost of control. This is an economic threshold. Tolerance of pests varies also by whether or not they are a health hazard (low tolerance) or merely a cosmetic damage (high tolerance in a non-commercial situation).

Different sites may also have varying requirements based on specific areas. White clover may be perfectly acceptable on the sides of a tee box on a golf course, but unacceptable in the fairway where it could cause confusion in the field of play.

5**. Choose an appropriate combination of management tactics**
For any pest situation, there will be several options to consider. Options include mechanical or physical control, cultural controls, biological controls and chemical controls. Mechanical or physical controls include picking pests off plants, or using netting or other material to exclude pests such as birds from grapes or rodents from structures. Cultural controls include keeping an area free of conducive conditions by removing or storing waste properly, removing diseased areas of plants properly. Biological controls can be support either through conservation of natural predators or augmentation of natural predators.

Augmentative control includes the introduction of naturally occurring predators at either an inundative or inoculative level. An inundative release would be one that seeks to inundate a site with a pest's predator to impact the pest population. An inoculative release would be a smaller number of pest predators to supplement the natural population and provide ongoing control.

Chemical controls would include horticultural oils or the application of pesticides such as insecticides and herbicides. A Green Pest Management IPM program would use pesticides derived from plants, such as botanicals, or other naturally occurring materials.

6. Evaluate results - How did it work?
Evaluation is often one of the most important steps. This is the process to review an IPM program and the results it generated. Asking the following questions is useful:

Did actions have the desired effect? Was the pest prevented or managed to farmer satisfaction?

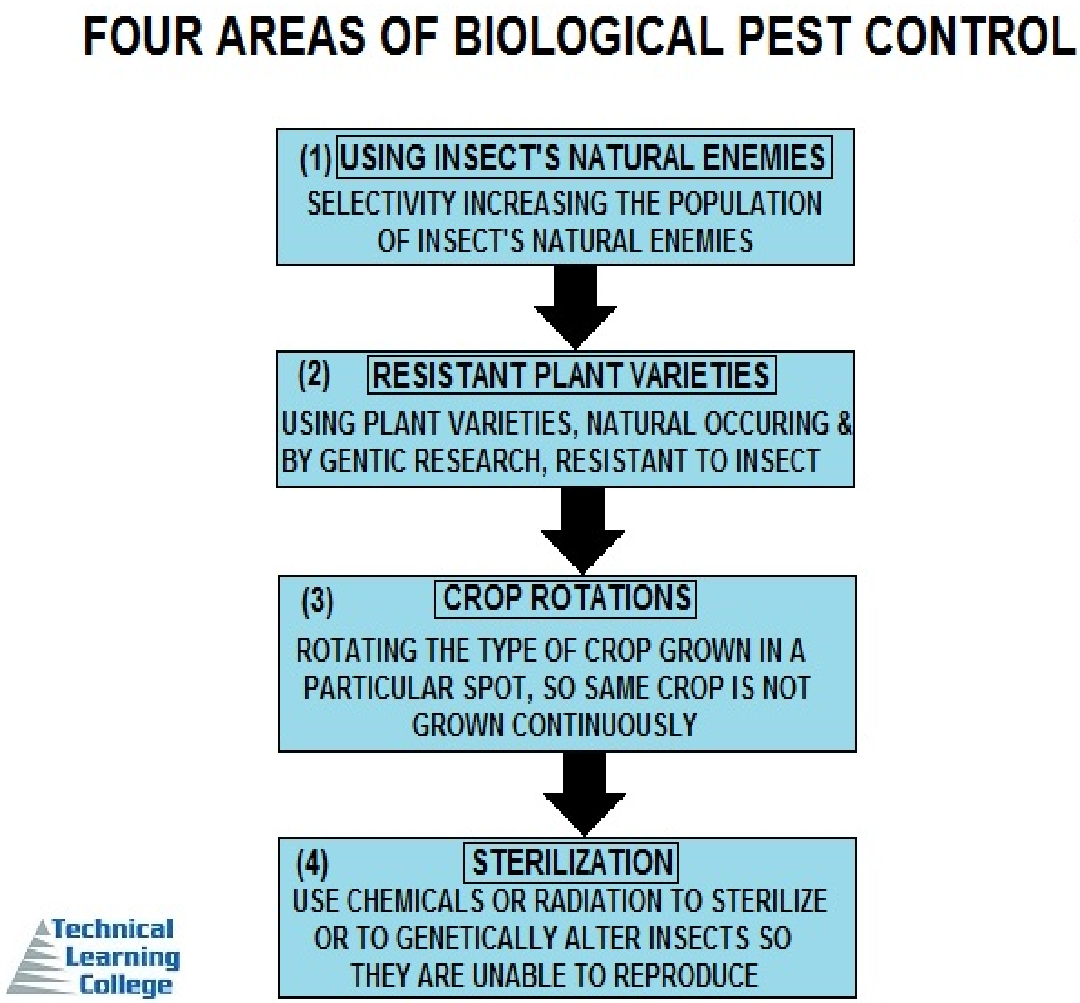
Was the method itself satisfactory? Were there any unintended side effects?

What can be done in the future for this pest situation?

Understanding the effectiveness of the IPM program allows the site manager to make modifications to the IPM plan prior to pests reaching the action threshold and requiring action again.

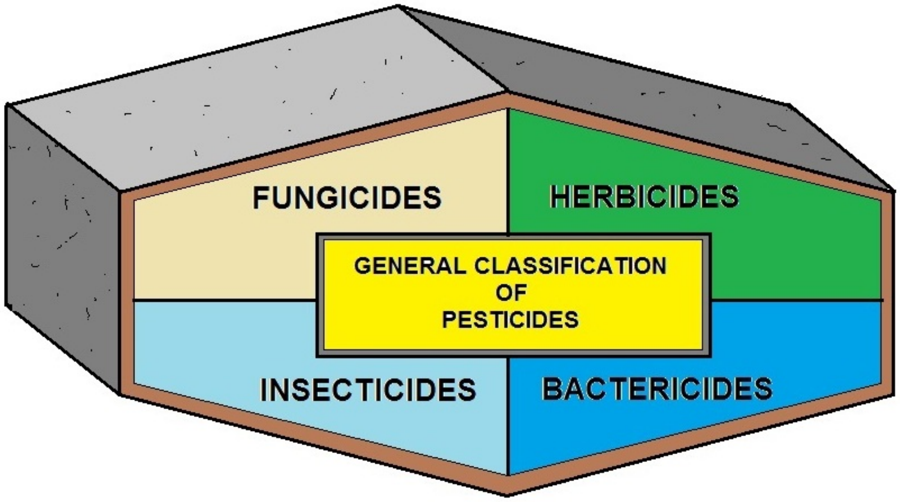
Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.



BIOLOGICAL PEST CONTROL METHODS DIAGRAM

Pesticide Organization – Chemical Families



CLASSIFICATION OF PESTICIDES DIAGRAM #1

Many pesticides can be grouped into chemical families. Prominent insecticide families include organochlorines, organophosphates, and carbamates. Organochlorine hydrocarbons (e.g., DDT) could be separated into dichlorodiphenylethanes, cyclodiene compounds, and other related compounds. They operate by disrupting the sodium/potassium balance of the nerve fiber, forcing the nerve to transmit continuously. Their toxicities vary greatly, but they have been phased out because of their persistence and potential to bioaccumulate.

Chemical Types of Pesticides

- Organophosphate pesticides attack the nervous system of pests and disrupt the enzyme that regulates acetylcholine action.
- Carbamate pesticides also disrupt the regulation of acetylcholine metabolism.
- Organochlorine pesticides were frequently used in the past, but many of them have been banned because of their negative effects on health and environment.
- Pyrethroid pesticides are synthetic kinds of the natural pyrethrin and produce toxic effect on the nervous system.

Biological Types of Pesticides

Biological types of pesticides come from natural sources such as plants, bacteria, animals, and some minerals.

- Microbial pesticides comprise bacteria, viruses, fungi, and protozoans that kill, suppress, or compete with pests.
- Biochemical pesticides such as pheromones and plant extracts are of natural origin and control pests by nontoxic mechanisms.
- Plant incorporated protectants are produced by plants from genetic materials previously introduced to the plant.

Biological control agents, except for certain microorganisms, are exempted from regulation by EPA. (Biological control agents include beneficial predators such as birds or ladybugs that eat insect pests.) Finally, EPA has also exempted certain other low-risk substances, such as cedar chips, garlic, and mint oil.

Organophosphate and Carbamates

- Organophosphate and carbamates largely replaced organochlorines. Both operate through inhibiting the enzyme acetylcholinesterase, allowing acetylcholine to transfer nerve impulses indefinitely and causing a variety of symptoms such as weakness or paralysis.

- Organophosphates are quite toxic to vertebrates and have in some cases been replaced by less toxic carbamates.

- Thiocarbamate and dithiocarbamates are subclasses of carbamates. Prominent families of herbicides include phenoxy and benzoic acid herbicides (e.g. 2,4-D), triazines (e.g., atrazine), ureas (e.g., diuron), and Chloroacetanilides (e.g., alachlor). Phenoxy compounds tend to selectively kill broad-leaf weeds rather than grasses. The phenoxy and benzoic acid herbicides function similar to plant growth hormones, and grow cells without normal cell division, crushing the plant's nutrient transport system. Triazines interfere with photosynthesis. Many commonly used pesticides are not included in these families, including glyphosate.

Organophosphate Insecticides

Organophosphate insecticides include chlorpyrifos, diazinon, dimethoate, disulfoton, malathion, methyl parathion, and ethyl parathion. The carbamate compounds include carbaryl, carbofuran, methomyl, and oxamyl. Organophosphates and carbamates inhibit the enzyme cholinesterase, causing a disruption of the nervous system. All life forms with cholinesterase in their nervous system, such as insects, fish, birds, humans, and other mammals, can be poisoned by these chemicals.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. But when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

By their very nature, most pesticides create some risk of harm to humans, animals, or the environment because they are designed to kill or otherwise adversely affect living organisms. At the same time, pesticides are useful to society because of their ability to kill potential disease-causing organisms and control insects, weeds, and other pests. In the United States, the Office of Pesticide Programs of the Environmental Protection Agency is chiefly responsible for regulating pesticides. Biologically-based pesticides, such as pheromones and microbial pesticides are becoming increasingly popular and often are safer than traditional chemical pesticides.

Food and Drug Administration

The U.S. definition of pesticides is quite broad, but it does have some exclusions: Drugs used to control diseases of humans or animals (such as livestock and pets) are not considered pesticides; such drugs are regulated by the Food and Drug Administration. Fertilizers, nutrients, and other substances used to promote plant survival and health are not considered plant growth regulators and thus are not pesticides.

Classes of Insecticides **(Most of this section comes from the USEPA)**

The classification of insecticides is done in several different ways:

- Contact insecticides are toxic to insects brought into direct contact. Efficacy is often related to the quality of pesticide application, with small droplets (such as aerosols) often improving performance.
- Inorganic insecticides are manufactured with metals and include arsenates, copper compounds and fluorine compounds, which are now seldom used, and sulfur, which is commonly used.
- Mode of action—how the pesticide kills or inactivates a pest—is another way of classifying insecticides. Mode of action is important in predicting whether an insecticide will be toxic to unrelated species, such as fish, birds and mammals.
- Natural insecticides, such as nicotine, pyrethrum and neem extracts are made by plants as defenses against insects. Nicotine based insecticides have been barred in the U.S. since 2001 to prevent residues from contaminating foods.
- Organic insecticides are synthetic chemicals which comprise the largest numbers of pesticides available for use today.
- Plant-Incorporated Protectants (PIP) are insecticidal substances produced by plants after genetic modification. For instance, a gene that codes for a specific Baccilus thuringiensis biocidal protein is introduced into a crop plant's genetic material. Then, the plant manufactures the protein. Since the biocide is incorporated into the plant, additional applications at least of the same compound are not required.
- Systemic insecticides are incorporated by treated plants. Insects ingest the insecticide while feeding on the plants.
- Heavy metals, e.g. arsenic have been used as insecticides; they are poisonous and very rarely used now by farmers.

Organochlorine Compounds

The insecticidal properties of the best known representative of this class of insecticides, DDT, was made by the Swiss Scientist Paul Müller. For this discovery, he was awarded the Nobel Prize for Physiology or Medicine in 1948. DDT was introduced on the market in 1944. With the rise of the modern chemical industry, it was possible to make chlorinated hydrocarbons. DDT works by opening the sodium channels in the nerve cells of the insect. A number of the organochlorine pesticides have been banned from most uses worldwide, and globally they are controlled via the Stockholm Convention on persistent organic pollutants. These include: aldrin, chlordane, DDT, dieldrin, endrin, heptachlor, mirex and toxaphene.

Penta or Pentachlorophenol

Penta or Pentachlorophenol (PCP) is an organochlorine compound used as a pesticide and a disinfectant. First produced in the 1930s, it is marketed under many trade names. It can be found in two forms: PCP itself or as the sodium salt of PCP, which dissolves easily in water.

In the past, PCP has been used as an herbicide, insecticide, fungicide, algaecide, disinfectant and as an ingredient in antifouling paint. Some applications were in agricultural seeds (for nonfood uses), leather, masonry, wood preservation, cooling tower water, rope and paper mill system. Its use has been significantly declined due to the high toxicity of PCP and its slow biodegradation. There are two general methods for preserving wood. The pressure process method involves placing wood in a pressure-treating vessel where it is immersed in PCP and then subjected to applied pressure. In the non-pressure process method, PCP is applied by spraying, brushing, dipping, and soaking.

Utility companies save millions of dollars in replacement poles, because the life of these poles increases from approximately 7 years for an untreated pole to about 35 years for a preservative-treated pole.

PCP has been detected in surface waters and sediments, rainwater, drinking water, aquatic organisms, soil, and food, as well as in human milk, adipose tissue, and urine. As PCP is generally used for its properties as a biocidal agent, there is considerable concern about adverse ecosystem effects in areas of PCP contamination.

Releases to the environment are decreasing as a result of declining consumption and changing use methods. However, PCP is still released to surface waters from the atmosphere by wet deposition, from soil by run off and leaching, and from manufacturing and processing facilities. PCP is released directly into the atmosphere via volatilization from treated wood products and during production. Finally, releases to the soil can be by leaching from treated wood products, atmospheric deposition in precipitation (such as rain and snow), spills at industrial facilities and at hazardous waste sites.

Since the early 1980s, the purchase and use of PCP in the U.S has not been available to the general public. Nowadays most of the PCP used in the U.S is restricted to the treatment of utility poles and railroad ties. In the United States, any drinking water supply with a PCP concentration exceeding the MCL, 1 ppb, must be notified by the water supplier to the public. Disposal of PCP and PCP contaminated substances are regulated under RCRA as a F-listed hazardous waste.

Organophosphates
The next large class developed was the organophosphates, which bind to acetylcholinesterase and other cholinesterases. This results in disruption of nerve impulses, killing the insect or interfering with its ability to carry on normal functions. Organophosphate insecticides and chemical warfare nerve agents (such as sarin, tabun, soman and VX) work in the same way. Organophosphates have an accumulative toxic effect to wildlife, so multiple exposures to the chemicals amplify the toxicity.

Carbamates
Carbamate insecticides have similar toxic mechanisms to organophosphates, but have a much shorter duration of action and are thus somewhat less toxic.

Organophosphates and Carbamates Pesticides
Organophosphates are phosphoric acid esters or thiophosphoric acid esters. When developed in the 1930s and 1940s, their original compounds were highly toxic to mammals. Organophosphates manufactured since then are less toxic to mammals but toxic to target organisms, such as insects. Malathion, dibrom, chlorpyrifos, temephos, diazinon and terbufos are organophosphates. Carbamates are esters of N-methyl carbamic acid. Aldicarb, carbaryl, propoxur, oxamyl and terbucarb are carbamates.

Although these pesticides differ chemically, they act similarly. When applied to crops or directly to the soil as systemic insecticides, organophosphates and carbamates generally persist from only a few hours to several months. However, they have been fatal to large numbers of birds on turf and in agriculture, and negatively impacted breeding success in birds. Many organophosphates are highly toxic to aquatic organisms.

These are two very large families of insecticides. Indeed, they have been the primary insecticides for the past 25 to 30 years. They range in toxicity from slightly to highly toxic. They are formulated in all kinds of ways from highly concentrated emusifiable concentrates (ECs) to very dilute granular (G) formulations.

These insecticide families are similar in their modes of action—they are all nervous system poisons. Insects and all other animals, including humans, have nervous systems that are susceptible. Both insecticide families are efficiently absorbed by inhalation, ingestion, and skin penetration. To a degree, the extent of poisoning depends on the rate at which the pesticide is absorbed.

Organophosphates break down chiefly by hydrolysis in the liver; rates of hydrolysis vary widely from one compound to another. With certain organophosphates whose breakdown is relatively slow, significant amounts may be temporarily stored in body fat.

The organophosphates and carbamates replaced the chlorinated hydrocarbons (e.g., chlordane, aldrin, and heptachlor) for all uses, including termite control. Examples of organophosphates are chlorpyrifos for termite control and diazinon for other household pests. An example of a carbamate is carbaryl, also used for household and lawn pests.

How can people be exposed to organophosphate and carbamate pesticides?
People can be exposed to organophosphates and carbamates pesticides through accidental exposure during use. People can accidentally inhale the pesticides if they are in an area where they were recently applied. The chemicals can be ingested with food or drinks that are contaminated.

How can these pesticides exhaust affect my health?
Acetylcholinesterase is an enzyme found in the nervous system, red blood cells and blood plasma. These pesticides damage nerve function by acting as acetylcholinesterase inhibitors in the nervous system.

Breathing - Short-term exposure can produce muscle twitching, headache, nausea, dizziness, loss of memory, weakness, tremor, diarrhea, sweating, salivation, tearing, constriction of pupils, and slowed heartbeat.

Long-term exposure can produce delayed neurotoxicity, such as tingling and burning in the extremities. This delayed neurotoxicity can progress to paralysis and is seldom reversible. Damage to the liver, kidney, immune system and bone marrow may occur. Some carbamates are also suspected carcinogens.

What should I do if exposed to these pesticides?
If you think you were exposed to these pesticides, contact your doctor.

Is there a medical test to show whether I was exposed to these pesticides?
The level of cholinesterase activity in red blood cells or plasma helps physicians determine exposure to these pesticides. However, other chemicals or disease states can alter acetylcholinesterase activity. Urine or blood tests only apply if a person was exposed to a large quantity. Persons who will use these pesticides regularly should ask their physician to establish a baseline value prior to prolonged use, followed by monthly monitoring.

Pyrroles

Chlorfenapyr is the only termiticide from the pyrrole family of chemistry and is active primarily as a stomach poison with some contact activity. It is also non-repellent to termites. Chlorfenapyr is registered as a termiticide under the trade name Phantom®. Chlorfenapyr acts on the mitochondria of cells and uncouples or inhibits oxidative phosphorylation, preventing the formation of the crucial energy molecule adenosine triphosphate (ATP). As a result, energy production in the cells shuts down, resulting in cellular and, ultimately, termite death.

Fiproles (or Phenylpyrazoles)

Fipronil is the only insecticide in this new class, introduced in 1990 and registered in the U.S. in 1996. It is marketed as a termiticide under the trade name Termidor®. This termiticide is a non-repellent material with contact and stomach activity. Fipronil works by blocking the gamma-aminobutyric acid (GABA) regulated chloride channel in neurons, thus disrupting the activity of the insect's central nervous system.

Termidor (Termidor is an example of Fipronil)

Termidor is applied at very low rates. Typically, the active ingredient (fipronil) is just 0.06% of the solution, a concentration much lower than that of older liquids and less than most insecticides. For an average home treatment, only about 8 ounces of the active ingredient is actually used.

Keep in mind, too, that since 1995, fipronil has been used around the world for flea and tick control on household pets and on agricultural crops to protect food supplies. Termidor has virtually no odor, which means you and your family won't notice a thing.

Termidor is made from a revolutionary new non-repellent or "undetectable" chemical technology treatment. This means termites cannot see, smell, taste or avoid Termidor. Instead they contact, ingest, and share it with their nestmates. This is in sharp contrast to older liquid termite controls, which rely on repellent barriers that termites can finds breaks in or avoid completely. Mix this in your backpack and never mix with a contact killer.

Fipronil Example

Maxforce Carpenter Ant bait gel with Fipronil uses foraging worker carpenter ants to take it back to hidden, inaccessible nests. This formula is a delayed-action kill.The workers feed on it and share the insecticide with the nest, thus destroying the entire colony, including the queen(s).

An ant bait that is the ideal means of targeted elimination of ant infestations. Baits are used to kill the entire colony, not just foraging workers. If the ants bite such as fire ants or if they are carpenter ants this is the product you need. The granules are unobtrusive, ready-to-use, and take less time to apply than conventional insecticides.

Talstar One (Fipronil Example)
Talstar One is the new label name for Talstar concentrate.
In the past, there were several different labels for general categories of pest control in lawns, shrubs, ornamentals, indoor pest control in homes and other areas of pest management concerns. Talstar One has the label you need for controlling the many different pests that Fipronil is known to effectively eliminate or control.

Lawn pests are listed with three different application rates allowed by the pesticide label: Low Rate (0.18 to 0.25 fluid ounces per 1,000 square feet), Medium Rate (0.25 to 0.50 fluid ounces per 1,000 square feet) and High Rate (0.50 to 1.00 fluid ounces per thousand square feet.) Special comments provided for Armyworms, Cutworms, Sod Webworms, and adult Annual Bluegrass Weevil, Banks Grass Mite, adult Billbugs, adult Black Turfgrass Ataenius, Chinch Bugs, Mites, Flea larvae, Imported Fire Ants, adult mole cricket, mole cricket nymphs and ticks.

An example of Bifenthrin (Pyrethroid)

Pyrethroids

To mimic the insecticidal activity of the natural compound pyrethrum another class of pesticides, pyrethroid pesticides, has been developed. These are non-persistent, which is a sodium channel modulators, and are much less acutely toxic than organophosphates and carbamates. Compounds in this group are often applied against household pests.

The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellent to MOST INSECTS AND ESPECIALLY termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes, and gardens. Some examples are bifenthrin, cyfluthrin, cypermethrin, deltamethrin, and permethrin. They may be applied alone or in combination with other insecticides. Pyrethroids are formulated as emusifiable concentrates (EC), wettable powders (WP), granulars (G), and aerosols.

Certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route. Systemic toxicity by inhalation and dermal absorption are low, however—there have been very few systemic poisonings of humans by pyrethroids. Though limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible. This course contains pesticide recommendations that are subject to change at any time.

These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to sunburn sensation of the face and especially the eyelids. Sweating, exposure to sun or heat, and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours.

First Aid

For first aid, wash with soap and water to remove as much residue as possible, and then apply a vitamin E oil preparation or cream to the affected area. Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano- groups: fenvalerate, cypermethrin, and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or microencapsulated formulation.

Prescription Treatment Brand Cy-Kick CS is a flowable concentrated controlled release Cyfluthrin. Simply mix 1-3 oz. per gallon of water and spray liberally along baseboards, into cracks and crevices, etc. Cy-Kick is also used as an outdoor perimeter or lawn treatment. Virtually odorless and very long lasting. Cy-Kick is the choice of many professional pest companies it is good but not cheap. It will also kill scorpions.

About These Pesticides
Pyrethrins and pyrethroids are insecticides included in over 3,500 registered products, many of which are used widely in and around households, including on pets, in mosquito control, and in agriculture. The use of pyrethrins and pyrethroids has increased during the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids. This change to less acutely toxic pesticides, while generally beneficial, has introduced certain new issues. For example, residential uses of pyrethrins and pyrethroids may result in urban runoff, potentially exposing aquatic life to harmful levels in water and sediment.

Pyrethrins are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death.

Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight.

Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product. These synergists have no pesticidal effects of their own but enhance the effectiveness of other chemicals.

Pyrethrins, a single pesticide active ingredient, contain six components that have insecticidal activity: pyrethrin 1, pyrethrin 2, cinerin 1, cinerin 2, jasmolin 1, and jasmolin 2

Pyrethroids include:
Allethrin stereoisomers, Bifenthrin, Beta-Cyfluthrin, Cyfluthrin, Cypermethrin, Cyphenothrin, Deltamethrin, Esfenvalerate, Fenpropathrin, Tau-Fluvalinate, Lambda-Cyhalothrin, Gamma Cyhalothrin, Imiprothrin, 1RS cis-Permethrin, Permethrin, Prallethrin, Resmethrin, Sumithrin (d-phenothrin), Tefluthrin, Tetramethrin, Tralomethrin, and Zeta-Cypermethrin

Synergists include:
MGK-264 and Piperonyl butoxide

Permethrin
Permethrin is a broad-spectrum pyrethroid insecticide. It is available in dusts, emusifiable concentrates, smokes, ULV concentrates, and wettable-powder formulations.

The historical development of the synthetic pesticides called pyrethroids is based on the pyrethrins, which are derived from chrysanthemums. Pyrethrins are a "natural" environmental product that is of low toxicity to mammals. They are highly photolabile and degrade quickly in sunlight, and the cost of reapplying them has limited their widespread agricultural use. Pyrethroids have been synthesized to be similar to pyrethrins yet more stable in the environment. Evidence suggests that they have a very large margin of safety when used as directed by the label (Aldridge, 1990; Chen et al., 1991; Snodgrass, 1992).

Commercial pyrethroid products commonly use petroleum distillates as carriers. Some commercial products also contain OP or carbamate insecticides because the rapid paralytic effect of pyrethrins on insects ("quick knockdown") is not always lethal (Cheremisinoff and King, 1994). Pyrethroids are formulated as emusifiable concentrates, wettable powders, granules, and concentrates for ULV application.

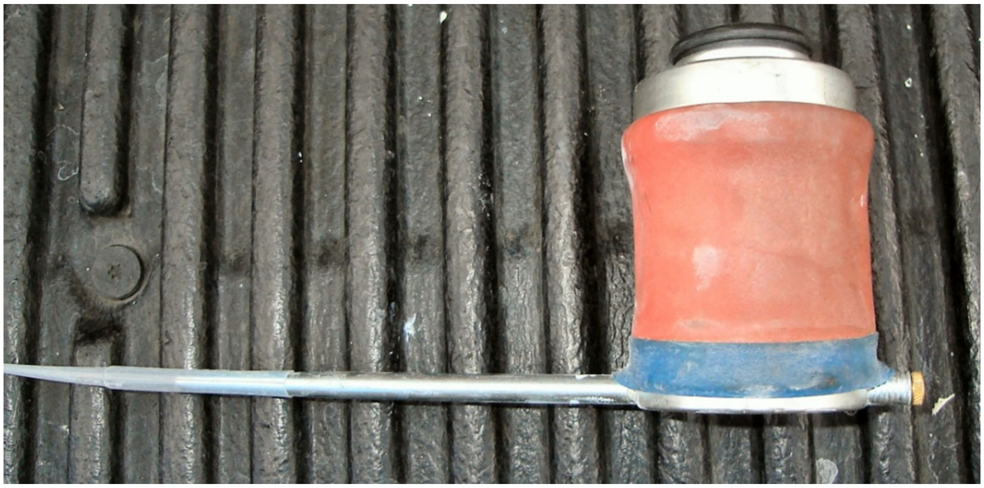
Borates

"Borate" is a generic term for compounds containing the elements boron and oxygen. Boron never occurs alone naturally but as calcium and sodium borate ores in several places in the world.

Borax and other sodium borates are used in numerous products such as laundry additives, eye drops, fertilizers, and insecticides. Though the mechanisms of toxicity are not fully understood, boron is very toxic to insects and decay fungi that commonly damage wood in structures. At low levels, however, boron is only minimally toxic, and perhaps beneficial, to humans, other mammals, and growing plants. Use of borate-treated wood for construction of homes and their wood-based contents appears to offer many advantages to today's environmentally sensitive world.

The item on below is often referred to as a "Centrobulb" or duster. This is a brand name and many variations are found. It is a simple tool to apply powder, dust or granular baits. An insecticide duster delivers a fine application of your favorite insecticidal dust. Get one that is non-conductive to electrical lines and switches. We have noticed that applicators will utilize this tool and proper product in areas that are wet or receive rain. This is a good use of product and good idea.

Centrobulb" or duster



The above photograph is a **Crusader Duster** or dust applicator and is great for voids in walls or cracks and crevices. Just pour your product in the top and squeeze the product into the cracks or inside switch plates. You have to get in the pest's home to kill them! Notice the plastic tip so that you do not get an electric shock. This moneymaking tool is great to kill cockroaches, bees or termites. Cockroaches are one of the easiest to kill if you can get product on them.

Right photograph, I like to call this my coffee pot type of dispenser. It is a hand held compressed air spot applicator for indoor use. I like to use Phantom or equivalent products in it and it works like dynamite on ants and termites alike. Notice the two red backpacks on this truck. Always have a backup backpack. Always follow the pesticide label's instructions and not my comments or suggestions. Some of my suggestions may be illegal in some areas or for certain products. Always follow the label!

Bottom photograph, Drax Gel (i.e. - Orthoboric acid 5%): Indoor ant bait in gel form. The "double barrel" syringe delivers both sugar and protein baits in one easy application. Bait can be placed in small amounts to cracks, crevices and other areas where conventional bait stations cannot be used. We have found excellent control of household ants by combining Drax Gel with FluorGuard bait stations. This ant bait combo gives you quick control of indoor ant populations. You will often find ants inside areas that have cockroach infestations.

Drax Gel

Unlike most other wood preservatives and organic insecticides that penetrate best in dry wood, borates are diffusible chemicals—they penetrate unseasoned wood by diffusion, a natural process. Wood moisture content and method and length of storage are the primary factors affecting penetration by diffusion. Properly done, diffusion treatments permit deep penetration of large timbers and refractory (difficult-to-treat) wood species that cannot be treated well by pressure.

The diffusible property of borates can be manipulated in many ways; suitable application methods range from complex automated industrial processes to simple brush or injection treatments.

Application methods include momentary immersion by bulk dipping; pressure or combination pressure/diffusion treatment; treatment of composite boards and laminated products by treatment of the wood finish; hot and cold dip treatments and long soaking periods; spray or brush-on treatments with borate slurries or pastes; and placement of fused borate rods in holes drilled in wood already in use. This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used.

Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Neonicotinoids

Neonicotinoids are synthetic analogues of the natural insecticide nicotine (with a much lower acute mammalian toxicity and greater field persistence). These chemicals are nicotinic acetylcholine receptor agonists. Broad-spectrum—systemic insecticides, they have a rapid action (minutes-hours). They are applied as sprays, drenches, seed and soil treatments—often as substitutes for organophosphates and carbamates. Treated insects exhibit leg tremors, rapid wing motion, stylet withdrawal (aphids), disoriented movement, paralysis and death.

Biological Insecticides

Recent efforts to reduce broad spectrum toxins added to the environment have brought biological insecticides back into vogue. An example is the development and increase in use of Bacillus thuringiensis, a bacterial disease of Lepidopterans and some other insects. Toxins produced by different strains of this bacterium are used as a larvicide against caterpillars, beetles, and mosquitoes. Because it has little effect on other organisms, it is considered more environmentally friendly than synthetic pesticides.

The toxin from B. thuringiensis (Bt toxin) has been incorporated directly into plants through the use of genetic engineering. Other biological insecticides include products based on entomopathogenic fungi (e.g. Beauveria bassiana, Metarhizium anisopliae), nematodes (e.g. Steinernema feltiae) and viruses (e.g. Cydia pomonella granulovirus).

Anti-feedants

Many plants have evolved substances, like polygodial, which prevent insects from eating, but do not kill them directly. The insect often remains nearby, where it dies of starvation. Since anti-feedants are nontoxic, they would be ideal as insecticides in agriculture. Much agrochemical research is devoted to make them cheap enough for commercial use.

Polygodial is an active constituent of Dorrigo Pepper, Mountain Pepper, Horopito, Canelo, Paracress and Water-pepper. It elicits a warm and pungent flavor.

The biological activity of polygodial has been reported in the scientific literature to include antifungal and antimicrobial activities, antihyperalgesia, potent attachment-inhibitory activity, insect antifeedant activity, antinociception, vasorelaxation action in vessels of rabbit and guinea pig, anti-inflammatory and anti-allergic activities.

Polygodial's primary antifungal action is as a nonionic surfactant, disrupting the lipid-protein interface of integral proteins nonspecifically, denaturing their functional conformation. It is also likely that polygodial permeates by passive diffusion across the plasma membrane, and once inside the cells may react with a variety of intracellular compounds. It is also used as an insecticide for its antifeedant property, which causes insects to starve.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Rotenone

Rotenone is an odorless chemical that is used as a broad-spectrum insecticide, piscicide, and pesticide. It occurs naturally in the roots and stems of several plants such as the jicama vine plant. In mammals, including humans, it is linked to the development of Parkinson's disease.

Rotenone is used in solution as a pesticide and insecticide, or in emulsified liquid form as a piscicide. People catch fish by extracting rotenone from plants and releasing it into water. Poisoned fish come to the surface and are easily caught. This method was first practiced by various indigenous tribes who smashed the roots. Fish caught this way can be eaten because rotenone is very poorly absorbed by the gastrointestinal tract of humans, whereas it is lethal to fish because it readily enters the blood stream of the fish through the gills.

Small-scale sampling with rotenone is used by fish researchers studying the biodiversity of marine fishes to collect cryptic, or hidden, fishes, which represent an important component of shoreline fish communities. Rotenone is the most effective tool available because only small quantities are necessary. It has only minor and transient environmental side-effects.

Rotenone is also used in powdered form to reduce parasitic mites on chickens and other fowl. In the United States and in Canada, all uses of rotenone except as a piscicide (fish killer) are being phased out.

Rotenone is sold as an organic pesticide dust for the garden. Unselective in action, it kills potato beetles, cucumber beetles, flea beetles, cabbage worms, raspberry bugs, and asparagus bugs, as well as most other arthropods. Rotenone rapidly bio-degrades under warm conditions so there is minimal harmful residue. A light dusting on the leaves of plants will control insects for several days. It is not known to be harmful to humans when used properly. However, a recent report from the National Institutes of Health finds statistically significant associations between use of either rotenone or paraquat with Parkinson's disease.

Rotenone is produced by extraction from the roots and stems of several tropical and subtropical plant species, especially those belonging to the genus Lonchocarpus or Derris.

Some of the plants containing rotenone:

- Hoary Pea or Goat’s Rue (Tephrosia virginiana) – North America
- Jícama (Pachyrhizus erosus) – North America
- Cubé Plant or Lancepod (Lonchocarpus utilis) – South America
- The root extract is referred to as Cubé resin
- Barbasco (Lonchocarpus urucu) – South America
- The root extract is referred to as Cubé resin
- Tuba Plant (Derris elliptica) – southeast Asia & southwest Pacific islands. The root extract is referred to as Derris or Derris root
- Jewel Vine (Derris involuta) – southeast Asia & southwest Pacific islands. Among the Mizo tribes of India (Derris walchii/D. thyrsiflora) the tender root is eaten as vegetable. The root extract is referred to as Derris or Derris root
- Duboisia – This shrub grows in Australia and bears white clusters of flowers and berry like fruit. The crushed plants were used by the Aboriginals for poisoning fish for food.
- Verbascum Thapsus
- Cork-Bush (Mundulea sericea) – southern Africa
- Florida fishpoison tree (Piscidia piscipula) – southern Florida, Caribbean

Insect Growth Regulators **(Most of this section comes from the USEPA)**

An insect growth regulator (IGR) is a synthetic chemical that mimics insect hormones. Hormones regulate a wide array of body and growth (physiological) functions. IGRs may interfere with molting, pupal emergence, or body wall formation. IGRs are often specific for an insect species or a group of very closely related species. They often have delayed effects because they are taken into the insect and stored until the insect reaches the right growth stage. This may range from days to weeks or even months. For example, if the IGR stops the insect from molting and a given insect is exposed just after a molt, it would continue to function normally until the next molt before dying.

Reduced Risk

Many IGRs are labeled "reduced risk" by the Environmental Protection Agency, meaning that they target juvenile harmful insect populations while causing less detrimental effects to beneficial insects. Unlike classic insecticides, IGRs do not affect an insect's nervous system and are thus more worker-friendly within closed environments. IGRs are also more compatible with pest management systems that use biological controls. In addition, while insects can become resistant to insecticides, they are less likely to become resistant to IGRs.

Hormonal IGRs

Hormonal IGRs typically work by mimicking or inhibiting the juvenile hormone (JH), one of the two major hormones involved in insect molting. IGRs can also inhibit the other hormone, ecdysone, large peaks of which trigger the insect to molt.

If JH is present at the time of molting, the insect molts into a larger larval form; if absent, it molts into a pupa or adult. IGRs that mimic JH can produce premature molting of young immature stages, disrupting larval development. They can also act on eggs, causing sterilization, disrupting behavior or disrupting diapause, the process that causes an insect to become dormant before winter. IGRs that inhibit JH production can cause insects to prematurely molt into a nonfunctional adult. IGRs that inhibit ecdysone can cause pupal mortality by interrupting the transformation of larval tissues into adult tissues during the pupal stage.

Chitin Synthesis Inhibitors

Chitin synthesis inhibitors work by preventing the formation of chitin, a carbohydrate needed to form the insect's exoskeleton. With these inhibitors, an insect grows normally until it molts.

The inhibitors prevent the new exoskeleton from forming properly, causing the insect to die. Death may be quick, or take up to several days depending on the insect. Chitin synthesis inhibitors can also kill eggs by disrupting normal embryonic development. Chitin synthesis inhibitors affect insects for longer periods of time than hormonal IGRs. These are also quicker acting but can affect predaceous insects, arthropods and even fish.

In the case of termite control, the slow action of the IGR allows the chemical to be widely spread throughout the colony as the termite workers feed and groom one another. IGRs are, in general, environmentally safe and have very low mammalian toxicity. Some examples are hexaflumuron, diflubenzuron, pyriproxyfen, and methoprene.

Hexaflumuron

Hexaflumuron (hexaflumeron) is an insect growth regulator that interferes with insects' chitin synthesis. It was registered in 1994 — the first active ingredient to be registered as a "reduced risk pesticide" through the U.S. Environmental Protection Agency's (EPA's) reduced risk program, which waives tests for new pesticides that are thought to pose fewer hazards than existing pesticides. It is registered for use on termites, and is the active ingredient in the Sentricon™ bait system. It functions by inhibiting the synthesis of chitin, the material that makes up the exoskeleton of insects (Cox, 1997).

Hexaflumuron is a benzoyl-phenylurea termiticide registered for use to control Eastern and Formosan subterranean termites. It is registered for use in above- and below-ground termite bait station systems in food and nonfood areas. Treatment sites may include interior and exterior surfaces of buildings and crawl spaces, fences, utility poles, decking, landscape decorations, trees, and other features which could be damaged by termite foraging and feeding activity.

Hexaflumuron is not approved for use in indoor residences. While it is not a restricted use product, hexaflumuron is sold in conjunction with a service provided by pest-control operators licensed by the state to apply termiticides. As hexaflumuron was first registered in 1994, it was not subject to the reregistration process as required by FIFRA.

The Agency anticipates conducting an ecological risk assessment for hexaflumuron, including an endangered species assessment. For human health, risk assessments may be required if there are changes in current use patterns. Below is a summary of the issues relevant to the registration review process of hexaflumuron.

Environmental Fate and Ecological Risk

• The application method for hexaflumuron (i.e., bait stations), is viewed by the Agency as a “closed system” with minimal likelihood of environmental exposure. No previous ecological risk assessments or drinking water exposure assessments have been conducted for hexaflumuron.

• The Agency has not conducted a risk assessment that supports a complete endangered species determination. The ecological risk assessment planned during registration review will allow the Agency to determine whether hexaflumuron use has “no effect” or “may affect” federally listed threatened or endangered species (listed species) or their designated critical habitats. When an assessment concludes that a pesticide’s use “may affect” a listed species or its designated critical habitat, the Agency will consult with the U.S. Fish and Wildlife Service and/or National Marine Fisheries Service (the Services), as appropriate.

• Considering the environmental fate properties of hexaflumuron and the method of application (i.e., bait stations), hexaflumuron has the potential to enter into the environment via termites eating the bait and then transporting it away from the bait station. Once in the termite, hexaflumuron could be transferred to termite predators, such as birds and mammals. Based on the fate properties of hexaflumuron, it has the potential to bioaccumulate in food webs. Another possible route of exposure where uncertainty exists is the ability of non-target terrestrial invertebrates, such as native ground-dwelling pollinators, to enter the hexaflumuron bait stations. Therefore, future ecological risk assessments of hexaflumuron will include assessing risks associated with exposures of terrestrial animals to hexaflumuron through consumption of contaminated termites and non-target terrestrial invertebrates that may enter bait stations.

• Hexaflumuron’s mode of action, fate and transport properties, and toxicity to non-target terrestrial species create the potential for hexaflumuron to reduce survival, reproduction, and/or growth in non-target terrestrial animals including birds, mammals, amphibians, reptiles and terrestrial insects when used in accordance with the current label. These non-target organisms include federally listed threatened and endangered species as well as non-listed species.

• Based on the application methods (i.e., above- and below-ground bait stations) and the environmental fate properties for hexaflumuron, the potential for hexaflumuron to migrate to the soil and to further migrate to surface water and/or groundwater sources is considered minimal. Therefore, ecological risk to aquatic organisms is expected to be low. In addition, unless the use patterns for hexaflumuron change, a drinking water exposure assessment will not be required to support registration review.

Human Health Risk

• Because of the low toxicity of hexaflumuron, and the low-exposure scenarios associated with hexaflumuron products, a human health risk assessment has not been previously conducted.

• Given the current uses, the Agency does not anticipate conducting a human health risk assessment for hexaflumuron to support registration review. However, if in the future new uses or use patterns emerge, human health risk assessments that examine the dietary, residential, aggregate, or occupational risks of hexaflumuron may be required.

• Based on the Agency's review of the available human health toxicity and exposure data for hexaflumuron, no additional data are expected to be required to support registration review.

Diflubenzuron

Diflubenzuron is an insecticide of the benzamide class. It is used in forest management and on field crops to selectively control insect pests. The mechanism of action of diflubenzuron involves inhibiting the production of chitin which is used by an insect to build its exoskeleton.

Diflubenzuron is an acaricide/insecticide (insect growth regulator) used to control many leaf eating larvae of insects feeding on agricultural, forest and ornamental plants (e.g. gypsy moths, mosquito larvae, rust mites).

Diflubenzuron is used primarily on cattle, citrus, cotton, mushrooms, ornamentals, standing water, forestry trees and in programs to control mosquito larvae and gypsy moth populations. Formulations include a soluble concentrate, flowable concentrate, wettable powder and a pelleted/tableted. Diflubenzuron is applied by airblast, aircraft and hydraulic sprayers.

Regulatory History

Diflubenzuron was first registered as a pesticide in the U.S. in 1976. EPA issued a Registration Standard for diflubenzuron in September 1985 (PB86-176500). A November 1991 Data Call-In (DCI) required additional residue chemistry and ecological effects data. Currently, 29 diflubenzuron products are registered.

Human Health
Assessment Toxicity

In studies using laboratory animals, diflubenzuron generally has been shown to be slightly toxic on an acute basis. It is absorbed by the dermal route and has been placed in Toxicity Category III (the second lowest of four categories). It has also been placed in Toxicity Category IV (the lowest of four categories) for ingestion by the oral and inhalation routes.

Occupational and Residential Exposure
Based on current use patterns, handlers (mixers, loaders, and applicators) may be exposed to diflubenzuron during and after normal use of applications in agricultural and other settings. The Agency is establishing a short-term (1 to 7 days) toxicological endpoint of sulfhemoglobinemia and intermediate-term (1 week to several months) toxicological endpoint of methemoglobinemia.

Human Risk Assessment
Diflubenzuron generally is of low acute toxicity, but affects the hemoglobin of animal in studies. Although the Agency has determined that there is no evidence of carcinogenicity for iflubenzuron per se (Group E); p-chloroaniline (PCA), a metabolite of diflubenzuron, is a probable human carcinogen (Group B2). The Agency has also determined that pchlorophenylurea (CPU), a metabolite of diflubenzuron that is closely related to PCA but has no adequate carcinogenicity data, is considered as having the same carcinogenicity potential (Q1*) as PCA. The total cancer risk estimate for PCA and related metabolites for the overall U.S. population is 1 X 10-6. The Rfd is 0.02 mg/kg/day, based on the NOEL of 2.0 mg/kg/day in the 52-week chronic oral study in dogs with a safety factor of 100 to account for interspecies extrapolation and intraspecies variability.

Occupational Exposure
Of greater concern is the risk posed to diflubenzuron handlers, particularly mixers/ loaders/ applicators. The risk for short-term occupational exposure is acceptable for handlers wearing long-sleeved shirts, long pants and chemical-resistant gloves. The risk for intermediate term occupational exposure is also acceptable, provided dust/mist respirators (TC-21C) are required for mixers, loaders and applicators when working with diflubenzuron for certain higher risk application methods.

Restricted Entry Interval
Post-application re-entry workers will be required to observe a 12-hour Restricted Entry Interval, as set by the WPS. Under the Food Quality Protection Act of 1996, the Agency has determined that there is a reasonable certainty that no harm will result to infants and children from aggregate exposure to diflubenzuron. The total dietary cancer risk for the published tolerances for the overall U.S. population is approximately 1 x 10-6. Since there are no detections of diflubenzuron in ground water, dietary risk from drinking water are expected to be negligible. Based on very low residues detected in forestry dissipation studies, a low dermal absorption rate, and extremely low dermal and inhalation toxicity, occupational uses of diflubenzuron in residential locations, parks, or forests treated with diflubenzuron are expected to result in insignificant risk.

Ecological Effects
Diflubenzuron is practically non-toxic to avian species, small mammals, freshwater fish and marine/estuarine fish on an acute oral dietary basis, while it is slightly toxic to avian species on a subacute dietary basis.

Diflubenzuron is non-toxic to bees. The results indicate that diflubenzuron is very highly toxic to freshwater aquatic invertebrates, including marine/estuarine crustacea, while it is highly toxic to marine/estuarine mollusks. The results indicate that diflubenzuron affects reproduction, growth and survival in freshwater invertebrates as well as reproduction in marine/estuarine invertebrates.

Pyriproxyfen

Pyriproxyfen is a pyridine based pesticide which is found to be effective against a variety of arthropoda. It was introduced to the US in 1996 to protect cotton crops against whitefly. It has also found useful for protecting other crops. It is also being used as a prevention for fleas on household pets.

Pyriproxyfen is a juvenile hormone analogue, preventing larvae from developing into adulthood and thus rendering them unable to reproduce. In the US pyriproxyfen is often marketed under the trade name Nylar. In Europe pyriproxyfen is known under the brand names Cyclio (Virbac) and Exil Flea Free TwinSpot (Emax).

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Methoprene

Methoprene is a juvenile hormone (JH) analog which can be used as an insecticide that acts as a growth regulator. Methoprene is an amber-colored liquid with a faint fruity odor which is essentially nontoxic to humans when ingested or inhaled. It is used in drinking water cisterns to control mosquitoes which spread malaria.

Methoprene is an insect growth regulator (IGR) with activity against a variety of insect species including horn flies, mosquitoes, beetles, tobacco moths, sciarid flies, fleas (eggs and larvae), fire ants, pharaoh ants, midge flies and Indian meal moths. Controlling some of these insects, methoprene is used in the production of a number of foods including meat, milk, mushrooms, peanuts, rice and cereals. It also has several uses on domestic animals (pets) for controlling fleas.

Methoprene products are sold under a number of trade names including Altosid, Precor, Kaba, Pharorid, Dianex, Apex, Fleatrol, Ovitrol, Extinguish and Diacon. Methoprene is considered a biochemical pesticide because rather than controlling target pests through direct toxicity, Methoprene interferes with an insect's life cycle and prevents it from reaching maturity or reproducing.

Antimicrobial Pesticides

Antimicrobial pesticides, such as disinfectants & sanitizers, are pesticides that are intended to "(i) disinfect, sanitize, reduce, or mitigate growth or development of microbiological organisms; or (ii) protect inanimate objects (for example floors and walls), industrial processes or systems, surfaces, water, or other chemical substances from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime." This category does not include certain pesticides intended for food use; but does encompass pesticides with a wide array of other uses. For example, antimicrobial pesticides act as preserving agents in paints, metalworking fluids, wood supports, and many other products to prevent their deterioration.

Antimicrobials are especially important because many are public health pesticides. They help to control microorganisms (viruses, bacteria, and other microorganisms) that can cause human disease. Antimicrobial public health pesticides are used as disinfectants in medical settings, where they are present in products used in cleaning cabinets, floors, walls, toilets, and other surfaces. Proper use of these disinfectants is an important part of infection control activities employed by hospitals and other medical establishments.

Only antimicrobial products from the primary registrants are included in the lists. All the EPA's registered pesticides must have an EPA registration number (EPA Reg #). The EPA Registration number for primary registrants consists of two set of numbers separated by a hyphen (-), for example EPA Reg#001234-000012.

The first set of numbers refers to the registrant's identification number and the second set of numbers represents the product identification number. A distributor's product may use a different name, but must have the first two sets of EPA Reg # of the primary registrant, plus a third set of numbers that represents the Distributor/ Relabeler Identification number, for example EPA Reg#001234-000012-000567. An establishment number (EPA Est #) is the place where the pesticide, formulation or device is produced and it is indicated by a set of codes which consist of the registrant's number followed by the State where the product is made and facility number. The approved label of a particular antimicrobial product can be found in the *Pesticide Product Label System (PPLS)* using the EPA registration number of the primary product.

For additional information please contact the Antimicrobials Division hotline at 703-308-0127, 703-308-6467 (FAX) or send an email to *info_antimicrobial@epa.gov*

Other Pest Control Methods

Sterilization
Laboratory studies conducted with U-5897 (3-chloro-1,2-propanediol) where attempted in the early 1970s although these proved unsuccessful. Research into sterilization bait is ongoing. Another effective method of soil sterilization is soil steaming. Pest is killed through hot steam which is induced into the soil.

Soil steam sterilization (soil steaming) is a farming technique that sterilizes soil with steam in open fields or greenhouses. Pests of plant cultures such as weeds, bacteria, fungi and viruses are killed through induced hot steam which causes their cell structure to physically degenerate.

Biologically, the method is considered a partial disinfection. Important heat-resistant, spore-forming bacteria survive and revitalize the soil after cooling down. Soil fatigue can be cured through the release of nutritive substances blocked within the soil. Steaming leads to a better starting position, quicker growth and strengthened resistance against plant disease and pests. Today, the application of hot steam is considered the best and most effective way to disinfect sick soil, potting soil and compost. It is being used as an alternative to bromomethane, whose production and use was curtailed by the Montreal Protocol. "Steam effectively kills pathogens by heating the soil to levels that cause protein coagulation.

Soil sterilization provides secure and quick relief of soils from substances and organisms harmful to plants such as:

- Metabolite
- Bacteria
- Viruses
- Fungi
- Nematodes and Other Pests

Further positive effects are:

- All weed and weed seeds are killed.
- Relief from soil fatigue through activation of chemical – biological reactions.
- Blocked nutritive substances in the soil are tapped and made available for plants.
- Alternative to Methyl Bromide and other critical chemicals in agriculture or enzyme inactivation.

Destruction of Infected Plants
Forest Services sometimes destroy all the trees in an area where some are infected with insects, if seen as necessary to prevent the insect species from spreading. Farms infested with certain insects, have been burned entirely, to prevent the pest from spreading elsewhere.

Biological Pest Control
Biological pest control is the control of one through the control and management of natural predators and parasites. For example: mosquitoes are often controlled by putting Bt Bacillus thuringiensis ssp. israelensis, a bacterium that infects and kills mosquito larvae, in local water sources.

The treatment has no known negative consequences on the remaining ecology and is safe for humans to drink. The point of biological pest control, or any natural pest control, is to eliminate a pest with minimal harm to the ecological balance of the environment in its present form.

Bacillus thuringiensis
Bacillus thuringiensis (or Bt) is a Gram-positive, soil-dwelling bacterium, commonly used as a biological alternative to a pesticide; alternatively, the Cry toxin may be extracted and used as a pesticide. B. thuringiensis also occurs naturally in the gut of caterpillars of various types of moths and butterflies, as well as on the dark surface of plants

During sporulation many Bt strains produce crystal proteins (proteinaceous inclusions), called endotoxins, that have insecticidal action. This has led to their use as insecticides, and more recently to genetically modified crops using Bt genes. There are however many crystal-producing Bt strains that do not have insecticidal properties.

Elimination of Breeding Grounds
Proper waste management and drainage of still water, eliminates the breeding ground of many pests. Garbage provides food and shelter for many unwanted organisms, as well as an area where still water might collect and be used as a breeding ground by mosquitoes. Communities that have proper garbage collection and disposal, have far less of a problem with rats, cockroaches, mosquitoes, flies and other pests than those that don't. Open air sewers are ample breeding ground for various pests as well. By building and maintaining a proper sewer system, this problem is eliminated.

Poisoned Bait
Poisoned bait is a common method for controlling rat populations, however is not as effective when there are other food sources around, such as garbage. Poisoned meats have been used for centuries for killing off wolves, birds that were seen to threaten crops, and against other creatures.

Field Burning
Traditionally, after a sugar cane harvest, the fields are all burned, to kill off any insects or eggs that might be in the fields.

Hunting
Historically, in some countries, when stray dogs and cats became too numerous, local populations gathered together to round up all animals that did not appear to have an owner and kill them. In some nations, teams of rat catchers work at chasing rats from the field, and killing them with dogs and simple hand tools. Some communities have in the past employed a bounty system, where a town clerk will pay a set fee for every rat head brought in as proof of a rat killing.

Traps
Traps have been used for killing off mice found in houses, for killing wolves, and for capturing raccoons and stray cats and dogs for disposal by town officials.

Poison Spray
Spraying poisons by planes, hand held units, or trucks that carry the spraying equipment, is a common method of pest control. Throughout the United States of America, towns often drive a town owned truck around once or twice a week to each street, spraying for mosquitoes. Crop dusters commonly fly over farmland and spray poison to kill off pest that would threaten the crops. Many find spraying poison around their yard, homes, or businesses, far more desirable than allowing insects to thrive there.

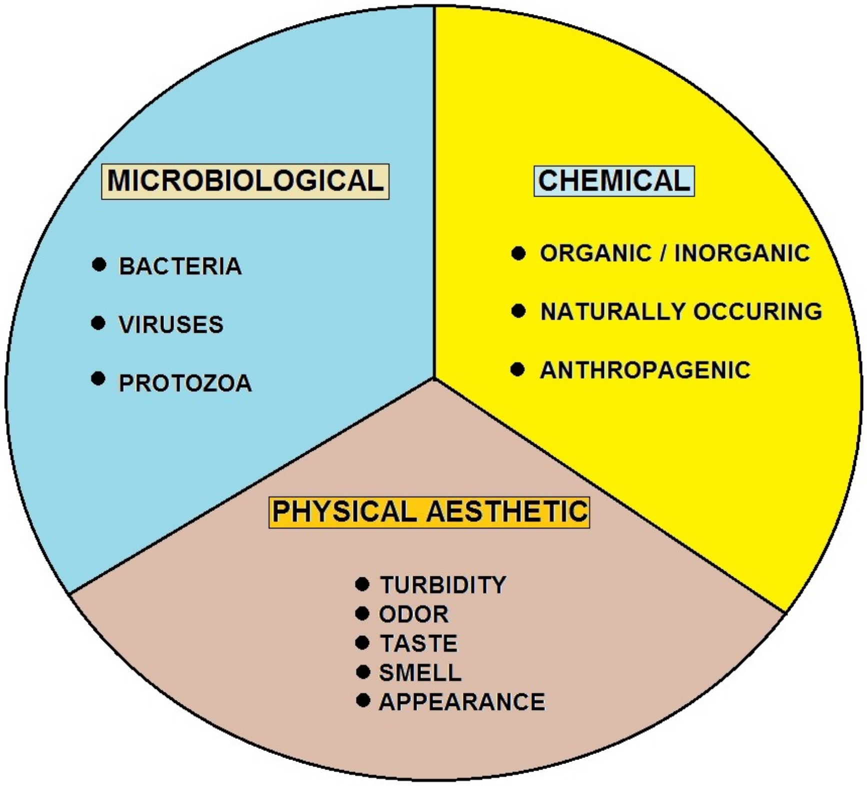
Space Fumigation
A project that involves a structure be covered or sealed airtight followed by the introduction of a penetrating, deadly gas at a killing concentration a long period of time (24-72hrs.). Although expensive, space fumigation targets all life stages of pests.

Space Treatment
A long term project involving fogging or misting type applicators. Liquid insecticide is dispersed in the atmosphere within a structure. Treatments do not require the evacuation or airtight sealing of a building, allowing most work within the building to continue but at the cost of the penetrating effects. Contact insecticides are generally used, minimizing the long lasting residual effects. On August 10, 1973, the Federal Register printed the definition of Space treatment as defined by the U.S. Environmental Protection Agency (EPA): “the dispersal of insecticides into the air by foggers, misters, aerosol devices or vapor dispensers for control of flying insects and exposed crawling insects”.

Natural Rodent Control
Several wildlife rehabilitation organizations encourage natural form of rodent control through exclusion and predator support and preventing secondary poisoning altogether. The United States Environmental Protection Agency agrees, noting in its Proposed Risk Mitigation Decision for Nine Rodenticides that “without habitat modification to make areas less attractive to commensal rodents, even eradication will not prevent new populations from recolonizing the habitat.”

Repellents
- Balsam fir oil from the tree Abies balsamea is an EPA approved non-toxic rodent repellent.
- Acacia polyacantha subsp. campylacantha root emits chemical compounds that repel animals including crocodiles, snakes and rats.

Pesticides and Water Quality Sub-Section



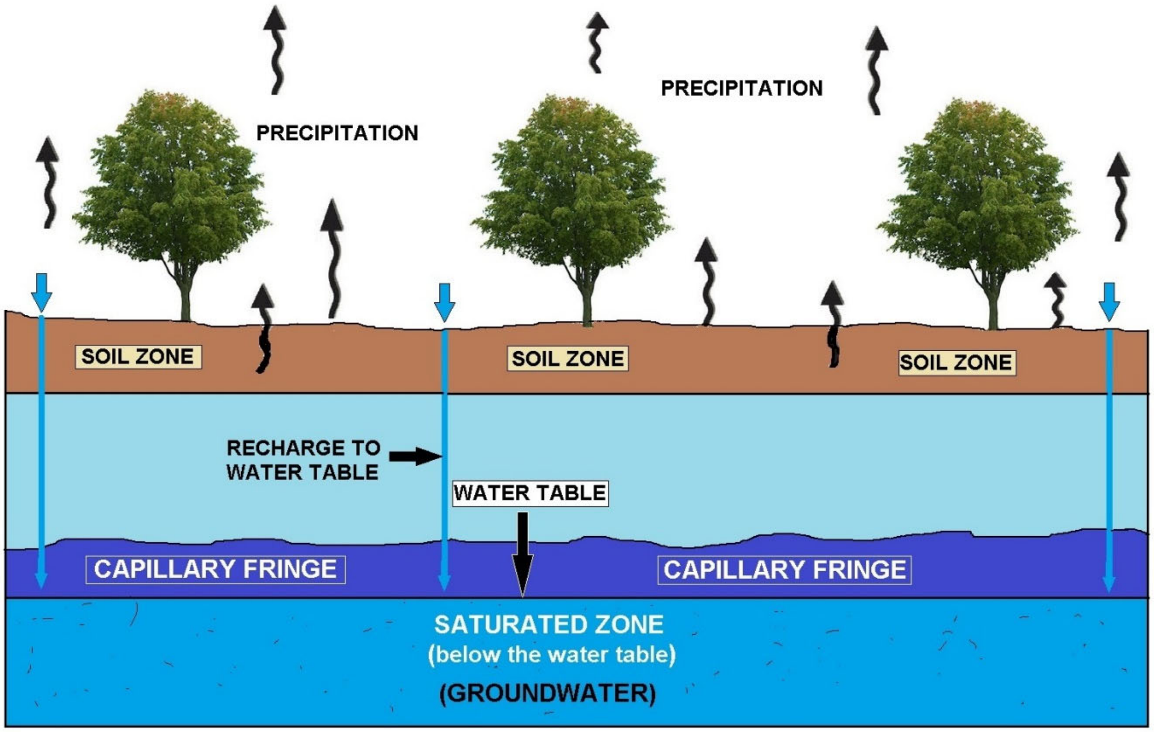
WATER QUALITY BROKEN DOWN INTO 3 BROAD CATEGORIES

Insecticides and herbicides (sometimes referred to as pesticides) are widely used in agriculture, industry, leisure facilities and gardens to control weeds and insect pests and may enter the water cycle in many ways. The Federal Insecticide, Fungicide, and Rodenticide Act, which authorizes EPA to control the availability of pesticides that have the ability to leach into ground water.

Agricultural activities (pesticide application) can make significant contributions to ground-water contamination with the millions of tons of fertilizers and pesticides spread on the ground and from the storage and disposal of livestock wastes. Homeowners, too, can contribute to this type of ground-water pollution with the chemicals they apply to their lawns, rosebushes, tomato plants, and other garden plants.

Groundwater
Groundwater originates as precipitation that sinks into the ground. Some of this water percolates down to the water table (shallowest surface of the groundwater) and recharges the aquifer. For shallow wells (i.e., less than 50-75 feet) the recharge area is often the immediate vicinity around the well or "wellhead."

Some wells are recharged in areas that may be a great distance from the well itself. If the downward percolating precipitation encounters any source of contamination, at the surface or below it, the water may dissolve some of that contaminant and carry it to the aquifer. Groundwater moves from areas where the water table is high to where the water table is low. Consequently, a contaminant may enter the aquifer some distance upgradient from you and still move towards your well.



CAPILLARY FRINGE
(Material above water table that may contain water by capillary pressure in small voids)

When a well is pumping, it lowers the water table in the immediate vicinity of the well, increasing the tendency for water to move towards the well. Contaminants can be lumped into three categories: microorganisms (bacteria, viruses, Giardia, etc.), inorganic chemicals (nitrate, arsenic, metals, etc.) and organic chemicals (solvents, fuels, pesticides, etc.).

Although it is common practice to associate contamination with highly visible features such as landfills, gas stations, industry or agriculture, potential contaminants are widespread and often come from common everyday activities as well, such as septic systems, lawn and garden chemicals, pesticides applied to highway right-of-ways, stormwater runoff, auto repair shops, beauty shops, dry cleaners, medical institutions, photo processing labs, etc. Importantly, it takes only a very small amount of some chemicals in drinking water to raise health concerns. For example, one gallon of pure trichloroethylene, a common solvent, will contaminate approximately 292 million gallons of water.

Wellhead Protection
Wellhead protection refers to programs designed to maintain the quality of groundwater used as public drinking water sources by managing the land uses around the wellfield. The theory is that management of land use around the well, and over water moving (underground) toward the well, will help to minimize damage to subsurface water supplies by spills or improper use of chemicals. The concept usually includes several stages. Until the 1970s, ground water was believed to be naturally protected from contamination. The layers of soil and particles of sand, gravel, crushed rocks, and larger rocks were thought to act as filters, trapping contaminants before they could reach the ground water.

Since then, however, every state in the nation has reported cases of contaminated ground water, with some instances receiving widespread publicity. We now know that some contaminants can pass through all of these filtering layers into the saturated zone to contaminate ground water.

Between 1971 and 1985, 245 ground-water related disease outbreaks, with 52,181 associated illnesses, were reported. Most of these diseases were short-term digestive disorders. About 10 percent of all ground-water public water supply systems are in violation of drinking water standards for biological contamination. In addition, approximately 74 pesticides, a number of which are known carcinogens, have been detected in the ground water of 38 states.

Although various estimates have been made about the extent of ground-water contamination, these estimates are difficult to verify given the nature of the resource and the difficulty of monitoring its quality.

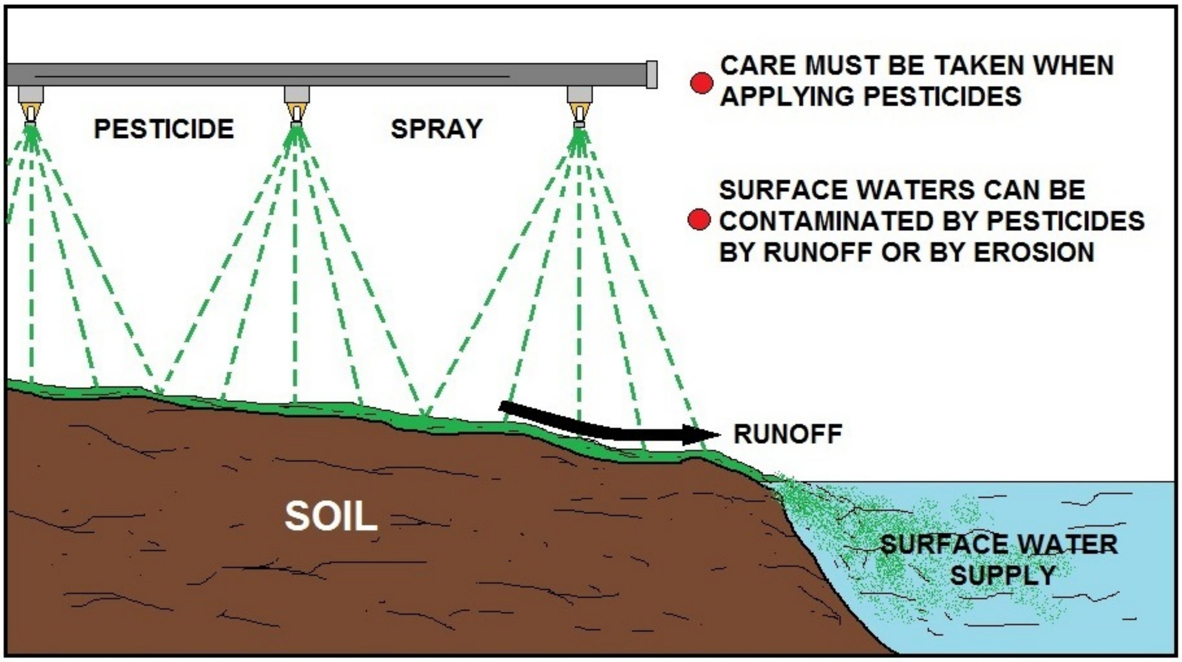
Checklist for protecting water from pesticides

- Always check pesticide labels to learn irrigation practices, rates and application methods.
- Be aware of the geology and the relative depth of the groundwater in your area.
- Build dikes around your bulk tanks to prevent off-site movement of pesticides.
- Clean your pesticide application equipment in a way that makes it easy to collect rinsates.
- Delay pesticide applications if rain is forecast.
- Ensure that any abandoned well near a pesticide handling or application site is properly closed.
- Grade the area around your well to divert surface runoff.
- Install a check-valve on your water hose to prevent back-siphoning.
- Know which pesticides you use have a potential for leaching.
- Leave a border of untreated vegetation between treated and sensitive areas.
- Store pesticides in their original containers in a cool, well-ventilated building with a concrete floor.
- Use pesticides only when necessary and then at the lowest rate needed to control a pest.

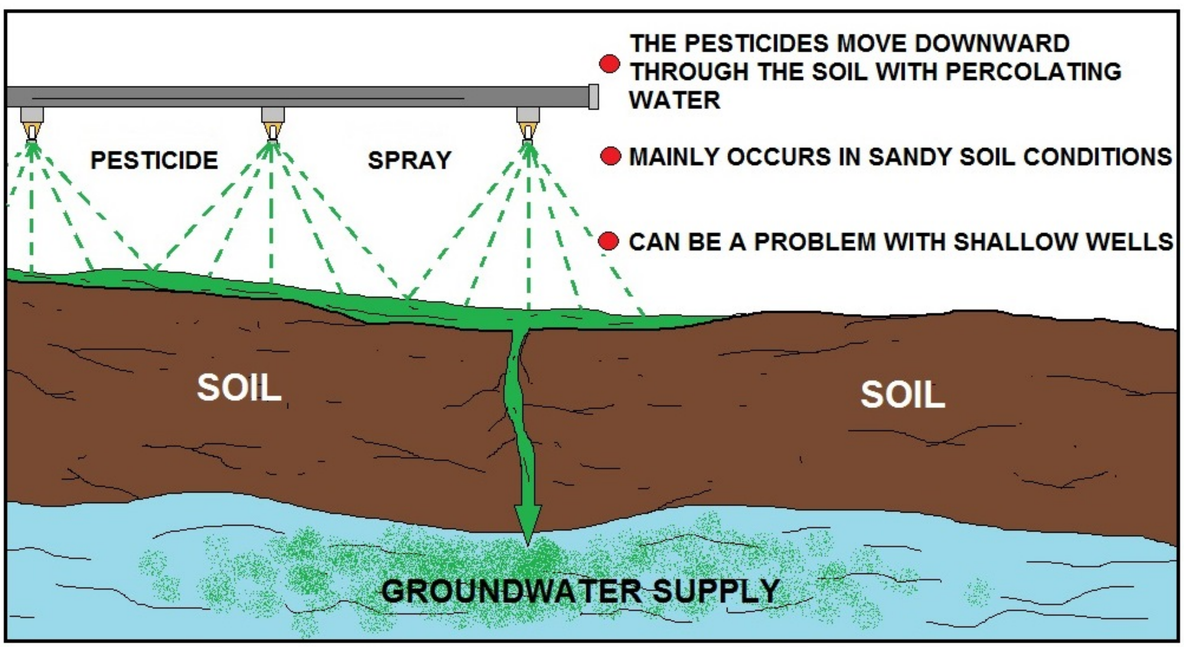
Reading the Pesticide Label

The pesticide label is your best guide to using pesticides safely and effectively. The directions on the label are there primarily to help you achieve “maximum” benefits—the pest control that you desire—with “minimum” risk. Both depend on following label directions and correctly using the pesticide. Read the label. Read the label before buying the pesticide.

Read the label before mixing or using the pesticide each time, and read the label before storing or disposing of the pesticide. Do not trust your memory. You may have forgotten part of the label instructions or they may have changed. Use of any pesticide in any way that is not consistent with label directions and precautions is illegal. It may also be ineffective and, even worse, dangerous.



HOW PESTICIDES CAN CONTAMINATE SURFACE WATER SUPPLYS



HOW PESTICIDES CONTAMINATE GROUNDWATER SUPPLYS

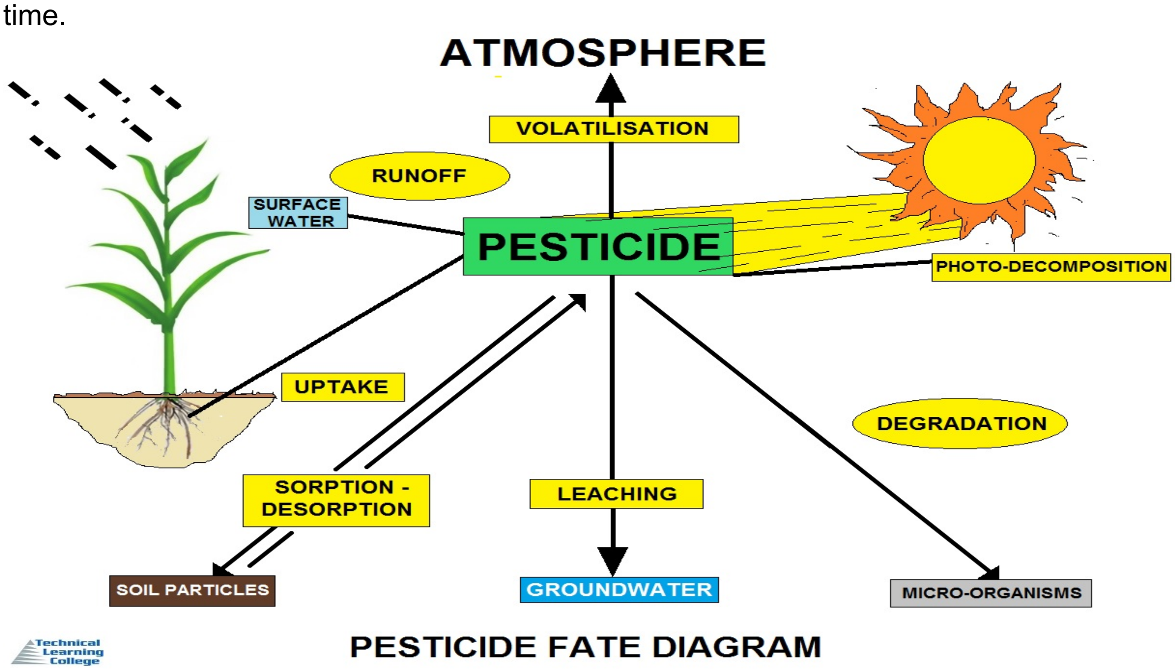
Understanding Pesticide Adsorption Sub-Section

Parts of this section come from Ohio and Missouri State University Extensions.

Adsorption Process

The adsorption process binds pesticides to soil particles, similar to iron filings or paper clips sticking to a magnet. Adsorption often occurs because of the attraction between a chemical and soil particles. Positively charged pesticide molecules, for example, are attracted to and can bind to negatively charged clay particles. Many soil factors influence pesticide adsorption. Soils high in organic matter or clay are more adsorptive than coarse, sandy soils, in part because a clay or organic soil has more particle surface area, or more sites onto which pesticides can bind. Moisture also affects adsorption. Wet soils tend to adsorb less pesticide than dry soils because water molecules compete with the pesticide for the binding sites.

Pesticides vary in their adsorption to soil particles. Some pesticides such as paraquat and glyphosate bind very tightly, while others bind only weakly and are readily desorbed or released back into the soil solution. As soon as the pesticide is applied into the environment it is affected by a number of physical, chemical or biological processes which then affect how persistent it might be or whether or not the pesticide moves. These processes are generally beneficial. On occasions some practices might be perceived as detrimental. For example, the watering in of a surface applied herbicide makes it work better because the herbicide is root absorbed. Therefore, there is little or no runoff or leaching. In addition, the degradation of a soil applied pesticide occurs through several mechanisms which reduce the toxicity over time.



PESTICIDE FATE DIAGRAM

As we then look at those processes that impact the pesticide, once introduced into the environment, we can divide them in to three major categories:

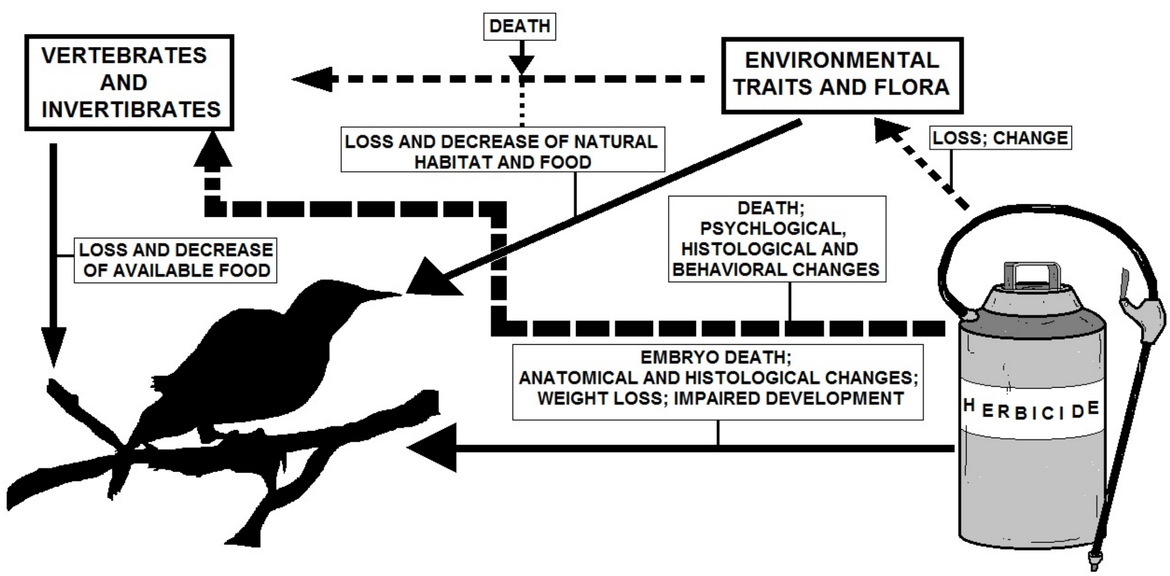
- **Adsorption**
- **Transfer**
- **Degradation**

Adsorption
Adsorption is the binding of the pesticide to the mineral components of the soil or organic matter, which is abundant in turf. In turf, organic matter includes, in many circumstances, a thatch layer. In other pesticide application circumstances there is not a thatch layer like we have in a turf system. This layer makes the turf system quite unique with regard to the buffering capacity of the system to those materials introduced into it.

There's also a transfer process (where pesticides can actually move in the environment) and, finally, a degradation process that removes pesticides (through degradation). Adsorption as a process is pretty straight forward and occurs when a chemical binds to organic or mineral matter in a way that it cannot be dislodged by water.

Transfer processes include such things as volatilization, runoff, leaching, up-take by various flora and fauna (including the turf), and removal of the treated vegetation. With turfgrass we commonly look at the transfer process in terms of removal (movement of pesticides) from the turf due to the mowing process (the collection of clippings and their transfer to some other location). In some circumstances detrimental effects can occur.

For example, if herbicides are applied to turf and then the clippings are removed soon after application and are applied to garden plants as a mulch, the herbicide may volatilize from those clippings and certain sensitive plants could be injured.



INDIRECT & DIRECT EFFECTS OF HERBICIDES ON BIRDS

The Fate Processes

One problem resulting from pesticide adsorption is reduced pest control. For example, weeds may not be controlled if a herbicide is held tightly to soil particles and cannot be taken up by the roots of the target weeds. Some pesticide labels recommend higher application rates when the chemical is applied to adsorptive soils.

Plant injury can be another problem resulting from adsorption of pesticides to soil particles. Injury can result when a pesticide used for one crop is later released from the soil particles in amounts great enough to cause injury to a sensitive rotational crop. This pesticide "carry-over" can also lead to the presence of illegal residues on rotational food or feed crops. Adsorption is particularly important because it influences whether other processes are able to affect pesticides.

Pesticide Adsorption
The adsorption process binds pesticides to soil particles and/or plant parts, similar to iron filings or paper clips sticking to a magnet. Adsorption often occurs because of the attraction between a chemical and soil or organic particles. For example, positively charged pesticide molecules are attracted to and can bind to negatively charged clay particles and plant debris.

Many soil factors influence pesticide adsorption. Soils high in organic matter or clay are more adsorptive than coarse sandy soils. This occurs, in part, because a clay or organic soil has a greater particle surface area or number of sites onto which pesticides can bind. Soil moisture also influences adsorption. Wet soils tend to adsorb less pesticide than dry soils because water molecules compete with the pesticide for the binding sites on soil particles. Pesticides may adsorb onto plant materials such as litter in no-till or minimum-till fields, the bark of trees, or thatch in turf. These organic layers may prohibit pesticide movement to target areas deeper in the soil. Pesticides vary in their tendency to adsorb to soil particles. Some pesticides, such as paraquat and glyphosate, bind very tightly, while others bind only weakly and are readily desorbed or released back into the soil solution. Adsorption is particularly important because it influences whether other processes can affect pesticides.

Pre-emergence Herbicides
Pre-emergence herbicides can be useful chemical tools for you as you attempt to manage weeds before they can compete for valuable space in your turf. Unfortunately, the level of control you desire does not always happen. There are a host of possible reasons for not getting the control that you want; but, by far and away, the most probable reason is improper timing of application — usually that they are not applied soon enough.

Chemical Barrier
You should have your pre-emergence herbicides on the ground and activated prior to the initiation of weed seed germination. Activation is important because you want to have an "active" chemical barrier present in the soil solution when the target weed seeds imbibe water. You can insure activation easily by irrigating immediately after herbicide activation. Be sure to irrigate at least equivalent to a half inch of rainfall. Actually, if you plan to use sprayed formulations of pre-emergence herbicides, a good way to insure activation is to apply them when it is raining. In circumstances where irrigation is not available and you must depend on rainfall for activation, you should apply pre-emergence herbicides earlier than you might when you could irrigate, to insure there is ample time for rainfall to occur

A variety of factors affect the performance of pre-emergence herbicides. These include timing of application in relation to weed seed germination, soil type, environmental conditions (primarily temperature and rainfall), target weed species and biotype. Ideally, pre-emergence herbicides should be applied just before weed seed germination begins. Applying too early may result in reduced control or no control due to leaching and/or normal herbicide degradation. However, there is a good deal of research that indicates pre-emergence summer annual grass control applications may be made as early as January.

The reason this works is that during cool weather the rate of herbicide degradation is slow and most of the pre-emergence grass herbicides do not leach readily. Pre-emergence herbicides must be in place and activated before weed seed germination begins. Activation of pre-emergence herbicides requires 0.25 to 0.5 inch of rainfall or irrigation. For optimum performance, rainfall or irrigation should occur within 24 hours of application to move the herbicides into the upper layer of the soil. The critical period between application and activation by rainfall or irrigation varies with herbicide, rate, and environmental conditions.

Crabgrass germinates in the spring (late March-April) when soil temperature at the 4-inch depth reaches 53 degrees Fahrenheit. Alternating wet and dry conditions at the soil surface as well as light encourage crabgrass germination.

Sequential or Repeat Applications of Pre-emergence Herbicides
In warm weather, herbicides begin to degrade soon after application eventually reaching a level at which weed seed germination can occur. Pre-emergence herbicides will degrade to the point of ineffectiveness from 6 to 16 weeks after application. For this reason, repeat or sequential applications are needed for full season control. Make sequential applications 60 days after the initial treatment.

Pesticide Transfer
Pesticide transfer is sometimes essential for pest control. For example, for certain pre-emergence herbicides to be effective, they must move within the soil to reach the germinating seeds. Too much movement, however, can move a pesticide away from the target pest. This can lead to reduced pest control, contamination of surface water and groundwater, and injury of non-target species, including humans. Five ways that pesticides can be transferred are through volatilization, runoff, leaching, absorption and crop removal.

Volatilization
Volatilization is the conversion of a solid or liquid into a gas. Once volatilized, a pesticide can move in air currents away from the treated surface. Vapor pressure is an important factor in determining whether a pesticide will volatilize. The higher the vapor pressure, the more volatile the pesticide.

Volatilization occurs when a pesticide partitions from the solid or aqueous phase to the gas phase. Once volatilized, a pesticide may diffuse into the atmosphere and either be destroyed or continue as an environmental risk. When mixing disturbs a soil contaminated by a pesticide or other organic compound, a 30 percent or greater loss of the soil contaminant through volatilization is not unusual.

Thermophilic Temperatures
Volatilization of a pesticide is highly temperature dependent; thermophilic temperatures typically increase pesticide losses. The tendency for a pesticide to volatilize also depends upon its size, structure, and function. Moisture also affects volatilization rates.

Water may physically impede the flow of a gas phase pesticide by obstructing the pores through which gases travel. Water may also promote volatilization by liberating weakly adsorbed pesticides.

Environmental factors tend to increase volatilization. They include high temperature, low relative humidity, and air movement. A pesticide tightly adsorbed to soil particles is less likely to volatilize; soil conditions such as texture, organic matter content, and moisture can thus influence pesticide volatilization.

Volatilization can result in reduced control of the target pest because less pesticide remains at the target site. Vapor drift, the movement of pesticide vapors or gases in the atmosphere, can lead to injury of non-target species. Herbicide vapors in particular can injure non-target plants.

To reduce pesticide volatilization, avoid applying volatile pesticides when conditions are unfavorable, such as very hot, dry days or when the soils are wet. Labels often provide warnings if there is a volatility hazard under certain conditions. Labels for volatile pesticides may suggest adding the pesticide to the soil by tillage or irrigation during or shortly after application. This helps to reduce volatilization by reducing the amount of exposed pesticide on the soil surface. Low-volatile formulations are also available for some pesticides.

Runoff
Runoff is movement of water over a sloping surface. Runoff occurs when water is applied faster than it can enter the soil. Pesticides can be carried in the water itself or bound to eroding soil particles. The severity of pesticide runoff depends on the slope or grade of an area; the erodibility, texture and moisture content of the soil; and the amount and timing of rainfall and irrigation. Pesticide runoff usually is greatest when a heavy or sustained rain follows soon after an application. Over-irrigation can lead to excess surface water; it also can lead to pesticide runoff, especially when an irrigation system is used to apply a pesticide.

Vegetation or crop residue tends to slow the movement of runoff water. Certain physical and chemical properties of the pesticide, such as how quickly it is absorbed by plants or how tightly it is bound to plant tissue or soil, are also important.

Herbicide runoff can cause direct injury to non-target plants. Insecticide and nematicide runoff into surface waters such as streams and ponds can be particularly harmful to aquatic organisms. Pesticide runoff also can lead to groundwater contamination and can cause injury to crops, livestock or humans if the contaminated water is used downstream.

Practices to reduce pesticide runoff include monitoring of weather conditions, careful application of irrigation water, using a spray mix additive to enhance pesticide retention on foliage, and incorporating the pesticide into the soil. Reduced-tillage cropping systems and surface grading, in addition to contour planting and strip cropping of untreated vegetation, can slow the movement of runoff water and help keep it out of wells, sinkholes, water bodies and other sensitive areas.

Leaching

Leaching is the movement of pesticides through the soil rather than over the surface. Leaching depends, in part, on the pesticide's chemical and physical properties. For example, a pesticide held strongly to soil particles by adsorption is less likely to leach. Another factor is solubility. A pesticide that dissolves in water can move with water in the soil. The persistence, or longevity, of a pesticide also influences the likelihood of leaching.

A pesticide that is rapidly broken down by a degradation process is less likely to leach because it may remain in the soil only a short time.

Water-soluble pesticides have a tendency to be “rinsed away” through a process called leaching, that is, the movement of a chemical within percolating water. Typically, leaching is of concern when the pesticide moves into groundwater or another location, posing an increased risk to humans and/or the environment. Many pesticides are not highly soluble in water, readily adsorbing onto the organic matter fraction. For this reason, use of composts in agricultural soils tends to reduce the threat of pesticide leaching losses.

Soil factors that influence leaching include texture and organic matter, in part because of their effect on pesticide adsorption. Soil permeability (how readily water moves through the soil) is also important. The more permeable a soil, the greater potential for pesticide leaching. A sandy soil is much more permeable than a clay.

The method and rate of application, the use of tillage systems that modify soil conditions, and the amount and timing of water a treated area receives after application can also influence pesticide leaching. Typically, the closer the time of application to a heavy or sustained rainfall, the greater the likelihood that some pesticide leaching will occur. A certain amount of pesticide leaching may be essential for control of a target pest. Too much leaching, however, can lead to reduced pest control, injury of non-target species and groundwater contamination.

Monitoring weather conditions and the amount and timing of irrigation can help minimize pesticide leaching. Careful pesticide selection is important because those pesticides that are not readily adsorbed, not rapidly degraded, and highly water soluble are the most likely to leach. Labels must be read carefully for instructions on the rates, timing and methods of application. The label may also advise against using the pesticide when certain soil, geologic or climatic conditions are present.

Pesticides can leach through the soil to groundwater from storage, mixing, equipment cleaning and disposal areas. Under certain conditions, some pesticides can leach to groundwater from normal applications. The section "Pesticides and water quality" provides further discussion on groundwater and safe handling practices to prevent contamination.

Absorption or Uptake

Absorption or uptake is the movement of pesticides into plants and animals. Absorption of pesticides by target and non-target organisms is influenced by environmental conditions and by the chemical and physical properties of the pesticide and the soil. Once absorbed by plants, pesticides may be broken down or they may remain in the plant until tissue decay or harvest.

Crop Removal
Crop removal transfers pesticides and their breakdown products from the treatment site. Most harvested food commodities are subjected to washing and processing procedures that remove or degrade much of the remaining pesticide residue. While we typically associate harvesting with food and feed products, it is easy to forget that pesticides potentially can be transferred during such operations as tree and shrub pruning and turfgrass mowing.

Pesticide Degradation
Pesticide degradation, or the breakdown of pesticides, usually is beneficial. Pesticide-destroying reactions change most pesticide residues in the environment to nontoxic or harmless compounds. However, degradation is detrimental when a pesticide is destroyed before the target pest has been controlled.

Biological Degradation
Microorganisms have developed many enzymes that can break down natural compounds. Modern scientists, though, have created pesticides with chemical structures not found in nature. These unique structures are often responsible for a pesticide's effectiveness and also explain why pesticides can persist in the environment. A pesticide's environmental persistence largely depends on its chemical structure and on the presence of unusual functional groups, which are large sub-structures within the pesticide molecule. The chemical structure helps determine its water solubility and consequently, its bioavailability, since microbes more readily assimilate water-soluble compounds.

When a pesticide’s functional groups are attached with weak or labile bonds, it can degrade more rapidly. Many modern pesticides have such bonds designed into them to avoid problems of extended persistence. Adding water may break many labile bonds. This process is called hydrolysis and the enzymes that promote hydrolysis are termed hydrolytic. Malathion is an example of an insecticide containing many such labile bonds that may be broken using hydrolytic enzymes (for example, esterase and phosphatase).

Hydrolytic Degradation
Other pesticides capable of hydrolytic degradation are: carbamate pesticides, urea derivatives, pyrethroids, diazinon, dicamba, dichloropicolinic acid, dimethoate, phenylalkanoic ester, dimethoate, phenylalkanoic pyrazon, atrazine, linuron, propanil, chlorpyrifos, and 2,4-D.Two other classes of enzymes, mono- and di-oxygenases, are also commonly associated with pesticide degradation. These enzymes introduce one or two oxygen atoms, respectively, into the structure of a pesticide.

This oxidation process often makes the pesticide more amenable to further degradation by increasing its water solubility, thereby increasing its bioavailability. Degradation may begin at the extracellular level and then proceed further at the intracellular level.

Extracellular Decomposition
Many of the same enzymes microorganisms use to break down cellulose, hemicellulose, and lignin—the primary natural compounds in most plant material—may also degrade pesticides during composting. The large polymeric structure of these natural compounds prevents their passage into the microorganism for consumption. To deal with this problem, microorganisms begin breaking down chemicals outside their “body,” or extracellularly. They excrete enzymes out of their cells that react with the bonds in cellulose, hemicellulose, and/or lignin, breaking them down into smaller components. The shortened polymers can then be subjected to further degradation.

Extracellular Enzymes
Extracellular enzymes can have very low “specificity,” working like a key that fits different locks. They can, therefore, react with many different chemicals. If the enzyme finds a pesticide before reaching its “intended” substrate (for example, cellulose, hemicellulose, lignin), it may react with it, changing the pesticide into a possibly less toxic and less hazardous form.

Such co-metabolism appears to play a significant role in degrading pesticides found in compost and soil. Fungi are the source of most extracellular enzymes. Some fungi often associated with compost and soil organic matter are in the genera Trichoderma, Gliocladium, Penicillium, and Phanerochaete. Fungi grow through the development of hyphae (long strings of cells) that extend throughout compost or soil organic matter. The hyphae release extracellular enzymes, which break down the pesticide and allow it to pass into the cells. This allows the production of additional hyphae and/or energy. Although fungi are present in compost feedstock, they contribute more to composting in its later stages. As bacteria exhaust the easily degraded organic matter from the feedstock, fungi then begin to degrade the more recalcitrant polymeric organic matter.

Intracellular Decomposition
After extracellular enzymes begin breaking down a pesticide or if it is otherwise bioavailable, a pesticide may enter the cell of a microorganism. To pass into a cell efficiently, the pesticide must be dissolved in water.

Generally pesticides containing more oxygen, nitrogen, and sulfur tend to be more water soluble due to hydrogen bonding. Once inside a cell, a pesticide may undergo varying degrees of degradation. Mineralization reduces the pesticide to carbon dioxide, water, and other inorganic components. Typically, it accounts for only a small portion of the “disappearance” of a pesticide through composting.

Last Word on Adsorption
Water-insoluble pesticides tend to adsorb onto and within organic matter, making them even less bioavailable. The chemistry of the functional groups in the pesticide and the organic matter dictates the strength of this pesticide-organic matter interaction.

Adsorbed pesticides are generally much more resistant to breakdown than water-soluble pesticides. This is because the latter have a much greater chance of contact with pesticide-degrading microorganisms as described above. Consequently, highly adsorbed pesticides are not considered bioavailable, enabling them to persist for months or even years.

However, when a pesticide is adsorbed to organic matter that eventually decomposes, it may once again become bioavailable. Additional factors can make adsorption a likely outcome for even water-soluble pesticides. For example, many pesticides contain acidic and nitrogen-containing functional groups that can adsorb due to the presence of a negative or positive charge, respectively. A negatively charged pesticide will adsorb to positively charged functional groups on organic matter, while positively charged pesticides will adsorb to negatively charged functional groups on organic matter and clays.

Three types of pesticide degradation are microbial, chemical, and photodegradation.

Microbial Degradation

Microbial degradation is the breakdown of pesticides by fungi, bacteria, and other microorganisms that use pesticides as a food source. Most microbial degradation of pesticides occurs in the soil. Soil conditions such as moisture, temperature, aeration, pH, and the amount of organic matter affect the rate of microbial degradation because of their direct influence on microbial growth and activity.

The frequency of pesticide application also is a factor that can influence microbial degradation. Rapid microbial degradation is more likely when the same pesticide is used repeatedly in a field. Repeated applications can actually stimulate the buildup of organisms that are effective in degrading the chemical. As the population of these organisms increases, degradation accelerates and the amount of pesticide available to control the pest is reduced. In extreme cases, accelerated microbial degradation has led to certain products being removed from the marketplace. Microorganisms greatly reduce the effectiveness of these chemicals soon after application. The possibility of very rapid pesticide breakdown is reduced by using pesticides only when necessary and by avoiding repeated applications of the same chemical. Alternating between different classes, groups or formulations of pesticides can minimize the potential for microbial degradation problems as well as pest resistance.

Chemical Degradation

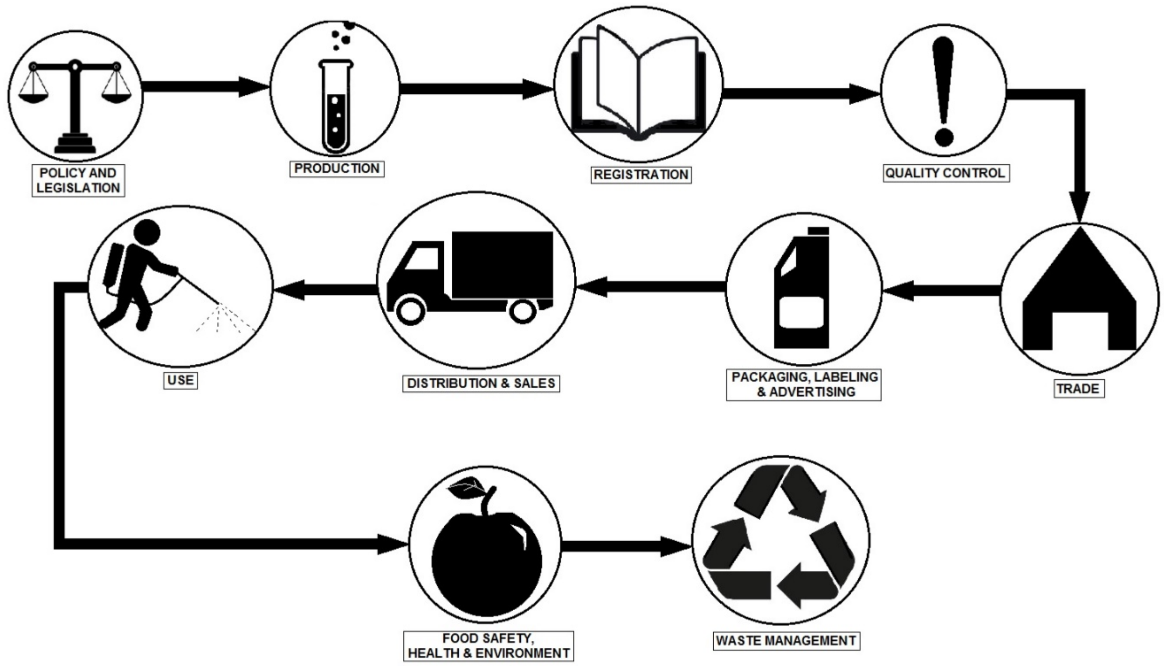
Chemical degradation is the breakdown of pesticides by processes that do not involve living organisms. Temperature, moisture, pH and adsorption, in addition to the chemical and physical properties of the pesticide, determine which chemical reactions take place and how quickly they occur. One of the most common pesticide degradation reactions is hydrolysis, a breakdown process in which the pesticide reacts with water. Many organophosphate and carbamate insecticides are particularly susceptible to hydrolysis under alkaline conditions. Some are actually broken down within a matter of hours when mixed with alkaline water. Product labels may warn against mixing a pesticide with certain fertilizers, other pesticides or water with specific characteristics. Following these precautions can help prevent pesticide degradation and potential incompatibility problems. In some situations, buffers or other additives may be available to modify spray mix conditions and prevent or reduce degradation. Pesticide degradation and possible corrosion of application equipment can be avoided by not allowing a spray mix to remain in a tank for a long period of time.

Photodegradation

Photodegradation is the breakdown of pesticides by light, particularly sunlight. Photodegradation can destroy pesticides on foliage, on the surface of the soil, and even in the air. Factors that influence pesticide photodegradation include the intensity of the sunlight, properties of the application site, the application method and the properties of the pesticide. Pesticide losses from photodegradation can be reduced by adding the pesticide to the soil during or immediately after application.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.



PESTICIDE MANAGEMENT (New & Current)

Topic 1 - Pesticide Safety Introduction Post Quiz
Answers are found after the Glossary Section
Internet Link to Assignment…

http://www.abctlc.com/downloads/PDF/Pest Safety Training Ass.pdf

Pesticide Definition
1. The most common pesticide are herbicides that account for approximately ____________ of all pesticide use.

Insecticide Definition
2. Nearly all insecticides have the potential to significantly alter ecosystems; many are toxic to humans; and others are concentrated in the_________________.

Reading the Pesticide Label
3. The pesticide label is your best guide to using pesticides safely and effectively. The directions on the label are there primarily to help you achieve "maximum" benefits—the pest control that you desire— with "minimum" risk. Both depend on following label directions and correctly using the pesticide.
True of False

4. What is the term which a pesticide can be injected into the ground to kill organisms in the soil that might harm the plant while it is growing? It can also be pumped into warehouses or barns to kill pests that could harm the plant during storage or transport for sale.

5. What is the term which is broadly defined as any substance added to the spray tank, separate from the pesticide formulation, that will improve the performance of the pesticide?

6. What is the term which is described in terms of half-life: the time needed for 50% of the chemical to break down (degrade). The longer the half-life, the more persistent the pesticide?

Pesticides are Broken Down or Degraded by:
7. What is the term which is the breakdown of chemicals in reaction to sunlight?

8. Pyrethroid Pesticides were developed as a synthetic version of the naturally occurring pesticide pyrethrin, which is found in____________________. They have been modified to increase their stability in the environment. Some synthetic pyrethroids are toxic to the nervous system.

Six Basic Components
An IPM system is designed around six basic components: The US Environmental Protection Agency has a useful set of IPM principles.
9. Acceptable pest levels: The emphasis is on control, not_________________.

Chemical Degradation
10. One of the most common pesticide degradation reactions is_______________, a breakdown process in which the pesticide reacts with water.

Topic 2 – Proper Pesticide Handling Section

Topic 2 - Section Focus: You will learn the basics of pesticide handling, mixing, storage and application. At the end of this section, the student will be able to understand and describe the primary pesticide handling techniques. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours

Topic Scope: If improperly handled and/or applied, pesticides will poison people, pets and livestock. They also can damage beneficial insects, birds, fish and other wildlife; harm desirable plants; and they may contaminate soil and groundwater. Take a close look at what pesticides have done to the honeybee industry.

Agricultural pesticide workers are shown above, this section will also apply to structural applicators as well. Although some of this section comes from the Worker Protection Standard, all of this information is valuable to all pesticide handlers and applicators. It is necessary to maintain careful and continuous control over the use and handling of these chemicals during the transport, storage, mixing, loading, application and disposal. Care must be exercised in cleaning equipment, clothing, and persons working with pesticides. Additionally, special precautions are necessary if pesticides are spilled or catch fire. Certain materials associated with vector control operations, including some pesticides, are considered by EPA and States to represent hazardous wastes.

General Pesticide Safety

To help reduce the hazards associated with pesticides, the following sections provide guidelines for the safe handling of pesticides.

- Check all pesticide equipment before you use it to ensure proper working condition.
- Read pesticide labels carefully. Follow the label direction when mixing, applying, storing, or disposing of pesticides.
- Wear personal protective equipment (PPE) to prevent skin contact, inhalation, and mucous membrane exposure when handling pesticides (mixing, transporting, and applying).
- Do not eat, drink, or smoke when handling pesticides.
- Do not transport, mix, or use pesticides unless you can call for help if needed.
- Keep an ample supply of water nearby to flush exposed areas, if a spill occurs.
- Wash clothing and bathe after working with pesticides to ensure that all chemicals are removed from clothing and skin.
- Always handle pesticides downhill from wells, cisterns, sink holes, ditches, or standing water.
- Do not apply pesticides when rain is imminent or if wind could affect the spraying area.
- Triple-rinse spray equipment and empty containers. Apply the rinse water to the treated field.
- Properly dispose of empty containers.

Pesticide Poisoning

Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. But when symptoms appear after contact with pesticides, you should seek medical attention immediately.

At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

Proper Pesticide Handling Introduction

Preparing to Apply Pesticides Preparation is essential for chemical safety. Follow the steps below to properly prepare for pesticide application:

A. Plan ahead

Always read chemical labels before attempting to work with pesticides. Prepare for a possible emergency by maintaining a personal decontamination site, a chemical spill kit, and by knowing the proper first aid procedures associated with your pesticide.

B. Move Pesticides Safely

Careless chemical transportation can cause spills and contamination. Do not carry pesticides in an enclosed area, such as a car. Be sure to secure the pesticides to prevent shifting or bouncing. In addition, never leave your vehicle unattended when transporting chemicals.

C. Select Application Equipment

Choose suitable equipment to properly apply pesticides. Before using the equipment, inspect it for good working order.

D. Select Appropriate Personal Protective Equipment

Regardless of the pesticide's toxicity; always wear a long-sleeve shirt and pants when working with pesticides. Wear additional protective equipment, as necessary. Inspect all PPE before each use for leaks, holes, tears, or worn places. Repair or discard any damaged equipment.

E. Provide Prior Notification

Prior to applying pesticides, inform all people in or around the application area. Notification allows people to protect themselves from harmful chemicals.

Transporting Pesticides

Pesticides can present a particularly severe hazard if they are involved in accidents during transportation. When pesticides are spilled on the roadway, they may catch fire, be scattered by passing cars and trucks, be blown by wind onto nearby crops or people, or be washed into ditches or streams by rain. If they catch fire, the fumes and smoke may injure fire fighters, police, and people far removed from the scene of the accident.

Even under relatively uneventful circumstances, pesticides may simply contaminate the vehicle, cargo, or people transporting the chemicals. When you transport pesticides, you are legally responsible for them.

To reduce the likelihood of pesticide spills or exposure of workers or others riding in vehicles transporting pesticides, the following guidelines should be followed:

1. Pesticides are most safely transported in the beds of trucks.
2. Pesticides should never be transported in the passenger compartment of any vehicle.
3. People should never be allowed to ride in the beds of pick-up trucks carrying pesticides. This applies especially to children as passengers.
4. Pesticides should never be transported in the same compartment with food, feed, or clothing.
5. All pesticide containers in shipment should be secured tightly. This is especially critical for glass containers.
6. Pesticide containers made of paper, cardboard, or similar materials should be protected from moisture during transport.
7. Pesticides in parked service vehicles must be made secure from theft, tampering, and contamination.

More on Storing Pesticide
It is necessary and legally required that pesticides be stored in a safe, secure and well-identified place. Here are some rules that pertain to pesticide storage:

1. Always store pesticides in their original, labeled container with the label clearly visible.
2. Always store pesticides in tightly sealed containers and check containers periodically for leakage, corrosion breaks, tears, etc.
3. Always store pesticides where they are protected from freezing or excessive heat.
4. Always be certain that pesticide storage areas are well-ventilated to prevent the accumulation of toxic fumes.
5. Always store different types of pesticides in different areas, to prevent cross contamination and the possibility of applying a product inadvertently.
6. Never store pesticides in old bottles or food containers where they could be mistaken for food or drink for humans or animals.
7. Never store pesticides near food, feed, or seed.
8. Agencies or programs that store significant amounts of pesticide should have a designated pesticide storage facility.

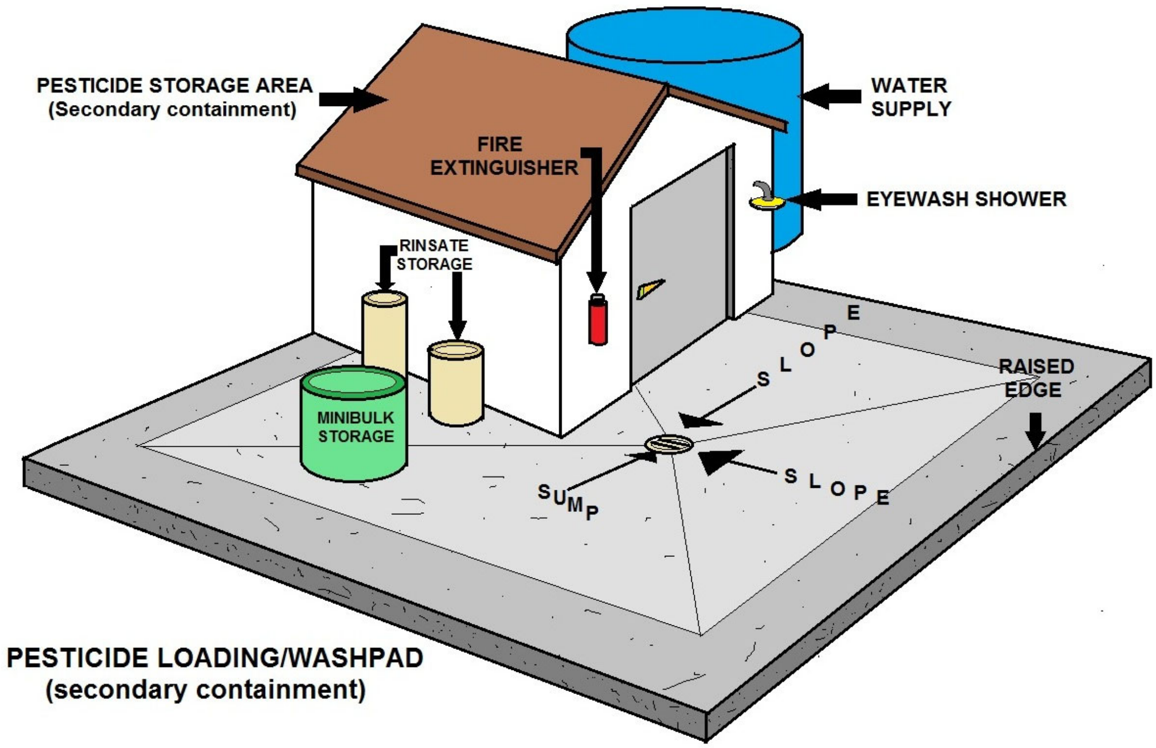
Requirements for Proper Pesticide Storage

1. Locking doors
2. Adequate lighting
3. Adequate ventilation
4. Fire extinguishers readily available
5. Spill containment design or equipment
6. Warning placards if Category I or II pesticides are stored – including emergency contact information
7. Personal protective equipment readily available
8. Wash water and eye wash stations available
9. Presence of label and SDS (formerly MSDS) book for stored materials

Recommended for Pesticide Storage

1. Fire resistant construction
2. Emergency shower station- with eyewash
3. Spill containment floor design or drum pallets

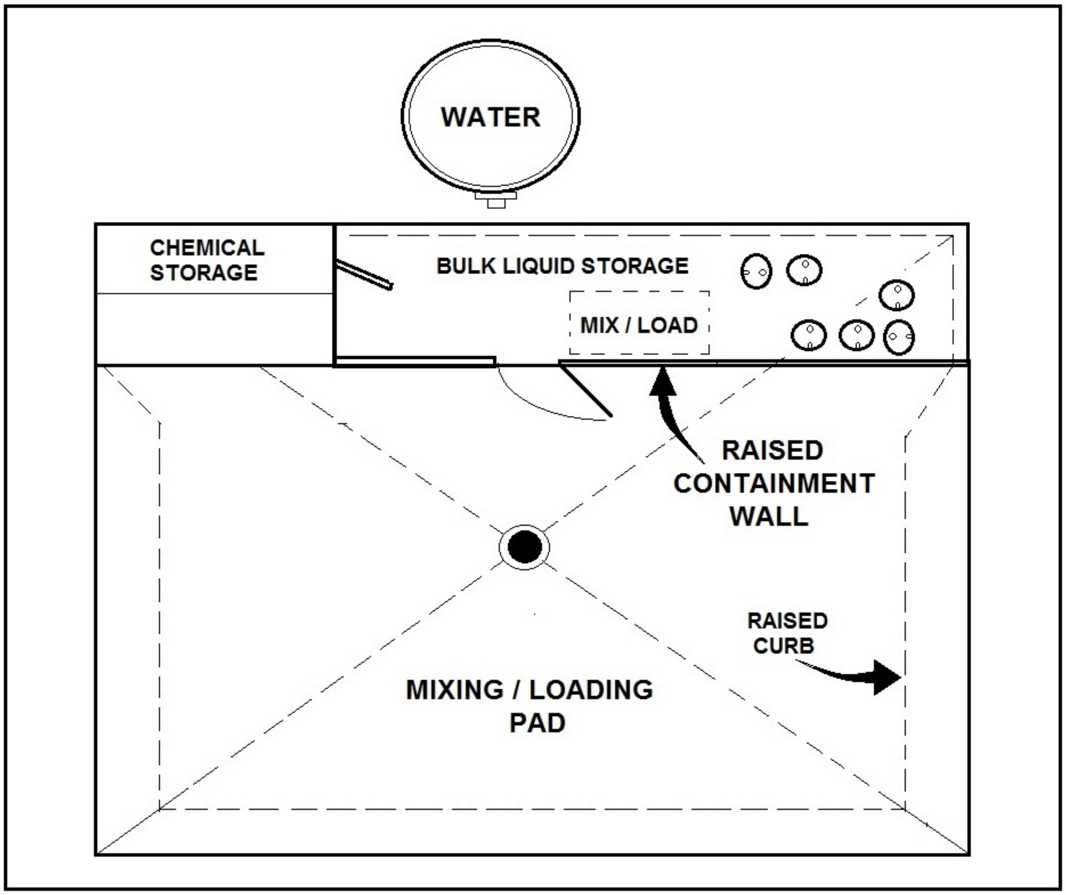
Site Storage Sub-Section



Site Storage
For temporary on-site storage, always:
1. Locate where flooding is unlikely.
2. Locate where runoff will not contaminate any water system.

Storage Facility
The permanent pesticide storage facility should meet the following guidelines:
1. Dry, well-ventilated, separate room, building, or covered area with fire protection (e.g., dry chemical fire extinguisher).
2. Secured by fence and/or locked doors.
3. Signs on rooms/buildings to provide hazard warning (e.g., DANGER, POISON, and PESTICIDE STORAGE).
4. Pesticide equipment should be properly labeled as contaminated and not removed from the site until decontaminated.
5. Proper decontamination area for personnel and equipment; dispose of contaminated water as excess pesticide; treat contaminated runoff collected as excess pesticide.

Operational Procedures
1. Store pesticide containers in rows with the labels plainly visible.
2. Place contents from damaged containers in sound containers.
3. If relevant, segregate pesticides by formulation.
4. Store rigid containers in an upright position and keep lids securely closed when not in use.
5. Maintain a complete inventory indicating the number and identity of containers.
6. Check containers regularly for corrosion and leaks.
7. Keep suitable absorbent (e.g., vermiculite) on hand in case of spills.



PESTICIDE STORING AND MIXING AREA DIAGRAM

Safety Precautions

a. Inspect pesticide containers for leaks before handling them.
b. Do not allow unauthorized personnel in the storage area.
c. Do not store pesticides next to items intended for consumption by animals or humans.
d. Do not eat, drink, smoke, or chew tobacco where pesticides are stored, mixed, handled, or applied.
e. Do not store beverages, food, eating utensils, or smoking material in the storage or loading areas.
f. Wear rubber gloves while handling containers of pesticides.
g. Wash hands immediately after handling pesticides. Remove contaminated protective clothing immediately; extra sets of clean clothing should be nearby.

IMPORTANT!
Never leave pesticide containers at a field site. Be sure to account for every container used, and safely dispose of empty containers. Call 911 in case of an emergency or take the individual directly to the nearest emergency room if signs of exposure are shown.

Mixing and Loading Pesticides

All pesticides are potentially harmful, particularly for those who work with them on a daily basis because of the potential for being exposed to large doses and the likelihood of chronic exposure. Many pesticide accidents occur when the chemicals are being mixed for use. One of the most dangerous jobs related to pesticide-related illness, is the mixing and loading of concentrated chemicals, specifically low-volume and ultra-low volume formulations.

Pour Pesticides Carefully

Always wear eye protection and take care not to splash chemicals when pouring pesticides. Never use your mouth to siphon pesticides.

A few common sense rules can make mixing and loading safer, thereby helping you to avoid the leading cause of pesticide-related illnesses:

1. Before handling a pesticide, READ THE LABEL.
2. Based on label recommendations, put on protective clothing and use other necessary protective equipment. Also from reading the label, follow instructions on what special equipment is necessary. If you have questions concerning protective equipment, contact your county agricultural commissioner or other expert before you open the container.
3. Mix the pesticides outdoors, in a place where there is good light and ventilation. If you must mix or load pesticides indoors or at night, make sure you have good ventilation and lighting.
4. Stand upwind of the pesticide to avoid contaminating yourself.
5. Use a sharp knife to open paper bags; do not tear them or the label.
6. Measure accurately; use only the amount you need to apply at the rate specified on the label.
7. When removing the concentrated material from the container, keep the container below your waist if possible to prevent the possibility of splashing or spilling any pesticide into your face and eyes.
8. If you splash or spill a pesticide while mixing or loading, stop immediately!

Remove contaminated clothing; and wash thoroughly with detergent and water. Speed is essential if you or your clothing are contaminated. Clean up the spill.

Mixing Pesticides Summary

Always read and carefully follow label directions when mixing pesticides. Even if you are familiar with a particular chemical, reread the label to ensure that you have the latest safety information. In addition, follow these guidelines for mixing pesticides:

A. Work in a Safe Area

The pesticide mixing and loading area should be well ventilated, well lighted, and downhill from any water sources. Concrete slabs are ideal for mixing chemicals since they allow for easy cleanup.

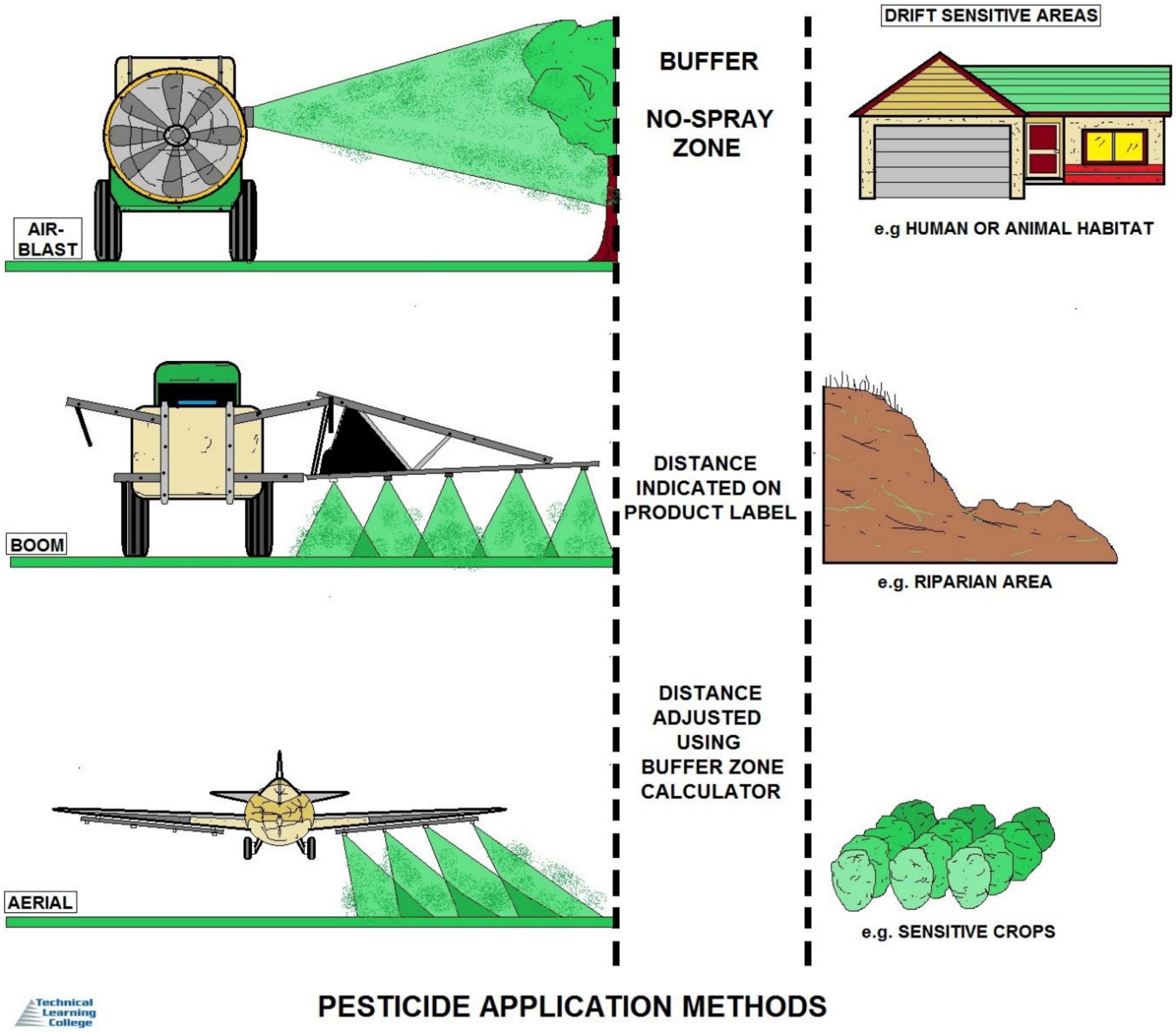
B. Measure Chemicals Correctly

Measure and mix pesticides carefully. Never mix different pesticides except as directed by the label or chemical manufacturer. Do not use more chemical than prescribed by the pesticide label.

The overuse of pesticides is illegal, and may result in the following:

1. Higher pest control costs
2. Pesticide residue in food
3. Surface water pollution
4. Groundwater pollution
5. Pesticide resistance

Applying Pesticides - Introduction

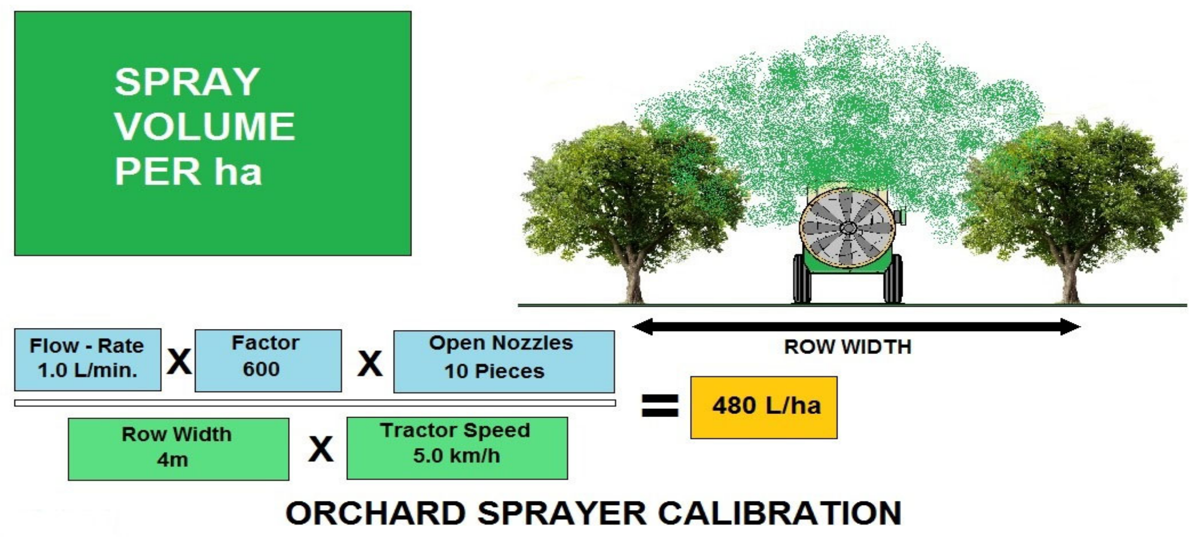


PESTICIDE APPLICATION METHODS

Careful attention to a few simple guidelines during pesticide application will greatly increase your chances of effectively controlling the pest. At the same time, attention to these details will make the job much safer for you, other people, pets, livestock, and the surrounding environment.

1. Before you begin the application, **READ THE LABEL**. Don't trust your memory for details concerning the use of any pesticide.
2. Check the application equipment. Look for leaking hoses or connections, plugged or worn nozzles, and examine the seals on the filter openings to make sure they will prevent spillage of the chemicals.
3. Calibrate your equipment before use. Make certain that your equipment is adjusted according to the manufacturer's specifications and meets label requirements for the product being applied. This will assure that the proper dosage is being applied to the target site.
4. Before the pesticide application starts, clear all livestock, pets and people from the area to be treated. Although it would be the ideal situation, most ULV labels do not require this. Always check the label for any specific restrictions.

5. Apply the pesticide at the recommended rate. Do not exceed the maximum application rate specified on the label or the written recommendation.
6. Apply pesticides only at the correct time and under acceptable weather conditions – check the label for specific limitations. Avoid applying pesticides when temperatures are extremely high or low. Be especially careful when temperatures exceed 85ºF or are below 50ºF.
7. When handling category I and II toxic pesticides, one should try to not work alone.
8. Use extreme care to prevent the pesticide from contaminating unintended target sites (e.g., streams, ponds, lakes or other bodies of water). Remember also that direct application of pesticides to these types of bodies of water requires special permitting.
9. Avoid situations where the pesticide may drift from the application area and contaminate non-targets.
10. Do not contaminate food or feed through careless application methods.



Applying Pesticides Summary

You are responsible for protecting yourself, other people, and the environment when applying pesticides. Follow these safety guidelines when applying pesticides:

A. Minimize Exposure

Even mildly toxic chemicals can harm you if you use them daily. Take care to minimize your exposure to any chemical. Avoid working in pesticide spray, mist, or runoff. Always work with another person when working with hazardous chemicals.

B. Avoid Applying Pesticides in Sensitive Areas

Avoid spraying pesticides near beehives or densely populated areas (e.g., student common areas, playgrounds, etc.). If you must apply pesticides in sensitive areas, plan to do so when the weather is calm and people are not around.

C. Avoid Pesticide Drift, Runoff, and Spills

Pesticides that fall outside the targeted application area can be very hazardous. Choose weather conditions, equipment, and chemicals that eliminate or minimize the risk of pesticide drift, runoff, and spills.

D. Avoid Equipment Accidents

Equipment accidents are often caused by poor maintenance and improper work habits. Avoid equipment accidents by following all operating instructions specific to the equipment being used, cleaning, and properly maintaining the equipment.

Carefully measure and mix the product and always use your air gap water protection device. So many applicators risk damaging the public water supply if they do not follow instructions and do not utilize the air gap protection device. Most applicators do not carefully measure the product to the instructions, this a not cost effective and usually the owners or managers are the ones need to properly instruct the chemical usage. I think this chemical costs about 80 cents an ounce and that does not seem to be that much but if you are wasting two or three dollars per job, that will cut the profit and may indeed end someone career.

Whatever pesticide treatment, always write down everything you did, take photographs and file properly label these to protect yourself. Even if you did a perfect job!

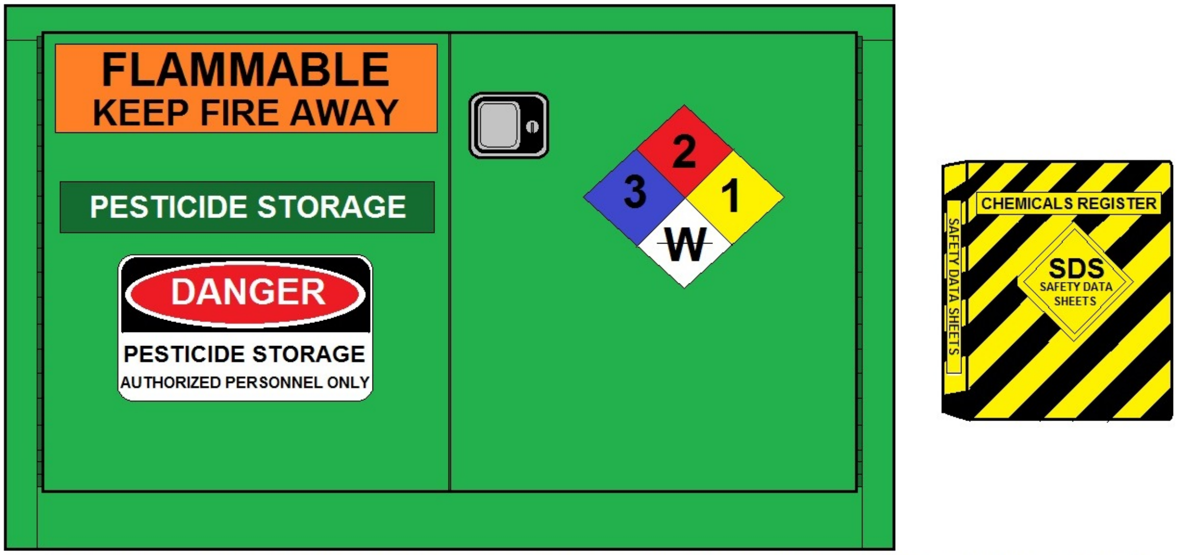
Carefully write the chemical amounts and document the areas you did <u>not</u> treat.

Both the State and the customers like to see this professionalism. Of course, paperwork takes a large percentage of time, but it is an insurance policy and covers your rear end if something comes back.

There are lawyers that specialize in freedom of information laws and will inspect State files and customer's complains in order to <u>find</u> a lawsuit. These lawyers look for ways to sue pesticide applicators, primarily the owners of the company and the pesticide manufacturer.

One area that needs attention...you as a professional (PCA) need to develop a relationship with the State Agency in order to call and make important concerns known to the State before these concerns come back on you.

More on Pesticide Storage and Disposal



STORE PESTICIDES IN PROPER STORAGE CABINETS AND ENSURE THAT SAFETY DATA SHEETS ARE READILY AVAILABLE IN CENTRAL LOCATION

Always try to use all the pesticide in your application tank. If pesticides remain, use them on other target locations. After emptying the tank, clean and store the equipment.

Never pour unused pesticides down sink or floor drains, storm drains, or into surface water.

The following summary of EPA storage criteria should be followed for pesticides labeled with the signal words DANGER, POISON, WARNING, or the skull and crossbones symbol. These procedures and criteria are not necessary for the storage of pesticides classed as less toxic (CAUTION word on the label) or for those registered for use in the home or garden.

Personal Protective Equipment Care and Disposal Clothing or other absorbent materials that have been drenched or heavily contaminated with an undiluted pesticide that has the signal word "DANGER" or "WARNING" on the labeling must be disposed of properly. These contaminated items must not be reused.

Pesticide handlers should clean their own clothing and PPE according to the label recommendations.

If the clothing or PPE will be cleaned by someone other than the licensed pesticide handler, the handler employee must inform people who clean or launder the items of the following information:

1. That the items may be contaminated with pesticides.
2. Of the potentially harmful effects of exposure to pesticides.
3. How to protect themselves when handling contaminated PPE.
4. How to clean PPE correctly.

Equipment Clean-up
After completing the application of any pesticide, immediately clean the mixing, loading, and application equipment. The cleaning operation can be somewhat hazardous if proper precautions are not followed.

People who clean the equipment must:
1. Know the correct procedures for cleaning and decontamination.
2. Wear the appropriate personal protective equipment.
3. Know and use the specific area set aside for cleaning. This will usually be on a wash rack or concrete apron that has a well-designed sump to contain all contaminated wash water and pesticides for later disposal, or in the field where rinse water may be considered part of the application.

Pesticide Wastes and Disposal Methods
Waste materials should be considered hazardous to the public, the people handling them and the environment. Deciding how to dispose of pesticide wastes should be done on a case-by-case basis. Materials that meet the legal requirements as hazardous wastes (some pesticides, used crankcase oil, used antifreeze, etc.) must be disposed of according to special rules.

Waste materials that are not classified as hazardous waste can be disposed of in other ways, but should never be dumped into drains or water courses of any kind. The best way to avoid all waste pesticides is to use them up in legal pesticide applications. Even the rinse water used in cleaning pesticide equipment can be used as a diluent in tank mixes that contain water soluble pesticides.

Pesticide Container Wastes
Always dispose of pesticide containers in a manner specified on the label. Pesticide container disposal can be a significant problem, particularly if you have a large number of containers. Many pesticide containers can be recycled, either as a part of a regular recycling program, if approved on the label, or by returning to the chemical supplier. Many chemical companies now re-cycle their pesticide containers.

Pesticide Poisoning
Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. But when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

Rinsing Pesticide Containers

Before disposing of any empty pesticide container, it must be rinsed. The correct rinse procedure follows:

1. Empty the container into the mixing tank and allow the pesticide to drain for an extra 30 seconds. Do not fill the tank to the desired level yet. First complete the triple rinse method described here, adding the rinse solution to the tank as described in (4) below.
2. Add the correct amount of water for thorough rinsing as follows:
   - Size of Container
   - Amount of Rinse Water
   - Less than 5 gallons
   - One-fourth container volume
   - 5 gallons or more
   - One-fifth container volume
3. Replace the container closure; then rotate and shake the container, so that the rinse reaches all interior surfaces.

4. Drain the rinse solution from the container into the mixing tank. Allow the container to drain for an extra 30 seconds after emptying.
5. Repeat this rinsing procedure at least two more times for a total of three rinses. Remember—it is important to empty each rinse into the mixing tank so that the pesticide goes on the target for which it is intended (this procedure also saves money). Never pour pesticides down an ordinary drain or flush them down a toilet!
6. Now the triple rinse procedure is complete. Let the container dry and replace the cover.

Many containers will be discarded after one use. Most regulations concerning pesticide container disposal do not apply to containers in which household pesticides have been packaged. However, these containers (except aerosol cans) should be rinsed carefully and destroyed to prevent their reuse.

Unused and Excess Pesticide Disposal

Disposing of unused (still in the original container) and excess (already mixed, but not needed) pesticides can be a significant problem. For vector control agencies, the easiest solution is to mix only as much product as will be needed. This is critical for Bacillus thuringiensis var. israelensis (Bti) because it loses efficacy after 24 hours.

The best way to dispose of any currently labeled pesticide is to apply it according to the label. If that is not possible because of a label change, contact your local County Agricultural Commissioner or equivalent– in many instances, you will be directed to use the remainder of the product per label instructions.

For any currently labeled pesticide, the best alternative would be to find another person or area with the same pest problem, so that the pesticide gets used up legally and effectively.

If you cannot find another area with the same problem, you might decide to dispose of the pesticide in an approved location. Contact the State Pesticide Agency for specific information on regulations and pesticide dump sites.

Proper rinsing of pesticide containers is easy to do, saves money, and helps protect people and the environment. It also helps prevent potential problems with un-rinsed containers, rinsate storage, and pesticide wastes.

Even during a busy season the few extra minutes it takes to properly rinse empty pesticide containers is time well spent.

- Rinsate from the containers, when added directly into the sprayer tank, efficiently and economically uses all pesticide in the container. This eliminates the need to store and later dispose of the rinsate.
- Unless rinsed from the container immediately, some pesticides will solidify and become difficult to remove.
- Rinsing containers removes a potential source of pesticide exposure to people, animals, and wildlife.
- Proper rinsing is required by federal and state regulations and is a good, sound agricultural and environmental practice.

Rinsing Helps Protect the Environment
Proper rinsing of pesticide containers reduces a potential source of contamination of soil, surface, and ground water. When contamination occurs, plants and animals may be harmed and water supplies affected. Prevention of environmental contamination is always better than cleanup. Rinsing also helps in reducing the problem of handling pesticide wastes.

No matter how an empty pesticide container is disposed of, **it must be properly rinsed and triple punched.**

Both federal and state laws require rinsing. Landfill operators and recyclers can only accept properly rinsed containers.

Pesticide containers should only be offered to recycling projects designed for pesticide containers and not general plastic and metal recycling programs. Pesticide container recycling project personnel will inspect containers to determine if they have been properly rinsed.

Rinsing is Effective
Pesticide residues measured in selected containers that passed visual inspection in the test project show rinsing at the time of use is effective:

Percent of pesticide residue removed with proper rinsing		
Pesticide	**Container**	**% Removal**
2, 4-D	2.5 gallon plastic	99.9999
pendimethalin	2.5 gallon plastic	99.9969
alachlor	5.0 gallon metal	99.9998
glyphosate	1.0 gallon plastic	99.9989
metolachlor	2.5 gallon plastic	99.9999
carbofuran	2.5 gallon plastic	99.9993

Types of Pesticide Containers
Currently the most common agricultural pesticide container is a 2.5 gallon plastic jug. Agricultural, animal, household, and other pesticide products also come packaged in glass, paper, metal and aerosol cans. Many liquid agricultural pesticides are also sold in returnable bulk containers and mini-bulk containers. Only plastic, glass and un-pressurized metal containers can be rinsed. Ease of handling and proper disposal should be considered when purchasing pesticides.

How to Properly Rinse
Two different procedures are effective for proper rinsing of pesticide containers: pressure-rinsing and triple-rinsing.

Pressure-Rinsing
A special nozzle is attached to the end of a hose to force the remaining pesticide from the container. Pressure-rinsing, which may be faster and easier than triple-rinsing, can be used with plastic and non-pressurized metal pesticide containers.

How to Pressure-Rinse
1. Remove cover from container. Check cover and container threads for pesticide. Rinse covers separately in a bucket of water for more than one minute and pour this rinse water into the spray tank.
2. Empty pesticide into the spray tank and let container drain for 30 seconds.
3. Insert pressure-nozzle by puncturing through the lower side of the pesticide container.
4. Hold the container upside down over the sprayer tank opening so rinsate will run into the sprayer tank.
5. Rinse for length of time recommended by the manufacturer (generally 30 seconds or more). Wiggle nozzle to rinse all inside surfaces. Be sure hollow handles are well rinsed.
6. Let container dry and then put cover back on container.

The FIFRA provides the EPA with the authority to regulate the storage and disposal of pesticides and their containers. Discarded pesticides and pesticide containers may also be considered solid waste under the Resource Conservation and Recovery Act (RCRA) if they meet certain criteria.

Regulations under this law vary for *small quantity* and *large quantity* generators of hazardous waste.

Farmers disposing of pesticides are exempt from RCRA regulations provided that they triple-rinse used pesticide containers and dispose of the containers according to instructions on the product label.

Triple-Rinsing Summary

It means rinsing the container three times. Triple-rinsing can be used with plastic, non-pressurized metal, and glass containers.

How to Triple-Rinse

1. Remove cover from the container.
2. Empty the pesticide into the sprayer tank and let the container drain for 30 seconds.
3. Fill the container 10% to 20% full of water or rinse solution.
4. Secure the cover on the container.
5. Swirl the container to rinse all inside surfaces.
6. Remove cover from the container. Add the rinsate from the container to sprayer tank and let drain for 30 seconds or more.
7. Repeat steps 2 through 5 **two more times.**
8. Let container dry and then put cover back on container. Triple punch the bottom.

Remember

- To read and to follow all label instructions.
- To wear appropriate protective gear when working with pesticides.
- Never reuse a pesticide container for any purpose.
- To dispose of all pesticide containers properly.
- When not using a water nurse tank, always use a back-flow prevention device when filling sprayer tanks or rinsing pesticide containers.
- Mixing and loading sites should be at least 150 feet away from all wells.

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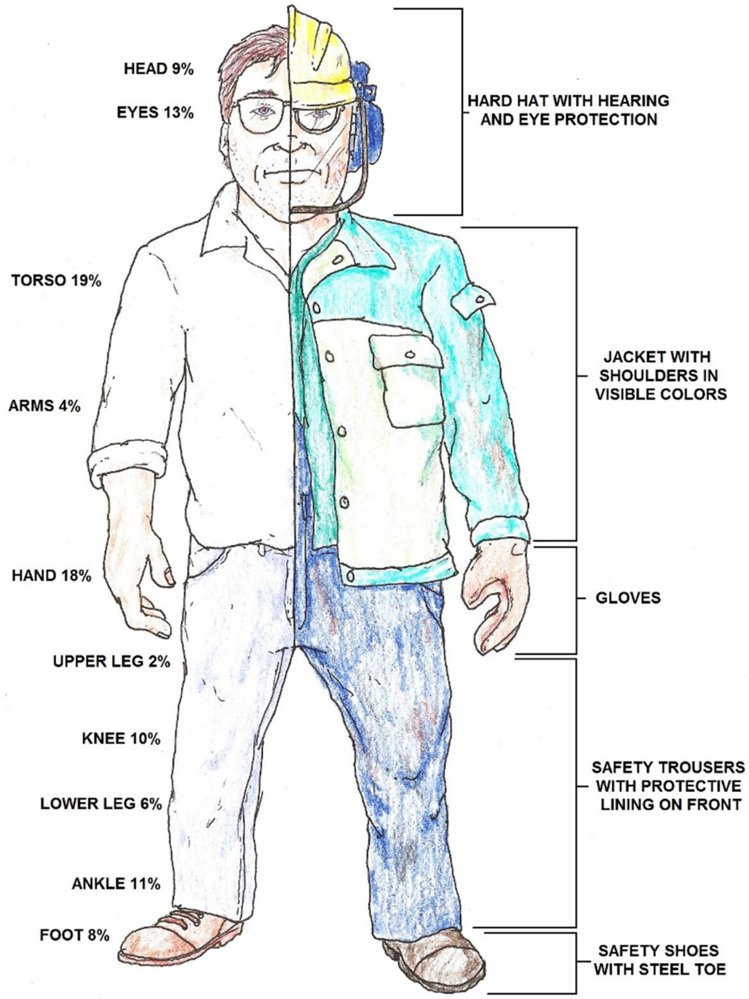


PESTICIDE PERSONAL PROTECTIVE EQUIPMENT DIAGRAM #1

Personal Clean Up Introduction

After you have completed the pesticide application, disposed of excess material, and cleaned the application equipment, you should thoroughly wash all your protective equipment. Remove your work clothes and place them in an area separate from other laundry items or properly dispose of them if they are disposable coverall, e.g., Tyvek®.

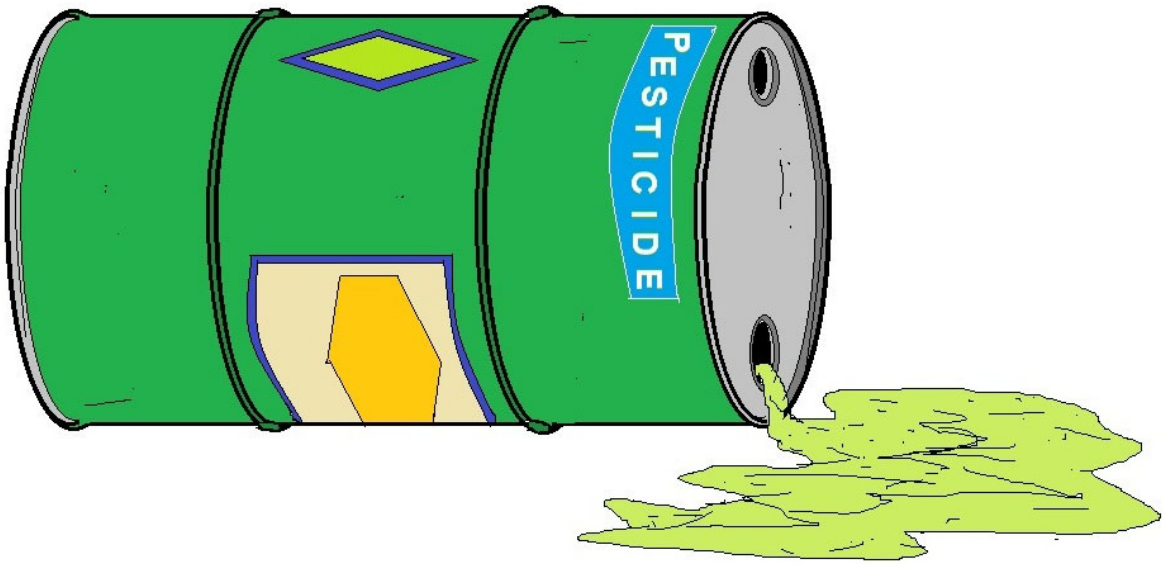
Do not allow children to play in or with the contaminated clothing. The pesticides on your work clothes could contaminate people who touch them, so warn whoever will be washing the clothes of the possible danger, and tell this person that pesticide-contaminated clothing should be washed separately from other clothing.

Now take a shower. Wash yourself completely with soap and water.

Remember to include your hair and fingernails in the wash-up. Do not put on any article of clothing worn while working with pesticides until after it has been laundered.

Pesticide Spills

Since some pesticides qualify as hazardous materials, a variety of local, county, and state agencies will become involved in reporting and cleanup, especially if the spill occurs while pesticides are in transit. In this case, peace officers are often the first responders, and they are required to report pesticide spills under DOT, HAZCOM or HAZWOPER rules. We will cover HazCom in this course.



Pesticide spills that cannot easily be cleaned-up and decontaminated by vector control or fire (HAZWOPER) program personnel and should be reported directly to the local health officer who will in turn contact the State Pesticide Agency, County Agricultural Commissioner, County Health and/or Environmental Health Department. One should also use common sense judgment to determine the danger created with a spill, e.g., a spill that occurs in a confined and enclosed area versus an open area.

In spite of the most careful use and handling of pesticides, accidental spills and fires occasionally occur. These range in size from small spills of a household pesticide container to huge fires involving entire manufacturing warehouses filled with the most toxic pesticides. Intelligent planning, knowledge of the chemicals involved and calm consideration of the actual hazards to be dealt with during the emergency will reduce the risk and damage resulting from the accident.

Pesticide spills can and do happen anywhere pesticides are transported, stored, or applied. When a spill occurs, it should be cleaned up as quickly and safely as possible.

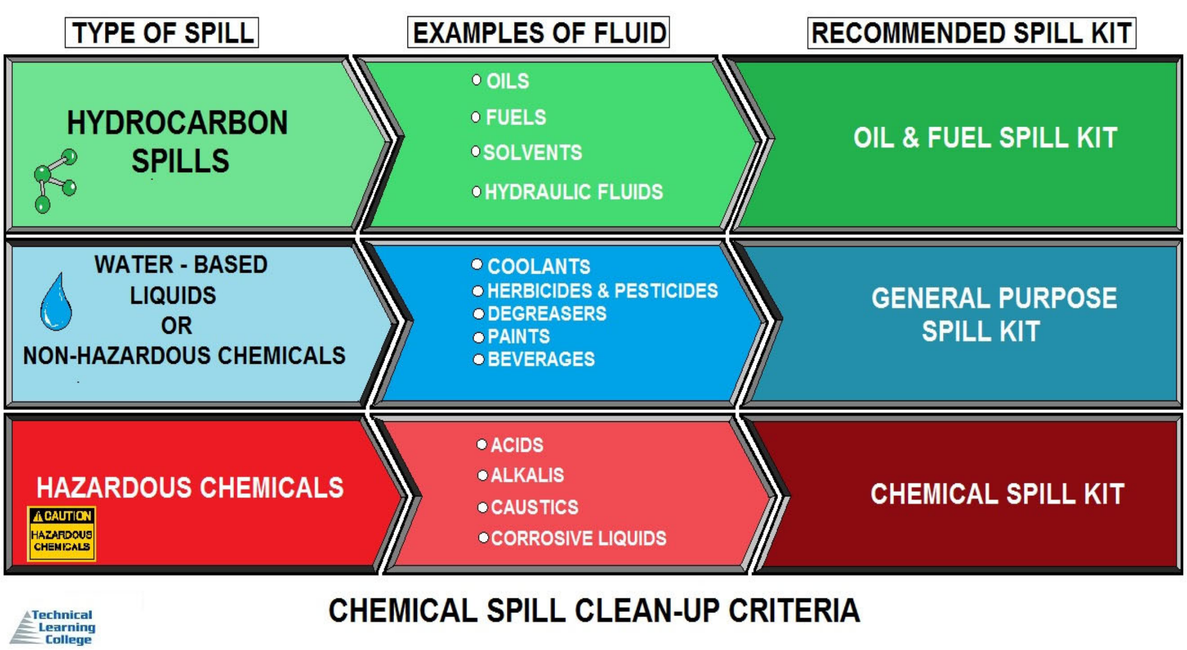
For some pesticides and formulations, such as Altosid® pellets, clean-up is as simple as collecting the spilled product and using it.

A few general rules apply to all pesticide spill clean-ups.

1. Avoid exposure of people and animals to the pesticide. If you spill a pesticide, immediately see to it that no one is exposed or contaminated by accidentally walking into the spill or breathing the fumes.
2. Start by putting on protective clothing so that you do not contaminate yourself.
3. Provide some sort of a barrier to the spread of a liquid pesticide. A barrier may be made of dirt, sawdust, old newspapers or anything that will soak up the pesticide.
4. Remove the contaminated materials to a safe place. If the spill is inside the home or another building, soak up liquid pesticides or sweep up powders and remove them to the outside. Ventilate the area to prevent the buildup of toxic fumes.
5. Thoroughly clean the affected surface. Consult the label for specific disposal and decontamination instructions. Take care to prevent the wash from spreading and possibly contaminating a larger area. Make sure any wash does not go into storm drains or sewer systems.
6. If the spill that cannot be easily cleaned involves a public area, such as a highway, notify the police, sheriff's office, fire department, the highway patrol, or other local emergency services agency.
7. While waiting for emergency personnel to arrive, do what you can to prevent others from being exposed to the pesticide.

Remember

The highest priorities are to prevent exposure to the pesticide and to prevent the spread of the spill. In the event of a large spill that cannot be easily contained, contact emergency services personnel, tell them about the nature of the chemical and explain to them what you know about the pesticide involved. If it is a Toxicity Category I or II pesticide, their lives may depend on your warning!

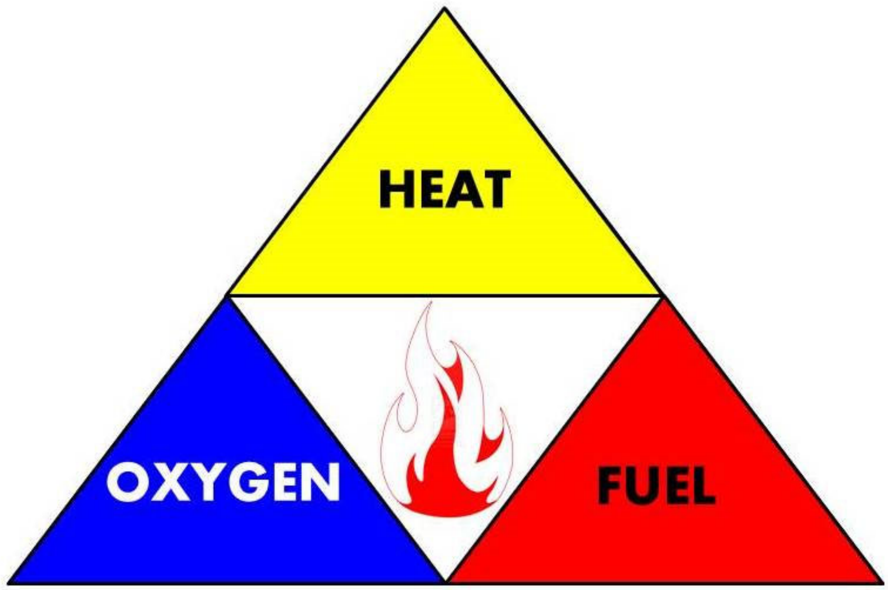


CHEMICAL SPILL CLEAN-UP CRITERIA

Pesticide Fires

Small Fires ***(We will cover this area in the HazCom section also.)***
If a fire occurs in an area where pesticides are used or stored, and the fire is very small and easily extinguished, you may elect to attack it yourself if you follow certain precautions:

1. Use foam or carbon dioxide from a fire extinguisher in lieu of water if at all possible.
2. Wear protective safety equipment.
3. Avoid exposure of smoke, mist, spray, runoff, and concentrated pesticide chemicals.



FIRE TRIANGLE

Large Fires
In the event of any large fire, contact emergency fire services immediately! When large fires involving the presence of very toxic materials (including pesticides) occurs, the fire department responding to the emergency call will seek the aid of specialized agencies that deal with such chemical emergencies.

Whenever pesticides are involved in fires, they can create special hazards. Anyone in the vicinity of the fire may be exposed to toxic fumes, poisonous runoff, and concentrated pesticides from leaking or exploding storage containers. Here are some general rules that apply to pesticide fires.

Maintaining communications with the responding fire department is essential. Keep them updated on what chemicals you are storing, where it is stored, how much is being stored, and supply them with any information such as material safety data sheets they may request concerning the nature of the chemicals. This may allow them to prepare for possible emergencies and may save lives and property.

Before the Fire Department Arrives - You Should

1. Not risk your own health to fight a large fire — consider the risks of potentially toxic smoke, explosion, and your limited capacity to control the fire. You may inadvertently risk the health and safety of the professionals or others, particularly if you are injured in your attempts. Do not attempt to fight the fire unless you have been trained to do so; it is the job of highly trained professionals to fight fires.
2. Avoid poisoning: Keep yourself and others out of smoke, mist, spray, and pesticide runoff.
3. Notify all those in close proximity of the fire and downwind and tell them to evacuate the area.
4. Wear personal protective equipment if it can be safely retrieved.

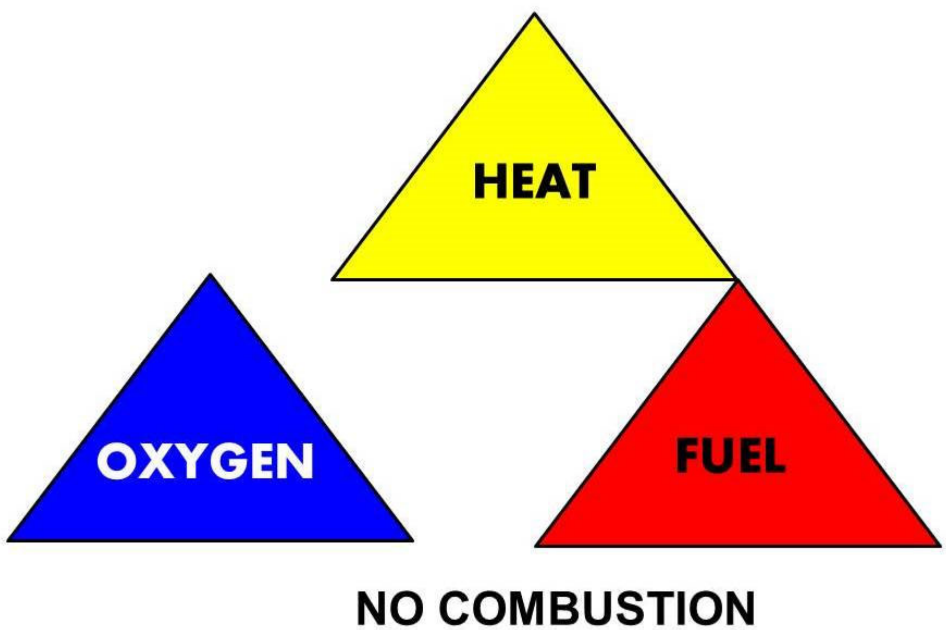
After the arrival of the fire department - you should

1. Without risking your health or safety, take steps to minimize contamination of areas outside the fire zone by runoff from firefighting. This can help contain spilled pesticide and thus avoid affecting people and domestic animals and the environment. It is especially important to avoid runoff of contaminated water into nearby streams or lakes.
2. Cool nearby pesticide containers; move vehicles and any threatened mobile equipment if it is safe to do so.

Adverse Pesticide Related Events

Adverse events (conspicuous or suspected) that must be reported:

1. Any human illness associated with a vector control pesticide application.
2. Any report of harmful non-target effects of an application to plants, domestic animals, or wildlife.
3. Any pesticide spill requiring an emergency services response.

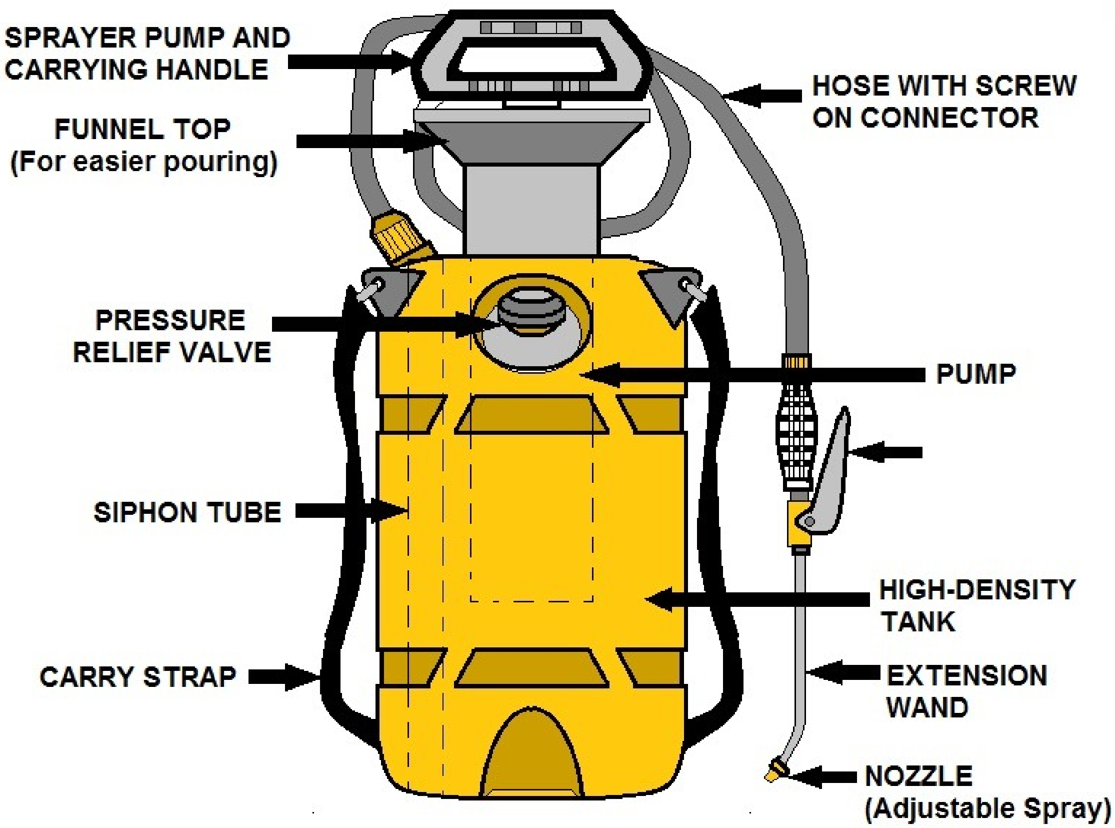


Sprayer (Backpack) Cleanout Information

Types of Sprayers

Manually Operated
1. Hand Syringe
2. Hand Sprayer
3. Backpack Sprayer
4. Bucket Sprayer
5. Rocket Sprayer

Power Operated
1. Stretcher Sprayer
2. Power Take Off Sprayer
3. Traction Sprayer
4. Ultra Low Volume Sprayer
5. Foot Sprayer or Pedal Pump



BACKPACK SPRAYER COMPONENTS DIAGRAM

Component
Because residues from previous applications can trap subsequent compounds and make it more difficult to clean them from the system, it is important to start with clean equipment. Equipment should be rinsed immediately after spraying, using cleaning procedures specified on the label as soon as possible after rinsing so that compounds will not dry onto the surface of tanks and hoses.

Key Points

- Proper cleaning and maintenance of spray equipment are essential parts of effective pest control.

- Sulfonylurea herbicides are no more difficult to remove from application equipment than any other herbicide. As with any herbicide, if a highly sensitive crop is going to be sprayed, it is important to use thoroughly cleaned equipment. When a crop is highly sensitive to any herbicide, even a very low level of carry-over can cause damage.

- Many factors can influence the effectiveness of sprayer cleaning procedures, including design and maintenance of the equipment, residues from previous applications, and the presence of tank mix partners (including additives).

The product label also notes approved product combinations. Incompatibility between products can result in deposits that are difficult to clean from equipment. For approved product combinations, it is important to add the products in the recommended order. Adding products in the wrong order can also result in deposits that are difficult to remove.

Even when the sprayer is operated until visibly empty, small amounts of spray solution can remain in the equipment. When the same equipment is used to spray different crops during the season, injury to sensitive crops may result if traces of previous products remain in the sprayer. The sensitivity of various crops to injury by different products is highly dependent on the specific product, the rate at which it is applied, the ability of the vegetation to break down the product, and the growth stage of the vegetation.

Cleanup procedures work through three primary mechanisms: dilution, deactivation, and extraction. All procedures use dilution, which lowers the concentration of the crop protection product by repeated addition and drainage of fresh cleaning solution.

Deactivation occurs when the cleaning solution causes the crop protection product to decompose into compounds that are no longer active for their intended use. Extraction occurs when the cleaning solution causes chemical deposits that can accumulate in application equipment to loosen or dissolve.

Older, poorly maintained spraying equipment with rusted, pitted components can trap crop protection products, making them difficult to remove. Multiple applications of a product over a period of time without interim rinsing can lead to a buildup of deposits.

Certain tank mixes can hinder cleanup by forming deposits and trapping products on equipment surfaces. If the sprayer is not clean prior to using, deposits from a previously used product can also trap subsequent products and ultimately reduce their exposure to the cleaning agent. These deposits can break free during subsequent applications.

When proper cleanup procedures are not followed, crop protection products left in the spray system can damage sensitive crops in a future application. Adequate cleanup procedures should be followed, according to the product label. DuPont works with sprayer manufacturers to design equipment that can be efficiently cleaned. DuPont also conducts research on improving cleanout procedures and on evaluating the effectiveness of cleaning agents.

Worker Protection Standard Introduction

Check to See if You Are in Compliance

Although this section applies solely to the agricultural pesticide applicator, it is good information to start a structural pesticide safety program. It will be a few years, but a structural pesticide standard standard will be coming. This checklist serves only as a brief overview of basic WPS requirements. For complete details of your responsibilities, refer to the "How to Comply Manual" or contact your nearest EPA office.

<u>Central Location:</u>
All information should be legible, up-to-date, and accessible to employees The EPA approved Safety Poster is posted and complete Display emergency medical information. The following records are displayed and available for at least 30 days following expiration of the restricted re-entry interval (REI): location of treated area, pesticide product name, active ingredient, EPA registration number, start date and time of the application, and REI.

<u>Pesticide Safety Training:</u> Complete WPS Training has been given to:
Workers prior to the 6th day of entering any treated areas and every 5 years thereafter. Handlers prior to performing any handler tasks and every 5 years thereafter "Basic Pesticide Safety Information" is provided to workers as necessary EPA developed or equivalent training materials are used in training. Training is presented in a language the trainees can understand Trainers are properly qualified.

Decontamination Sites: Handler decontamination sites have/are:
At least 3 gallons of water per handler, soap, single-use towels, and coveralls Located at mixing/loading sites, within 1/4 mile of the application site and where PPE is removed Supplied with at least 1 pint of immediately available clean water for eye flushing when the label specifies the use of protective eyewear.

Worker decontamination sites have/are:
At least 1 gallon of water per handler, soap, and single-use towels Located within 1/4 mile of the work site. Provided for 30 days following the end of the REI (7 days with REIs of 4 hours or less).

Applicator Notification:

- Oral and/or posted warnings given according to label requirements.
- Appropriate warning signs are used and posted at all usual entry points to treated areas.
- Warning signs are posted not more than 24 hours prior to treatment and removed within 3 days following the end of the REI.
- Oral warnings are given in a language workers can understand.

Personal Protective Equipment (PPE):
Label required PPE is provided for handlers and early entry workers PPE is kept clean and well maintained. A clean place for PPE storage is provided.

Employer Information Exchange: Custom applicator supplies information for Central Location. Posting **prior** to applications Information is supplied to custom applicators about REIs in effect on the property which they are exposed to.

Monitoring Handlers:
Sight or voice contact made at least every 2 hours with handlers using Skull & Crossbones pesticides. Constant voice or visual contact is maintained with handlers using fumigants indoors.

Protect Yourself While Cleaning PPE

(We will cover this area in much more detail in next couple of sections)

1. The clothing and protective equipment items you will be cleaning may have pesticides on them.

2. Although you may not be able to see or smell the pesticides, they can rub off on you when you touch the clothing and equipment.

3. If pesticides get on you, they can hurt you. They can:
    - cause skin rashes or burns,
    - go through your skin and into your body and make you ill,
    - burn your eyes,
    - make you ill if you breathe them or get them in your mouth.

4. To avoid harm from the pesticide, you should:
    - Pour the clothes from their container into the washer without touching them.
    - Handle only the inner surfaces, such as the inside of boots, aprons, or coveralls.
    - Do not breathe the steam from the washer and dryer.

5. Pesticides should not be allowed to stay on your hands:
    - When you wash clothing or equipment by hand, use plenty of water and rinse your hands often.
    - Wash your hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
    - Wash your hands as soon as you finish handling the clothing or equipment.

6. You should not allow clothing and equipment with pesticides on them to be washed with regular laundry. The pesticides can rub off on other items.

Cleaning Eyewear and Respirators
Hand-wash reusable respirator facepieces, goggles, face shields, and shielded safety glasses, following manufacturer's instructions. In general, use mild detergent and warm water to wash the items thoroughly. Rinse well. Wipe dry, or hang in a clean area to air dry.

Cleaning Other PPE
1. Follow the manufacturer's cleaning instructions. If the instructions say only to wash the item, or if there are no cleaning instructions, follow the procedure below.

2. Recommended procedure for washing most PPE:
    a. **Rinse** in a washing machine or by hand.
    b. **Wash in a washing machine**, using a heavy-duty detergent and hot water for the wash cycle.
    c. **Wash only a few items at a time** to allow plenty of agitation and water for dilution. Use the highest water-level setting.
    d. **Rinse twice** using two rinse cycles and warm water.
    e. **Use two entire machine cycles** to wash items that are moderately to heavily contaminated.

f. **Run the washer through at least one more entire cycle** without clothing, using detergent and hot water, to clean the machine.

3. Some plastic or rubber items that are not flat, such as gloves, footwear, and coveralls, must be washed twice — once to clean the outside and a second time after turning the item inside out.

4. Some items, such as heavy-duty boots and rigid hats or helmets, should be washed by hand using hot water and heavy-duty detergent.

5. **Hang the items to dry**, if possible. Let them hang for at least 24 hours in an area with plenty of fresh air — preferably outdoors. Do not hang items in enclosed living areas.

6. You may **use a clothes dryer** for fabric items if it is not possible to hang them to dry. But after repeated use, the dryer may become contaminated with pesticides.

Note to Employers:
This fact sheet will help you comply with the section of the WPS that requires you to provide information to people (other than your own handlers) who clean or maintain you pesticide equipment. You are not required to give them this information in written form, but you may find that photocopying this fact sheet is an easy way to pass along the necessary information.

WORKING SAFELY WITH PESTICIDE EQUIPMENT
1. The equipment you will be cleaning, adjusting, or repairing may have pesticides on it. Although you may not be able to see or smell the pesticides, they can rub off on you when you touch the equipment.

2. If pesticides get on you, they can hurt you. They can:
- cause skin rashes or burns,
- go through your skin and into your body and make you ill,
- burn your eyes,
- make you ill if you get them in your mouth.

3. You should wear work clothing that protects your body from pesticide residues, such as long-sleeved shirts, long pants, shoes, and socks. If possible, avoid touching the parts of the equipment where the pesticide is most likely to be. Or, if practical for the job that you will be doing, consider wearing rubber or plastic gloves and an apron.

4. You should not let pesticides stay on your hands:
- Wash your hands as soon as you finish handling the equipment.
- Wash your hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Wash or shower with soap and water, shampoo your hair, and put on clean clothes after work.
- Wash work clothes that may have pesticides on them separately from other clothes before wearing them again.

Agricultural Pesticide Application Record Example

Farm:	Fertilization:
Field/Site:	Date Harvested:
Soil Type:	Yield:
Crop Last Year:	Notes:

The first eight items are required to be kept for two years by United States Department of Agriculture for all restricted use pesticide applications under the Food Agriculture Conservation and Trade (FACT) Act of 1990.

1. NAME AND CERTIFICATION NUMBER OF APPLICATOR:

MAKE A RECORD OF EACH APPLICATION OF EACH PESTICIDE					
1. Name	App. # 1	App. # 2	App # 3	App. # 4	App. # 5
2. Field or Site Location/ID					
3. Date (Mo., Day, Year)					
4. Size of Area Treated					
5. Pesticide Used (Brand Name)					
6. EPA Registration Number					
7. Total Amount Applied					
8. Crop/Commodity or Site					
9. Formulation					
10. Additives					
11. Method of Application					
12. Stage of Crop Growth					
13. Purpose of Application					
14. Stage of Development of Pest					
15. Soil Conditions					
16. Temperature					
17. Time of Day					
18. Wind					
19. Cloud Cover					
20. Effectiveness					

Instructions

This form can be used for recording pesticide applications for weed, insect, or disease control to a particular field or part of a field during a growing season. Farmers may find the record useful for evaluating results and planning future chemical treatments.

The United States Department of Agriculture now requires all applicators of Restricted Use Pesticides (RUP) to record certain information within 14 days of every RUP application. These records are required to be kept for two full years. An "*" is placed next to the USDA required RUP information.

1. *Name and certification number of applicator.
2. *Field or Site Location/ID—give name or location of the field or site (or the part of field) treated. See map section below.
3. *Date—fill in the month, day, and year of the application.
4. *Area treated—in acres, square feet, etc. If banding pesticides give total size of the field, not just the area actually treated in the band.
5. *Pesticide used—give product, trade, or brand name. Listing common names of active ingredients in the product is also often helpful.
6. *EPA registration number—from the pesticide label.
7. *Total amount applied—list total amount of formulated product (pounds, ounces, quarts, gallons, etc.) used on the total area treated given in 3 above.
8. *Crop or site—give the crop, commodity, stored product or site to which the pesticide was applied.
9. Formulation—use liquid (L), emulsifiable concentrate (EC), wettable powder (WP), granules (G), dust (D), soluble powder (SP), dry flowables (DF), or pellets (P).Additives—indicate type and amount of any additives such as oils, spreaders, stickers, surfactants, wetting agents, detergents, or other adjuvants.
10. Method of application—broadcast, band, pre-plant, pre-emergence, post-emergence, directed, aerial, airblast, and method of incorporation (if any), and implement used.
11. Stage of crop growth—use height in inches, number of leaves or other generally used description (tasseling, flowering, heading, etc.).
12. Purpose of application—give specific names of target weeds, insects, diseases, or other reason.
13. Stage of development of pest—for weeds, diseases and insects. List height of weeds, number of leaves; adult, larva, or nymph stage of insect; degree of infestation or percentage of plants infected.
14. Soil conditions—at time of treatment.
15. Temperature—self-explanatory.
16. Time of day—self-explanatory.
17. Wind—self-explanatory.
18. Cloud cover—self-explanatory.
19. Effectiveness—indicate good, fair, or poor. It is advisable to sometimes leave untreated check strips.

Follow the Keys to Pesticide Safety

READ THE LABEL ON EACH PESTICIDE CONTAINER BEFORE EACH USE. Follow all instructions, heed all precautions, and use protective clothing and equipment as required.

APPLY PESTICIDES ONLY AS DIRECTED. Follow label directions for time, rate, method and crop or site of application.

RINSE PESTICIDE CONTAINERS AT THE TIME OF USE. Follow required triple-rinse or pressure-rinse procedures.

STORE PESTICIDES IN THEIR ORIGINAL, LABELED CONTAINERS. Keep them out of the reach of children and irresponsible people.

Field or site Location and ID

NORTH	

Master List

Applicator's Name	E.P.A. Certification Number

Pesticide Spill Kit
The pesticide spill kit shall contain the following:

1 - 55-gallon open-head drum
1 - 50-pound bag of absorbent material
3 - 1-gallon jugs of household bleach
1 - 1-gallon jug of liquid detergent
1 - 24-inch push broom
1 - square point "D" handle shovel
1 - shop brush (dust pan brush)
1 - dust pan
12 - polyethylene bags w/ties

Whenever any of the above items are used, they shall be cleaned and/or replaced.

In addition to the Federal Insecticide, Fungicide, and Rodenticide Act and the Federal Food, Drug, and Cosmetic Act, a number of other federal laws regulate the use, storage, disposal and transportation of pesticides. The Occupational Safety and Health Act mandates that employers, including farmers and ranchers, protect their employees from hazards in the work place. With respect to pesticides, the law covers workers in pesticide manufacturing plants and also farmworkers applying pesticides to crops.

Hazard communication standards developed by the Occupational Safety and Health Administration require employers to have a written hazard communication plan, possess a safety data sheet (SDS) for each hazardous chemical, and provide training for employees on protective measures. A SDS must contain detailed information on the chemical, its hazards, and procedures to be followed in the event of an emergency.

Pesticide use is regulated by several federal laws designed to protect the environment. The Federal Endangered Species Act makes it unlawful to harm any plant or animal listed by the Fish and Wildlife Service (FWS) as *endangered* or *threatened*. The EPA, in cooperation with the USDA and the FWS, developed an Endangered Species Protection Program to protect listed species from harmful effects of pesticides. Under the program, pesticide use is restricted in areas where endangered species are likely to be exposed.

Product labels instruct users to consult county bulletins specifying locations within the county where use of the products is restricted. The Clean Water Act protects the nation’s waterways from both point and non-point sources of pollution. Discharges of waste products (point source pollution) are controlled by the EPA through a permit system.

Amendments to the Clean Water Act in 1987 allow for restrictions on non-point source pollutants, such as runoff of agricultural chemicals. The EPA is presently requiring states to submit management plans for the control of nonpoint source pollution. Pesticides in drinking water falls under the jurisdiction of the Safe Drinking Water Act. This law authorizes the EPA to set maximum contaminant levels for pesticides in drinking water.

Pesticide Poisoning

Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. But when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

Pesticide Exposure Control Measures

Steps to control exposure may also be listed, such as:

- ✓ Ventilation requirements.
- ✓ Hygiene practices-such as showering and washing work clothes at work.
- ✓ Examples of safe handling, storage, and use, such as "Keep drum closed when not in use" and "Store in a cool, dry place."

Personal protective equipment (PPE) and clothing prevents employees from contacting hazardous substances. The SDS will list the necessary PPE for eye and face protection, respiratory protection, or skin protection. Check with a supervisor about PPE selection, use, or care. (*Refer to training sessions on PPE: Eye and Face, PPE: Respirator Use, and PPE: Protective Clothing.)*

Hazardous Consumer Products

These include cleaning products and pesticides. Their labels will be somewhat different because these products are regulated by the Consumer Product Safety Commission or the Environmental Protection Agency, not OSHA. The same basic warning information is provided but usually in greater detail.

Treat these products the same as other chemicals: Read the label before starting any job. Check the products you use at home, too.

Summary

- ✓ Check all incoming containers to be sure they have complete labels. Report any problems.
- ✓ Check all containers before handling or using them to see if they have legible labels with all the required information. Report any problems.
- ✓ Never handle or use the contents of a container that has no label—or an incomplete or illegible one.
- ✓ If you cannot understand some information on a label, ask your supervisor.
- ✓ If there's not enough information on a label to determine how to store or use the chemical or what protective clothing to wear, check the SDS (formerly MSDS).
- ✓ Follow label warnings and instructions. They are a key part of every worker's right to know about hazards on the job and how to protect against those risks.

Decontamination Supplies

(See Also Specific Duties Section Below)

Handler employers must make sure that decontamination supplies (described below) for washing off pesticides and pesticide residues are provided to **handlers** while they are doing handling tasks.

Worker employers must make sure that decontamination supplies (described below) for washing off pesticide residues are provided to **workers** who are working in a pesticide-treated area and are doing tasks that involve contact with anything that has been treated with the pesticide, including soil, water, or surfaces of plants.

Specific Duties
When Must the Supplies Be Provided?
For **handlers**, for the duration of the handling task.
For **workers**, until 30 days after the end of any restricted-entry interval for that area. If there is no restricted-entry interval, until 30 days after the end of any application in that area.

Exception
When the only pesticides used in the treated area are products with a restricted-entry interval of 4 hours or less, the decontamination supplies must be provided until 7 days after the end of the restricted-entry interval. ***Note****:* When products have no restricted-entry interval listed on the label, the decontamination supplies must be provided until 30 days after the end of any application in that area.

For **early-entry workers who will contact** anything that has been treated with the pesticide, the decontamination supply requirements are different.

Supplies
Provide workers and handlers with:
1. **Water** — enough for:
   - routine washing, and
   - emergency eyeflushing.

If the water is stored in a tank, the water ***must not*** *be used for mixing pesticides, unless the tank is equipped with correctly functioning anti-backsiphoning or check valves or other mechanisms (such as air gaps) that prevent pesticides from moving into the tank.*
2. **Soap and single use towels —** enough for workers' or handlers' needs.
3. **For handlers**, ***also*** provide:
   - **enough water for washing the entire body** in case of emergency, and
   - **clean change of clothes**, such as one-size-fits-all coveralls, to put on if the handlers' garments are contaminated and need to be removed right away.

Recommendation: How Much Water Should Be Provided?
Obviously, running water meets the requirement. However, if it is not available, use the following guidelines.

• **Workers:** At least 1 gallon of water is recommended for each worker using the supplies. If you find that 1 gallon per worker is inadequate to last for the entire work period, provide more water or replenish the water as needed during the work period.

•**Handlers:** At least 3 gallons of water is recommended for each handler using the supplies. If you find that 3 gallons per handler is inadequate to last for the entire work period, provide more water or replenish the water as needed during the work period.

Location
1. All decontamination supplies for workers must be located together and all decontamination supplies for handlers must be located together. Decontamination supplies must be reasonably accessible to the workers and handlers. Handlers mixing pesticides must have decontamination supplies at the mixing area.

Exceptions:

- For a pilot who is applying pesticides aerially, the decontamination supplies must be at the aircraft's loading site or in the aircraft.
- For tasks performed more than 1/4 mile from the nearest point reachable by vehicles (cars, trucks, or tractors), the decontamination supplies may be at the access point. In this circumstance, clean water from springs, streams, lakes, or other sources may be used for decontamination if such water is more readily available than the water at the access point.

Worker decontamination supplies must ***not*** be in an area being treated with pesticides or in an area under a restricted-entry interval.

Handler decontamination supplies may be located in an area being treated with pesticides (or an area that has a restricted-entry interval in effect), **only if**:

- They are in the area where the handler is doing handling tasks, *and*

- The soap, single-use towels, and clean change of clothing are in closed containers, *and*
- The water is running tap water or is in a closed container.

Emergency Eyeflushing
Provide each **handler** with at least 1 pint of emergency eyeflush water when the pesticide labeling requires protective eyewear for the handling task being performed. The emergency eyeflush water must be **immediately accessible**. For example, it could be carried by the handler or be on a vehicle the handler is using. The water that is supplied for general decontamination may also be used as eyeflush water, if it is immediately accessible.

Decontamination After Handling Tasks
At the site where handlers remove their personal protective equipment (PPE), provide:

- soap,
- clean towels, and
- enough water to allow handlers to wash thoroughly after removing PPE.

If the pesticide is not applied as scheduled, you must display the corrected time and date before the application takes place. ***If you are unable to make the correction before the application takes place, make it as soon as possible thereafter.***

Solutions (S)
Some pesticide active ingredients dissolve readily in a liquid carrier such as water or a petroleum-based solvent. When mixed with the carrier, they form a solution that does not settle out or separate. Formulations of these pesticides usually contain the active ingredient, the carrier, and one or more other ingredients. Solutions may be used in any type of sprayer, indoors or outdoors.

Ready-to-Use Low-Concentrate Solutions (RTU)
Low-concentrate formulations are ready to use and require no further dilution before application. They consist of a small amount of active ingredient (often 1 percent or less per unit volume) dissolved in an organic solvent. They usually do not stain fabrics or have unpleasant odors.

They are especially useful for structural and institutional pests and for household use. Major disadvantages of low-concentrate formulations include limited availability and high cost per unit of active ingredient. Many organic solvents are harmful to foliage, so they often cannot be used as plant sprays.

Ultra-Low Volume (ULV)
These concentrates may approach 100 percent active ingredient. They are designed to be used as is or to be diluted with only small quantities of a specified carrier and are used at rates of no more than 1/2 gallon per acre. These special purpose formulations are used mostly in outdoor applications, such as in agricultural, forestry, ornamental, and mosquito control programs.

Advantages

- Relatively easy to handle, transport, and store.
- Remain in solution; little agitation required.
- Not abrasive to equipment.
- Will not plug screens and nozzles.
- Leave little visible residue on treated surfaces.

Disadvantages

- Difficult to keep pesticide on target—high drift hazard.
- Specialized equipment required.
- Easily absorbed through skin of humans or animals.
- Solvents may cause rubber or plastic hoses, gaskets, and pump parts and surfaces to deteriorate.

Employers of Commercial Agricultural Pesticide Handlers

Must make sure that their customer — the operator of the farm, forest, nursery, or greenhouse — knows certain information, described below, about the pesticide before it is applied on the establishment. **Operators of farms, forests, nurseries, and greenhouses** (agricultural employers) must make sure that, whenever a **commercial handler** will be doing pesticide handling tasks (including tasks as a crop advisor) on their establishment, the **commercial handler's employer knows specific information**, described below, concerning treated areas on the agricultural establishment.

Information for Establishment Operators
Commercial handler employers must inform their customer — the operator of the farm, forest, nursery, or greenhouse — about:

- the specific location and description of the area(s) on the agricultural establishment that are to be treated with a pesticide,
- time and date the pesticide is scheduled to be applied,
- product name, EPA registration number, and active ingredient(s),
- restricted-entry interval for the pesticide,
- whether the pesticide labeling requires both treated-area posting **and** oral notification, and
- any other specific requirements on the pesticide labeling concerning protection of workers and other persons during or after application. Operators of agricultural establishments must have this information to protect their employees.

Information for Commercial Handler Employers
Operators of agricultural establishments must provide the following information to the commercial pesticide handler employer that they hire:
• Specific location and description of any areas on the agricultural establishment: – that may be treated with a pesticide or be under a restricted-entry interval while the commercial handler will be there, *and* – that the commercial handlers may be in (or walk within 1/4 mile of).
• Restrictions on entering those areas. Operators of commercial pesticide handling establishments must have this information to protect their employees.

Personal Protective Equipment
(i) Personal protective equipment (PPE) means devices and apparel that are worn to protect the body from contact with pesticides or pesticide residues, including, but not limited to, coveralls, chemical- resistant suits, chemical-resistant gloves, chemical-resistant footwear, respiratory protection devices, chemical-resistant aprons, chemical-resistant headgear, and protective eyewear.
(ii) Long-sleeved shirts, short-sleeved shirts, long pants, short pants, shoes, socks, and other items of work clothing are not considered personal protective equipment for the purposes of this section and are not subject to the requirements of this section, although pesticide labeling may require that such work clothing be worn during some activities.
(iii) When "chemical-resistant" personal protective equipment is specified by the product labeling, it shall be made of material that allows no measurable movement of the pesticide being used through the material during use.
(iv) When "waterproof" personal protective equipment is specified by the product labeling, it shall be made of material that allows no measurable movement of water or aqueous solutions through the material during use.

(v) When a "chemical-resistant suit" is specified by the product labeling, it shall be a loose-fitting, one- or two-piece, chemical-resistant garment that covers, at a minimum, the entire body except head, hands, and feet.
(vi) When "coveralls" are specified by the product labeling, they shall be a loose-fitting, one- or two-piece garment, such as a cotton or cotton and polyester coverall, that covers, at a minimum, the entire body except head, hands, and feet. The pesticide product labeling may specify that the coveralls be worn over a layer of clothing. If a chemical-resistant suit is substituted for coveralls, it need not be worn over a layer of clothing.

Restrictions during Application

The handler employer must assure that:

- No pesticide is applied so as to contact any worker (directly or through drift) other than an appropriately trained and equipped handler.
- Workers handling highly toxic pesticides are monitored visually or by voice communication at least every 2 hours.
- Any worker who handles a fumigant in a greenhouse, including a handler entering before acceptable safe entry criteria have been met, maintains continuous visual or voice contact with another handler who has immediate access to the required PPE if rescuing the handler in the greenhouse becomes necessary.

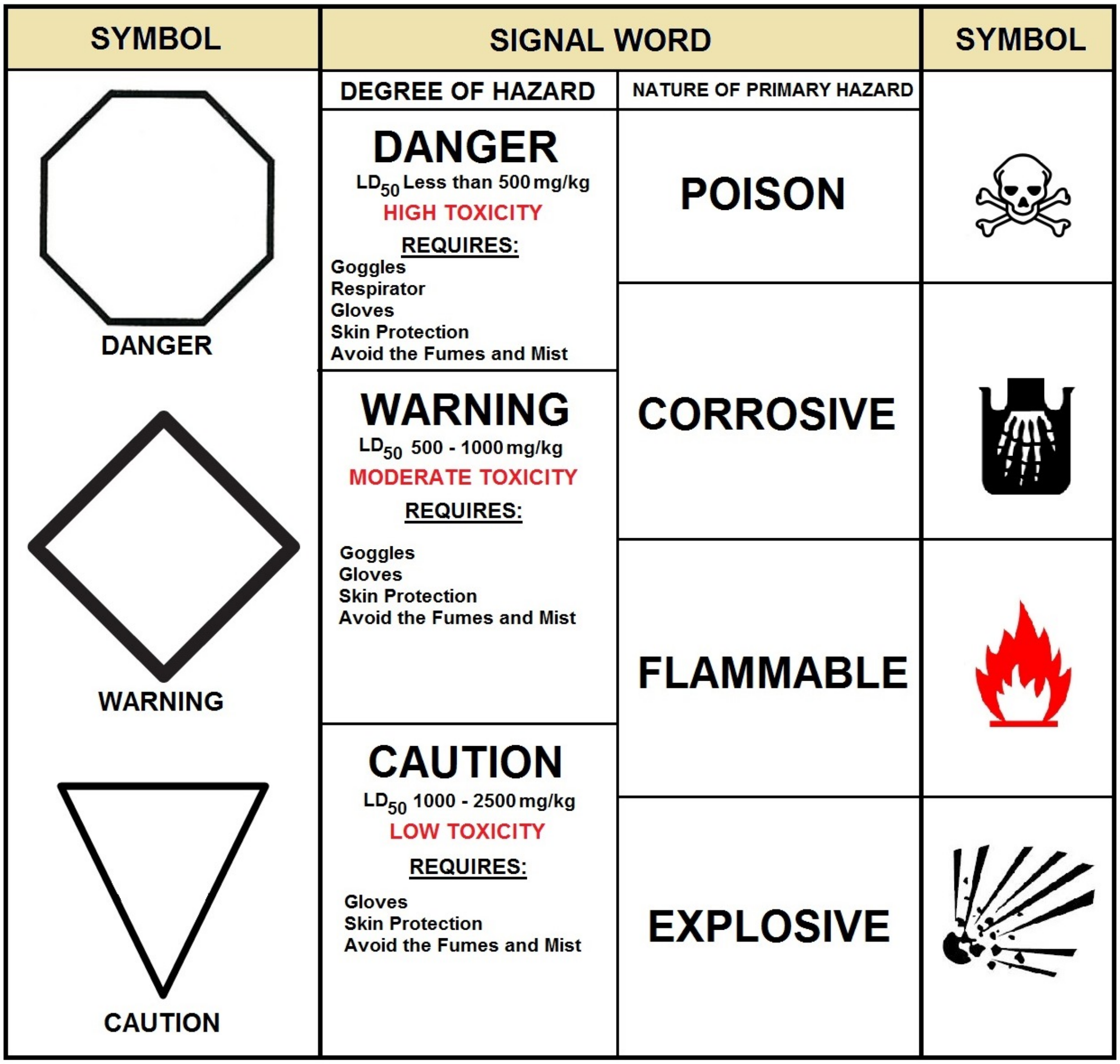
Notice of Application to Agricultural Employers

Prior to applying any pesticide on an agricultural establishment, a handler employer must provide the following information to an agricultural employer or be assured that the agricultural employer is aware of the specific time, date, location, and description of the pesticide-treated area, labeling requirements relating to protection of workers during or after application, product name, the EPA registration number, active ingredients, REI, and notification requirements.

Pesticide Safety Training

A handler employer must assure that each handler is properly trained in pesticide safety by a qualified trainer. The minimum pesticide training required, as well as the criteria for qualified trainers, is specified in the standard. Certified handlers and handlers who have been trained under 40 Code of Federal Regulations, Part 171 are exempt from this requirement.

Symbols and Applications - Basic Requirements



GRAPH DEPICTING DEGREE OF RISK & HAZARD SYMBOLS RELATED TO PESTICIDES

(See Also Specific Duties Section Below)
Under most circumstances, **worker employers** must make sure that **workers** are notified about areas where pesticide applications are taking place or where restricted-entry intervals are in effect.

Specific Duties Both Oral Warnings and Posted Signs
Some pesticide labels require you to notify workers ***both*** orally ***and*** with signs posted at entrances to the treated area. If both types of notification are required, the following statement will be in the "Directions for Use" section of the pesticide labeling under the heading "Agricultural Use Requirements".

"**Notify workers of the application by warning them orally and by posting warning signs at entrances to treated areas**."

Notification on Farms, Forests, and Nurseries
Unless the pesticide labeling requires both types of notification, notify workers ***either*** orally ***or*** by the posting of warning signs at entrances to treated areas. You must inform workers which method of notification is being used.

Notification in Greenhouses
In greenhouses, **you must post all treated areas**, except as described below. If the pesticide labeling requires both types of notification, you must also notify workers orally.

Exceptions to Worker Notification
1. **Oral warnings** need ***not*** be given to:

- **any** worker on your farm, forest, or nursery who will not be in the treated area, or walk within 1/4 mile of a treated area, during the pesticide application or while the restricted-entry interval is in effect,
- **any** worker who will not be in your greenhouse during a pesticide application or while a restricted-entry interval is in effect there, ***or***
- **any** worker who applied (or supervised the application of) the pesticide and is aware of all of the information required to be given in the oral warning.

2. Treated area posting is ***not*** required if:

- **no** workers on your farm, forest, or nursery will be in the treated area, or walk within 1/4 mile of the treated area, during the pesticide application or while the restricted-entry interval is in effect,
- **no** workers will be in the greenhouse during the pesticide application or while the restricted-entry interval is in effect there, ***or***
- the **only** workers for whom you need to post applied (or supervised the application of) the pesticide and are aware of all of the information required to be given in the oral warning.

Posted Warning Signs (Agricultural)

Signs meeting these Use WPS-design signs when you post warnings at entrances to treated areas. For a *requirements should be* detailed description, see Requirements for Warning Signs*.*

EXAMPLE OF WARNING SIGNS USED IN PESTICIDE APPLICATION

1. **Location:**

    • **On farms, forests, and nurseries**, post the signs so they can be seen from all points where workers usually enter the treated area, including at least: – each access road, – each border with any labor camp adjacent to the treated area, and – each established walking route that enters the treated area. When there are no usual points of worker entry, post the signs in the corners of the treated area or in places where they will be most easily seen.

    • **In greenhouses**, post the signs so they can be seen from all points where workers usually enter the treated area, including doorways, aisles, and other walking routes. When there are no usual points of worker entry to the treated area, post the signs in the corners of the treated area or in places where they will be easily seen.

2. **Timing and Visibility of Warning Signs**:

    • Post signs 24 hours or less before the scheduled application of the pesticide.
    • Keep signs posted during application and throughout the restricted-entry interval (if any),
    • Remove the signs within 3 days after the end of the restricted-entry interval. If there is no restricted-entry interval for that application, remove the signs within 3 days after the end of the application.
    • Keep workers out during the entire time the signs are posted, (except for trained and equipped early-entry workers entering as permitted under WPS).
    • Keep signs visible and legible while they are posted.

3. **Posting Adjoining Areas** When several adjoining areas are to be treated with pesticides on a rotating or sequential *Requirements for Warning Signs,* you may post the entire area at the same time. Worker entry, except for early entry *description, see* permitted by the WPS, is prohibited for the entire area while the signs are posted.

4. **Design and Size**
- Each warning sign must look like this:

Exception:
As an option, you may use warning signs that replace the Spanish words with the same words in **Red** another language (other than English) that is read by the largest number of your workers who do not read English. The replacement sign must meet all other requirements for the WPS warning sign.
- You may put **additional information** on the warning sign, such as the name of the pesticide or the date of application, if it does not lessen the impact of the sign or change the meaning of the required information. If you add the required information in other languages, the words must be translated correctly.
- The signs must be at least 14 inches by 16 inches, and the letters must be at least 1 inch high.

Exception:
On farms and forests, you may use smaller signs if the treated area is too small to accommodate 14- by 16-inch signs. For example, when a single plant needs to be posted, a smaller sign would be appropriate. In nurseries and greenhouses, you may, at any time, use a sign smaller than the standard size.

Whenever a small sign is used, there are specific posting distances depending on the size of the lettering and symbol on the sign (see table below).

Sign Size
Signs with the words "DANGER" and "PELIGRO" in letters less than *7/16 inch in height* ***or*** *with any words in letters* less than *1/4 inch in height* ***or*** *with the circle graphic containing an upraised hand and a stern face* less than *1½ inches in diameter do not meet WPS sign requirements.*

* This distance requirement is for places where multiple signs are used to post a single treated area, such as a field or a greenhouse section. It does not apply where individual signs are used for separate small treatment areas (such as single potted plants in a greenhouse).

Chemical degradation is the breakdown of pesticides by processes that do not involve living organisms. Temperature, moisture, pH and adsorption, in addition to the chemical and physical properties of the pesticide, determine which chemical reactions take place and how quickly they occur. One of the most common pesticide degradation reactions is hydrolysis, a breakdown process in which the pesticide reacts with water.

Many organophosphate and carbamate insecticides are particularly susceptible to hydrolysis under alkaline conditions. Some are actually broken down within a matter of hours when mixed with alkaline water. Product labels may warn against mixing a pesticide with certain fertilizers, other pesticides or water with specific characteristics.

CATEGORIES of PESTICIDE TOXICITY				
	CATEGORY I	CATEGORY II	CATEGORY III	CATEGORY IV
SIGNAL WORDS	DANGER / DANGER POISON	WARNING	CAUTION	NONE REQUIRED
ACUTE / ORAL	≤ 50 mg/kg	< 50 - 500 mg/kg	> 500 - 5000 mg/kg	> 5000 mg/kg
ACUTE DERMAL	≤ 200 mg/kg	> 200 - 2000 mg/kg	> 2000 - 5000 mg/kg	> 5000 mg/kg
ACUTE INHALATION	≤ 0.05 mg/L	> 0.05 - 0.5 mg/L	> 0.5 - 2 mg/L	> 2 mg/L
PRIMARY EYE IRRITATION	CORROSIVE	CORNEAL INVOLVEMENT OR OTHER EYE IRRITATION CLEARING IN 8 - 21 DAYS	CORNEAL INVOLVEMENT OR OTHER EYE IRRITATION CLEARING IN ≤ 7 DAYS	MINIMAL EFFECTS CLEARING IN < 24 Hours
PRIMARY SKIN IRRITATION	CORROSIVE	SEVERE IRRITATION AT 72 Hours	MODERATE IRRITATION AT 72 Hours	MILD or SLIGHT IRRITATION AT 72 Hours

TOXICITY OF PESTICIDE CATEGORIES AND SPECIFIC SIGNAL WORDS

Following these precautions can help prevent pesticide degradation and potential incompatibility problems. In some situations, buffers or other additives may be available to modify spray mix conditions and prevent or reduce degradation. Pesticide degradation and possible corrosion of application equipment can be avoided by not allowing a spray mix to remain in a tank for a long period of time.

Pesticide Poisoning

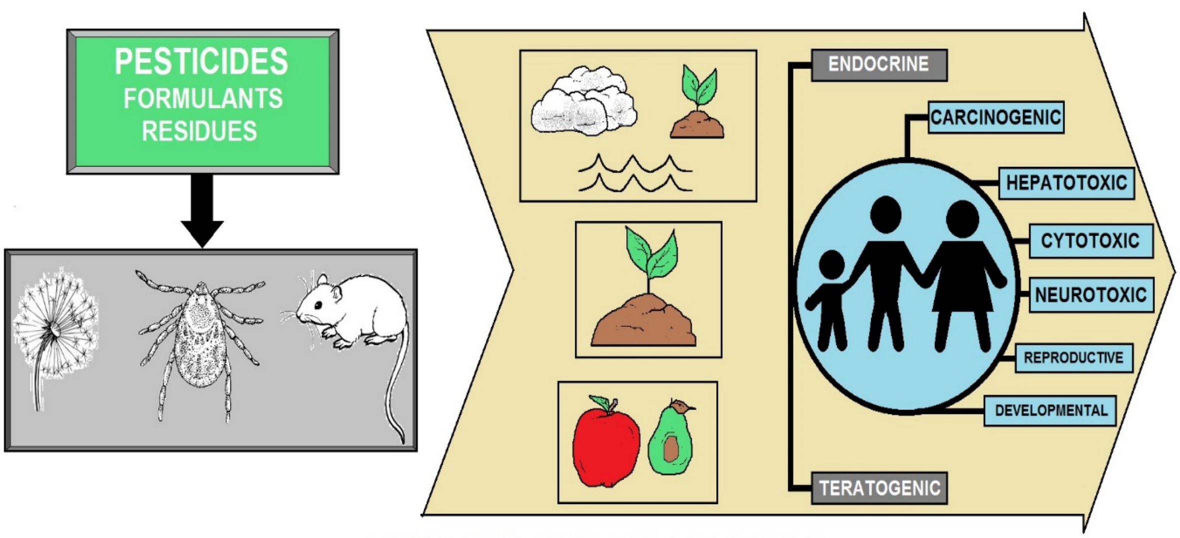
Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. But when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

PESTICIDE POST TREATMENT WARNING SIGN EXAMPLES

PESTICIDE USE TRAINING IS REQUIRED BY ALL STATE PESTICIDE AGENCIES



TOXIC EFFECTS OF PESTICIDES

Oral Warnings to Agricultural Workers

1. **Content**:
Oral warnings must include:
- the location and description of the treated area,
- the time during which entry is restricted, and
- instructions not to enter the treated area until the restricted-entry interval has expired.

2. **Communication**:
Provide oral warnings to workers in a manner that they can understand.
3. **Timing**:
- Workers who are on your establishment at the start of an application must be orally warned **before the application takes place**.
- Workers who are ***not*** on your establishment at the start of an application must be orally warned **at the beginning of their first work period** if (1) the application is still taking place or (2) the restricted-entry interval for the pesticide is in effect.

*Entering either enclosed or outdoor fumigated areas to ventilate, remove tarps or other coverings used in the fumigation, or to measure air concentration levels are **handling tasks**, not early entry. Only appropriately trained and equipped handlers can do these tasks.*

Basic Responsibilities
Worker employers must take actions, described below, to protect **workers and other persons** during pesticide applications on agricultural establishments. **Worker employers** also must take actions, described below, to protect **workers** during restricted-entry intervals.

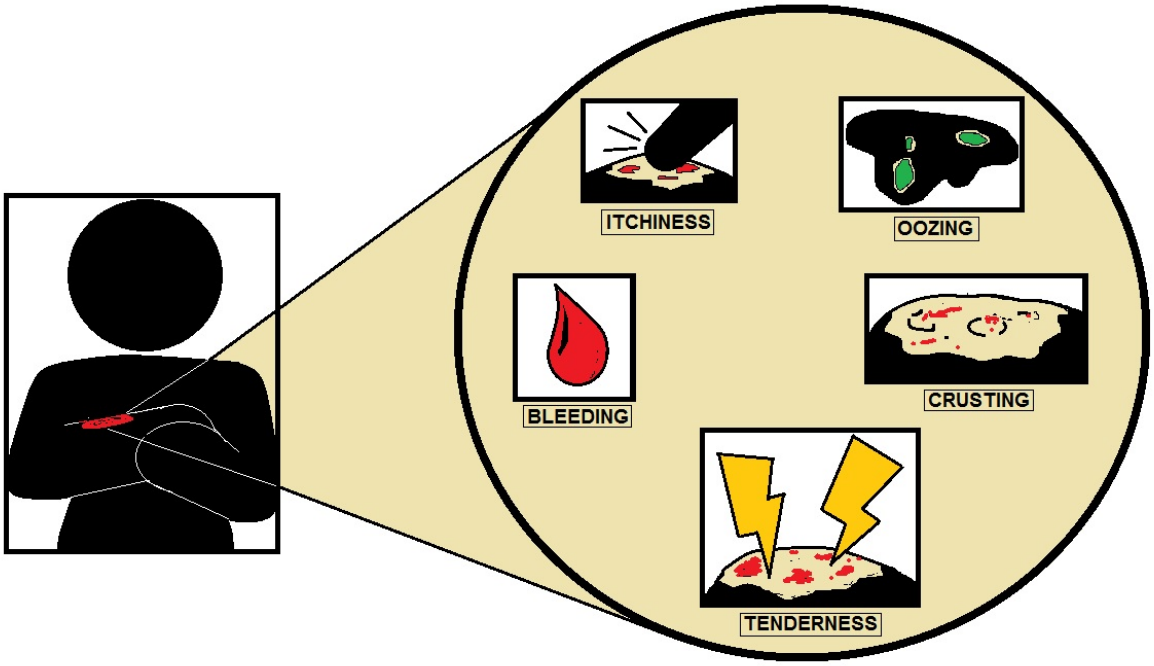
Specific Duties During Applications
1. Keep everyone except appropriately trained and equipped handlers out of areas being treated with pesticides.
2. In nurseries and greenhouses, during some applications, also keep workers and other persons out of the area **immediately around** the area being treated. The size of this "keep-out zone" depends on the pesticide used and the application method. In some greenhouse situations, the greenhouse must be adequately ventilated before workers are allowed to enter.

During Restricted-Entry Intervals
In general, keep workers out of a treated area during the restricted-entry interval. This restriction has only two types of exceptions: (1) early entry **with no contact**, described below, and (2) early entry **with contact** for short-term, emergency, or specially excepted tasks. Note, however, that entry into treated areas during a restricted-entry interval is also allowed to perform handling (including crop advisor) tasks as long as the persons entering such areas are trained and equipped as pesticide handlers and receive all other applicable WPS handler protections.

Restricted-Entry Interval (REI)
The restricted-entry interval is the time immediately after a pesticide application when entry into the treated area is limited. Some pesticides have one REI, such as 12 hours, for all crops and uses. Other products have different REIs depending on the crop or method of application. When two (or more) pesticides are applied at the same time, and have different REIs, you must follow the longer interval.

Location of REIs on Labeling
The restricted-entry interval is listed on the pesticide labeling:

- under the heading "Agricultural Use Requirements" in the "Directions for Use" section of the pesticide labeling, or
- next to the crop or application method to which it applies.



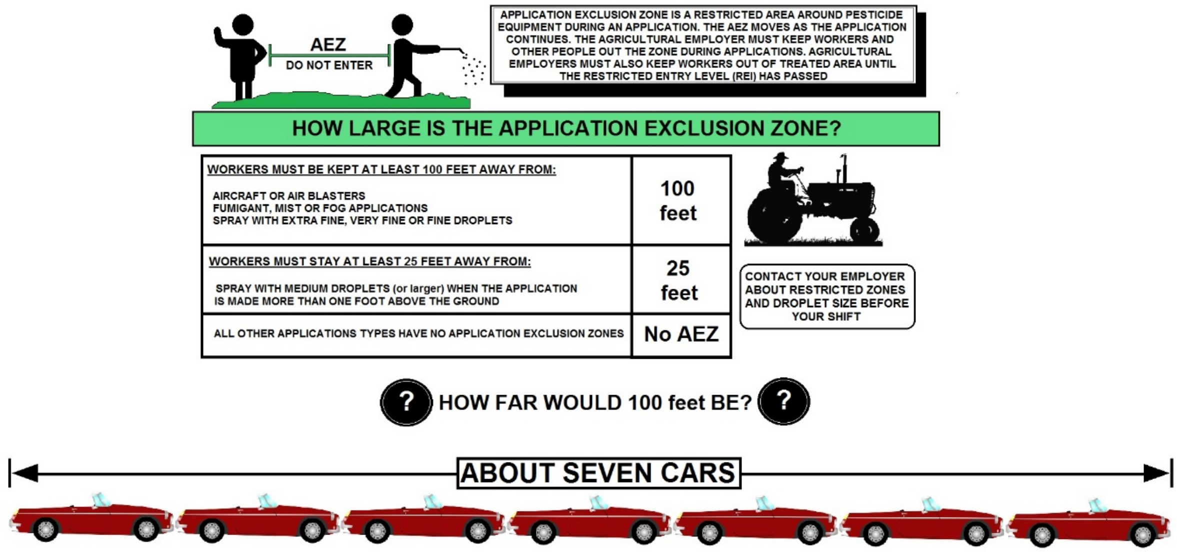
SYMPTOMS OF BOWENS DISEASE
(Caused from Crop Dusting using Arsenic Powders)

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015, the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active, it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Arid Area REIs (Agricutural) **We will cover other REIs in a few pages**



APPLICATION EXCLUSION ZONE (AEZ)

Some pesticide labeling require a different REI for arid areas. Labeling might say, for example, “72 hours in outdoor areas where average annual rainfall is less than 25 inches a year.” You can get information on average annual rainfall for your area from any nearby weather bureau, such as one located at a local airport or one affiliated with the National Oceanographic and Atmospheric Administration.

No-Contact Early Entry
If workers **will have no contact with anything that has been treated with the pesticide** to which the restricted-entry interval applies, you may permit them to enter pesticide-treated areas when the application is finished.

1. After any inhalation exposure level listed on the product labeling has been reached or any WPS ventilation criteria have been met, you may permit workers into a treated area

Avoiding contact by during an REI if they will ***not* touch or be touched by** any pesticide residues, including: *using personal protective equipment does* ***not*** *qualify as no contact early entry.*

• **on plants**, including both agricultural plants and weeds, • **on or in soil** or planting medium,
• **in water**, such as irrigation water or water standing in drainage ditches or puddles,
• **in air**, if pesticide remains suspended after application, such as after fumigation or after a smoke, mist, fog, or aerosol application.

Employers must provide current and specific information about the pesticides being applied for the benefit of their employees (handlers and workers). Employees must be informed of the central location and allowed access.

Employers (owner/operator of agricultural establishments) must post the following information just prior to applications and for 30 days after the REI has expired whenever pesticide handlers or workers are on the agricultural establishment:

- an approved EPA safety poster or an equivalent
- emergency medical information, including the name, address and telephone number of the nearest emergency medical care facility
- a list of dates and times that pesticides have been applied within the last 30 days, including a description of each treated area, and the product name, EPA registration number, active ingredient(s) and REI for each pesticide on that list

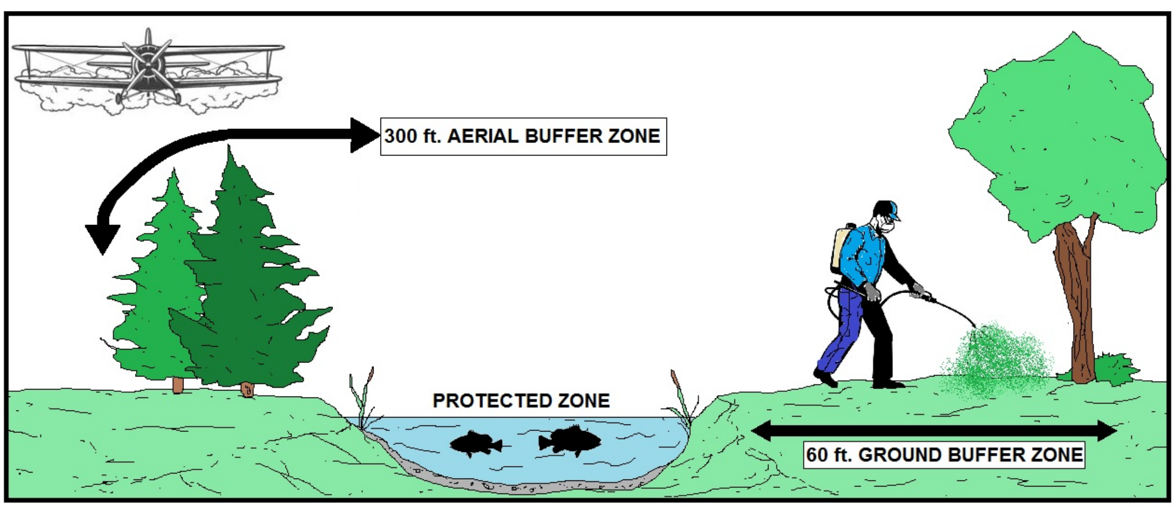
The information at the central location must be easily seen and read. Workers and handlers must be informed where it is and given access. By "access," the EPA wants the workers to be able to view the information without having to ask anyone to let them see it. Some examples of a central location include: field or forest entrance; parking area; common areas; break areas; port-a-pots.

The central location cannot be in a treated area. The EPA safety poster or an equivalent needs to show how to keep pesticides from getting on or entering the body and information about how to clean up if an individual comes in contact with pesticides.

If the emergency medical information changes, update the posted information in the central location and ensure that it remains legible.

Pesticide applications must remain on the list from before each application begins and remain posted through 30 days after the REI has expired. The list must remain accessible by the workers for the entire required posting period at the designated central location.

Handlers and workers must be informed of pesticide label requirements and information. A grower must have all the material safety data sheets (SDS (formerly MSDS)) of the labeled pesticides he/she is using on file and available upon request.



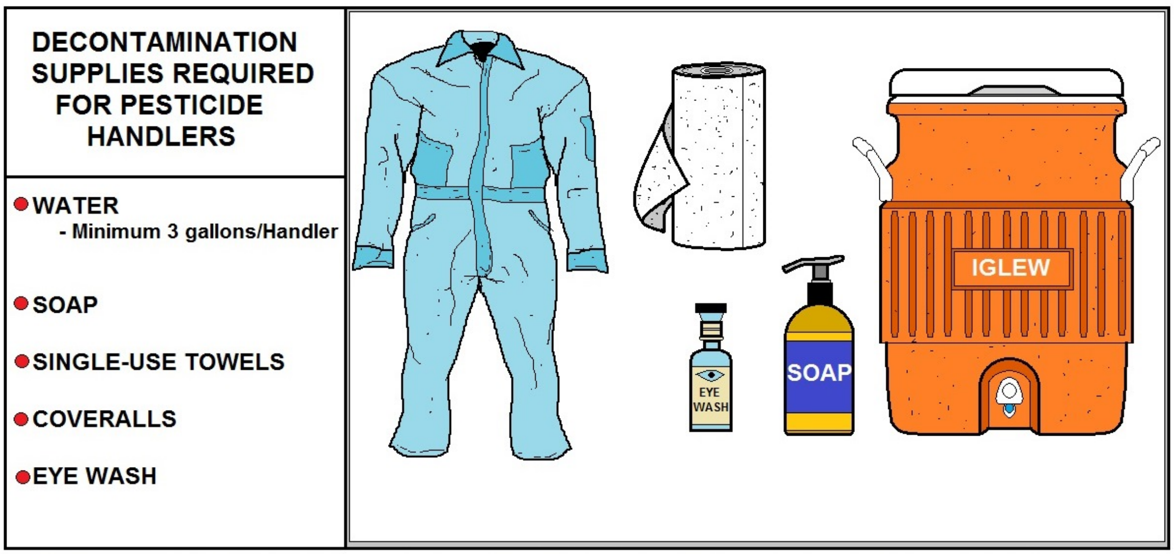
OBSERVE "NO-SPRAY" BUFFER ZONES

Technical Learning College

WPS Requires Providing Decontamination Sites

This section is for all agricultural employees and applicators; however, the principles are valid for structural applications.

Employers must establish a decontamination site for all workers and handlers for washing off pesticides and pesticide residues. A decontamination site must be within a quarter (1/4) mile of the employees' work site.



DECONTAMINATION SUPPLIES REQUIRED FOR PESTICIDE HANDLERS
(Must be located within 1/4 of a Mile of ALL Workers AND Handlers)

Employers must provide a site where workers and handlers can wash pesticide residue from their hands and body. A decontamination site should supply:

- Enough water for routine and emergency whole body washing and for eye flushing.
- Plenty of soap and single use towels.
- Employers also must provide water that is safe and cool enough for washing, eye flushing, and drinking. Employers may not use tank stored water that also is used for mixing or diluting pesticides.

Specific requirements differ depending whether employees are doing worker or handler tasks. Worker decontamination site requirements:

- Decontamination sites must be provided for workers from application to 30 days after expiration of the REI.
- Worker decontamination sites may not be in areas being treated or under an REI.

No-contact early-entry workers do ***not*** have to be provided the special protections required in Early Entry. However, they must be provided the following protections offered to other agricultural workers: information at a central location, pesticide safety training for workers, notification, restrictions during applications and during restricted-entry intervals, and emergency assistance.

Decontamination supplies, however, need ***not*** be provided to no-contact early-entry workers.
2. The following are examples of situations where a worker would ***not*** be expected to contact pesticide residues in a treated area after sprays, dusts, and vapors have settled out of the air:

- The worker is wearing footwear and is walking in aisles or on roads, footpaths, or other pathways through the treated area where the plants or other treated surfaces cannot brush against the worker and cannot drop or drip pesticides onto the worker.
- The worker is in an open-cab vehicle in a treated area where the plants cannot brush against the worker and cannot drop or drip pesticide onto the worker.
- After a pesticide application that is incorporated or injected into the soil, the worker is doing tasks that do not involve touching or disrupting the soil subsurface.
- The worker is in an enclosed cab on a truck, tractor, or other vehicle.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator's clothing becoming contaminated.

Decontamination at the End of Exposure Period
At the site where early-entry workers take off their PPE, provide:

- soap,
- clean towels, and
- enough water to allow early-entry workers to wash thoroughly after removing their PPE.

PPE for early-entry activities is listed on the pesticide label in the "Directions for Use" section under the heading "Agricultural Use Requirements."

Structural and Agricultural Training Requirements Introduction

This section and the HazCom Section is for all structural and agricultural employees and applicators. OSHA's Hazard Communication regulation, also called "Right to Know," applies to all employees who are or could be exposed to hazardous chemicals in their workplaces.

Training Requirements
Employers must establish hazard communication programs to inform their employees of the hazards of chemicals. Labels, material safety data sheets (SDS's (formerly MSDS)), and training programs all inform employees of danger and can reduce the number of chemical-related illnesses and injuries.

Employees must have a sound understanding of the terminology associated with their facility's hazard communication program to adequately recognize the dangers of hazardous chemicals in the workplace. Training must take place before employees work with a hazardous chemical and whenever the hazard changes.

Background for Trainer
SDS need to be retained as long as hazardous chemicals are used at a facility. Employers would be prudent to keep SDS's as part of their organizations' permanent medical records. SDS's often provide information about employee chemical exposure, and OSHA requires retention of records on worker exposure to hazardous chemicals.

To meet all the training requirements of 29 CFR 1910.1200, use additional sessions:

- ✓ Hazard Communication: SDS Training.
- ✓ Hazard Communication: HazCom Standard.
- ✓ Hazard Communication: Labeling Training.
- ✓ Emergency Response: Part I-Emergency Prevention.
- ✓ Personal Protective Equipment: For Emergency Response.
- ✓ Personal Protective Equipment: Protective Clothing.
- ✓ Personal Protective Equipment: Eye and Face Protection.
- ✓ Personal Protective Equipment: Respirator Use.

We will cover this area in detail in the HazCom section.

SDS Training Session Introduction

This section and the HazCom Section is for all structural and agricultural employees and applicators.

Session Objectives

Following the successful completion of this training, the participants will be able to:

- ✓ Define common terms found in safety data sheets from their own work areas.
- ✓ Differentiate between health hazards, physical hazards, and hazardous limits.
- ✓ Recognize the hazards posed by chemicals in the workplace.

Suggested Materials

For a successful training session, you will want to have the following items on hand:

- ✓ Site-specific SDS's.
- ✓ Copies of "*SDS Terms and Definitions*" (found as a handout at the end of this session.)
- ✓ Copies of the Post-Quiz for distribution.

Pre-Quiz

Start by asking the members of the group the questions listed below. You can test participants' general knowledge of the topic, which will help guide you on what points to emphasize during the session.

1. Do you know where SDS's are located in this facility? (SDS must be kept in a central location accessible to all employees.)

2. Are you unfamiliar with any terms that you have found on our SDS? (If you are uncertain of a definition, do not hesitate to tell the trainees. Making up an answer that is potentially incorrect may lead to disastrous consequences.)

Training Session

Under OSHA's Hazard Communication Standard, employees must be able to adequately recognize the dangers of hazardous chemicals in the workplace. To do that, employees must have a sound understanding of the terminology associated with their facility's hazard communication program.

The safety data sheet (SDS) plays a big part in hazard communication.

- ✓ Chemical manufacturers and distributors must provide an SDS for each hazardous chemical or mixture.
- ✓ Employers have to make SDS's-along with training on how to understand and use them-available to employees.
- ✓ Employees are responsible for using SDS (formerly MSDS)s to work safely with chemicals.

Emergency and First-Aid Procedures

This section applies to all structural and agricultural employees and applicators.

Emergency procedures—know what to do in case of an emergency such as an accidental spill or exposure. The SDS may also provide emergency phone numbers for reporting certain spills/releases.

First aid—know what to do in case of exposure. The SDS can tell what professional treatment is needed, as well as basic first-aid steps, such as:

- ✓ Wash skin for 15 minutes immediately after contact.
- ✓ Move a person who has inhaled the pesticide or chemical to fresh air.
- ✓ Make sure SDS's are available to emergency responders.

Protection beyond Work

Here are some additional ways the SDS may inform and protect:

- ✓ Environment and ecology: disposal methods, spill or release response instructions
- ✓ Transportation: information required for shipping, such as:
  DOT name and description
  Hazard class
  Identification number
- ✓ Regulations that affect the chemical

29 CFR 1910.1200

OSHA's Hazard Communication Standard (29 CFR 1910.1200) gives employees the right to know about pesticides or chemical hazards. The SDS plays a big part in hazard communication.

- ✓ Pesticide or chemical manufacturers and distributors must provide an SDS for each hazardous chemical or mixture.
- ✓ Employers have to make SDSs available to employees-along with training on how to understand and use them.
- ✓ Employees are responsible for using the SDS to work safely with pesticide or chemicals.

Make sure you understand a chemical's or product's

- ✓ Name and hazardous ingredients
- ✓ Physical and chemical characteristics
- ✓ Hazards to health and safety
- ✓ Required safety procedures and equipment

Summary

There must be at least one SDS for each pesticide or chemical in your workplace. Employees must know where they are kept, must read them, and must follow their instructions each time they work with a pesticide or chemical. The SDS tells what employees must know to work safely with pesticides or chemicals.

Decontamination Supplies for Early-Entry Workers
(See Also Specific Duties Section Below)

This section is for all agricultural employees and applicators; however, the principles are valid for structural applications.

Worker employers must provide their **early-entry workers** with decontamination supplies for washing off pesticides and pesticide residues.

Supplies
Provide early-entry workers with:
1. Water — enough for:
• routine washing, and
• emergency eye flushing. If the water is stored in a tank, the water ***must not*** be used for mixing pesticides, unless the tank is equipped with correctly functioning anti-backsiphoning or check valves or other mechanisms (such as air gaps) that prevent pesticides from moving into the tank.

2. Soap and single use towels — enough for the needs of early-entry workers.
Recommendation: How Much Water Should Be Provided?
Obviously, running water meets the requirement. However, if it is not available, use the following guidelines.
• **Early-Entry Workers:** At least 1 gallon of water is recommended for each early-entry worker using the supplies. If you find that 1 gallon per early-entry worker is inadequate to last for the entire work period, provide more water or replenish the water as needed during the work period.

Location
Make sure:
1. The decontamination supplies are ***not*** in an area being treated with pesticides.
2. The decontamination supplies are ***not*** in an area under a restricted-entry interval, ***unless*** that location is necessary for the supplies to be reasonably accessible to early-entry workers.
3. The decontamination supplies are reasonably accessible to and not more than 1/4 mile from early-entry workers.

Exception
For tasks performed more than 1/4 mile from the nearest point reachable by vehicle (car, truck, or tractor), the decontamination supplies may be at the access point. In this circumstance, clean water from springs, streams, lakes, or other sources may be used for decontamination if such water is more readily available than the water at the access point.

Emergency Eyeflushing
Provide each early-entry worker with at least 1 pint of emergency eyeflush water when the pesticide labeling requires protective eyewear for early entry. The emergency eyeflush water must be **immediately accessible**.

For example, it could be carried by the handler or be on a vehicle the early-entry worker is using. The water that is supplied for general decontamination may also be used as eyeflush water, if it is immediately accessible.

Personal Protective Equipment for Early-Entry Workers

This section is for all agricultural employees and applicators; however, the principles are valid for structural applications.

Worker employers must provide their **early-entry workers** with the early-entry PPE required by the pesticide labeling, make sure they wear the PPE, and make sure they use the PPE correctly.

Duties Related to Personal Protective Equipment
1. Provide the appropriate PPE in clean and operating condition to each early-entry worker.
2. Make sure early-entry workers wear PPE correctly for its intended purpose and use it according to the manufacturer's instructions.
3. Inspect all PPE before each day of use for leaks, holes, tears, or worn places. Repair or discard any damaged equipment.
4. Provide early-entry workers clean places away from pesticide storage and pesticide use areas to:
    - store personal clothing not in use,
    - put on PPE at the start of any exposure period, and
    - take off PPE at the end of any exposure period.

5. Take necessary steps to prevent heat illness (too much heat stress) while PPE is being worn.
6. Do not allow early-entry workers to wear home or take home PPE contaminated with pesticides.

Cleaning and Maintaining PPE
1. Keep pesticide-contaminated PPE separate from other clothing or laundry, and wash it separately.
2. If PPE will be reused, clean it before each day of reuse according to the instructions from the PPE manufacturer, unless the pesticide labeling specifies different requirements. If there are no such instructions or requirements, wash the PPE thoroughly in detergent and hot water.
3. Thoroughly dry the clean PPE before it is stored, or put it in a well-ventilated place to dry.
4. Store clean PPE separately from personal clothing and away from pesticide-contaminated areas.

Disposal of PPE
Comply with any applicable federal, state, tribal, and local regulations when you dispose of PPE that cannot be cleaned correctly.

Instructions for Persons Who Clean PPE
Inform anyone who cleans or launders PPE:
- that PPE may be contaminated with pesticides,
- of the potentially harmful effects of pesticides,
- how to protect themselves when handling contaminated PPE, and

Handler employers must make sure that:
• pesticides do not touch **people**, other than appropriately trained and equipped handlers, during pesticide applications, and

• **pesticide handlers** are monitored, as described below, when handling certain types of pesticides. **Pesticide handlers** must make sure that pesticides do not touch **people**, other than appropriately trained and equipped handlers, during pesticide applications.

Restrictions During Applications
Both handler employers and pesticide handlers must make sure that each pesticide is applied so that it does not contact, either directly or through drift, anyone except appropriately trained and equipped handlers.

Monitoring Handlers
1. Pesticides with skull and crossbones
At least once every 2 hours, someone must check on — by sight or by voice communication — any handler who is handling a pesticide that has a skull and crossbones symbol on its label. (For monitoring the handling of fumigants in greenhouses, see immediately below.)

2. Fumigants handled in greenhouses
Someone must maintain constant visual or voice contact with any handler who is applying or otherwise handling a fumigant in a greenhouse. This includes handlers who enter the greenhouse during fumigation to operate ventilation systems, adjust tarps or other coverings used in the fumigation, or check air concentration levels.

The person monitoring the fumigant handler must:
- be trained as a pesticide handler, and
- have immediate access to the PPE that the fumigant labeling requires for applicators.

Fumigant
Any pesticide product that is a vapor or gas, or forms a vapor or gas on application, and whose method of pesticidal action is through the gaseous state.

***Option**: You may allow handlers to read the labeling themselves, if they are able to read and understand it.*

Operators of agricultural establishments are required to make sure that commercial handler employers have this information.

Specific Instructions for Handlers
See Also Specific Duties Section Below)

Handler employers must make sure that, before **handlers** do any handling task, the handlers:

- are given information from the pesticide labeling and have access to the labeling itself, and

- are instructed in the safe operation of the equipment they will be using. **Commercial (custom) handler employers** must make sure that, whenever one of their handlers will be doing pesticide handling tasks (including tasks as a crop advisor) on an agricultural establishment, he or she is aware of specific information, described below, concerning pesticide-treated areas on the agricultural establishment.

SPECIFIC DUTIES Labeling Access and Information
This section is for all agricultural employees and applicators; however, the principles are valid for structural applications.

1. Inform handlers, in a manner they can understand, about all labeling requirements related to safe use of the pesticide, including at least:
    - the signal word,
    - human hazard statements and precautions,
    - personal protective equipment requirements,
    - first aid instructions,
    - environmental precautions, and
    - any additional precautions about the handling task to be performed.

2. Provide handlers access to the pesticide labeling information during handling tasks.

Safe Operation of Equipment
Make sure that handlers know how to safely and correctly use all equipment they are assigned to use for handling pesticides, including, if applicable, how to avoid drift and how to use chemigation equipment safely.

Instructions for Commercial Pesticide Handlers
Commercial (custom) pesticide handler employers must make sure that their handler employees are informed about:

1. Specific location and description of any areas on the agricultural establishment:
    - that may be treated with a pesticide or be under a restricted-entry interval while the commercial handler will be there, ***and***
    - that the commercial handler may be in (or walk within 1/4 mile of).

2. Restrictions on entering those areas.

For example, if custom applicators are scheduled to use ground equipment to apply a pesticide on a farm, they need to be informed of any nearby areas on the farm that they should stay out of because the area has an REI in effect. Or if commercial crop advisors are scheduled to scout in an area on a farm that remains under an REI, they need to be told what personal protective equipment they must wear while in that area.

Handler employers must make sure that equipment used for mixing, loading, transferring, or applying pesticides (pesticide handling equipment) is inspected and repaired and that **persons repairing, cleaning, or adjusting** such equipment are protected or informed, as described below.

Equipment Inspection
Inspect pesticide handling equipment before each day of use for leaks, clogging, and worn or damaged parts. Repair or replace any damaged equipment.

Protections for Persons Maintaining Equipment
Remove pesticide residues from pesticide handling equipment before anyone other than an appropriately trained and equipped handler is allowed to repair, clean, or adjust it.

Exception
If it is not feasible to remove pesticide residues from pesticide handling equipment, and the people who will be repairing, cleaning, or adjusting the equipment are not your employees (and, therefore, are not handlers for whom you are responsible under the WPS), you must inform them:

- that the equipment may be contaminated with pesticides,
- of the potentially harmful effects of exposure to pesticides, and
- how to correctly handle such equipment.

In the pesticide labeling, PPE for handling activities is listed in the "Hazards to Humans" section.

Handler employers must make sure that **pesticide handlers**:

- are provided with the PPE the pesticide labeling requires for the task,
- wear the PPE for the entire handling task, and
- use the PPE correctly. **Each pesticide handler** is responsible for wearing the required personal protective equipment during the entire handling task.

2017 Changes to EPA's Farm Worker Protection Standard

In late 2015, the Environmental Protection Agency issued the long awaited revision to the Worker Protection Standard (WPS). Although it is now technically active, it will not be enforced until 2017 but the original WPS will still be enforced until the end of 2016. Please keep in mind that the WPS covers both restricted use AND general use pesticides.

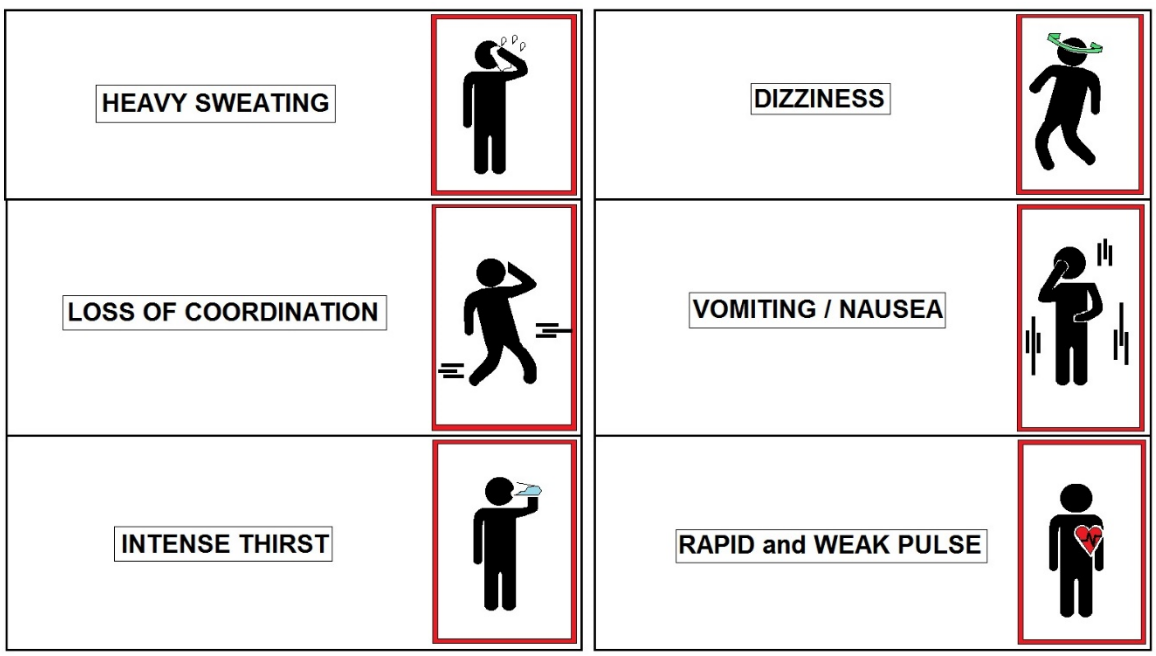
This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Duties Related to Personal Protective Equipment

Employers must:

1. Provide handlers with the appropriate PPE in clean and operating condition.
2. Make sure the handlers wear the PPE correctly and use it according to the manufacturer's instructions. If a handler wears a respirator, make sure that it fits the wearer correctly.
3. Inspect all PPE before each day of use for leaks, holes, tears, or worn places, and repair or discard any damaged equipment.
4. Provide handlers with clean places away from pesticide storage and pesticide use areas to:
    - store personal clothing not in use,
    - put on PPE at the start of any exposure period,
    - take off PPE at the end of any exposure period.

5. Take any necessary steps to prevent heat illness (too much heat stress) while PPE is being worn.
6. Do not allow any handler to wear home or take home PPE contaminated with pesticides.



SYMPTOMS OF HEAT STRESS

Cleaning and Maintaining PPE
Employers must do the following:

1. Keep pesticide-contaminated PPE away from other clothing or laundry, and wash it separately.
2. If PPE will be reused, clean it before each day of reuse according to the instructions from the PPE manufacturer unless the pesticide labeling specifies other requirements. If there are no such instructions or requirements, wash PPE thoroughly in detergent and hot water.

3. Thoroughly dry the clean PPE before it is stored, or put it in a well-ventilated place to dry.
4. Store clean PPE separately from personal clothing and away from pesticide-contaminated areas.

Replacing Respirator Filters, Cartridges, or Canisters

Employers must:
1. Replace dust/mist respirator filters:
   - when breathing resistance becomes excessive,
   - if the filter is damaged or torn,
   - whenever the respirator manufacturer or pesticide labeling says to replace them (if the instructions differ, change the filter at the shorter interval),
   - at the end of each day's work period, if no other instructions or indications of service life are available.

2. Replace gas- and vapor-removing respirator cartridges or canisters:
   - at the first indication of odor, taste, or irritation,
   - when the respirator manufacturer or pesticide labeling says to replace them (if instructions differ, change the cartridge or canisters at the shorter interval),
   - at the end of each day's work period, if no other instruction or indications of service life are available.

Disposal of PPE
Employers must:

1. Discard coveralls or other absorbent materials that have been drenched or heavily contaminated with an undiluted pesticide that has the signal word "DANGER" or "WARNING" on the labeling. They must not be reused.

2. Comply with any applicable Federal, State, Tribal, and local regulations when disposing of PPE that cannot be cleaned correctly.

Instructions for Persons Who Clean PPE
Employers must inform people who clean or launder PPE:
- that the PPE may be contaminated with pesticides,
- of the potentially harmful effects of exposure to pesticides,
- how to protect themselves when handling contaminated PPE, and
- how to clean PPE correctly. For more information about laundering pesticide-contaminated clothing, please visit the Worker Protection Standard topic page on the Ag Center's Web site at: http://www.epa.gov/agriculture/twor.html

Crop Advisers Introduction - Basic Responsibilities

The WPS requires employers to provide certain protections to their employees who are working as crop advisors.

Crop Advisor
Any person who is assessing pest numbers or damage, pesticide distribution, or the status, condition, or requirements of agricultural plants. The term does ***not*** include any person who is performing hand labor tasks, such as weeding, planting, cultivating, or harvesting. Examples of crop advisors are crop consultants, scouts, and integrated pest management monitors.

Independent or Commercial Crop Advisor
Any person who is working as a crop advisor and is employed (including self-employed) by anyone other than the agricultural establishment on which the work is being done. Such a person may be either certified/licensed or uncertified/unlicensed.

Noncommercial Crop Advisor
Any person who is working as a crop advisor and is employed directly by the agricultural establishment on which the work is being done. Such a person may be either certified/licensed or uncertified/unlicensed.

Certified or Licensed Crop Advisor
Any person who is certified or licensed as a crop advisor by a program acknowledged, in writing, as appropriate by EPA or a state or tribal lead agency for pesticide enforcement. The certification or licensing program must require pesticide safety training that includes at least all the information specified for WPS pesticide handler training.

Direct Supervision
A person is considered to be under a certified/licensed crop advisor's direct supervision (and therefore eligible for crop advisor exceptions) only when the crop advisor has informed the person about all of the following:

- the appropriate personal protective equipment,
- the appropriate decontamination supplies,
- how to conduct the crop advising tasks safely,
- the pesticide products and active ingredient(s) applied,
- the method of application,
- the time of application,
- the restricted-entry interval,
- which crop advisor tasks to undertake, and
- how to contact the certified/licensed crop advisor. Direct supervision does not require that the crop advisor be physically present at all times, but the crop advisor must be readily accessible to the employees at all times.

Exemptions
Certified/licensed crop advisors and persons performing crop advising tasks under their direct supervision are exempt from certain WPS duties and requirements when specific conditions are met.

Required Protections During or Soon After a Pesticide Application
1. Same Protections as Pesticide Handlers
Employers must provide their crop advisors with the WPS protections required for **pesticide handlers *if*** the crop advisor enters an area on an agricultural establishment:

- while a pesticide is being applied,
- before any inhalation exposure level listed in the pesticide labeling has been reached or before one of the ventilation criteria in the WPS or in the pesticide labeling has been reached,
- while a restricted-entry interval is in effect.

2. No Time Limits
Crop advisors may enter an area during a pesticide application or during a restricted-entry interval as long as they are trained as pesticide handlers, are given other pesticide-handler protections (listed below), and are wearing the appropriate personal protective equipment. The restrictions on entry, such as waiting for 4 hours after application is completed or limiting the time spent in the entry-restricted area to 1 hour or any other period, ***do not apply*** to crop advisors.

3. Required Protections

- Information at a central location.

Exception
Employers of independent (commercial) crop advisors do ***not*** have to provide their crop advisors with information at a central location.

- Pesticide safety training for handlers.
- Decontamination supplies.
- Emergency assistance.
- Monitoring handlers.

Note: After the application is complete, crop advisors entering a treated area during a restricted-entry interval need not be monitored.

- Special instructions for handlers.
- Duties related to PPE.

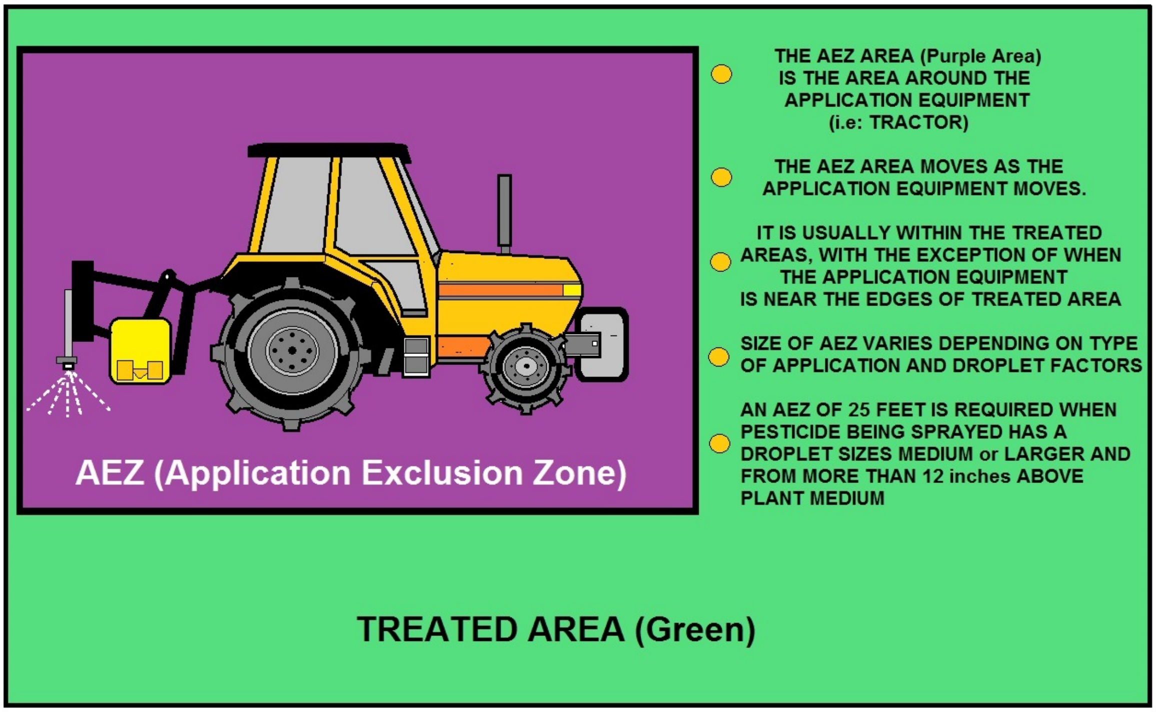
4. Personal Protective Equipment During REIs Early-Entry PPE for Early Entry "With Contact": Crop advisors who enter a treated area during a restricted-entry interval, and whose crop advisor activities involve contact with anything that has been treated with a pesticide, including soil, water, and surfaces of plants, may wear the PPE listed on the pesticide labeling **for early-entry tasks** (instead of the PPE listed for handling tasks), if:

- Application has been completed for at least 4 hours, and
- Any inhalation exposure level listed in the labeling has been reached or any ventilation requirements established by the WPS or pesticide labeling have been met.

Crop advisors may enter treated areas during an application or during a restricted-entry interval if they receive handler-type protections.

No PPE for "No Contact" Early Entry: Crop advisors who enter a treated area during a restricted-entry interval and whose crop advisor activities do ***not*** involve contact with anything that has been treated with the pesticide to which the restricted-entry interval applies are not required to wear personal protective equipment.

WPS- Required Protections after the REI



EXAMPLE OF AN "APPLICATION EXCLUSION ZONE" (AEZ)

1. Independent (Commercial) Crop Advisors
When independent (commercial) crop advisors enter any area on an agricultural establishment where no application is underway and no restricted-entry interval is in effect, their employers need ***not*** provide them with any WPS protections.

2. Noncommercial Crop Advisors
When noncommercial crop advisors (employees of the farm, forest, nursery, or greenhouse) enter any area on the agricultural establishment where no application is underway and no restricted-entry interval is in effect, their employer must provide them with the WPS protections required for **agricultural workers**.

For specific information about each of these protections, see the pages referenced below.

The protections include:
Information at a central location.

– certain information (pesticide safety poster, application information, location of emergency facility) must be displayed at a central location whenever (1) the crop advisor is on the agricultural establishment, and (2) a pesticide has recently been applied.

• Pesticide safety training for workers.

– crop advisors must be trained about general pesticide safety before they accumulate 5 days of entry into treated areas on the establishment where, within the past 30 days, a pesticide has been applied or a restricted-entry interval has been in effect.

Decontamination supplies

– decontamination supplies for washing off pesticide residues must be provided to any crop advisor who is working an area where a pesticide has recently been applied and who is doing tasks that involve contact with anything that has been treated with the pesticide, including soil, water, or surfaces of plants.

Emergency assistance

– Emergency assistance must be provided to the crop advisor if there is reason to believe that the employee has been poisoned or injured by a pesticide used on the agricultural establishment — for example, through application, spills, splashes, drift, or contact with pesticide residues.

Notice about applications

– with a few exceptions, the crop advisor must be notified about areas on the agricultural establishment where pesticide applications are taking place or where restricted-entry intervals are in effect.

Restrictions during and after applications

– the crop advisor must be protected during pesticide applications and during restricted-entry intervals on the agricultural establishment.

Direct Supervision Exemption

Certified/licensed crop advisors and persons performing crop advising tasks under their direct supervision are exempt from certain WPS duties and requirements, provided the certified/licensed crop advisors:

• do not enter, or allow persons under their supervision to enter, treated areas until after application is completed, and

• perform, and make sure that persons under their supervision perform, crop advisor tasks only, including assessing pest numbers or damage, checking pesticide distribution, or determining the status, condition, or requirements of agricultural plants, and

• specifically determine the appropriate personal protective equipment, and the appropriate decontamination supplies and how to conduct the crop advising tasks safely, and

• inform each person under their direct supervision – in a language that the person can understand — about the appropriate personal protective equipment, the appropriate decontamination supplies, and how to conduct the crop advising tasks safely, and

• using an established practice of communication, inform each person under their direct supervision about ***all*** the following:

– the pesticide product(s) and active ingredient(s) applied,
– the method of application,
– the time of application,
– the restricted entry interval,
– which crop advisor tasks to undertake,
– how to contact the certified/licensed crop advisor.

Requirements for Entry During an Application

The certified/licensed crop advisor exemption does not apply when crop advisors or persons under their direct supervision enter an area before application is completed.

WPS - Required Protections for Entry during an REI

When crop advisors enter into treated areas while a restricted-entry interval is in effect, they are defined in the WPS as pesticide handlers. When all the conditions of the certified/licensed crop advisor exemption are met, **certified/licensed crop advisors and persons under their direct supervision are exempt from the following WPS handler requirements**:

- Decontamination supplies
- Emergency assistance
- Special instructions for handlers

Note: Despite this exemption, the WPS does require that any agricultural establishment owner or operator who hires a commercial crop advisor must inform the employer of that advisor about the specific location and description of any areas on the agricultural establishment (1) that may be treated with a pesticide or be under a restricted-entry interval while the commercial crop advisor will be there, ***and***
(2) that the commercial crop advisor may be in (or walk within 1/4 mile of).

The operator must also provide information about restrictions on entering those areas.
• Duties related to PPE

However, while a restricted-entry interval is in effect, **employers must provide the following WPS protections to certified/licensed crop advisors and persons under such crop advisors' direct supervision**:

- Information at a central location

– certain information (pesticide safety poster, application information, location of emergency facility) must be displayed at a central location whenever
(1) the crop advisor is on the agricultural establishment, and (2) a pesticide has recently been applied.

Exception
The requirement above applies only to noncommercial certified/licensed crop advisors (employees of the establishment where they are working). Employers who hire independent (commercial) crop advisors do ***not*** have to provide those crop advisors with information at a central location.

- Pesticide handler training

Exception
As a requirement of any approved certification or licensing program, certified/ licensed crop advisors have received pesticide safety training equivalent to WPS pesticide handler training. Employers do not need to retrain either commercial or noncommercial certified/licensed crop advisors.

However, WPS pesticide handler training IS required for any unlicensed/uncertified crop advisors working under the direct supervision of certified/licensed crop advisors, and they must be retrained at least once every 5 years.

Other REI Protections

1. Independent (Commercial) Crop Advisors
When certified/licensed independent (commercial) crop advisors enter any area on an agricultural establishment where no application is underway and no restricted-entry interval is in effect, their employers need ***not*** provide them with any WPS protections.

2. Noncommercial Crop Advisors
When noncommercial crop advisors (employees of the farm, forest, nursery, or greenhouse) enter any area on the agricultural establishment where no application is underway and no restricted-entry interval is in effect, they are defined in the WPS as agricultural workers. When all the conditions of the certified/licensed crop advisor exemption are met, certified/licensed crop advisors or persons under their direct supervision are exempt from the following WPS agricultural worker requirements:

Decontamination supplies
• Emergency assistance. However, agricultural employers must provide the following WPS protections to their employees who are certified/licensed crop advisors, or who are persons under such crop advisors' direct supervision, when the employees enter treated areas on the agricultural establishment where no application is underway and when no restricted-entry interval is in effect:

Information at a central location
– certain information (pesticide safety poster, application information, location of emergency facility) must be displayed at a central location whenever
(1) the crop advisor is on the agricultural establishment, and (2) a pesticide has recently been applied.
• Pesticide safety training and safety information for workers

Exceptions

As a requirement of any approved certification or licensing program, certified/ licensed crop advisors have received pesticide safety training equivalent to WPS pesticide handler training.

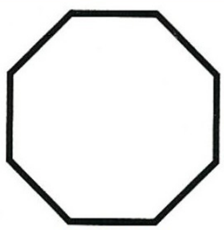
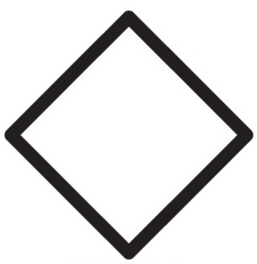
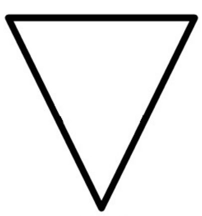
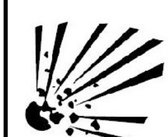
They need not be retrained. However, uncertified/ unlicensed crop advisors working under the direct supervision of a certified/ licensed crop advisor must receive pesticide safety training and safety information for workers and must be retrained within 5 years.
• Notice about applications.
  – with a few exceptions, the crop advisor must be notified about areas on the agricultural establishment where pesticide applications are taking place or where restricted-entry intervals are in effect.

• Restrictions during and after applications
  – the crop advisor must be protected during pesticide applications and during restricted-entry intervals on the agricultural establishment.

Each WPS Safety Poster Must Convey to Workers and Handlers

1. That there are federal rules to protect them, including a requirement for safety training.
2. How to help keep pesticides from getting on or into their bodies. The poster must include the following instructions:

• Avoid getting on your skin or into your body any pesticides that may be on plants and soil, in irrigation water, or drifting from nearby applications.
• Wash before eating, drinking, chewing gum, using tobacco, or using the toilet.
• Wear work clothing that protects your body from pesticide residues, such as long-sleeved shirts, long pants, shoes, socks, and hats or scarves.
• Wash or shower with soap and water, shampoo your hair, and put on clean clothes after work.
• Wash work clothes separately from other clothes before wearing them again.
• Wash immediately in the nearest clean water if pesticides are spilled or sprayed on your body. As soon as possible, shower, shampoo, and change into clean clothes.
• Follow directions about keeping out of treated or restricted areas.

SYMBOL	SIGNAL WORD: DEGREE OF HAZARD	SIGNAL WORD: NATURE OF PRIMARY HAZARD	SYMBOL
 DANGER	**DANGER** LD_{50} Less than 500 mg/kg HIGH TOXICITY REQUIRES: Goggles Respirator Gloves Skin Protection Avoid the Fumes and Mist	POISON	
 WARNING	**WARNING** LD_{50} 500 - 1000 mg/kg MODERATE TOXICITY REQUIRES: Goggles Gloves Skin Protection Avoid the Fumes and Mist	CORROSIVE	
		FLAMMABLE	
 CAUTION	**CAUTION** LD_{50} 1000 - 2500 mg/kg LOW TOXICITY REQUIRES: Gloves Skin Protection Avoid the Fumes and Mist	EXPLOSIVE	

GRAPH DEPICTING DEGREE OF RISK & HAZARD SYMBOLS RELATED TO PESTICIDES

WPS - Warning Signs Requirements

1. Required Words:
• The words “DANGER — PELIGRO” and “PESTICIDES — PESTICIDAS” must be located at the top of the sign and “KEEP OUT—NO ENTRE” at the bottom.

Exception
As an option, you may use warning signs that replace the Spanish words with the same words in another language (other than English) that is read by the largest number of your workers who do not read English. The replacement sign must meet all of the other requirements for the WPS warning sign.
• The words must be clearly legible.

2. Required Design:
- A circle containing an upraised hand on the left and a stern face on the right must be near the center of the sign.
- The background outside the circle must contrast with the inside of the circle.
- The hand and a large portion of the face must contrast with the inside of the circle.
- The remainder of the inside of the circle must be red.
- The length of the hand must be at least twice the height of the smallest letters.
- The length of the face must be only slightly smaller than the hand.

3. Additional Information:
You may put additional information on the warning sign, such as the name of the pesticide and the date of application, if it does not detract from the appearance of the sign or change the meaning of the required information.

4. Size:
The signs must be at least 14 inches by 16 inches, and the letters must be at least 1 inch high.

Exception
On farms and in forests, you may use smaller signs if the treated area is too small to accommodate 14- by 16-inch signs. For example, when a single plant needs to be posted, a smaller sign would be appropriate. In nurseries and greenhouses, you may use a sign smaller than the standard size. Whenever a small sign is used, there are specific posting distances depending on the size of the lettering and symbol on the sign.

Signs with the words “DANGER” and “PELIGRO” in letters less than *7/16 inch in height* ***or*** *with any words in letters* less than *1/4 inch in height* ***or*** *with the circle graphic containing an upraised hand and a stern face* less than *1½ inches in diameter do not meet.*

WPS sign requirements. * This distance requirement is for places where multiple signs are used to post a single treated area, such as a nursery or a greenhouse section. It does not apply where individual signs are used for separate small treatment areas (such as single potted plants in a greenhouse).

APPENDIX A – Criteria for WPS Materials

CRITERIA FOR WORKER TRAINING

1. WPS training for workers must include at least the following information:
    - Where and in what form pesticides may be encountered during work activities.
    - Hazards of pesticides resulting from toxicity and exposure, including acute effects, chronic effects, delayed effects, and sensitization.
    - Routes through which pesticides can enter the body.
    - Signs and symptoms of common types of pesticide poisoning.
    - Emergency first aid for pesticide injuries or poisonings.
    - How to obtain emergency medical care.
    - Routine and emergency decontamination procedures, including emergency eyeflushing techniques.
    - Hazards from chemigation and drift.
    - Hazards from pesticide residues on clothing.
    - Warnings about taking pesticides or pesticide containers home.
    - An explanation of the WPS requirements designed to protect workers, including application and entry restrictions, design of the warning sign, posting of warning signs, oral warnings, availability of specific information about applications, and protection against retaliatory acts.
2. WPS worker training materials must use terms that the worker can understand.

WPS training for handlers must include at least the following information:

- Format and meaning of information on pesticide labels and in labeling, including safety information such as precautionary statements about human health hazards.
- Hazards of pesticides resulting from toxicity and exposure, including acute effects, chronic effects, delayed effects, and sensitization.
- Routes through which pesticides can enter the body.
- Signs and symptoms of common types of pesticide poisoning.
- Emergency first aid for pesticide injuries or poisonings.
- How to obtain emergency medical care.
- Routine and emergency decontamination procedures, including emergency eyeflushing techniques.
- Need for and appropriate use of personal protective equipment.
- Prevention, recognition, and first aid treatment of heat-related illness.
- Safety requirements for handling, transporting, storing, and disposing of pesticides, including general procedures for spill cleanup.
- Environmental concerns such as drift, runoff, and wildlife hazards.
- Warnings about taking pesticides or pesticide containers home.
- An explanation of WPS requirements that handler employers must follow for the protection of handlers and others, including the prohibition against applying pesticides in a manner that will cause contact with workers or other persons, the requirement to use personal protective equipment, the provisions for training and decontamination, and the protection against retaliatory acts.

Restricted Use Products (RUP) Report

The Restricted Use Products Report is a compilation of both active and cancelled pesticide products classified as "**Restricted Use**". The "**Restricted Use**" classification restricts a product, or its uses, to use by a certified pesticide applicator or under the direct supervision of a certified applicator. (For detailed information on the "**Restricted Use**" Classification, consult 40 CFR Subpart I, 152.160)

In the RUP Report, the criteria on which the restricted use classification is based, uses, formulations, EPA Registration Numbers, product names, product status and revision date are organized by pesticide active ingredient (**AI**). The Product Manager (**PM**) Number is also provided for each AI.

EACH PESTICIDE HANDLER EMPLOYEE MUST HAVE AN UNDERSTANDING OF THE FOLLOWING SUBJECT AREAS TO SAFELY USE AND HANDLE PESTICIDES:
PESTICIDE PRODUCT LABELING - Format and meaning of information, such as the precautionary statements concerning human health hazards.
HAZARDS OF PESTICIDES - These are identified in product labeling, Safety Data Sheets (SDS), or PSIS Leaflet (Pesticide Safety Information Series).
PESTICIDE SAFETY REQUIREMENTS AND PROCEDURES - This in regards to regulation, PSIS Leaflets, SDS, Including Engineering Controls, for handling, transporting, storing and disposal of Pesticides.
ENVIRONMENTAL CONCERNS - This addressess the aspect of drift, runoff, and the hazards to Wildlife.
ROUTES OF ENTRY - This area addressess the hazards of which Pesticides can enter the body: Dermal (skin) , Oral (swallowed), Inhalation (breathe in), Ocular (through the eyes).
COMMON SIGNS AND SYMPTOM OF EXPOSURE - Some of the basic symptoms include: Headache, fatigue, weakness, nervousness, nausea, perspiration, eye and skin irritation.
EMERGENCY FIRST AID - Know and understand the basic procedures necessary for first aid concerning exposure to pesticides. This may include basic CPR.
USE AND CARE OF PERSONAL PROTECTIVE EQUIPMENT - Each employee who handles or may have the chance of being exposed to pesticides must have required Personal Protective Equipment available, and each employee must know and understand the proper use and care of this equipment.
THE ITEMS LISTED ABOVE ARE JUST BASICS REQUIRED TO SAFELY HANDLE PESTICIDES

Technical Aspects of Pesticide Pathophysiology Sub-Section

Damages from Pesticides that you need to recognize

Organochlorines
DDT is an organochlorine. The organochlorine pesticides, like DDT, aldrin, and dieldrin are extremely persistent and accumulate in fatty tissue. Through the process of bioaccumulation (lower amounts in the environment are magnified sequentially up the food chain), large amounts of organochlorines can accumulate in top species like humans. There is substantial evidence to suggest that DDT, and its metabolite DDE, act as endocrine disruptors, interfering with hormonal function of estrogen, testosterone, and other steroid hormones.

Anticholinesterase compounds
Malathion is an organophosphate anticholinesterase. Certain organophosphates have long been known to cause a delayed-onset toxicity to nerve cells, which is often irreversible. Several studies have shown persistent deficits in cognitive function in workers chronically exposed to pesticides. Newer evidence suggests that these pesticides may cause developmental neurotoxicity at much lower doses and without depression of plasma cholinesterase levels.

Diagnosis
Most pesticide-related illnesses have signs and symptoms that are similar to common medical conditions, so a complete and detailed environmental and occupational history is essential for correctly diagnosing a pesticide poisoning. A few additional screening questions about the patient's work and home environment, in addition to a typical health questionnaire, can indicate whether there was a potential pesticide poisoning.

If one is regularly using carbamate and organophosphate pesticides, it is important to obtain a baseline cholinesterase test. Cholinesterase is an important enzyme of the nervous system, and these chemical groups kill pests and potentially injure or kill humans by inhibiting cholinesterase. If one has had a baseline test and later suspects a poisoning, one can identify the extent of the problem by comparison of the current cholinesterase level with the baseline level.

Prevention
Accidental poisonings can be avoided by proper labeling and storage of containers. When handling or applying pesticides, exposure can be significantly reduced by protecting certain parts of the body where the skin shows increased absorption, such as the scrotal region, underarms, face, scalp, and hands. Using chemical-resistant gloves has been shown to reduce contamination by 33-86%.

Treatment
Specific treatments for acute pesticide poisoning are often dependent on the pesticide or class of pesticide responsible for the poisoning. However, there are basic management techniques that are applicable to most acute poisonings, including skin decontamination, airway protection, gastrointestinal decontamination, and seizure treatment.

Decontamination of the skin is performed while other life-saving measures are taking place. Clothing is removed, the patient is showered with soap and water, and the hair is shampooed to remove chemicals from the skin and hair. The eyes are flushed with water for 10–15 minutes. The patient is intubated and oxygen administered, if necessary. In more severe cases, pulmonary ventilation must sometimes be supported mechanically. Seizures are typically managed with lorazepam, phenytoin and phenobarbitol, or diazepam (particularly for organochlorine poisonings).

Gastric lavage is not recommended to be used routinely in pesticide poisoning management, as clinical benefit has not been confirmed in controlled studies; it is indicated only when the patient has ingested a potentially life-threatening amount of poison and presents within 60 minutes of ingestion. An orogastric tube is inserted and the stomach is flushed with saline to try to remove the poison. If the patient is neurologically impaired, a cuffed endotracheal tube inserted beforehand for airway protection. Studies of poison recovery at 60 minutes have shown recovery of 8%-32%.

However, there is also evidence that lavage may flush the material into the small intestine, increasing absorption. Lavage is contra-indicated in cases of hydrocarbon ingestion.

Activated Charcoal
Activated charcoal is sometimes administered as it has been shown to be successful with some pesticides. Studies have shown that it can reduce the amount absorbed if given within 60 minutes, though there is not enough data to determine if it is effective if time from ingestion is prolonged. Syrup of ipecac is no longer recommended for most pesticide poisonings. Urinary alkalinization has been used in acute poisonings from chlorophenoxy herbicides (such as 2,4-D, MCPA, 2,4,5-T and mecoprop) however evidence to support its use is poor.

Epidemiology
Acute pesticide poisoning is a large-scale problem, especially in developing countries. "Most estimates concerning the extent of acute pesticide poisoning have been based on data from hospital admissions which would include only the more serious cases. The latest estimate by a WHO task group indicates that there may be 1 million serious unintentional poisonings each year and in addition 2 million people hospitalized for suicide attempts with pesticides. This necessarily reflects only a fraction of the real problem. On the basis of a survey of self-reported minor poisoning carried out in the Asian region, it is estimated that there could be as many as 25 million agricultural workers in the developing world suffering an episode of poisoning each year." Estimating the numbers of chronic poisonings worldwide is more difficult.

All agricultural employers whose workers perform hand labor operations in fields, forests, nurseries, and greenhouses treated with pesticides, and handle pesticides in these locations are covered by the U.S. Environmental Protection Agency's worker protection standard revised 2005.

Agricultural employers must be in full compliance with this regulation before April 15, 1994. Additionally, owners, operators, and their immediate family members must comply with some of the provisions of this standard. This supplement to *“A Summary of Federal Laws and Regulations Affecting Agricultural Employers,”* summarizes this regulation.

Agricultural employers must be in full compliance with the U.S. Environmental Protection Agency's (EPA) 2005 worker protection standard. This standard, which became effective on October 20, 1992, revises EPA's 1974 worker protection standard. Precise estimates of the number of workers and handlers who will be covered by the WPS are unknown, but the EPA estimates that nearly 4 million owners, operators, family members, hired workers and handlers could be affected.

The WPS covers every agricultural employer, including livestock producers, who have employees that perform hand labor operations in fields, forests, nurseries, and greenhouses treated with pesticides.

Unlike other laws and regulations affecting agricultural labor, the WPS does not exempt any employment in commercial agriculture involving hand labor in fields, but owners or operators and immediate family members are specifically exempt from some provisions. The WPS expands coverage to include more employees and expands employers' requirements for training employees who handle pesticides, protecting employees from pesticide exposure, and providing emergency assistance to exposed employees. Although many laws affecting agricultural employment exempt farming enterprises that employ small numbers of hired farmworkers, the new standard has no exemptions based on the number of employees.

Employers covered by the WPS must:
Reduce overall exposure to pesticides by prohibiting handlers from exposing workers during pesticide application, excluding workers from areas being treated and areas under a restricted entry interval, and notifying workers about treated areas. Some activities are allowed during restricted entry intervals if workers are properly trained and protected.

Mitigate exposures by requiring decontamination supplies be present and emergency assistance be available.

Inform workers about pesticide hazards by requiring safety training (workers and handlers), safety posters, access to labeling information, and access to specific information (listing of treated areas on the establishment).

WPS provisions are very complicated and are likely to affect a large number of employers and their workers. States may also issue worker protection standards that are stricter than the WPS.

Therefore, employers should contact their State agency that regulates the Federal Insecticide, Fungicide, and Rodenticide Act in cooperation with the EPA to determine whether they must comply with the WPS and local regulations. Nothing in this report replaces technical and professional legal advice.

Background
The Federal Insecticide, Fungicide, and Rodenticide Act (**FIFRA**) of 1947, as amended, sets an overall risk/benefit standard for pesticide registration, requiring that all pesticides perform their intended function, when used according to labeling directions, without imposing unreasonable risks of adverse effects on human health or the environment (Runyan, 1992).

During the congressional discussion of FIFRA amendments in 1972, the Senate Committee on Agriculture and Forestry (Committee) "*found protection of man and the environment to be a broad term encompassing farmers, farmworkers, and others who come into contact with pesticides...*" (57 FR 38102).

The Committee further found "that the bill [The Federal Environmental Pesticide Control Act of 1972 (FEPCA)] requires the Administrator to require that the labeling and classification of pesticides be such as to protect farmers, farmworkers, and others coming in contact with pesticides or pesticide residues" (57 FR 38102).

Given the above mandate, the EPA issued regulations in 1974 dealing with pesticide-related occupational safety and health of workers performing hand labor operations in fields during and after application of pesticides (40 CFR).

Pesticide Security Alert

Pesticide Safety and Site Security
The Environmental Protection Agency is issuing this *Alert* to all pesticide industry organizations, facilities, and handlers as a precaution during this heightened state of security awareness. This *Alert* highlights some general security areas that companies may want to review to ensure that appropriate measures are being implemented. The EPA's Office of Pesticide Programs has developed this tailored summary of the Agency's Chemical Safety Alert entitled, "*Chemical Accident Prevention: Site Security*," which outlines measures to ensure secure and accident-free operations.

It is important that all pesticide establishments review this information and take appropriate steps to minimize risk. This document does not substitute for the EPA's regulations, nor is it a regulation itself. It cannot and does not impose legally binding requirements on the EPA or the regulated community, and measures it describes may not apply to a particular situation based upon circumstances. The Agency may continue to provide further guidance in the future, as appropriate.

Knowing and Understanding Potential Security Threats
Businesses that manufacture, reformulate, sell, distribute, transport, store, or apply pesticides have long known the importance of risk mitigation steps for the safety of their workers, their customers, and their communities.

For manufacturers and reformulators, efforts focus on ensuring that the facility is operated safely on a day-to-day basis. Manufacturers must use well-designed equipment, conduct preventive maintenance, implement up-to-date operating procedures, and employ well-trained staff. Those who distribute pesticides have focused on safe storage and accurate labeling of their products.

For the pesticide user community, safety efforts have focused on strictly reading and following all label directions. Today, these efforts aren't necessarily enough. While many of the steps to ensure an effective security program seem routine, they are *critical* to the health and safety of your business, facility, and community. Without effective security procedures, your business may be vulnerable to both internal and external threats, posing risks to yourself and employees, your building and machinery, stored pesticides, and even sensitive business information. If you have mobile pest application equipment, particularly aerial application equipment, special precautions should be taken to protect both your equipment and the surrounding community.

Recommended Considerations in Evaluating Pesticide Security
The security needs and critical control points will differ for every business and facility. However, some of the fundamental security control points include:

- **Securing Buildings, Manufacturing Facilities, Storage Areas, and Surrounding Property:** One of the most fundamental security needs is the prevention of intrusion to areas used to manufacture or store pesticides and other toxic pesticides or chemicals. Elements of an effective security plan can range from basic fencing, lighting, and locks, to intrusion detection systems, cameras, and trained guards.

- **Securing Pesticide Application Equipment and Vehicles:** Facilities and pesticide businesses should ensure that they have appropriate security protection to prevent intruder access to equipment used in mixing, loading, and applying pesticides. Before operating pesticide application tools and vehicles, handlers must have proper authorization and identification.

- **Aerial Application Equipment:** Security awareness is particularly important for large-scale pesticide application equipment like aircraft and large trucks. The FBI has requested that aerial applicators be vigilant to any suspicious activity relative to the use, training in, or acquisition of dangerous pesticides or chemicals or airborne application of the same, including threats, unusual purchases, suspicious behavior by employees or customers, and unusual contacts with the public. Any suspicious circumstances or information should be reported to the FBI.

- **Protecting Confidential Information:** As business, safety, and security systems become more reliant on computer and communications technology, the need to secure these systems has grown. Such efforts include contingency planning for power losses, effective monitoring of access ports, adherence to password and backup procedures, and other mechanisms to maintain access for authorized personnel only.

- **Designing Facilities and Equipment to Minimize Risk of Damage:** Whether an intrusion to a computer by a hacker or a physical intrusion of your facility by a vandal or saboteur, it is important to take steps to minimize the extent of damage. For example, in order to prevent damage, the use of sturdy, reliable, and potentially blast-proof materials is essential in the construction of equipment used to transport and apply pesticides.

- **Developing Procedures and Policies that Support Security Needs:** Even the best hardware and staffing budgets are only as effective as the procedures and policies that control their use.

- Effective hiring and labor relations policies are important to obtain and retain good employees who will support and follow safety precautions. For example, the hiring process should ensure that pesticide handlers have all requisite training necessary to handle pesticides safely. Background checks of staff that have access to secure areas, particularly those areas where pesticides may be stored, are also necessary.

- Inventory management policies can help limit the amount of potentially hazardous pesticides stored on site, reducing the risks of accidental or intentional release or theft.

- Effective advance emergency response procedures can be critical, helping ensure that business officials and employees understand how to respond and whom to contact in the case of an emergency. Aside from accidents, such plans must also consider vandalism, bomb threats, and potential terrorist activity.

Cooperation with Security Authorities

Because of terrorism, pesticides and the possibilities of someone using pesticides to injure others is covered by new security related rules.

If a breach of security or suspicious activity does occur, timely cooperation with authorities is crucial. In addition to cooperation with your local police department, the FBI requests that you expeditiously report any threats or suspicious behavior to your local FBI field office.

These agencies also must be informed if, as a registrant, you are made aware of any reports of adverse exposure under circumstances that are incongruous with your pesticide product's normal use pattern. Information on the location of the appropriate FBI office is available at www.fbi.gov.

For More Information

The EPA and other Federal agencies have developed a variety of reference materials that may be helpful in reviewing the security of your business or operation.

- Many of the tips listed in this fact sheet are described in more detail in the Chemical Safety Alert entitled: A Chemical Accident Prevention: Site Security, @ published by the EPA on February 2000 and available on the EPA Web site at: www.epa.gov/
- For information on other Agency programs to promote facility security and readiness, visit http://www.epa.gov/
- DOT has produced a separate advisory for transporters, available by contacting DOT at 202-366-6525.

For objective science-based information about a variety of pesticide-related subjects, including pesticide products, recognition and management of pesticide poisonings, toxicology, and environmental chemistry, contact the National Pesticide Information Center (NPIC). NPIC, a toll-free hotline funded, in part, by the EPA, lists state pesticide regulatory agencies and provides links to their Web sites.

NPIC can be contacted at: 1-800-858-7378, by e-mail at npic@ace.orst.edu, or by visiting the Web at: http://npic.orst.edu/. Pesticide is any substance or mixture of substances intended for preventing, destroying, repelling, or mitigating any pest.

Pests can be insects, mice and other animals, unwanted plants (weeds), fungi, or microorganisms like bacteria and viruses. Though often misunderstood to refer only to *insecticides*, the term pesticide also applies to herbicides, fungicides, and various other substances used to control pests. Under United States law, a pesticide is also any substance or mixture of substances intended for use as a plant regulator, defoliant, or desiccant.

CATEGORY	NONREFILLABLE CONTAINERS	REFILLABLE CONTAINERS	REPACKING PESTICIDE PRODUCTS	CONTAINER LABELING	CONTAINMENT STRUCTURES
WHO MUST COMPLY	REGISTRANTS	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS PESTICIDE USERS (Must Follow New Directions)	AG RETAILERS AG COMMERCIAL APPLICATORS AG CUSTOM BLENDERS
MAJOR REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • CONTAINER DISPENSING CAPABILITY • STANDARD CLOSURES • RESIDUAL REMOVAL • RECORDKEEPING	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• IDENTIFY CONTAINER AS NONREFILLABLE OR FILLABLE (All) • STATEMENTS TO PROHIBIT REUSE AND OFFER FOR RECYCLING; BATCH CODE (All Nonrefillables) • CLEANING INSTRUCTIONS • CLEANING INSTRUCTONS BEFORE FINAL DISPOSAL	•SECONDARY CONTAINMENT STRUCTURES (Dikes) AROUND STATIONARY TANKS •CONTAINMENT PADS FOR PESTICIDE DISPENSING AREAS •GOOD OPERATING PROCEDURES •MONTHLY INSPECTION OF TANKS AND STRUCTURES •RECORDKEEPING
COMPLIANCE DATE	AUGUST 17, 2009	AUGUST 17, 2011	AUGUST 17, 2011	AUGUST 16, 2011 (Based on the October 8, 2010 Final Rule)	AUGUST 17, 2009

PESTICIDE CONTAINER AND CONTAINMENT RULE

Technical Learning College

Federal Pesticide Recordkeeping Requirements

Questions and Answers
Final regulations to implement requirements in section 1491 of the Food, Agriculture, Conservation, and Trade (**FACT**) Act of 1990, commonly referred to as the 1990 Farm Bill, went into effect **May 10, 1993.** On February 10, 1995 amendments to the regulations were published, which become effective on May 11, 1995. The regulations are administered by the U.S. Department of Agriculture's Agricultural Marketing Service (**AMS**).

Why are there regulations for restricted use pesticide recordkeeping for certified private applicators? The FACT Act of 1990, subtitle H, section 1491, states that the Secretary of Agriculture, in consultation with the Administrator of the Environmental Protection Agency (**EPA**), ***"shall require certified applicators of restricted use pesticides..... to maintain records comparable to records maintained by commercial applicators of pesticides in each State."*** Certified applicators include both commercial and private applicators.

The EPA currently requires certified commercial applicators to keep records under regulations implementing the Federal Insecticide, Fungicide, and Rodenticide Act (**FIFRA**). The EPA is prohibited from requiring certified private applicators to maintain records. However, some individual States require certified private applicators to maintain records.

Do the regulations apply to all pesticide applications? No. The regulations only require recordkeeping for applications of federally-restricted use pesticides. Pesticides are classified as restricted use, general use, or for both uses.

Is a Federal form required for maintaining the record(s)? No. The regulations do not require the use of a standardized form. This allows applicators the flexibility to fit the recordkeeping requirements into their current recordkeeping scheme.

What information is a certified private applicator required to maintain on a restricted use pesticide application? The recordkeeping requirements are:

1. The brand or product name, and the EPA registration number of the restricted use pesticide that was applied;
2. The total amount of the restricted use pesticide applied;
3. The location of the application, the size of area treated, and the crop, commodity, stored product, or site to which a restricted use pesticide was applied;
4. The month, day, and year when the restricted use pesticide application occurred; and
5. The name and certification number (if applicable) of the certified applicator who applied or who supervised the application of the restricted use pesticide.

When does the pesticide application information have to be recorded? The information required shall be recorded within 14 days following the pesticide application.

How long are records required to be kept? Restricted use pesticide records must be retained by the applicator for 2 years from the date of application and made available to individuals who are authorized to have access to the record information. Certified applicators have no reporting requirements under the regulations.

Who has authorization to obtain record information from the certified applicator? Individuals representing the Secretary of Agriculture or the State designated agency, which is most commonly the State Department of Agriculture. Also the attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, is authorized access to record information when it is determined the information is needed to provide medical treatment or first aid to an individual who may have been exposed to the restricted use pesticide for which the record is maintained.

Are there any penalties for violation of the Federal pesticide recordkeeping requirements? Yes. Any certified applicator who violates the requirements shall be subject to a civil penalty of not more than $500 in the case of the first offense, and shall be subject to a civil penalty of not less than $1000 for each violation for subsequent offenses, except that the civil penalty shall be less than $1000 if the Administrator determines that the certified applicator made a good faith effort to comply.

Amendments to Regulations

1. **Change in the way the location of a "spot application" is recorded.**
   A" spot application" is an application(s) of a restricted use pesticide made on the same day in a total area of less than one-tenth of an acre. This provision still does not apply to records maintained for greenhouse and nursery applications. The regulations were amended to require a more detailed description of the location of a ***"spot application."*** Spot applications must be recorded with the following information: Brand or product name and EPA registration number; total amount applied; location must be designated as ***"spot application,"*** followed by a concise description of the location (**Examples:** Spot application, noxious weeds were spot sprayed throughout field number 5 and 6. Spot application, sprayed for weeds next to the silo); and month, day, and year of application.
2. **Shortened the time period to make a record of the restricted use pesticide application.** The time period was reduced from 30 days to 14 days for the required information to be legibly recorded following the restricted use pesticide application. However, whether or not the written record has been completed, the certified applicator shall provide the record information for medical treatment or first aid.
3. **Change in the definition of a medical emergency.**
   A medical emergency is defined as a situation that requires immediate medical treatment or first aid to treat possible symptoms of pesticide poisoning or exposure.
4. **Change in the definition of a licensed health care professional.**
   A licensed health care professional is defined as a physician, nurse, emergency medical technician, or other qualified individual, licensed or certified by a State to provide medical treatment.
5. **Change in accessing records to facilitate medical treatment.**
   When the attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, determines that any record of the application of any restricted use pesticide required to be maintained is necessary to provide medical treatment or first aid to an individual who may have been exposed to the restricted use pesticide for which the record is or will be maintained, the certified applicator required to maintain the record shall promptly provide the record information and any available label information.

Topic 2 – Proper Pesticide Handling Section Post Quiz

Preparing to Apply Pesticides Preparation is essential for chemical safety. Follow the steps below to properly prepare for pesticide application:

Select Appropriate Personal Protective Equipment
1. Regardless of the pesticide's toxicity; always wear a long-sleeve shirt and pants when working with pesticides. Wear additional protective equipment, as necessary. Inspect all PPE before each use for leaks, holes, tears, or worn places. Repair or discard any damaged equipment.
True or False

Transporting Pesticides
2. Pesticides can present a particularly mild hazard if they are involved in accidents during transportation.
True or False

Work in a Safe Area
3. Which missing term should be well ventilated, well lighted, and downhill from any water sources?

Measure Chemicals Correctly
4. It is permissible to use more chemical than prescribed by the pesticide label.
True or False

Rinsing Helps Protect the Environment
5. Prevention of which missing term is always better than cleanup.

Ready-to-Use Low-Concentrate Solutions (RTU)
6. Low-concentrate formulations are ready to use and require no further dilution before application.
True or False

Ultra-low Volume (ULV)
7. These concentrates may approach which percentage of active ingredient?

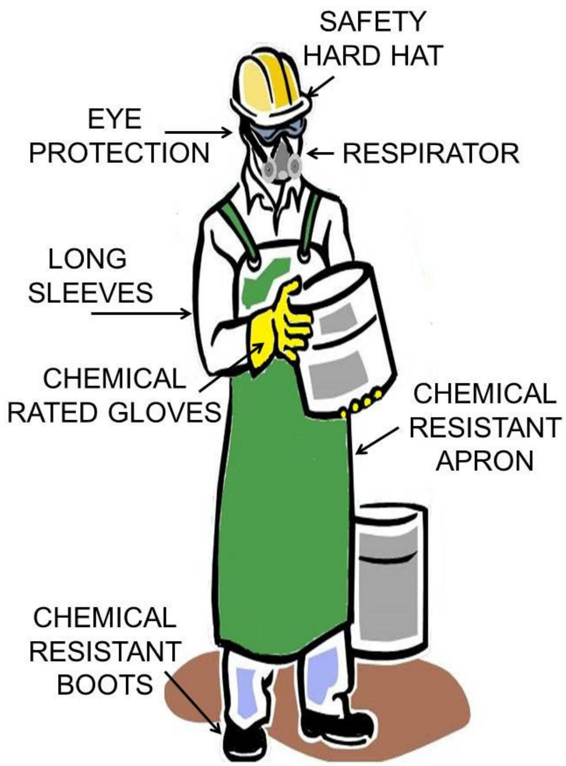
Restricted-Entry Interval (REI)
8. When two (or more) pesticides are applied at the same time, and have different REIs, you must follow the shortest interval.
True or False

WPS Requires Providing Decontamination Sites
9. Employers must establish a decontamination site for all workers and handlers for washing off pesticides and pesticide residues. A decontamination site must be within which distance of the employees' work site.

Activated Charcoal
10. Syrup of ipecac is no longer recommended for most pesticide poisonings.

Topic 3 – Personal Protection (PPE) Section

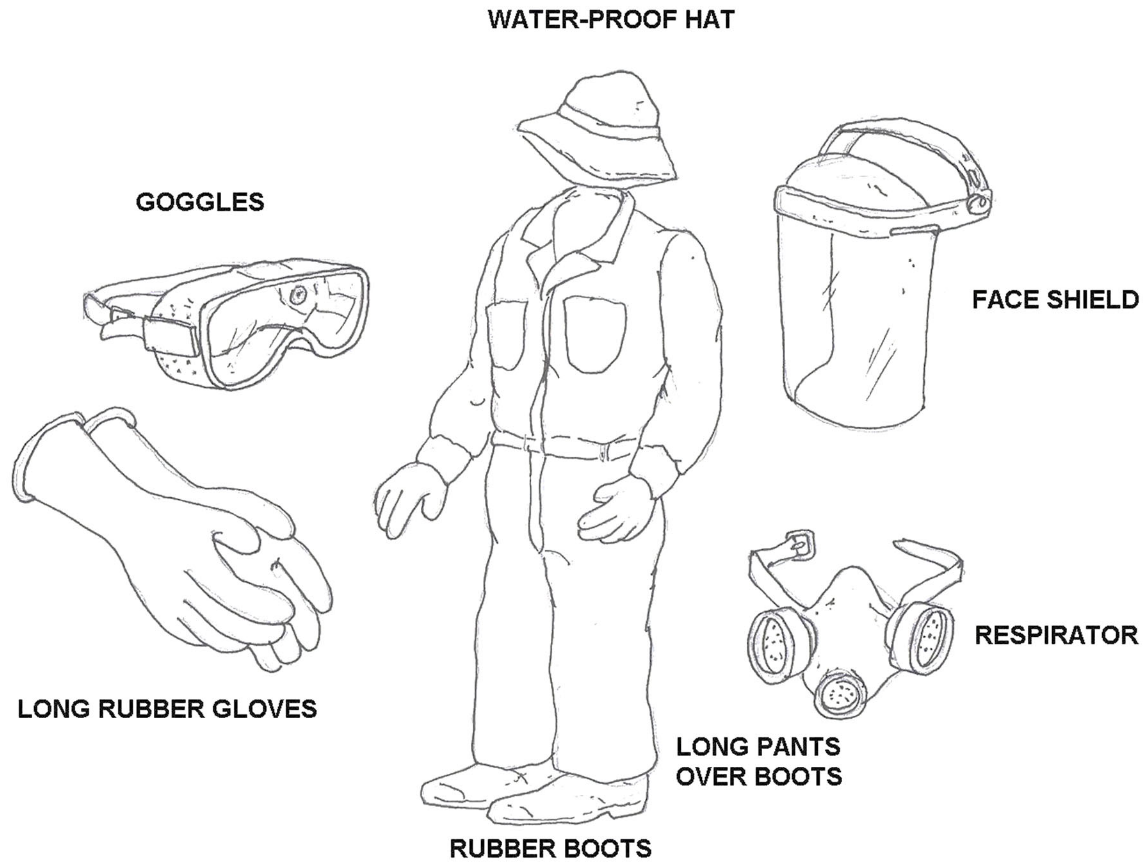
Topic 3 - Section Focus: You will learn the basics of personal safety –personal protection equipment including respiratory protection and emergency procedures. At the end of this section, the student will be able to understand and describe emergency procedures of dealing with pesticides and proper personal protection equipment, rules and proper PPE usage. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.



Topic Scope: Most of this section will come from the Agricultural Worker Protection Standard (WPS) but it is an excellent standard for structural pesticide usage.

It is common to see PCA's and pesticide handlers suing pesticide and herbicide manufacturers because these people have developed cancer and other diseases. The bottom line is the pesticides are toxic and will slowly kill you over time without proper personal protection.

Take the time and wear the proper PPE. Document everything you do. If you are not an agricultural pesticide worker, follow the new WPS. The WPS was designed for agricultural workers' safety but the information should apply to structural pesticide applicators. If your company will not follow or provide basic PPE, then you need to make a choice, purchase your own equipment or find a different career. When selecting personal protective equipment (PPE) for yourself or your employees who are applying pesticides, the label on the pesticide is your main source of information. Unlike most other types of product labels, pesticide labels are legally enforceable. In other words, the label is the law!



REQUIRED PPE EQUIPMENT DIAGRAM #2

Authors' Commentary

In our pesticide application experience, safety was always inadequate and yet our management said that our safety procedures were adequate. The pesticide manufactures said not to worry so much. We as PAs were ignorant of the dangers of pesticide exposure. There we many times that our clothes and boots were covered in pesticides and we would eat food with unwashed hands. We would wash our clothes with the normal household laundry. We would mix and spray chemicals without any respiratory protection. We never had any medical monitoring of any sort. If we had respiratory protection, it was inadequate. Many times, we lacked faceshields and RP for termitidor pumping application.

Need for Personal Protection Equipment (PPE)

Pesticides pose hazards to humans and our environment. The severity of a harmful effect or poisoning depends on the pesticide's chemical formulation, and the pesticide's path into the body, the amount that enters the body, and the length of exposure. Wearing proper Personal Protective Equipment, or "PPE", can greatly reduce the potential for dermal, inhalation, eye, and oral exposure, and thereby significantly reduce the chances of a pesticide poisoning.

"PPE" refers to clothing and devices worn to protect the human body from contact with pesticides or pesticide residues. PPE includes such items as protective suits, footwear, gloves, aprons, respirators, eyewear, and headgear. We will go into detail on these concerns.

When purchasing and prior to using a pesticide product, it is essential that you ***read and understand*** all portions of the pesticide product label. You are legally obligated to follow the instructions and requirements on the label. The label is the law, AND it contains vital information about the use, safety and handling of the product. We recommend that you document all of your actions daily to protect yourself years down the road.

Carefully review the signal word, precautionary statements, personal protective equipment requirements, entry restriction statements, emergency first aid measures, and directions for use – they are included to protect you, others, and the environment. We will master each of these instructions and signal words in this course.

Different pesticide products require different personal protective equipment. Remember that any product that contains a pesticide – including baits, aerosols, fertilizers, seed, "natural" products, etc. – must be handled using the required PPE, in the correct way. In addition, there are basic PPE principles and practices that must be understood to protect the health and safety of everyone involved in handling a pesticide.

§170.240 Personal Protective Equipment

(a) *Requirement.* Any person who performs tasks as a pesticide handler shall use the clothing and personal protective equipment specified on the labeling for use of the product.

(b) *Definition.*
(1) Personal protective equipment (PPE) means devices and apparel that are worn to protect the body from contact with pesticides or pesticide residues, including, but not limited to, coveralls, chemical-resistant suits, chemical-resistant gloves, chemical-resistant footwear, respiratory protection devices, chemical-resistant aprons, chemical-resistant headgear, and protective eyewear.

(2) Long-sleeved shirts, short-sleeved shirts, long pants, short pants, shoes, socks, and other items of work clothing are not considered personal protective equipment for the purposes of this section and are not subject to the requirements of this section, although pesticide labeling may require that such work clothing be worn during some activities.

Before we start, we will examine the Safety Data Sheet (formerly MSDS)
There is a Safety Data Sheet (SDS) for every pesticide product, most of the time, you can find one attached to the product. The SDS provides details on the effects of acute (very short-term or one-time) exposure to the pesticide, as well as information on dermal and inhalation toxicity and eye irritation.

The SDS contains data on any birth defects, cancer, or reproductive impairments indicated in laboratory studies. The toxicological information summarized in an SDS forms the basis for label requirements specifying certain protective clothing and equipment. SDS's are prepared for all product formulations, but few manufacturers write SDS's for end-use dilutions.

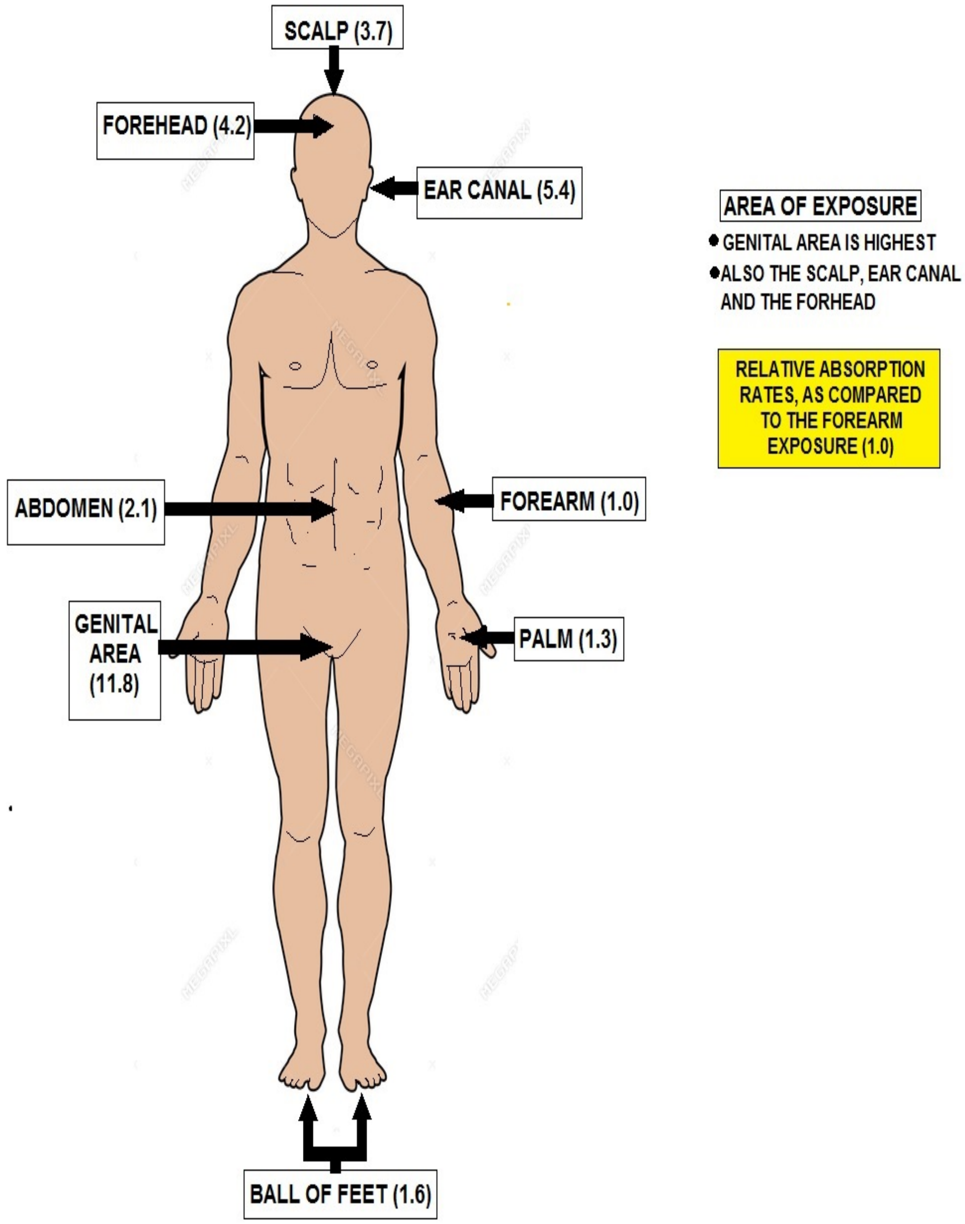
The SDS provides information on possible adverse health effects linked to chronic exposure (multiple exposures, over time) to the product. Information on cancer, birth defects, and other potential chronic effects, if any, is included in the SDS.

While the short-term effects of a pesticide may be minimal, requiring only basic PPE, its cumulative, long-term effects may necessitate label language specifying more sophisticated equipment.

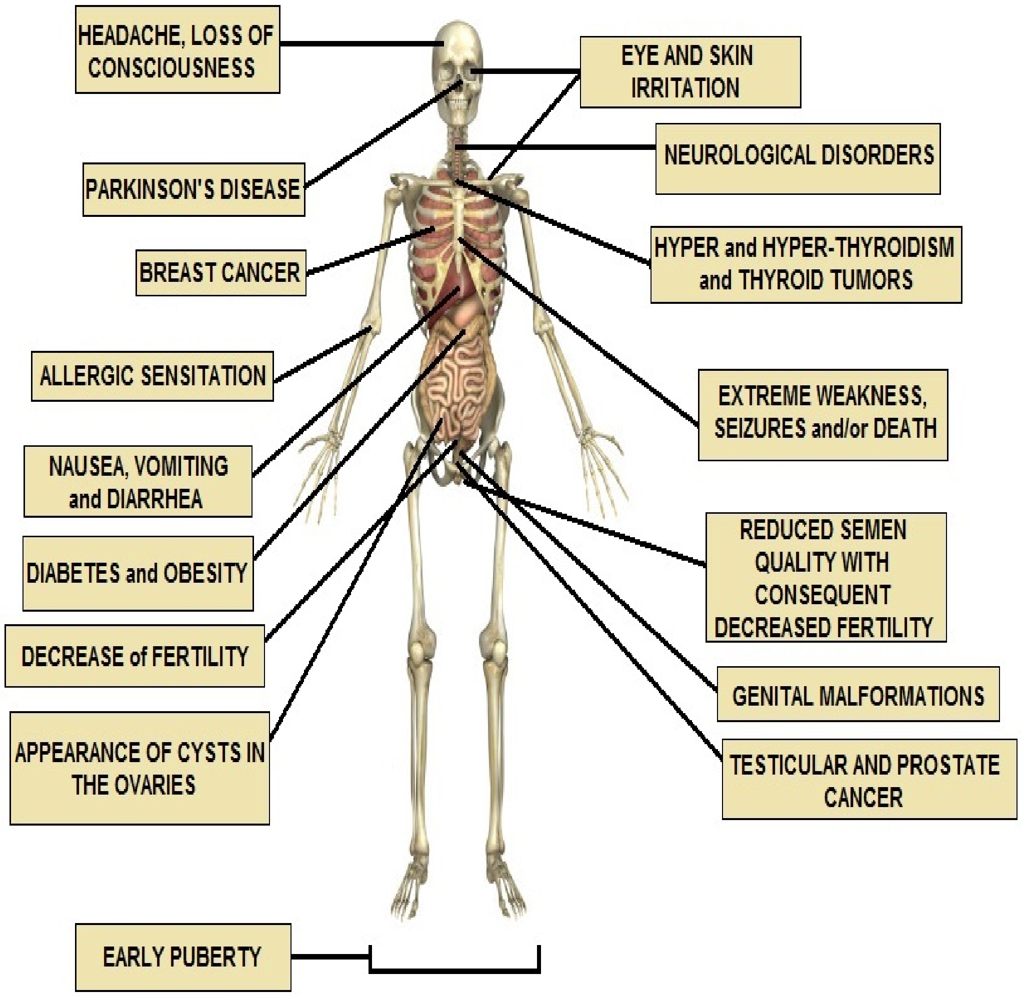
Employee attitudes about personal safety and PPE for pesticide use often reflect the views of co-workers and supervisors. Companies that emphasize pesticide safety and consistent use of appropriate PPE are less likely to jeopardize their employees' health and corporate profits—and less likely to face pesticide-related lawsuits and penalties for noncompliance. On-the-job training, hands-on demonstrations, work evaluations, and compliance checks by supervisors can stimulate consistent use of PPE.

A company's commitment to pesticide safety is a key factor in whether or not its use of a given product constitutes risk.

Applicators who have PPE available and have been trained to use it properly can minimize exposure, thus protecting their health and that of their coworkers regardless of the product's toxicity.



ABSORPTION RATES OF PESTICIDE EXPOSURE



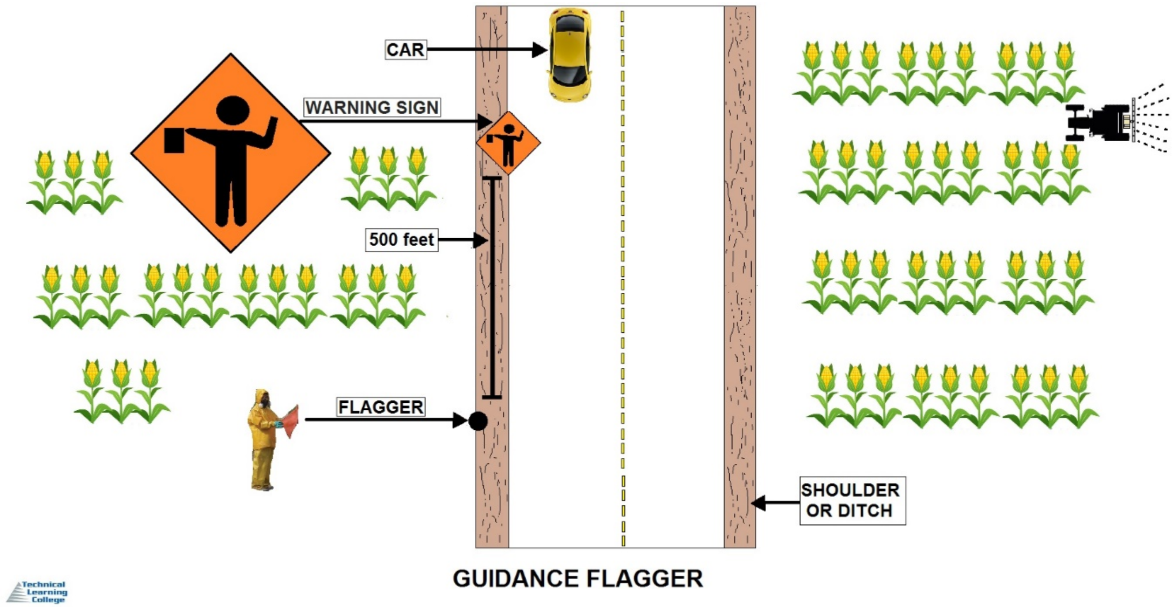
TOXIC IMPACT OF PESTICIDES ON HUMAN BODY

	GLOVES	HARD HAT	APRON	COVERALLS	RESPIRATOR	FOOTWEAR	PROTECTIVE EYEWEAR
MIXING / LOADING	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
ENCLOSED CAB	NO	NO	NO	NO	NO	SHOES + SOCKS	NO
OPEN CAB	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
CLEANOUT	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO

PESTICIDE HANDLING SAFETY REFERENCE (PPE)

Pesticide Application - Preparation and PPE Sub-Section

Follow the steps below to properly prepare for pesticide application all of this information is is essential for chemical safety.



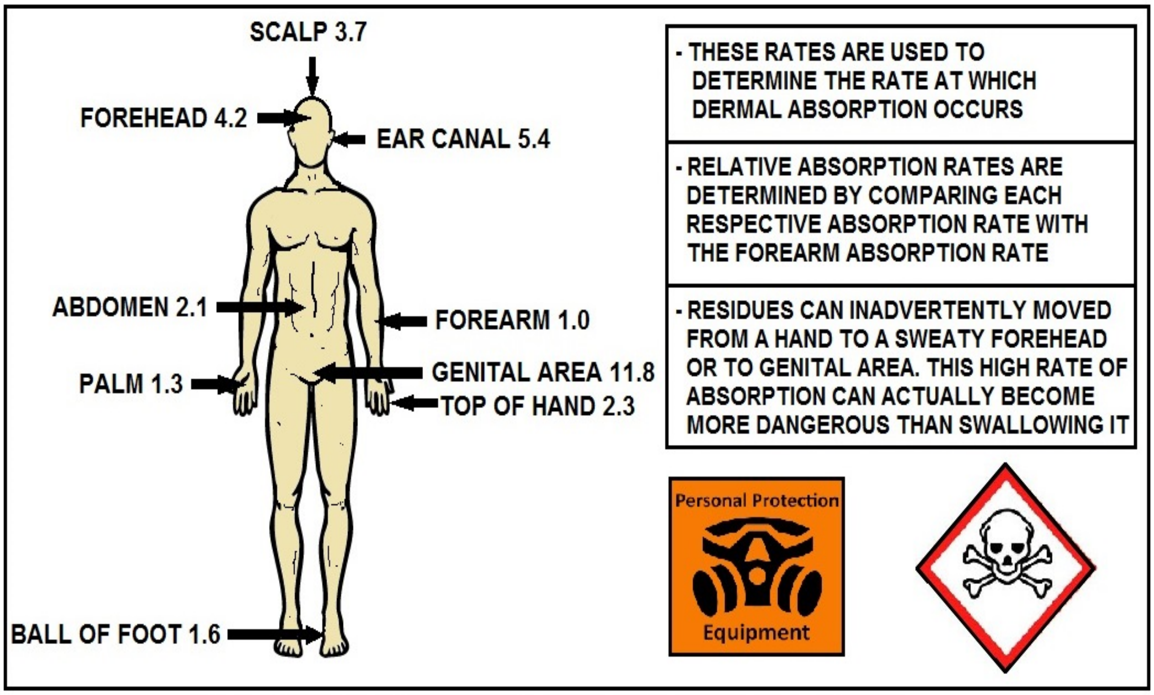
A. Plan Ahead
Always read chemical labels before attempting to work with pesticides. Prepare for a possible emergency by maintaining a personal decontamination site, a chemical spill kit, and by knowing the proper first aid procedures associated with your pesticide.

B. Move Pesticides Safely
Careless chemical transportation can cause spills and contamination. Do not carry pesticides in an enclosed area, such as a car. Be sure to secure the pesticides to prevent shifting or bouncing. In addition, never leave your vehicle unattended when transporting chemicals.

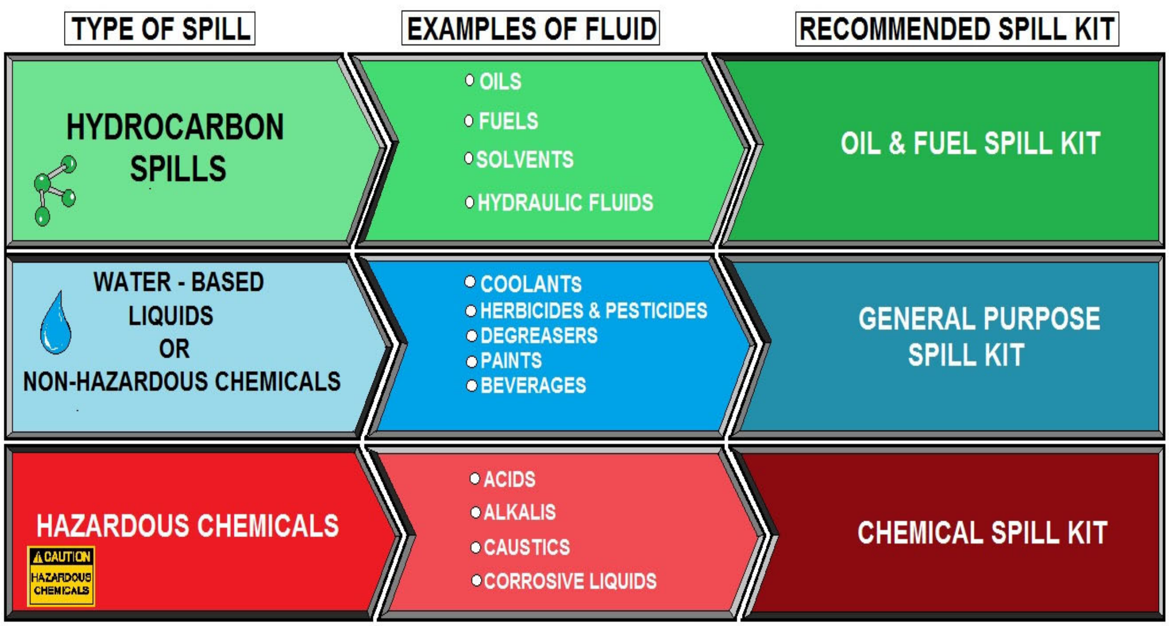
C. Select Application Equipment
Choose suitable equipment to properly apply pesticides. Before using the equipment, inspect it for good working order.

D. Select Appropriate Personal Protective Equipment
Regardless of the pesticide's toxicity; always wear a long-sleeve shirt and pants when working with pesticides. Wear additional protective equipment, as necessary. Inspect all PPE before each use for leaks, holes, tears, or worn places. Repair or discard any damaged equipment.

E. Provide Prior Notification
Prior to applying pesticides, inform all people in or around the application area. Notification allows people to protect themselves from harmful chemicals.



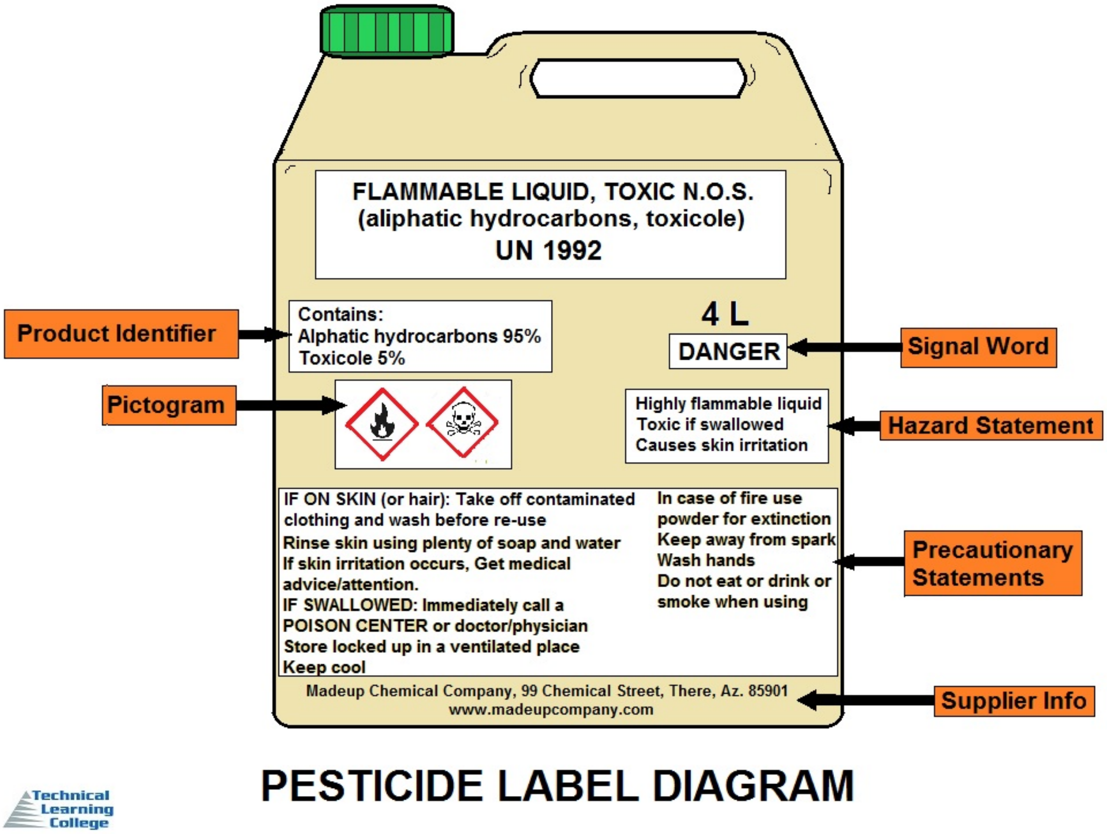
RATES OF PESTICIDE EXPOSURE THROUGH THE SKIN



CHEMICAL SPILL CLEAN-UP CRITERIA

Pesticide Label Introduction - Breakdown

The following is a quick review of the label. We will cover this area more in detail in the Hazard Communication section. The label will explain what PPE you will require in use of the product. We will master this section by the end of the course.



Restricted Use Designation
Restricted use chemicals require a pesticide license and will not be in most retail stores and is not meant for homeowner use.

Precautionary Statements
Hazard and precautionary statements that are not required on the front panel may appear on other panels of the label. These statements must appear together on the label under the heading “Precautionary Statements” and under the appropriate subheadings.

Signal Word
The signal word corresponding to the highest/most toxic acute toxicity category to which a pesticide product is assigned must appear on the front panel of the label. Products classified as Toxicity Category I based on acute oral, acute dermal, or acute inhalation hazard; or certain inert ingredients must also include the word “Poison” (in red on a contrasting background color) next to the signal word DANGER, with the skull and crossbones symbol in close proximity.

Personal Protective Equipment
All pesticide handlers—applicators, mixer/loaders, flaggers, and early-entry agricultural workers—are legally required to follow all PPE instructions that appear on the product label. A pesticide label lists the minimum PPE that a person must wear while performing handling or early-entry activities. Once the correct toxicity category has been established, the product-specific handler PPE can be identified.

Hazard = Toxicity x Exposure
The toxicity of a pesticide is a measure of its capacity or ability to cause injury or illness. The toxicity of a particular pesticide is determined by subjecting test animals to varying dosages of the active ingredient (a.i.) and each of its formulated products. The active ingredient is the chemical component in the pesticide product that controls the pest. By understanding the difference in toxicity levels of pesticides, a user can minimize the potential hazard by selecting the pesticide with the lowest toxicity that will control the pest.

Acute Toxicity and Acute Effects
Acute toxicity of a pesticide refers to the chemical's ability to cause injury to a person or animal from a single exposure, generally of short duration. The harmful effects that occur from a single exposure by any route of entry are termed "acute effects." The four routes of exposure are dermal (skin), inhalation (lungs), oral (mouth), and the eyes. Acute toxicity is determined by examining the dermal toxicity, inhalation toxicity, and oral toxicity of test animals. In addition, eye and skin irritation are also examined.

Pesticide Poisoning
Insecticides cause the greatest number of pesticide poisonings in the United States. The most serious pesticide poisonings usually result from acute exposure to organophosphate and carbamate insecticides.

Organophosphate Insecticides
Organophosphate insecticides include chlorpyrifos, diazinon, dimethoate, disulfoton, malathion, methyl parathion, and ethyl parathion. The carbamate compounds include carbaryl, carbofuran, methomyl, and oxamyl. Organophosphates and carbamates inhibit the enzyme cholinesterase, causing a disruption of the nervous system. All life forms with cholinesterase in their nervous system, such as insects, fish, birds, humans, and other mammals, can be poisoned by these chemicals.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. But when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

PPE for Mixing, Handling and Applying Pesticides

ALWAYS WEAR PPE WHEN HANDLING PESTICIDES

Basic PPE
Coveralls and Gloves

The Environmental Protection Agency controls labeling requirements for pesticide products. Manufacturers must provide personal protective equipment guidance for handlers to ensure their safety when mixing, loading, applying, or otherwise handling pesticides. Some of this information may be confusing. For instance, what does the label mean when it specifies "chemical-resistant" protective clothing?

Chemical-resistant materials prevent the measurable movement of certain chemicals through the material to your skin for a limited period of time.

Although material can be chemical-resistant, there is not a material that is entirely chemical proof. If the label refers to a chemical-resistance category (A – H), choose the material that best matches the length of time you will be handling the pesticide or the time before you change into a new pair of gloves, for instance, before you reach the resistance time limit for the material. The resistance categories are based on the solvents used in the pesticides, not the active ingredients. Different formulations of the same pesticide may require personal protective equipment from different chemical-resistance categories.

Chemical-Resistant Gloves

The pesticide label will often provide recommendations for a type of glove in the PPE section. Waterproof gloves are not necessarily chemical resistant.

Chemical-resistant gloves with non-separate liners (i.e., flocking) are prohibited.

You may wear shorter cotton gloves underneath the chemical-resistant ones, but they must be disposed of immediately upon contact with liquid. In addition, the cotton liners must be disposed of after 10 hours of use or within 24 hours from when they are first worn. Never wear cotton, leather, or canvas gloves unless the label specifically requires that type (for example, for aluminum phosphide fumigants).

Chemical-resistant coveralls A one- or two-piece suit that the manufacturer specifies to be resistant to certain chemicals. Suits made of butyl rubber, neoprene, PVC, or one of the newer coated and laminated polyethylene fabrics may be appropriate. Generally, greater thickness, bound or sealed seams, and covered zippers and vent holes will increase the protection offered.

These garments are often elasticized at the wrist and ankle. Some are reusable if properly cleaned, and some must be disposed of after a single use. You will be safest and most comfortable in protective clothing that fits. Do not use coveralls made from fabrics such as cotton, polyester, or uncoated, non-woven olefin unless the label specifies “long-sleeved shirt and long pants” or “coverall worn over long-sleeved shirt and long pants.”

Pesticide labels must have signal words, which describe the acute (short-term) toxicity of the formulated pesticide product. The signal word will be one of the following: DANGER/POISON, DANGER, WARNING, or CAUTION.

Products with the DANGER/POISON signal words are the most toxic. Products with the signal word CAUTION are comparatively less toxic. All products must be handled with care.

Chemical-Resistant Footwear

Can be one-piece, pull-on boots made of natural rubber, which may be coated with polyurethane, PVC, or blends, or you may use disposable or reusable shoe covers. Either way, pant legs should be worn outside of the boots to prevent pesticides from entering the footwear. Leather boots or canvas-leather sports shoes should never be worn when handling pesticides. Change shoes when you are finished spraying. Leave your contaminated footwear at work. Chemical-resistant hood or wide-brimmed hat Hats must be rubber-, PVC-, or plastic-coated, either safari-style or wide-brimmed. Hoods must be rubber-, plastic-, or other barrier-coated.

A full hood or helmet that is part of a respirator, like a powered air purifying respirator, is also acceptable if made of chemical-resistant material. Avoid cloth hats or liners that will absorb chemicals. Chemical-resistant apron May be required when mixing and loading pesticide spray tanks or when cleaning equipment. Aprons should be coated on both sides with the resistant material with edges sealed to prevent pesticide absorption and wicking. They should provide full protection of the front of the body from the neck to the knees. A chemical-resistant spray suit may be worn instead of an apron.

Eye Protection

Use the appropriate eye protection level when the label specifies the following:

- Protective eyewear – Use safety glasses with brow, front, and temple protection; a face shield; fully-enclosed goggles; or a full-face respirator.
- Goggles – Use fully-enclosed, chemical-splash-resistant goggles or a full-face respirator.
- Full-face respirator – You must use a tight-fitting, full-face respirator.

Personal Protective Equipment WPS Rule Summary

(i) Personal protective equipment (PPE) means devices and apparel that are worn to protect the body from contact with pesticides or pesticide residues, including, but not limited to, coveralls, chemical- resistant suits, chemical-resistant gloves, chemical-resistant footwear, respiratory protection devices, chemical-resistant aprons, chemical-resistant headgear, and protective eyewear.

(ii) Long-sleeved shirts, short-sleeved shirts, long pants, short pants, shoes, socks, and other items of work clothing are not considered personal protective equipment for the purposes of this section and are not subject to the requirements of this section, although pesticide labeling may require that such work clothing be worn during some activities.

(iii) When "chemical-resistant" personal protective equipment is specified by the product labeling, it shall be made of material that allows no measurable movement of the pesticide being used through the material during use.

(iv) When "waterproof" personal protective equipment is specified by the product labeling, it shall be made of material that allows no measurable movement of water or aqueous solutions through the material during use.

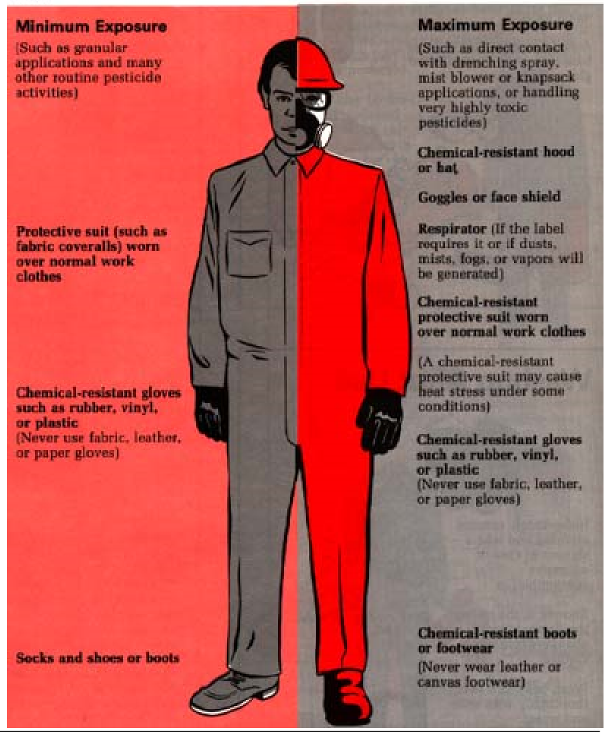
(v) When a "chemical-resistant suit" is specified by the product labeling, it shall be a loose-fitting, one- or two-piece, chemical-resistant garment that covers, at a minimum, the entire body except head, hands, and feet.

(vi) When "coveralls" are specified by the product labeling, they shall be a loose-fitting, one- or two-piece garment, such as a cotton or cotton and polyester coverall, that covers, at a minimum, the entire body except head, hands, and feet. The pesticide product labeling may specify that the coveralls be worn over a layer of clothing. If a chemical-resistant suit is substituted for coveralls, it need not be worn over a layer of clothing.

Handling Concentrates

Dilute Pesticides

You need to decide! Read the label. The formulation, signal word, precautionary statements, personal protective equipment statements, the application method, and the projected length of exposure indicate the personal protective equipment you need.



CARTRIDGE COLOR CODE	COLOR	USED TO PROTECT AGAINST
	BLACK	ORGANIC VAPORS (PESTICIDES) and PAINT SPRAYING
	GREEN	AMMONIA: ANHYDROUS or FROM LIVESTOCK CONFINEMENT
	YELLOW	ACID GASES (i.e: HYDROGEN SULFIDE (H_2S) or CARBON DIOXIDE (CO_2))
	OLIVE	ORGANIC VAPORS, AMMONIA and ACID GASES
	PINK	WELDING FUMES AND DUSTS

CHART SHOWING RESPIRATOR CARTRIDGES THAT CAN BE USED IN PESTICIDE APPLICATIONS
(Color Coding to show specific use)

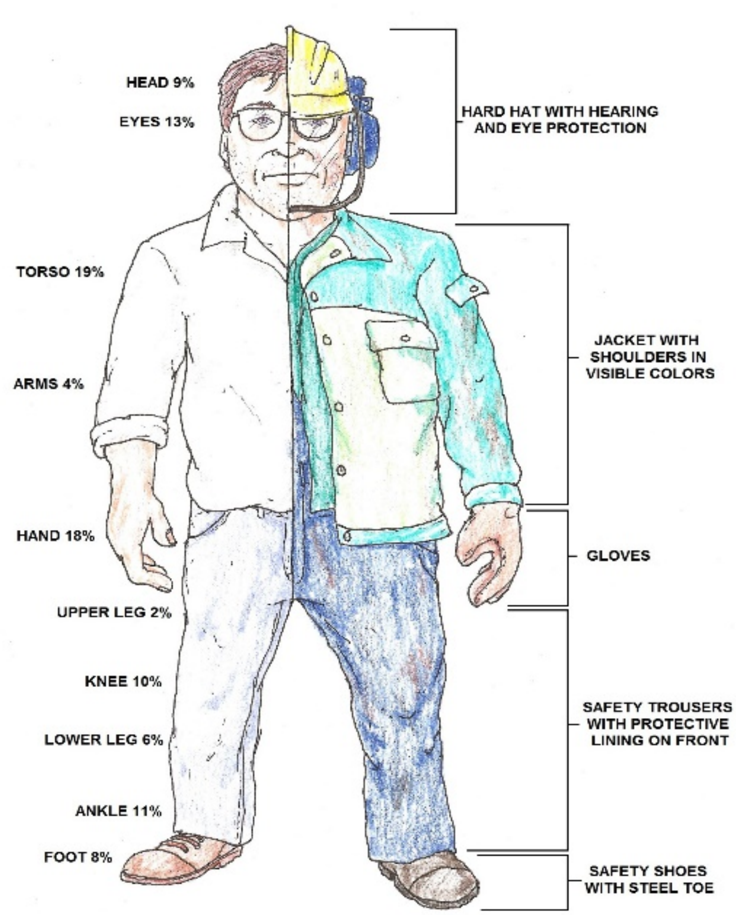
Personal Protective Equipment (PPE) Requirements

One of the changes that happened as a direct result of implementing the WPS regulation is that protective clothing requirements are more clearly and completely listed on product labels. Each product label should list the specific PPE to be worn when the product is being used or when the potential for exposure to the product exists. Most labels now include the protective clothing requirements outside of the "Agricultural Use Requirements" section. As a result, even those who are exempt from the WPS must wear the protective clothing listed.

Employers must supply handlers with personal protective equipment (PPE) as required by the pesticide label. All PPE should be stored in an area separate from pesticides.

PPE should be well maintained, frequently cleaned, and checked for wear. Employers are responsible for making sure handlers wear the proper PPE.

When the PPE requirement falls under the WPS, the employer has the following responsibilities:



PERSONAL PROTECTIVE EQUIPMENT

1. Provide PPE to each early entry worker or handler.
2. Clean and maintain PPE.
3. Make sure that each person wears and uses PPE correctly.
4. Provide each person with a clean place to put on, take off, and store PPE.
5. Take action, if necessary, to prevent heat-related illness while PPE is being worn.
6. Provide soap, single-use towels, and water to each person at the end of any handling activity when PPE is removed.
7. Prevent any person from wearing or taking home contaminated PPE, unless proper instructions have been given regarding the washing and care of PPE.
The type of PPE needed depends on the specific application and the type equipment being used. Although every pesticide is different and the label should be consulted to determine the PPE requirements for each chemical, some general rules apply for choosing PPE according to the different pesticide toxicity levels found in Table 1.

Table 1. Minimum PPE and work clothing for pesticide-handling activities.
Toxicity Category of End-Use Product

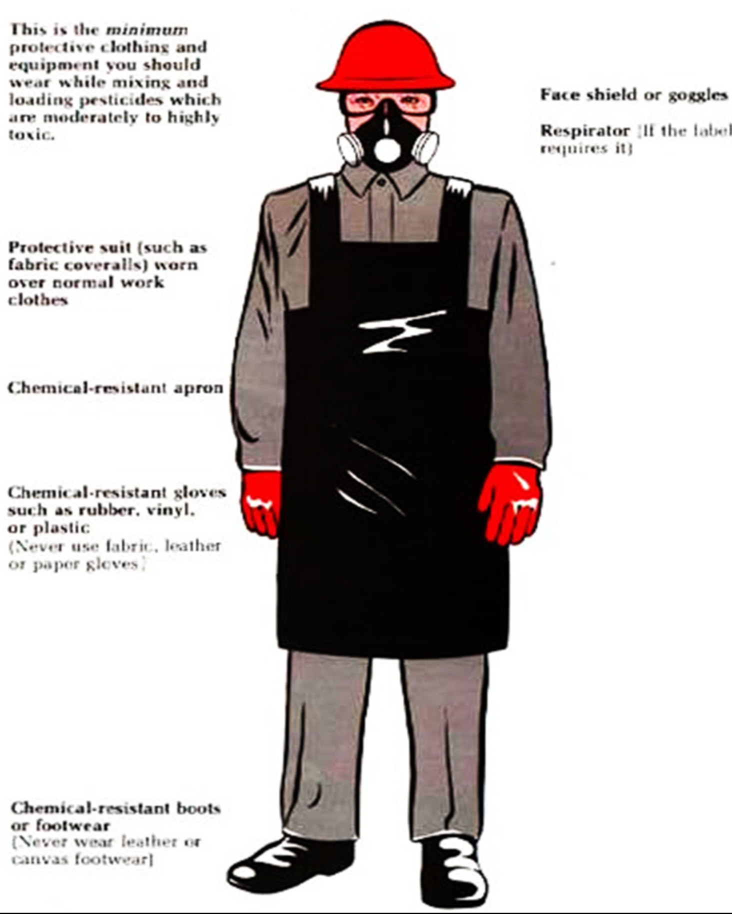
Route of Exposure	1	2	3	4
Dermal toxicity or skin irritation potential	Coveralls worn over long-sleeved shirts and long pants	Coveralls work over short-sleeved shirts and short pants	Long-sleeved shirt and long pants	Long-sleeved shirt and long pants
	Socks	Socks	Socks	Socks
	Chemical-resistant footwear	Chemical-resistant footwear	Shoes	Shoes
	Chemical-resistant gloves	Chemical-resistant gloves	No minimum	No minimum
Inhalation Toxicity	Respiratory protection device	Respiratory protection device	No minimum	No minimum
Eye Irritation Potential	Protective eyewear	Protective eyewear	No minimum	No minimum

Proper cleaning and maintenance of PPE is just as important as making it available to early entry workers and handlers. Employers must instruct persons who clean or launder PPE to keep pesticide-contaminated PPE away from other clothing or laundry and to wash it separately. In addition, employers are required to perform the following tasks:
1. If PPE will be reused, clean it before each day of reuse according to the PPE manufacturer's instructions. If instructions are unavailable, wash PPE with detergent in hot water.
2. Thoroughly wash and dry all PPE before it is reused or stored.
3. Store clean PPE separate from personal clothing and away from pesticide-contaminated areas. PPE that has been soaked or otherwise heavily contaminated should be discarded.

In regard to the proper care of respiratory PPE, employers must take the following actions:
1. Replace dust/mist respirator filters at the following times:
- ***a.*** *When breathing becomes difficult*
- ***b.*** *If the filter is damaged or torn*
- ***c.*** *Whenever the respirator manufacturer or pesticide label says to replace them*
- ***d.*** *At the end of each day's work period if no other instructions regarding service life are available*

2. Replace gas-and-vapor-removing respirators or canisters at the following times:
- ***a.*** *At the first sign of odor, taste, or irritation*
- ***b.*** *When the respirator manufacturer or pesticide label says to replace them*
- ***c.*** *At the end of each day's work period if no other instructions regarding service life are available*

Handling Concentrates



Type of Personal Protective Material								
Selection category listed on pesticide label	**Barrier laminate**	**Butyl rubber ≥14 mils**	**Nitrile rubber ≥14 mils**	**Neoprene rubber* ≥14 mils**	**Natural rubber ≥14 mils**	**Polyethylene**	**Polyvinyl chloride (PVC) ≥14 mils**	**Viton ≥14 mils**
A *(dry and water-based)*	High	High	High	High	High	High	High	High
B	High	High	Slight	Slight	None	Slight	Slight	Slight
C	High	High	High	High	Moderate	Moderate	High	High
D	High	High	Moderate	Moderate	None	None	None	Slight
E	High	Slight	High	High	Slight	None	Moderate	High
F	High	High	High	Moderate	Slight	None	Slight	High
G	High	Slight	Slight	Slight	None	None	None	High
H	High	Slight	Slight	Slight	None	None	None	High

Characteristics of some Commonly-used Pesticide Coveralls

Consult product manufacturer for more information

Material	Particulate Protection Class*	Splash Protection Class*	Liquid proof?	Liquid chemical protection?	Breathable?	Relative cost
Tempro®	IV	(none)	NO	NO	YES	LOW
ProShield2®	I	III	NO	YES	YES	LOW
Tyvek®	I	III	NO	NO	YES	LOW
Tyvek® QC/ sewn seams	I	II	NO	YES	NO	LOW
Tyvek® QC/ sealed seams	I	II	YES	YES	NO	MODERATE
Kleenguard® LP	I	III	NO	NO	YES	LOW
Tychem® SL/ surged seams	I	I	NO	YES	NO	MODERATE
Tychem® SL/ sealed seams	I	I	YES	YES	NO	HIGH
PVC coverall	I	I	YES	YES	NO	HIGH
PVC suit	I	I	YES	YES	NO	MODERATE

	GLOVES	HARD HAT	APRON	COVERALLS	RESPIRATOR	FOOTWEAR	PROTECTIVE EYEWEAR
MIXING / LOADING	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
ENCLOSED CAB	NO	NO	NO	NO	NO	SHOES + SOCKS	NO
OPEN CAB	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
CLEANOUT	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO

PESTICIDE HANDLING SAFETY REFERENCE (PPE)

PPE Cleaning Procedures

1. The clothing and protective equipment items you will be cleaning may have pesticides on them.

2. Although you may not be able to see or smell the pesticides, they can rub off on you when you touch the clothing and equipment.

3. If pesticides get on you, they can hurt you. They can:
• cause skin rashes or burns,
• go through your skin and into your body and make you ill,
• burn your eyes,
• make you ill if you breathe them or get them in your mouth.

4. To avoid harm from the pesticide, you should:
• Pour the clothes from their container into the washer without touching them.
• Handle only the inner surfaces, such as the inside of boots, aprons, or coveralls.
• Do not breathe the steam from the washer and dryer.

5. Pesticides should not be allowed to stay on your hands:
• When you wash clothing or equipment by hand, use plenty of water and rinse your hands often.
• Wash your hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
• Wash your hands as soon as you finish handling the clothing or equipment.

6. You should not allow clothing and equipment with pesticides on them to be washed with regular laundry. The pesticides can rub off on other items.

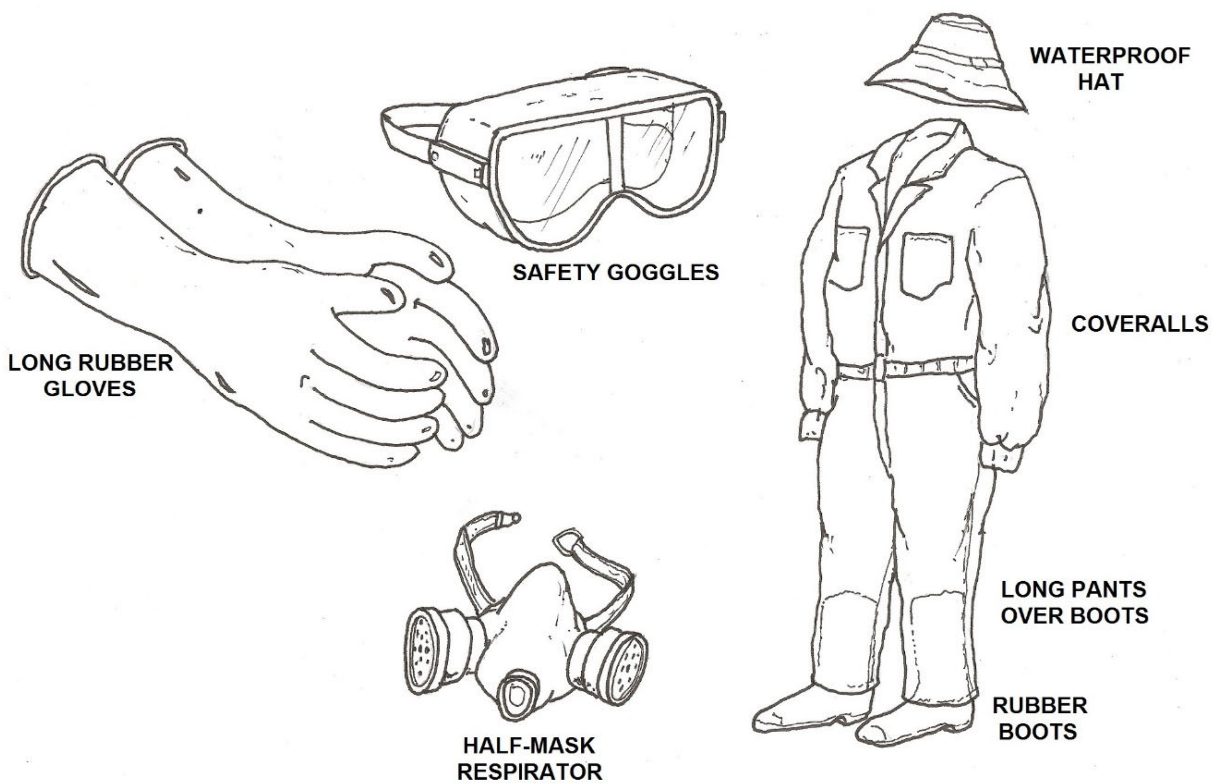
Cleaning Eyewear and Respirators
Hand-wash reusable respirator facepieces, goggles, face shields, and shielded safety glasses, following manufacturer's instructions. In general, use mild detergent and warm water to wash the items thoroughly. Rinse well. Wipe dry, or hang in a clean area to air dry.

Cleaning Other PPE
1. Follow the manufacturer's cleaning instructions. If the instructions say only to wash the item, or if there are no cleaning instructions, follow the procedure below.

2. Recommended procedure for washing most PPE:
a. **Rinse** in a washing machine or by hand.
b. **Wash in a washing machine**, using a heavy-duty detergent and hot water for the wash cycle.
c. **Wash only a few items at a time** to allow plenty of agitation and water for dilution. Use the highest water-level setting.
d. **Rinse twice** using two rinse cycles and warm water.
e. **Use two entire machine cycles** to wash items that are moderately to heavily contaminated.
f. **Run the washer through at least one more entire cycle** without clothing, using detergent and hot water, to clean the machine.

3. Some plastic or rubber items that are not flat, such as gloves, footwear, and coveralls, must be washed twice — once to clean the outside and a second time after turning the item inside out.
4. Some items, such as heavy-duty boots and rigid hats or helmets, should be washed by hand using hot water and heavy-duty detergent.
5. **Hang the items to dry**, if possible. Let them hang for at least 24 hours in an area with plenty of fresh air — preferably outdoors. Do not hang items in enclosed living areas.
6. You may **use a clothes dryer** for fabric items if it is not possible to hang them to dry. But after repeated use, the dryer may become contaminated with pesticides.

Note to Employers:
This information will help you comply with the section of the WPS that requires you to provide information to people (other than your own handlers) who clean or maintain your pesticide equipment. You are not required to give them this information in written form, but you may find that photocopying this section is an easy way to pass along the necessary information.



REQUIRED PESTICIDE APPLICATION PERSONAL PROTECTIVE EQUIPMENTV DIAGRAM #3

Working Safety with Pesticide Distribution Equipment

1. The equipment you will be cleaning, adjusting, or repairing may have pesticides on it. Although you may not be able to see or smell the pesticides, they can rub off on you when you touch the equipment.

PROPER SIGNAGE

2. If pesticides get on you, they can hurt you. They can:
- cause skin rashes or burns,
- go through your skin and into your body and make you ill,
- burn your eyes,
- make you ill if you get them in your mouth.

3. You should wear work clothing that protects your body from pesticide residues, such as long-sleeved shirts, long pants, shoes, and socks. If possible, avoid touching the parts of the equipment where the pesticide is most likely to be.

Or, if practical for the job that you will be doing, consider wearing rubber or plastic gloves and an apron.

4. You should not let pesticides stay on your hands:
- Wash your hands as soon as you finish handling the equipment.
- Wash your hands before eating, drinking, chewing gum, using tobacco, or using the toilet.
- Wash or shower with soap and water, shampoo your hair, and put on clean clothes after work.
- Wash work clothes that may have pesticides on them separately from other clothes before wearing them again.

Equipment Safety
1. Inspect pesticide handling equipment before each day of use, and repair or replace as needed. 170.309 (j) and 170.313 (g)
2. Allow only appropriately trained and equipped handlers to repair, clean, or adjust pesticide equipment that contains pesticides or residues, unless they are not employed on the establishment. 170.309 (g) and 170.507 (a) See Additional Agricultural Employer

Personal Protective Equipment (PPE) Handlers
Must Use
1. Provide handlers with the PPE required by the pesticide labeling, and be sure it is: 170.507 (b)
- Clean and in operating condition, 170.507 (b)
- Worn and used according to the manufacturer's instructions,170.507 (c)
- Inspected before each day of use, 170.507 (c)(2)
- Repaired or replaced as needed. 170.507 (c)(2)

2. When a respirator is required by product labeling, provide handlers with:
- A medical evaluation to ensure the handler is physically able to safely wear the respirator,
- Training in respirator use, and
- A fit test to ensure the respirator fits correctly.
- Keep records on the establishment of these items for two years. 170.507 (b)(10)

3. Take steps to avoid heat-related illness when labeling requires the use of PPE for a handler activity. 170.507 (e)
4. Provide handlers a pesticide-free area for:
- Storing personal clothing not in use,
- Putting on PPE at start of task,
- Taking off PPE at end of task. 170.507 (d)(9)

5. Do not allow used PPE to be taken home. 170.507 (d)(10)

Care of PPE
1. Store and wash used PPE separately from other clothing and laundry. 170.507 (d)(3)
2. If PPE will be reused, clean it before each day of reuse, according to the instructions from the PPE manufacturer unless the pesticide labeling specifies other requirements. If there are no other instructions, wash in detergent and hot water. 170.507 (d)(1)
3. Dry the clean PPE before storing. 170.507 (d)(4)
4. Store clean PPE away from personal clothing and apart from pesticide-contaminated areas. 170.507 (d)(5)

Replacing Respirator Purifying Elements
1. Replace particulate filters or filtering facepiece respirators when any following condition is met:
- When breathing becomes difficult,
- When the filter is damaged or torn,
- When the respirator label or pesticide label requires it,
- After 8 total hours of use, in the absence of any other instructions or indications of service life. 170.507 (d)(6)

2. Replace vapor-removing cartridges/canisters when any following condition is met:
- When odor/taste/irritation is noticed,
- When the respirator label or pesticide label requires it (whichever is shorter),
- When breathing resistance becomes excessive,
- After 8 total hours of use, in the absence of any other instructions or indications of service life. 170.507 (d)(7)

Disposal of PPE
1. Discard, do not clean, coveralls and other absorbent materials that are heavily contaminated with pesticide having a signal word
"DANGER" or "WARNING." When discarding PPE, ensure that it is unusable as apparel or made unavailable for further use.
2. Follow federal, state, and local laws when disposing of PPE that cannot be cleaned correctly. 170.507 (d)(2)

Instructions for People Who Clean PPE 170.507 (d)(8)
The handler employer must inform people who clean or launder PPE:
- That PPE may be contaminated with pesticides,
- Of the potential for harmful effects of exposure to pesticides,
- How to protect themselves when handling PPE,
- How to clean PPE correctly, and
- Decontamination procedures to follow after handling contaminated PPE.

The Central Notification Board
Safety Poster with Emergency Medical Care Facility Information

Provide establishment-specific information to workers.

Provide pesticide application and hazard information upon request of worker, medical personnel or designated representative.

Notify workers of applications – posting, oral warning, or both.

Provide information (Information Exchange) to Commercial Pesticide Handler Employer (CPHE) (i.e., custom application or crop advisor).

Provide tasks and instructions to worker supervisors to ensure compliance with WPS requirements.

Ensure supervisors give directions to workers for WPS compliance.
The EPA provides a safety poster containing all of the required information. It has a section at the bottom where you can fill in the name, address and phone number of the nearest emergency medical care facility.

Posting Information About Pesticide Applications
You must post the following information about pesticide applications on the Central Notification Board:

- Location and description of the treated area.
- Product name, EPA Registration Number, and Active Ingredients; all found on the pesticide label.
- Start time, end and date pesticide will be applied.
- Restricted entry interval for the pesticide; found on the pesticide label.

Post the information before you make the application and keep it posted for 30-days after the REI has expired.

IMPORTANT: *Starting in January 2017, the safety poster must also be posted at all permanent decontamination supply locations. A safety data sheet (SDS), must also be posted for each product that is applied. The SDS and the pesticide application information must be kept on record for two years and must be made available to workers, handlers or their authorized representatives.*

Starting in January 2018, posting of additional safety information will be required. The information can be posted in any format. A poster will not be required, but EPA will likely provide an updated poster with the required additional information.

Emergency Assistance
If there is reason to believe that an employee has been poisoned or injured by a pesticide exposure, you must provide prompt transportation to an emergency medical facility and provide the SDS. You must provide information about the circumstances of the exposure and the pesticide(s) involved. Bring SDS and product labels with you.

Pesticide and Herbicide Poisoning Introduction

It is still important to recognize signs and symptoms of pesticide/herbicide poisoning. When in doubt, seek medical attention and be sure to bring the fumigants label and SDS to the physician.

Poisoning Recognition
Certain pesticide/herbicide may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development.

Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers. Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific chemical or product involved and the level of exposure. If you have been working with pesticide/herbicides and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The pesticide/herbicide's label or SDS will have a telephone number to contact in case of a medical incident.

Procedures
- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Material Safety Data Sheet (SDS (formerly MSDS)) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Pesticide/herbicides on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Pesticide/herbicides in Eye
Eye exposure to pesticide/herbicides can be serious. Always pour, measure, or mix pesticide/herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Pesticide/herbicides contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Pesticide/herbicides in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Pesticide/herbicides in Mouth or Swallowed

Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator’s clothing becoming contaminated.

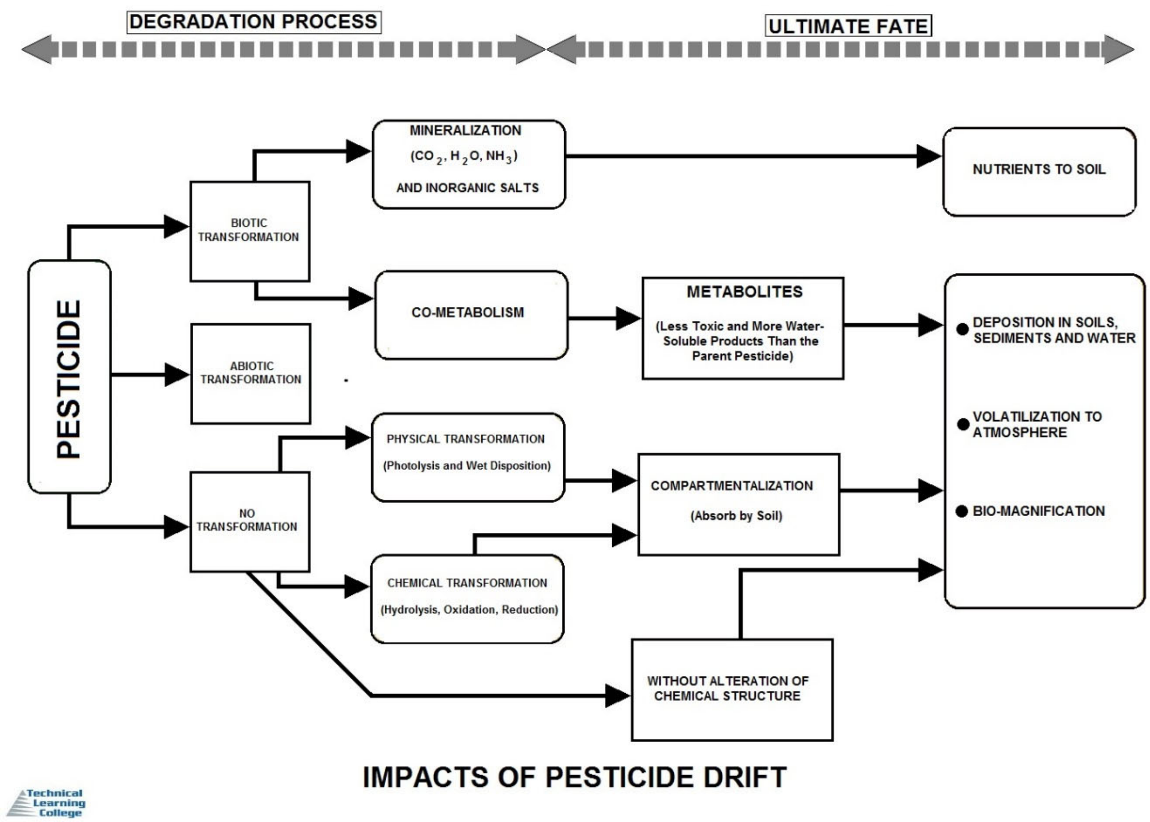
“Spill kits” are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

WPS- Drift Control Sub-Section - Introduction

The EPA defines spray or dust drift as:
"the physical movement of pesticide droplets or particles through the air at the time of pesticide application or soon thereafter from the target site to any non- or off-target site. Spray drift shall not include movement of pesticides to non- or off-target sites caused by erosion, migration, volatility, or windblown soil particles that occurs after application or application of fumigants unless specifically addressed on the product label with respect to drift control requirements."

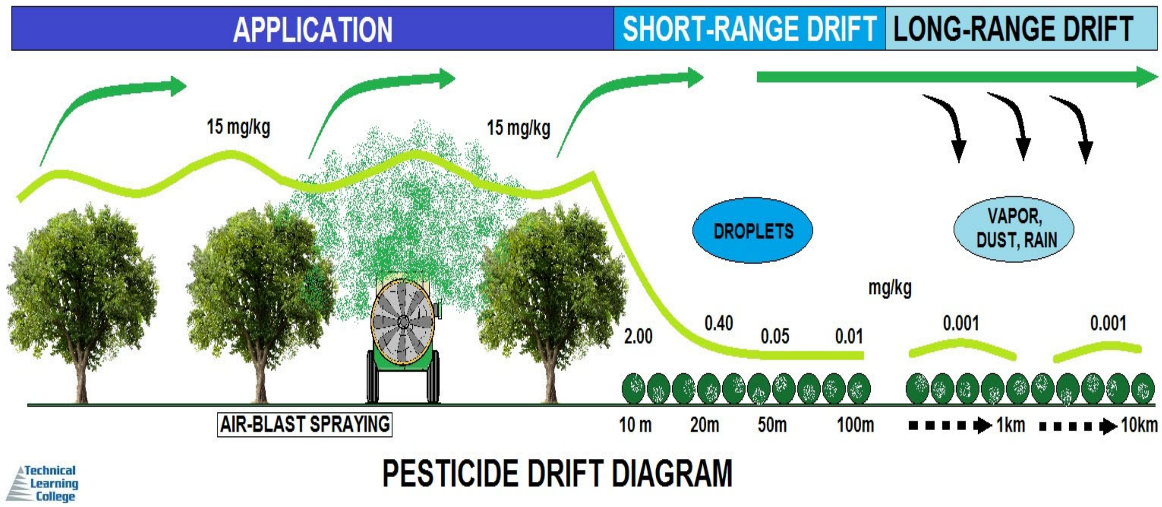


This definition is based on a definition of spray drift composed by participants of the National Coalition on Drift Minimization, which include representatives from federal (including the EPA and the U. S. Department of Agriculture) and state agencies and tribes, pesticide and equipment manufacturers, university scientists, and others, who have focused their attention on enhancing pesticide applicator education, application research, and regulatory initiatives to foster reductions in spray drift.

The Agency recognizes that pesticide vapor and the off-target movement of pesticides by other means, not included in this definition, can nevertheless present substantial risks to humans and the environment. The EPA generally addresses these routes of exposure and associated risk at the individual pesticide level through its regulatory programs.

In addition to the safety problems associated with the preparation and application of pesticides, there are several important problems related to pesticide use that should be understood by every applicator.

These problems include pesticide drift, pesticide residues, phytotoxicity, destruction of beneficial species of animals and plants, resistance of pests to pesticides, and environmental pollution. There are many ways in which these undesirable effects can be reduced or eliminated. Each depends upon knowledge of the proper handling and use of pesticides, the components of the environment susceptible to contamination, the pesticides most likely to cause contamination, and preventive measures.



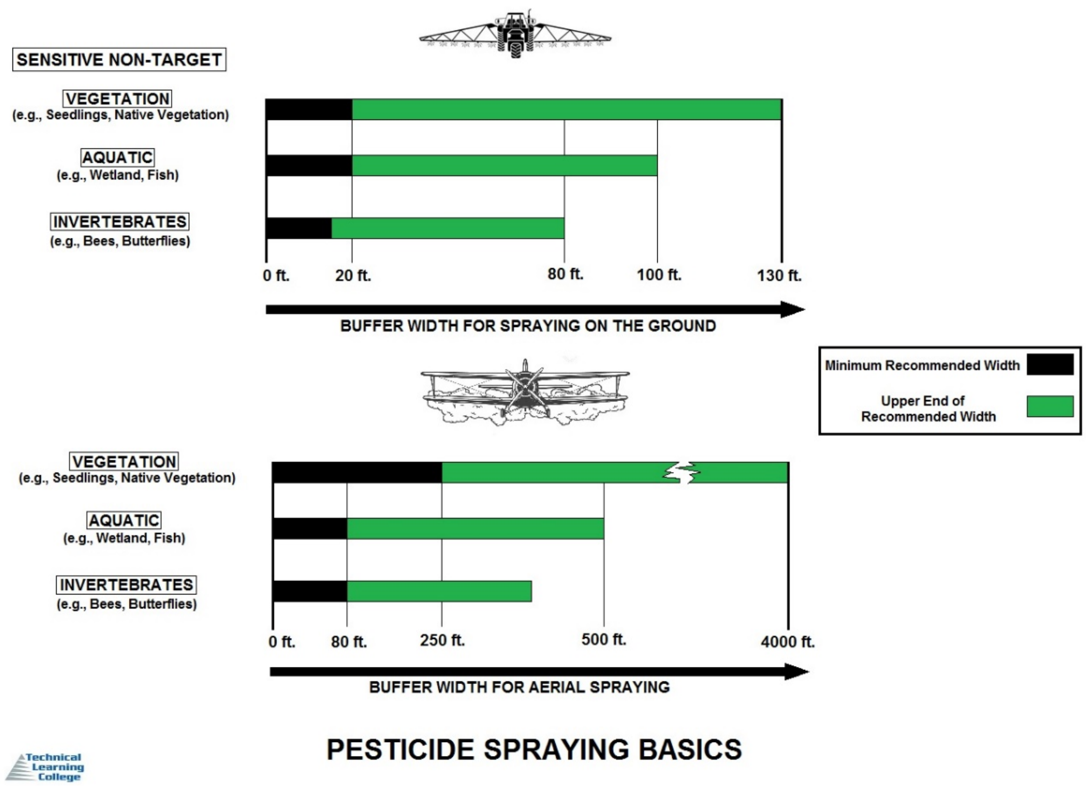
Except for ultra-low volume (ULV) spraying to control adult mosquitoes, drift is an undesirable side effect associated with both aerial and ground pesticide applications. Spray drift is defined as airborne particles produced during application of a pesticide moving outside the intended treatment area. The severity of drift depends on the physical form of the material, the method of application, weather conditions, and to a lesser degree, movement of the substrate to which the product was applied (both soil and water).

Drift is a desirable and necessary part of an ULV application. In fact, pesticide labels specify that ULV applications must be done during weather conditions that favor pesticide drift (temperature inversion or lateral winds below 10 MPH). In a ULV application, the longer the effective drift of the product, the greater the efficacy.

For other pesticide applications, the formulation of the pesticide is a significant factor. Dusts are most likely to drift and granules least likely. High pressure sprayers are more likely to produce fine droplets that are more likely to drift than low pressure sprays. A variety of other factors can affect the amount of drift. When spraying liquid formulations of pesticides, the nozzle and pump pressure have the greatest influence on subsequent drift. Improper or worn nozzles or excessive pressures cause the spray to be produced in a form which drifts readily.

The rate at which a drop of liquid falls through the air depends upon the size of the droplet. Very small droplets fall very slowly. These small droplets can drift for miles before they reach the ground. The method and amount of material applied also influences the hazard of pesticide drift.

Small amounts applied by hand from the ground are rarely involved in drift problems. Spray from ground air blast sprayers is highly subject to drift. Aerial applications of large quantities of pesticides always present the possibility of significant drift.



PESTICIDE SPRAYING BASICS

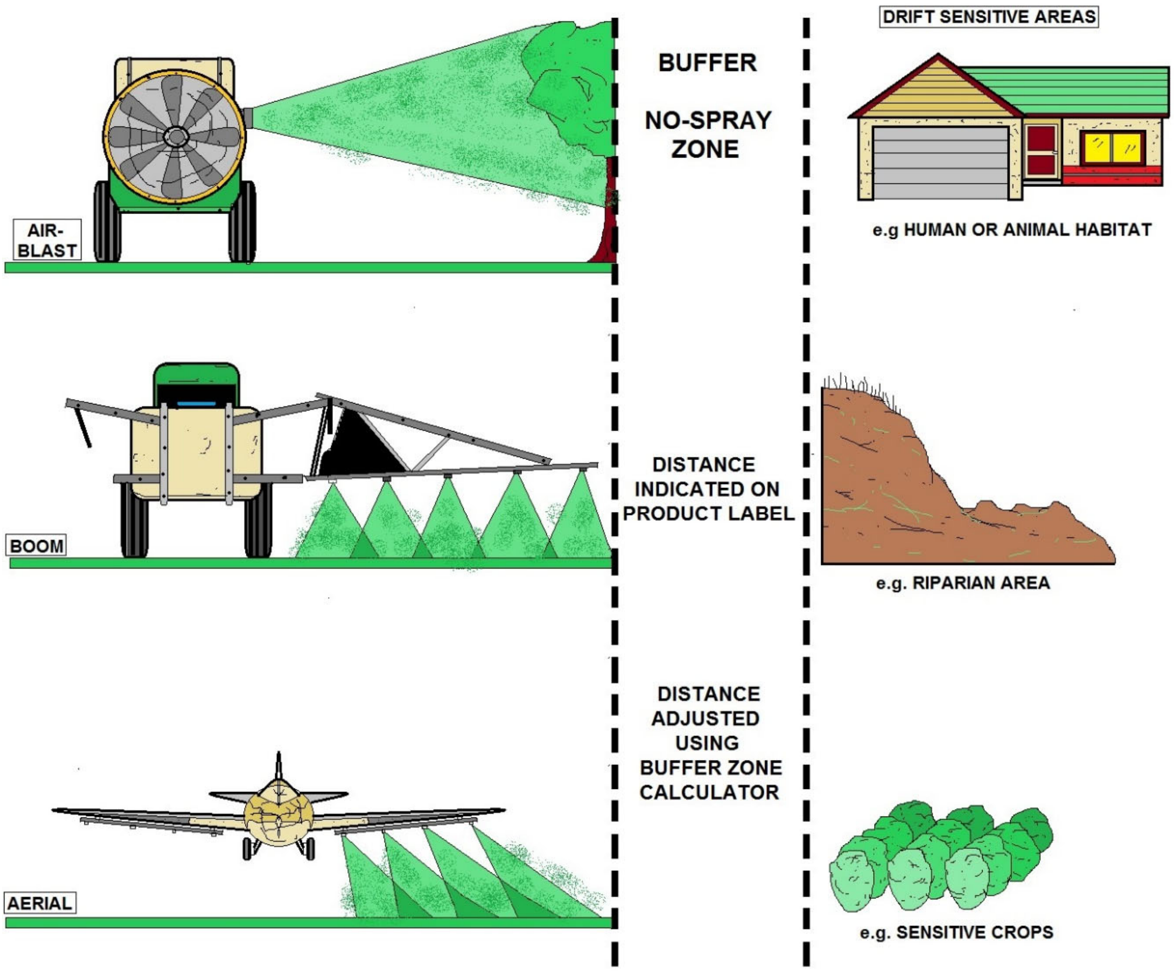
A second form of drift occurs when pesticides evaporate during and after application. Certain herbicide formulations may volatilize and cause damage to plants miles from the point of application. A few herbicide formulations may drift as a result of evaporation following application; use of these may be restricted in many areas.

Drift should be avoided because:

- It wastes resources, including pesticides, fuel, and technician time.
- It spreads pesticides into the surrounding environment where they may become illegal residues on food crops, cause health problems, damage wildlife, and have other undesirable effects.
- It can damage sensitive crops.
- It has been the subject of many damage claims for crop losses. Drift can be a severe problem and should be taken into consideration before making any type of pesticide application

What Is Pesticide Spray Drift?

The EPA defines pesticide spray drift as the physical movement of a pesticide through air at the time of application or soon thereafter, to any site other than that intended for application (often referred to as off target). The EPA does not include in its definition the movement of pesticides to off-target sites caused by erosion, migration, volatility, or contaminated soil particles that are windblown after application, unless specifically addressed on a pesticide product label with respect to drift-control requirements.

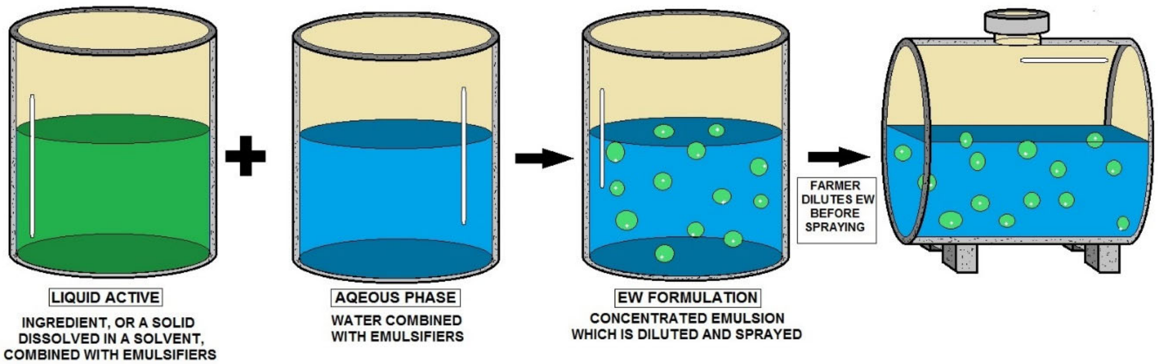


PESTICIDE APPLICATION METHODS

How Does Spray Drift Occur?
When pesticide solutions are sprayed by ground spray equipment or aircraft, droplets are produced by the nozzles of the equipment. Many of these droplets can be so small that they stay suspended in air and are carried by air currents until they contact a surface or drop to the ground. A number of factors influence drift, including weather conditions, topography, the crop or area being sprayed, application equipment and methods, and decisions by the applicator.

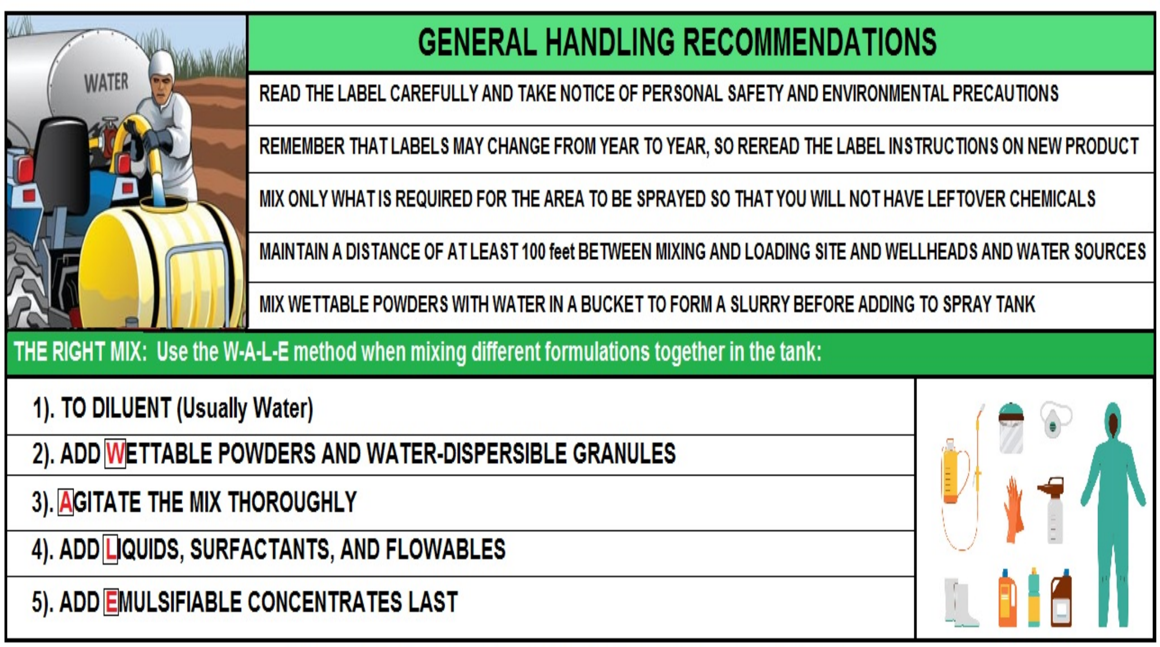
What Are the Impacts of Spray Drift?
Off-target spray can affect human health and the environment. For example, spray drift can result in pesticide exposures to farmworkers, children playing outside, and wildlife and its habitat. Drift can also contaminate a home garden or another farmer's crops, causing illegal pesticide residues and/or plant damage. The proximity of individuals and sensitive sites to the pesticide application, the amounts of pesticide drift, and toxicity of the pesticide are important factors in determining the potential impacts from drift.

Whenever a pesticide chemical is applied, some of the chemical becomes a deposit on or in the treated crop, animal or object. The pesticide may remain in its original chemical form or it may be altered chemically by weathering, metabolic degradation or other processes. In any case, the quantity of material remaining is called a residue.

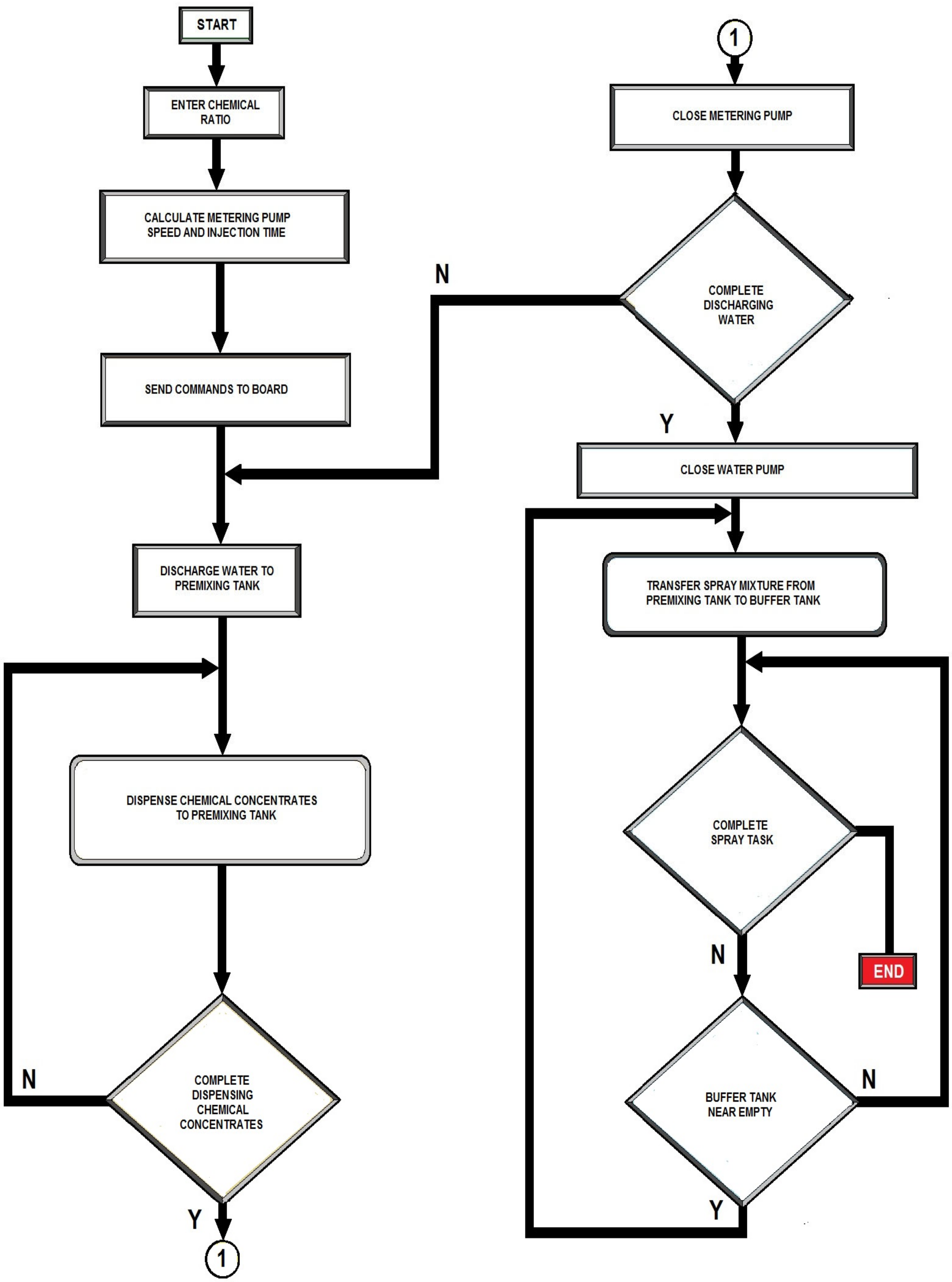


CONCENTRATED AQUEOUS EMULSION PROCESS

Residues may result from direct application, from drift from nearby fields, from uptake from contaminated soil, or from other sources. In some situations, residues are desirable and produce prolonged effective pest control, as in the control of certain public health and structural pests. In other situations, however, residues represent a source of unwanted and illegal contamination — for example, when residues exceed legally determined limits on food or feed crops at harvest.



PESTICIDE MIXING AND LOADING CHECKLIST



METERING PESTICIDE DISPERSAL

Pesticide Residues

Pesticide residues are generally meant to include pesticides that are detectible in or on places other than their intended target. Fresh water reservoirs, stream bed sediments, and harvested food would be examples of places that would be tested for pesticide residues. Needless to say, if high levels of residues were found to occur in such situations, few would consider the test results to be a good thing. Pesticide residues are usually measured and tolerances expressed in parts per million (ppm) to parts per billion (ppb) on a weight basis.

One ppm is one milligram in a kilogram, or one ounce of salt in 62,500 pounds of sugar, or one pound of pesticide in one million pounds of raw agricultural commodity. In some instances, modern analytical chemistry techniques can test residue levels below one ppb.

The residue levels allowed on food crops at harvest are legally set by the federal and state regulatory agencies and are called tolerances. Tolerances are simply the maximum amounts of pesticide permitted to be present on or in raw agricultural commodities. These tolerances represent levels of pesticide residues which scientists have determined may safely remain on the food crop without injury to the consumer. Tolerances vary according to the pesticide and the crop.

When pesticide tolerances are found to be exceed legal tolerances, the agricultural commodities involved may be seized and destroyed. Ordinarily, such situations would arise from the application of agricultural pesticides on crops, but it could happen even where pesticide applications are not specifically targeted at a crop pest, such as the application of pesticides on rice fields for mosquito control.

Before allowing the use of a pesticide on food crops, EPA sets a tolerance. If no tolerance has been set for that pesticide on that crop, the pesticide cannot be legally applied on the crop. Some pesticides may be considered "safe" by EPA, and they would be exempted from a tolerance.

How Does the EPA View Off-Target Spray Drift?
The EPA recognizes the importance of exposures to pesticides resulting from spray drift. There are thousands of reported complaints of off-target spray drift each year.

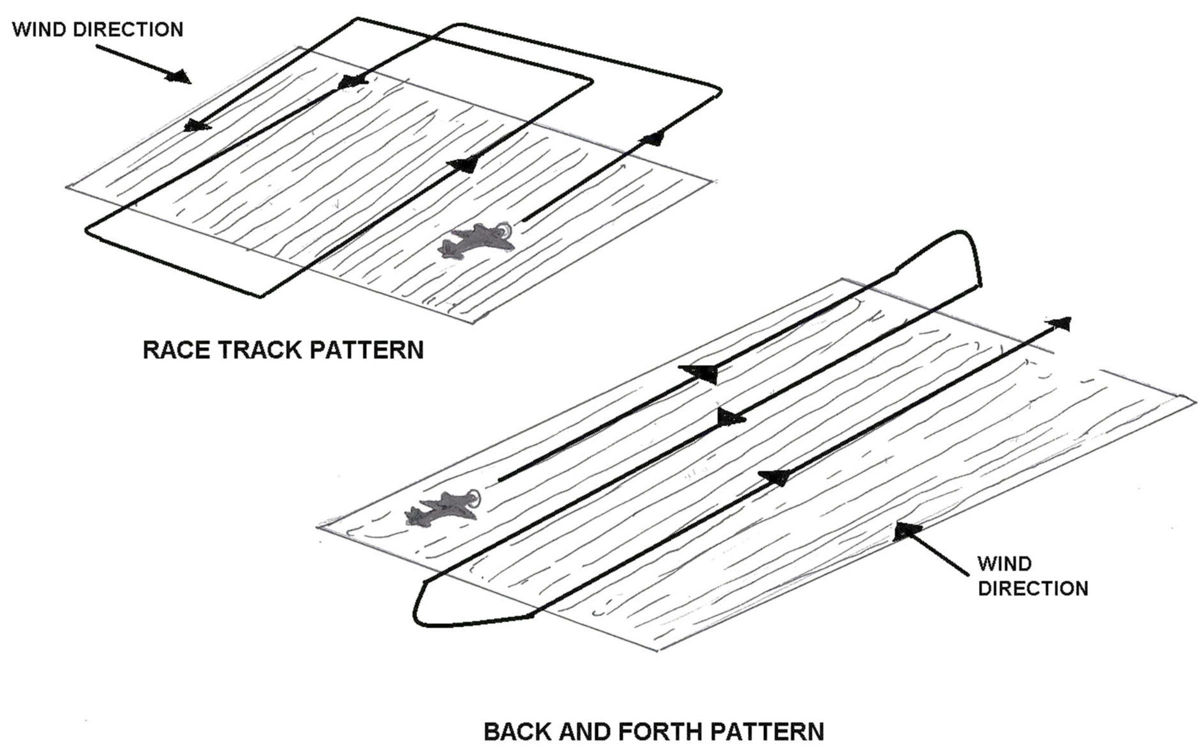
Reports of exposures of people, plants, and animals to pesticides due to off-target drift (often referred to as "*drift incidents*") are an important component in the scientific evaluation and regulation of the uses of pesticides. Other routes of pesticide exposure include consuming foods and drinking water which may contain pesticide residues, applying pesticides, and contacting treated surfaces in agricultural, industrial, or residential settings. The EPA considers all of these routes of exposure in regulating the use of pesticides.

Off-Target Drift
When labels of pesticide products state that off-target drift is to be avoided or prohibited, our policy is straightforward: pesticide drift from the target site is to be prevented. However, we recognize that some degree of drift of spray particles will occur from nearly all applications.

Nevertheless, applicators and other responsible parties must use all available application practices designed to prevent drift that will otherwise occur. In making their decisions about pesticide applications prudent and responsible applicators must consider all factors, including wind speed, direction, and other weather conditions; application equipment; the proximity of people and sensitive areas; and product label directions.

A prudent and responsible applicator must refrain from application under conditions that are inconsistent with the goal of drift prevention, or are prohibited by the label requirements. The EPA uses its discretion to pursue violations based on the unique facts and circumstances of each drift situation.

How Does EPA Help Protect People and the Environment from Off-Target Spray Drift?
The EPA is responsible for a number of important programs that help protect people and the environment from potential adverse effects that can be related to off-target drift from pesticide applications. These programs include restricting how pesticides are used, certification and training of applicators, and enforcement and compliance of pesticide laws.



Bodily Damage from Pesticide Application

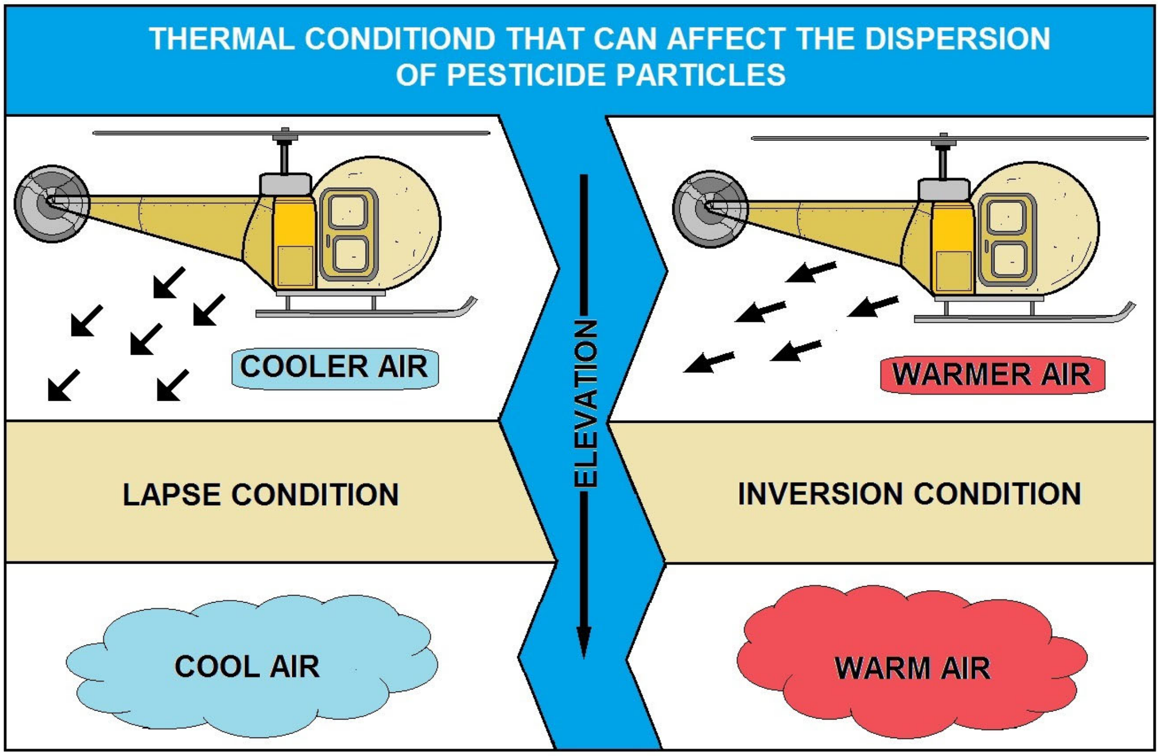
Pesticides enter the body through:
a) ingestion/swallowing through the mouth, accidental or deliberate;
b) dermal, through the skin when handling, measuring and pouring;
c) inhalation of small particles or dust when handling, spraying and flagging.

Of the above three routes, dermal exposure is the most common hazard. Avoiding exposure by the use of appropriate protective clothing and equipment (PPE), and paying attention to personal hygiene by washing exposed parts of the body after work and before eating, smoking and toileting will minimize risk. Personal protective equipment must be selected in accordance with the label recommendation. It must be comfortable to wear/use and be made of material, which will prevent penetration of the pesticide.

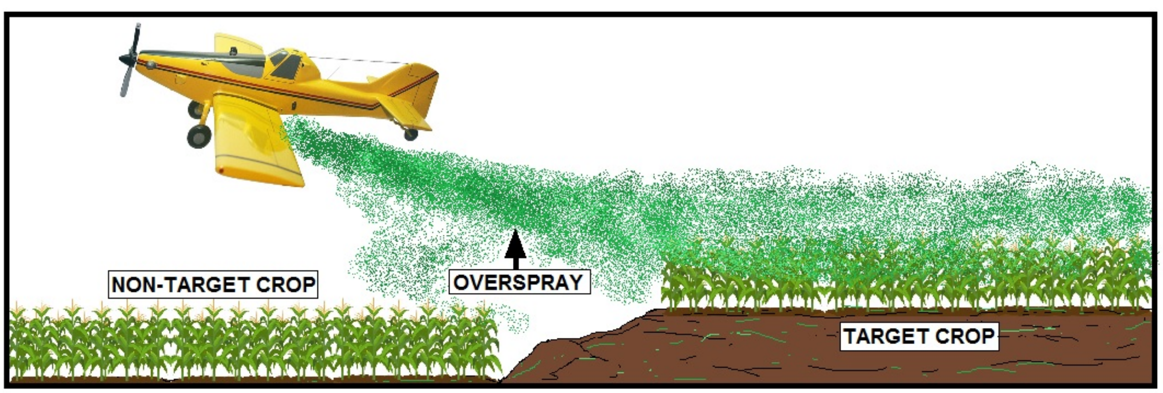
Where undiluted formulations are applied as ULV sprays, specific PPE requirements are stated on the product label. ULV treatments require PPE, which is approved for the particular product in use. PPE must bear an approval mark and should be comfortable to wear and not restrictive in use. The material used for PPE manufacture must prevent penetration of the particular formulation to be used (break-through time). PPE will only remain efficient if it is correctly maintained. Where damaged, repairs must restore it to its original specification and if this is not possible the item must be replaced.

Respirators must be checked on a regular basis and filter elements replaced in accordance with the manufacturer's instructions.

The operation of an airstrip involves additional safety considerations. As well as PPE for the ground crew and Crop Advisors, Workers Handlers, and, appropriate fire extinguishers must be provided for both the aircraft and the airstrip. The pilot must have a crash helmet and an approved safety harness for cockpit use and a respirator/fresh-air mask.



THERMAL CONDITIONS EFFECT ON PESTICIDE APPLICATION



EXAMPLE OF AERIAL APPLICATION OVERSPRAY HAZARDS

Pesticide Application Sub-Section

Pre-Application

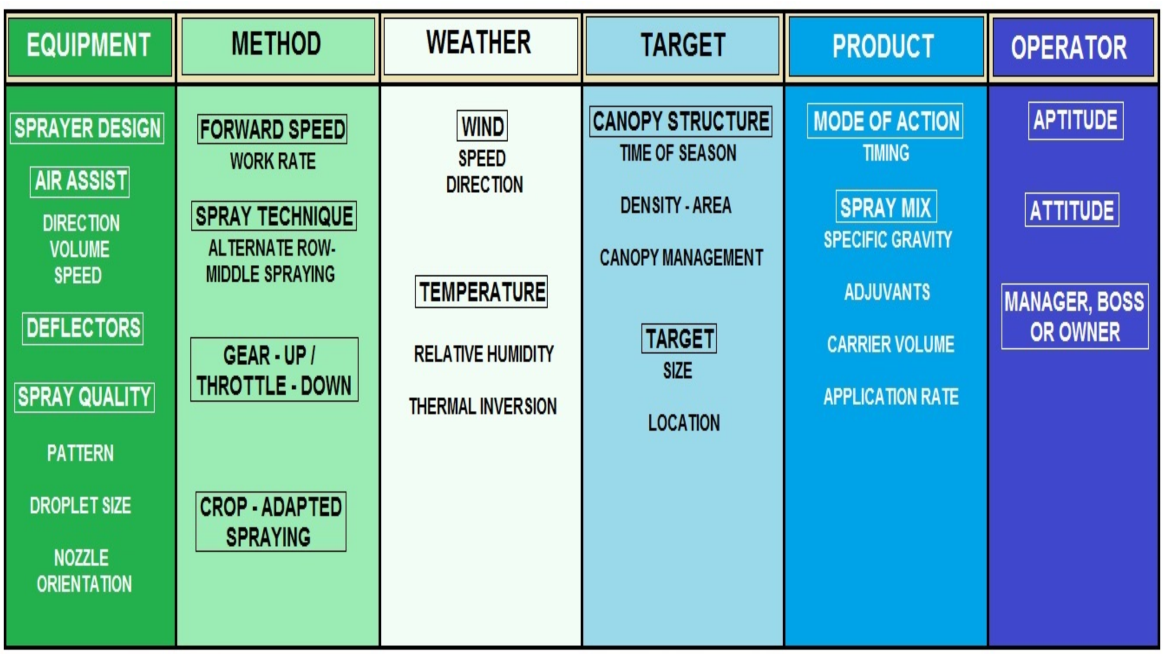
Time taken to check spray equipment before use will reduce costly delays when the season begins. Pre-season operational checks can be carried out with clean water but safety clothing should always be worn. Any checks suggested in this publication will be additional to the procedures specifically laid out by the equipment manufacturers in their user instructions.

Spray Equipment

It is essential that the equipment is appropriate for the pesticide formulation to be sprayed.

Conventional aqueous solutions are applied through hydraulic systems but where materials are to be applied undiluted (ULV), suitable atomizers must be fitted to the spray booms instead of nozzles.

Pumping and plumbing layouts are common to both application techniques but certain system components may have to be changed in cases where an aircraft is used for ULV spraying. Liquid flow rates for ULV spraying are lower than those for conventional spraying so that aircraft using this method require to be fitted with a spray liquid flow meter.



THINGS TO BE AWARE OF WHEN DOING A CALIBRATION FOR PESTICIDE APPLICATION

Spray Related Equipment Serviceability

Before spraying, several key points related to the equipment must be checked:

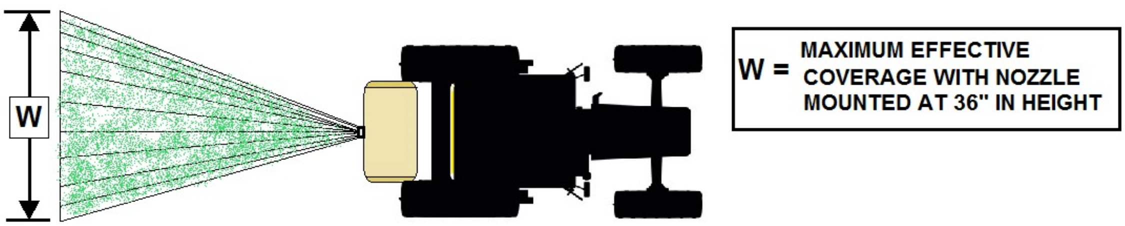
- Structures on and around the airstrip: steps, ladders, handrails and loading equipment must all be checked for serviceability.
- Guards on engine driven pumping and filling systems must be in place and secure.
- The aircraft's maintenance manual and the spray equipment manufacturer's instructions must always be consulted in the first instance.
- The pilot and the support staff are responsible for the aircraft's airworthiness, however, in many cases, the spraying system is maintained by an aircraft mechanic who must be trained and fully protected when working on the spray equipment.
- When starting up the system, before spraying it is advisable to initially rotate the spray pump by hand, irrespective of drive type (wind, hydraulic or electric) to ensure that it is free to turn.
- Blade angle on some wind driven pumps can be checked for adjustment and the transport brake, for locking the pump during ferry runs, must be fully clear when released.
- All filters must be in place and self-fill valves and couplings clean and serviceable.
- Hoses and hose joints must be visually assessed, and where component parts are wired to the aircraft for security the condition of the wires must be checked.
- In the cockpit, operation of the three-way valve must be positive and the hopper emergency dump mechanism safe and operational.
- Nozzles and nozzle bodies must be checked for wear and damage and the diaphragm check valves must be in good condition to ensure a positive spray cut-off. Rotary atomizers must be in balance and rotate freely. If they are blade driven, the blades must be free from damage and correctly adjusted for the selected rotational speed (droplet size control). Liquid flow restrictor adjustment must to be checked and adjusted for the required throughput for the desired application rate.
- It may not be possible to fully pressurize the spray system on the ground, particularly where the spray pump is wind driven, but at some stage the system must be checked for leaks. The aircraft will have to be flown to check the operation of the spray system and the efficiency of the pressure gauge. If the gauge does not return to zero when the spraying system is switched off the three-way valve may not be closing correctly. This in turn will reduce the efficiency of the "suck-back" circuit when the spray is turned off.
- Aircraft mounted electronic equipment such as the spray liquid flowmeter, output printer and navigational aid system have to be checked and re-calibrated against manufacturer's calibration figures.

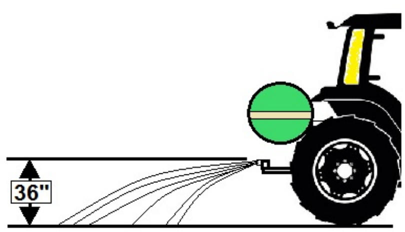
Adjustment and Control Checks

The spray system on/off and liquid flow rate controls are adjusted by the pilot during the operational checks. The spraying system must be checked as outlined above and the boom orientation in relation to flight direction may have to be adjusted to alter droplet size from hydraulic nozzles. Nozzle selection can be made according to product label recommendation but nozzle types; spray angles and throughputs must not be mixed on the boom. Boom orientation and nozzle positioning must be finally verified to ensure vortex creation is minimum.

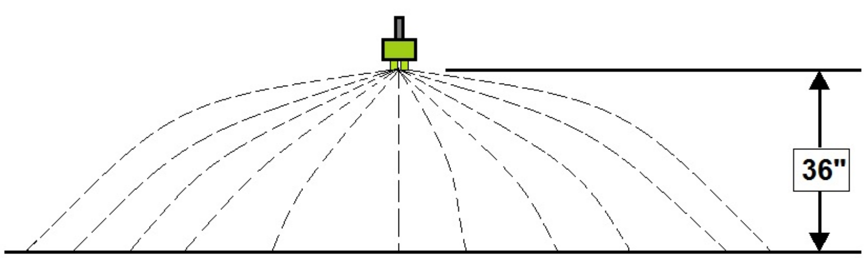
Where rotary atomizers are used, they should be adjusted for similar speeds. Occasionally inboard atomizers are adjusted to compensate for the increase in air speed from fuselage "screw", and the manufacturer's instructions should be referred to.

Where liquid flow rate is controlled using an adjustable restrictor, it is important to ensure that the liquid feed is the same for each atomizer. Atomizer speed is monitored via a tachometer unit that feeds information for individual atomizer rotational speeds to a cockpit-readout.





NOZZLE MOUNTED VERTICALLY

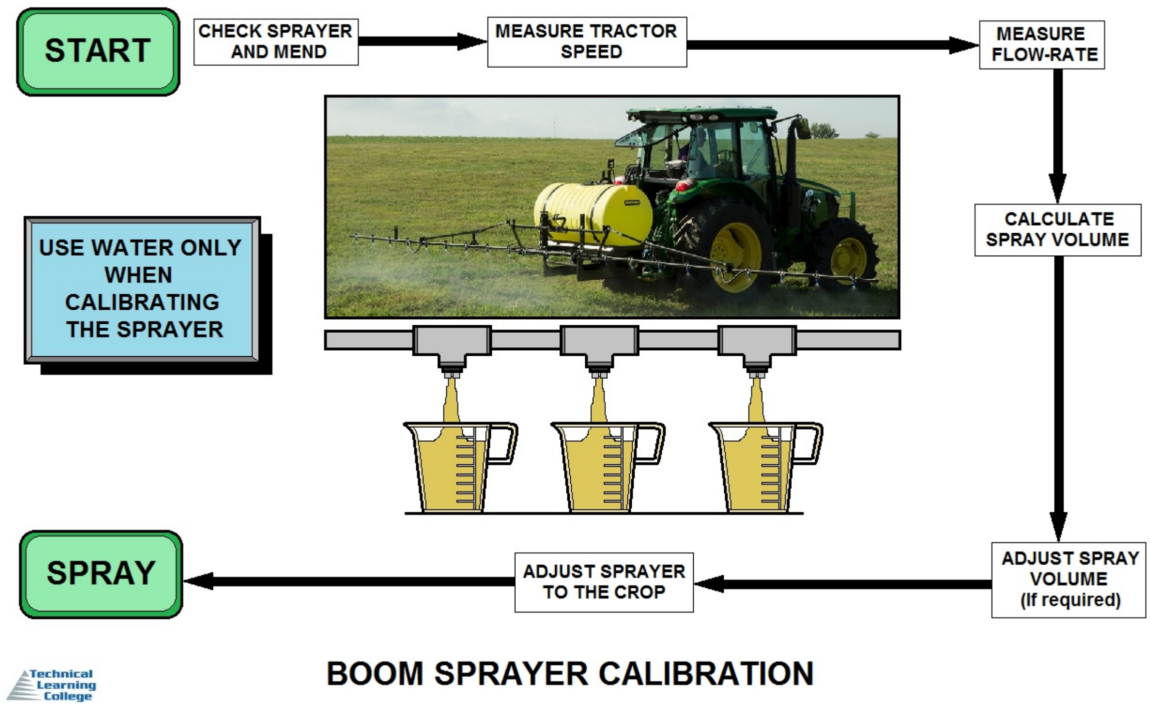


BOOMLESS NOZZLE SPRAYER

Technical Learning College

Conventional Spray Calibration
The Department of Agriculture or Pesticide Agency may have in place a schedule of use rules for spray aircraft that include regular spray system calibration and distribution checks and general equipment serviceability assessments. To ensure such that checks are efficiently carried out the use of an independent agency or service is recommended.

Spray equipment calibration must be carried out at the start of each season, after equipment repair or when changing application technique.

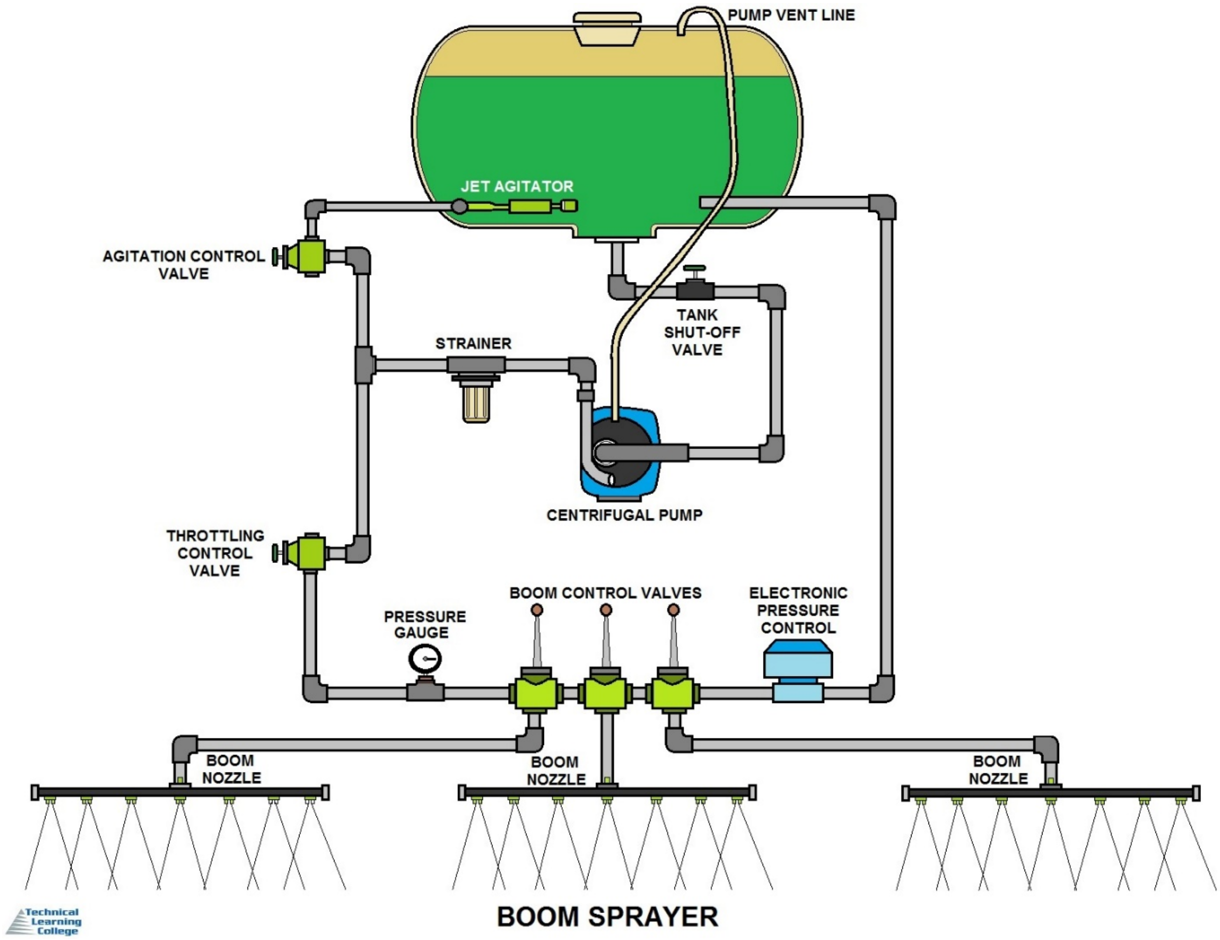


BOOM SPRAYER CALIBRATION

There are three major factors, which influence sprayer calibration:
a) Speed over the ground (m/h)
b) Swath width and lane separation
c) Liquid flow rate (1/min)

a) Forward speed over the ground can be determined by timing the aircraft over a measured distance flying in both directions to compensate for wind influence. This operation must be replicated three times to obtain an average speed and is necessary as the aircraft instrumentation will indicate only speed through the air.
b) Effective swath width is taken as the lane separation for each aircraft pass and will vary between conventional and ULV application. Recommended flying height should also be checked during field observation as a function of swathe width.
c) The spray liquid flow rate from the nozzles at a given operating pressure can be obtained from the nozzle manufacturer's information sheets. Such information is generated spraying clean water and presents a good starting point. However, unless the nozzles are specifically designed for it the special conditions and the low volume rates of aerial applications may result in different flow rates than indicated in the manufacturer's information.

The spray liquid output from an aircraft fitted with an electric or hydraulic driven pump can be determined on the ground but to determine the output from a wind driven pump system the aircraft will have to be flown at spraying speed.

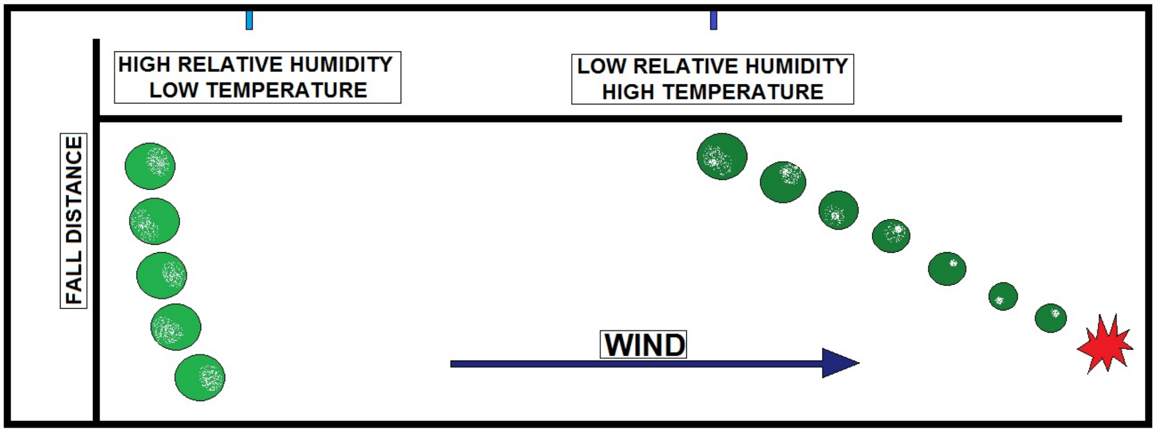


BOOM SPRAYER

ULV Spray Calibration

ULV spraying applies formulations, usually undiluted, in high concentrations of both active ingredient and non- volatile agents. There is a high degree of drift associated with the small droplets used for ULV spraying, which makes the technique more suited for large areas of crop, rangeland and for public health programs. The actual field spraying using aircraft is more demanding than that for conventional work because the viscosity and therefore the flow rate of formulations vary. Initial settings can be taken from the manufacturer's data for water but ready-to-use ULV formulations may have a higher viscosity and lower flow rate than water so will have to be corrected by multiplying the total flow rate by between 1.1 and 1.3 depending on the formulation viscosity.

Determining the speed of the aircraft over the ground is the same as for conventional spraying, however, with ULV spraying, the swath width will be wider as the aircraft is usually flown slightly higher. For ULV, there are fewer spray emission points on the boom than for conventional spraying and accordingly flying height should be increased by 6-10 feet to allow the spray plumes from each atomizer to fully develop and meet.



EVAPORATION OF PESTICIDE DROPLETS EXAMPLE

Otherwise, there is the danger of leaving untreated strips on each pass, however, and alternative solution is to increase the number of outlet points on the booms (i.e. additional atomizers at closer spacing). Flying height can be re-confirmed following and assessment of spray distribution, which must be included as part of the calibration process.

Rotary atomizers are usually propeller driven by the aircraft slipstream but where slow aircraft or helicopters are used, electric or hydraulic drives may be necessary. This is particularly important for helicopter spraying where atomizers must quickly regain operational speed to maintain the correct droplet size following sharp turns “out of and into work”.

The degree of phytotoxicity caused by pesticides may vary in response to a number of factors. Some toxicants (active ingredients) are particularly damaging to plants. Other components of the pesticide mixture, such as the diluent, may cause plant damage. The plants themselves may vary in susceptibility to injury by various chemicals. The phytotoxic reaction may vary with the species of plant, with the age of the plant, or with the weather at the time of exposure.

The manner in which a chemical is applied may determine whether or not injury will occur. For example, excessive pump pressures while spraying may cause physical injury to the plant or drive the chemical into the plant tissues.

Excessive concentrations of a chemical may cause plant damage. Certain combinations of pesticides may cause phytotoxic reactions.

Some pest problems require two or more chemicals combined in the tank mix. Mixtures are used commonly with great success. However, some chemicals are not compatible with others and one of the results of this incompatibility may by severe phytotoxicity. Many herbicide labels list other products with which they may be combined.

General Pesticide and Herbicide First Aid Sub-Section

It is still important to recognize signs and symptoms of pesticide/herbicide poisoning. When in doubt, seek medical attention and be sure to bring the fumigants label and SDS to the physician.

Poisoning Recognition
Certain pesticide/herbicide may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers.

Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific chemical or product involved and the level of exposure. If you have been working with pesticide/herbicides and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The pesticide/herbicide's label or SDS will have a telephone number to contact in case of a medical incident.

Procedures

- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the SDS for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Pesticide/herbicides on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Pesticide/herbicides in Eye
Eye exposure to pesticide/herbicides can be serious. Always pour, measure, or mix pesticide/herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Pesticide/herbicides contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Pesticide/herbicides in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Pesticide/herbicides in Mouth or Swallowed

Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator’s clothing becoming contaminated.

“Spill kits” are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Signs and Symptoms

Acute Exposure for Insecticide Active Ingredients

Active Ingredient	Brand Name	Signs and Symptoms
Acephate (organophosphate)	Orthene	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Aldicarb (N-methyl carbamate)	Temik	Malaise, muscle weakness, dizziness, sweating. Headache, salivation, nausea, vomiting, abdominal pain, diarrhea. Nervous system depression, pulmonary edema in serious cases.
Carbaryl (N-methyl carbamate)	Sevin	Malaise, muscle weakness, dizziness, sweating. Headache, salivation, nausea, vomiting, abdominal pain, diarrhea. Nervous system depression, pulmonary edema in serious cases.
Chlorpyrifos (organophosphate)	Dursban	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Endosulfan (organochlorine)	Thiodan	Itching, burning, tingling of skin. Headache, dizziness, nausea, vomiting, lack of coordination, tremor, mental confusion. Seizures, respiratory depression, coma.
Malathion (organophosphate)	Cythion	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Methyl Parathion (organophosphate)	Penncap-M	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Phosmet (organophosphate)	Imidan	Headache, excessive salivation and tearing, muscle twitching, nausea, diarrhea. Respiratory depression, seizures, loss of consciousness. Pinpoint pupils.
Pyrethrins (natural origin)		Irritating to skin and upper respiratory tract. Contact dermatitis and allergic reactions--asthma.
Pyrethroids (synthetic pyrethrin)	Cypermethrin, permethrin	Abnormal facial sensation, dizziness, salivation, headache, fatigue, vomiting, diarrhea. Irritability to sounds or touch. Seizures, numbness.

Signs and Symptoms of Acute Exposure for Herbicide Active Ingredients

Active Ingredient	Brand Name	Signs and Symptoms
2,4-dichlorophenoxyacetic acid	2,4-D, Barrage	Irritating to skin, mucous membranes. Vomiting, headache, diarrhea, confusion. Bizarre or aggressive behavior. Muscle weakness in occupationally exposed individuals.
Acetochlor	Harness, Surpass	Irritating to skin, eyes, and respiratory tract.
Atrazine	Aatrex, Atranex	Irritating to skin, eyes, and respiratory tract. Abdominal pain, diarrhea, vomiting. Eye irritation, irritation of mucous membranes, skin reactions.
Dicamba	Banvel, Metambane	Irritating to skin, respiratory tract. Loss of appetite (anorexia), vomiting, muscle weakness, slowed heart rate, shortness of breath. Central nervous system effects.
Glyphosate	Rodeo, Roundup	Irritating to skin, eyes, and respiratory tract.
Mecoprop	Kilporp, MCPP	Irritating to skin, mucous membranes. Vomiting, headache, diarrhea, confusion. Bizarre or aggressive behavior. Muscle weakness in occupationally exposed individuals.
Metolachlor	Bicep, Dual	Irritating to skin, eyes
Paraquat	Gramoxone	Burning in mouth, throat, chest, upper abdomen. Diarrhea. Giddiness, headache, fever, lethargy. Dry, cracked hands, ulceration of skin.
Pendimethalin	Prowl, Stomp	Irritating to skin, eyes, respiratory tract
Propanil	Propanex, Stampede	Irritating to skin, eyes, respiratory tract

Signs and Symptoms of Acute Exposure for Fungicide Active Ingredients

Active Ingredient	Brand Name	Signs and Symptoms
Azoxystrobin	Abound, Quadris	Irritating to skin, eyes, respiratory tract
Captan	Captol, Orthocide	Irritating to skin, eyes, respiratory tract
Chlorothalonil	Bravo, Daconil	Irritation to skin, mucous membranes of the eye, respiratory tract. Allergic contact dermatitis.
Copper Compounds	Bordeaux mixture, Copper sulfate	Irritating to skin, eyes, respiratory tract. Salts are corrosive to mucous membranes and cornea Metallic taste, nausea, vomiting, intestinal pain.
Mancozeb	Dithane M-45, Manzate 200	Irritating to skin, eyes, respiratory tract
Maneb	Dithane M-22, Manzate	Irritating to skin, eyes, respiratory tract. Skin disease in occupationally exposed individuals.
Pentachloronitrobenzene	PCNB, Terraclor	Allergic reactions
Sulfur	Cosan, Thiolux	Irritating to skin, eyes, respiratory tract. Breath odor of rotten eggs. Diarrhea. Irritant dermatitis in occupationally exposed individuals
Thiram	Polyram-Ultra, Spotrete-F	Irritating to skin, eyes, respiratory mucous membranes
Ziram	Cuman, Vancide	Irritating to skin, eyes, respiratory tract Prolonged inhalation causes neural and visual disturbances

CATEGORY	NONREFILLABLE CONTAINERS	REFILLABLE CONTAINERS	REPACKING PESTICIDE PRODUCTS	CONTAINER LABELING	CONTAINMENT STRUCTURES
WHO MUST COMPLY	REGISTRANTS	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS PESTICIDE USERS (Must Follow New Directions)	AG RETAILERS AG COMMERCIAL APPLICATORS AG CUSTOM BLENDERS
MAJOR REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • CONTAINER DISPENSING CAPABILITY • STANDARD CLOSURES • RESIDUAL REMOVAL • RECORDKEEPING	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• IDENTIFY CONTAINER AS NONREFILLABLE OR FILLABLE (All) • STATEMENTS TO PROHIBIT REUSE AND OFFER FOR RECYCLING; BATCH CODE (All Nonrefillables) • CLEANING INSTRUCTIONS • CLEANING INSTRUCTONS BEFORE FINAL DISPOSAL	•SECONDARY CONTAINMENT STRUCTURES (Dikes) AROUND STATIONARY TANKS •CONTAINMENT PADS FOR PESTICIDE DISPENSING AREAS •GOOD OPERATING PROCEDURES •MONTHLY INSPECTION OF TANKS AND STRUCTURES •RECORDKEEPING
COMPLIANCE DATE	AUGUST 17, 2009	AUGUST 17, 2011	AUGUST 17, 2011	AUGUST 16, 2011 (Based on the October 8, 2010 Final Rule)	AUGUST 17, 2009

PESTICIDE CONTAINER AND CONTAINMENT RULE

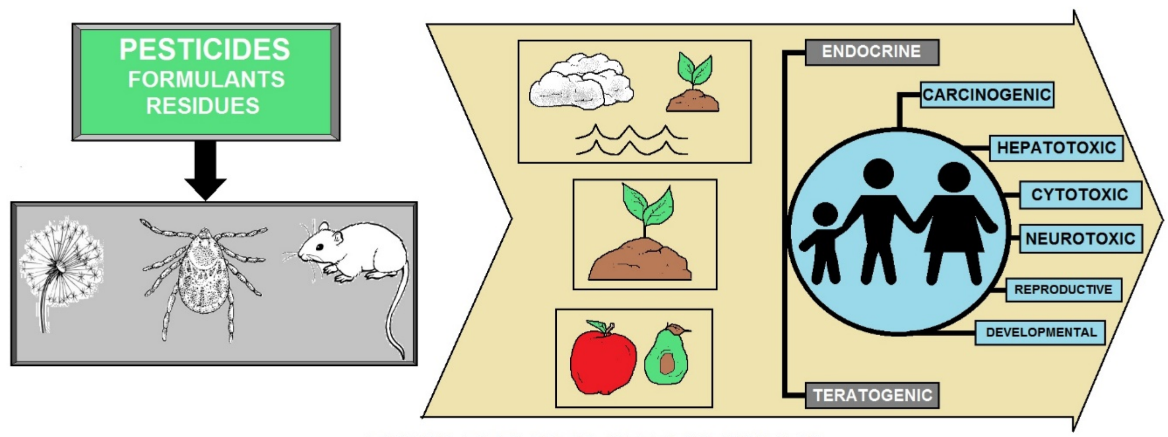
Technical Learning College

Pesticide Emergency Procedures

"Help! Someone's Been Poisoned!"

What to Do in a Pesticide Emergency
If the person is unconscious, having trouble breathing, or having convulsions, ACT FAST! Speed is crucial. Give needed first aid immediately. Call 911 or your local emergency service. If possible, have someone else call for emergency help while you give first aid. If the person is awake or conscious, not having trouble breathing, and not having convulsions . . .

Read the label for first aid instructions.
Call your local poison center at 1-800-222-1222, or the National Pesticide Information Center at 1-800-858-7378. Give first aid.



TOXIC EFFECTS OF PESTICIDES

First Aid for Pesticide Poisoning
When you realize a pesticide poisoning has occurred or is occurring, try to determine what the victim was exposed to and what part of the body was affected before you take action—taking the right action is as important as taking immediate action. If the person is unconscious, having trouble breathing, or having convulsions, ACT FAST! Speed is crucial. Give needed first aid immediately.

Call 911 or your local emergency service. If possible, have someone else call for emergency help while you give first aid. If the person is awake or conscious, not having trouble breathing, and not having convulsions, read the label for first aid instructions.

Call your local poison center at 1-800-222-1222 or the National Pesticide Information Center at 1-800-858-7378. Give first aid.

Read the Statement of Practical Treatment section on the product label. The appropriate first aid treatment depends on the kind of poisoning that has occurred. Follow these general guidelines:

Swallowed poison
A conscious victim should drink a small amount of water to dilute the pesticide. Induce vomiting only if a poison center or physician advises you to do so. Call the poison center at 1-800-222-1222.

Poison on skin
Drench skin with water for at least 15 minutes. Remove contaminated clothing. Wash skin and hair thoroughly with soap and water. Later, discard contaminated clothing or thoroughly wash it separately from other laundry.

Chemical burn on skin
Drench skin with water for at least 15 minutes. Remove contaminated clothing. Cover burned area immediately with loose, clean, soft cloth. Do not apply ointments, greases, powders, or other drugs. Later, discard contaminated clothing or thoroughly wash it separately from other laundry.

Poison in Eye
Hold eyelid open and wash eye quickly and gently with clean cool running water from the tap or a hose for 15 minutes or more. Use only water; do not use eye drops, chemicals, or drugs in the eye. Eye membranes absorb pesticides faster than any other external part of the body, and eye damage can occur in a few minutes with some types of pesticides. If a poisoning has occurred, call for help, and be ready to read information from the pesticide label.

Inhaled Poison
If the victim is outside, move or carry the victim away from the area where pesticides were recently applied. If the victim is inside, carry or move the victim to fresh air immediately. If you think you need protection like a respirator before helping the victim, call the Fire Department and wait for emergency equipment before entering the area. Loosen the victim's tight clothing. If the victim's skin is blue or the victim has stopped breathing, give artificial respiration (if you know how) and call 911 for help. Open doors and windows so no one else will be poisoned by fumes.

What to Do After First Aid
First aid may precede but should not replace professional medical treatment. After giving first aid, call the poison center at 1-800-222-1222. Have the pesticide label at hand when you call. If emergency treatment is needed in a doctor's office or emergency room, carry the container in your trunk or flatbed away from the passengers in your vehicle. The doctor needs to know what active ingredient is in the pesticide before prescribing treatment. This information is on the label, which sometimes also includes a telephone number to call for additional treatment information.

National Pesticide Information Center
Another good resource in a pesticide emergency is NPIC, the National Pesticide Information Center, a toll-free telephone service that operates seven days a week, from 6:30 a.m.–4:30 p.m. Pacific Time (9:30 a.m.–7:30 p.m. Eastern Time). NPIC provides information on pesticides and how to recognize and respond to pesticide poisonings. If necessary, staff at NPIC can transfer your call directly to a local poison center. Call NPIC toll free at 1-800-858-7378.

Animal Poisonings
NPIC staff answer questions about animal poisonings, too. To keep your pets from being poisoned, follow label directions on flea and tick products carefully. If you are concerned about the chemicals used in these products, consult your veterinarian.

How to Recognize Pesticide Poisoning
External Irritants
That contact skin may cause skin damage such as redness, itching, or pimples. External irritants may also cause an allergic skin reaction that produces redness, swelling, or blistering. The mucous membranes of the eyes, nose, mouth, and throat are also quite sensitive to chemicals. Pesticide exposure may cause stinging and swelling in these membranes.

CHEMICAL SPILL / EMERGENCY RESPONSE

Internal Injuries
Also may occur if a pesticide is swallowed, inhaled, or absorbed through the skin. Symptoms vary from organ to organ. Lung injury may result in shortness of breath, drooling (heavy salivation), or rapid breathing. Direct injury to the stomach and intestines may produce nausea, vomiting, abdominal cramps, or diarrhea. Injury to the nervous system may cause excessive fatigue, sleepiness, headache, muscle twitching, and numbness. In general, different types of pesticides produce different sets of symptoms.

If someone develops symptoms after working with pesticides, seek medical help immediately to determine if the symptoms are pesticide related. In certain cases, blood or urine should be collected for analysis, or other specific exposure tests can be made. It is better to be too cautious than too late.

What spills need to be reported?
The requirement to report a chemical spill is based on the potential for harm to human health or the environment from the spill. Therefore, it is impossible to give simple guidance.

Who can help me decide how to respond to a spill?
The National Response Center can help you decide how to respond to a spill. They can be reached at 1-800-424-8802. In addition, CHEMTREC maintains a large database of Material Safety Data Sheets, chemical information references resources, and networks of chemical and hazardous material experts. CHEMTREC provides access to technical information regarding chemical products as well as telephone access to product specialists, chemists, or other experts. (1-800-424-9300 in the U.S. or 703-527-3887 outside the U.S.)

CERCLA
The Comprehensive Environmental Response, Compensations, and Liability Act requires that all releases of hazardous substances (including radionuclides) exceeding reportable quantities be reported by the responsible party to the National Response Center. Title 40 of the Code of Federal Regulations Part 302 promulgates reportable quantities and reporting criteria. All the Extremely Hazardous Chemicals (EHS) that overlap with the CERCLA listed chemicals table (40 CFR Part 302.4) should be reported to NRC as well as to the LEPC and SERC.

For small pesticide spills or for more information, call the pesticide manufacturer or the National Pesticide Information Center (NPIC) at 1-800-858-7378.

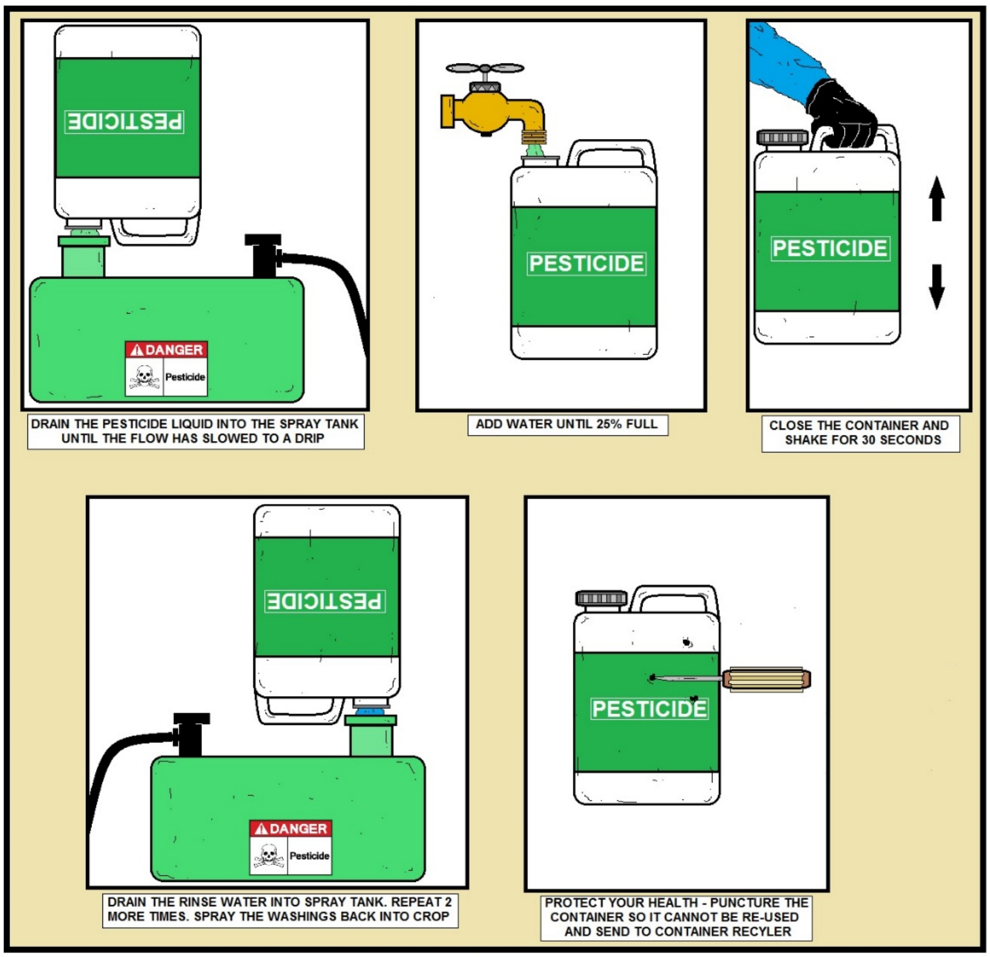
How do I report a spill?
The National Response Center (NRC) is the sole federal point of contact for reporting oil and chemical spills. If you have a spill to report, contact NRC at 1-800-424-8802 (toll-free) or check out their Web site for additional information on reporting requirements and procedures. For those without 800 access, please contact the NRC at 202-267-2675.

Where can I get more information?
For more information, contact the National Pesticide Information Center (NPIC) at 1-800-858-7378.

Pesticide Incident Reporting

Emergency Information

Federal law requires registrants of pesticides to inform EPA about harmful effects of their products. These effects include, for example, unexpected levels of toxicity observed in test animals or incidents such as death or hospitalization of a person. Information reportable under this provision includes not only new information derived from scientific studies, but also reports of incidents of harmful effects resulting from the use of pesticide products. Thus, the requirement provides an important check on the correctness of the original decision to register a pesticide.



PROPER DISPOSAL OF PESTICIDE CONTAINERS

Pesticide Container and Containment Rule

Resources

EPA is required by the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA) to promulgate regulations prescribing procedures and standards for container design and the removal of pesticides from containers prior to disposal. Information on this page will help registrants, refillers, retailers, commercial applicators and custom blenders to comply with the requirements of this rule.

See Sections 19(e) and (f) of the FIFRA. EPA's final regulations, "Standards for Pesticide Containers and Containment" were published in a Federal Register notice on August 16, 2006 - part a, part b, and part c.

On October 29, 2008, EPA published a final rule that amended the pesticide container and containment regulations to provide a one-year extension of the labeling compliance date; to make some other changes to the label requirements; and to correct typographical and other minor errors. See below for more details about the final amendments. On October 8, 2010, EPA published a final rule that extended the labeling compliance date to August 16, 2011.

The pesticide container and containment regulations include five sections, which are described below.

1. Non-refillable Containers: This section addresses "one-way" or disposable containers and applies to pesticide registrants. The purpose of these standards is to ensure that containers are strong and durable, minimize human exposure during container handling and facilitate container disposal and recycling.

2. Refillable Containers: This section applies to containers that are intended to be refilled and reused more than once and applies to pesticide registrants. The purpose of these standards is to ensure that containers are strong and durable, minimize cross-contamination of pesticides distributed in refillable containers, and encourage the use of refillable containers to reduce container disposal problems.

3. Repackaging: This section, which describes procedures and other safeguards for repackaging pesticide into refillable containers, applies to pesticide registrants and anyone who refills pesticide containers for sale (registrants, formulators, distributors and dealers). These regulations are intended to minimize cross-contamination of pesticides distributed in refillable containers, codify safe refilling management practices and encourage the use of refillable containers to reduce container disposal problems.

4. Labeling: The labeling segment includes instructions for how to properly clean pesticide containers and a statement identifying the container as non-refillable or refillable. Pesticide registrants are required to ensure that labels include the specified information. Pesticide users are required to comply with the instructions on the labels.

5. Containment Structures: This section establishes standards for secondary containment structures at certain bulk storage sites and for containment pads at certain pesticide dispensing operations. Pesticide dealers who repackage pesticides, commercial applicators and custom blenders have to comply with the requirements. The purpose of these standards is to protect the environment from leaks and spills at bulk storage areas and from contamination due to pesticide dispensing operations.

The pesticide label is your best guide to using pesticides safely and effectively. The directions on the label are there primarily to help you achieve "maximum" benefits—the pest control that you desire— with "minimum" risk. Both depend on following label directions and correctly using the pesticide. Read the label.

Read the label before buying the pesticide. Read the label before mixing or using the pesticide each time, and read the label before storing or disposing of the pesticide. Do not trust your memory. You may have forgotten part of the label instructions or they may have changed. Use of any pesticide in any way that is not consistent with label directions and precautions is illegal. It may also be ineffective and, even worse, dangerous.

Emergency Assistance - Basic Requirements

(See Also Specific Duties Section Below)
Worker employers must provide emergency assistance, described below, to anyone who is or has been employed as a **worker** on their farm, forest, nursery, or greenhouse if there is reason to believe that the worker has been poisoned or injured by a pesticide used on the agricultural establishment — for example, through application, spills, splashes, drift, or contact with pesticide residues.

READ THE LABEL!

Pesticide handler employers must provide emergency assistance, described below, to anyone who is or has been employed as a **handler** on their farm, forest, nursery, or greenhouse or on their commercial pesticide handling establishment, if there is reason to believe that the handler has been poisoned or injured by a pesticide as a result of that employment — for example, through application, spills, splashes, drift, handling tasks, or contact with pesticide residues.

Specific Duties Emergency Transportation
1. Promptly make emergency transportation available to take the **worker** to an emergency medical facility able to provide treatment:

- from the agricultural establishment, *or Employers can "make transportation taking the employee to the emergency medical facility,* or *calling an such as an ambulance,* or *making sure the employee has a ride to the medical and facility with someone else.*

- from a labor camp located on the establishment.

2. Promptly make emergency transportation available to take the **handler** to an *available" by:* emergency medical facility able to provide treatment:

- from the agricultural establishment, *or*
- from another handling site, such as a commercial handling establishment or an airport hangar.

Emergency Information

Provide to the worker or handler or to treating medical personnel, promptly upon *emergency vehicle,* request, any obtainable information on:

- product name, EPA registration number, and active ingredients for any product(s) to which the person may have been exposed,
- antidote, first aid, statement of practical treatment and other medical or emergency information from the product labeling,
- description of the way the pesticide was being used,
- circumstances of the worker's or handler's exposure to the pesticide.

Emergency Assistance

If there is reason to believe that a worker has been poisoned or injured by pesticides, the employer must make prompt transportation to a medical facility available to the worker. On request the employer must provide, to either the worker or medical personnel providing treatment, information about the product including the EPA registration number, active ingredients in any product the worker might have been exposed to in the past 30 days, antidote and other first aid information from the product labeling, and information about the application and the exposure of workers to the pesticide.

Requirements for Handlers

The general applicability, exceptions and exemptions in the requirements for handlers and workers are the same. However, the requirements for handlers have specific differences.

Respiratory Protection Sub-Section

General
In the Respiratory Protection program, pesticide hazard assessment and selection of proper respiratory PPE is conducted in the same manner as for other types of PPE. In the control of those occupational diseases caused by breathing air contaminated with harmful pesticide related dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination.

This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation, and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used.

References: OSHA Standards ***Respiratory Protection*** (29 CFR 1910.134)

Why Respirators Are Needed
Respirators protect against the inhalation of dangerous substances (pesticide vapors, fumes, dust, gases). They can also provide a separate air supply in a very hazardous situation.

Some of the health hazards that respirators prevent include:
- *Lung damage*
- *Respiratory diseases*
- *Cancer and other illnesses.*

Respiratory Protection Responsibilities:
The employer is responsible for,
- Providing training in the use and care of respirators
- Ensuring that equipment is adequate, sanitary, and reliable
- Allowing employees to leave area if ill, for breaks, and to obtain parts
- Fit testing
- Providing annual medical evaluation
- Providing a powered air-purifying respirator (**PAPR**) if an employee cannot wear a tight-fitting respirator

The Employee is responsible for:
- Properly using respirators
- Maintaining respirator properly
- Reporting malfunctions
- Reporting medical changes

Selection of Respiratory Protection
When choosing the correct respiratory protection for your work environment, it is important to consider:
- Identification of the substance or substances for which respiratory protection is necessary
- A substance's material safety data sheet (**SDS**) (it will state which type of respirator is most effective for the substance)
- Activities of the workers

- Hazards of each substance and its properties
- Maximum levels of air contamination expected
- Probability of oxygen deficiency
- Period of time workers will need to use the respiratory protection devices
- Capabilities and physical limitations of the device used

Basic Types of Respirators
Air-purifying or filtering respirators. Such respirators are used when there is enough oxygen (at least 19.5 percent) and contaminants are present below IDLH level. The respirator filters out or chemically "*scrubs*" contaminants, usually with a replaceable filter. Use color-coded filter cartridges or canisters for different types of contaminants. It is important to select the right filter for the situation.

Air-supplying respirators. These respirators are required when air-purifying respirators are not effective. Air-purifying respirators are not sufficient in the following settings:

- When there is not enough oxygen
- Confined spaces
- When contaminants cannot be filtered out
- When contaminants are at or above IDLH level.

Different kinds of Air-Supplying Respirators include

- Those connected by hose to stationary air supply (airline)
- Portable tank self-contained breathing apparatus (**SCBA**).

The Importance of Correct Fit

Even a tiny gap between the respirator and the face can allow contaminants to enter. Respirators should be comfortable and properly fitted. Proper fit includes:

- Secure but not too tight
- No slipping or pinching
- Allowance for head movement and speech

An OSHA-accepted qualitative fit test or quantitative fit test must be performed prior to an employee using any tight-fitting respirator.

Tight-fitting respirators must be seal checked before each use by using positive- or negative-pressure check procedures or the manufacturer's instructions.

Respirator Filters/Cartridges

For protection against pesticide gases and vapors, the cartridges used for air-purifying respirators must be either equipped with an end-of-service-life indicator (ESLI), certified by NIOSH for the contaminant, or a cartridge change schedule has to be established.

For protection against particulates, there are nine classes of filters (three levels of filter efficiency, each with three categories of resistance to filter efficiency degradation). Levels of filter efficiency are 95 percent, 99 percent, and 99.97 percent. Categories of resistance to filter efficiency degradation are labeled N, R, and P.

Protection Factors

The protection factor of a respirator is an expression of performance based on the ratio of two concentrations: The contaminant concentration outside the respirator to the contaminant concentration inside the respirator. Each class of respirator is also given an assigned protection factor (APF). The APF is a measure of the minimum anticipated level of respiratory protection that a properly functioning respirator or class of respirators would provide to a percentage of properly fitted and trained users. When a contaminant concentration is known, the APF can be used to estimate the concentration inside a particular type of respirator worn by a user.

Who Cannot Wear a Respirator?

Respirator fit is essential. Employees must have a medical checkup to make sure they can wear respirators safely. Generally, respirators cannot be worn when a person:

- Wears glasses or personal protective equipment that interferes with the seal of the face piece to the face of the user
- Has facial hair that comes between the sealing surface of the face piece and the face or interferes with valve function
- Has a breathing problem, such as asthma
- Has a heart condition
- Is heat sensitive

Sometimes a person's facial features will not permit a good fit. Check with the supervisor or medical department if the fit is a problem.

Checking for Damage
Before each use, make sure there are no holes, tears, etc., in the respirator. Rubber parts can wear out and should be checked very carefully every time a respirator is used. Replace worn and damaged parts when necessary. Make sure air and oxygen cylinders are fully charged.

Staying Prepared for Respirator Use
Respirators are bulky and awkward, so getting used to them takes practice. Possible problems with wearing respirators may include heat exhaustion or heat stroke. Be alert for symptoms, use the "buddy system," and wear a lifeline or harness when necessary. Drink plenty of fluids and take frequent breaks. Poor maneuverability.

Practice with respirators in narrow passages, on ladders, etc., if your use of respirators may be in these types of conditions. Using up the air supply. When a SCBA is in use, keep checking the gauges and listening for alarms; be ready to leave the area immediately if there is a problem. Panic. Remember the importance of staying calm in a hot, stressful, or awkward situation.

Cleaning Respirators
Respirators should be cleaned and disinfected after every use. Check the respirator for damage before putting it away; look for holes, cracks, deterioration, dented cartridges, etc. If any damage is found, it should be reported to a supervisor. Respirators stored for emergency use must be inspected monthly when not in use, as well as after each use.

Respirators should be stored away from light, heat, cold, chemicals, and dust. Store respirators in a "*normal*" (natural, undistorted) position to hold their shape. Do not allow respirators to get crushed, folded, or twisted.

Overview
OSHA requires that supervisors consult with employees and encourage their participation in the process safety management plan. In fact, managers must have a written plan of action for employee participation in process safety management.

Employee participation is critical because;
- Employees know a lot about the process they work on.
- They play key roles in making sure that process operation is conducted safely.

Operating Procedures
Pesticide managers must furnish written operating procedures that clearly explain how to perform each covered process safely. The procedures must be accurate and must be written in language that employees can understand. Avoid technical jargon and, if necessary, supply translations.

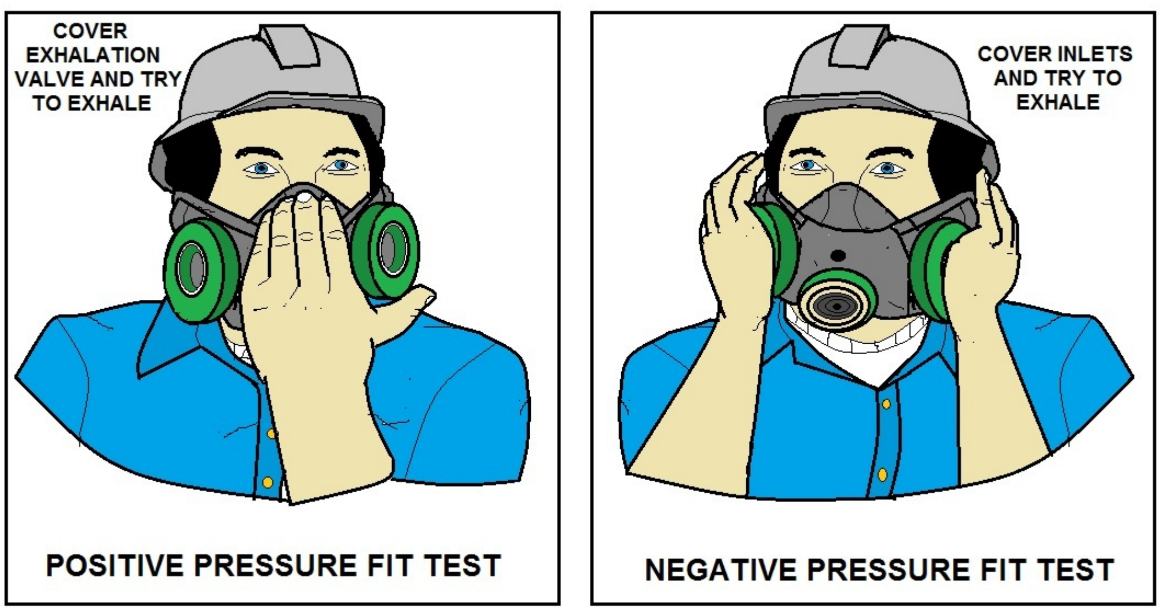
Operating procedures must include at least the following:

- Operating steps for initial startup, normal and temporary operations, emergency shutdown (including when it is called for and who does it), emergency operations, normal shutdown, and startup after a turnaround or an emergency shutdown.

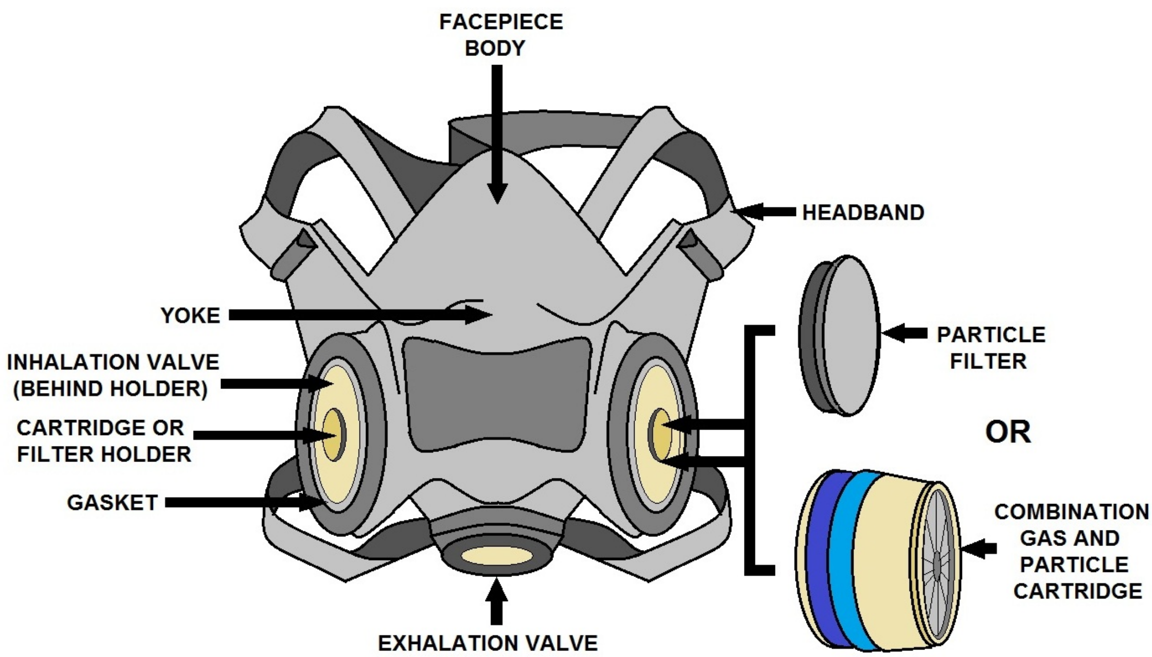
- Operating limits, including what happens if workers do not conform to operating limits and how to avoid or correct such problems.

- Safety and health considerations, such as chemical or other hazards, precautions to prevent exposure, quality and inventory control for chemicals, and what to do if an employee is exposed to a hazardous substance.

- Safety systems and their functions, including up-to-date operating procedures and safe work practices.



POSITIVE AND NEGATIVE PRESSURE FIT CHECKS



BASIC PARTS OF A HALF-FACEPIECE RESPIRATOR

NIOSH TC Number	Type of Respirator
TC-84A	Air-purifying respirator (APR) with a particulate filter or an APR with a combination chemical cartridge and a particulate filter.
TC-14G	Full-face gas mask APR with canister-type filter for a specific type of chemical contaminant – typically organic vapors.
TC-23C	Powered air-purifying respirator (PAPR) with a combination chemical cartridge and particulate filter.
TC-21C	PAPR with particulate filter only.

Respiratory Protection Written Program

This paragraph requires the pesticide employer to develop and implement a written respiratory protection program with required worksite-specific procedures and elements for required respirator use. The program must be administered by a suitably trained program administrator. In addition, certain program elements may be required for voluntary use to prevent potential hazards associated with the use of the respirator.

The Small Entity Compliance Guide contains criteria for the selection of a program administrator and a sample program that meets the requirements of this paragraph. Copies of the Small Entity Compliance Guide is available from the Occupational Safety and Health Administration's Office of Publications, Room N 3101, 200 Constitution Avenue, NW, Washington, DC, 20210 (202-219-4667).

(c)(1) In any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required by the employer, the employer shall establish and implement a written respiratory protection program with worksite-specific procedures. The program shall be updated as necessary to reflect those changes in workplace conditions that affect respirator use. The employer shall include in the program the following provisions of this section, as applicable:

(c)(1)(i) Procedures for selecting respirators for use in the workplace;

(c)(1)(ii) Medical evaluations of employees required to use respirators;

(c)(1)(iii) Fit testing procedures for tight-fitting respirators;

(c)(1)(iv) Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

(c)(1)(v) Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and otherwise maintaining respirators;

(c)(1)(vi) Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

(c)(1)(vii) Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations;

Example of Responsibilities
All Employees shall follow the requirements of the Respiratory Protection Program.

Management
- implement the requirements of this program
- provide a selection of respirators as required
- enforce all provisions of this program
- appoint a *Specific Designated* individual to conduct the respiratory protection program

Administrative Department
- Review sanitation/storage procedures.
- ensure respirators are properly, stored, inspected and maintained.
- monitor compliance for this program.
- provide training for affected Employees.
- review compliance and ensure monthly inspection of all respirators.
- provide respirator fit testing.

Designated Occupational Health Care Provider
- conducts medical aspects of program.

Program Administrator
Each Department will designate a program administrator who is qualified by appropriate training or experience that is commensurate with the complexity of the program to administer or oversee the respiratory protection program and conduct the required evaluations of program effectiveness.

Voluntary Use of Respirators is Prohibited
OSHA requires that voluntary use of respirators, when not required by the Employer, must be controlled as strictly as under required circumstances. To prevent violations of the Respiratory Protection Standard, Employees are not allowed voluntary use of their own or Employer supplied respirators of any type.

Exception: Employees whose only use of respirators involves the voluntary use of filtering (non-sealing) face pieces (dust masks).

Program Evaluation
Evaluations of the workplace are necessary to ensure that the written respiratory protection program is being properly implemented; this includes consulting with employees to ensure that they are using the respirators properly. Evaluations shall be conducted as necessary to ensure that the provisions of the current written program are being effectively implemented and that it continues to be effective.

Program evaluation will include discussions with employees required to use respirators to assess the employees' views on program effectiveness and to identify any problems.

Any problems that are identified during this assessment shall be corrected. Factors to be assessed include, but are not limited to:
- Respirator fit (including the ability to use the respirator without interfering with effective workplace performance);
- Appropriate respirator selection for the hazards to which the employee is exposed;
- Proper respirator use under the workplace conditions the employee encounters; and
- Proper respirator maintenance.

RP Recordkeeping

The pesticide employer will retain written information regarding medical evaluations, fit testing, and the respirator program.

This information will facilitate employee involvement in the respirator program, assist the Employer in auditing the adequacy of the program, and provide a record for compliance determinations by OSHA.

Training and Information
Effective training for pesticide applicators who are required to use respirators is essential. The training must be comprehensive, understandable, and recur annually and more often if necessary. Training will be provided prior to requiring the employee to use a respirator in the workplace.

The training shall ensure that each employee can demonstrate knowledge of at least the following:

- Why the respirator is necessary and how improper fit, usage, or maintenance can compromise the protective effect of the respirator
- Limitations and capabilities of the respirator
- How to use the respirator effectively in emergency situations, including situations in which the respirator malfunctions
- How to inspect, put on and remove, use, and check the seals of the respirator
- What the procedures are for maintenance and storage of the respirator
- How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators
- The general requirements of this program

Retraining shall be conducted annually and when:

- changes in the workplace or the type of respirator render previous training obsolete
- inadequacies in the employee's knowledge or use of the respirator indicate that the employee has not retained the requisite understanding or skill
- other situations arise in which retraining appears necessary to ensure safe respirator use

Training is divided into the following sections:

Classroom Instruction

1. Overview of the pesticide employer's Respiratory Protection Program & OSHA Standard
2. Respiratory Protection Safety Procedures
3. Respirator Selection
4. Respirator Operation and Use
5. Why the respirator is necessary
6. How improper fit, usage, or maintenance can compromise the protective effect.
7. Limitations and capabilities of the respirator.
8. How to use the respirator effectively in emergency situations, including respirator malfunctions
9. How to inspect, put on and remove, use, and check the seals of the respirator.
10. What the procedures are for maintenance and storage of the respirator.

11. How to recognize medical signs and symptoms that may limit or prevent the effective use of respirators.
12. Change out schedule and procedure for air purifying respirators.

Fit Testing - Hands-on Respirator Training (see appendix A for more information)
1. Respirator Inspection
2. Respirator cleaning and sanitizing
3. Record Keeping
4. Respirator Storage
5. Respirator Fit Check
6. Emergencies

Basic Respiratory Protection Safety Procedures
1. Only authorized and trained Employees may use Respirators. Those Employees may use only the Respirator that they have been trained on and properly fitted to use.
2. Only Physically Qualified Employees may be trained and authorized to use Respirators. A pre-authorization and annual certification by a qualified physician will be required and maintained. Any changes in an Employees health or physical characteristics will be reported to the Occupational Health Department and will be evaluated by a qualified physician.
3. Only the proper prescribed respirator or SCBA may be used for the job or work environment. Air cleansing respirators may be worn in work environments when oxygen levels are between 19.5 percent to 23.5 percent and when the appropriate air cleansing canister, as determined by the Manufacturer and approved by NIOSH or MESA, for the known hazardous substance is used. SCBAs will be worn in oxygen deficient and oxygen rich environments (below 19.5 percent or above 23.5 percent oxygen).
4. Employees working in environments where a sudden release of a hazardous substance is likely will wear an appropriate respirator for that hazardous substance (example: Employees working in an ammonia compressor room will have an ammonia APR respirator on their person.).
5. Only SCBAs will be used in oxygen deficient environments, environments with an unknown hazardous substance or unknown quantity of a known hazardous substance or any environment that is determined *"Immediately Dangerous to Life or Health"* (IDLH).
6. Employees with respirators loaned on "permanent check out" will be responsible for the sanitation, proper storage and security. Respirators damaged by normal wear will be repaired or replaced by the Employer when returned.
7. The last Employee using a respirator and/or SCBA that are available for general use will be responsible for proper storage and sanitation. Monthly and after each use, all respirators will be inspected with documentation to assure its availability for use.
8. All respirators will be located in a clean, convenient and sanitary location.
9. In the event that Employees must enter a confined space, work in environments with hazardous substances that would be dangerous to life or health should an RPE fail (a SCBA is required in this environment), and/or conduct a HAZMAT entry, a "*buddy system*" detail will be used with a Safety Watchman with constant voice, visual or signal line communication. Employees will follow the established Emergency Response Program and/or Confined Space Entry Program when applicable.
10. Management will establish and maintain surveillance of jobs and work place conditions and degree of Employee exposure or stress to maintain the proper procedures and to provide the necessary RPE.
11. Management will establish and maintain safe operation procedures for the safe use of RPE with strict enforcement and disciplinary action for failure to follow all general and specific safety rules.

Selection of Respirators

The pesticide employer is responsible for and needs to have evaluated the respiratory hazard(s) in each workplace, identified relevant workplace and user factors and has based respirator selection on these factors. Also included are estimates of employee exposures to respiratory hazard(s) and an identification of the contaminant's chemical state and physical form.

This selection has included appropriate protective respirators for use in IDLH atmospheres, and has limited the selection and use of air-purifying respirators. All selected respirators are NIOSH-certified.

Filter Classifications - These classifications are marked on the filter or filter package
N-Series: Not Oil Resistant

- Approved for non-oil particulate contaminants
- Examples: pesticides, dust, fumes, mists not containing oil

R-Series: Oil Resistant

- Approved for all particulate contaminants, including those containing oil
- Examples: dusts, mists, fumes
- Time restriction of 8 hours when oils are present

P-Series: Oil Proof

- Approved for all particulate contaminants including those containing oil
- Examples: pesticides, dust, fumes, mists
- See Manufacturer's time use restrictions on packaging

Respirators for IDLH atmospheres.

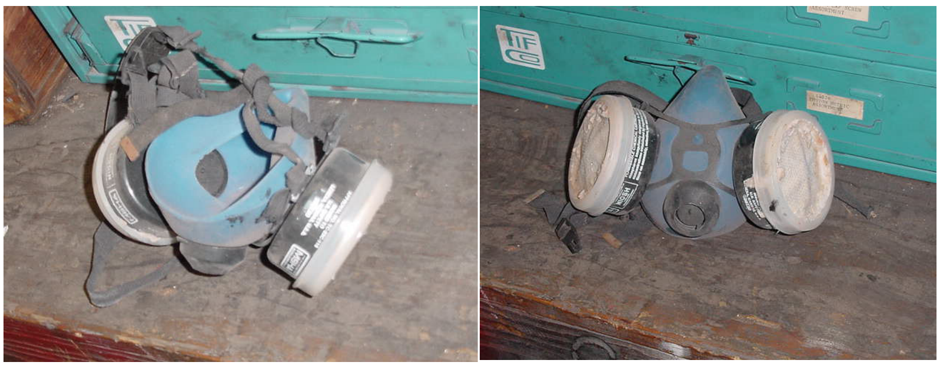
- The following respirators will be used in IDLH atmospheres:
- A full face piece pressure demand SCBA certified by NIOSH for a minimum service life of thirty minutes, or
- A combination full-face piece pressure demand supplied-air respirator (**SAR**) with auxiliary self-contained air supply.
- Respirators provided only for escape from IDLH atmospheres shall be NIOSH-certified for escape from the atmosphere in which they will be used.

Respirators for atmospheres that are not IDLH.
The respirators selected for pesticide applications shall be adequate to protect the health of the employee and ensure compliance with all other OSHA statutory and regulatory requirements, under routine and reasonably foreseeable emergency situations. The respirator selected shall be appropriate for the chemical state and physical form of the contaminant.

Identification of Filters & Cartridges
All filters and cartridges shall be labeled and color coded with the NIOSH approval label and the label must not be removed and remain legible. A change out schedule for filters and canisters has been developed to ensure these elements of the respirators remain effective.

Respirator Filter & Canister Replacement
An important part of the Respiratory Protection Program includes identifying the useful life of canisters and filters used on air-purifying respirators. Each filter and canister shall be equipped with an end-of-service-life indicator (ESLI) certified by NIOSH for the contaminant; ***or***

If there is no ESLI appropriate for conditions, a change schedule for canisters and cartridges that is based on objective information or data that will ensure that canisters and cartridges are changed before the end of their service life.



Unacceptable maintenance and storage. (OSHA Violation)

Filter & Cartridge Change Schedule
Stock of spare filters and cartridges shall be maintained to allow immediate change when required or desired by the employee.

Cartridges shall be changed based on the most limiting factor below:
- Prior to expiration date
- Manufacturers recommendations for the specific use and environment
- After each use
- When requested by employee
- When contaminate odor is detected
- When restriction to air flow has occurred as evidenced by increase effort by user to breathe normally
- Cartridges shall remain in their original sealed packages until needed for immediate use

Filters shall be changed on the most limiting factor below:
- Prior to expiration date
- Manufacturers recommendations for the specific use and environment
- When requested by employee
- When contaminate odor is detected
- When restriction to air flow has occurred as evidenced by increase effort by user to breathe normally
- When discoloring of the filter media is evident
- Filters shall remain in their original sealed package until needed for immediate use.

Respiratory Protection Schedule by Job and Working Condition

The Pesticide Employer needs to maintain a Respiratory Protection Schedule by Job and Working Condition. This schedule is provided to each authorized and trained Employee. The Schedule provides the following information:

1. Job/Working Conditions
2. Work Location
3. Hazards and /or Pesticides Present
4. Type of Respirator or SCBA Required
5. Type of Filter/Canister Required
6. Location of Respirator or SCBA
7. Filter/Cartridge change out schedule

The schedule will be reviewed and updated at least annually and whenever any changes are made in the work environments, machinery, equipment, or processes or if different respirator models are introduced or existing models are removed.

Permanent respirator schedule assignments are:
Each person who engages in welding will have their own employer provided dust-mist-fume filter APR.

Physical and Medical Qualifications
Records of medical evaluations must be retained and made available in accordance with 29 CFR 1910.1020.

Medical evaluation required
Using a respirator may place a physiological burden on employees that varies with the type of respirator worn, the job and workplace conditions in which the respirator is used, and the medical status of the employee. The employer is required to provide a medical evaluation to determine the employee's ability to use a respirator before the employee is fit tested or required to use the respirator in the workplace.

Medical evaluation procedures
The employee will be provided a medical questionnaire by the designated Occupational Health Care Provider

Follow-up Medical Examination
The Pesticide Employer shall ensure that a follow-up medical examination is provided for an employee who gives a positive response to any question among questions in Part B of the questionnaire or whose initial medical examination demonstrates the need for a follow-up medical examination. The follow-up medical examination shall include any medical tests, consultations, or diagnostic procedures that the Physician deems necessary to make a final determination.

Administration of the Medical Questionnaire and Examinations
The medical questionnaire and examinations shall be administered confidentially during the employee's normal working hours or at a time and place convenient to the employee. The medical questionnaire shall be administered in a manner that ensures that the employee understands its content. The Employer shall provide the employee with an opportunity to discuss the questionnaire and examination results with the Physician.

Supplemental information for the Physician
The following information must be provided to the Physician before the Physician makes a recommendation concerning an employee's ability to use a respirator

- The type and weight of the respirator to be used by the employee
- The duration and frequency of respirator use (including use for rescue and escape)
- The expected physical work effort
- Additional protective clothing and equipment to be worn
- Temperature and humidity extremes that may be encountered
- Any supplemental information provided previously to the Physician regarding an employee need not be provided for a subsequent medical evaluation if the information and the Physician remain the same

The Employer has provided the Physician with a copy of the written respiratory protection program and a copy of the OSHA Standard 1910.134

Medical Determination

In determining the employee's ability to use a respirator, the pesticide employer shall:

- Obtain a written recommendation regarding the employee's ability to use the respirator from the Physician. The recommendation shall provide only the following information.
- Any limitations on respirator use related to the medical condition of the employee, or relating to the workplace conditions in which the respirator will be used, including whether or not the employee is medically able to use the respirator.
- The need, if any, for follow-up medical evaluations.
- A statement that the Physician has provided the employee with a copy of the Physician's written recommendation.
- If the respirator is a negative pressure respirator and the Physician finds a medical condition that may place the employee's health at increased risk if the respirator is used, the Employer shall provide an APR if the Physician's medical evaluation finds that the employee can use such a respirator; if a subsequent medical evaluation finds that the employee is medically able to use a negative pressure respirator, then the Employer is no longer required to provide an APR.

Additional Medical Evaluations
At a minimum, the Employer shall provide additional medical evaluations that comply with the requirements of this section if:

- An employee reports medical signs or symptoms that are related to ability to use a respirator.
- A Physician, supervisor, or the respirator program administrator informs the Employer that an employee needs to be re-evaluated.
- Information from the respiratory protection program, including observations made during fit testing and program evaluation, indicates a need for employee reevaluation.
- A change occurs in workplace conditions (e.g., physical work effort, protective clothing, and temperature) that may result in a substantial increase in the physiological burden placed on an employee.

Respirator Fit Testing (see Appendix A for more information)
Before an employee is required to use any respirator with a negative or positive pressure tight-fitting face piece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used. The Employer shall ensure that an employee using a tight-fitting face piece respirator is fit tested prior to initial use of the respirator, whenever a different respirator face piece (size, style, model or make) is used, and at least annually thereafter.

The Employer has established a record of the qualitative and quantitative fit tests administered to employees including:

- The name or identification of the employee tested
- Type of fit test performed
- Specific make, model, style, and size of respirator tested
- Date of test
- The pass/fail results for QLFTs or the fit factor and strip chart recording or other recording of the test results for QNFTs

Additional fit tests will be conducted whenever the employee reports, or the Employer, Physician, supervisor, or program administrator makes visual observations of, changes in the employee's physical condition that could affect respirator fit. Such conditions include, but are not limited to, facial scarring, dental changes, cosmetic surgery, or an obvious change in body weight. If after passing a QLFT or QNFT, the employee notifies the Employer's program administrator, supervisor, or Physician that the fit of the respirator is unacceptable, the employee shall be given a reasonable opportunity to select a different respirator face piece and to be retested.

Types of Fit Tests

The fit test shall be administered using an OSHA-accepted QLFT or QNFT protocol. The OSHA-accepted QLFT and QNFT protocols and procedures are contained in Appendix A of OSHA Standard 1910.134.

- QLFT may only be used to fit test negative pressure air-purifying respirators that must achieve a fit factor of 100 or less.
- If the fit factor, as determined through an OSHA-accepted QNFT protocol, is equal to or greater than 100 for tight-fitting half face pieces, or equal to or greater than 500 for tight-fitting full face pieces, the QNFT has been passed with that respirator.
- Fit testing of tight-fitting atmosphere-supplying respirators and tight-fitting powered air-purifying respirators shall be accomplished by performing quantitative or qualitative fit testing in the negative pressure mode, regardless of the mode of operation (negative or positive pressure) that is used for respiratory protection.
- Qualitative fit testing of these respirators shall be accomplished by temporarily converting the respirator user's actual face piece into a negative pressure respirator with appropriate filters, or by using an identical negative pressure air-purifying respirator face piece with the same sealing surfaces as a surrogate for the atmosphere-supplying or powered air-purifying respirator face piece.
- Quantitative fit testing of these respirators shall be accomplished by modifying the face piece to allow sampling inside the face piece in the breathing zone of the user, midway between the nose and mouth. This requirement shall be accomplished by installing a permanent sampling probe onto a surrogate face piece, or by using a sampling adapter designed to temporarily provide a means of sampling air from inside the face piece.
- Any modifications to the respirator face piece for fit testing shall be completely removed, and the face piece restored to NIOSH approved configuration, before that face piece can be used in the workplace.

Fit test records shall be retained for respirator users until the next fit test is administered. Written materials required to be retained shall be made available upon request to affected employees.

Respirator Operation and Use

Respirators will only be used following the respiratory protection safety procedures established in this program. The Operations and Use Manuals for each type of respirator will be maintained by the Program Administrator and be available to all qualified users.

Surveillance by the direct supervisor shall be maintained of work area conditions and degree of employee exposure or stress. When there is a change in work area conditions or degree of employee exposure or stress that may affect respirator effectiveness, the Employer shall reevaluate the continued effectiveness of the respirator.

For continued protection of respirator users, the following general use rules apply:

- Users shall not remove respirators while in a hazardous environment.
- Respirators are to be stored in sealed containers out of harmful atmospheres.
- Store respirators away from heat and moisture.
- Store respirators such that the sealing area does not become distorted or warped.
- Store respirator such that the face piece is protected.
- Face piece seal protection.

The Employer does not permit respirators with tight-fitting face pieces to be worn by employees who have:

- Facial hair that comes between the sealing surface of the face piece and the face or that interferes with valve function; or
- Any condition that interferes with the face-to-face piece seal or valve function.

If an employee wears corrective glasses or goggles or other personal protective equipment, the Employer shall ensure that such equipment is worn in a manner that does not interfere with the seal of the face piece to the face of the user.

Continuing Effectiveness of Respirators

The Employer shall ensure the following that employees leave the respirator use area:

- To wash their faces and respirator face pieces as necessary to prevent eye or skin irritation associated with respirator use
- If they detect vapor or gas breakthrough, changes in breathing resistance, or leakage of the face piece
- To replace the respirator or the filter, cartridge, or canister elements.

If the employee detects vapor or gas breakthrough, changes in breathing resistance, or leakage of the face piece, the Employer will replace or repair the respirator before allowing the employee to return to the work area.

Procedures for IDLH Atmospheres

For all IDLH atmospheres, the Employer shall ensure that:

- One employee or, when needed, more than one employee is located outside the IDLH atmosphere
- Visual, voice, or signal line communication is maintained between the employee(s) in the IDLH atmosphere and the employee(s) located outside the IDLH atmosphere
- The employee(s) located outside the IDLH atmosphere are trained and equipped to provide effective emergency rescue
- The Employer or designee is notified before the employee(s) located outside the IDLH atmosphere enter the IDLH atmosphere to provide emergency rescue
- The Employer or designee authorized to do so by the Employer, once notified, provides necessary assistance appropriate to the situation

Employee(s) located outside the IDLH atmospheres will be equipped with:

- Pressure demand or other positive pressure SCBAs, or a pressure demand or other positive pressure supplied-air respirator with auxiliary SCBA; and either
- Appropriate retrieval equipment for removing the employee(s) who enter(s) these hazardous atmospheres where retrieval equipment would contribute to the rescue of the employee(s) and would not increase the overall risk resulting from entry; or
- Equivalent means for rescue where retrieval equipment is not required.

Cleaning and Disinfecting
The Pesticide Employer shall provide each respirator user with a respirator that is clean, sanitary, and in good working order. The Employer shall ensure that respirators are cleaned and disinfected using the Standard Operating Procedure SOP: Cleaning and Disinfecting**.**

The respirators shall be cleaned and disinfected when:
- Respirators issued for the exclusive use of an employee shall be cleaned and disinfected as often as necessary to be maintained in a sanitary condition.
- Respirators issued to more than one employee shall be cleaned and disinfected before being worn by different individuals.
- Respirators maintained for emergency use shall be cleaned and disinfected after each use.
- Respirators used in fit testing and training shall be cleaned and disinfected after each use.

Cleaning and Storage of respirators assigned to specific employees is the responsibility of that Employee.

Respirator Inspection
All respirators/SCBAs, both available for "*General Use*" and those on "*Permanent Check-out*", will be inspected after each use and at least monthly. Should any defects be noted, the respirator/SCBA will be taken to the program Administrator. Damaged Respirators will be either repaired or replaced. The inspection of respirators loaned on "*Permanent Check-out*" is the responsibility of that trained Employee.

Respirators shall be inspected as follows:
- All respirators used in routine situations shall be inspected before each use and during cleaning.
- All respirators maintained for use in emergency situations shall be inspected at least monthly and in accordance with the manufacturer's recommendations, and shall be checked for proper function before and after each use.
- Emergency escape-only respirators shall be inspected before being carried into the workplace for use.

Respirator inspections include the following:
- A check of respirator function, tightness of connections, and the condition of the various parts including, but not limited to, the face piece, head straps, valves, connecting tube, and cartridges, canisters or filters.
- Check of elastomeric parts for pliability and signs of deterioration.
- Self-contained breathing apparatus shall be inspected monthly. Air and oxygen cylinders shall be maintained in a fully charged state and shall be recharged when the pressure falls to 90% of the manufacturer's recommended pressure level. The Employer shall determine that the regulator and warning devices function properly.

Respirator Storage

Respirators are to be stored as follows:
- All respirators shall be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals, and they shall be packed or stored to prevent deformation of the face piece and exhalation valve.

Emergency Respirators shall be:
- Kept accessible to the work area;
- Stored in compartments or in covers that are clearly marked as containing emergency respirators; and
- Stored in accordance with any applicable manufacturer instructions.

Repair of Respirators
Respirators that fail an inspection or are otherwise found to be defective will be removed from service to be discarded, repaired or adjusted in accordance with the following procedures:
- Repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer's NIOSH-approved parts designed for the respirator;
- Repairs shall be made according to the manufacturer's recommendations and specifications for the type and extent of repairs to be performed; and
- Reducing and admission valves, regulators, and alarms shall be adjusted or repaired only by the manufacturer or a technician trained by the manufacturer.

Breathing Air Quality and Use
The Employer shall ensure that compressed air, compressed oxygen, liquid air, and liquid oxygen used for respiration accords with the following specifications:
- Compressed and liquid oxygen shall meet the United States Pharmacopoeia requirements for medical or breathing oxygen; and
- Compressed breathing air shall meet at least the requirements for Grade D breathing air described in ANSI/Compressed Gas Association Commodity Specification for Air, G-7.1-1989, to include:
- Oxygen content (**v/v**) of 19.5-23.5%;
- Hydrocarbon (condensed) content of 5 milligrams per cubic meter of air or less;
- Carbon monoxide (**CO**) content of 10 ppm or less;
- Carbon dioxide content of 1,000 ppm or less; and
- Lack of noticeable odor.
- Compressed oxygen will not be used in atmosphere-supplying respirators that have previously used compressed air.
- Oxygen concentrations greater than 23.5% are used only in equipment designed for oxygen service or distribution.
- Cylinders used to supply breathing air to respirators meet the following requirements.
- Cylinders are tested and maintained as prescribed in the Shipping Container Specification Regulations of the Department of Transportation (49 CFR part 173 and part 178).
- Cylinders of purchased breathing air have a certificate of analysis from the supplier that the breathing air meets the requirements for Grade D breathing air.

- Moisture content in breathing air cylinders does not exceed a dew point of -50 deg. F (-45.6 deg. C) at 1 atmosphere pressure.
- Breathing air couplings are incompatible with outlets for non-respirable worksite air or other gas systems. No asphyxiating substance shall be introduced into breathing air lines.
- Breathing gas containers shall be marked in accordance with the NIOSH respirator certification standard, 42 CFR part 84.

For Emergency Use Respirators the additional requirements apply:
- Certify the respirator by documenting the date the inspection was performed, the name (or signature) of the person who made the inspection, the findings, required remedial action, and a serial number or other means of identifying the inspected respirator.
- Provide this information on a tag or label that is attached to the storage compartment for the respirator, is kept with the respirator, or is included in inspection reports stored as paper or electronic files. This information shall be maintained until replaced following a subsequent certification.

RP Summary
Following this training session, pesticide applicators should:
- Wear the respirator assigned to him or her.
- Always check for fit before wearing.
- Always check for damage and deterioration before wearing.
- Know when to replace canisters and cartridges.
- Practice maneuvering with a respirator.
- Store carefully in the proper location.

CARTRIDGE COLOR CODE	COLOR	USED TO PROTECT AGAINST
	BLACK	ORGANIC VAPORS (PESTICIDES) and PAINT SPRAYING
	GREEN	AMMONIA: ANHYDROUS or FROM LIVESTOCK CONFINEMENT
	YELLOW	ACID GASES (i.e: HYDROGEN SULFIDE (H_2S) or CARBON DIOXIDE (CO_2))
	OLIVE	ORGANIC VAPORS, AMMONIA and ACID GASES
	PINK	WELDING FUMES AND DUSTS

CHART SHOWING RESPIRATOR CARTRIDGES THAT CAN BE USED IN PESTICIDE APPLICATIONS (Color Coding to show specific use)

WPS Personal Protective Equipment Requirements Summary

Personal protective equipment (PPE) is worn to protect the body from contact with pesticides, for example respirator, chemical resistant gloves, and protective eyewear. The pesticide label indicates what PPE must be worn. PPE must be provided in clean and operating condition, and employers must make sure it is worn correctly.

PPE must be inspected before each day of use and any damaged PPE either repaired or discarded. PPE must be cleaned at the end of the day or before reuse. Any contaminated PPE must be kept separate and washed separately from any other clothing or laundry. PPE is considered contaminated with any use around pesticides or in a treated area.

All clean PPE must be either dried thoroughly before being stored or must be put in a well ventilated place to dry.

It must be stored separately from personal clothing and apart from pesticide contaminated areas.

Do not store PPE in the pesticide storage area.

Early-entry workers and pesticide handlers must have a clean place away from pesticide storage and pesticide use areas where they can put on, remove and store their PPE. They are not allowed to wear home or to take home PPE they have used.

Any person who cleans or launders PPE at the establishment must be told:
• That it may be contaminated with pesticides.
• About the potentially harmful effects of exposure to pesticides.
• The correct way(s) to handle and clean it to protect themselves from exposure.
Take appropriate measures to prevent heat-related illness when PPE is required.

PPE Requirements
• Provide handlers and early-entry workers with all label-required PPE in clean and operating condition. PPE is not required for acceptable no contact, early-entry worker activities.
• Make sure employees are wearing the PPE correctly.
• Inspect PPE for damage each day and discard any that cannot be repaired.
• Clean and dry the PPE at the end of the day.
• Store PPE separately from personal clothing and other personal items. Do not store PPE in a pesticide-contaminated area and never store PPE in the pesticide storage room.
• Do not allow handlers or early-entry workers to wear home or to take home PPE that has been used.
• Keep contaminated PPE separate and wash it separately from other laundry.
• Make sure the person who cleans or launders PPE knows that it might be contaminated with pesticides. Inform them of the potentially harmful effects of exposure to pesticides. Show them the correct way(s)to handle and clean PPE to avoid exposure.
• Take appropriate measures to prevent heat-related illness when PPE is worn. It is acceptable to wear a higher level or more PPE than is required by the label, but never to wear less. When considering whether to require handlers to wear more PPE than required by the label, employers must consider how the extra PPE might cause over-heating and potential heat-related illness.

Review

Personal Protective Equipment (PPE) may be required by pesticide product labeling, regulations, or restricted material permit conditions.

Assure that all PPE is inspected before each day of use for leaks, holes, tears, or worn parts.

Repair, clean or discard and replace damaged or heavily contaminated PPE.

Assure that employees wear appropriate protective eyewear when mixing, loading, or applying pesticides by hand or ground rig, and when exposed to application, mixing, or loading equipment that contains or is contaminated with pesticide.

Assure that protective eyewear provides brow and temple protection that conforms to the curvature of the face and side protection to the eyes and marked as meeting the American National Standards Institute's Standards for Occupational and Educational Personal Eye and Face Protection Devices (ANSI Z87.1-2010).

Use of a respirator with a full-face mask will satisfy the protective eyewear requirement, unless it is prohibited by pesticide labeling.

Assure that you provide the PPE required by pesticide labeling and the worker safety regulations for the particular handling or early-entry activity:

Employees wear the required PPE until the handling or early-entry activity is complete, and
Employees use the required PPE correctly.

Know when certain label-required PPE may be substituted when using certain engineering controls (closed-systems, enclosed cabs, soluble bags).

Assure that you provide a clean, pesticide-free place for employees to store any personal clothing not in use while at work handling pesticides.

Assure that if chemical-resistant gloves are required by pesticide labeling without specification of a barrier material or category, the barrier material may be any listed above.

All gloves must be 14 mils or thicker except: Laminate and polyethylene materials; or When chemical-resistant gloves are used to make fine adjustments to equipment or other activities that require high dexterity and motor control skill, the gloves must be made of an appropriate barrier material, as listed above, used only once for a maximum of 15 minutes, and then discarded.

Separable glove liners made of cotton or other absorbent material may be worn under chemical resistant gloves unless expressly prohibited by labeling. The liners must not extend beyond the end of the glove, and liners must be disposed of at the end of the workday, or immediately if any portion of the liner comes in contact with pesticide.

Leather gloves may be worn over chemical-resistant gloves when required by working conditions. Once leather gloves have been used for this purpose, they must only be worn over chemical-resistant gloves.

If chemical-resistant gloves are brought into the cockpit of an aircraft that has been used to apply pesticides, the gloves must be stored in an enclosed chemical-resistant container.

Assure that you take all precautions to prevent heat- related illness while the PPE is worn.

Provide a clean-designated area where employees can remove their PPE at the end of their exposure period.

Provide clean towels, soap, and sufficient water to allow for thorough washing.

Assure that PPE remains under your control and that employees do not take home potentially contaminated PPE.

Assure that any PPE to be reused is clean before each day of reuse according to instructions from the PPE manufacturer, or absent any instructions, wash in detergent and hot water.

Potentially contaminated PPE is kept and washed separately from other clothing and laundry, and Clean PPE is either dried thoroughly before being stored or is put in a well-ventilated place to dry.

Assure that any person or firm assigned or hired to clean or repair potentially contaminated PPE is protected and informed of the hazards of the pesticides they may encounter.

Assure that employees use approved respiratory equipment when handling pesticides where respirators are required by label, restricted material permit condition, or regulation.

Assure that in any workplace where respirators are required by label, restricted material permit condition, regulation, or employer, a written respiratory protection program is established with work site specific procedures. Update the program whenever changes in workplace conditions affect respirator use.

Assure that the respiratory protection program provides:

Medical evaluations of employees required to use respirators;

Fit testing procedures for tight-fitting respirators;

Procedures for proper use of respirators in routine and reasonably foreseeable emergency situations;

Procedures and schedules for cleaning, disinfecting, storing, inspecting, repairing, discarding, and managing respirators;

Procedures to ensure adequate air quality, quantity, and flow of breathing air for atmosphere-supplying respirators;

Procedures for selecting respirators;
Training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations, including Immediately Dangerous to Life or Health atmospheres, if appropriate; and Training of employees in the proper use of respirators, including putting on and removing them, limitations on their use, and their maintenance.

Assure that required respirators, training, and medical evaluations are provided at no cost to the employee.

Topic 3 – Personal Protection Section Post Quiz
PPE Summary – Answers are in the rear after the Glossary

1. Verify that Personal Protective Equipment (PPE) may be required by pesticide product labeling, regulations, or restricted material permit conditions.
True or False

2. Guarantee that employees wear appropriate protective eyewear when mixing, loading, or applying pesticides by hand or ground rig, and when exposed to application, mixing, or loading equipment that contains or is contaminated with pesticide.

3. Confirm that you provide a clean, pesticide-free place for employees to store any personal clothing not in use while at work handling pesticides.

4. Validate that separable glove liners made of cotton or other absorbent material may be worn under chemical resistant gloves unless expressly prohibited by labeling. The liners must not extend beyond the end of the glove, and liners must be disposed of at the end of the workday, or immediately if any portion of the liner comes in contact with pesticide.

5. Guarantee that you take all precautions to prevent heat- related illness while the PPE is worn.

6. Confirm that employees use approved respiratory equipment when handling pesticides where respirators are required by label, restricted material permit condition, or regulation.

7. Guarantee that in any workplace where respirators are required by label, restricted material permit condition, regulation, or employer, a written respiratory protection program is established with work site specific procedures. Update the program whenever changes in workplace conditions affect respirator use.

8. Verify that potentially contaminated PPE is kept and washed separately from other clothing and laundry, and Clean PPE is either dried thoroughly before being stored or is put in a well-ventilated place to dry.

9. Confirm that any person or firm assigned or hired to clean or repair potentially contaminated PPE is protected and informed of the hazards of the pesticides they may encounter.

Procedures for selecting respirators;

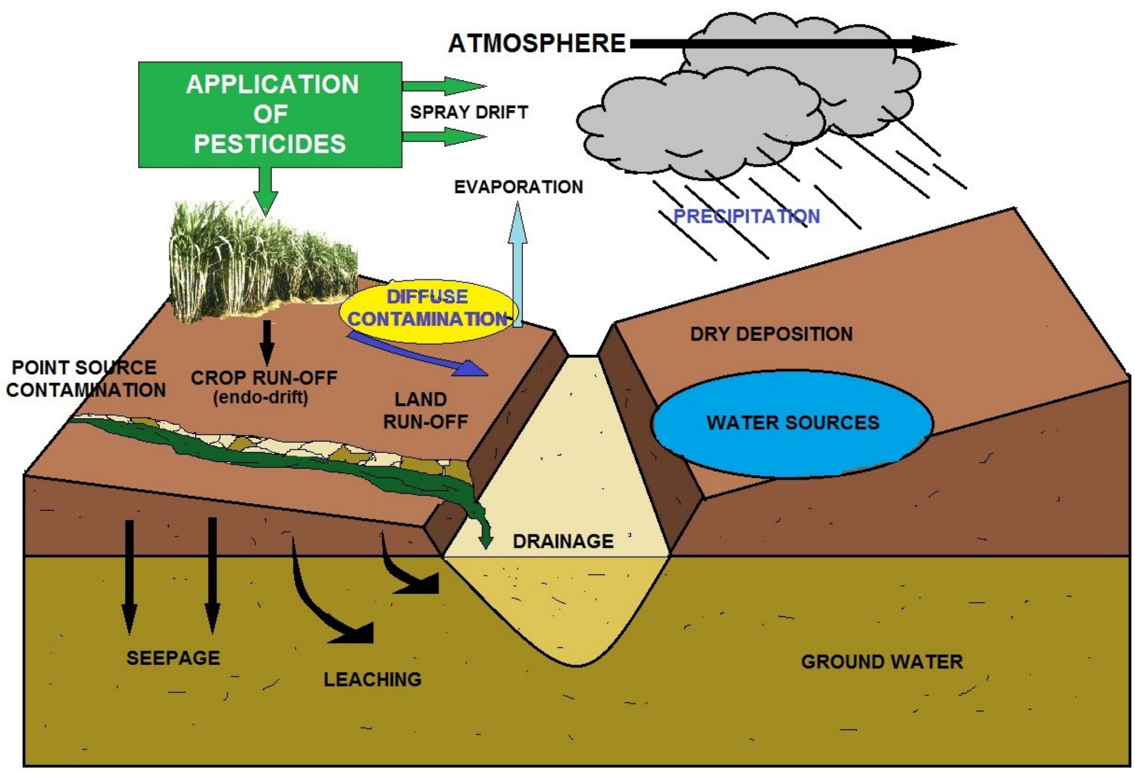
10. Substantiate the training of employees in the respiratory hazards to which they are potentially exposed during routine and emergency situations, including Immediately Dangerous to Life or Health atmospheres, if appropriate; and Training of employees in the proper use of respirators, including putting on and removing them, limitations on their use, and their maintenance.

Topic 4 – Environmental Effects

Common Environmental Effects from Pesticide Application

Topic 4 - Section Focus: You will learn the about the damages and other environmental side effects from pesticide application including drift to honey bee protection. At the end of this section, the student will be able to understand and describe common environmental effects from pesticides. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Topic Focus: Pesticides will contaminate soil, water, turf, and other vegetation. In addition to killing insects or weeds, pesticides can be toxic to a host of other organisms including birds, fish, beneficial insects, and non-target plants. Insecticides are generally the most acutely toxic class of pesticides, but herbicides can also pose risks to non-target organisms. One non-target concerns is our food.



ENVIRONMENTAL CONTAMINATION FROM PESTICIDES

Pesticides can reach surface water through runoff from treated plants and soil. Contamination of water by pesticides is widespread. The results of a comprehensive set of studies done by the U.S. Geological Survey (USGS) on major river basins across the country in the early to mid- 90s yielded startling results. More than 90 percent of water and fish samples from all streams contained one, or more often, several pesticides.

Silent Spring

In 1962, American biologist Rachel Carson wrote the groundbreaking book "Silent Spring," in which she warned of the devastating environmental impacts of DDT (dichloro-diphenyl-trichloroethane), suggesting the chemical may also have harmful effects on human health.

She rightfully questioned the logic and sanity of using such vast amounts of a chemical without knowing much about its ecological and human health impact. Her book triggered a revolution in thinking that gave birth to the modern environmental movement, and the public outcry that resulted from her book eventually led to DDT being banned for agricultural use in the U.S. in 1972. Many of her ideas and concerns are the primarily reason that we have to have certification and continuing education on pesticide safety and other concerns.

Unfortunately, DDT was simply replaced with other equally unsafe and untested chemicals. Today, we're also exposed to even vaster amounts of pesticides, and a wider variety of them, which is why it's so important to share this film with as many people as possible.

Consider this: the very same companies that developed chemical warfare weapons during World War II simply transitioned into agriculture after the war, and many of the same warfare chemicals are now sprayed *on our food*. The notion that these chemicals are good for humans, the environment and the business of agriculture is a fabricated one.

Importance of Pollinators
Many types of plants, including fruit and vegetable crops, depend on animals for pollination. In addition to honey bees, many other types of animals pollinate crops and wildflowers, including:

- Wild bees
- Ants
- Beetles
- Wasps
- Lizards
- Birds
- Bats
- Butterflies

We are concerned about declines in pollinator health and are working to protect bees and other pollinators from pesticide risks.

Dangers of Pesticide Residues

Pesticides are often considered a quick, easy, and inexpensive solution for controlling weeds and insect pests in urban landscapes. However, pesticide use comes at a significant cost. Pesticides have contaminated almost every part of our environment. Pesticide residues are found in soil and air, and in surface and ground water across the countries, and urban pesticide uses contribute to the problem.

Pesticide contamination poses significant risks to the environment and non-target organisms ranging from beneficial soil microorganisms, to insects, plants, fish, and birds. Contrary to common misconceptions, even herbicides can cause harm to the environment. In fact, weed killers can be especially problematic because they are used in relatively large volumes. The best way to reduce pesticide contamination (and the harm it causes) in our environment is for all of us to do our part to use safer, non-chemical pest control (including weed control) methods.

There is a need to convey the message that prevention of adverse health effects and promotion of health are profitable investments for employers and employees as a support to a sustainable development of economics.

To sum up, based on our limited knowledge of direct and/or inferential information, the domain of pesticides illustrates a certain ambiguity in situations in which people are undergoing life-long exposure. There is thus every reason to develop health education packages based on knowledge, aptitude and practices and to disseminate them within the community in order to minimize human exposure to pesticides.

Pesticide residues are generally meant to include pesticides that are detectible in or on places other than their intended target. Fresh water reservoirs, stream bed sediments, and harvested food would be examples of places that would be tested for pesticide residues. Needless to say, if high levels of residues were found to occur in such situations, few would consider the test results to be a good thing. Pesticide residues are usually measured and tolerances expressed in parts per million (ppm) to parts per billion (ppb) on a weight basis.

One ppm is one **milligram in a kilogram**, or one ounce of salt in 62,500 pounds of sugar, or one pound of pesticide in one million pounds of raw agricultural commodity. In some instances, modern analytical chemistry techniques can test residue levels below one ppb.

The residue levels allowed on food crops at harvest are legally set by the federal and state regulatory agencies and are called tolerances.

Tolerances
Tolerances are simply the maximum amounts of pesticide permitted to be present on or in raw agricultural commodities. These tolerances represent levels of pesticide residues which scientists have determined may safely remain on the food crop without injury to the consumer. Tolerances vary according to the pesticide and the crop.

When **pesticide tolerances** are found to be exceed legal tolerances, the agricultural commodities involved may be seized and destroyed. Ordinarily, such situations would arise from the application of agricultural pesticides on crops, but it could happen even where pesticide applications are not specifically targeted at a crop pest, such as the application of pesticides on rice fields for mosquito control.

Before allowing the use of a pesticide on food crops, **EPA** sets a tolerance. If no tolerance has been set for that pesticide on that crop, the pesticide cannot be legally applied on the crop. Some pesticides may be considered "safe" by EPA, and they would be exempted from a tolerance.

By law, EPA is responsible for regulating the pesticides that are used by growers to protect crops grown for human food and animal feed and for setting limits on the amount of pesticides that may remain in or on foods marketed in the USA. These limits on pesticides left on foods are called "tolerances" in the United States (they are referred to as maximum residue limits, or MRLs, in many other countries).

EPA establishes tolerances for each crop use of a pesticide after developing a risk assessment that considers:

- The aggregate, non-occupational exposure from the pesticide (exposure through diet and drinking water and from pesticides used in and around the home).
- The cumulative effects from exposure to pesticides that have a common mechanism of toxicity (that is, two or more pesticide chemicals or other substances that cause a common toxic effect(s) by the same, or essentially the same, sequence of major biochemical events, interpreted as mode of action).
- Whether there is increased susceptibility to infants and children or other sensitive subpopulations, from exposure to the pesticide.
- Whether the pesticide produces an effect in people similar to an effect produced by a naturally occurring estrogen or produces other endocrine disruption-effects.

Some risk assessments use the assumption that residues will always be present in food at the maximum level permitted by the tolerance. Other risk assessments use actual or anticipated residue data, to reflect real-world consumer exposure as closely as possible.

Read more about:

The U.S. Department of Agriculture (USDA) and the Food and Drug Administration (FDA) enforce tolerances to ensure that the nation's food supply is maintained safely at all times:

- USDA enforces tolerances established for meat, poultry and some egg products.
- FDA enforces tolerances established for other foods.

In August 1996, the Federal Food, Drug, and Cosmetic Act was amended to include the Food Quality Protection Act or FQPA. This Act required EPA to reassess by August 2006 all of the pesticide tolerances that were in place in early August 1996 to ensure that they met current safety standards and were supported by up-to-date scientific data. We completed this reassessment by the deadline and since then, reviews of tolerances have been included in the registration review of pesticides.

Generally during registration review, we review any new data to support tolerance decisions based on:

- the anticipated residue levels of the pesticide in or on food, as reflected in crop field trial or food processing studies, or
- the actual levels of the pesticide that have been measured through food monitoring studies and surveillance programs.

Periodically, and depending on the specific pesticide tolerance in question, EPA will reexamine the risk assessments used to set tolerances, to ensure that tolerances accurately reflect actual or anticipated residue levels in foods. This reexamination, in conjunction with a review of other exposure routes for that pesticide (from drinking water and residential uses of the pesticide), will ensure "a reasonable certainty that no harm will result from aggregate exposure."

What has EPA done to decrease or restrict the amount of pesticides in food?

The 1996 FQPA directed EPA to completely reassess pesticide residues on food, with a special emphasis on the unique vulnerability of children. From 1996 to 2006, EPA used the improved safety standards in FQPA to cancel or restrict the use of 270 pesticides for household and food uses because they posed particular threats to children and infants. EPA also lowered the permissible pesticide residue levels for many kid's foods – for example, apples, grapes, and potatoes.

The FQPA safety standard isn't the only reason why EPA has been able to take so many steps to reduce children's exposure to pesticides in recent years. Once a pesticide is registered for its specific uses, it is not left unchecked. Starting in 2007, EPA began the systematic reevaluation of all old pesticides.

Here are some of the most notable EPA actions in recent years:

- In 2009, EPA canceled all uses of carbofuran, canceled aldicarb use on potatoes and citrus, and canceled methamidophos use on all commodities.
- In 2010, EPA canceled methomyl use on grapes and strawberries.
- In 2010, EPA canceled all products containing methyl parathion.
- In 2012 EPA canceled acephate use on green beans, oxamyl use on soybeans, and imidacloprid use on almonds.
- In 2013, EPA canceled all domestic uses of methyl parathion and canceled all uses of formetanate HCI on apples, pears, and peaches.

We have seen, through USDA's Pesticide Data Program (PDP) data, an overall decrease in the amount of pesticide residues in food, especially since the passing of FQPA in 1996. The stricter standards of FQPA and major improvements in science and data, and an increase in the use of safer, less toxic pesticides, has led to an overall trend of reduced risk from pesticides.

For example, from 1995 to 2013, children's exposure to carbamates (a group of insecticides that affect the nervous system) fell by 70% – EPA canceled or restricted many carbamates during this time. From 1998 to 2008, tomatoes with detectable organophosphate pesticide residues fell from 37% to 9%, due to EPA canceling most organophosphates. It is important to note for some of the more recent actions, EPA expects declines will show up in future PDP data.

Unwanted Environmental Effects of Pesticides

Unwanted pesticide chemicals in air, soil, water and vegetation are a form of environmental pollution. Accumulation and storage of pesticides in plants and animals from long lasting insecticides such as DDT was once a form of environmental pollution. This bio-storage and bio-accumulation of pesticides does not occur with modern insecticides that degrade rapidly under ambient conditions and are metabolized quickly by living organisms. As the population of the world increases, our environment is becoming more and more polluted. Pesticide use contributes to this condition, especially in large-scale agricultural operations. Care in the use and disposal of pesticides will aid in reducing environmental pollution. In order to accomplish this, people who use pesticides should have an understanding of the fate of these chemicals after they have been released into the environment.

Most **organochlorine** pesticides (e.g., DDT, chlordane) are very **persistent**. Most of the **organophosphates** (e.g., parathion, malathion) and pyrethroids are much less persistent. **Pyrethrins**, and **carbamate** pesticides are nonpersistent.

Some factors that influence the persistence of a chemical and the possibility that residues may remain are:

- The amount of chemical applied
- The formulation
- The pH (acidity or alkalinity) of the water **diluent** and of the target tissue, soil, or water.
- The nature of the surface to which it is applied
- **Exposure** to weathering from wind, rain, etc.
- Chemical breakdown from high temperatures and humidity
- Photochemical reactions from sunlight
- Biological reactions.

If public health pesticides are applied properly and in accordance with label restrictions for applications around food crops residues on or in the crop should never be a problem.

Pesticides Released in the Atmosphere

Whenever pesticides are used some proportion of the amount applied fails to reach the target. Furthermore, the material eventually reaches the general environment in either its original form or in the form of a breakdown product. Each pesticide has its own unique chemical and physical properties and therefore its own unique behavior in the environment.

However, when the effects of pesticides on the environment are considered as a whole, it is possible to make a few generalizations. Pesticides may enter the atmosphere by several methods. They may be blown away with soil particles in cultivation or as smoke from burning materials. A major source of atmospheric pesticide pollution is from improper application of sprays and dusts. Spraying during windy periods or with the wrong or improperly maintained equipment are major contributors to this problem. Once in the atmosphere, pesticides are either degraded to other compounds or trapped in rain, fog or dust. They eventually fall to earth.

Very few persistent pesticides are used in vector control operations any more. Because some weed control projects may involve the use of long-lasting herbicides, public health pesticide applicators should be familiar with the ways persistent pesticides can cause pollution of soils.

Many pesticides are applied in areas with vegetation of some kind. If persistent pesticides are applied to plants, some of the material reaching the ground during the application and some of the material contained in harvest residues may be incorporated into the soil. Long-lasting pesticides also may be applied directly to the soil to control insects, weeds, fungi and nematodes. In this case most of the material reaches the ground immediately and in unchanged form; then it may be incorporated into the soil through agricultural operations.

When excess or repeated applications of inorganic or very persistent organic pesticides are made, soil residues can build up until they become a severe problem. Residues of hundreds of pounds per acre have accumulated in some soils. Pesticides in the soil may cause illegal residues in root crops or they may be translocated into the tops of plants. They may also leach into nearby surface or groundwater supplies or they may cause undesired phytotoxicity

Once in the soil, organic pesticides may be rapidly broken down by natural processes or they may remain unchanged for years. Pesticides in soils break down through chemical reactions which depend on the structure of the soil, its moisture content, its pH, salinity and other factors. Many organic pesticides are broken down by the action of microbes in the soil. Microbial decomposition depends on the temperature, moisture, and organic matter in the soil, as well as on the chemical nature of the pesticide itself. Cultural practices can have an important effect on the longevity of pesticides in soils.

Proper cultivation and irrigation practices can speed removal of unwanted pesticides from soil. Pesticide labels often contain useful information on prevention of soil pollution problems associated with the material.

Damage to Beneficial Insects

The efficient production of many crops, including fruits, vegetables, forage, and seeds, would not be possible without the activities of honeybees and other pollinating **insects**. In California, the beekeeping industry maintains millions of honeybee colonies. Each year honeybees pollinate billions of dollars' worth of crops in the state.

Over the past 100 years or so, the honeybee industry has sustained serious losses from pesticide applications. Recently, pesticide poisoning has come under suspicion for reductions in honey bees in the USA. Some agricultural pesticides used currently are known to pose a significant hazard to bees. Vector control applications are ordinarily done in a manner that minimizes risk to bees and other beneficial insects.

In addition to pesticide exposure, honeybee colonies are at risk from a variety of **parasites**, **pathogens**, marauding **mammals**, and other factors. To protect these valuable insects from losses due to pesticide poisoning it is necessary to know where colonies are located before starting a pesticide application, and to protect them in some way. Moving colonies to areas far from the possibility of drift and avoiding the use of pesticides known to be especially toxic to bees are two ways to minimize damage. If public health pesticide applications are planned for areas known to be close to bee colonies, it is also a sound policy to warn hive owners in advance of the applications so they have an opportunity to protect them.

There are other pollinating insects that may suffer damage from pesticide applications, such as alkali bees and other wild bees. Wild bees are not in hives, but are present in a variety of nest types. This complicates their protection from pesticides.

Other insects are beneficial because they prey on or parasitize pests. There have been many studies on the effects on **non-target** organisms of pesticides in a variety of settings. Your local extension specialist can provide you with copies of reports of this kind of research.

By definition, pesticides that harm non-target organism populations significantly are non-selective.

If use of a **non-selective pesticide** is considered essential, it must be justified based on the relative benefits balanced against the relative harm. In the case of public health pesticides, the threat to human health is a necessary consideration.

The ideal pesticide would be selectively nontoxic to bees and other beneficial organisms, while toxic to a specific pest. Few products available for adult mosquito control meet this ideal, but several larval mosquito control products and many herbicides are selective. For adult mosquito control and other pesticide applications, the best compromise must be found.

Resistance Management
Based on the genetic principles of development of pesticide resistance in pests, a number of principles have evolved over the years that when implemented can either delay resistance, or avoid it entirely.

Some of these principles are:

- ✓ Avoid under-dosing in pesticide applications. If this is done repeatedly it encourages survival of individual pests carrying genes for resistance, especially when the effects of the gene are not absolute (protects only partially).

- ✓ Do not always treat a given population with the same pesticide. Switch to other products periodically. This is called pesticide rotation.

- ✓ Test populations of vectors for evidence of resistance, and when it is detected switch to alternate pesticides.

- ✓ Avoid slow-release applications where pest populations are exposed for long periods of time to sub-lethal doses of one pesticide.

- ✓ Combine pesticide applications with other forms of pest management such as biological control, habitat alteration, and use of biorational pesticides. The use of biorational pesticides is not a guarantee that resistance to these products will not occur, but resistance to biorational pesticides have been far less common than to conventional pesticides.

Pesticide Environmental Side-Effects	
Pesticide/class	**Effect(s)**
Organochlorine DDT/DDE	Egg shell thinning in raptorial birds
	Endocrine disruptor
	Thyroid disruption properties in rodents, birds, amphibians and fish
	Acute mortality attributed to inhibition of acetylcholine esterase activity
DDT	Carcinogen
	Endocrine disruptor
DDT/Diclofol, Dieldrin and Toxaphene	Juvenile population decline and adult mortality in wildlife reptiles
DDT/Toxaphene/Parathion	Susceptibility to fungal infection
Triazine	Earthworms became infected with monocystid gregarines
Chlordane	Interact with vertebrate immune systems
Carbamates, the phenoxy herbicide 2,4-D, and atrazine	Interact with vertebrate immune systems
Anticholinesterase	Bird poisoning
	Animal infections, disease outbreaks and higher mortality.
Organophosphate	Thyroid disruption properties in rodents, birds, amphibians and fish
	Acute mortality attributed to inhibition of acetylcholine esterase activity
	Immunotoxicity, primarily caused by the inhibition of serine hydrolases or esterases
	Oxidative damage
	Modulation of signal transduction pathways
	Impaired metabolic functions such as thermoregulation, water and/or food intake and behavior, impaired development, reduced reproduction and hatching success in vertebrates.
Carbamate	Thyroid disruption properties in rodents, birds, amphibians and fish
	Impaired metabolic functions such as thermoregulation, water and/or food intake and behavior, impaired development, reduced reproduction and hatching success in vertebrates.
	Interact with vertebrate immune systems
	Acute mortality attributed to inhibition of acetylcholine esterase activity

Phenoxy herbicide 2,4-D	Interact with vertebrate immune systems
Atrazine	Interact with vertebrate immune systems
	Reduced northern leopard frog (Rana pipiens) populations because atrazine killed phytoplankton, thus allowing light to penetrate the water column and periphyton to assimilate nutrients released from the plankton. Periphyton growth provided more food to grazers, increasing snail populations, which provide intermediate hosts for trematode.
Pyrethroid	Thyroid disruption properties in rodents, birds, amphibians and fish
Thiocarbamate	Thyroid disruption properties in rodents, birds, amphibians and fish
Triazine	Thyroid disruption properties in rodents, birds, amphibians and fish
Triazole	Thyroid disruption properties in rodents, birds, amphibians and fish
	Impaired metabolic functions such as thermoregulation, water and/or food intake and behavior, impaired development, reduced reproduction and hatching success in vertebrates.
Neonicotinoic/Nicotinoid	respiratory, cardiovascular, neurological, and immunological toxicity in rats and humans
	Disrupt biogenic amine signaling and cause subsequent olfactory dysfunction, as well as affecting foraging behavior, learning and memory.
Imidacloprid, Imidacloprid/pyrethroid λ-cyhalothrin	Impaired foraging, brood development, and colony success in terms of growth rate and new queen production.
Thiamethoxam	High honey bee worker mortality due to homing failure (risks for colony collapse remain controversial)
Spinosyns	Affect various physiological and behavioral traits of beneficial arthropods, particularly hymenopterans
Bt corn/Cry	Reduced abundance of some insect taxa, predominantly susceptible Lepidopteran herbivores as well as their predators and parasitoids.
Herbicide	Reduced food availability and adverse secondary effects on soil invertebrates and butterflies
	Decreased species abundance and diversity in small mammals.
Benomyl	Altered the patch-level floral display and later a two-thirds reduction of the total number of bee visits and in a shift in the visitors from large-bodied bees to small-bodied bees and flies

Honeybee Protection Sub-Section

EPA's actions to protect pollinators from pesticide exposure include:

Implemented a policy in 2017 that protects bees from agricultural pesticide spray and dust applications while the bees are under contract to provide pollination services. The policy also recommends that states and tribes develop pollinator protection plans and best management practices.

Reasonable Precautions

For vector control technicians, protecting domestic bees is primarily a concern when doing ULV adult mosquito control. The pesticides most commonly used for these applications (pyrethrins and pyrethroids) are toxic to bees. However, they are applied in minute quantities (often less than 1 ounce per acre of total volume of material) during the evening or early morning when bees are inactive. Taking the reasonable precaution of turning off the sprayer while passing the hives should be adequate to prevent any mortality in the bees from the product.

Bees are readily poisoned by organophosphates and many agricultural pesticides. When a pesticide known to be harmful to bees is used near bee hives or to any cropland where honey bees are working, special procedures must be followed. In some areas centralized private organizations operate a beekeeper notification program. Bee notification maps are maintained and each day copies of beekeepers' requests for notification from the County Agricultural Commissioner are received. Then interested beekeepers are notified by a single telephone call of all intended applications within one mile of their hives.

Pesticide Resistance
Pesticide resistance is the ability of pests to avoid the lethal effects of pesticides. Certain populations of pests use one or more different physiological or behavioral defense mechanisms to withstand doses of pesticides that previously were lethal to the pests. This can happen through spontaneous mutations in populations resulting in genes that confer pesticide resistance, or because a small proportion of the population carries a gene for pesticide resistance naturally. In either case, resistance develops gradually to the point where pesticide applications begin to fail after repeated exposure to the same pesticide.

This is because the parts of the population that carry the gene for susceptibility are killed off, and soon, a disproportionate segment of the population carrying the gene for resistance predominates. This can be an unintended effect of using pesticides. Resistance in numerous pests of public health importance has occurred to a variety of pesticides. For mosquitoes and flies, resistance to organochlorines and organophosphates has been particularly common.

Selective pressure is the repeated exposure of a population of pests to treatments of the same pesticide over time resulting in a change in the genetic makeup of that population. In this case, the population is selected to favor resistant genes at the expense of susceptible genes, and the population becomes resistant to that pesticide. Because of the nature of population genetics, the population never becomes completely resistant, but the frequency of individuals have susceptible genes becomes very small.

Knowing the mechanisms of development of pesticide resistance is important to developing strategies to avoid creation of resistance in pest populations. The basic principle is the preservation of susceptible genes in pest populations, and the endeavor to do this is named pesticide resistance management.

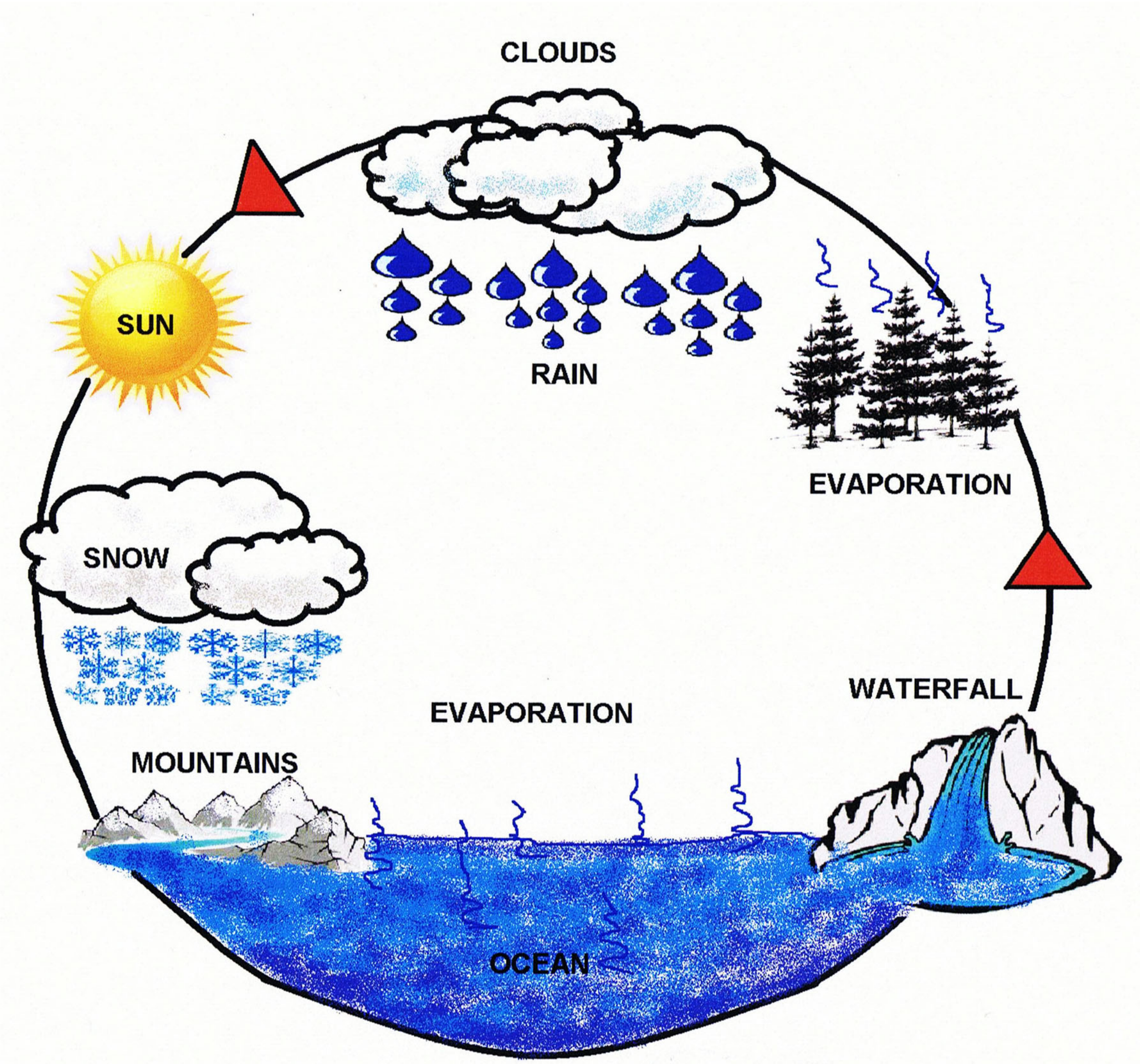
Usually, when a pest population becomes resistant to one pesticide it can still be controlled by other pesticides, especially pesticides in a different family of chemicals. Occasionally, resistance to pesticides other than the pesticide responsible for resistance may occur. This is called cross-resistance. Its occurrence is usually seen among chemically related pesticides where the mode of action is identical or very similar.

Early Signs of Resistance
Not all pest control failures are the result of resistance. Improper pest control practices may be at fault. However, if the material was timed and applied properly at the recommended rate and no other important factors (such as unfavorable weather) have interfered with the pesticide application, resistance should be considered.

Early signs of resistance may sometimes be recognized in the field. These include increasing difficulty in controlling a pest, increasing numbers of formerly minor pests, and increasing trouble with insect-transmitted disease. Developing resistance can be very subtle and may go unnoticed for a time; it may appear in certain locations or breeding sites. Suspected resistance should be reported to your supervisor immediately since early detection may make it possible to delay resistance by the application of counter measures.

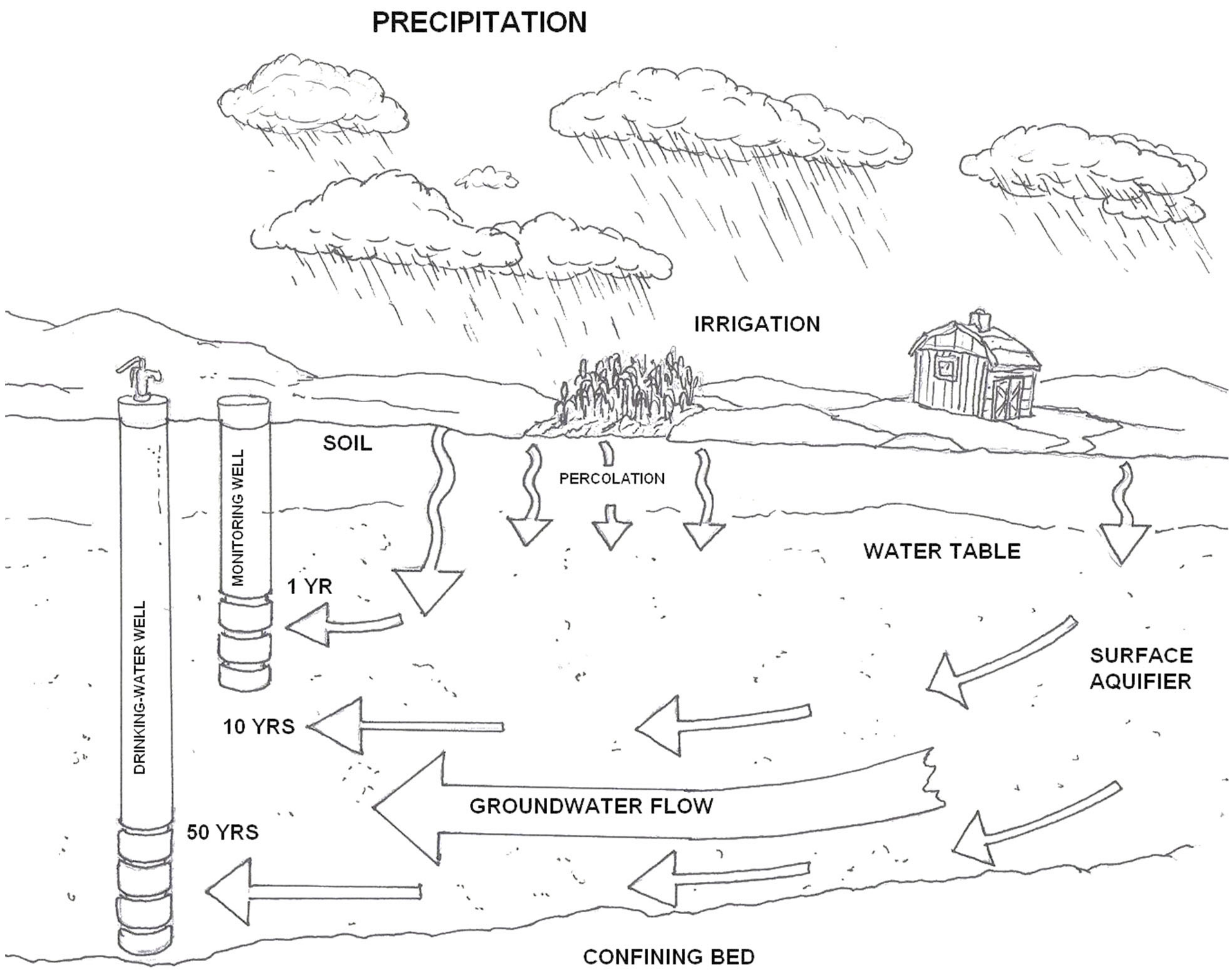
Unintentional Water Pollution

Pesticides occur in water as intentional and unintentional additives. Intentional applications are made to control aquatic organisms including mosquitoes and gnats, algae, snails, weeds and "trash" fish. Use of pesticides in water presents special hazards to plants growing in or irrigated with the water, to fish and other animals living in the water. Specific hazards include non-target toxicity and biological oxygen demand created by decaying vegetation. Fish, animals and people who might drink or bathe in the water may be at risk. Therefore, it is extremely important that those planning to apply pesticides directly to bodies of water be completely familiar with and follow label directions pertaining to any material being used in or around water - including posting notice of the application when required by the product label.



Pesticide contamination of groundwater is a subject of national importance because groundwater is used for drinking water by about 50 percent of the Nation's population. This especially concerns people living in the agricultural areas where pesticides are most often used, as about 95 percent of that population relies upon groundwater for drinking water.

Before the mid-1970s, it was thought that soil acted as a protective filter that stopped pesticides from reaching groundwater. Studies have now shown that this is not the case. Pesticides can reach water-bearing aquifers below ground from applications onto crop fields, seepage of contaminated surface water, accidental spills and leaks, improper disposal, and even through injection waste material into wells.



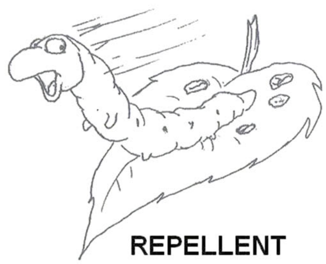
Unintentional water pollution has resulted from drift, drainage from treated soils, accidental applications, unintentional spills, and from sewage effluents. Pesticides in the atmosphere are washed down by rain and reach streams, lakes, and the ocean. Other pesticides reach the surface waters through runoff from soils and from industrial waste disposal.

At times pesticides have been accidentally sprayed onto bodies of water, where they cause extensive pollution. Such contamination is usually preventable. Pesticide spills are usually of limited local importance and, because of their emergency nature, are frequently dealt with very effectively. Sewage effluents are generally associated with manufacturing processes and are of little direct concern to the pesticide applicator.

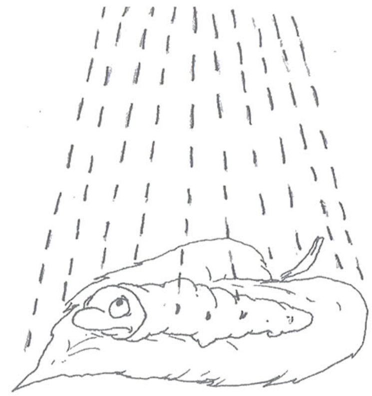
Biotic Pollution

A biotic factor is any living component that affects the population of another organism, or the environment. This includes animals that consume the organism, and the living food that the organism consumes. Biotic factors also include human influence, pathogens, and disease outbreaks. Each biotic factor needs energy to do work and food for proper growth. All species are influenced by biotic factors in one way or another. For example, if the number of predators will increase, the whole food web will be affected as the population number of organisms that are lower in the food web will decrease due to depredation. Similarly, when organisms have more food to eat, they will grow quicker and will be more likely to reproduce, so the population size will increase.

INGESTED

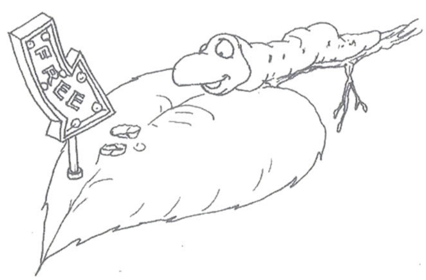


REPELLENT



DIRECT CONTACT

SECONDARY CONTACT



LURE AND KILL

FUMIGANT

The direct effects of pesticides on wildlife depend on the kind and formulation of the pesticide, the target pest species, and on the species of wildlife exposed. For example, pyrethrins are highly toxic to fish, but virtually non-toxic to mammals or birds. Direct effects on wildlife also depend on the exposure of the animals to the pesticide; pesticides with long residual actions may cause wildlife losses for extended periods. On the other hand, pesticides with short residual effects may cause large losses but only for a short time.

The largest potential for indirect effects to wildlife is from vegetative changes that can improve or degrade habitat for many species of wildlife. Changes in vegetation or insect populations can significantly alter the food resources available to wildlife species. Recently, residual accumulations of PBO, a synergist commonly used to increase the effectiveness of pyrethrins and pyrethroids, has been detected in stream bottom sediments. Although non-toxic itself, PBO may have the potential to make other pesticide residues in stream bottoms more toxic to aquatic organisms. This has raised the question of a potential role for PBO as a harmful stream pollutant.

Minimizing Environmental Effects

While each of us wants to protect the environment, we need to remember that pesticides are necessary tools in managing vector and pest populations. Each pesticide label contains a warning of known environmental effects of the active ingredient. Careful attention to label directions will aid you in the selecting and using of all pesticides in ways that minimize adverse environmental effects.

Managing Applicator, Worker or Handler Exposure Sub-Section

The speed of operation and the large areas that can be rapidly treated using spray aircraft make managing exposure an important consideration when selecting a pesticide. Product toxicology influences applicator, worker or handler exposure-time limitations and methods and techniques to keep applicator, worker or handler exposure to a minimum should be carefully considered in the product selection process. Label recommendations and the instructions on the use of PPE must be carefully followed.

EACH PESTICIDE HANDLER EMPLOYEE MUST HAVE AN UNDERSTANDING OF THE FOLLOWING SUBJECT AREAS TO SAFELY USE AND HANDLE PESTICIDES:
PESTICIDE PRODUCT LABELING - Format and meaning of information, such as the precautionary statements concerning human health hazards.
HAZARDS OF PESTICIDES - These are identified in product labeling, Safety Data Sheets (SDS), or PSIS Leaflet (Pesticide Safety Information Series).
PESTICIDE SAFETY REQUIREMENTS AND PROCEDURES - This in regards to regulation, PSIS Leaflets, SDS, Including Engineering Controls, for handling, transporting, storing and disposal of Pesticides.
ENVIRONMENTAL CONCERNS - This addressess the aspect of drift, runoff, and the hazards to Wildlife.
ROUTES OF ENTRY - This area addressess the hazards of which Pesticides can enter the body: Dermal (skin) , Oral (swallowed), Inhalation (breathe in), Ocular (through the eyes).
COMMON SIGNS AND SYMPTOM OF EXPOSURE - Some of the basic symptoms include: Headache, fatigue, weakness, nervousness, nausea, perspiration, eye and skin irritation.
EMERGENCY FIRST AID - Know and understand the basic procedures necessary for first aid concerning exposure to pesticides. This may include basic CPR.
USE AND CARE OF PERSONAL PROTECTIVE EQUIPMENT - Each employee who handles or may have the chance of being exposed to pesticides must have required Personal Protective Equipment available, and each employee must know and understand the proper use and care of this equipment.
THE ITEMS LISTED ABOVE ARE JUST BASICS REQUIRED TO SAFELY HANDLE PESTICIDES

Engineering controls, such as closed chemical transfer systems, to reduce applicator, worker or handler contamination when handling and loading the concentrate material are essential to minimize applicator, worker or handler exposure.

These systems must be capable of accurately extracting and measuring products from their original containers and should be easy to calibrated for products of different viscosities.

Applicator, worker or handler health surveillance to is an important requirement. All staff must undergo regular health checks, which should include blood tests. Effective worker health monitoring can indicate changes in health of an individual attributed to working with particular pesticides.

The use of a pesticide may put people, other life forms, and the environment at risk, therefore the decision to use a pesticide should only be taken when all other alternative control measures have been fully considered and its use controlled within an integrated control program.

Alternatives to Pesticide Use IPM
The alternatives to pesticide use can be divided into Natural and Applied Control measures. Natural control may utilize naturally occurring pest enemies, or rely on meteorological conditions to effect pest and disease control. Applied Control can include crop rotation, the selection of disease resistant crop varieties, changes in sowing dates as well the use of pesticides. The system, which offers the least hazard should always be selected.

Risk/Benefit Consideration
The risks and benefits of using a pesticide must be addressed before selecting a pesticide product. By completing a risk assessment, harmful effects can be minimized. In some cases, a prophylactic treatment e.g. seed treatment may be justified but the effect of weeds pest and disease on crop yield reduction should be monitored to determine when it is economically justified to use a pesticide.

Such information should be gathered by systematically by regular inspection of the crop to monitor numbers of pest and beneficial organisms or weed species and their appearance frequency, in combination with the use of insect traps to assist treatment timing.
An understanding of the pest's life cycle and the crop's ability to compensate for any pest or disease damage, will also help in decision-making.

Product Selection
The decision to select a given pesticide product must be based on an assessment of the risks and benefits and the hazard potential to both man and the environment. Where there is a choice of product, the material offering the least hazard should always be selected.

Label information
The manufacturer's product label is the main source of information for the end user. It should be read and understood by anyone using the product. The user must also make sure that the label terminology is fully understood. The label is attached to the product container and usually reproduced on the outer container or wrapper of the transport container or carton. In all states, adhering to the label recommendations is a legal obligation.

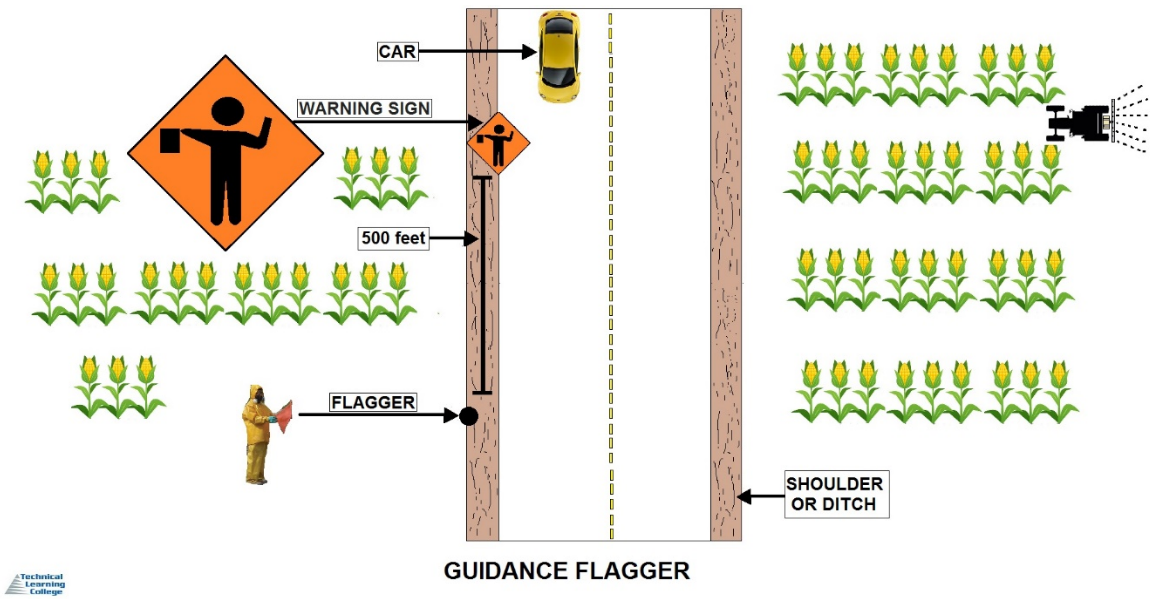
Never Use an Unlabeled or Unapproved Product
The product label carries statutory instructions for the user, and must cover the crops for which it is registered, the recommended dose rate; the number of treatments permitted during the growing season and how many days before harvest the last treatment may be applied. Additionally, the label will inform the user of the correct PPE to be used when handling and applying the product and advise on environmental protection measures to be carried out. Such measures may refer to a "non-spray" barrier (buffer zone).

Buffer Zone Introduction

A buffer zone is an untreated area wide enough to capture drift fallout adjacent to the sprayed area. Nozzle type, droplet size, product dose, dilution and spray technique should be considered when this unsprayed barrier (buffer) width is determined.

For aircraft spraying the buffer zone needs to be wider than for ground spraying as it is more difficult to make a precise spray cut-off with an aircraft operating at speed. The width of a buffer zone is also influenced by the pesticide product type and by the presence of adjacent waterways.

For example, a buffer zone of 5,000 meters is recommended for certain organochlorine insecticides. This distance is considered adequate to capture sedimenting spray droplets following the completion of a spray run.



Some pesticides are highly toxic to aquatic life so that spray drift fallout over water should be carefully avoided with products with this classification. The product label should provide application details, which should include nozzle selection, volume applied, and application timing. When ULV applications are to be made using rotary atomizers, liquid flow regulation and atomizer rotational speed should also be stated on the label.

The label usually carries first aid information to assist a doctor in the event of accidental contamination. Information on cleaning ("decontamination") and disposal of empty containers is also usually included on the label.

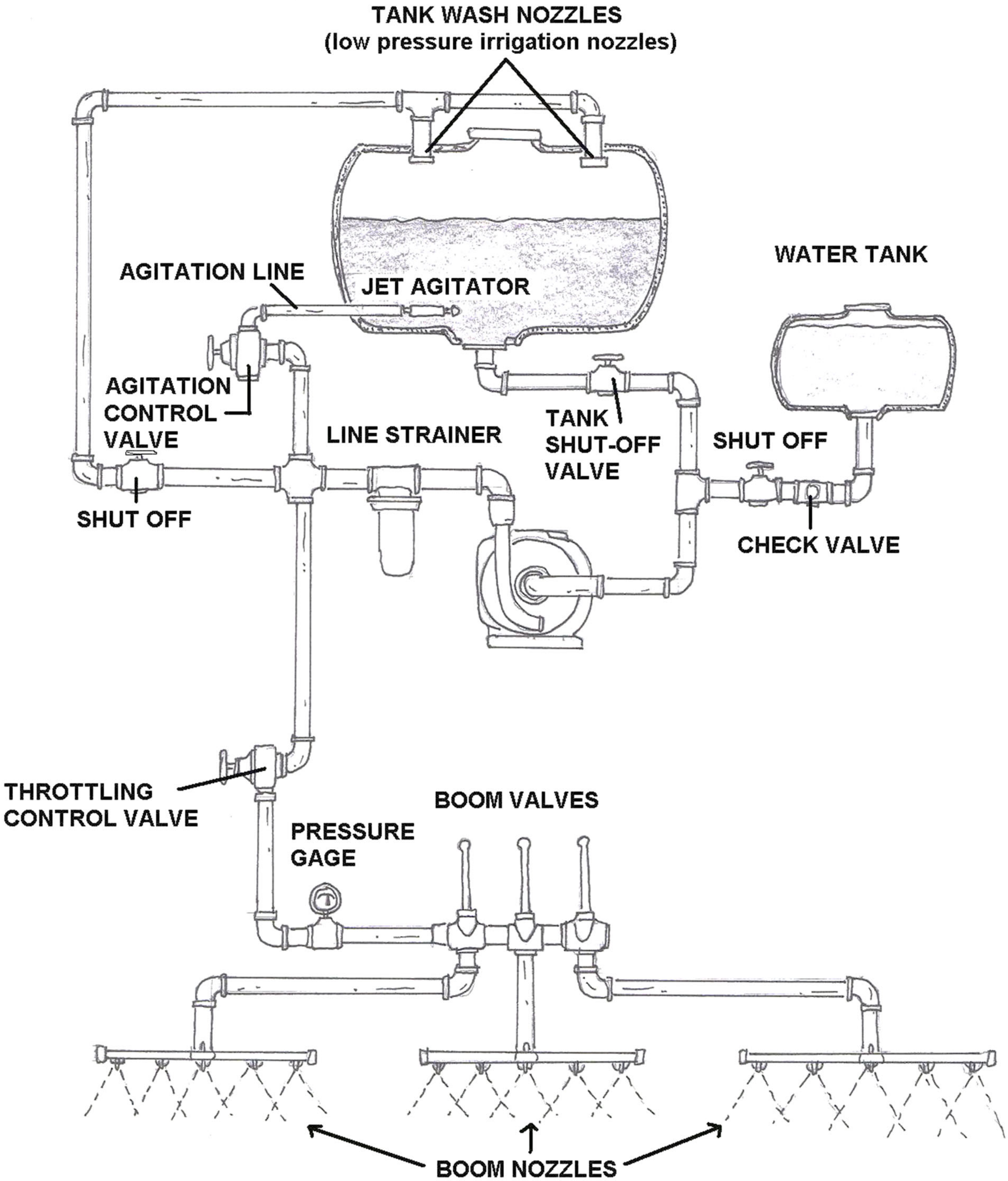
Tank Mixing
Applying more than one product at the same time (tank-mixing) can improve the logistics and cost of spraying provided the respective treatment timings coincide and the formulations are chemically and physically compatible. Only approved mixtures should be used.

Risks associated with tank mixing may include a reduction in biological activity due to product antagonism. This may be present as crop scorch, which although it may be only transient, can often reduce final yield.

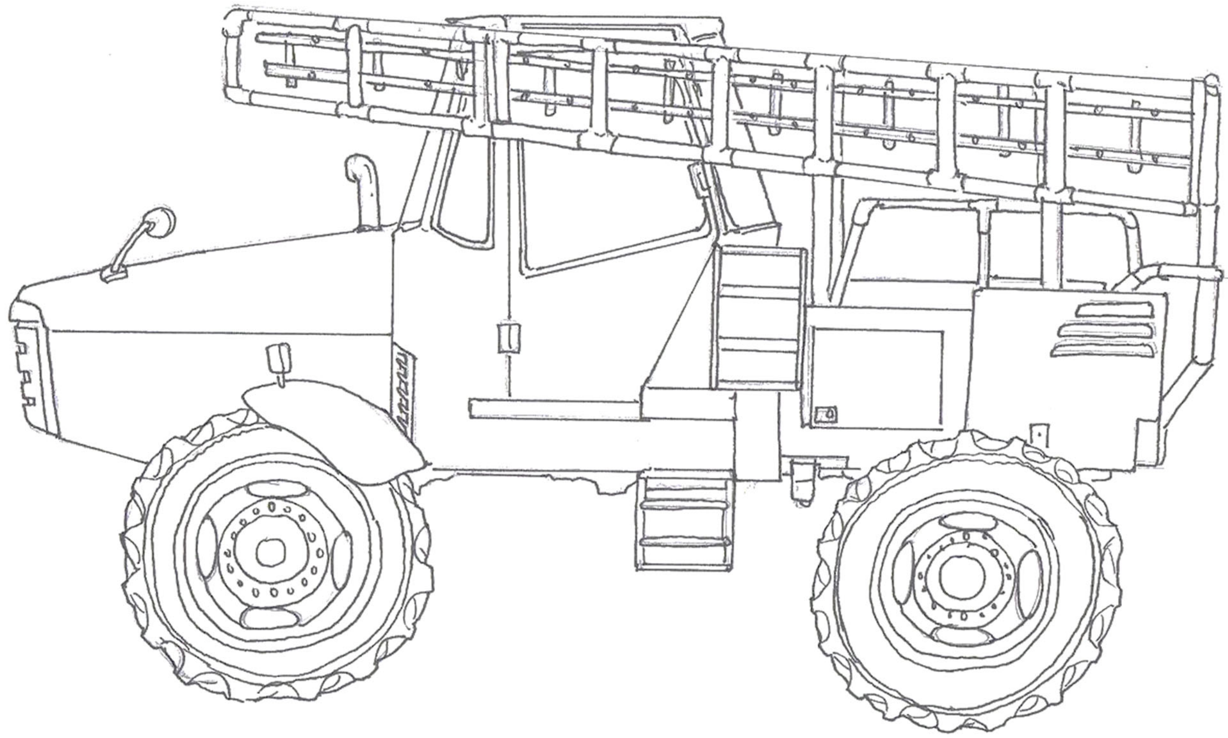
The most common limitation, however, is physical incompatibility, which can result in nozzle and filter blockage as well as phase separation in the spray tank where agitation is inadequate. This is common when during flights to the spray area (ferry flights) the spray pump is secured or turned off in the case of an electrically driven pump. This means that there is no circulation of the spray liquid back to the tank.

Where aircraft are refilled from a ground (“nurse”) tank, frequent re-circulation of the contents will ensure that there is no phase separation within the nurse tank. Product labels should give advice on tank mixing and approved mixture partners, information on the sequence of introducing the products into the tank and the need for agitation. Water temperature, quality and pH can also influence chemical stability of tank mixes.

Safety
The overall safety of crop protection chemicals must be the objective of all users and those engaged in the storage, distribution and retailing of agrochemicals.



BOOM SPRAYER SYSTEM DIAGRAM



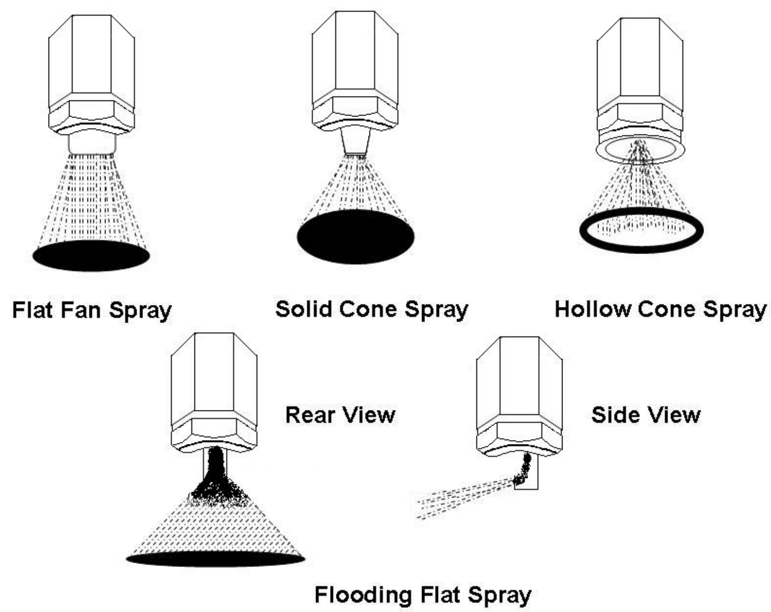
BOOM SPRAYER/TRACTOR MOUNTED DIAGRAM

Applicator, Worker or Handler Health Surveillance

The health of applicator, worker or handler’s exposed to pesticide must be monitored. The surveillance should cover health records and medical checks, which can alert medical authorities of any health changes, which might be related to exposure during work with pesticides. Health surveillance should also help determine whether safety practices and the selection and use of PPE are adequate for the products being used.

Spray Nozzles and Drift Sub-Section

A variety of materials are used to make nozzles, including brass, stainless steel, ceramic and nylon. There are advantages and disadvantages with each type of material. However, it is wisest to invest in the best quality nozzles available. Brass nozzles are relatively inexpensive, but they wear rapidly with abrasive materials, such as wettable powders and liquid fertilizers.



Stainless steel and hardened stainless steel are the most resistant to wear, but their expense discourages some users. Frequent replacement of brass nozzles usually makes their use more costly in relation to the area sprayed. The smooth surface of nylon nozzles makes them relatively resistant to wear, but the threads are easily damaged in use, especially when over tightened.

Modified nylon tips in metal housings avoid some of these problems. However, some solvents react with nylon, causing the material to swell and become unusable. Ceramic spray nozzles are also abrasion resistant, but are expensive and breakable. There are different types of spray patterns produced by nozzles each designed for a specific application.

Choosing the proper nozzle for a particular treatment will ensure good coverage and minimum drift. The selection of a nozzle is determined by the type of treatment being applied as well as certain aspects of the spray equipment such as flow rate and operating pressure. Herbicides are applied at low pressure to produce large droplets that reduce drift.

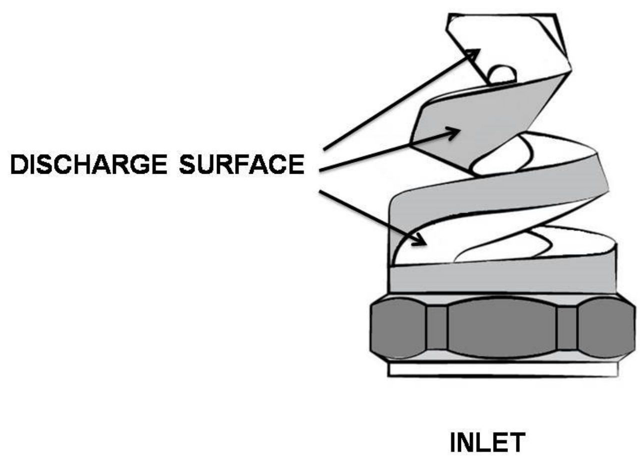
Higher pressures are used with fungicides to produce small droplets for better coverage of foliage. Insecticides are applied with pressure ranges between these two extremes. Drift control adjuvants work best with nozzles that reduce the number of fine and mist-like drops. To be effective and safe, nozzles may need to be changed for different pesticide applications.

Nozzle Section
Nozzles are a critical part of aircraft spray equipment. Their selection, location, calibration and testing are essential factors. The selection of nozzles is based on manufacturers' recommendations. Care must be exercised not to limit line pressure below 30 to 45 P.S.I. for water solutions. Special nozzles which entrain air or mix fluids in the tips are available. These are classified as foaming and bi-fluid systems. Nozzles for handling emulsions and slurries must have larger orifices.

Droplet Size
Droplet size is greatly affected by nozzle orientation on the boom. More shear and liquid break-up may be obtained by orienting nozzles with the direction of flight. A swivel action is desirable.

Nozzle types, in order of break-up or particle size, are: (1) fine--hollow cone; (2) intermediate--flat fan; (3) coarse--solid cone. Droplet size may also be controlled by the type of mixture being used (example: water emulsion or chemical wetting agent, etc.).

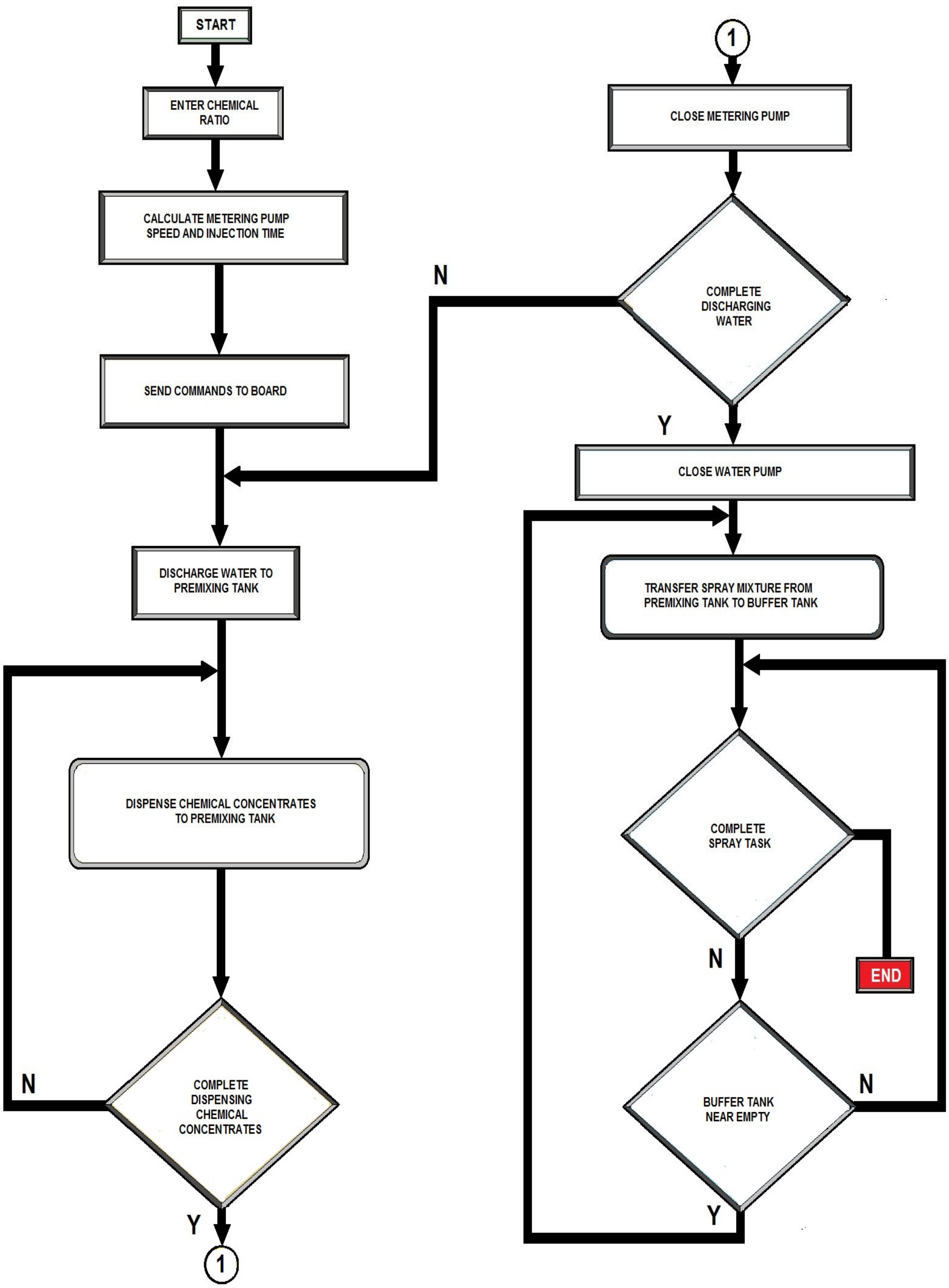
Other influencing factors are the density, viscosity and surface tension of the liquid, and the evaporative conditions in the air between the point of release from the aircraft and the point of impingement on the ground.



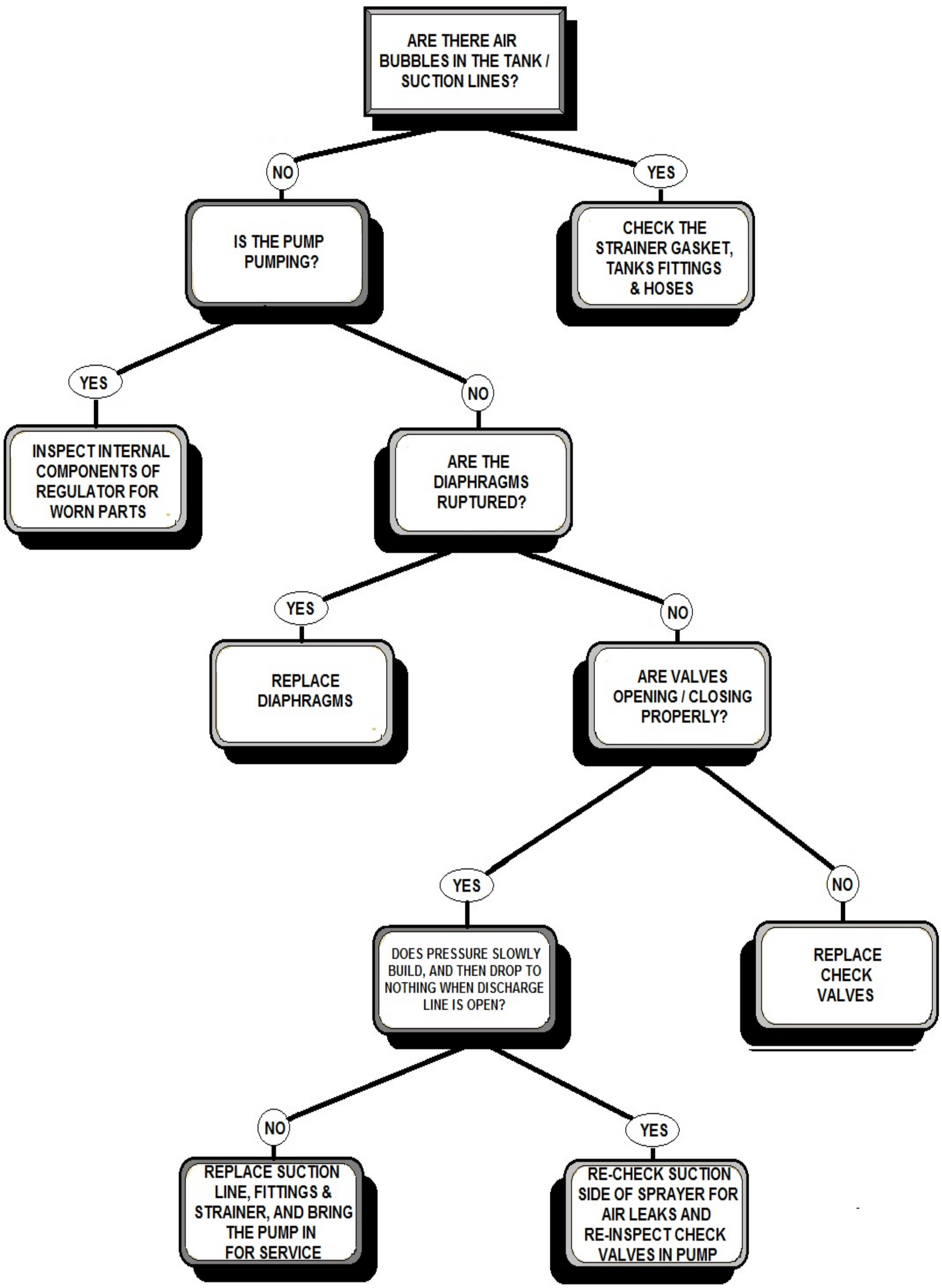
SPIRAL SPRAY NOZZLE

For safety and economic considerations, positive shut-off control is essential. This may be attained through the use of diaphragm or ball check valves or a suction return control. Diaphragm nozzles are considered more efficient. All types require maintenance to ensure proper performance.

Rotary Spray Systems
Spray systems for rotary wing aircraft include tanks mounted on the side of the frame in line with the rotor shaft. A common cross pipe feeds the engine-driven pump. Filter, regulator and control valves are attached to the lower frame of the fuselage in view of the pilot. Boom and nozzles may be mounted on the rotor, frame, or toe of the skids, enabling the pilot to see them.



METERING PESTICIDE DISPERSAL



TROUBLESHOOTING PRESSURE ISSUES (Sprayer Pump)

Technical Learning College

Using Pesticides Correctly

Product selection should be made taking into consideration the environmental risk, the potential applicator, worker or handler exposure hazard and the recommended dose rates. The products chosen must be used strictly in accordance with the label specification.

The majority of pesticide products and formulations approved for conventional aerial spraying are similar to products applied through conventional ground sprayers, however, when applied by air they are generally used at lower water volumes and therefore at higher spray solution concentrations. Where products used are not designed for aerial application, some formulations can present problems such as thickening, excessive foaming and emulsion inversion.

Chemicals are often used for control of invasive weeds and brush that hamper revegetation efforts on rangelands. Agricultural herbicides undergo extensive toxicological, environmental, plant efficacy, and cost-benefit tests before being released for widespread use. This database of knowledge enables the applicator to select herbicides to fit the targeted weeds and brush for maximum efficacy, efficiency, safety, and economics.

The number of herbicides for use on rangeland has changed little in the past two decades, and it appears that there will be little change in the next 20 years. The major change in application practice has been a shift from broad-scale aerial applications to individual plant treatments with ground equipment. In either case, the application equipment has been designed for more precision and safer use. Global positioning systems (GPS) and geographic information systems (GIS) on aircraft or ground units allow the applicator, worker or handler to “sculpt” the landscape for multiple land-uses, e.g. wildlife habitat, grazing, water harvesting, and aesthetics.

Herbicides will continue to play a significant role both singly and in combination with fire and mechanical treatments in revegetation projects. Persons applying restricted-use pesticides must have state certified Applicator’s License and follow specifications on the chemical’s Product Label. It is important to note that the Directions for Use section of all pesticide product labels begin with the statement: “It is a violation of Federal law to use this product in a manner inconsistent with its labeling.”

Granular Dispersal Systems
Granular dispersal systems are used for applying dust, impregnated granules, fertilizers and seed. A hopper with agitation must be provided to prevent bridging of fine material. Fine materials less than 60 mesh require agitators to prevent bridging. Frequent inspection of metering gates is required to ensure against leakage common under flight conditions of low pressure. The metering gate is the means of calibration. Size, shape, density and flowability of material all affect the swath width, application rate and pattern. The use of granular systems is on the decline in agricultural work.

Distance between Nozzle and Target (Boom Height)
Less distance between the droplet release point and the target will reduce spray drift. Less distance means less time to travel from nozzle to target and therefore less drift occurs.

Herbicide Volatility
All herbicides can drift as spray droplets, but some herbicides are sufficiently volatile to cause plant injury from drift of vapor (fumes). For example, 2,4-D or MCPA esters may produce damaging vapors, while 2,4-D or MCPA amines are essentially non-volatile and can drift only as droplets or dry particles.

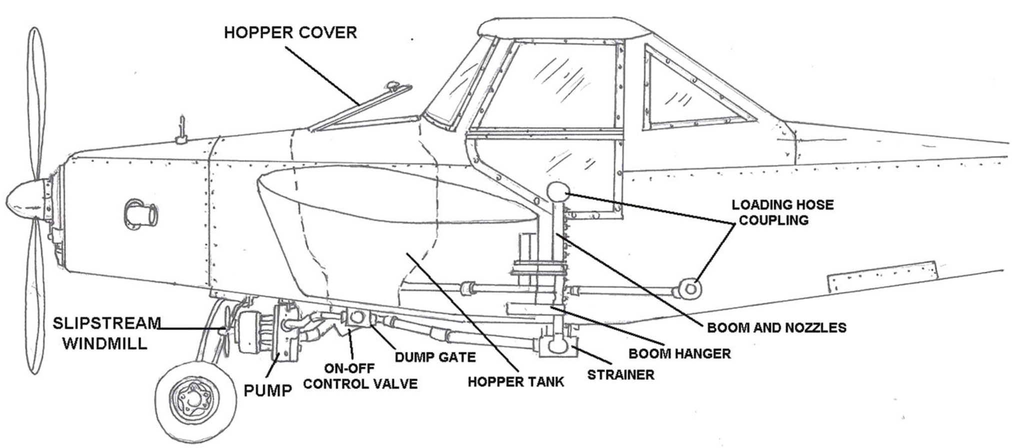
Relative Humidity and Temperature
Low relative humidity and/or high temperature will cause more rapid evaporation of spray droplets between the spray nozzle and the target than will high relative humidity and/or low temperature. Evaporation reduces droplet size, which in turn increases the potential drift of spray droplets.

Wind Direction and Velocity
Herbicides should not be applied when the wind is blowing toward an adjoining susceptible crop or a crop in a vulnerable stage of growth. The amount of herbicide lost from the target area and the distance the herbicide moves will increase as wind velocity increases, so greater wind velocity generally will cause more drift. However, severe crop injury from drift can occur with low wind velocities, especially under conditions that result in vertically stable air.

Over the past several decades the greatest and most widespread uses of herbicides have been in the production of row-crops and forages and in the clearing of brush for pasture improvement.

Oversight and carelessness in the use of herbicides on these crops and pastures have often resulted in unwarranted crop damage and substantial economic loss to growers or users of herbicides. This is especially true where small scale, high-value crops of sensitive nature are involved.

Sometimes farmers and landowners unknowingly apply hazardous herbicides in such close proximity or under such unfavorable climatic conditions that they injure their own crops or those of their neighbors.



CROP DUSTER COMPONENTS

Evaluating Pesticides - EPA Registration

All pesticides sold or distributed in the United States must be registered by EPA, based on scientific studies showing that they can be used without posing unreasonable risks to people or the environment.

Because of advances in scientific knowledge, the law requires that pesticides that were first registered before November 1, 1984, be reregistered to ensure that they meet today's more stringent standards.

In evaluating pesticides for reregistration, EPA obtains and reviews a complete set of studies from pesticide producers, describing the human health and environmental effects of each pesticide. The Agency develops any mitigation measures or regulatory controls needed to effectively reduce each pesticide's risks. EPA then reregisters pesticides that can be used without posing unreasonable risks to human health or the environment. When a pesticide is eligible for reregistration, EPA explains the basis for its decision in a Reregistration Eligibility Decision (RED) document.

Occupational Exposure to Pesticides

A pesticide poisoning occurs when chemicals intended to control a pest affect non-target organisms such as humans, wildlife, or bees. Pesticide poisoning is an important occupational health issue because pesticides are used in a large number of industries, which puts many different categories of workers at risk. Extensive use puts agricultural workers in particular at increased risk for pesticide illnesses. Workers in other industries are at risk for exposure as well. For example, commercial availability of pesticides in stores puts retail workers at risk for exposure and illness when they handle pesticide products.

The ubiquity of pesticides puts emergency responders such as fire-fighters and police officers at risk, because they are often the first responders to emergency events and may be unaware of the presence of a poisoning hazard. The process of aircraft disinsection, in which pesticides are used on inbound international flights for insect and disease control, can also make flight attendants sick.

Different job functions can lead to different levels of exposure. Most occupational exposures are caused by absorption through exposed skin such as the face, hands, forearms, neck, and chest. This exposure is sometimes enhanced by inhalation in settings including spraying operations in greenhouses and other closed environments, tractor cabs, and the operation of rotary fan mist sprayers. When used properly, pesticides offer a variety of benefits to society. They increase crop production, preserve produce, combat insect infestations, and control exotic species. However, pesticides also have the potential for causing harm.

Approximately 1.1 billion pounds of pesticide active ingredient are used annually in the U.S., and over 20,000 pesticide products are being marketed in the U.S.

The Environmental Protection Agency estimates that 10,000-20,000 physician-diagnosed pesticide poisonings occur each year among the approximately 2 million U.S. agricultural workers. Agricultural workers, groundskeepers, pet groomers, fumigators, and a variety of other occupations are at risk for exposure to pesticides including fungicides, herbicides, insecticides, rodenticides, and sanitizers.

Surveillance for occupational pesticide-related illness and injury is designed to protect workers by determining the magnitude and underlying causes of over-exposure to pesticides in the workplace. Surveillance also serves as an early warning system of any harmful effects not detected by manufacturer testing of pesticides.

Toxicity

Toxicity is the degree to which a substance can damage an organism. Toxicity can refer to the effect on a whole organism, such as an animal, bacterium, or plant, as well as the effect on a substructure of the organism, such as a cell (cytotoxicity) or an organ (organotoxicity), such as the liver (hepatotoxicity).

By extension, the word may be metaphorically used to describe toxic effects on larger and more complex groups, such as the family unit or society at large. A central concept of toxicology is that effects are dose-dependent; even water can lead to water intoxication when taken in large enough doses, whereas for even a very toxic substance such as snake venom there is a dose below which there is no detectable toxic effect.

There are generally three types of toxic entities; chemical, biological, and physical:

- Chemical toxicants include inorganic substances such as lead, mercury, asbestos, hydrofluoric acid, and chlorine gas, organic compounds such as methyl alcohol, most medications, and poisons from living things.
- Biological toxicants include bacteria and viruses that can induce disease in living organisms. Biological toxicity can be difficult to measure because the "threshold dose" may be a single organism. Theoretically, one virus, bacterium or worm can reproduce to cause a serious infection. However, in a host with an intact immune system the inherent toxicity of the organism is balanced by the host's ability to fight back; the effective toxicity is then a combination of both parts of the relationship. A similar situation is also present with other types of toxic agents.
- Physical toxicants are substances that, due to their physical nature, interfere with biological processes. Examples include coal dust and asbestos fibers, both of which can ultimately be fatal if inhaled.

Teratogenic Agents

A wide range of different chemicals and environmental factors are suspected or are known to be teratogenic in humans and in animals. A selected few include:

- **Drugs and medications:** tobacco, caffeine, drinking alcohol (ethanol) (see fetal alcohol spectrum disorder), isotretinoin (13-cis-retinoic acid, Roaccutane), temazepam (Restoril; Normisson), nitrazepam (Mogadon), nimetazepam (Ermin), aminopterin or methotrexate, androgenic hormones, busulfan, captopril, enalapril, coumarin, cyclophosphamide, diethylstilbestrol, phenytoin (diphenylhydantoin, Dilantin, Epanutin), etretinate, lithium, methimazole, penicillamine, tetracyclines, thalidomide, trimethadione, methoxyethyl ethers, Flusilazole, valproic acid, and many more.
- **Environmental chemicals:** polycyclic aromatic hydrocarbons (polynuclear aromatic hydrocarbons), polychlorinated biphenyls (PCBs), polychlorinated dibenzodioxins a.k.a dioxin, polychlorinated dibenzofurans (PCDFs), hexachlorobenzene hexachlorophene, organic mercury, ethidium bromide, etc.
- **Ionizing radiation:** atomic weapons fallout (Iodine-131, uranium), background radiation, diagnostic x-rays, radiation therapy.
- **Infections:** cytomegalovirus, herpes virus, parvovirus B19, rubella virus (German measles), syphilis, toxoplasmosis, Venezuelan equine encephalitis virus. (An easy way to remember maternal infections is TORCH: Toxoplasmosis, Other agents, Rubella, CMV and HSV.
- **Metabolic imbalance**: alcoholism, endemic cretinism, diabetes, folic acid deficiency, iodine deficiency, hyperthermia, phenylketonuria, rheumatic disease and congenital heart block, virilizing tumors

The status of some of the above substances (e.g. diphenylhydantoin) is subject to debate, and many other compounds are under varying degrees of suspicion. These include Agent Orange, nicotine, aspirin and other NSAIDs. Other compounds are known as severe teratogens based on veterinary work and animal studies, but are not listed above because they have not been studied in humans, e.g. cyclopamine. Teratogenic effects also help to determine the pregnancy category assigned by regulatory authorities; in the United States, a pregnancy category of X, D, or C may be assigned if teratogenic effects (or other risks in pregnancy) are documented or cannot be excluded.

Isotretinoin (13-cis-retinoic-acid; brand name Roaccutane), which is often used to treat severe acne, is such a strong teratogen that just a single dose taken by a pregnant woman may result in serious birth defects. Because of this effect, most countries have systems in place to ensure that it is not given to pregnant women, and that the patient is aware of how important it is to prevent pregnancy during and at least one month after treatment. Medical guidelines also suggest that pregnant women should limit vitamin A intake to about 700 μg/day, as it has teratogenic potential when consumed in excess.

Teratogenic Outcomes
Exposure to teratogens can result in a wide range of structural abnormalities such as cleft lip, cleft palate, dysmelia, anencephaly, ventricular septal defect. Exposure to a single agent can produce various abnormalities depending on the stage of development it occurs. Specific birth defects are not characteristic of any single agent.

Plantae
In botany, teratology investigates the theoretical implications of abnormal specimens. For example, the discovery of abnormal flowers—for example, flowers with leaves instead of petals, or flowers with staminoid pistils—furnished important evidence for the "foliar theory", the theory that all flower parts are highly specialized leaves.

Carcinogen
When assessing possible cancer risk posed by a pesticide, EPA considers how strongly carcinogenic the chemical is (its potency) and the potential for human exposure. The pesticides are evaluated not only to determine if they cause cancer in laboratory animals, but also as to their potential to cause human cancer. For any pesticide classified as a potential carcinogen, the risk would depend on the extent to which a person might be exposed (how much time and to what quantity of the pesticide). The factors considered include short-term studies, long-term cancer studies, mutagenicity studies, and structure activity concerns. (The term “weight-of-the-evidence” is used in referring to such a review. This means that the recommendation is not based on the results of one study, but on the results of all studies that are available.)

Teratogen
Teratology is the study of abnormalities of physiological development. It is often thought of as the study of human birth defects, but it is much broader than that, taking in other non-birth developmental stages, including puberty; and other non-human life forms, including plants.

Pesticide chemicals in their “raw” or unformulated state are not usually suitable for pest control. These concentrated chemicals (active ingredients) may not mix well with water, may be chemically unstable, and may be difficult to handle and transport. For these reasons, manufacturers add inert substances such as clays and solvents to improve application effectiveness, safety, handling, and storage. Inert ingredients do not possess pesticidal activity and are added to serve as a carrier for the active ingredient.

The mixture of active and inert ingredients is called a pesticide formulation. This formulation may consist of:

- The pesticide active ingredient that controls the target pest.
- The carrier, such as an organic solvent or mineral clay.
- Surface-active ingredients, such as stickers and spreaders.
- Other ingredients, such as stabilizers, dyes, and chemicals that improve or enhance pesticidal activity.

Usually you need to mix a formulated product with water or oil for final application. Baits, granules, gels, and dusts, however, are ready for use without additional dilution. Manufacturers package many specialized pesticides, such as products for households, in ready-to-use formulations. A single active ingredient often is sold in several kinds of formulations.

A pesticide poisoning occurs when chemicals intended to control a pest affect non-target organisms such as humans, wildlife, or bees.

Pesticide poisoning is an important occupational health issue because pesticides are used in a large number of industries, which puts many different categories of workers at risk. Extensive use puts agricultural workers in particular at increased risk for pesticide illnesses. Workers in other industries are at risk for exposure as well.

For example, commercial availability of pesticides in stores puts retail workers at risk for exposure and illness when they handle pesticide products. The ubiquity of pesticides puts emergency responders such as fire fighters and police officers at risk, because they are often the first responders to emergency events and may be unaware of the presence of a poisoning hazard. The process of aircraft disinsection, in which pesticides are used on inbound international flights for insect and disease control, can also make flight attendants sick.

Different job functions can lead to different levels of exposure. Most occupational exposures are caused by absorption through exposed skin such as the face, hands, forearms, neck, and chest. This exposure is sometimes enhanced by inhalation in settings including spraying operations in greenhouses and other closed environments, tractor cabs, and the operation of rotary fan mist sprayers.

Abbreviations
Abbreviations are often used to describe the formulation (e.g., WP for wettable powders); how the pesticide is used (e.g., TC for termiticide concentrate); or the characteristics of the formulation (e.g., LO for a low-odor formulation). The amount of active ingredient (a.i.) and the kind of formulation are listed on the product label.

For example, an 80% SP contains 80 percent by weight of active ingredient and is a soluble powder. If it is in a 10-pound bag, it contains 8 pounds of a.i. and 2 pounds of inert ingredient. Liquid formulations indicate the amount of a.i. in pounds per gallon. For example, 4F means 4 pounds of the a.i. per gallon in a flowable formulation.

If you find that more than one formulation is available for your pest control situation, you should choose the best one for the job. Before you make the choice, ask yourself several questions about each formulation.

Common Abbreviations for Pesticide Formulations

A= Aerosol
AF= Aqueous flowable
AS= Aqueous solution or aqueous suspension
B = Bait
C= Concentrate
CM= Concentrate mixture
CG = Concentrate granules
D= Dust
DF= Dry flowables
DS= Soluble dust
E= Emulsifiable concentrate
EC= Emulsifiable concentrate
F= Flowable (liquid)
G = Granules
GL= Gel
L= Liquid (flowable)
LC= Liquid concentrate or low concentrate
LV = Low volatile
M= Microencapsulated
MTF= Multiple temperature formulation
P = Pellets
PS= Pellets
RTU= Ready-to-use
S= Solution
SD= Soluble dust
SG = Soluble granule
SP = Soluble powder or soluble packet
ULV = Ultra low volume
ULW = Ultra low weight or ultra-low wettable
W = Wettable powder
WDG = Water-dispersible granules
WP = Wettable powder
WS= Water soluble
WSG = Water-soluble granules
WSL= Water-soluble liquid
WSP = Water-soluble powder or water-soluble packet

Pesticide Formulation Process Sub-Section

Regardless of their source, pesticide active ingredients have a range of solubilities. Some dissolve readily in water; others, only in oils. Some active ingredients may be relatively insoluble in either water or oil. Solubility characteristics and the intended use of the pesticide generally define which formulations best deliver the active ingredient. Usually, an active ingredient is combined with appropriate inert materials prior to packaging. The brief review of basic chemical terminology below should prove helpful in understanding differences among the various types of formulations.

Combinations
Combining two or more pesticides and applying them at the same time is convenient and cost effective. Most pesticide manufacturers sell some of their products as premixes, but often you must still combine two or more pesticides at the time of application. When you combine mixtures of two or more pesticides and/or fertilizers at the time of application, you create a tank mix. A common tank mix involves combining fungicides with insecticides as a spray for tree fruit crops. Another involves combining two or more herbicides to increase the number of weed species controlled. Some people mix pesticides with micronutrients or fertilizers. This practice saves money by reducing the time, labor, and fuel required for multiple applications.

Tank mixes reduce equipment wear and decrease labor costs. They lessen the mechanical damage done to crops and soil by heavy application equipment. Combinations may, however, affect the toxicity and the physical and chemical properties of any of the components of the tank mix increase residues, and damage or injure the target site, plant, or animal. If you mix DANGER—POISON pesticides with WARNING or CAUTION pesticides, treat the mixture as a DANGER—POISON pesticide. You must use the required safety equipment and follow all other label restrictions found on the label having the greatest restrictions.

Incompatibility
Incompatibility is a condition that prevents pesticides from mixing together properly to form a uniform solution or suspension. The formation of flakes, crystals, or oily clumps, or severe separation is unacceptable. Such incompatible mixtures clog application equipment and limit even distribution of the active ingredient in the spray tank. The cause of incompatibility may be the chemical nature of the materials you are mixing. Impurities in the spray tank or water also may affect compatibility. Even the order in which you mix pesticides in the spray tank is important. Sometimes the types of formulations being mixed influence compatibility. Pesticide formulations of the same type are rarely incompatible with one another because they usually contain many of the same inert ingredients and solvents.

Sometimes tank mixes seem compatible during testing and after mixing in the spray tank, but problems arise during application. This is known as field incompatibility. The temperature of the water in the tank can cause this problem. It could also be due to water impurities. Water pH (acidity vs. alkalinity) also may unexpectedly change for some unknown reason. Sometimes the amount of time the spray mixture has been in the tank causes field incompatibility.

Adjuvants are chemicals that do not possess pesticidal activity. Adjuvants are either premixed in the pesticide formulation or added to the spray tank to improve mixing or application or to enhance pesticidal performance. They are used extensively in products de-signed for foliar applications. Adjuvants can be used to customize the formulation to specific needs and compensate for local conditions. The right adjuvant may reduce or even eliminate spray application problems, thereby improving overall pesticide efficacy. Because adjuvants themselves have no pesticidal properties, they are not registered by the EPA. As a result, there is no set of standards for composition and quality, although some states have modified registration requirements for these chemicals and may require labels, technical data sheets, and efficacy information.

Before using any adjuvant, consult the pesticide label. Many registered pesticide products have very specific recommendations on their labels for use with one or more adjuvants. Failure to follow these instructions is as much a violation of the product label as inappropriate use of the pesticide. If you have questions about the specific properties of an adjuvant, contact the manufacturer before attempting to use it. Companies that produce adjuvants can provide labels, technical data sheets, SDS (formerly MSDS), supplemental labeling, and promotional literature about their products. Adjuvants are designed to perform specific functions, including wetting, spreading, sticking, reducing evaporation, reducing volatilization, buffering, emulsifying, dispersing, reducing spray drift, and reducing foaming. No single adjuvant can perform all these functions, but compatible adjuvants often can be combined to perform multiple functions simultaneously.

Types of Adjuvants

Much of the confusion surrounding adjuvants can be attributed to the lack of understanding of adjuvant terminology. For example, many people use the terms adjuvant and surfactant interchangeably. These terms can refer to the same product because all surfactants are adjuvants. However, not all adjuvants are surfactants.

Surfactants

Surfactants, also called wetting agents and spreaders, physically alter the surface tension of a spray droplet. For a pesticide to perform its function properly, a spray droplet must be able to wet the foliage and spread out evenly over a leaf. Surfactants enlarge the area of pesticide coverage, thereby increasing the pest’s exposure to the chemical. Surfactants are particularly important when applying a pesticide to waxy or hairy leaves. Without proper wetting and spreading, spray droplets often run off or fail to cover leaf surfaces adequately. Too much surfactant, however, can cause excessive runoff and reduce pesticide efficacy.

Surfactants are classified by the way they ionize or split apart into electrically charged atoms or molecules called ions. A surfactant with a negative charge is anionic. One with a positive charge is cationic, and one with no electrical charge is nonionic. Pesticidal activity in the presence of a nonionic surfactant can be quite different from activity in the presence of a cationic or anionic surfactant. Selecting the wrong surfactant can reduce the efficacy of a pesticide product and injure the target plant. Anionic surfactants are most effective when used with contact pesticides (i.e., pesticides that control the pest by direct contact rather than being absorbed systemically). Cationic surfactants should never be used as stand-alone surfactants because they usually are phytotoxic.

Nonionic surfactants, often used with systemic pesticides, help pesticide sprays penetrate plant cuticles. Nonionic surfactants are compatible with most pesticides, and most EPA-registered pesticides that require a surfactant recommend a nonionic type.

Stickers
A sticker is an adjuvant that increases the adhesion of solid particles to target surfaces. These adjuvants can decrease the amount of pesticide that washes off during irrigation or rain. Stickers also can reduce evaporation of the pesticide, and some slow down the degradation of pesticides by sunlight. Many adjuvants are formulated as spreader-stickers to make a general-purpose product.

Extenders
Some adjuvant manufacturers have named their products "extenders." Extenders function like stickers by retaining pesticides longer on the target area, slowing evaporation, and inhibiting degradation by sunlight.

Plant Penetrants
These adjuvants have a molecular configuration that enhances penetration of some pesticides into plants. An adjuvant of this type may increase penetration of a pesticide on one species of plant but not another. Enhanced penetration increases the activity of some pesticides.

Compatibility Agents
Pesticides are commonly combined with liquid fertilizers or other pesticides. Certain combinations can be physically or chemically incompatible, which causes clumps and uneven distribution in the tank. Occasionally the incompatible mixture plugs the pump and distribution lines resulting in expensive cleanup and repairs. A compatibility agent may eliminate these problems. Read product label directions carefully before adding a compatibility agent to a spray mix. You may wish to do a compatibility test in a quart jar to determine the stability of the mixture. After adding the desired pesticides and the compatibility adjuvant to the jar, shake the mixture and then check for clumping, separation, thickening, and heat release. Any one of these signs indicates an incompatibility problem.

Buffers or pH Modifiers
Most pesticide solutions or suspensions are stable between pH 5.5 and pH 7.0 (slightly acidic to neutral). Above pH 7.0 (alkaline or basic), the pesticide may be subject to degradation. Once a pesticide solution becomes alkaline, the risk exists that the pesticide degrades. Buffers and acidifiers are adjuvants that acidify and stabilize the water in the spray tank. Buffers must be added to the tank mix water first. The water must be neutralized or slightly acidified prior to adding pesticides and adjuvants.

Drift Control Additives
Drift is a function of droplet size. Small, fine drops with diameters of 100 microns or less tend to drift away from targeted areas. Drift control additives, also known as deposition aids, improve on-target placement of the pesticide spray by increasing the average droplet size. Drift reduction can be very important near sensitive sites and may well be worth the small reduction in efficacy that may result from the change in droplet size.

Defoaming Agents
Some pesticide formulations create foam or a frothy “head” in spray tanks. This is often the result of both the type of surfactant used in the formulation and the type of spray tank agitation system. The foam usually can be reduced or eliminated by adding a small amount of a defoaming agent.

Thickeners
As the name suggests, thickeners increase the viscosity (thickness) of spray mixtures. These adjuvants are used to control drift or slow evaporation after the spray has been deposited on the target area. Slowing evaporation is important when using systemic pesticides because they can penetrate the plant cuticle only as long as they remain in solution.

How to Choose the Right Adjuvant
Many factors must be considered when choosing an adjuvant for use in a pest management program. Following are some guidelines:

- Use only adjuvants manufactured and marketed for agricultural or horticultural uses. Do not use industrial products or household detergents with pesticides because they may interfere with pesticide performance.
- Remember, there are no miracle adjuvants. It is generally wise to be skeptical of such claims as “keeps spray equipment clean” or “causes better root penetration” unless the manufacturer has supporting evidence to back up such claims.
- Make sure the adjuvant has been thoroughly tested and proven effective for your intended use. Test questionable products on a limited area before proceeding with full-scale use.
- Certain pesticides and application procedures require certain types of adjuvants. Determine the correct type and use only an adjuvant of that type. For example, do not substitute an anionic surfactant when a nonionic surfactant is recommended.
- A particular pesticide label may require one or more adjuvants for a certain use yet prohibit any adjuvant for another use. Read the pesticide label carefully.
- Using an adjuvant is not always necessary. It is just as important to know when not to use an adjuvant as it is to know when to use one.

Spray Adjuvants Summary
Spray adjuvants can contribute substantially to safe and effective pest control. Many spray adjuvants are available, each formulated to solve problems associated with a particular type of application. Check pesticide and adjuvant labels to make sure adjuvants are suitable for the site you plan to spray, the target pest, your equipment, and, of course, the pesticide you plan to use.

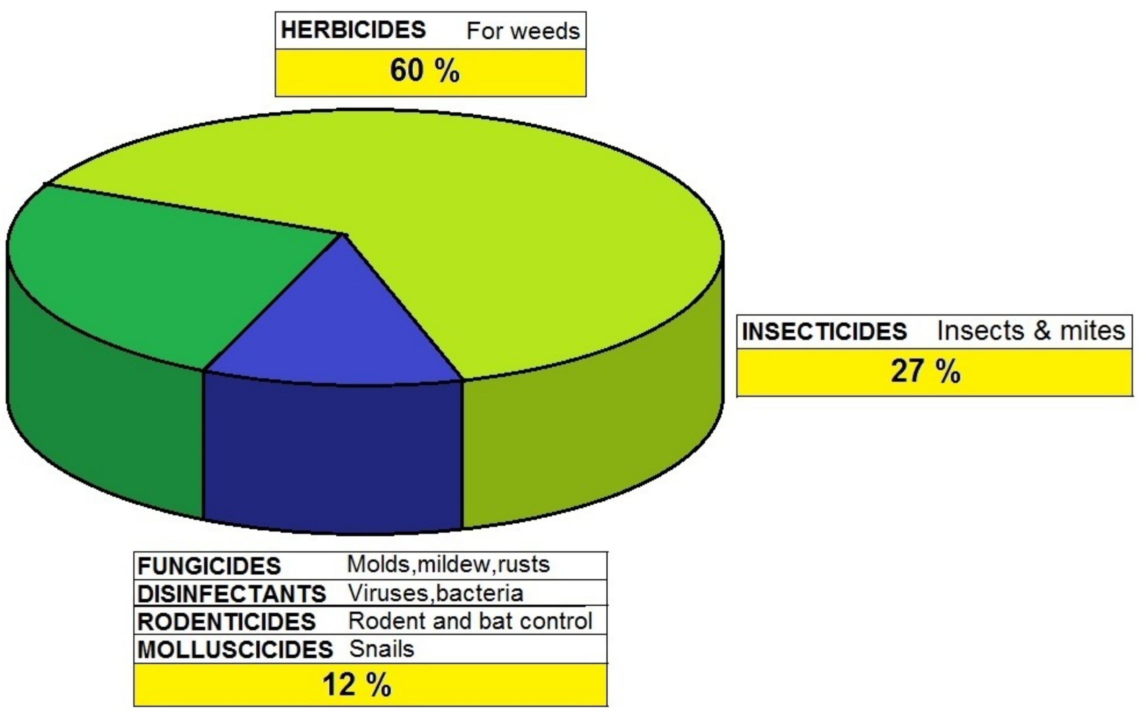
Remember, many pesticide products already contain an adjuvant. If a pesticide is already formulated properly for your crop, using an additional wetting agent, for example, may not give better spreading or coverage; instead, it could increase runoff, reduce deposit, and even severely damage the target plants.

A pesticide formulation consists of both active and inert ingredients. The active ingredient (a.i.) functions as the pesticide; the inert ingredient includes the carrier and adjuvants. The active ingredient includes always listed on the product label. The type of formulation may also be given. Persons handling pesticides must become familiar with the active ingredients and formulation types to better understand the nature of the products.

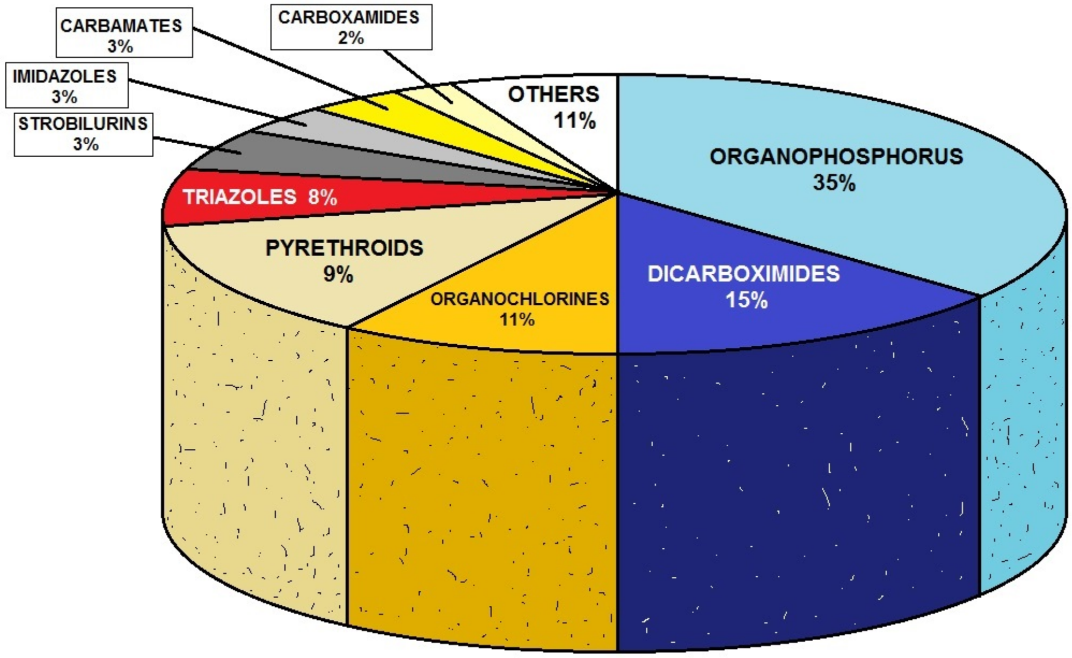
Emulsifiable Concentrates
Pesticides are formulated in a variety of processes such as being dissolved in a solution or dispersed in a suspension or an emulsion. Many liquid and dry formulations are available, including emulsifiable concentrates (EC), solutions (S), flowables (F), dusts (D), baits (B), and soluble powders (SP), to mention a few. Other formulations are available that cannot be clearly classified as either liquid or dry/solid pesticide formulations. These products, such as microencapsulated materials and water-soluble packets, have special properties that make them preferable for certain pest control situations. Understanding the relative advantages and disadvantages of the various formulation types helps the applicator decide which one is best to use in a given pest control situation.

Adjuvants are added to pesticide formulations to improve the pesticide's ability to control pests, although the adjuvants themselves do not possess pesticidal activity. For example, surfactant type adjuvants function as wetting agents or spreaders that improve pesticide coverage over an area such as a leaf surface. The pesticide handler should know how and when to use an adjuvant. Always read the pesticide label carefully to determine whether adding an adjuvant is recommended for use with the pesticide product.

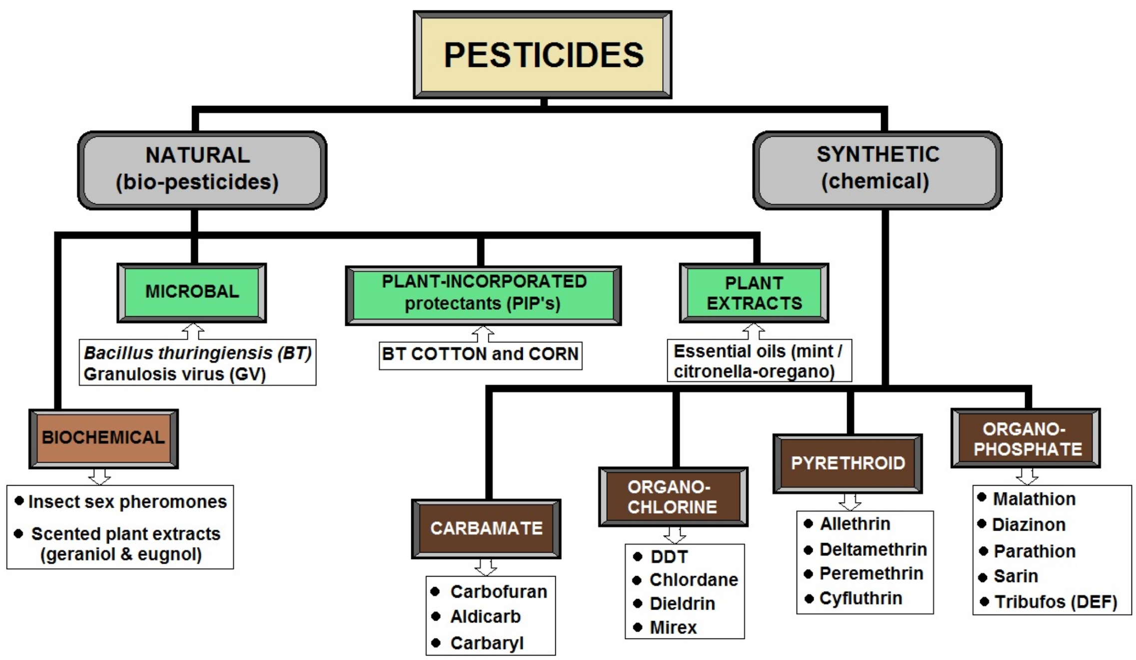
In summary, the pesticide user must consider several factors when selecting a pesticide formulation, such as the risks associated with the formulation type, the practicality of using the formulation on the target site or pest, and whether it will provide effective control. Having a basic understanding of formulation types before using pesticides helps the user avoid mistakes and accidents in choosing, mixing, loading, and applying the product.



PESTICIDE USAGE CHART BY TYPE DIAGRAM



PERCENTAGE OF PESTICIDE BY CHEMICAL CLASSIFICATION



DIFFERENT CLASSIFICATIONS OF PESTICIDES

Pesticide Reregistration Eligibility Decision (RED)

Biological Controls
Microscopic pathogens such as fungi, bacteria, and viruses control pests. An example is milky spore disease, which attacks Japanese beetles. A number of these biological pesticides are available commercially at hardware and garden stores. Biochemical pesticides include pheromones and juvenile insect hormones. Pheromones are chemical substances released by various organisms (including insects) as means of communicating with others of the same species, usually as an aid to mating. Pheromones lure pests inside a trap. Juvenile insect hormones interfere with an insect's normal growth and reproductive functions by mimicking the effects of compounds that occur naturally in the pest.

Beneficial predators such as purple martins and other birds eat insects; bats can eat thousands of insects in one night; lady beetles (ladybugs) and their larvae eat aphids, mealybugs, whiteflies, and mites. Other beneficial bugs include spiders, centipedes, ground beetles, lacewings, dragonflies, big-eyed bugs, and ants. You can install a purple martin house in your yard. You can also buy and release predatory insects. They are available from sources such as gardening catalogs and magazines. Contact your County Cooperative Extension Service, a nursery, or a garden association for information on how to attract and protect beneficial predators.

Parasitoids such as miniature wasps lay their eggs inside the eggs or bodies of insect pests such as tomato hornworms. Once the eggs hatch, the offspring kill their insect hosts, making parasitoids highly effective pest controllers. Before a pesticide can be marketed and used in the United States, the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) requires that EPA evaluate the proposed pesticide to assure that its use will not pose unreasonable risks of harm to human health and the environment. This regulation involves an extensive review of health and safety information.

Biopesticides include naturally occurring substances that control pests (biochemical pesticides), microorganisms that control pests (microbial pesticides), and pesticidal substances produced by plants containing added genetic material (plant-incorporated protectants) or PIPs.

Biopesticide Registration Tools
The federal pre-marketing approval of pesticides - termed registration -- is a complex process. The documents linked from this page augment the general registration process as they relate specifically to the registration of biopesticides. The e-mail address bppdconsistency@epa.gov has been created to respond to issues concerning biopesticide registration inconsistency that affect processing of submissions.

When you are ready to buy a pesticide product, follow these recommendations:
First, be certain that you have identified the problem correctly. Then, choose the least-toxic pesticide that will achieve the results you want and be the least toxic to you and the environment. When the words "broad-spectrum" appear on the label, this means the product is effective against a broad range of pests. If the label says "selective," the product is effective against one or a few pests.

Find the signal word—either Danger, Warning, or Caution on the pesticide label. The signal word tells you how poisonous the product is to humans.

Choose the form of pesticide (aerosol, dust, bait, or other) best suited to your target site and the pest you want to control.

- ✓ **DANGER** means poisonous or corrosive.
- ✓ **WARNING** means moderately hazardous.
- ✓ **CAUTION** means least hazardous.

Reading the Pesticide Label

The pesticide label is your best guide to using pesticides safely and effectively. The directions on the label are there primarily to help you achieve “maximum” benefits—the pest control that you desire— with “minimum” risk. Both depend on following label directions and correctly using the pesticide. Read the label. Read the label before buying the pesticide. Read the label before mixing or using the pesticide each time, and read the label before storing or disposing of the pesticide. Do not trust your memory. You may have forgotten part of the label instructions or they may have changed. Use of any pesticide in any way that is not consistent with label directions and precautions is illegal. It may also be ineffective and, even worse, dangerous.

The main sections of a pesticide label are described below:

1. EPA Registration Number. This number tells you that EPA has reviewed the product and determined that it can be used with minimal or low risk if you follow the directions on the label
properly. The number is not a stamp of approval or guarantee of effectiveness.

2. Ingredients Statement or Active Ingredients. Active ingredients are the chemicals in the pesticide that kill or control the target pest(s).

3. Signal Words. The signal words—Caution, Warning, or Danger—indicate the pesticide’s potential for making you sick. The word CAUTION appears on pesticides that are the least harmful to you. A pesticide with the word WARNING is more poisonous than those with a Caution label. Pesticides with the word DANGER on the label are very poisonous or irritating. They should be used with extreme care because they can severely burn your skin and eyes.

4. Precautionary Statements. This part describes the protective clothing, such as gloves or goggles, that you should wear when using the pesticide. The section also tells you how to protect children or pets by keeping them away from areas treated with pesticides.

5. Environmental Hazards. This section tells you if the product can cause environmental damage—if it’s harmful to wildlife, fish, endangered plants or animals, wetlands, or water.

6. Directions for Use. Make sure that the product is labeled for use against the pest(s) that you are trying to control. (For example, products labeled only for termites should not be used to control fleas.) Use only the amounts recommended, and follow the directions exactly.

7. First Aid Instructions. The label tells you what to do if someone is accidentally poisoned by the pesticide. Look for this information in the Statement of Practical Treatment section. The instructions are only first aid. ALWAYS call a doctor or your local poison center. You may have to take the person to a hospital right away after giving first aid. Remember to take the pesticide label or container with you.

8. Storage and Disposal. Read carefully and follow all directions for safe storage and disposal of pesticide products. Always keep products in the original container and out of reach of children, in a locked cabinet or locked garden shed.

Safe Disposal of Pesticides

The best way to dispose of small amounts of excess pesticides is to use them—apply them—according to the directions on the label. If you cannot use them, ask your neighbors whether they have a similar pest control problem and can use them. If all of the remaining pesticide cannot be properly used, check with your local solid waste agency, environmental agency, or health department to find out whether your community has a household hazardous waste collection program or a similar program for getting rid of unwanted, leftover pesticides.

These authorities can also inform you of any local requirements for pesticide waste disposal. Earth 911 (1-800-CLEANUP or www.earth911.com) is another source for information about disposal and special waste collection programs in your local area.

State and local laws regarding pesticide disposal may be stricter than the federal requirements on the label. Be sure to check with your state or local solid waste agency before disposing of your pesticide containers. If no community program or guidance exists, follow the label directions for disposal. In general, to dispose of less than a full container of a liquid pesticide, leave it in the original container with the cap tightly in place to prevent spills or leaks. Put the container in a covered trash can for routine collection with municipal trash. If you do not have a regular trash collection service, take the package to a permitted landfill (unless your town has other requirements).

Note: No more than 1 gallon of liquid pesticide at a time should be thrown out with the regular trash in this manner.

- ✓ Place individual packages of dry pesticides in a tight carton or bag, and tape or tie the package closed. Put the package in a covered trash can for routine collection.

Note: No more than 5 pounds of dry pesticide at a time should be thrown out with the regular trash in this manner.

Leftover Pesticides

- Do not pour leftover pesticides down the sink, into the toilet, or down a sewer or street drain. Pesticides may interfere with the operation of wastewater treatment systems or pollute waterways. Many municipal systems are not equipped to remove all pesticide residues. If pesticides reach waterways, they may harm fish, plants, and other living things.
- Do not pour leftover pesticides down the sink, into the toilet, or down a sewer or street drain.
- An empty pesticide container can be as hazardous as a full one because of residues left inside. Never reuse such a container. When empty, replace the cap or closure securely and place in trash. Dispose of the container according to label instructions. Do not puncture or burn a pressurized or aerosol container—it could explode.

Many communities have programs to recycle household waste such as empty bottles and cans. Do not recycle any pesticide containers, however, unless the recycling program specifically accepts pesticide containers and you follow the program's instructions for preparing the empty containers for collection.

Reducing Pesticide Risk

By their nature as substances that in many cases are designed to kill pests, pesticides can pose risks to humans and to the environment. It is possible to reduce those risks in several ways. For example:

- EPA gives priority in its registration program for conventional chemical pesticides to pesticides that meet reduced risk criteria: low-impact on human health, low toxicity to non-target organisms (birds, fish, and plants), low potential for groundwater contamination, lower use rates, low pest resistance potential, and compatibility with Integrated Pest Management.
- Some pesticides are by their nature less risky, for example, many biological pesticides that are derived from such natural materials as animals, plants, bacteria, and certain minerals pose a lower risk. For example, canola oil and baking soda have pesticidal applications and are considered biopesticides. However, other plant-derived pesticides such as nicotine can be quite toxic.
- EPA is reviewing older pesticides to ensure that they meet current safety standards. The results of these reviews often include actions to reduce risks from pesticides, such as establishing or enlarging buffers to protect surface water bodies, changing the amount or frequency of use of a pesticide to reduce exposure, limiting use of the pesticide during periods when a non-pest species might be affected, eliminating or modifying uses that pose unacceptable risks to people, particularly children.
- In many situations, there may be non-chemical methods to control pests. EPA recommends considering and using these methods as part of an overall pest management strategy, often called Integrated Pest Management.

CATEGORY	NONREFILLABLE CONTAINERS	REFILLABLE CONTAINERS	REPACKING PESTICIDE PRODUCTS	CONTAINER LABELING	CONTAINMENT STRUCTURES
WHO MUST COMPLY	REGISTRANTS	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS PESTICIDE USERS (Must Follow New Directions)	AG RETAILERS AG COMMERCIAL APPLICATORS AG CUSTOM BLENDERS
MAJOR REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • CONTAINER DISPENSING CAPABILITY • STANDARD CLOSURES • RESIDUAL REMOVAL • RECORDKEEPING	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• IDENTIFY CONTAINER AS NONREFILLABLE OR FILLABLE (All) • STATEMENTS TO PROHIBIT REUSE AND OFFER FOR RECYCLING; BATCH CODE (All Nonrefillables) • CLEANING INSTRUCTIONS • CLEANING INSTRUCTONS BEFORE FINAL DISPOSAL	• SECONDARY CONTAINMENT STRUCTURES (Dikes) AROUND STATIONARY TANKS • CONTAINMENT PADS FOR PESTICIDE DISPENSING AREAS • GOOD OPERATING PROCEDURES • MONTHLY INSPECTION OF TANKS AND STRUCTURES • RECORDKEEPING
COMPLIANCE DATE	AUGUST 17, 2009	AUGUST 17, 2011	AUGUST 17, 2011	AUGUST 16, 2011 (Based on the October 8, 2010 Final Rule)	AUGUST 17, 2009

PESTICIDE CONTAINER AND CONTAINMENT RULE

Technical Learning College

Integrated Pest Management Example

IPM offers growers an array of tools to help manage pest problems. At the foundation of this approach are good growing practices, preventive pest management measures, and a regular pest monitoring program that enables producers to accurately determine if a pest control measure is economically justified. IPM uses a common sense approach to find the weak link in a pest's life cycle.

Sound pest programs do not attempt to eradicate pests, but rather to manage them so that economic crop losses are minimized. IPM is the primary BMP for pest management.

It involves combining practices such as:

- Selecting crops and varieties which are resistant to pest pressures.
- Timing planting and harvest dates to minimize pest damage.
- Rotating crops.
- Monitoring pest and natural enemy populations.
- Employing beneficial insects and other biological controls.

The philosophy behind the IPM approach is to create unfavorable conditions for pest buildup by enhancing crop vigor and by protecting natural enemies that aid in controlling pest populations.

IPM relies on a combination of practices to reduce damage by insects and related pests. Crop rotation and resistant varieties can be used to avoid some pest problems. Identifying pests promptly allows necessary and effective treatments to be applied before pest populations reach damaging levels. Treating a pest problem with either synthetic or natural pesticides is only a temporary solution. If a pest is recurring from year to year, then a new management strategy should be developed. As usually practiced, IPM includes judicious use of chemical pesticides applied only after scouting reveals pests at economically damaging threshold levels.

Scouting

An IPM program depends on good scouting. The scout walks through the field and inspects plants for insects at least once a week, sometimes more frequently when weather and season favor rapid pest buildups. Scouting for pests can prevent damage by identifying problems early, and it can save money if fewer treatments are needed.

Scouts target specific insects and select search techniques accordingly. Grasshoppers, for example, appear first on field edges, spider mites next to harvested small grains, and armyworms next to wheat. Other specific scouting tips are given later in this chapter. As well as looking carefully at a random sample of plants, scouts may use sweep nets to sample highly mobile insects such as potato leafhoppers.

Bean leaf beetles, cucumber beetles, Mexican bean beetles, and stinkbugs will drop onto a ground cloth or 'beat sheet' when the plant is shaken. Bright, adhesive-covered cards placed near plants will trap small, hard-to-see insects such as aphids, thrips, and whiteflies. Aphids and whiteflies are attracted to yellow cards and thrips to blue ones.

Economic Injury Thresholds
Economic injury thresholds are available for some, but not all, pests in the southern states. Economic injury levels given in this chapter are only intended as general guidelines. Information from cooperative extension agents and the experience of local growers are the best guides.

Insecticide Use
Before any insecticide is used in an IPM program, the presence of damaging levels of a pest insect should be confirmed by scouting. Unnecessary applications of insecticide increase costs, promote development of insecticide resistance, and degrade the environment. Use of insecticides sometimes increases the numbers of non-target pests.

On potatoes, for example, carbaryl (Sevin) application has produced peak green peach aphid populations that were more than ten times greater than those in untreated plots. The main factor in this population increase was direct stimulation of aphid reproduction by the carbaryl.

Total nitrogen content, which has been shown to increase aphid populations, also increased slightly, but predator and parasite populations were not affected by carbaryl.

Once the need for an insecticide is confirmed, it should be applied as efficiently as possible. In the middle of hot, dry days, insects are less active and less likely to come in contact with the insecticide. It will also be difficult to get good coverage of wilted plants, and heat will volatilize some insecticides before they reach the plant.

Using the most appropriate sprayer will also increase efficiency as only chemicals deposited on plant surfaces kill insects. For aphids and other underleaf insects, only spray deposited on leaf undersides is effective. Conventional sprayers rely on gravity and inertia to deliver pesticides. By some estimates, only half the pesticide applied adheres to the plant.

Persistence of a Chemical
Most organochlorine pesticides (e.g., DDT, chlordane) are very persistent. Most of the organophosphates (e.g., parathion, malathion) and pyrethroids are much less persistent. Pyrethrins, and carbamate pesticides are nonpersistent. Some factors that influence the persistence of a chemical and the possibility that residues may remain are:

- ✓ The amount of chemical applied
- ✓ The formulation
- ✓ The pH (acidity or alkalinity) of the water diluent and of the target tissue, soil, or water.
- ✓ The nature of the surface to which it is applied.
- ✓ Exposure to weathering from wind, rain, etc.
- ✓ Chemical breakdown from high temperatures and humidity
- ✓ Photochemical reactions from sunlight
- ✓ Biological reactions.

If public health pesticides are applied properly and in accordance with label restrictions for applications around food crops residues on or in the crop should never be a problem.

WPS - Chemical Control in an IPM Program

Regular field scouting, coupled with forecasting pest problems and determining economic thresholds, is used to ensure that pesticides are only applied when pest populations warrant chemical control. The traditional approach of applying pesticides routinely or at the first sign of any crop pest is replaced with a philosophy that seeks to optimize crop growth and allow natural enemies of pests the opportunity to suppress the outbreak.

Producers and consumers must understand, however, that there is no "*silver bullet*" in an IPM program and that some level of pests and diseases must be tolerated. Fortunately, most crops can tolerate a certain level of infestation before significant yield or quality losses occur.

Electrostatic Sprayers
Electrostatic sprayers which apply an electrical charge to the material being sprayed reduce spraying time and improve insect and disease control per unit of chemical applied.

The charged chemical is attracted to the opposite electric charge on the leaf surface so that retention is better. To further increase efficiency, the charged spray can be delivered with a turbulent air blast, carrying the material deeper into the plant canopy. Such air-assisted electrostatic sprayers deposited four times more spray onto both upper and lower leaf surfaces than conventional mist-blower equipment. Higher amounts of sprays from air-assisted electrostatic units were also found deeper in the crop canopy compared to the amounts delivered by uncharged hydraulic sprayers. These sprayers also deposit more spray on any fruit present in the canopy, however.

Some systemic insecticides are applied to the soil at planting to control early season insects. Thoroughly incorporating granules of these soil-applied chemicals increases control efficiency, while reducing hazards to birds and wildlife from surface granules and granules spilled at the ends of the rows.

Weeds and Insects
Weedy areas may provide habitat for both pests and beneficial insects, but if plants in adjacent weedy areas are related to crop plants, weedy areas are more likely to be a source of insect pests. Morning glory is related to sweetpotato, for example, and nightshade to tomatoes, potatoes and eggplant. Pests with a wide host range such as armyworms, crickets, cutworms, darkling beetles, flea beetles, grasshoppers, lygus bugs, slugs and snails, stink bugs and thrips often inhabit weedy areas and in some cases will attack nearby crops. Mowing weedy areas for the first time after the crop emerges may encourage migration onto crop plants. It may be best not to mow weedy areas at all or to mow before the crop emerges and regularly after emergence.

Tillage Practices and Insects
Plowing under plant debris to speed up decomposition is a common method to lower pest populations by destroying overwintering stages. Seed corn maggots, for example, survive in decomposing plant material. However, tillage operations will also reduce populations of beneficial insects. A study of field crops showed lower populations of carabid beetles and spiders in conventionally tilled fields compared to no-till fields. Both of these predators can help control seed and seedling pests. Strip tillage preserves habitat for beneficial insects, while still destroying soil-dwelling insects in the plowed area.

Crop Rotation
Crop rotation is a traditional production practice used to enhance soil fertility and tilt, increase crop vigor, and reduce the buildup of crop pests. Crop rotations cannot solve all weed, insect, and disease problems. However, without rotations, producers are essentially locked into pesticide-based control programs. Rotations are most likely to be effective on pests that tend to be crop specific and overwinter on site. By switching to another crop, pest cycles may be interrupted when they become active and find their food source is gone.

The key to a good rotation plan is to determine which pests are of most concern and then select crops accordingly. Obviously, market factors must be considered for producers to remain profitable. Continuous corn and alfalfa, as well as vegetable only and wheat-fallow cropping systems are common. These systems have some production and marketing advantages, but usually result in weed and other pest problems. Rotating to different crops, such as from vegetables to small grains, provides the additional benefit of scavenging excess soil nitrate.

IPM programs are difficult to implement under cropping systems that do not include rotations. Where rotation is practiced, pesticide use can often be greatly reduced with no significant losses. For example, corn rootworm insecticide is used in the greatest volume of any agricultural insecticide in the United States. Rotating corn fields to any other crop generally eliminates the need for insecticide application, saving money and reducing potential environmental impacts.

Resistant Crop Varieties
Plant breeders have been selecting pest resistant varieties to improve crop productivity for many years. Now, host plant resistance is a cornerstone of many successful IPM programs.

Non-chemical Pest Control Practices
IPM may result in reduced pesticide use by employing preventive pest management and non-chemical pest controls. Non-chemical pest management methods include crop rotation, resistant varieties, cultural practices, and biological controls. These methods are basic to effective IPM and should be the first line of defense. However, producers must plan for their use in advance of pest outbreaks to successfully use non-chemical management tools.

Plants have many natural characteristics for keeping pests at bay: repellent or toxic chemicals, thorns, hairs, and resistant tissues. The greatest plant breeding successes have been in the selection of disease resistant varieties, but insect tolerant lines have also been developed. With some pests, such as plant viruses, the only effective control is the use of resistant varieties and clean planting material. Resistant varieties will not interfere with other pest control measures and may reduce the need for pesticide treatment. However, resistance is not available for all problems. Potential drawbacks include decreased yields, increased susceptibility to other pests, and shifts in predominant pest biotypes as a result of over-exposure to the resistance genes.

Examples of pest resistant crops include Russian wheat aphid tolerant winter wheat, curly top virus resistant sugarbeets, European corn borer resistant corn hybrids, sorghum unpalatable to birds, and dry beans with tolerance to white mold and halo blight.

Other Cultural Practices
Pests have a more difficult time getting established when crop plants are thriving. For example, many late emerging annual weeds cannot compete successfully once the crop canopy shades the row. Insects such as spider mites thrive on drought stressed plants, but are much less competitive on vigorous crops. Producers should employ cultural practices to their advantage.

Optimum plant population, row spacing, fertility, and irrigation are practices that can improve crop vigor, thereby reducing pest competitiveness and impact. Growers should evaluate their production practices for areas where they can enhance crop health and vigor. Usually, these improvements will increase crop yield and economic return. Adjusting planting, tillage, and harvest dates can sometimes help crops avoid pests. Early tillage destroys weeds where some insects lay their eggs. Tillage also is very important for destroying volunteer crops where pests such as Russian wheat aphid or wheat curl mite may overwinter or become established early. Early planting may help the shorter season corn varieties escape economic damage from second generation European corn borer.

Planting too early in the spring or too late in the fall has some drawbacks that producers should consider. Late frost and slowed emergence can make plants more susceptible to disease and insect pressure. A good technique for many growers is to plant a range of maturity dates, beginning as soon as the soil is at the proper temperature for germination.

Producers may want to delay the planting of fields with problem weeds to allow for weed emergence and cultivation prior to crop establishment. Winter wheat growers can avoid wheat streak mosaic and Russian wheat aphid by delaying fall planting.

In some cases, crops can be harvested early instead of spraying. Harvesting alfalfa early may substitute for pesticide in reducing alfalfa weevil populations. An early first cutting can decrease the weevil population by mechanically damaging larvae and exposing them to predation and weather.

Early harvesting is also a good way to manage foliar diseases in alfalfa. Harvesting corn for silage or high moisture grain may prevent losses caused by lodging due to stalk rot or corn borer.

Biological Pest Control
Beneficial organisms can help control weeds, diseases, and insects in crop fields when broad spectrum pesticides are avoided. These organisms may occur naturally or may be purposely introduced. Beneficials include predatory insects and mites, parasitic insects, and microbial organisms.

Predators such as lady beetles and green lacewings feed on plant-eating pests. Insect parasites, like the tiny braconid wasp, lay eggs on or inside the developing pest. The single-celled protozoa, Nosema, is a microbial pathogen of grasshoppers. Additionally, grazing animals such as sheep can help control difficult weed species such as leafy spurge. Given favorable conditions, naturally occurring and introduced biological controls can do an excellent job of reducing some pests below economic injury levels.

Due to the cost of introducing biological controls, conserving the natural enemies already in your field is a useful IPM technique. Unfortunately, beneficial insects are often killed when broad spectrum pesticides are applied.

To conserve beneficials in your fields:
Preserve habitat and alternate food sources for beneficials.

- Learn to distinguish beneficial insects from pests.
- Minimize broad spectrum pesticide applications.
- Use selective pesticides that are less toxic to beneficials.
- Treat only those portions of the field where pests cause economic levels of damage.

These natural controls often work more slowly than pesticides, but they can be effective, environmentally friendly, and economically sustainable.

Table 1. Examples of insect biological control organisms released for pest control by the Colorado Department of Agriculture.

Control Organism	Pest Crop
Macrocentrus ancylivorus	Oriental fruit moth Peach
Hippodamia variegata	Russian wheat aphid Wheat
Tetrastichus incertus	Alfalfa weevil Alfalfa
Phrydiuchus tau	Mediterranean sage Range
Ceutorhynchus litura	Canada thistle Range
Rhinocyllus conicus	Musk thistle Range
Calophasia lunula	Toadflax Range
Microlarinus lareynii	Puncturevine Range
Aphthona flava	Leafy spurge Range
Urophora affinis	Knapweed Range

Commercially available biological control organisms are being used successfully by some growers of high value crops. A number of suppliers throughout the United States provide beneficial organisms for release in gardens, greenhouses, and fields. The economic benefit of field releases of beneficial insects is uncertain in many crops because of limited knowledge about when and how to achieve establishment and control.

Biological Pesticides
Biological pesticides, such as *Bacillus thuringiensis* (Bt), are commercially available and are effective against some pests. These products are extremely selective and of low toxicity to humans and non-target organisms. Examples of biological pesticides include bacteria, fungi, viruses, or their toxins.

The bacterial insecticide, Bt, is currently the most commonly used biological pesticide.

Consider using these products in place of more toxic pesticides, especially when water supplies are vulnerable to contamination. Be sure to follow all label directions for application and storage of these products.

Product Handling
The product label is usually the first reference for guidance on handling formulated pesticide products. It will usually describe the requirements for the use of Personal Protective Equipment (PPE) both for handling the undiluted (concentrate) product and for diluted spray solution.

Applicator, worker or handler exposure and environmental contamination can be substantially reduced when closed filling systems are used to extract the product from its shipping container and deliver it either directly to the spray tank or via a metering system to a separate mixing tank. This avoids contact with the loading crew and accidental spillage. Some closed transfer systems can empty and rinse chemical containers automatically and can eliminate the need for rinsing empty containers and the disposal of the contaminated water.

Chemical Container Management
On no account must empty chemical containers be reused. Empty containers must be thoroughly washed and rendered unusable before disposal. Empty containers can be effectively cleaned by manual methods or by a closed transfer system that collects the washing water (rinsate).

Empty containers must be collected and securely stored prior to disposal and should not be left unsecured at the mixing site. Some states allow controlled burial for empty and thoroughly cleaned containers whilst high-temperature incineration is permitted in other cases. Local environmental pollution control regulations must be consulted.

Chemical container management can be facilitated where products are purchased in returnable containers. In this case sealed containers are returned to the manufacturer for re-filling; a process, which often can be repeated several times during the life of a container. An approved, compatible extraction system to both measure and extract the chemical for use is required and systems must be capable of handling products of different viscosities and containers of different closure sizes.

Accident Procedures
If spillage occurs during transport or handling a pesticide, this may result in a fire, injury to humans, property damage or environmental contamination. Rapid action must follow the accident to contain and minimize any adverse effects. Pesticide transporters and users must be familiar with label recommendations and procedures to be followed. In the event of an accident, the appropriate authorities (Environment, Water, Police etc.) must be notified. Records must be kept of all incidents and remedial action taken. Only vehicles correctly equipped to carry pesticides must be used to transport product to the airstrip.

Organic Agricultural Methods
Organic farming is a form of agriculture which does not permit the use of synthetic fertilizers and pesticides, plant growth regulators, livestock feed additives, and genetically modified organisms. As far as possible, organic farmers rely on crop rotation, green manure, compost, biological pest control, and mechanical cultivation to maintain soil productivity and control pests. Organic agricultural methods are internationally regulated and legally enforced by many nations, based in large part on the standards set by the International Federation of Organic Agriculture Movements, an international umbrella organization for organic organizations established in 1972. The United States Department of Agriculture also tracks organic policies and procedures nationally.

Vector control technicians working near these farms need work closely with the landowner to prevent vectors from coming from the property, and to avoid jeopardizing the organic status of the crop.

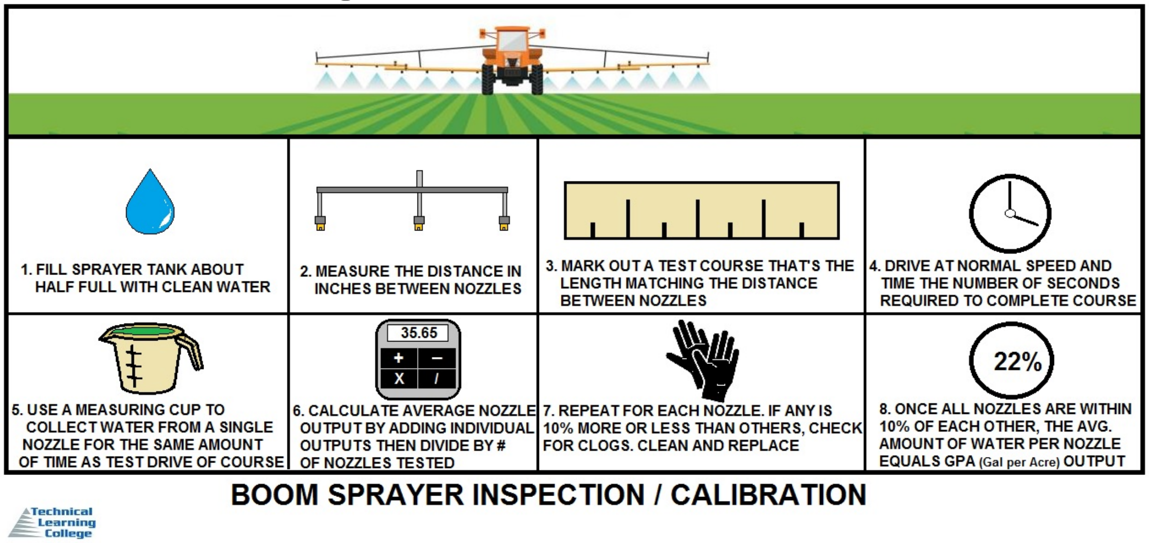
If a pesticide excluded for use on organically produced commodities is accidentally applied to an organic crop, the crop may no longer qualify to be sold as organic. If this occurs in connection with a vector control operation, the producer can pursue a settlement from the vector control program for his loss. While that particular harvested crop may no longer be considered organic, the farm will still qualify as "certified organic". If there is repeated contamination by any party, the farm will lose its organic certification and must wait at least 3 years before it may apply for organic certification again.

With the growth of organic farming, vector control operations will face increasing challenges in applying pesticides in the vicinity of organic farms. This will involve developing innovative methods of preventing vector problems from occurring on and adjacent to organic farms while respecting the landowner's desire to maintain organic practices.

Phytotoxic Reaction

Phytotoxicity is the injury or death of a plant due to exposure to a chemical. Plants may be injured or killed by various kinds of chemicals, including salts, fertilizers, or pesticides. Sometimes, plant injury is intentional, as when an herbicide is applied to a weed. In other cases, the plant injury is an accidental side effect of pesticide use. Phytotoxicity can affect any part of a plant, including roots, stems, foliage, blossoms, or fruit.

WPS - How to Avoid Problems When Treating around Fish Ponds, Fish-bearing Streams and Estuarine Areas



Use maximum gallonage (3 gallons spray or more by air or 6 gallons/acre with ground equipment) per acre and low pressure (max 25 PSI for aircraft and 40 PSI for ground sprayers).

- Delay treatments near fish ponds, etc., until wind is blowing away from sensitive area.

- Use the chemical less toxic to fish if the choice is available. Apply IPM principles such as scouting, etc., and treat only when necessary and with minimum rate to obtain control.

- Advise farmers, where practical, to plant crops near ponds and fish-bearing waters that will require a minimum of insect control (soybeans rather than cotton, for example).

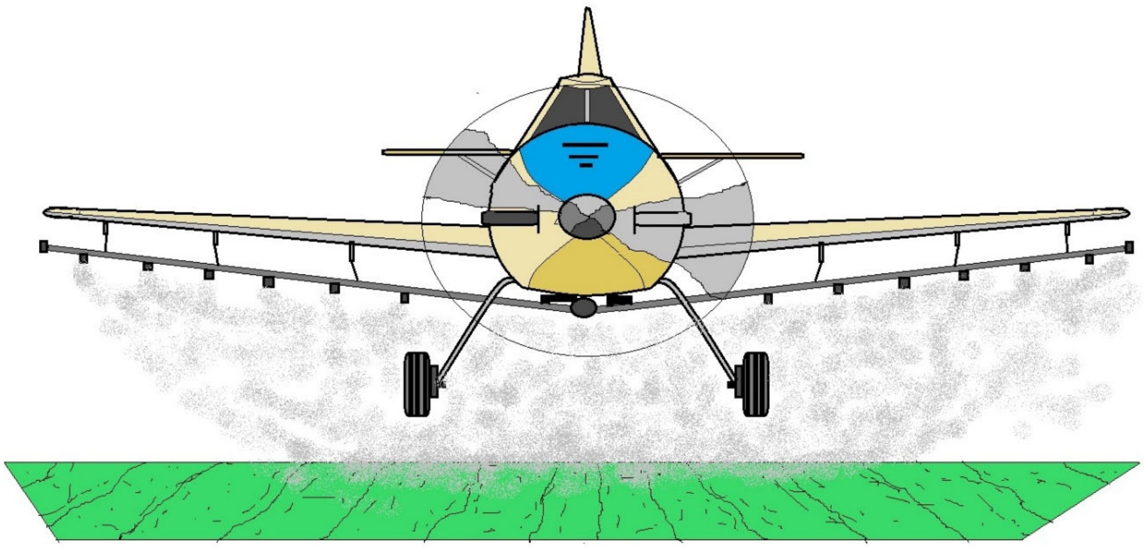
- Check application equipment daily to ensure there are no leaks in hoses and fittings.

- Aerial applicators, whether equipment is loaded or empty, should not fly over fish ponds or fish-bearing waters if it can possibly be avoided. Avoid the use of LV or ULV sprayers in the vicinity of fish ponds or fish-bearing waters.

- Check to ensure that chemicals are mixed adequately before initiating spray operations (for example, premix chemical before loading sprayers). Aerial applicators should check calibration and follow all practices which enhance accurate delivery of pesticides. See Application section of handbook for tips on calibration, etc.

WPS - How to Reduce Drift (Aerial Applications)

Try to get good field-end coverage on initial spray runs; crossing the ends of fields which are bordered by trees or other obstacles usually means flying higher and increasing the chance of drift.



- ***Fly slow. Fly low***. Slow speeds are combined with lower pump pressures to produce larger droplets. Herbicides should be applied at a lower height than other pesticides.

- For fixed wing aircraft, don't use a whirl-plate, rather, use a 1/16 to 1/18 inch diameter orifice plate directed straight back.

- Be sure the positive shut-off is working properly, and ***use it!***

- Nozzle orientation affects wind shear across the nozzle face, and subsequently droplet size. Use a nozzle orientation that will give the desired droplet size.

- Boom length should be no more than 75% of the wingspan of fixed wing craft, or of the rotor diameter on helicopters to reduce drift caused by wingtip and rotor vortices.

- Use Microfoil boom, Tru-Value boom or an equivalent drift control system. See the pesticide label.

- When there is *any* possibility or concern of drift, use a drift retardant as a standard part of your spraying service. Using drift retardants can promote a positive environmental concern and help eliminate legal problems.

Summary

Pesticides, in addition to their potential negative effects on human health, pose adverse effects also on the environment (water, soil and air contamination, toxic effects on non-target organisms). In particular, inappropriate use of pesticides has been linked with:
(1) adverse effects on non-target organisms (e.g., reduction of beneficial species populations),
(2) water contamination from mobile pesticides or from pesticide drift,
(3) air pollution from volatile pesticides,
(4) injury on non-target plants from herbicide drift,
(5) injury to rotational crops from herbicide residues remained in the field,
(6) crop injury due to high application rates, wrong application timing or unfavorable environmental conditions at and after pesticide application.

Impact of Pesticides on Soil
Once applied to crops, pesticides work their way into the soil, where it has devastating effects. Perhaps the most detrimental of these effects is that pesticide causes biodiversity loss in soil. This means the soil has a lower quality overall and is less fertile. Additionally, it removes a large percentage of organic matter. Organic matter helps soil retain water, which can be extremely helpful to agricultural workers, particularly during droughts. This lack of organic matter also allows pesticides to continue to build up in the soil instead of breaking down the chemicals. Less fertile soils mean less plant growth, which, in turn, means farmers must use increased quantities of fertilizer for successful crop yields.

Impact of Pesticides on Water
Pesticides seep into the soil and find their way into groundwater. Additionally, they may be washed into nearby streams and rivers. In fact, research has found that every stream and around 90% of all water wells are polluted with pesticides in the US. Rain and groundwater sources have also been found to be contaminated. Several countries around the world, including the US and the UK, have passed drinking water safety laws in an attempt to regulate and reduce the amount of pesticides found in public water systems.

Impact of Pesticides on Air
Pesticides do not only collect on plants, seep into the ground, and wash away into nearby waterways. These chemicals are also easily carried on the wind to other, non-agricultural areas, in a phenomenon known as pesticide drift. Pesticide drift occurs when pesticide is sprayed on crops and carried off by the wind before reaching the plants or when it undergoes volatilization.

Herbicide (or pesticide) volatilization is what happens when the chemical reaches its intended destination and later evaporates into the air, being carried downwind. It is more common in warmer climates and seasons when evaporation occurs at a faster rate, preventing the pesticide from being absorbed into the ground.

Once the chemicals leave the intended target, they can be carried across long distances, potentially entering delicate ecosystems. The distance that these pesticides can travel depends on wind speed, relative humidity levels, and external temperatures. This means that warmer summer temperatures typically result in increased pesticide concentrations in the air, which are then introduced to human and animal respiratory systems.

Some pesticides also emit volatile organic compounds that react with other chemicals in the atmosphere and create tropospheric ozone, a greenhouse gas that affects how long methane and other hydrocarbons remain in the atmosphere. In order to prevent pesticides from being carried through the air, many countries have implemented regulations that require windbreaks or buffer zones around targeted crops. These can take the form of tall pine trees planted around the agricultural land or empty fields surrounding the pesticide-treated area.

Impact of Pesticides on Wildlife

Pesticide use affects both plants and animals. Chemicals reduce nitrogen fixation, the symbiotic relationship between nitrogen fixing bacteria and plants that is required for proper plant growth. A reduction in nitrogen fixation results in reduced crop yield, particularly in legume type plants. When this occurs, additional fertilizer must be applied to the fields. Pesticide use is also directly linked to the constantly declining bee population, a species which is vital to plant pollination. In fact, researchers have studied this effect, known as pollinator decline, in order to understand Colony Collapse Disorder (CCD). This disorder occurs when bee colonies are exterminated without prior indicators of population decline. The US Department of Agriculture has released an estimate suggesting that US farmers lose approximately $200 million annually due to reduced pollination.

Groundwater Contamination

The effects of past and present land-use practices may take decades to become apparent in groundwater. When weighing management decisions for protection of groundwater quality, it is important to consider the time lag between application of pesticides and fertilizers to the land and arrival of the chemicals at a well. This time lag generally decreases with increasing aquifer permeability and with decreasing depth to water. In response to reductions in chemical applications to the land, the quality of shallow groundwater will improve before the quality of deep groundwater, which could take decades.

Pesticides are mostly modern chemicals. There are many hundreds of these compounds, and extensive tests and studies of their effect on humans have not been completed. That leads us to ask just how concerned we should be about their presence in our drinking water. Certainly it would be wise to treat pesticides as potentially dangerous and, thus, to handle them with care. We can say they pose a potential danger if they are consumed in large quantities, but, as any experienced scientist knows, you cannot draw factual conclusions unless scientific tests have been done.

Some pesticides have had a designated Maximum Contaminant Limit (MCL) in drinking water set by the U.S. Environmental Protection Agency (EPA), but many have not. Also, the effect of combining more than one pesticide in drinking water might be different than the effects of each individual pesticide alone. It is another situation where we don't have sufficient scientific data to draw reliable conclusions.

Topic 4 – Environmental Effects Post Quiz
Answers are found in rear after the Glossary

Unwanted Environmental Effects of Pesticides

1. Most of the organophosphates (e.g., parathion, malathion) and pyrethroids are much less persistent.
True or False

2. Pyrethrins, and carbamate pesticides are very persistent.
True or False

3. Most organochlorine pesticides (e.g., DDT, chlordane) are nonpersistent.
True or False

Spray Nozzles and Drift

4. Stainless steel and hardened stainless steel are relatively inexpensive, but they wear rapidly with abrasive materials, such as wettable powders and liquid fertilizers.
True or False

5. Brass nozzles are the most resistant to wear, but their expense discourages some users.
True or False

6. Surfactants are particularly important when applying a pesticide to waxy or hairy leaves. Without proper wetting and spreading, spray droplets often run off or fail to cover leaf surfaces adequately. Too much surfactant, however, can cause excessive runoff and reduce pesticide efficacy.
True or False

7. Nonionic surfactants, often used with systemic pesticides, help pesticide sprays penetrate plant cuticles. Nonionic surfactants are compatible with most pesticides, and most EPA-registered pesticides that require a surfactant recommend a nonionic type.
True or False

8. Stickers can reduce evaporation of the pesticide, and some slow down the degradation of pesticides by sunlight. Many adjuvants are formulated as spreader-stickers to make a general-purpose product.
True or False

9. Vapor drift injury can never results when the herbicide volatilizes and the vapors move to a susceptible crop such as cotton. Injury from vapor drift cannot occur at rather long distances from the sprayed area.
True or False

10. Hot temperatures, moist soils, and temperature inversions all decrease the potential for vapor drift. Vapor drift is simply the movement of material caused by wind. In fact, calm or no wind may not lead to inversions that could result in vapor drift.
True or False

Topic 5 –Hazard Communication Section

Topic 5 - Section Focus: You will learn the basics of the revised OSHA Hazard Communication (HazCom) Standard and the labeling and Safety Data Sheet requirements. At the end of this section, the student will be able to understand and describe OSHA's Hazard Communication rule and how it relates to pesticide application. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours

Topic Scope: Hazard communication is an important way to protect the health of structural, agricultural workers and pesticide handlers. OSHA requires all pesticide employers must ensure that employees receive hazard communication protections in the workplace. Commercial pesticide employers shall make sure all SDS's are available to all employees and that all chemical products like mixed chemicals and fumigants have proper placards and labeling. Hazard communication is the practice of properly informing employees about pesticide/chemical dangers they might encounter.

The name of a chemical that pest control companies commonly use as a fumigant is called vikane gas. The name vikane is actually only a brand name and the real name of the chemical being used is Sulfuryl Fluoride. There competitors that also sell sulfuryl fluoride under a different names such as Profume, Zythor, Profume and MasterFume. However, the Vikane gas fumigant is the most famous of these brands and has been used by pest control businesse for decades. The Vikane fumigant is odourless – it has no smell. Because humans cannot detect the gas, small amounts of tear gas are mixed with it so that any humans which accidentally come across this chemical will be informed of its harmful presence, thus being alerted to its dangers.

Author's Commentary
Generally speaking, there are several safety related training concerns that most employers lack. We will mention three from our experience.

Three of these safety-lacking concerns are
1. Lack of hazard communication program or missing SDSs.
2. Lack of proper Personal protection equipment and/or training procedures.
3. Lack of an attitude about being safe with pesticide usage and lack of recordkeeping.

Generally, this number 2 and 3 is due to production over safety. But all three are because of a lack of leadership.

Somehow, employers are too busy to ensure that the employee has a copy of the SDS in a folder in their vehicle and that the employee is usually ignorant of the importance of the safety and storage of the product. We have all seen unsafe action or have done these ourselves. We all have eaten or placed something in our mouths that could contain some pesticide residual. After time, we feel invincible to pesticides as a whole. All of us have at some time have not worn proper PPE or respirators. The problem is we are ignorantly killing ourselves 20-30 years down the road.

'Much of this HazCom safety information is redundant because similar information is covered in the new Worker Protection Standard (WPS). One problem with the WPS is that much of the same information is overlapping; however, there are 7 areas in HazCom that are not covered by WPS. Structural pesticide applicators are not subject to the WPS, therefore the structural and agricultural pesticide applicators need to know and be fully trained on this revised OSHA standard.

Your Rights under HazCOM or WPS As A Pesticide Applicator or Employee
By federal law you must be told about possible dangers where you work. You must also be trained to recognize and avoid those dangers. As an employee you have the following rights:

- You have the right to know what pesticides were sprayed and to look at the application records.
- You have the right to file a complaint about the dangers at work without being punished or fired. Your supervisor will not be told who filed the complaint.
- You have the right to look at Safety Data Sheets (SDS), if available, for each pesticide used. These documents tell you about the pesticides and their dangers.
- Your supervisor must plan ahead for medical care and make sure that you are taken to the doctor if you get sick or hurt because of pesticides at your job.

Medical care is available for you at:

- If you get sick or injured on the job, you have the right to file a claim for worker's compensation. Workers' compensation will pay for your medical costs, and in some cases, lost pay.

Hazard Communication Introduction

Revised Hazard Communication Program

New 2012 changes to OSHA's Hazard Communication Standard (29 CFR 1910.1200) are bringing the U.S. into alignment with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), improving safety and health protections for America's workers. These new revisions to OSHA's current Hazard Communication Standard, the GHS is expected to prevent injuries and illnesses, save lives and improve trade conditions for chemical manufacturers. The Hazard Communication Standard in 1983 gave the workers the 'right to know,' but the new Globally Harmonized System gives workers the 'right to understand.'

The new Hazard Communication Standard still requires chemical manufacturers and importers to evaluate the chemicals they produce or import and provide hazard information to employers and workers by putting labels on containers and preparing safety data sheets. However, the old standard allowed chemical manufacturers and importers to convey hazard information on labels and material safety data sheets in whatever format they chose. The modified standard provides a single set of harmonized criteria for classifying chemicals according to their health and physical hazards and specifies hazard communication elements for labeling and safety data sheets.

The Safety Data Sheet (SDS), also known as the Material Safety Data Sheet (MSDS), is at the heart of federal OSHA's hazard communication standard (HazCom). The SDS/MSDS is a detailed, written description of a hazardous chemical that must be kept in the workplace where such chemicals are used.

Significant new requirements were added to OSHA's HazCom rule that will require employers to train their employees how to read and interpret the new SDS.

By December 1, 2013, employers had to train their employees how to read and interpret the new SDS. Many employers went through a phase-in period where both MSDSs and SDSs will be present in the workplace. During the phase-in period, employers trained their employees how to read and interpret SDSs, or MSDSs, or both at the same time. By June 1, 2015, all MSDSs were replaced with SDSs.

As the global market has expanded to include many countries and languages so has the labeling of hazards of chemical products. Several years ago the United Nations recognized this as a problem and began a push for countries to adopt a standardized system of classification and labeling. As a result, in the very near future, OSHA plans to implement the new Globally Harmonized System of Classification and Labeling of Chemicals or better known as GHS. The goal is that the same set of rules for classifying hazards, and the same format and content for labels and Material Safety Data Sheets (now to be called Safety Data Sheets or SDS) will be adopted worldwide.

Once implemented the new HazCom should provide consistent hazard information, greater awareness of hazards, and safer use of chemicals. For employers the expectation is that it will reduce costs and ease compliance.

The big question for many employers is obviously…"How will GHS affect my company?" Depending on the type of operations you conduct in your company, the answers will vary. OSHA has developed some websites to help with the transitioning process.

GHS Concept	**How it affects the employer**	**The challenge**
Material Safety Data Sheets	MSDSs will become Safety Data Sheets (SDS). The new SDS will be in a standardized format and provide additional information including ecological information, disposal considerations, transport information and regulatory information. The consistent format will help employees in quickly finding information on the SDS.	Ensuring that all MSDSs are updated to the new SDS format and making sure this information is distributed accurately to employees will be difficult. One of the key challenges will be working with your chemical product vendors to produce the SDSs in a timely manner.
Container Labeling	The GHS standard will become a requirement and replace HMIS, NFPA or any other labeling system you are currently using. The new format includes pictograms, signal words and physical, health and environmental hazard statements. The labels must also have precautionary measures, pictograms and first aid statements along with complete chemical identification and manufacturer contact information.	Properly labeling all secondary and tertiary containers is a significant task. The employer must ensure all containers are labeled properly. This includes original containers received from vendors. Unfortunately, you cannot assume that your vendors will be able to provide the labeling information in a timely fashion. Additionally, it is unlikely OSHA will require chemical manufacturers to produce SDSs for discontinued products so employers will be stuck determining GHS labels for older products.
Training	Employees will need educated on the label and MSDS changes due to the updated product classifications, pictograms, signal words and precautionary statements. Written programs will need updated to include changes to labeling, MSDS communication and employee training.	OSHA has stated that employers will be required to train employees within 2 years of the publication of the final rule. Training employees and updating the written program will require significant resources and should occur as soon as your organization begins its GHS transition.

More on the Revised Hazard Communication Standard

"Exposure to hazardous chemicals is one of the most serious threats facing American workers today," said U.S. Secretary of Labor Hilda Solis. "Revising OSHA's Hazard Communication standard will improve the quality and consistency of hazard information, making it safer for workers to do their jobs and easier for employers to stay competitive." The Hazard Communication Standard (HCS) is now aligned with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS) .

This update to the Hazard Communication Standard (HCS) will provide a common and coherent approach to classifying chemicals and communicating hazard information on labels and safety data sheets. Once implemented, the revised standard will improve the quality and consistency of hazard information in the workplace, making it safer for workers by providing easily understandable information on appropriate handling and safe use of hazardous chemicals.

This update will also help reduce trade barriers and result in productivity improvements for American businesses that regularly handle, store, and use hazardous chemicals while providing cost savings for American businesses that periodically update safety data sheets and labels for chemicals covered under the hazard communication standard.

Rationale
In order to ensure chemical safety in the workplace, information about the identities and hazards of the chemicals must be available and understandable to workers. OSHA's Hazard Communication Standard (HCS) requires the development and dissemination of such information:

- Chemical manufacturers and importers are required to evaluate the hazards of the chemicals they produce or import, and prepare labels and safety data sheets to convey the hazard information to their downstream customers;
- All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately.

Major changes to the Hazard Communication Standard

- **Hazard classification**: Provides specific criteria for classification of health and physical hazards, as well as classification of mixtures.
- **Labels**: Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category. Precautionary statements must also be provided.
- **Safety Data Sheets:** Will now have a specified 16-section format.
- **Information and training:** Employers are required to train workers by December 1, 2013 on the new labels elements and safety data sheets format to facilitate recognition and understanding.

Container means any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle, are not considered to be containers.

What is the Globally Harmonized System?

The Globally Harmonized System (GHS) is an international approach to hazard communication, providing agreed criteria for classification of chemical hazards, and a standardized approach to label elements and safety data sheets. The GHS was negotiated in a multi-year process by hazard communication experts from many different countries, international organizations, and stakeholder groups. It is based on major existing systems around the world, including OSHA's Hazard Communication Standard and the chemical classification and labeling systems of other US agencies.

The result of this negotiation process is the United Nations' document entitled "Globally Harmonized System of Classification and Labeling of Chemicals," commonly referred to as The Purple Book. This document provides harmonized classification criteria for health, physical, and environmental hazards of chemicals. It also includes standardized label elements that are assigned to these hazard classes and categories, and provide the appropriate signal words, pictograms, and hazard and precautionary statements to convey the hazards to users. A standardized order of information for safety data sheets is also provided. These recommendations can be used by regulatory authorities such as OSHA to establish mandatory requirements for hazard communication, but do not constitute a model regulation.

Why did OSHA decide to modify the Hazard Communication Standard to adopt the GHS?

OSHA has modified the Hazard Communication Standard (HCS) to adopt the GHS to improve safety and health of workers through more effective communications on chemical hazards. Since it was first promulgated in 1983, the HCS has provided employers and employees extensive information about the chemicals in their workplaces. The original standard is performance-oriented, allowing chemical manufacturers and importers to convey information on labels and material safety data sheets in whatever format they choose. While the available information has been helpful in improving employee safety and health, a more standardized approach to classifying the hazards and conveying the information will be more effective, and provide further improvements in American workplaces. The GHS provides such a standardized approach, including detailed criteria for determining what hazardous effects a chemical poses, as well as standardized label elements assigned by hazard class and category.

This will enhance both employer and worker comprehension of the hazards, which will help to ensure appropriate handling and safe use of workplace chemicals. In addition, the safety data sheet requirements establish an order of information that is standardized. The harmonized format of the safety data sheets will enable employers, workers, health professionals, and emergency responders to access the information more efficiently and effectively, thus increasing their utility.

Adoption of the GHS in the US and around the world will also help to improve information received from other countries—since the US is both a major importer and exporter of chemicals, American workers often see labels and safety data sheets from other countries. The diverse and sometimes conflicting national and international requirements can create confusion among those who seek to use hazard information effectively.

For example, labels and safety data sheets may include symbols and hazard statements that are unfamiliar to readers or not well understood. Containers may be labeled with such a large volume of information that important statements are not easily recognized. Given the differences in hazard classification criteria, labels may also be incorrect when used in other countries. If countries around the world adopt the GHS, these problems will be minimized, and chemicals crossing borders will have consistent information, thus improving communication globally.

Exposure or exposed means that an employee is subjected in the course of employment to a chemical that is a physical or health hazard, and includes potential (e.g. accidental or possible) exposure. "Subjected" in terms of health hazards includes any route of entry (e.g. inhalation, ingestion, skin contact or absorption.)

What is the phase-in period in the revised Hazard Communication Standard?
The table below summarizes the phase-in dates required under the revised Hazard Communication Standard (HCS):

Effective Completion Date	Requirement(s)	Who
December 1, 2013	Train employees on the new label elements and safety data sheet (SDS) format.	Employers
June 1, 2015* December 1, 2015	Compliance with all modified provisions of this final rule, except: The Distributor shall not ship containers labeled by the chemical manufacturer or importer unless it is a GHS label	Chemical manufacturers, importers, distributors and employers
June 1, 2016	Update alternative workplace labeling and hazard communication program as necessary, and provide additional employee training for newly identified physical or health hazards.	Employers
Transition Period to the effective completion dates noted above	May comply with either 29 CFR 1910.1200 (the final standard), or the current standard, or both	Chemical manufacturers, importers, distributors, and employers

*This date coincides with the EU implementation date for classification of mixtures.

During the phase-in period, employers would be required to be in compliance with either the existing HCS or the revised HCS, or both. OSHA recognizes that hazard communication programs will go through a period of time where labels and SDSs under both standards will be present in the workplace. This will be considered acceptable, and employers are not required to maintain two sets of labels and SDSs for compliance purposes.

Why must training be conducted prior to the compliance effective date?
OSHA is requiring that employees are trained on the new label elements (e.g., pictograms and signal words) and SDS format by December 2013, while full compliance with the final rule began in 2015.

While many countries are in various stages of implementing the GHS, OSHA believes that it is possible that American workplaces may begin to receive labels and SDSs that are consistent with the GHS shortly after publication. Thus, making it important to ensure that when employees begin to see the new labels and SDSs in their workplaces, they will be familiar with them, understand how to use them, and access the information effectively.

What are the major changes to the Hazard Communication Standard?
The three major areas of change are in hazard classification, labels, and safety data sheets.

- **Hazard classification:** The definitions of hazard have been changed to provide specific criteria for classification of health and physical hazards, as well as classification of mixtures. These specific criteria will help to ensure that evaluations of hazardous effects are consistent across manufacturers, and that labels and safety data sheets are more accurate as a result.
- **Labels:** Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category. Precautionary statements must also be provided.
- **Safety Data Sheets:** Will now have a specified 16-section format.

The GHS does not include harmonized training provisions, but recognizes that training is essential to an effective hazard communication approach. The revised Hazard Communication Standard (HCS) requires that workers be re- trained within two years of the publication of the final rule to facilitate recognition and understanding of the new labels and safety data sheets.

For a side-by-side comparison of the current HCS and the final revised HCS please see OSHA's hazard communication safety and health topics webpage at: http://www.osha.gov/dsg/hazcom/index.html

What Hazard Communication Standard provisions are unchanged in the revised HCS?
The revised Hazard Communication Standard (HCS) is a modification to the existing standard. The parts of the standard that did not relate to the GHS (such as the basic framework, scope, and exemptions) remained largely unchanged. There have been some modifications to terminology in order to align the revised HCS with language used in the GHS. For example, the term "hazard determination" has been changed to "hazard classification" and "material safety data sheet" was changed to "safety data sheet." OSHA stakeholders commented on this approach and found it to be appropriate.

How will chemical hazard evaluation change under the revised Hazard Communication Standard?
Under both the current Hazard Communication Standard (HCS) and the revised HCS, an evaluation of chemical hazards must be performed considering the available scientific evidence concerning such hazards. Under the current HCS, the hazard determination provisions have definitions of hazard and the evaluator determines whether or not the data on a chemical meet those definitions. It is a performance-oriented approach that provides parameters for the evaluation, but not specific, detailed criteria.

The hazard classification approach in the revised HCS is quite different. The revised HCS has specific criteria for each health and physical hazard, along with detailed instructions for hazard evaluation and determinations as to whether mixtures or substances are covered. It also establishes both hazard classes and hazard categories—for most of the effects; the classes are divided into categories that reflect the relative severity of the effect.

United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

1.0 Background

The purpose of this document is to describe the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS), why it was developed, and how it relates to the sound management of chemicals.

1.1 What is the GHS?

The GHS is an acronym for *The Globally Harmonized System of Classification and Labeling of Chemicals*. The GHS is a system for standardizing and harmonizing the classification and labeling of chemicals. It is a logical and comprehensive approach to:

- Defining health, physical and environmental hazards of chemicals;
- Creating classification processes that use available data on chemicals for comparison with the defined hazard criteria; and
- Communicating hazard information, as well as protective measures, on labels and Safety Data Sheets (SDS).

Figure 1.1
GHS Document ("Purple Book")

Many countries already have regulatory systems in place for these types of requirements. These systems may be similar in content and approach, but their differences are significant enough to require multiple classifications, labels and safety data sheets for the same product when marketed in different countries or even in the same country when parts of the life cycle are covered by different regulatory authorities. This leads to inconsistent protection for those potentially exposed to the chemicals, as well as creating extensive regulatory burdens on companies producing chemicals.

For example, in the United States (U.S.) there are requirements for classification and labeling of chemicals for the Consumer Product Safety Commission, the Department of Transportation, the Environmental Protection Agency, and the Occupational Safety and Health Administration.

The GHS itself is not a regulation or a standard. The GHS Document (referred to as "The Purple Book", shown in Figure 1.1) establishes agreed hazard classification and communication provisions with explanatory information on how to apply the system. The elements in the GHS supply a mechanism to meet the basic requirement of any hazard communication system, which is to decide if the chemical product produced and/or supplied is hazardous and to prepare a label and/or Safety Data Sheet as appropriate. Regulatory authorities in countries adopting the GHS will thus take the agreed criteria and provisions, and implement them through their own regulatory process and procedures rather than simply incorporating the text of the GHS into their national requirements. The GHS Document thus provides countries with the regulatory building blocks to develop or modify existing national programs that address classification of hazards and transmittal of information about those hazards and associated protective measures. This helps to ensure the safe use of chemicals as they move through the product life cycle from "cradle to grave."

1.2 Why was the GHS developed?
The production and use of chemicals is fundamental to all economies. The global chemical business is more than a $1.7 trillion per year enterprise. In the U.S., chemicals are more than a $450 billion business and exports are greater than $80 billion per year.

Chemicals directly or indirectly affect our lives and are essential to our food, our health, and our lifestyle. The widespread use of chemicals has resulted in the development of sector-specific regulations (transport, production, workplace, agriculture, trade, and consumer products). Having readily available information on the hazardous properties of chemicals, and recommended control measures, allows the production, transport, use and disposal of chemicals to be managed safely. Thus, human health and the environment are protected.

The sound management of chemicals should include systems through which chemical hazards are identified and communicated to all who are potentially exposed. These groups include workers, consumers, emergency responders and the public. It is important to know what chemicals are present and/or used, their hazards to human health and the environment, and the means to control them. A number of classification and labeling systems, each addressing specific use patterns and groups of chemicals, exist at the national, regional and international levels. The existing hazard classification and labeling systems address potential exposure to chemicals in all the types of use settings listed above.

While the existing laws and regulations are similar, they are different enough to require multiple labels for the same product both within the U.S. and in international trade and to require multiple safety data sheets for the same product in international trade. Several U.S. regulatory agencies and various countries have different requirements for hazard definitions as well as for information to be included on labels or material safety data sheets.

<table>
<tr><th colspan="9">Acute oral toxicity LD_{50} (mg/kg)</th></tr>
<tr><th rowspan="2">Organization/Country/
Regulation or
Standard</th><th colspan="2">High</th><th colspan="4">Hazard</th><th colspan="2">Low</th></tr>
<tr><td colspan="2">0 ....</td><td colspan="2">< 50 ....</td><td colspan="2">< 500 ....</td><td colspan="2">< 5000 ....</td></tr>
<tr><td>ANSI/US/A 129.1</td><td colspan="2">< 50
Highly Toxic</td><td colspan="2">> 50 < 500
Toxic</td><td>> 500 < 2000
Harmful</td><td colspan="3"></td></tr>
<tr><td>OSHA/US/HCS</td><td colspan="2">< 50
Highly Toxic</td><td colspan="2">> 50 < 500
Toxic</td><td colspan="4"></td></tr>
<tr><td>EPA/US/FIFRA</td><td colspan="2">0 ≤ 50
Toxicity Category I</td><td colspan="2">> 50 ≤ 500
Toxicity Category II</td><td colspan="2">> 500 < 5000
Toxic Category III</td><td colspan="2">> 5000
Toxicity
Category IV</td></tr>
<tr><td>CPSC/US/FHSA</td><td colspan="2">< 50
Highly Toxic</td><td colspan="2">> 50 ≤ 500
Toxic</td><td colspan="4"></td></tr>
<tr><th>GHS</th><th>≤ 5</th><th>> 5 ≤ 50</th><th colspan="2">> 50 ≤ 300</th><th>> 300 ≤ 2000</th><th colspan="3">> 2000 ≤ 5000</th></tr>
<tr><td>DOT/US</td><td>< 5
Picking
Group 1</td><td>> 5 < 50
Picking
Group II</td><td colspan="2">> 50 < 200 (solid)
> 50 > 500 (liquid)
Picking Group III</td><td colspan="4"></td></tr>
<tr><td>NFPA/US</td><td>≤ 5
Hazard
Category 4</td><td>> 5 ≤ 50
Hazard
Category 3</td><td colspan="2">> 50 ≤ 500
Hazard
Category
2</td><td>> 500 ≤ 2000
Hazard Category
1</td><td colspan="2">> 2000
Hazard
Category
0</td><td></td></tr>
<tr><td>NPCA/US/HMIS</td><td>≤ 1
Toxicity
Rating 4</td><td>> 1 ≤ 50
Toxicity
Rating 3</td><td colspan="2">> 50 ≤ 500
Toxicity
Rating 2</td><td colspan="2">> 500 ≤ 5000
Toxicity
Rating 1</td><td colspan="2">> 5000
Toxicity
Rating 0</td></tr>
<tr><td>EU</td><td>< 25
Very Toxic</td><td colspan="2">> 25 > 200
Toxic</td><td colspan="2">> 200 < 2000
Harmful</td><td colspan="3"></td></tr>
<tr><td>WHMIS/Canada</td><td colspan="2">≤ 50
Very Toxic
WHMIS Class D,
Division 1,
Subdivision A</td><td colspan="2">> 50 ≤ 500
Toxic
WHMIS Class D, Division 1,
Subdivision B</td><td colspan="4"></td></tr>
<tr><td>Australia/NOHSC</td><td>< 25
Very Toxic</td><td colspan="2">> 25 < 200
Toxic</td><td colspan="2">> 200 < 2000
Harmful</td><td colspan="3"></td></tr>
<tr><td>Mexico</td><td><1
Extremely
Toxic</td><td>>20 < 50
Highly Toxic</td><td colspan="2">> 50 < 500
Moderately
Toxic</td><td colspan="4">> 500 < 5000
Mildly Toxic</td></tr>
<tr><td>Malaysia</td><td colspan="2">< 25
Very Toxic</td><td colspan="2">200 to 500
Harmful</td><td colspan="4"></td></tr>
<tr><td>Japan</td><td colspan="2">< 30
Poisonous</td><td colspan="2"></td><td colspan="2">300 to 3000
Powerful</td><td colspan="2"></td></tr>
<tr><td>Korea</td><td>< 25
Very Toxic</td><td colspan="2">> 50 < 200
Toxic</td><td colspan="2">> 200 < 2000
Harmful</td><td colspan="3"></td></tr>
</table>

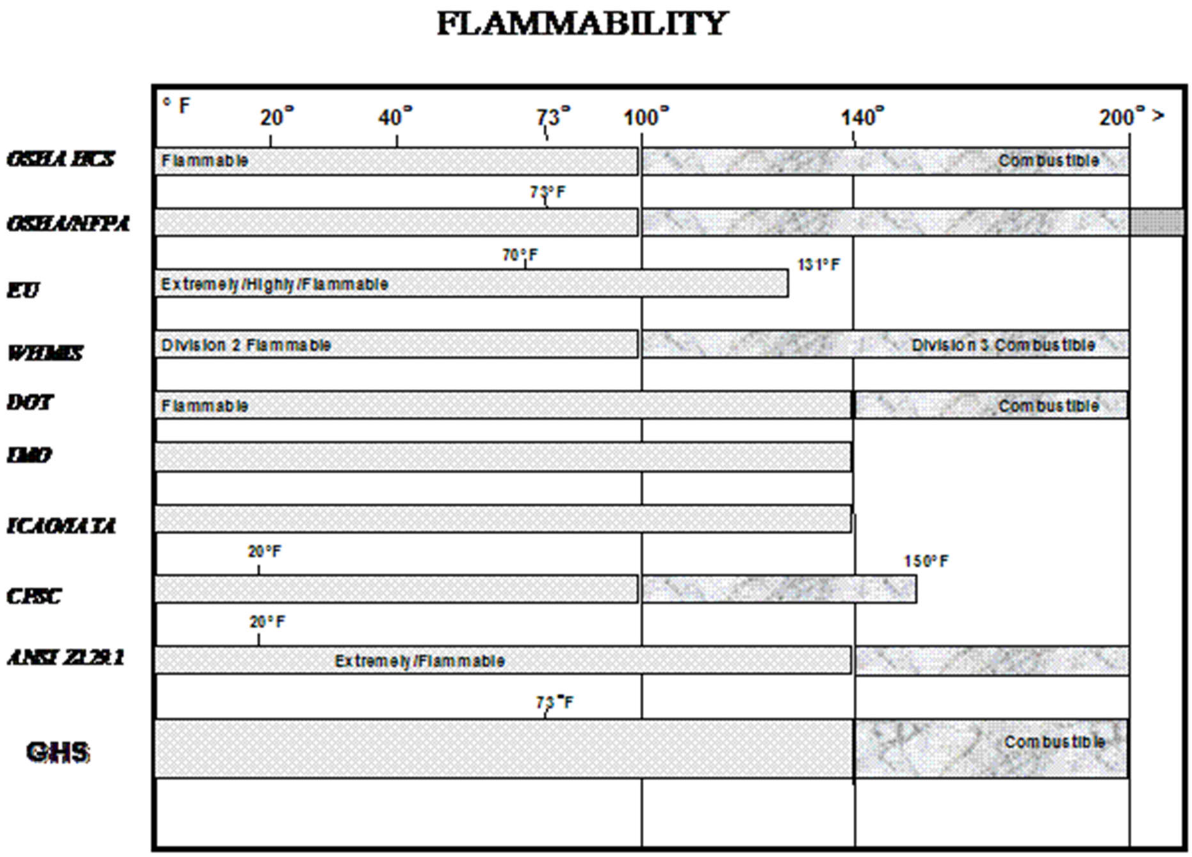
Figure 1.2

The numerical values on the hazard index scale in the table are not to scale.

For example, a product may be considered flammable or toxic by one agency or country, but not by another.

We can see by comparing a few hazards how complex it is to comply with all domestic and global regulations. Acute oral toxicity (LD_{50}) is a good example (Figure 1.2). Although most existing systems cover acute toxicity, we can see in the figure that what is considered hazardous varies considerably. These differences allow the same product to be hazardous in one country/system and not in another. At the very least, the same product has different labels and SDSs.

Figure 1.3



The numerical values on the hazard index scale in the table are not to scale.

Text Version of Chart:

Title: FLAMMABILITY
Type: Bar line graph by Fahrenheit degree from 0 degrees to 200 degrees with ten chart segments.

Chart data:

- OSHA HCS

  Flammable = 0-100 Degrees

  Combustible = 100-200 degrees

- OSHA/NFPA

  Flammable = 0-100 Degrees

  Combustible = 100-200+ degrees

- EU

  Extremely/Highly/Flammable = 0-131 Degrees

- WHMIS

  Division 2 Flammable = 0-100 Degrees

  Division 3 Combustible = 100-200 degrees

- DOT

  Flammable = 0-140 Degrees

  Combustible = 140-200 degrees

- IMO

  Flammable = 0-140 Degrees

- ICAO/IATA

  Flammable = 0-140 Degrees

- CPSC

  Flammable = 0-100 Degrees

  Combustible = 100-150 degrees

- ANSI Z129.1

  Extremely Flammable = 0-140 Degrees

  Combustible = 140-200 degrees

- GHS

  Flammable = 0-140 Degrees

  Combustible = 140-200 degrees

Flammable liquid is another hazard that is covered by most existing systems. As shown in Figure 1.3, the coverage varies between existing systems within the U.S. and globally. This means that the same product can be non-hazardous or hazardous with different labels/SDSs. In Section 4, Figures 4.1 through 4.7 show the diverse domestic and international labels for a fictitious product (ToxiFlam) which has both oral toxicity and flammability hazards.

These differences in hazards and SDS/labels impact both protection and trade. In the area of protection, users may see different label warnings or safety data sheet information for the same chemical. In the area of trade, the need to comply with multiple regulations regarding hazard classification and labeling is costly and time-consuming.

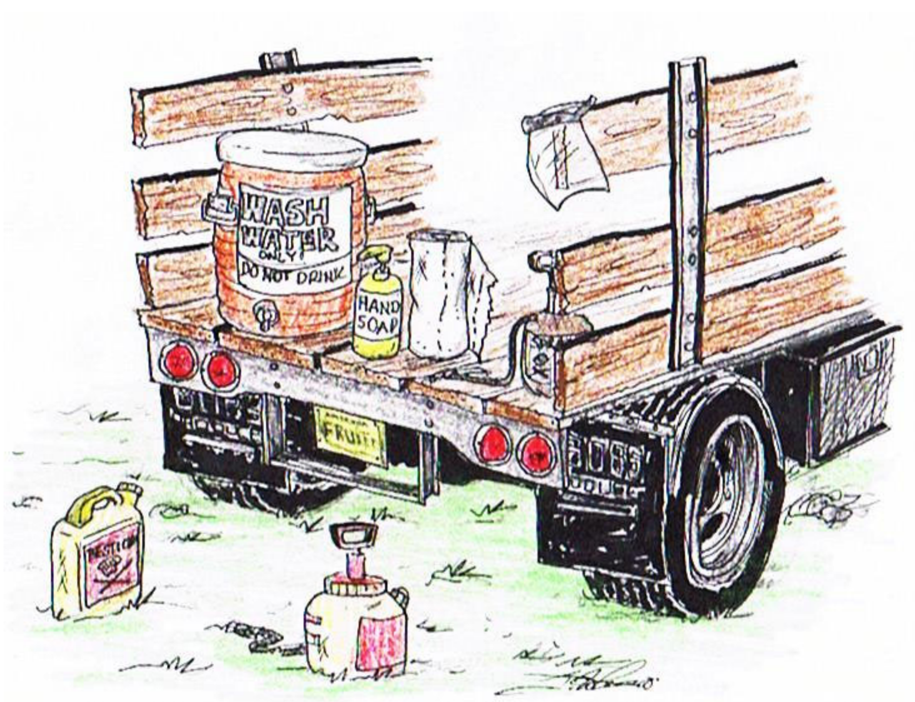
Some multinational companies have estimated that there are over 100 diverse hazard communication regulations for their products globally. For small and medium size enterprises (SMEs) regulatory compliance is complex and costly, and it can act as a barrier to international trade in chemicals.

1.3 What was the International Mandate?

Figure 1.4
International mandate from UNCED Agenda 21, Chapter 19
"A globally harmonized hazard classification and compatible labeling system, including material safety data sheets and easily understandable symbols, should be available, if feasible, by the year 2000."

The single most important force that drove the creation of the GHS was the international mandate (Figure 1.4) adopted in the 1992 United Nations Conference on Environment and Development (UNCED), often called the "Earth Summit".

The harmonization of classification and labeling of chemicals was one of six program areas that were endorsed by the United Nations General Assembly to strengthen international efforts concerning the environmentally sound management of chemicals. It was recognized that an internationally harmonized approach to classification and labeling would provide the foundation for all countries to develop comprehensive national programs to ensure the safe use of chemicals.



LETHAL DOSE 50 (LD50): A single dose of a material expected to kill 50 percent of a group of test animals. The dose is expressed as the amount per unit of body weight, the most common expression being milligrams of material per kilogram of body weight (mg/kg of body weight). Usually refers to oral or skin exposure.

1.4 How was the GHS developed?

In conjunction with its Convention and Recommendation on Safety in the Use of Chemicals at Work, the International Labor Organization (ILO) studied the tasks required to achieve harmonization. The ILO concluded that there were four major existing systems that needed to be harmonized to achieve a global approach.

No international organization covers all aspects of chemical classification and labeling. A broad scope and extensive expertise and resources were required to develop a system. In order to proceed, several decisions were needed:

(a) what systems would be considered "major" and thus the basis for harmonization, and (b) how could the work be divided to get the best expertise for different aspects. Four existing systems (Figure #1.5) were deemed to be major and the primary basis for the GHS. While not considered major, requirements of other systems were examined as appropriate, and taken into account as proposals were developed.

Figure 1.5

Existing Systems Included in the Harmonization Process

- UN Transport Recommendations
- U.S. Requirements for Workplace, Consumer and Pesticides
- European Union Dangerous Substance and Preparations Directives
- Canadian Requirements for Workplace, Consumers and Pesticides

A Coordinating Group for the Harmonization of Chemical Classification Systems (CG/HCCS) was created under the Inter-organization Program for the Sound Management of Chemicals (IOMC) and they were charged with coordinating and managing development of the system. The GC/HCCS worked on a consensus basis and included representatives from major stakeholders, including national governments, industry and workers. They created a set of guiding principles (Figure 1.6). The scope and guiding principles created a common framework for the organizations that were charged with developing the different elements of the system.

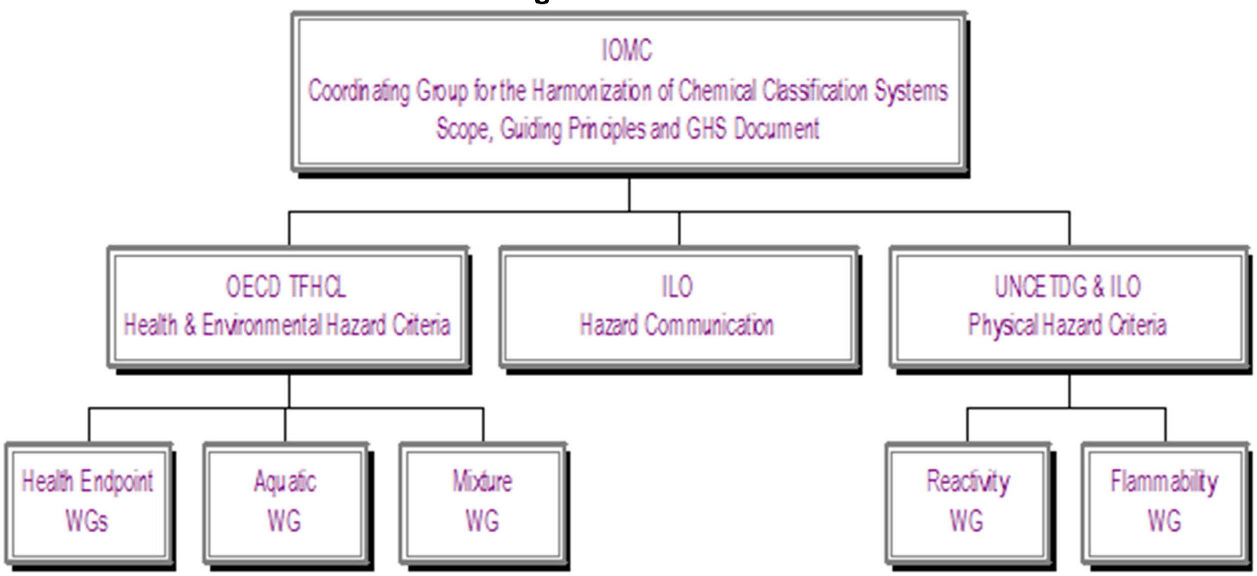
Figure 1.6

Key Guiding Principles of the Harmonization Process

- Protection will not be reduced
- Will be based on intrinsic properties (hazards) of chemicals
- All types of chemicals will be covered
- All systems will have to be changed
- Involvement of all stakeholders should be ensured
- Comprehensibility must be addressed

In order to get the best expertise and resources, the work was divided among three technical focal points. Figure 1.7 shows how the work was assigned to the three technical focal points and the overall responsibilities of the Coordinating Group itself. The UN Committee of Experts on Transport of Dangerous Goods was selected as the lead for work on physical hazards, in cooperation with the ILO. Based on their work in the testing guidelines and other chemical issues, the Organization for Economic Cooperation and Development (OECD) was selected for health/environmental hazards and mixtures. ILO has a long history in MSDS/labels, and was selected to be the lead in hazard communication. The OECD and ILO groups also included representatives from governments, industry and workers.

Figure 1.7



Text Version of Flowchart:

IOMC
Coordinating Group for the Harmonization of Chemical Classification Systems
Scope, Guiding Principles and GHS Document

OECD TFHCL
Health & Environmental Hazard Criteria

ILO
Hazard Communication

UNCE TDG & ILO
Physical Hazard Criteria

Health Endpoint WGs

Aquatic WGs

Mixture WGs

Reactivity WGs

Flammability WGs

1.5 How will the GHS be maintained and updated?
In October 1999, the United Nations Economic and Social Council decided (resolution 1999/65) to enlarge the mandate of the Committee of Experts on the Transport of Dangerous Goods by reconfiguring it into a Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and labeling of Chemicals (UNCETDG/GHS). At the same time, a new Sub-Committee of Experts on the Globally Harmonized System of Classification and labeling of Chemicals (GHS Sub-Committee) was also created.

When the IOMC completed developing the GHS, the system was presented to the UN GHS Sub-Committee, which formally adopted the system at its first session in December 2002. It was subsequently endorsed by the UNCETDG/GHS. The UN Economic and Social Council endorsed the GHS in July 2003.

The Sub-Committee of Experts on the Globally Harmonized System of Classification will:

- Act as custodian of the system, managing and giving direction to the harmonization process,
- Keep the system up-to-date, as necessary, considering the need to introduce changes or updates to ensure its continued relevance,
- Promote understanding and use of the system and encourage feedback,
- Make the system available for worldwide use,
- Make guidance available on the application of the system, and on the interpretation and use of technical criteria to support consistency of application,
- Prepare work programs and submit recommendations to the UNCETDG/GHS.

1.6 When will the GHS be implemented?
There is no international implementation schedule for the GHS. It is likely that different national systems/sectors will require different timeframes for GHS implementation. Existing systems will need to consider phase-in strategies for transition from their current requirements to the new GHS requirements.

Several international bodies have proposed implementation goals. The World Summit on Sustainable Development (WSSD) and the Intergovernmental Forum for Chemical Safety (IFCS) have encouraged countries to implement the new GHS as soon as possible with a view to having the system fully operational by 2008. The Ministers of the Asia-Pacific Economic Cooperation (APEC) have also said that as many APEC economies as possible should implement, on a voluntary basis, the GHS by 2006. Under the North American Free Trade Agreement (NAFTA), the Tri-national Occupational Safety and Health Group and the NAFTA Pesticides Technical Working Group are discussing the GHS.

Some of the major existing systems have begun discussions about GHS implementation and situational analyses comparing existing requirements to GHS requirements. Some countries are considering harmonization to the greatest extent possible between their national sectors.

1.7 What are the benefits?
The basic goal of hazard communication is to ensure that employers, employees and the public are provided with adequate, practical, reliable and comprehensible information on the hazards of chemicals, so that they can take effective preventive and protective measure for their health and safety. Thus, implementation of effective hazard communication provides benefits for **governments**, **companies**, **workers**, and **members of the public**.

The GHS has maximum value if it is accepted in all major regulatory systems for chemical hazard communication. The diversity of hazard definitions is shown in Figures 1.2 and 1.3. The array of domestic and global labels for one product is shown in Figures 4.1 to 4.7. In the USA implementation of the GHS would harmonize hazard definitions and label information among U.S. regulatory agencies (CPSC, DOT, EPA, OSHA, etc.). If the GHS is implemented globally, consistent information will be communicated on labels and SDSs.

It is anticipated that application of the GHS will:

- Enhance the protection of human health and the environment by providing an internationally comprehensible system,
- Provide a recognized framework to develop regulations for those countries without existing systems,
- Facilitate international trade in chemicals whose hazards have been identified on an international basis,
- Reduce the need for testing and evaluation against multiple classification systems.

The tangible benefits to **governments** are:

- Fewer chemical accidents and incidents,
- Lower health care costs,
- Improved protection of workers and the public from chemical hazards,
- Avoiding duplication of effort in creating national systems,
- Reduction in the costs of enforcement,
- Improved reputation on chemical issues, both domestically and internationally.

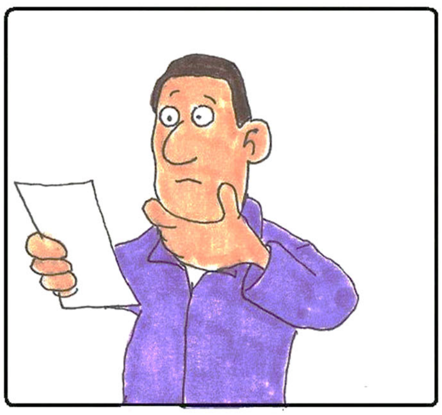
Benefits to **companies** include:

- A safer work environment and improved relations with employees,
- An increase in efficiency and reduced costs from compliance with hazard communication regulations,
- Application of expert systems resulting in maximizing expert resources and minimizing labor and costs,
- Facilitation of electronic transmission systems with international scope,

- Expanded use of training programs on health and safety,
- Reduced costs due to fewer accidents and illnesses,
- Improved corporate image and credibility.

Benefits to **workers** and **members of the public** include:

- Improved safety for workers and others through consistent and simplified communications on chemical hazards and practices to follow for safe handling and use,
- Greater awareness of hazards, resulting in safer use of chemicals in the workplace and in the home.



READ THE SAFETY DATA SHEET

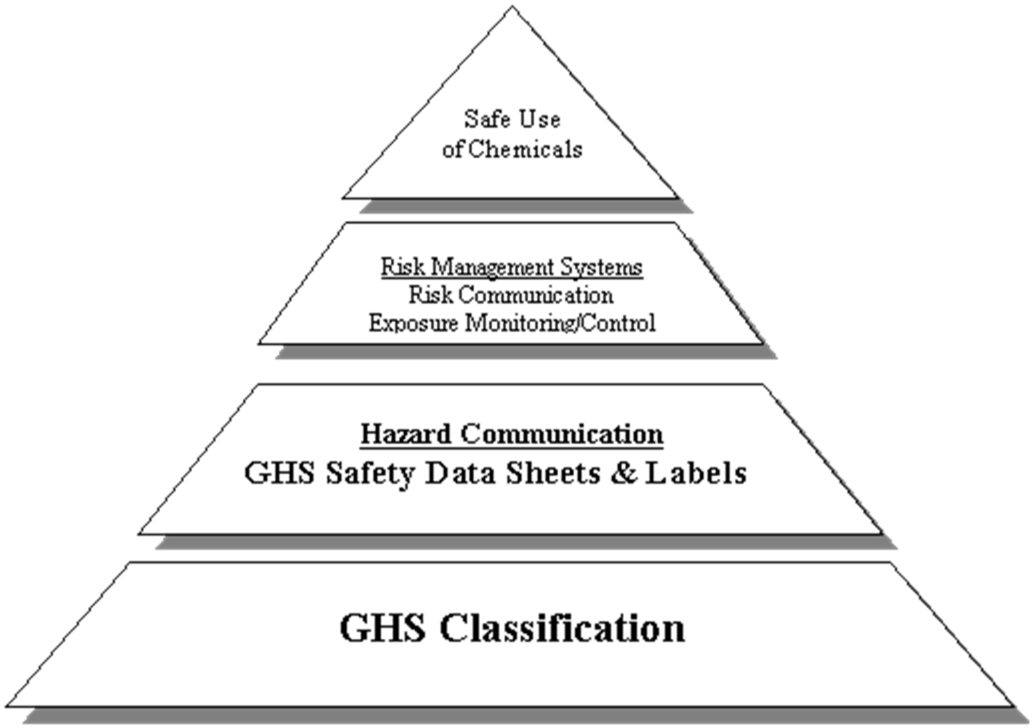
WEAR PROPER PPE

HANDLING CHEMICALS

2.0 How is the GHS to be applied?

The GHS Classification and Communication elements are the foundation of programs to ensure the safe use of chemicals, as shown in Figure 2.1. The first two steps in any program to ensure the safe use of chemicals are to identify intrinsic hazard(s) (i.e., classification) and then to communicate that information. The design of the GHS communication elements reflect the different needs of various target audiences, such as workers and consumers. To proceed further up the pyramid, some existing national programs also include risk management systems as part of an overall program on the sound management of chemicals. The general goal of these systems is to minimize exposure, resulting in reduced risk. The systems vary in focus and include activities such as establishing exposure limits, recommending exposure monitoring methods and creating engineering controls. However, the target audiences of such systems are generally limited to workplace settings. With or without formal risk management systems, the GHS is designed to promote the safe use of chemicals.

Figure 2.1



2.1 Are all chemicals covered by the GHS?
The GHS covers all hazardous chemicals. There are no complete exemptions from the scope of the GHS for a particular type of chemical or product. The term "chemical" is used broadly to include substances, products, mixtures, preparations, or any other terms that may be used by existing systems. The goal of the GHS is to identify the intrinsic hazards of chemical substances and mixtures and to convey hazard information about these hazards. The GHS is not intended to harmonize risk assessment procedures or risk management decisions, as described above.

"Articles" as defined in the OSHA Hazard Communication Standard (HCS) (29 CFR 1910.1200), or by similar definitions, are outside the scope of the GHS. Chemical inventory (e.g., TSCA, EINECS, etc.) and chemical control requirements in various countries are not harmonized by the GHS.

Classification in the GHS is criteria-based, not limiting coverage to a list that can become outdated. It is not anticipated that the GHS will develop or maintain an international classification authority or international classification list. Several countries currently maintain regulatory lists. GHS classification criteria can be used to reclassify chemicals on lists, if desired. Existing lists, such as those provide by organizations that evaluate cancer hazards, could be used in conjunction with the GHS to promote harmonization.

2.2 Will all hazardous chemicals require a GHS label and Safety Data Sheet?

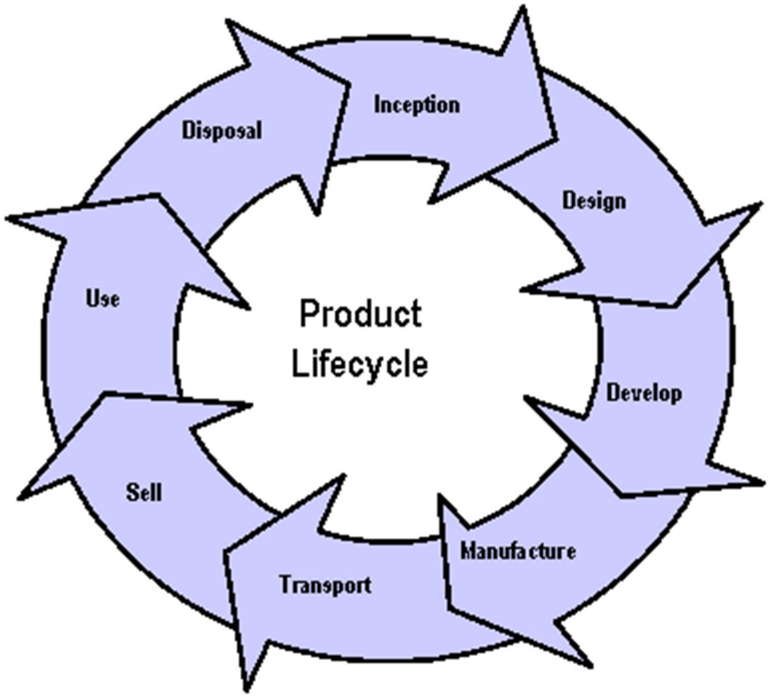


Figure 2.2

The need for GHS labels and/or Safety Data Sheets is expected to vary by product category o the chemical's lifecycle from research/production to end use. The sequence of lifecycle events Figure 2.2. For example, pharmaceuticals, food additives, cosmetics and pesticide residues in **not** be covered by the GHS at the point of consumption, but will be covered where workers ma exposed (workplaces), and in transport.

Also, the medical use of human or veterinary pharmaceuticals is generally addressed in package inserts and is not part of existing hazard communication systems. Similarly, foods are generally not labeled under existing hazard communication systems. The exact requirements for labels and Safety Data Sheets will continue to be defined in national regulations.

However, national requirements are expected to be consistent with the detailed discussic provided in **Chapter 1.1 of the GHS document**.

2.3 How will the GHS impact existing regulations?
The GHS is a voluntary international system that imposes no binding treaty obligations on countries. To the extent that countries adopt the GHS into their systems, the regulatory changes would be binding for covered industries. For countries with existing systems, it is expected that the GHS components will be applied within the framework/infrastructure of existing hazard communication regulatory schemes. For example, exceptions and exemptions found in existing regulations would not be expected to change (e.g., transportation of limited quantities).

However, the specific hazard criteria, classification processes, label elements and SDS requirements within an existing regulation will need to be modified to be consistent with the harmonized elements of the GHS.

It is anticipated that **ALL** existing hazard communication systems will need to be changed in order to apply the GHS. For example, in the U.S. EPA and OSHA would be expected to require hazard pictograms/symbols on labels. Canada and the EU would be expected to adopt the GHS pictograms/symbols instead of those currently in use.

The transport sector is expected to adopt the changed criteria (LD_{50}/LC_{50}) for the GHS Acute Toxicity Categories 1 - 3. OSHA HCS, WHMIS and the EU would all need to change their acute toxicity criteria.

Test data already generated for the classification of chemicals under existing systems should be accepted when classifying these chemicals under the GHS, thereby avoiding duplicative testing and the unnecessary use of test animals.

2.4 What is meant by GHS Building Blocks?
The GHS classification and communication requirements can be thought of as a collection of building blocks. In regulatory schemes, coverage and communication of hazards vary by the needs of target audiences/sectors. Accordingly, the GHS was designed to contain the hazard endpoints and communication tools necessary for application to known regulatory schemes. The GHS is structured so that the appropriate elements for classification and communication, which address the target audiences, can be selected.

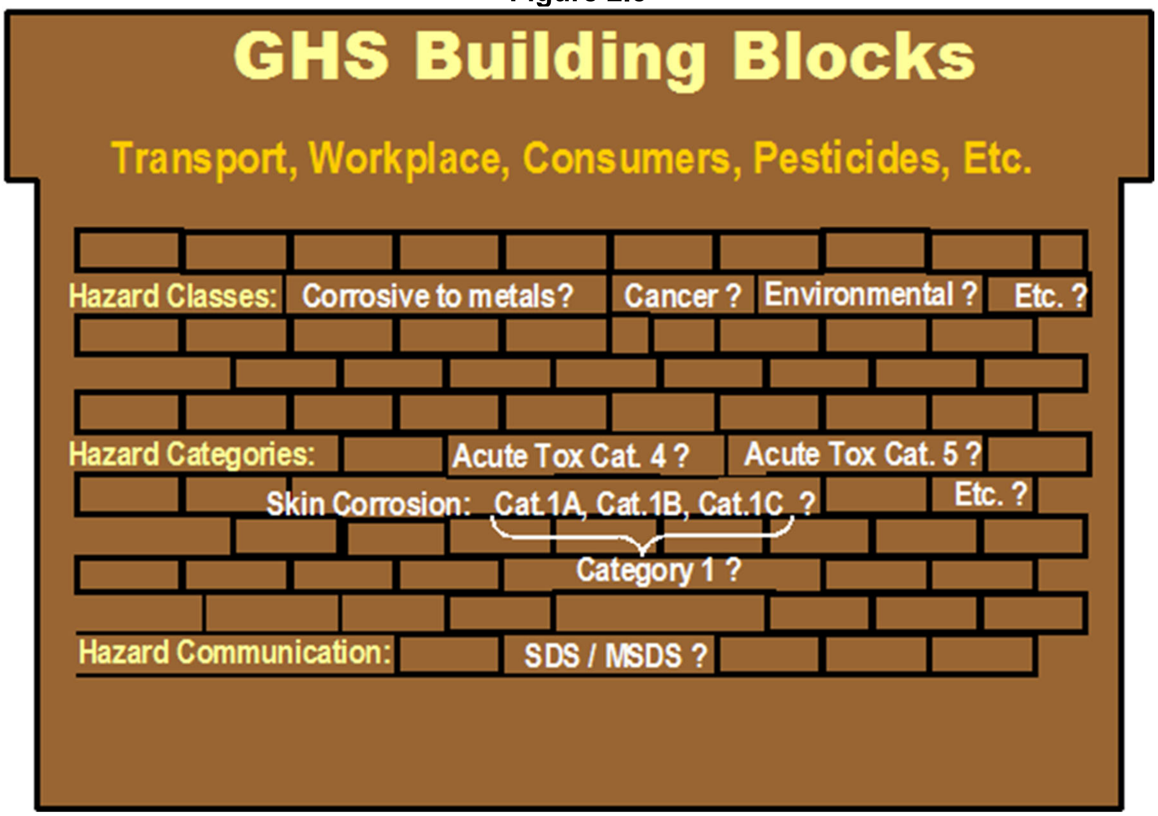
The full range of harmonized elements is available to everyone, and should be used if a country or organization chooses to cover a certain effect when it adopts the GHS. The full range of these elements does not have to be adopted. Countries can determine which of the building blocks will be applied in different parts of their systems (consumer, workplace, transport, pesticides, etc.). For example, some options for implementing the GHS include:

- Not using a GHS class (e.g., cancer, hazardous to the aquatic environment, etc.);
- Not using a GHS category (normally at the beginning or end of a class, e.g., Acute Toxicity Cat. 5);
- Combining categories (e.g., Acute Toxicity Cat.# 1 and Cat.# 2; Skin Corrosion Cat.1A, 1B and 1C).

2.5 How should the GHS Building Blocks by applied?
Appropriate implementation of the GHS means that the hazards covered by a Competent Authority (CA) are covered consistently with the GHS criteria and requirements. The EPA, Health Canada and OSHA are examples of Competent Authorities. Competent Authorities will decide how to apply the various elements of the GHS based on the CA needs and the needs of target audiences.

When a regulatory scheme covers something that is in the GHS, and implements the GHS, that coverage should be consistent. Once an endpoint and subclasses are selected, as needed, the GHS classification criteria, assigned label elements and SDS provisions should be followed as specified in the GHS. If a regulatory system covers carcinogenicity, for example, it should follow the harmonized classification scheme, the harmonized label elements and, where appropriate, the SDS. Figure 2.3 shows some of the hazard endpoint/subcategory and hazard communication building block choices for the transport, workplace, consumer and pesticide sectors.

Figure 2.3



To gain a better understanding of the building block approach, it is helpful to look at the specific sectors/target audiences. The needs and regulations of the various sectors vary depending on the type of chemical and use pattern. Different target audiences or sectors receive and use hazard information in different ways. The primary sectors/target audiences are transport, workplace, consumers and agriculture (pesticides). These sectors are described in more detail below.

2.5.1 Transport
For transport, it is expected that application of the GHS will be similar to application of current transport requirements.

- GHS physical, acute and environmental hazard criteria are expected to be adopted in the transport sector.
- Containers of dangerous goods will have pictograms that address acute toxicity, physical hazards, and environmental hazards.
- GHS hazard communication elements such as signal words, hazard statements and SDS are not expected to be adopted in the transport sector.

2.5.2 Workplace
In the workplace, it is expected that most of the GHS elements will be adopted, including;·

- GHS physical and health hazard criteria, as appropriate;
- Labels that have the harmonized core information under the GHS (signal words, hazard statements and symbols, etc.);
- Safety Data Sheets;
- Employee training to help ensure effective communication is also anticipated;

All workplace systems may not have the jurisdiction to adopt environmental hazards.

2.5.3 Consumer
For the consumer sector, it is expected that labels will be the primary focus of GHS application.·

- The appropriate GHS hazard criteria are expected to be adopted;
- These labels will include the core elements of the GHS (signal words, hazard statements and symbols, etc.), subject to some sector-specific considerations in certain systems (e.g., risk-based labeling).

2.5.4 Pesticides
For pesticides, it is expected that the GHS will be adopted.

- The appropriate GHS hazard criteria are expected to be adopted;
- Pesticide labels will include the core elements of the GHS (signal words, hazard statements and symbols, etc.), subject to some sector-specific considerations in certain systems.

2.6 How will the GHS impact countries without existing regulations?
Developing and maintaining a classification and labeling system is not a simple task. The GHS can be used as a tool for developing national regulations. It is expected that countries that do not have systems will adopt GHS as their basic scheme. The GHS provides the building blocks from which countries can construct chemical safety programs. Although the GHS will facilitate the process, many challenges exist in creating new regulations. For example:

- What is the appropriate legal framework for adopting/implementing the GHS?
- What government agencies should be involved? Are there ministries/agencies ready to implement and maintain the GHS?
- How will stakeholder cooperation and support for implementing the GHS be managed?

Work has begun in international organizations (e.g., UNITAR and ILO) under the guidance of the UN GHS Sub-Committee, to develop technical assistance for developing countries to write new regulations using the GHS elements.

Guidance has been developed on how to implement a national GHS action plan. Additionally, pilot implementations have begun in a few countries. The opportunities and challenges learned from the pilot programs will be documented and are expected to facilitate future implementations.

3.0 What is Classification?
Classification is the starting point for hazard communication. It involves the identification of the hazard(s) of a chemical or mixture by assigning a category of hazard/danger using defined criteria. The GHS is designed to be consistent and transparent.

It draws a clear distinction between classes and categories in order to allow for **"self-classification"**. For many hazards a decision tree approach (e.g., eye irritation) is provided in the GHS Document. For several hazards the GHS criteria are semi-quantitative or qualitative. Expert judgment may be required to interpret these data.

Figure 3.1
Hazard Classification

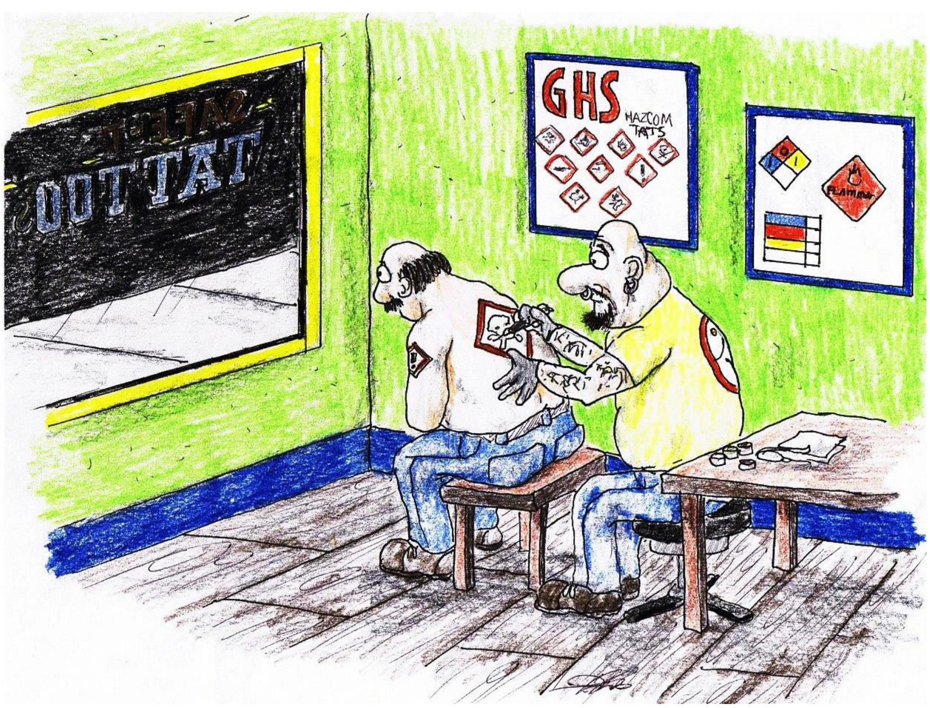
The term "hazard classification is used to indicate that only the intrinsic hazardous properties of substances and mixtures are considered and involves the following 3 steps:

a) Identification of relevant data regarding the hazards of a substance or mixture;
b) Subsequent review of those data to ascertain the hazards associated with the substance or mixture; and
c) A decision on whether the substance or mixture will be classified as a hazardous substance or mixture and the degree of hazard, where appropriate, by comparison of the data with agreed hazard classification criteria.

Figure 3.1 shows the harmonized definition for hazard classification, which can be applied to all hazard categories in the system.

The data used for classification may be obtained from tests, literature, and practical experience. The GHS health and environmental hazard criteria/definitions are test method neutral. Accordingly, tests that determine hazardous properties conducted according to internationally recognized scientific principles can be used for purposes of hazard classification.

The GHS endpoints that cover physical, health and environmental hazards are listed in Figures 3.2 and 3.3, respectively. As mentioned earlier, the GHS hazard definitions are criteria-based. The following information provides an overview of the GHS definitions and classification criteria. It is recommended that the person responsible for GHS implementation consult the GHS Document or "Purple Book" for more complete information.



3.1 What are the GHS Physical Hazards?

The GHS physical hazards criteria, developed by the ILO and UNCETDG, were largely based on the existing criteria used by the UN Model Regulation on the Transport of Dangerous Goods. Therefore, many of the criteria are already being used on a worldwide basis. However, some additions and changes were necessary since the scope of the GHS includes all target audiences. The physical hazards classification process provides specific references to approved test methods and criteria for classification. The GHS physical hazard criteria apply to mixtures. It is assumed that mixtures will be tested for physical hazards.

In general, the GHS criteria for physical hazards are quantitative or semi-quantitative with multiple hazard levels within an endpoint. This is different from several of the existing systems that currently have qualitative criteria for various physical hazards (e.g., organic peroxide criteria under WHMIS and OSHA HCS). This could make classification under the GHS more consistent.

In developing GHS criteria for physical hazards it was necessary to define physical states. In the GHS,

- a **gas** is a substance or mixture which at 50°C has a vapor pressure greater than 300 kPa; or is completely gaseous at 20°C and a standard pressure of 101.3 kPa.

- a **liquid** is a substance or mixture that is not a gas and which has a melting point or initial melting point of 20°C or less at standard pressure of 101.3 kPa.

- a **solid** is a substance or mixture that does not meet the definitions of a liquid or a gas.

The GHS physical hazards are briefly described below. For many of the physical hazards the GHS Document contains Guidance Sections with practical information to assist in applying the criteria.

Figure 3.2
Physical Hazard

- Explosives
- Flammable Gases
- Flammable Aerosols
- Oxidizing Gases
- Gases Under Pressure
- Flammable Liquids
- Flammable Solids
- Self-Reactive Substances
- Pyrophoric Liquids
- Pyrophoric Solids
- Self-Heating Substances
- Substances which, in contact with water emit flammable gases
- Oxidizing Liquids
- Oxidizing Solids
- Organic Peroxides
- Corrosive to Metals

3.1.1 Explosives

An explosive substance (or mixture) is a solid or liquid which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases. A pyrotechnic substance (or mixture) is designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative, self-sustaining, exothermic chemical reactions.

Classification as an explosive and allocation to a division is a three-step process:

- Ascertain if the material has explosive effects (Test Series 1);
- Acceptance procedure (Test Series 2 to 4);
- Assignment to one of six hazard divisions (Test Series 5 to 7).

Table 3.1 Explosives

Division	Characteristics
1.1	Mass explosion hazard
1.2	Projection hazard
1.3	Fire hazard or minor projection hazard
1.4	No significant hazard
1.5	Very insensitive substances with mass explosion hazard
1.6	Extremely insensitive articles with no mass explosion hazard

Explosive properties are associated with certain chemical groups that can react to give very rapid increases in temperature or pressure. The GHS provides a screening procedure that is aimed at identifying the presence of such reactive groups and the potential for rapid energy release. If the screening procedure identifies the substance or mixture to be a potential explosive, the acceptance procedure has to be performed.

Substances, mixtures and articles are assigned to one of six divisions, 1.1 to 1.6, depending on the type of hazard they present. See, *UN Manual of Tests and Criteria* Part I Test Series 2 to 7. Currently, only the transport sector uses six categories for explosives.

3.1.2 Flammable Gases
Flammable gas means a gas having a flammable range in air at 20°C and a standard pressure of 101.3 kPa. Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the test or calculation method (ISO 10156:1996).

3.1.3 Flammable Aerosols

Aerosols are any gas compressed, liquefied or dissolved under pressure within a non-refillable container made of metal, glass or plastic, with or without a liquid, paste or powder. The container is fitted with a release device allowing the contents to be ejected as solid or liquid particles in suspension in a gas, as a foam, paste or powder or in a liquid or gaseous state.

Aerosols should be considered for classification as either a Category 1 or Category 2 Flammable Aerosol if they contain any component classified as flammable according to the GHS criteria for flammable liquids, flammable gases, or flammable solids.

Classification is based on:

- Concentration of flammable components;
- Chemical heat of combustion (mainly for transport/storage);
- Results from the foam test (foam aerosols) (mainly for worker/consumer);
- Ignition distance test (spray aerosols) (mainly for worker/consumer);
- Enclosed space test (spray aerosols) (mainly for worker/consumer).

Aerosols are considered:

- Nonflammable, if the concentration of the flammable components $\leq$ 1% and the heat of combustion is < 20 kJ/g.
- Extremely flammable, if the concentration of the flammable components >85% and the heat of combustion is $\geq$ 30 kJ/g to avoid excessive testing.

See the *UN Manual of Tests and Criteria* for the test method.

3.1.4 Oxidizing Gases

Oxidizing gas means any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis that, generally by providing oxygen, they cause or contribute to the combustion of other material more than air does. The test method is ISO 10156:1996.

Currently, several workplace hazard communication systems cover oxidizers (solids, liquids, gases) as a class of chemicals.

3.1.5 Gases under Pressure

Gases under pressure are gases that are contained in a receptacle at a pressure not less than 280 Pa at 20°C or as a refrigerated liquid. This endpoint covers four types of gases or gaseous mixtures to address the effects of sudden release of pressure or freezing which may lead to serious damage to people, property, or the environment independent of other hazards the gases may pose.

For this group of gases, the following information is required:

- vapor pressure at 50°C;
- physical state at 20°C at standard ambient pressure;
- critical temperature.

Criteria that use the physical state or compressed gases will be a different classification basis for some workplace systems.

Table 3.2 Gases under Pressure

Group	Criteria
Compressed gas	Entirely gaseous at -50°C
Liquefied gas	Partially liquid at temperatures > -50°C
Refrigerated liquefied gas	Partially liquid because of its low temperature
Dissolved gas	Dissolved in a liquid phase solvent

Data can be found in the literature, and calculated or determined by testing. Most pure gases are already classified in the UN Model Regulations. Gases are classified, according to their physical state when packaged, into one of four groups as shown in Table 3.2.

3.1.6 Flammable Liquids

Flammable liquid means a liquid having a flash point of not more than 93°C. Substances and mixtures of this hazard class are assigned to one of four hazard categories on the basis of the flash point and boiling point (See Table 3.3). Flash Point is determined by closed cup methods as provided in the GHS document, Chapter 2.5, paragraph 11.

Table 3.3 Flammable Liquids

Category	Criteria
1	Flash point < 23°C and initial boiling point ≤ 35°C (95°F)
2	Flash point < 23°C and initial boiling point > 35°C (95°F)
3	Flash point ≥ 23°C and ≤ 60°C (140°F)
4	Flash point ≥ 60°C (140°F) and ≤ 93°C (200°F)

3.1.7 Flammable Solids

Flammable solids are solids that are readily combustible, or may cause or contribute to fire through friction. Readily combustible solids are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly.

Substances and mixtures of this hazard class are assigned to one of two hazard categories (Table 3.4) on the basis of the outcome of the UN Test N.1 (*UN Manual of Tests and Criteria*). The tests include burning time, burning rate and behavior of fire in a wetted zone of the test sample.

Table 3.4 Flammable Solids

Category	Criteria
1	Metal Powders: burning time ≤ 5 minutes Others: wetted zone does not stop fire & burning time < 45 seconds or burning > 2.2 mm/second
2	Metal Powders: burning time > 5 and ≤ 10 minutes Others: wetted zone stop fire for at least 4 minutes & burning time < 45 seconds or burning rat > 2.2mm/second

3.1.8 Self-Reactive Substances

Self-reactive substances are thermally unstable liquids or solids liable to undergo a strongly exothermic thermal decomposition even without participation of oxygen (air). This definition excludes materials classified under the GHS as explosive, organic peroxides or as oxidizing.

These materials may have similar properties, but such hazards are addressed in their specific endpoints. There are exceptions to the self-reactive classification for material: (i) with heat of decomposition <300 J/g or (ii) with self-accelerating decomposition temperature (SADT) > 75°C for a 50 kg package.

Substances and mixtures of this hazard class are assigned to one of the seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H (*UN Manual of Tests and Criteria*). Currently, only the transport sector uses seven categories for self-reactive substances (Table 3.5).

Table 3.5 Self-Reactive Substances

Type	Criteria
A	Can detonate or deflagrate rapidly, as packaged.
B	Possess explosive properties and which, as packaged, neither detonates nor deflagrates, but is liable to undergo a thermal explosion in that package.
C	Possess explosive properties when the substance or mixture as package cannot detonate or deflagrate rapidly or undergo a thermal explosion.
D	▪ Detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or ▪ Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or ▪ Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.
E	Neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.
F	Neither detonates in the cavitated bubble state nor deflagrates at all and shows only a low or no effect when heated under confinement as well as low or no explosive power.
G	Neither detonates in the cavitated state nor deflagrates at all and shows non effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60°C to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point not less than 150°C is used for desensitization.

Pyrophorics

3.1.9 Pyrophoric Liquids
A pyrophoric liquid is a liquid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of the UN Test N.3 (UN Manual of Tests and Criteria).

3.1.10 Pyrophoric Solids
A pyrophoric solid is a solid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of the UN Test N.2 (*UN Manual of Tests and Criteria)*.

3.1.11 Self-Heating Substances
A self-heating substance is a solid or liquid, other than a pyrophoric substance, which, by reaction with air and without energy supply, is liable to self-heat. This endpoint differs from a pyrophoric substance in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days). Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the UN Test N.4 (*UN Manual of Tests and Criteria)*.

3.1.12 Substances which on Contact with Water Emit Flammable Gases
Substances that, in contact with water, emit flammable gases are solids or liquids which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test N.5 *UN Manual of Tests and Criteria*) which measure gas evolution and speed of evolution.

Table 3.6 Substances which on Contact with Water Emit Flammable Gases

Category	Criteria
1	≥10 L/kg/1 minute
2	≥20 L/kg/ 1 hour + < 10 L/kg/1 min
3	≥1 L/kg/1 hour + < 20 L/kg/1 hour
Not classified	< 1 L/kg/1 hour

3.1.13 Oxidizing Liquids
An oxidizing liquid is a liquid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test O.2 *UN Manual of Tests and Criteria*) which measure ignition or pressure rise time compared to defined mixtures.

3.1.14 Oxidizing Solids
An oxidizing solid is a solid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test O.1 *UN Manual of Tests and Criteria*) which measure mean burning time and re compared to defined mixtures.

3.1.15 Organic Peroxides

An organic peroxide is an organic liquid or solid which contains the bivalent -0-0- structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term also includes organic peroxide formulations (mixtures). Such substances and mixtures may:

- be liable to explosive decomposition;
- burn rapidly;
- be sensitive to impact or friction;
- react dangerously with other substances.

Substances and mixtures of this hazard class are assigned to one of seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H (*UN Manual of Tests and Criteria*). Currently, only the transport sector uses seven categories for organic peroxides.

Table 3.7 Organic Peroxides

Type	Criteria
A	Can detonate or deflagrate rapidly, as packaged.
B	Possess explosive properties and which, as packaged, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in that package.
C	Possess explosive properties when the substance or mixture as packaged cannot detonate or deflagrate rapidly or undergo a thermal explosion.
D	▪ Detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or ▪ Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or ▪ Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.
E	Neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.
F	Neither detonates in the caviated bubble state nor deflagrates at all and shows only a low or no effect when heated under confinements as well as low or non-explosive power.
G	Neither detonates in the caviated state nor deflagrates at all and shows no effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60°C to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point not less than 150°C is used for desensitization.

3.1.16 Substances Corrosive to Metal

A substance or a mixture that by chemical action will materially damage, or even destroy, metals is termed 'corrosive to metal'. These substances or mixtures are classified in a single hazard category on the basis of tests (Steel: ISO 9328 (II): 1991 - Steel type P235; Aluminum: ASTM G31-72 (1990) - non-clad types 7075-T6 or AZ5GU-T66). The GHS criteria are a corrosion rate on steel or aluminum surfaces exceeding 6.25 mm per year at a test temperature of 55°C.

The concern in this case is the protection of metal equipment or installations in case of leakage (e.g., plane, ship, tank), not material compatibility between the container/tank and the product. This hazard is not currently covered in all systems.

3.2 What are the GHS Health and Environmental Hazards?

The GHS health and environmental hazard criteria represent a harmonized approach for existing classification systems (see Figure 3.3). The work at the OECD to develop the GHS criteria included:

- A thorough analysis of existing classification systems, including the scientific basis for a system and its criteria, its rationale and an explanation of the mode of use;
- A proposal for harmonized criteria for each category. For some categories the harmonized approach was easy to develop because the existing systems had similar approaches. In cases where the approach was different, a compromise consensus proposal was developed.
- Health and environmental criteria were established for substances and mixtures.

Figure 3.3
Health Hazard

- Acute Toxicity
- Skin Corrosion/Irritation
- Serious Eye Damage/Eye Irritation
- Respiratory or Skin Sensitization
- Germ Cell Mutagenicity
- Carcinogenicity
- Reproductive Toxicology
- Target Organ Systemic Toxicity - Single Exposure
- Target Organ Systemic Toxicity - Repeated Exposure
- Aspiration Toxicity

Environmental Hazard

- Hazardous to the Aquatic Environment

  Acute aquatic toxicity

  Chronic aquatic toxicity

  - Bioaccumulation potential
  - Rapid degradability

The GHS Health and Environmental Endpoints

The following paragraphs briefly describe the GHS health and environmental endpoints. The criteria for classifying substances are presented first. Then the GHS approach to classifying mixtures is briefly discussed. It is recommended that the person responsible for GHS implementation consult the GHS Document or "Purple Book" for more complete information.

3.2.1 Acute Toxicity

Five GHS categories have been included in the GHS Acute Toxicity scheme from which the appropriate elements relevant to transport, consumer, worker and environment protection can be selected. Substances are assigned to one of the five toxicity categories on the basis of LD_{50} (oral, dermal) or LC_{50} (inhalation). The LC_{50} values are based on 4-hour tests in animals. The GHS provides guidance on converting 1-hour inhalation test results to a 4-hour equivalent. The five categories are shown in the Table 3.8 Acute Toxicity.

Table 3.8 Acute Toxicity

Acute toxicity	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Category 5
Oral (mg/kg)	≤ 5	> 5 ≤ 50	> 50 ≤ 300	> 300 ≤ 2000	Criteria: ▪ Anticipated oral LD50 between 2000 and 5000 mg/kg; ▪ Indication of significant effect in humans;* ▪ Any mortality at class 4;* ▪ Significant clinical signs at class 4;* ▪ Indications from other studies.* *If assignment to more hazardous class is not warranted.
Dermal (mg/kg)	≤ 50	> 50 ≤ 200	> 200 ≤ 1000	> 1000 ≤ 2000	
Gases (ppm)	≤ 100	> 100 ≤ 500	> 500 ≤ 2500	> 2500 ≤ 5000	
Vapors (mg/l)	≤ 0.5	> 0.5 ≤ 2.0	> 2.0 ≤ 10	> 10 ≤ 20	
Dust & mists (mg/l)	≤ 0.05	> 0.05 ≤ 0.5	> 0.5 ≤ 1.0	> 1.0 ≤ 5	

Category 1, the most severe toxicity category, has cut-off values currently used primarily by the transport sector for classification for packing groups. Some Competent Authorities may consider combining Acute Categories 1 and 2. Category 5 is for chemicals which are of relatively low acute toxicity but which, under certain circumstances, may pose a hazard to vulnerable populations. Criteria other than LD50/LC50 data are provided to identify substances in Category 5 unless a more hazardous class is warranted.

3.2.2 Skin Corrosion

Skin corrosion means the production of irreversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single harmonized corrosion category. For Competent Authorities, such as transport packing groups, needing more than one designation for corrosivity, up to three subcategories are provided within the corrosive category. See the Skin Corrosion/Irritation Table 3.9.

Several factors should be considered in determining the corrosion potential before testing is initiated:

- Human experience showing irreversible damage to the skin;
- Structure/activity or structure property relationship to a substance or mixture already classified as corrosive;
- pH extremes of less than 2 and more than 11.5 including acid/alkali reserve capacity.

Table 3.9 Skin Corrosion/Irritation

<table>
<tr><th colspan="3">Skin Corrosion
Category 1</th><th>Skin Irritation
Category 2</th><th>Mild Skin Irritation
Category 3</th></tr>
<tr><td colspan="3">Destruction of dermal tissue: visible necrosis in at least one animal</td><td rowspan="2">Reversible adverse effects in dermal tissue

Draize score: ≥ 2.3 < 4.0
or persistent inflammation</td><td rowspan="2">Reversible adverse effects in dermal tissue

Draize score: ≥ 1.5 < 2.3</td></tr>
<tr><td>Subcategory 1A
Exposure < 3 min.
Observation < 1hr,</td><td>Subcategory 1B
Exposure < 1hr.
Observation < 14 days</td><td>Subcategory 1C
Exposure < 4 hrs.
Observation < 14 days</td></tr>
</table>

3.2.3 Skin Irritation

Skin irritation means the production of reversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single irritant category. For those authorities, such as pesticide regulators, wanting more than one designation for skin irritation, an additional mild irritant category is provided. See the Skin Corrosion/Irritation Table 3.9.

Several factors should be considered in determining the irritation potential before testing is initiated:

- Human experience or data showing reversible damage to the skin following exposure of up to 4 hours;

- Structure/activity or structure property relationship to a substance or mixture already classified as an irritant.

3.2.4 Eye Effects

Several factors should be considered in determining the *serious eye damage* or *eye irritation* potential before testing is initiated:

- Accumulated human and animal experience;

- Structure/activity or structure property relationship to a substance or mixture already classified;

- pH extremes like ≤ 2 and ≥ 11.5 that may produce serious eye damage.

Table 3.10 Eye Effects

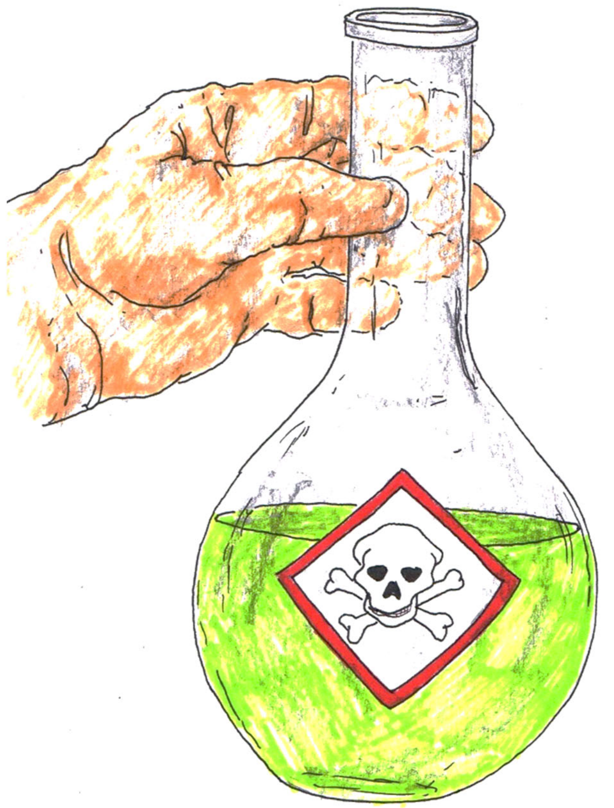
<table>
<tr><th>Category 1
Serious eye damage</th><th colspan="2">Category 2
Eye Irritation</th></tr>
<tr><td rowspan="2">Irreversible damage 21 days after exposure

Draize score:
Corneal opacity ≥ 3
Iritis > 1.5</td><td colspan="2">Reversible adverse effects on cornea, iris, conjunctiva

Draize score:
Corneal opacity ≥ 1
Iritis > 1
Redness ≥ 2
Chemosis ≥ 2</td></tr>
<tr><td>Irritant
Subcategory 2A
Reversible in 21 days</td><td>Mild Irritant
Subcategory 2B
Reversible in 7 days</td></tr>
</table>

Serious eye damage means the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the front surface of the eye, which is not fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized category.

Eye irritation means changes in the eye following the application of a test substance to the front surface of the eye, which are fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized hazard category. For authorities, such as pesticide regulators, wanting more than one designation for eye irritation, one of two subcategories can be selected, depending on whether the effects are reversible in 21 or 7 days.



3.2.5 Sensitization

Respiratory sensitizer means a substance that induces hypersensitivity of the airways following inhalation of the substance. Substances and mixtures in this hazard class are assigned to one hazard category.

Skin sensitizer means a substance that will induce an allergic response following skin contact. The definition for "skin sensitizer" is equivalent to "contact sensitizer". Substances and mixtures in this hazard class are assigned to one hazard category. Consideration should be given to classifying substances which cause immunological contact urticaria (an allergic disorder) as contact sensitizers.

3.2.6 Germ Cell Mutagenicity

Mutagen means an agent giving rise to an increased occurrence of mutations in populations of cells and/or organisms. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories. See the Germ Cell Mutagenicity (Table 3.11) below.

Table 3.11 Germ Cell Mutagenicity

<table>
<tr><th colspan="2">Category 1
Known/Presumed</th><th>Category 2
Suspected/Possible</th></tr>
<tr><td colspan="2">Known to produce heritable mutations in human germ cells</td><td rowspan="2">▪ May include heritable mutations in human germ cells
▪ Positive evidence from tests in mammals and somatic cell tests
▪ In vivo somatic genotoxicity supported by in vitro mutagenicity</td></tr>
<tr><td>Subcategory 1A
Positive evidence from epidemiological studies</td><td>Subcategory 1B
Positive results in:
▪ In vivo heritable germ cell tests in mammals
▪ Human germ cell tests
▪ In vivo somatic mutagenicity tests, combined with some evidence of germ cell mutagenicity</td></tr>
</table>

3.2.7 Carcinogenicity

Carcinogen means a chemical substance or a mixture of chemical substances which induce cancer or increase its incidence. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories. The Carcinogenicity Guidance Section in the GHS Document includes comments about IARC.

Table 3.12 Carcinogenicity

<table>
<tr><th colspan="2">Category 1
Known or Presumed Carcinogen</th><th>Category 2
Suspected Carcinogen</th></tr>
<tr><td>Subcategory 1A
Known Human Carcinogen Based on human evidence</td><td>Subcategory 1B
Presumed Human Carcinogen
Based on demonstrated animal carcinogenicity</td><td>Limited evidence of human or animal carcinogenicity</td></tr>
</table>

3.2.8 Reproductive Toxicity

Reproductive toxicity includes adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in offspring. Substances and mixtures with reproductive and/or developmental effects are assigned to one of two hazard categories, 'known or presumed' and 'suspected'. Category 1 has two subcategories for reproductive and developmental effects. Materials which cause concern for the health of breastfed children have a separate category, Effects on or Via Lactation.

Table 3.13 Reproductive Toxicity

<table>
<tr><th colspan="2">Category 1</th><th>Category 2
Suspected</th><th>Additional
Category</th></tr>
<tr><td colspan="2">Known or presumed to cause effects on human reproduction or on development</td><td rowspan="2">Human or animal evidence possibly with other information</td><td rowspan="2">Effects on or via lactation</td></tr>
<tr><td>Category 1A
Known
Based on human evidence</td><td>Category 1B
Presumed
Based on experimental animals</td></tr>
</table>

3.2.9 Target Organ Systemic Toxicity (TOST): Single Exposure & Repeated Exposure

The GHS distinguishes between single and repeat exposure for Target Organ Effects. Some existing systems distinguish between single and repeat exposure for these effects and some do not.

All significant health effects, not otherwise specifically included in the GHS, that can impair function, both reversible and irreversible, immediate and/or delayed are included in the non-lethal target organ/systemic toxicity class (TOST). Narcotic effects and respiratory tract irritation are considered to be target organ systemic effects following a single exposure.

Substances and mixtures of the single exposure target organ toxicity hazard class are assigned to one of three hazard categories in Table 3.14.

Table 3.14 TOST: Single Exposure

Category 1	Category 2	Category 3
Significant toxicity in humans - Reliable, good quality human case studies or epidemiological studies Presumed significant toxicity in humans - Animal studies with significant and/or severe toxic effects relevant to humans at generally low exposure (guidance)	Presumed to be harmful to human health - Animal studies with significant toxic effects relevant to humans at generally moderate exposure (guidance) - Human evidence in exceptional cases	Transient target organ effects - Narcotic effects - Respiratory tract irritation

Substances and mixtures of the repeated exposure target organ toxicity hazard class are assigned to one of two hazard categories in Table 3.15.

Table 3.15 TOST: Repeated Exposure

Category 1	Category 2
Significant toxicity in humans - Reliable, good quality human case studies or epidemiological studies Presumed significant toxicity in humans - Animal studies with significant and/or severe toxic effects relevant to humans at generally low exposure (guidance)	Presumed to be harmful to human health - Animal studies with significant toxic effects relevant to humans at generally moderate exposure (guidance) - Human evidence in exceptional cases

In order to help reach a decision about whether a substance should be classified or not, and to what degree it would be classified (Category 1 vs. Category 2), dose/concentration 'guidance values' are provided in the GHS. The guidance values and ranges for single and repeated doses are intended only for guidance purposes.

This means that they are to be used as part of the weight of evidence approach, and to assist with decisions about classification. They are not intended as strict demarcation values. The guidance value for repeated dose effects refer to effects seen in a standard 90-day toxicity study conducted in rats. They can be used as a basis to extrapolate equivalent guidance values for toxicity studies of greater or lesser duration.

3.2.10 Aspiration Hazard

Aspiration toxicity includes severe acute effects such as chemical pneumonia, varying degrees of pulmonary injury or death following aspiration. Aspiration is the entry of a liquid or solid directly through the oral or nasal cavity, or indirectly from vomiting, into the trachea and lower respiratory system. Some hydrocarbons (petroleum distillates) and certain chlorinated hydrocarbons have been shown to pose an aspiration hazard in humans. Primary alcohols, and ketones have been shown to pose an aspiration hazard only in animal studies.

Table 3.16 Aspiration Toxicity

Category 1: Known (regarded) human	**Category 2:** Presumed human
- human evidence - hydrocarbons with kinematic viscosity ? 20.5 mm^2/s at 40° C.	- Based on animal studies - surface tension, water solubility, boiling point - kinematic viscosity ? 14 mm^2/s at 40°C & not Category 1

Substances and mixtures of this hazard class are assigned to one of two hazard categories this hazard class on the basis of viscosity.

3.3 Environmental Hazards

3.3.1 Hazardous to the Aquatic Environment

The harmonized criteria are considered suitable for packaged goods in both supply and use in multi-modal transport schemes. Elements of it may be used for bulk land transport and bulk marine transport under MARPOL (International Convention for the Prevention of Pollution from Ships) insofar as this uses aquatic toxicity.

Two Guidance Documents (Annexes 8 and 9 of the GHS Document) cover issues such as data interpretation and the application of the criteria to special substances. Considering the complexity of this endpoint and the breadth of the application, the Guidance Annexes are important in the application of the harmonized criteria.

3.3.1.1 Acute Aquatic Toxicity

Acute aquatic toxicity means the intrinsic property of a material to cause injury to an aquatic organism in a short-term exposure. Substances and mixtures of this hazard class are assigned to one of three toxicity categories on the basis of acute toxicity data: LC_{50} (fish) or EC_{50} (crustacea) or ErC_{50} (for algae or other aquatic plants). In some regulatory systems these acute toxicity categories may be subdivided or extended for certain sectors.

3.3.1.2 Chronic Aquatic Toxicity

Chronic aquatic toxicity means the potential or actual properties of a material to cause adverse effects to aquatic organisms during exposures that are determined in relation to the lifecycle of the organism. Substances and mixtures in this hazard class are assigned to one of four toxicity categories on the basis of acute data *and* environmental fate data: LC_{50} (fish) or EC_{50} (crustacea) or ErC_{50} (for algae or other aquatic plants) *and* degradation/bioaccumulation.

While experimentally derived test data are preferred, where no experimental data are available, validated Quantitative Structure Activity Relationships (QSARs) for aquatic toxicity and log KOW may be used in the classification process. The log K_{OW} is a surrogate for a measured Bioconcentration Factor (BCF), where such a measured BCF value would always take precedence.

Chronic Category IV is considered a "safety net" classification for use when the available data do not allow classification under the formal criteria, but there are some grounds for concern.

Table 3.17 Acute & Chronic Aquatic Toxicity

<table>
<tr><td colspan="2">Acute Cat. I
Acute toxicity ≤ 1.00 mg/l</td><td colspan="1">Acute Cat. II
Acute toxicity > 1.00 but ≤ 10.0 mg/l</td><td colspan="1">Acute Cat. III
Acute toxicity ≤ 10.0 but < 100 mg/l</td></tr>
<tr><td>Chronic Cat. I
Acute toxicity ≤ 1.00 mg/l and lack of rapid degradability and log K_{ow} ≥ 4 unless BCF < 500</td><td>Chronic Cat. II
Acute toxicity > 1.00 but ≤ 10.0 mg/l and lack of rapid degradability and log K_{ow} ≥ 4 unless BCF < 500 and unless chronic toxicity > 1 mg/l</td><td>Chronic Cat. III
Acute toxicity > 10.0 but ≤ 100.0 mg/l and lack of rapid degradability and log K_{ow} ≥ 4 unless BCF < 500 and unless chronic toxicity > 1 mg/l</td><td>Chronic Cat. IV
Acute toxicity > 100 mg/l and lack of rapid degradability and log K_{ow} ≥ 4 unless BCF < 500 and unless chronic toxicity > 1 mg/l</td></tr>
</table>

3.4 What is the GHS approach to classifying mixtures?

For consistency and understanding the provisions for classifying mixtures, the GHS defines certain terms. These working definitions are for the purpose of evaluating or determining the hazards of a product for classification and labeling.

Substance: Chemical elements and their compounds in the natural state or obtained by any production process, including any *additive* necessary to preserve the stability of the product and any *impurities* deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

Mixture: Mixtures or solutions composed of two or more substances in which they do not react.

Alloy: An alloy is a metallic material, homogeneous on a macroscopic scale, consisting of two or more elements so combined that they cannot be readily separated by mechanical means. Alloys are considered to be mixtures for the purpose of classification under the GHS.

Where impurities, additives or individual constituents of a substance or mixture have been identified and are themselves classified, they should be taken into account during classification if they exceed the cutoff value/concentration limit for a given hazard class.

Figure 3.4

Tier Approach to Classification of Mixtures

Generally, use test data for the mixture, if available,
↓
Compared to substance hazard criteria
Use bridging principles, if applicable
↓
Estimate hazard(s) based on the known component information

As mentioned previously, the GHS physical hazard criteria apply to mixtures. It is assumed that mixtures will be tested for physical hazards. Each health and environmental endpoint chapter in the GHS contains specific criteria for classifying mixtures as well as substances.

The GHS Document or "Purple Book" should be consulted for complete information on classifying mixtures.

The process established for classifying a mixture allows the use of
(a) available data for the mixture itself and/or

(b) similar mixtures and/or

(c) data for ingredients of the mixture. The GHS approach to the classification of mixtures for health and environmental hazards is tiered, and is dependent upon the amount of information available for the mixture itself and for its components. The process for the classification of mixtures is based on the following steps:

(1) Where test data are available for the mixture itself, the classification of the mixture will be based on that data (See exception for carcinogens, mutagens & reproductive toxins in the GHS Document);

(2) Where test data are not available for the mixture itself, then the appropriate bridging principles (as described below) in the specific chapter should be used;

(3) If (i) test data are not available for the mixture itself, and (ii) the bridging principles cannot be applied, then use the calculation or cutoff values described in the specific endpoint to classify the mixture.

3.5 What are Bridging Principles?

Bridging principles are an important concept in the GHS for classifying untested mixtures. When a mixture has not been tested, but there are sufficient data on the components and/or similar tested mixtures, these data can be used in accordance with the following bridging principles:

- **Dilution**: If a mixture is diluted with a diluent that has an equivalent or lower toxicity, then the hazards of the new mixture are assumed to be equivalent to the original.
- **Batching**: If a batch of a complex substance is produced under a controlled process, then the hazards of the new batch are assumed to be equivalent to the previous batches.
- **Concentration of Highly Toxic Mixtures**: If a mixture is severely hazardous, then a concentrated mixture is also assumed to be severely hazardous
- **Interpolation within One Toxic Category: Mixtures** having component concentrations within a range where the hazards are known are assumed to have those known hazards.
- **Substantially Similar Mixtures**: Slight changes in the concentrations of components are not expected to change the hazards of a mixture and substitutions involving toxicologically similar components are not expected to change the hazards of a mixture
- **Aerosols**: An aerosol form of a mixture is assumed to have the same hazards as the tested, non-aerosolized form of the mixture unless the propellant affects the hazards upon spraying.

All bridging principles do not apply to every health and environmental endpoint. Consult each endpoint to determine which bridging principles apply.

When the bridging principles do not apply or cannot be used, the health and environmental hazards of mixtures are estimated based on component information. In the GHS, the methodology used to estimate these hazards varies by endpoint. The GHS Document or "Purple Book" should be consulted for more complete information on classifying mixtures. Figure 3.5 summarizes the GHS mixtures approach for the various health and environmental endpoints.

3.6 What testing is required?

The GHS itself does not include requirements for testing substances or mixtures. Therefore, there is no requirement under the GHS to generate test data for any hazard class. Some parts of regulatory systems may require data to be generated (e.g., for pesticides), but these requirements are not related specifically to the GHS. The GHS criteria for determining health and environmental hazards are test method neutral, allowing different approaches as long as they are scientifically sound and validated according to international procedures and criteria already referred to in existing systems.

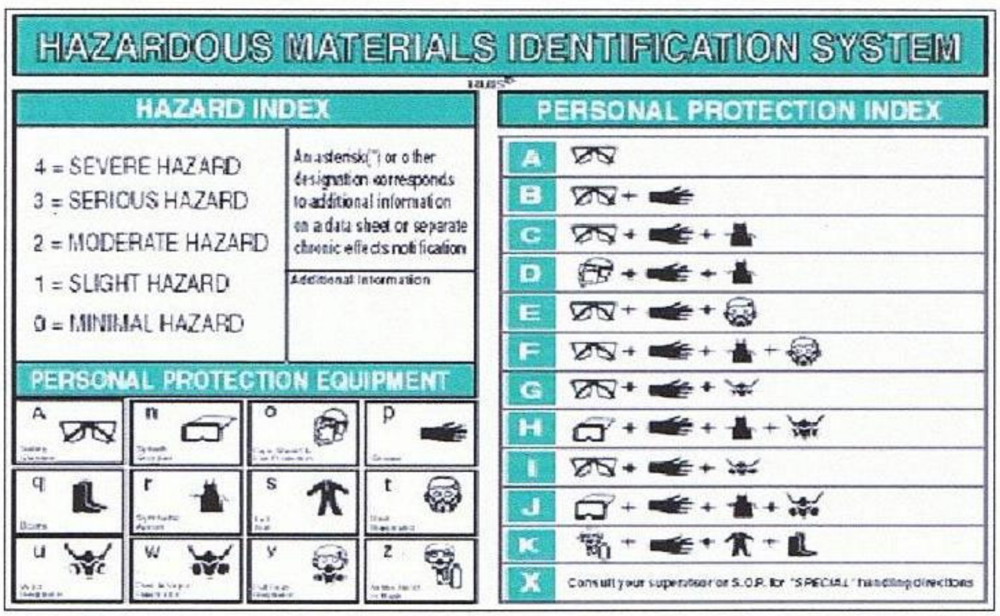
Test data already generated for the classification of chemicals under existing systems should be accepted when classifying these chemicals under the GHS, thereby avoiding duplicative testing and the unnecessary use of test animals. The GHS physical hazard criteria are linked to specific test methods. It is assumed that mixtures will be tested for physical hazards.

Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency

Figure 3.5 GHS Mixtures

Hazard Endpoint	Classification Approach	Bridging Principles Comments	
Acute toxicity	Acute Toxicity Estimate (ATE): 2 formulas	All	Conversion values, relevant components usually at ³ 1%
Serious Eye Damage & Eye Irritation	Mostly additivity approach, sometimes cutoffs	All	Relevant components usually at ³ 1%, exceptions for certain chemical classes
Skin corrosion & Skin Irritation	Mostly additivity approach, sometimes cutoffs	All	Relevant components usually at ³ 1%, exceptions for certain chemical classes
Skin Sensitization	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures, Aerosols	
Respiratory Sensitization	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures, Aerosols	
Germ Cell Mutagenicity	Cutoffs	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by case
Carcinogenicity	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by-case
Reproductive Toxicity	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by-case
Target Organ Systemic Toxicity	Cutoffs with CA options	All	
Aspiration Toxicity	Cutoffs	Dilution, Batching, Concentration of highly toxic mixtures, Interpolation within one toxicity category, Substantially similar mixtures	
Hazardous to the Aquatic Environment	Additivity Formula (Acute only); Summation Method (Acute or Chronic); Combination of Additivity Formula & Summation Method	Dilution, Batching, Concentration of highly toxic mixtures, Interpolation within one toxicity category, Substantially similar mixtures	Relevant components usually at ³ 1%, Mixture test data only case-by-case for chronic

HEALTH	
FLAMMABILITY	
REACTIVITY	
PERSONAL PROTECTION	



HAZARDOUS MATERIAL INFORMATION SYSTEM

4.0 Hazard Communication Intrinsic Hazards

Section 3, explained that classification is the starting point for the GHS. Once a chemical has been classified, the hazard(s) must be communicated to target audiences. As in existing systems, labels and Safety Data Sheets are the main tools for chemical hazard communication. They identify the hazardous properties of chemicals that may pose a health, physical or environmental hazard during normal handling or use. The goal of the GHS is to identify the intrinsic hazards found in chemical substances and mixtures, and to convey information about these hazards.

The international mandate for the GHS included the development of a harmonized hazard communication system, including labeling, Safety Data Sheets and easily understandable symbols, based on the classification criteria developed for the GHS.

4.1 What factors influenced development of the GHS communication tools?
Early in the process of developing the GHS communication tools, several significant issues were recognized. One of the most important was comprehensibility of the information provided. After all, the aim of the system is to present hazard information in a manner that the intended audience can easily understand and that will thus minimize the possibility of adverse effects resulting from exposure. The GHS identifies some guiding principles to assist in this process:

- Information should be conveyed in more than one way, e.g., text and symbols;
- The comprehensibility of the components of the system should take account of existing studies and literature as well as any evidence gained from testing;
- The phrases used to indicate degree (severity) of hazard should be consistent across the health, physical and environmental hazards.

Comprehensibility is challenging for a single culture and language. Global harmonization has numerous complexities. Some factors that affected the work include:

- Different philosophies in existing systems on how and what should be communicated;
- Language differences around the world;
- Ability to translate phrases meaningfully;
- Ability to understand and appropriately respond to symbols/pictograms.

These factors were considered in developing the GHS communication tools. The GHS Purple Book includes a comprehensibility-testing instrument in Annex 6.

EACH PESTICIDE HANDLER EMPLOYEE MUST HAVE AN UNDERSTANDING OF THE FOLLOWING SUBJECT AREAS TO SAFELY USE AND HANDLE PESTICIDES:
PESTICIDE PRODUCT LABELING - Format and meaning of information, such as the precautionary statements concerning human health hazards.
HAZARDS OF PESTICIDES - These are identified in product labeling, Safety Data Sheets (SDS), or PSIS Leaflet (Pesticide Safety Information Series).
PESTICIDE SAFETY REQUIREMENTS AND PROCEDURES - This in regards to regulation, PSIS Leaflets, SDS, Including Engineering Controls, for handling, transporting, storing and disposal of Pesticides.
ENVIRONMENTAL CONCERNS - This addressess the aspect of drift, runoff, and the hazards to Wildlife.
ROUTES OF ENTRY - This area addressess the hazards of which Pesticides can enter the body: Dermal (skin) , Oral (swallowed), Inhalation (breathe in), Ocular (through the eyes).
COMMON SIGNS AND SYMPTOM OF EXPOSURE - Some of the basic symptoms include: Headache, fatigue, weakness, nervousness, nausea, perspiration, eye and skin irritation.
EMERGENCY FIRST AID - Know and understand the basic procedures necessary for first aid concerning exposure to pesticides. This may include basic CPR.
USE AND CARE OF PERSONAL PROTECTIVE EQUIPMENT - Each employee who handles or may have the chance of being exposed to pesticides must have required Personal Protective Equipment available, and each employee must know and understand the proper use and care of this equipment.
THE ITEMS LISTED ABOVE ARE JUST BASICS REQUIRED TO SAFELY HANDLE PESTICIDES

0 - 4 Hours	4 - 12 Hours	12 - 24 Hours	24 + Hours
DO NOT ENTER	EARLY RE-ENTRY BY A CERTIFIED FARMER	EARLY RE-ENTRY BY WORKERS	ALL ENTRY
- THE END OF THE APPLICATION IS THE START OF THE 24-Hour RESTRICTED ENTRY INTERVAL - NO ONE MAY ENTER THE TREATED AREA	- MUST NOT DO ANY LABOR TASKS - MUST ONLY BE THE AREA FOR LESS THAN 24 - Hours - MUST WEAR THE PROTECTIVE CLOTHING AND PPE STATED ON THE LABEL FOR MIXING PLUS WEAR: NIOSH-APPROVED RESPIRATOR	- MUST NOT DO ANY LABOR TASKS - CANNOT CONTACT ANY SURFACES THAT MAY HAVE RESIDUES - MUST WEAR THE PROTECTIVE CLOTHING AND PPE ITEMS IF THEY ARE STATED ON THE LABEL FOR EARLY RE-ENTRY	- END OF REI ONLY ON A LABEL WITH A RE-ENTRY FROM 24 Hours TO SEVERAL DAYS - EVERYONE MAY ENTER

EXAMPLE OF AN REI (Restricted Entry Interval) FROM A PESTICIDE LABEL

4.2 Labels

4.2.1 What does a label look like?
Existing systems have labels that look different for the same product. We know that this leads to worker confusion, consumer uncertainty and the need for additional resources to maintain different systems. In the U.S. as well as in other countries, chemical products are regulated by sector/target audience. Different agencies regulate the workplace, consumers, agricultural chemicals and transport. Labels for these sectors/target audiences vary both in the U.S. and globally.

In order to understand the value of the GHS and its benefits to all stakeholders, it is instructive to look at the different labels for one fictional product. In the U.S. the product, ToxiFlam, which has a flash point of 120°F and has an oral LD50 of 275 mg/kg, has different labels for different sectors/target audiences. Label examples as seen in the U.S.A. are shown first, followed by international examples.

4.2.2 USA Examples:
Workplace and Workers
In the U.S., regulatory requirements for workplace labels are 'performance oriented'. This results at a minimum in a straightforward label that has a product identity, hazard statement and supplier identification (Figure 4.1). Some products can also have additional labeling requirements depending on their end use.

Figure 4.1
ToxiFlam
TOXIC
COMBUSTIBLE LIQUID AND
VAPOR

My Company, My Street, MyTown NJ
00000
Tel. 444 999 9999

However, many companies follow the voluntary ANSI Z129.1 Precautionary Labeling Standard for workplace labeling and often use it also for labeling consumer products. The American National Standards Institute (ANSI) standard includes several label elements that are core to the GHS as well as other helpful elements to assist users in safe handling (Figure 4.2).

Figure 4.2
ToxiFlam (Contains XYZ)

WARNING! HARMFUL IF SWALLOWED, FLAMMABLE LIQUID AND VAPOR

Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID: If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.
In case of Fire, use water fog, dry chemical, CO_2, or alcohol foam. Water may be ineffective.

Flash Point = 120°F. Residue vapor may explode or ignite on ignition; do not cut, drill, grind, or weld on or near the container.

See Material Safety Data Sheet for further details regarding safe use of this product.

My Company, My Street, MyTown NJ 00000 Tel. 444 999 9999

Consumer Products and Consumers

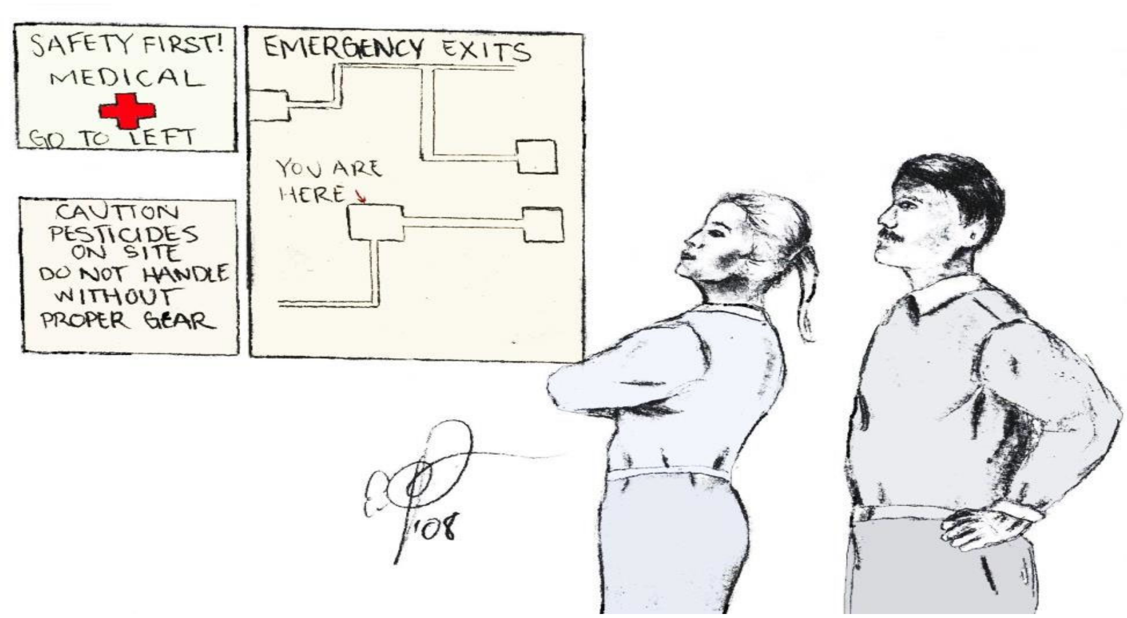
Figure 4.3
ToxiFlam
(Contains XYZ)

WARNING! HARMFUL IF SWALLOWED, FLAMMABLE LIQUID AND VAPOR
Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID
If swallowed, do NOT induce vomiting unless directed to do so by medical personnel.
Never give anything by mouth to an unconscious person.
Keep out of reach of children

My Company, My Street, MyTown NJ 00000 Tel. 444 999 9999

In several countries consumer products are regulated separately from workplace chemicals. In the U.S. the CPSC regulates consumer products. Consumer products have required label elements, but only the signal words are specified. The ANSI labeling standard is often used in developing consumer labels.



UNSTABLE EXPLOSIVES

FLAMMABLE

OXIDIZER

COMPRESSED GAS

CORROSIVE

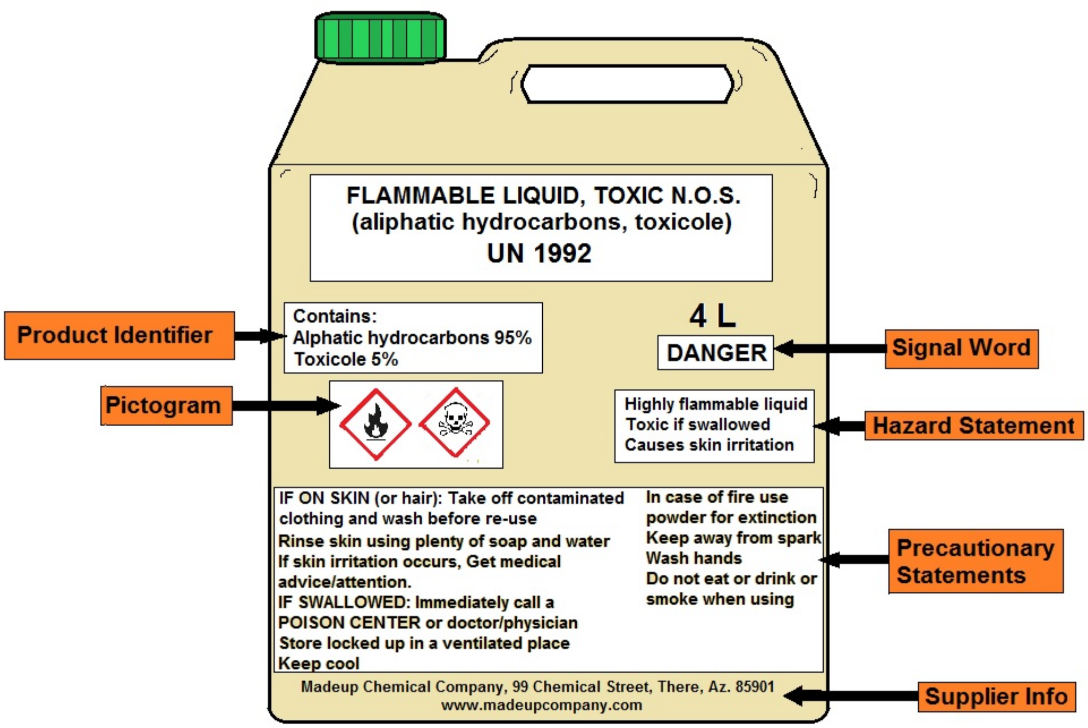
ACUTE TOXICITY

ACUTE TOXICITY
(skin & eye irritant)

HUMAN HEALTH HAZARD

ACUTE/CHRONIC HAZARDS

GLOBALLY HARMONIZED SYSTEM CLASSIFCATION LABELS



PESTICIDE LABEL DIAGRAM

Transport and Emergency Responders

For hazardous products being transported, outer containers have required label elements, product identifier and hazard symbols. Transportation requirements are in addition to workplace or end use label requirements.

Figure 4.4
Flammable liquids, toxic, n.o.s. (contains XYZ)
UN 1992

My Company, My Street NJ 00000

Agricultural Chemicals and Pesticides
In many systems, agricultural chemicals often have special label requirements. In the U.S. the EPA is the agency covering these chemicals. A pesticide product with the same hazards as ToxiFlam would have a label developed using FIFRA requirements. FIFRA has requirements for product identity, chemical identity, signal word, hazard statements, and precautionary measures including first aid.

Figure 4.5
ToxiFlam
Active/ Inerts: Contains XYZ %

KEEP OUT OF THE REACH OF CHILDREN
PRECAUTIONARY STATEMENTS - HAZARDS TO HUMANS AND DOMESTIC ANIMALS:
WARNING: May be fatal if swallowed. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco.

PHYSICAL AND CHEMICAL HAZARDS: Combustible. Do not use or store near heat or open flame.

FIRST AID:
If swallowed
- Call a poison control center or doctor immediately for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not induce vomiting unless told to do so by a poison control center or doctor.
- Do not give anything by mouth to an unconscious person.

My Company, My Street, My Town AZ 00000, Tel: 444 999 9999

EPA Est . No. 5840-AZ-1 EPA Reg. No. 3120-280

4.2.3 International Examples

All the previous examples are specific to the U.S. Many companies do business globally. So in addition to the U.S. regulations, these companies would need to comply with the corresponding regulations in the countries to which they export products. Canada and the EU are two existing systems that were considered in the development of the GHS. To illustrate the differences in labeling, it is interesting to examine an EU and Canadian label for ToxiFlam.

European Union Label

Labels in the EU have chemical identity, symbols, and R/S (Risk and Safety) phrases which are hazard statements, precautionary measures and first aid.

Figure 4.6
ToxiFlam (contains XYZ)

KEEP OUT OF THE REACH OF CHILDREN

Harmful If Swallowed. (R22)
Flammable. (R10)
Keep away from food, drink and animal feeding stuffs. (S13)
Wear suitable protective clothing. (S36)
If swallowed, seek medical advice immediately and show this
Container label. (S46)
In case of fire, use water, fog, CO2, or alcohol foam. (S43)

My Company, My Street, MyTown XX 00000, Tel: 44 22 999 9999

Canadian Workplace Hazardous Materials Identification System (WHMIS) Label

The WHMIS label requires product identifier, hazard symbol, hazard statement, precautionary measures, first aid, MSDS statement and supplier identification. In addition to these common label elements, WHMIS requires a hatched border.

Figure 4.7
ToxiFlam

TOXIC
COMBUSTIBLE LIQUID AND VAPOR

Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID

If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.

See Material Safety Data Sheet for further details regarding safe use of this product.
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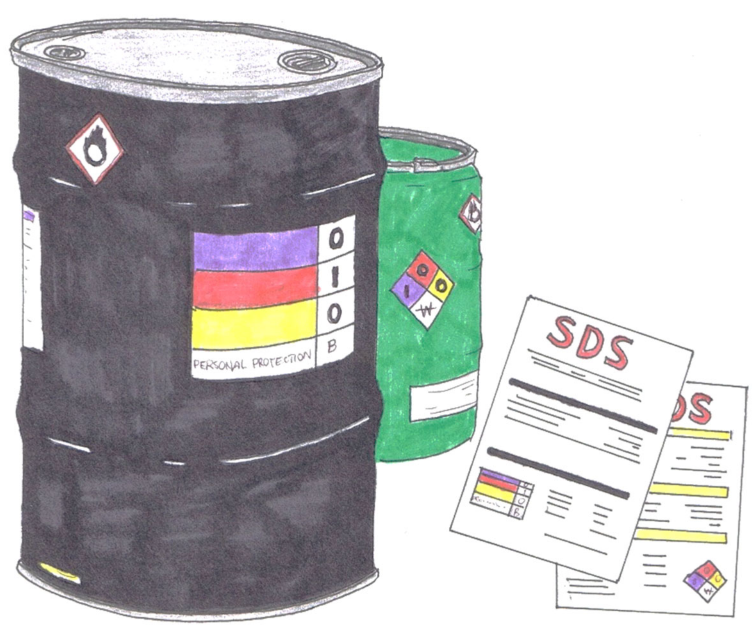
4.3 What are the GHS Label Elements?

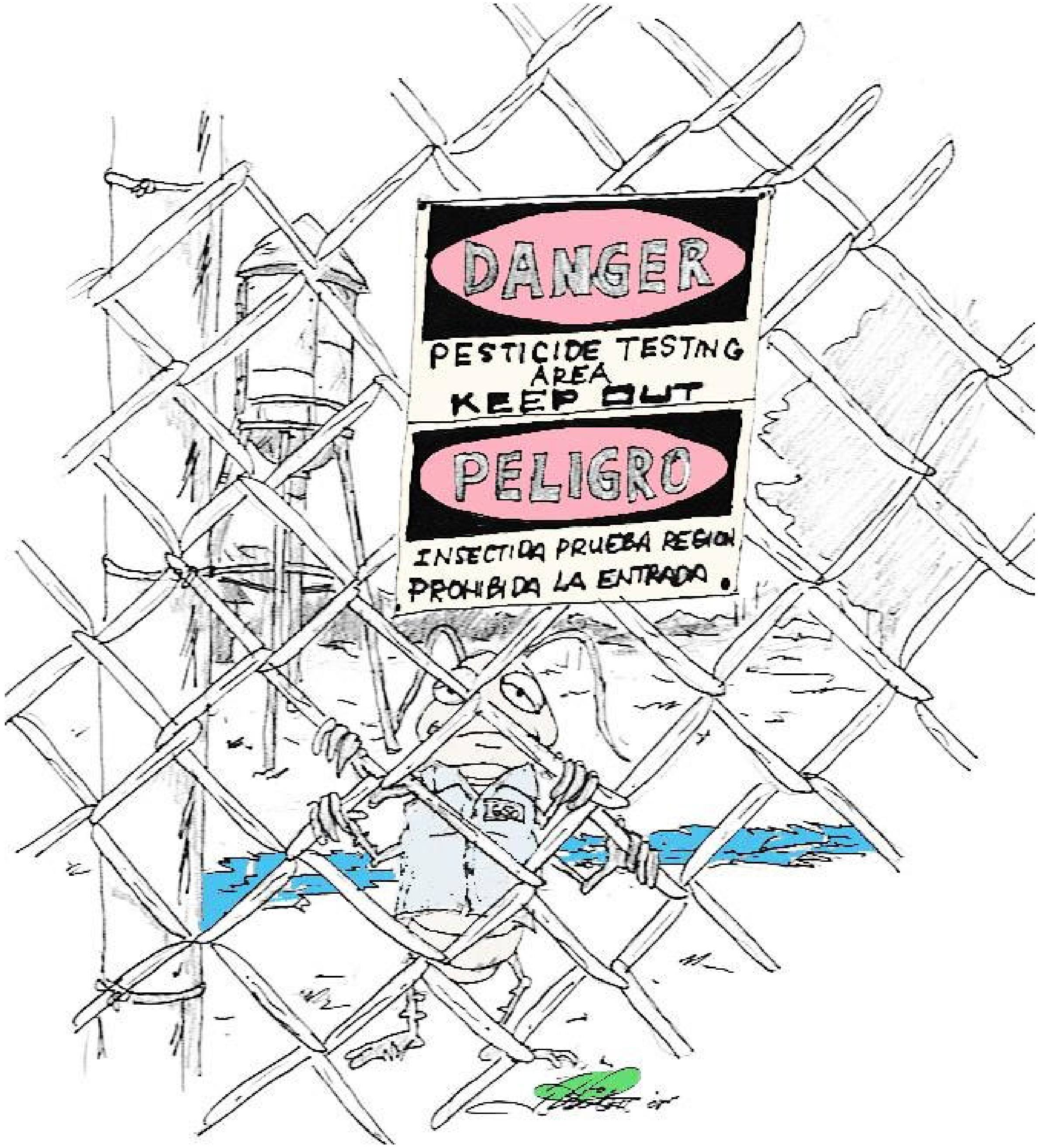
Some GHS label elements have been standardized (identical with no variation) and are directly related to the endpoints and hazard level. Other label elements are harmonized with common definitions and/or principles. See Figure 4.8 for an illustration of the GHS label elements.

The standardized label elements included in the GHS are:

- **Symbols (hazard pictograms)**: Convey health, physical and environmental hazard information, assigned to a GHS hazard class and category.
- **Signal Words:** "Danger" or "Warning" are used to emphasize hazards and indicate the relative level of severity of the hazard, assigned to a GHS hazard class and category.
- **Hazard Statements:** Standard phrases assigned to a hazard class and category that describe the nature of the hazard.

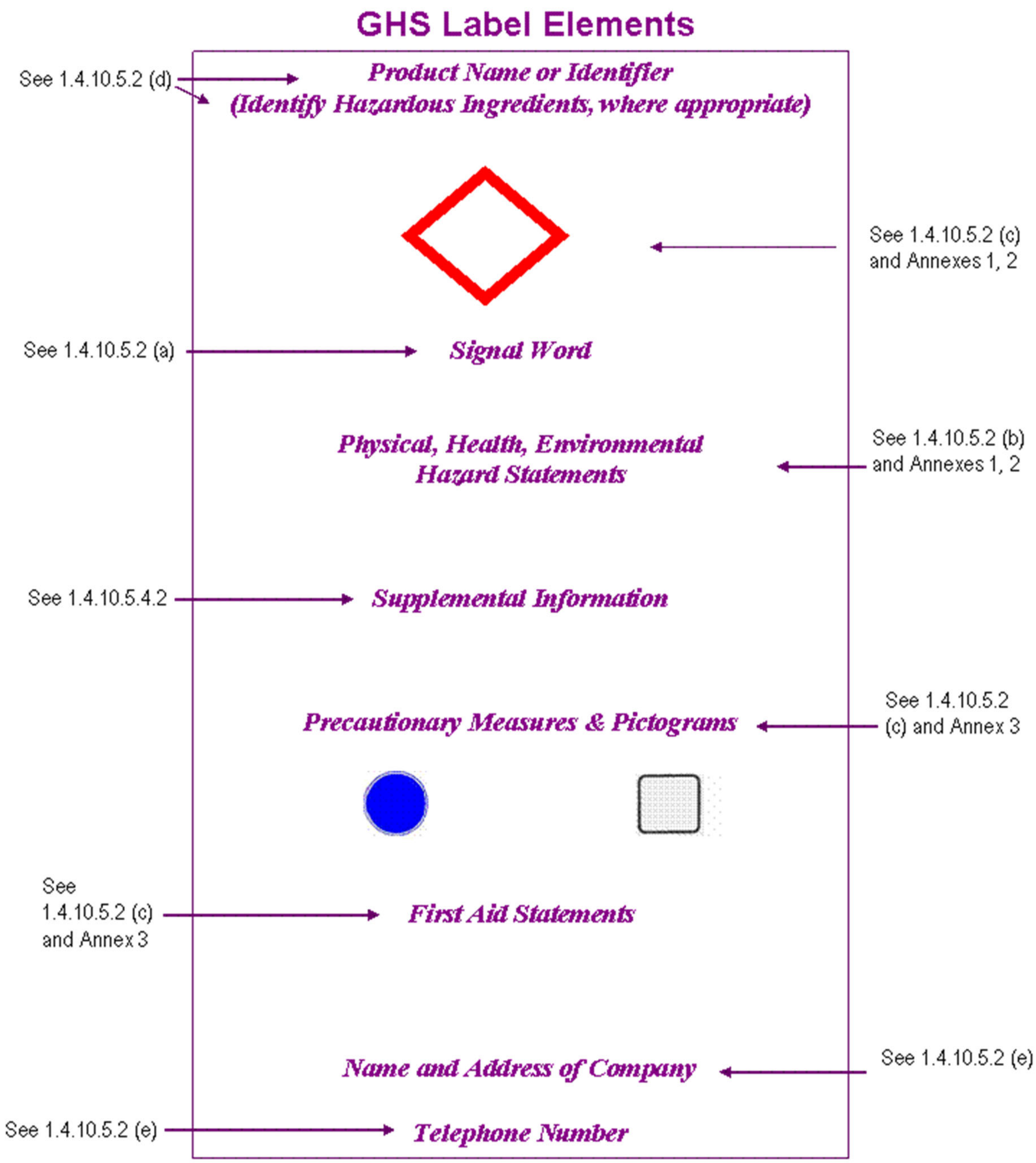
The symbols, signal words, and hazard statements have all been standardized and assigned to specific hazard categories and classes, as appropriate. This approach makes it easier for countries to implement the system and should make it easier for companies to comply with regulations based on the GHS. The prescribed symbols, signal words, and hazard statements can be readily selected from Annex 1 of the GHS Purple Book. These standardized elements are not subject to variation, and should appear on the GHS label as indicated in the GHS for each hazard category/class in the system. The use of symbols, signal words or hazard statements other than those that have been assigned to each of the GHS hazards would be contrary to harmonization.





Reproductive Toxin: Any agent that has a harmful effect on the adult male or female reproductive system or a developing fetus or child. Such hazards have a variety of effects on people, including loss of sexual drive, mental disorders, impotence, infertility, sterility, mutagenic effects on germ cells, teratogenic effects on a fetus, and transplacental carcinogenesis.

Figure 4.8



The Section numbers refer to the sections in the GHS Document or "Purple Book".

4.3.1 Symbols/Pictograms

The GHS symbols have been incorporated into pictograms for use on the GHS label. Pictograms include the harmonized hazard symbols plus other graphic elements, such as borders, background patterns or colors which are intended to convey specific information. For transport, pictograms (Table 4.10) will have the background, symbol and colors currently used in the UN Recommendations on the Transport of Dangerous Goods, Model Regulations.

For other sectors, pictograms (Table 4.9) will have a black symbol on a white background with a red diamond frame. A black frame may be used for shipments within one country. Where a transport pictogram appears, the GHS pictogram for the same hazard should not appear.

4.3.2 Signal Words

The signal word indicates the relative degree of severity a hazard. The signal words used in the GHS are

"Danger" for the more severe hazards, and **"Warning"** for the less severe hazards.

Signal words are standardized and assigned to the hazard categories within endpoints. Some lower level hazard categories do not use signal words. Only one signal word corresponding to the class of the most severe hazard should be used on a label.

4.3.3 Hazard Statements

Hazard statements are standardized and assigned phrases that describe the hazard(s) as determined by hazard classification. An appropriate statement for each GHS hazard should be included on the label for products possessing more than one hazard. The assigned label elements are provided in each hazard chapter of the Purple Book as well as in Annexes 1 & 2. Figure 4-11 illustrates the assignment of standardized GHS label elements for the acute oral toxicity categories.

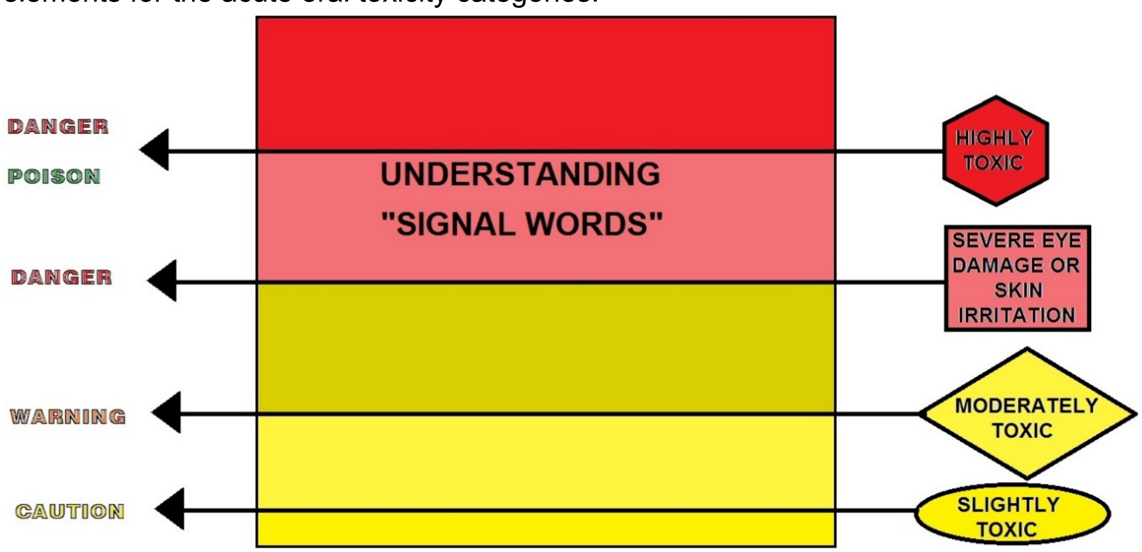


Figure 4.9

GHS Pictograms and Hazard Classes		
		
▪ Oxidizers	▪ Flammables ▪ Self Reactives ▪ Pyrophorics ▪ Self-Heating ▪ Emits Flammable Gas ▪ Organic Peroxides	▪ Explosives ▪ Self Reactives ▪ Organic Peroxides
		
▪ Acute toxicity (severe)	▪ Corrosives	▪ Gases Under Pressure
		
▪ Carcinogen ▪ Respiratory Sensitizer ▪ Reproductive Toxicity	▪ Environmental Toxicity	▪ Irritant ▪ Dermal Sensitizer ▪ Acute toxicity (harmful)

▪ Target Organ Toxicity ▪ Mutagenicity ▪ Aspiration Toxicity		▪ Narcotic Effects ▪ Respiratory Tract ▪ Irritation

ALWAYS WEAR PPE WHEN HANDLING PESTICIDES

The Hazard Communication Standard requires employees to understand chemical hazards, labels, and SDSs and to use them on the job. Before starting jobs involving possible exposure to hazardous substances, employees must read SDSs to know what they're working with and procedures for safe handling.

Figure 4.10

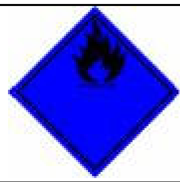
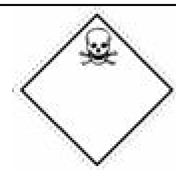
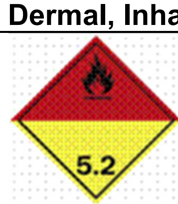
Transport "Pictograms"		
		
Flammable Liquid Flammable Gas Flammable Aerosol	Flammable solid Self-Reactive Substances	Pyrophorics (Spontaneously Combustible) Self-Heating Substances
		
Substances, which in contact with water, emit flammable gases (Dangerous When Wet)	Oxidizing Gases Oxidizing Liquids Oxidizing Solids	Explosive Divisions 1.1, 1.2, 1.3
		
Explosive Division 1.4	Explosive Division 1.5	Explosive Division 1.6
		
Compressed Gases	Acute Toxicity (Poison): Oral, Dermal, Inhalation	Corrosive
		
Marine Pollutant	Organic Peroxides	

Figure 4.11

ACUTE ORAL TOXICITY - Annex 1					
	Category 1	**Category 2**	**Category 3**	**Category 4**	**Category 5**
LD_{50}	less 5 mg/kg	> 5 < 50 mg/kg	³ 50 < 300 mg/kg	³ 300 < 2000 mg/kg	³ 2000 < 5000 mg/kg
Pictogram					No symbol
Signal word	Danger	Danger	Danger	Warning	Warning
Hazard statement	Fatal if swallowed	Fatal if swallowed	Toxic if swallowed	Harmful if swallowed	May be harmful if swallowed

Other GHS label elements include:

- **Precautionary Statements and Pictograms:** Measures to minimize or prevent adverse effects.
- **Product Identifier (ingredient disclosure):** Name or number used for a hazardous product on a label or in the SDS.
- **Supplier identification:** The name, address and telephone number should be provided on the label.
- **Supplemental information:** non-harmonized information.

4.3.4 Precautionary Statements and Pictograms

Precautionary information supplements the hazard information by briefly providing measures to be taken to minimize or prevent adverse effects from physical, health or environmental hazards. First aid is included in precautionary information. The GHS label should include appropriate precautionary information. Annex 3 of the GHS Purple Book includes precautionary statements and pictograms that can be used on labels.

Annex 3 includes four types of precautionary statements covering: prevention, response in cases of accidental spillage or exposure, storage, and disposal. The precautionary statements have been linked to each GHS hazard statement and type of hazard. The goal is to promote consistent use of precautionary statements. Annex 3 is guidance and is expected to be further refined and developed over time.

4.3.5 Product Identifier (Ingredient Disclosure)

A product identifier should be used on a GHS label and it should match the product identifier used on the SDS. Where a substance or mixture is covered by the UN Model Regulations on the Transport of Dangerous Goods, the UN proper shipping name should also be used on the package.

The GHS label for a substance should include the chemical identity of the substance (name as determined by IUPAC, ISO, CAS or technical name). For mixtures/alloys, the label should include the chemical identities of all ingredients that contribute to acute toxicity, skin corrosion or serious eye damage, germ cell mutagenicity, carcinogenicity, reproductive toxicity, skin or respiratory sensitization, or Target Organ Systemic Toxicity (TOST), when these hazards appear on the label. Where a product is supplied exclusively for workplace use, the Competent Authority may give suppliers discretion to include chemical identities on the SDS, in lieu of including them on labels. The Competent Authority rules for confidential business information (CBI) take priority over the rules for product identification.

4.3.6 Supplier Identification
The name, address and telephone number of the manufacturer or supplier of the product should be provided on the label.

4.3.7 Supplemental Information
Supplemental label information is non-harmonized information on the container of a hazardous product that is not required or specified under the GHS. In some cases this information may be required by a Competent Authority or it may be additional information provided at the discretion of the manufacturer/distributor. The GHS provides guidance to ensure that supplemental information does not lead to wide variation in information or undermine the GHS information. Supplemental information may be used to provide further detail that does not contradict or cast doubt on the validity of the standardized hazard information. It also may be used to provide information about hazards not yet incorporated into the GHS. The labeler should have the option of providing supplementary information related to the hazard, such as physical state or route of exposure, with the hazard statement.

4.4 How are multiple hazards handled on labels?
Where a substance or mixture presents more than one GHS hazard, there is a GHS precedence scheme for pictograms and signal words. For substances and mixtures covered by the UN Recommendations on the Transport of Dangerous Goods, Model Regulations, the precedence of symbols for physical hazards should follow the rules of the UN Model Regulations. For health hazards the following principles of precedence apply for symbols:

(a) if the skull and crossbones applies, the exclamation mark should not appear;
(b) if the corrosive symbol applies, the exclamation mark should not appear where it is used for skin or eye irritation;
(c) if the health hazard symbol appears for respiratory sensitization, the exclamation mark should not appear where it is used for skin sensitization or for skin or eye irritation.

If the signal word 'Danger' applies, the signal word 'Warning' should not appear. All assigned hazard statements should appear on the label. The Competent Authority may choose to specify the order in which they appear.

4.5 Is there a specific GHS label format / layout?
The GHS hazard pictograms, signal word and hazard statements should be located together on the label. The actual label format or layout is not specified in the GHS. National authorities may choose to specify where information should appear on the label or allow supplier discretion.

Figure 4.12 shows an example of a GHS label for the fictional product 'ToxiFlam'. The core GHS label elements are expected to replace the need for the array of different labels shown earlier for ToxiFlam. (Figure 4.8 also illustrates the GHS label elements.)

Figure 4.12 Example GHS Inner Container Label (e.g., bottle inside a shipping box)

ToxiFlam (Contains: XYZ)

Danger! Toxic If Swallowed, Flammable Liquid and Vapor

Do not eat, drink or use tobacco when using this product. Wash hands thoroughly after handling. Keep container tightly closed. Keep away from heat/sparks/open flame. - No smoking. Wear protective gloves and eye/face protection. Ground container and receiving equipment. Use explosion-proof electrical equipment. Take precautionary measures against static discharge.

Use only non-sparking tools. Store in cool/well-ventilated place.

IF SWALLOWED: Immediately call a POISON CONTROL CENTER or doctor/physician. Rinse mouth.

In case of fire, use water fog, dry chemical, CO_2, or "alcohol" foam.

See Material Safety Data Sheet for further details regarding safe use of this product.

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There has been discussion about the size of GHS pictograms and that a GHS pictogram might be confused with a transport pictogram or "diamond". Transport pictograms (Table 4.10) are different in appearance than the GHS pictograms (Table 4.9). Annex 7 of the Purple Book explains how the GHS pictograms are expected to be proportional to the size of the label text. So that generally the GHS pictograms would be smaller than the transport pictograms.

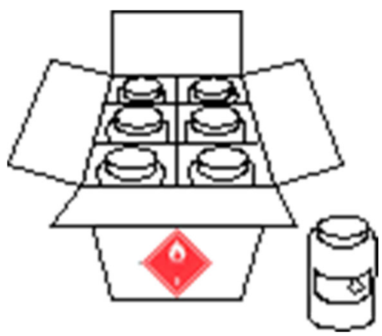

Figure 4.13 Combination Packaging (Outer box with inner bottles)

Several arrangements for GHS labels are also provided in Annex 7 of the Purple Book. Figure 4.13 shows an arrangement for a combination packaging with an outer shipping box and inner bottles. The shipping box has a transportation pictogram. The inner bottles have a GHS label with a GHS pictogram.

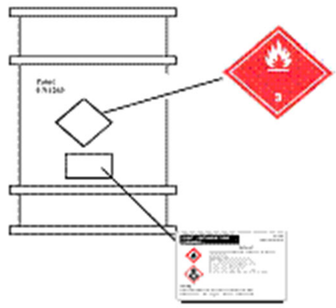

Figure 4.14 Combination Packaging (Outer box with inner bottles)

For a container such as a 55 gallon drum, the transport required markings and pictograms may be combined with the GHS label elements or presented separately. In Figure 4.14 a label arrangement for a single packaging such as a 55 gallon drum is shown. Pictograms and markings required by the transport regulations as well as GHS label and non-duplicative GHS pictogram are shown on the drum.

A label merging the transportation requirements and the GHS requirements into one label for the fictional product "ToxiFlam" is shown in Figure 4.15. This combined type label could also be used on a 55 gallon drum.

Figure 4.15 Example GHS Outer Container Label (55 gallon/200 liter drum)

ToxiFlam

Danger! Toxic If Swallowed
Flammable Liquid and Vapor

Flammable liquids, toxic, n.o.s.
(contains XYZ)
UN 1992

Do not eat, drink or use tobacco when using this product. Wash hands thoroughly after handling. Keep container tightly closed. Keep away from heat/sparks/open flame. - No smoking. Wear protective gloves and eye/face protection. Ground container and receiving equipment. Use explosion-proof electrical equipment. Take precautionary measures against static discharge. Use only non-sparking tools. Store in cool/well-ventilated place

IF SWALLOWED: Immediately call a POISON CONTROL CENTER or doctor/physician. Rinse mouth.

In case of fire, use water fog, dry chemical, CO_2, or "alcohol" foam.

See Material Safety Data Sheet for further details regarding safe use of this product.

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4.6 What about risk?
Competent Authorities may vary the application of the components of the GHS by the type of product (industrial, pesticide, consumer, etc.) or the stage in the lifecycle (workplace, farm, retail store, etc.). Once a chemical is classified, the likelihood of adverse effects may be considered in deciding what informational or other steps should be taken for a given product or use setting. Annex 5 of the GHS Purple Book includes a discussion of an example of how risk-based labeling could be considered for chronic health effects of consumer products in the consumer use setting.

4.7 Are workplace containers covered in the GHS ?
Products falling within the scope of the GHS will carry the GHS label at the point where they are supplied to the workplace, and that label should be maintained on the supplied container in the workplace. The GHS label or label elements can also be used for workplace containers (e.g., storage tanks). However, the Competent Authority can allow employers to use alternative means of giving workers the same information in a different written or displayed format when such a format is more appropriate to the workplace and communicates the information as effectively as the GHS label. For example, label information could be displayed in the work area, rather than on the individual containers. Some examples of workplace situations where chemicals may be transferred from supplier containers include: containers for laboratory testing, storage vessels, piping or process reaction systems or temporary containers where the chemical will be used by one worker within a short timeframe.

4.8 What is the GHS Safety Data Sheet (SDS)?
The (Material) Safety Data Sheet (SDS) provides comprehensive information for use in workplace chemical management. Employers and workers use the SDS as sources of information about hazards and to obtain advice on safety precautions. The SDS is product related and, usually, is not able to provide information that is specific for any given workplace where the product may be used. However, the SDS information enables the employer to develop an active program of worker protection measures, including training, which is specific to the individual workplace and to consider any measures that may be necessary to protect the environment. Information in a SDS also provides a source of information for other target audiences such as those involved with the transport of dangerous goods, emergency responders, poison centers, those involved with the professional use of pesticides and consumers.

The SDS should contain 16 headings (Figure 4.14). The GHS MSDS headings, sequence and content are similar to the ISO, EU and ANSI MSDS/SDS requirements, except that the order of sections 2 and 3 have been reversed. The SDS should provide a clear description of the data used to identify the hazards. Figure 4.14 and the GHS Purple Book provide the minimum information that is required in each section of the SDS. Examples of draft GHS SDSs are provided in Appendix B of this guidance document.

The revised Purple Book contains guidance on developing a GHS SDS (Annex 4). Other resources for SDSs include:

- ILO Standard under the Recommendation 177 on Safety in the Use of Chemicals at Work,

- International Standard 11014-1 (1994) of the International Standard Organization (ISO) and ISO Safety Data Sheet for Chemical Products 11014-1: 2003 DRAFT,

Figure 4.14

Minimum information for an SDS

1.	**Identification of the substance or mixture and of the supplier**	▪ GHS product identifier. ▪ Other means of identification. ▪ Recommended use of the chemical and restrictions on use. ▪ Supplier's details (including name, address, phone number, etc.). ▪ Emergency phone number.
2.	**Hazards identification**	▪ GHS classification of the substance/mixture and any national or regional information. ▪ GHS label elements, including precautionary statements. (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull and crossbones.) ▪ Other hazards which do not result in classification (e.g., dust explosion hazard) or are not covered by the GHS.
3.	**Composition/information on ingredients**	**Substance** ▪ Chemical identity. ▪ Common name, synonyms, etc. ▪ CAS number, EC number, etc. ▪ Impurities and stabilizing additives which are themselves classified and which contribute to the classification of the substance. **Mixture** ▪ The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present above their cutoff levels. ***NOTE**: For information on ingredients, the competent authority rules for CBI take priority over the rules for product identification.*
4.	**First aid measures**	▪ Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion. ▪ Most important symptoms/effects, acute and delayed. ▪ Indication of immediate medical attention and special treatment needed, if necessary.
5.	**Firefighting measures**	▪ Suitable (and unsuitable) extinguishing media. ▪ Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products). ▪ Special protective equipment and precautions for firefighters.
6.	**Accidental release measures**	▪ Personal precautions, protective equipment and emergency procedures.

		▪ Environmental precautions. ▪ Methods and materials for containment and cleaning up.
7.	**Handling and storage**	▪ Precautions for safe handling. ▪ Conditions for safe storage, including any incompatibilities.
8.	**Exposure controls/personal protection**.	▪ Control parameters, e.g., occupational exposure limit values or biological limit values. ▪ Appropriate engineering controls. ▪ Individual protection measures, such as personal protective equipment.
9.	**Physical and chemical properties**	▪ Appearance (physical state, color, etc.). ▪ Odor. ▪ Odor threshold. ▪ pH. ▪ melting point/freezing point. ▪ initial boiling point and boiling range. ▪ flash point. ▪ evaporation rate. ▪ flammability (solid, gas). ▪ upper/lower flammability or explosive limits. ▪ vapor pressure. ▪ vapor density. ▪ relative density. ▪ solubility(ies). ▪ partition coefficient: n-octanol/water. ▪ autoignition temperature. ▪ decomposition temperature.
10.	**Stability and reactivity**	▪ Chemical stability. ▪ Possibility of hazardous reactions. ▪ Conditions to avoid (e.g., static discharge, shock or vibration). ▪ Incompatible materials.

		▪ Hazardous decomposition products.
11.	**Toxicological information**	Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including: ▪ information on the likely routes of exposure (inhalation, ingestion, skin and eye contact); ▪ Symptoms related to the physical, chemical and toxicological characteristics; ▪ Delayed and immediate effects and also chronic effects from short- and long-term exposure; ▪ Numerical measures of toxicity (such as acute toxicity estimates).
12.	**Ecological information**	▪ Ecotoxicity (aquatic and terrestrial, where available). ▪ Persistence and degradability. ▪ Bioaccumulative potential. ▪ Mobility in soil. ▪ Other adverse effects.
13.	**Disposal considerations**	▪ Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.
14.	**Transport information**	▪ UN Number. ▪ UN Proper shipping name. ▪ Transport Hazard class(es). ▪ Packing group, if applicable. ▪ Marine pollutant (Yes/No). ▪ Special precautions which a user needs to be aware of or needs to comply with in connection with transport or conveyance either within or outside their premises.
15.	**Regulatory information**	▪ Safety, health and environmental regulations specific for the product in question.
16.	**Other information including information on preparation and revision of the SDS**	

4.9 What is the difference between the GHS SDS and existing MSDSs/SDSs?

SDSs are in use globally. So it is useful to have an understanding of the similarities and differences in the existing MSDS/SDS content and format and the GHS SDS content and format. A table comparing MSDS/SDS content/format is provided in Appendix A of this guidance document.

4.10 When should SDSs and labels be updated?
All hazard communication systems should specify a means of responding in an appropriate and timely manner to new information and updating labels and SDS information accordingly. Updating should be carried out promptly on receipt of the information that necessitates the revision. The Competent Authority may choose to specify a time limit within which the information should be revised.

Suppliers should respond to "new and significant" information they receive about a chemical hazard by updating the label and safety data sheet for that chemical. New and significant information is any information that changes the GHS classification and leads to a change in the label information or information that may affect the SDS.

4.11 How does the GHS address Confidential Business Information (CBI)?
Confidential business information (CBI) will not be harmonized under the GHS. National authorities should establish appropriate mechanisms for CBI protection. The GHS established CBI principles which include:

- CBI provisions should not compromise the health and safety of users;
- CBI claims should be limited to the names of chemicals and their concentrations in mixtures;
- Mechanisms should be established for disclosure in emergency and non-emergency situations.

4.12 Does the GHS address training?
The GHS states in Chapter 1.4, Section1.4.9, the importance of training all target audiences to recognize and interpret label and/or SDS information, and to take appropriate action in response to chemical hazards.

Training requirements should be appropriate for and commensurate with the nature of the work or exposure.

Key target audiences include workers, emergency responders and also those responsible for developing labels and SDSs. To varying degrees, the training needs of additional target audiences have to be addressed. These should include training for persons involved in transport and strategies required for educating consumers in interpreting label information on products that they use.

How will labels change under the revised Hazard Communication Standard?

Under the current Hazard Communication Standard (HCS), the label preparer must provide the identity of the chemical, and the appropriate hazard warnings. This may be done in a variety of ways, and the method to convey the information is left to the preparer. Under the revised HCS, once the hazard classification is completed, the standard specifies what information is to be provided for each hazard class and category.

Labels will require the following elements:

- **Pictogram:** a symbol plus other graphic elements, such as a border, background pattern, or color that is intended to convey specific information about the hazards of a chemical. Each pictogram consists of a different symbol on a white background within a red square frame set on a point (i.e. a red diamond). There are nine pictograms under the GHS. However, only eight pictograms are required under the HCS.

- **Signal words:** a single word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The signal words used are "danger" and "warning." "Danger" is used for the more severe hazards, while "warning" is used for less severe hazards.

- **Hazard Statement:** a statement assigned to a hazard class and category that describes the nature of the hazard(s) of a chemical, including, where appropriate, the degree of hazard.

- **Precautionary Statement:** a phrase that describes recommended measures to be taken to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, or improper storage or handling of a hazardous chemical.

What pictograms are required in the revised Hazard Communication Standard? What hazard does each identify?
There are nine pictograms under the GHS to convey the health, physical and environmental hazards. The final Hazard Communication Standard (HCS) requires eight of these pictograms, the exception being the environmental pictogram, as environmental hazards are not within OSHA's jurisdiction.

HCS Pictograms and Hazards

Health Hazard	Flame	Exclamation Mark
		
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non Mandatory)
Gas Cylinder	**Corrosion**	**Exploding Bomb**
		
• Gases under Pressure	• Skin Corrosion/ burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame over Circle	**Environment (Non Mandatory)**	**Skull and Crossbones**
		
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (fatal or toxic)

Can I use a black border on pictograms for domestic shipment?
Under the revised Hazard Communication Standard (HCS), pictograms must have red borders. OSHA believes that the use of the red frame will increase recognition and comprehensibility. Therefore, the red frame is required regardless of whether the shipment is domestic or international.

Will OSHA allow blank red borders?
The revised Hazard Communication Standard (HCS) requires that all red borders printed on the label have a symbol printed inside it. If OSHA were to allow blank red borders, workers may be confused about what they mean and concerned that some information is missing. OSHA has determined that prohibiting the use of blank red borders on labels is necessary to provide the maximum recognition and impact of warning labels and to ensure that users do not get desensitized to the warnings placed on labels.

When must label information be updated?
In the revised Hazard Communication Standard (HCS), OSHA is lifting the stay on enforcement regarding the provision to update labels when new information on hazards becomes available. Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within **six months** of becoming aware of the new information, and shall ensure that labels on containers of hazardous chemicals shipped after that time contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importer, distributor, or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

How will workplace labeling provisions be changing under the revised Hazard Communication Standard?
The current standard provides employers with flexibility regarding the type of system to be used in their workplaces and OSHA has retained that flexibility in the revised Hazard Communication Standard (HCS). Employers may choose to label workplace containers either with the same label that would be on shipped containers for the chemical under the revised rule, or with label alternatives that meet the requirements for the standard. Alternative labeling systems such as the National Fire Protection Association (NFPA) 704 Hazard Rating and the Hazardous Material Information System (HMIS) are permitted for workplace containers. However, the information supplied on these labels must be consistent with the revised HCS, e.g., no conflicting hazard warnings or pictograms.

How is the Safety Data Sheet (SDS) changing under the revised Hazard Communication Standard?
The information required on the safety data sheet (SDS) will remain essentially the same as that in the current standard. The current Hazard Communication Standard (HCS) indicates what information has to be included on an SDS but does not specify a format for presentation or order of information. The revised HCS requires that the information on the SDS is presented using consistent headings in a specified sequence.

Paragraph (g) of the final rule indicates the headings of information to be included on the SDS and the order in which they are to be provided. In addition, Appendix D indicates what information is to be included under each heading. The SDS format is the same as the ANSI standard format which is widely used in the U.S. and is already familiar to many employees.

The format of the 16-section SDS should include the following sections:

Section 1. Identification
Section 2. Hazard(s) identification
Section 3. Composition/information on ingredients
Section 4. First-Aid measures
Section 5. Fire-fighting measures
Section 6. Accidental release measures
Section 7. Handling and storage
Section 8. Exposure controls/personal protection
Section 9. Physical and chemical properties
Section 10. Stability and reactivity
Section 11. Toxicological information
Section 12. Ecological information
Section 13. Disposal considerations
Section 14. Transport information
Section 15. Regulatory information
Section 16. Other information, including date of preparation or last revision
Sections 12-15 may be included in the SDS, but are not required by OSHA.

Will TLVs be required on the Safety Data Sheet (SDS)?
OSHA is retaining the requirement to include the American Conference of Government Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) on the safety data sheet (SDS) in the revised Standard. OSHA finds that requiring TLVs on the SDS will provide employers and employees with useful information to help them assess the hazards presented by their workplaces. In addition to TLVs, OSHA permissible exposure limits (PELs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet are also required.

May the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) lists be used to make carcinogen classifications?
In the revised Hazard Communication Standard (HCS), OSHA has provided classifiers with the option of relying on the classification listings of IARC and NTP to make classification decisions regarding carcinogenicity, rather than applying the criteria themselves. OSHA believes that this will make classification easier for classifiers, as well as lead to greater consistency. In addition, OSHA has provided in non-mandatory Appendix F of the revised rule, guidance on hazard classification for carcinogenicity.

Part A of Appendix F includes background guidance provided by GHS based on the Preamble of the IARC "Monographs on the Evaluation of Carcinogenic Risks to Humans" (2006). Part B provides IARC classification information. Part C provides background guidance from the National NTP "Report on Carcinogens" (RoC), and Part D is a table that compares GHS carcinogen hazard categories to carcinogen classifications under IARC and NTP, allowing classifiers to be able to use information from IARC and NTP RoC carcinogen classifications to complete their classifications under the GHS, and thus the HCS.

Will the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) classifications be required on the Safety Data Sheet (SDS)?

OSHA has retained the requirement to include IARC and NTP classifications on safety data sheets (SDSs). Therefore, if a chemical is listed as a carcinogen by either IARC or NTP, it must be noted on the SDS. Additionally, if OSHA finds a chemical to be a carcinogen, it must be noted on the SDS as well.

How has OSHA addressed hazards covered under the current Hazard Communication Standard that have not been addressed by the GHS?

In the Notice of Proposed Rulemaking (NPRM), OSHA proposed to include hazards currently covered under the Hazard Communication Standard (HCS) that have yet to be addressed by the GHS (OSHA provided several examples: simple asphyxiants, and combustible dust) in a separate category called "Unclassified Hazards". In response to comments from the regulated community, OSHA has renamed the category to "Hazards Not Otherwise Classified (HNOC)" to minimize confusion. In the final HCS, HNOC hazards will not be required to be disclosed on the label but will be required to be disclosed in section 2 of the Safety Data Sheet (SDS). This reflects how GHS recommends these hazards should be disclosed. Chemical manufacturers and importers are expected to assess these hazards when they are conducting their hazard evaluation of physical and health hazards. A new or separate evaluation is not required. Also in the final standard, in response to comments, OSHA has removed pyrophoric gases, simple asphyxiants, and combustible dust from the HNOC hazard category and has addressed these chemicals individually (see question below for more information on each hazard).

How has OSHA addressed pyrophoric gases, simple asphyxiants, and combustible dust?

In the revised Hazard Communication Standard (HCS), OSHA has added pyrophoric gases, simple asphyxiants and combustible dust to the definition of "hazardous chemical". OSHA has also added definitions to the revised HCS for pyrophoric gases and simple asphyxiants, and provided guidance on how to define combustible dust for the purposes of complying with the HCS.

- **Pyrophoric gases**:
  OSHA has retained the definition for pyrophoric gases from the current HCS. Pyrophoric gases must be addressed both on container labels and SDSs. OSHA has provided label elements for pyrophoric gases which include the signal word "danger" and the hazard statement "catches fire spontaneously if exposed to air".
- **Simple asphyxiants:**
  OSHA has revised the definition of simple asphyxiants that was proposed in the Notice of Proposed Rulemaking (NPRM) as a result of comments from the regulated community. In the final HCS, simple asphyxiants must be labeled where appropriate, and be addressed on SDSs. OSHA has provided label elements for simple asphyxiants which include the signal word "warning" and the hazard statement "may displace oxygen and cause rapid suffocation".
- **Combustible dust:**
  OSHA has **not** provided a definition for combustible dust to the final HCS given ongoing activities in the specific rulemaking, as well as in the United Nations Sub-Committee of Experts on the GHS (UN/SCEGHS). However, guidance is being provided through existing documents, including the Combustible Dust National Emphasis Program Directive CPL 03-00-008, which includes an operative definition, as well as provides information about current responsibilities in this area.

In addition, there are a number of voluntary industry consensus standards (particularly those of the NFPA) that address combustible dust.

- In the final HCS, combustible dust hazards must be addressed on labels and SDSs. Label elements are provided for combustible dust in the final HCS and include the signal word "warning" and the hazard statement "May form combustible dust concentrations in the air".
- For chemicals in a solid form that do not present a combustible dust hazard, but may form combustible dusts while being processed in normal downstream uses, paragraph (f)(4) of the HCS allows the chemical manufacturer some flexibility in labeling requirements. The manufacturer or importer to may transmit the label to the customer at the time of the initial shipment, but the label does not need to be included with subsequent shipments unless it changes. This provides the needed information to the downstream users on the potential hazards in the workplace, while acknowledging that the solid metal or other materials do not present the same hazards that are produced when these materials are processed under normal conditions of use.

How many businesses and workers would be affected by the revised Hazard Communication Standard?

OSHA estimates that over 5 million workplaces in the United States would be affected by the revised Hazard Communication Standard (HCS). These are all those workplaces where employees—a total of approximately 43 million of them—could be exposed to hazardous chemicals. Included among these 5 million workplaces are an estimated 90,000 establishments that create hazardous chemicals; these chemical producers employ almost 3 million workers.

What are the estimated overall costs for industry to comply with the revised Hazard Communication Standard?

The revised Hazard Communications Standard's (HCS) total cost, an estimated $201 million a year on an annualized basis for the entire United States, is the sum of four major cost elements. (1) OSHA estimates that the cost of classifying chemical hazards in accordance with the GHS criteria and revising safety data sheets and labels to meet new format and content requirements would be $22.5 million a year on an annualized basis. (2) OSHA estimates that training for employees to become familiar with new warning symbols and the revised safety data sheet format under GHS would cost $95.4 million a year on an annualized basis. (3) OSHA estimated annualized costs of $59 million a year for management to become familiar with the new GHS system and to engage in other management-related activities as may be necessary for industry's adoption of GHS. (4) OSHA estimated annualized costs of $24.1 million for printing packaging and labels for hazardous chemicals in color.

What are the estimated benefits attributable to the revised Hazard Communication Standard?

OSHA expects that the modifications to the Hazard Communication Standard (HCS) will result in increased safety and health for the affected employees and reduce the numbers of accidents, fatalities, injuries, and illnesses associated with exposures to hazardous chemicals. The GHS revisions to the HCS standard for labeling and safety data sheets would enable employees exposed to workplace chemicals to more quickly obtain and to more easily understand information about the hazards associated with those chemicals.

In addition, the revisions to HCS are expected to improve the use of appropriate exposure controls and work practices that can reduce the safety and health risks associated with exposure to hazardous chemicals.

OSHA estimates that the revised HCS will result in the prevention of 43 fatalities and 585 injuries and illnesses (318 non-lost-workday injuries and illnesses, 203 lost-workday injuries and illnesses, and 64 chronic illnesses) annually. The monetized value of this reduction in occupational risks is an estimated $250 million a year on an annualized basis.

OSHA estimates that the revised HCS will result in savings of $475.2 million from productivity improvements for health and safety managers and logistics personnel, $32.2 million during periodic updating of SDSs and labels, and $285.3 million from simplified hazard communication training.

OSHA anticipates that, in addition to safety and health benefits, the revised HCS will result in four types of productivity benefits: (1) for chemical manufacturers, because they will need to produce fewer SDSs in future years; (2) for employers, in providing training to new employees as required by the existing OSHA HCS through the improved consistency of the labels and SDSs. (3) for firms engaging in, or considering engaging in, international trade.

I understand that the United Nations revises the GHS every two years. How will OSHA manage and communicate changes to the Hazard Communication Standard?
It is expected that the GHS will be a living document and is expected to remain up-to-date and relevant; therefore, further changes may be adopted on a two year cycle. Presently most of the recent updates have been clarification of text.

However, OSHA anticipates that future updates of the Hazard Communication Standard (HCS) may be necessary and can be done through various rulemaking options, including:

- **Technical updates** for minor terminology changes,
- **Direct Final Rules** for text clarification, and
- **Notice and Comment rulemaking** for more substantive or controversial updates such as additional criteria or changes in health or safety hazard classes or categories.

Topic 5 – Introduction to Hazard Communication Post Quiz Answers are in rear of the Glossary

Revised Hazard Communication Program

1. New 2012 changes to OSHA's- what missing term - are bringing the U.S. into alignment with the Globally Harmonized System of Classification and Labeling of Chemicals, improving safety and health protections for America's workers.

2. The Safety Data Sheet is at the heart of federal OSHA's?

3. Which terms provides specific criteria for classification of health and physical hazards, as well as classification of mixtures?

4. A decision on whether the substance or mixture will be classified as a hazardous substance or mixture and the - this missing term -, where appropriate, by comparison of the data with agreed hazard classification criteria.

5. Which term may be obtained from tests, literature, and practical experience?

6. Tests that determine hazardous properties conducted according to internationally recognized scientific principles can be used for purposes of?

7. Which term represents, if the concentration of the flammable components $\leq$ 1% and the heat of combustion is < 20 kJ/g?

8. Which term represents, if the concentration of the flammable components $>85\%$ and the heat of combustion is $\geq$ 30 kJ/g to avoid excessive testing?

Oxidizing Gases

9. Which term means any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does?

3.1.14 Oxidizing Solids

10. An oxidizing solid is a solid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the?

Topic 6 – Advanced Safety Competency Part 1
Common Pesticide/Herbicides A-L Section

Alphabetical Order A through L Names, Types, Classifications, Pesticide Formulations, Trade Names and Classes

Topic 6 - Section Focus: You will learn the basics of conventional and commonly used pesticides including tradename, formulations and pesticide classes. This section will focus on pesticides in the alphabetical order from the letters A to L. At the end of this section, the student will be able to understand and describe common pesticides, herbicides and fungicides, tradenames and usages. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Section Scope: You will master commonly found agricultural and structural pesticides, insecticides, herbicides and fungicides. Some of this information will repeat because of the different products, functions and uses. In addition, there are many different pesticide purposes and formats of pesticide application. We want you to keep this course as a pesticide "bible" for any type of pesticide emergency. Use the Table of Contents to assist in finding your concern. Remember to always follow the label's instructions.

Seeking Medical Attention 1-800-222-1222

If you are having symptoms but are unsure if they are pesticide related, at least notify someone in case your symptoms become worse. However, when symptoms appear after contact with pesticides, you should seek medical attention immediately. At this time, call the **National Poison Center at 1-800-222-1222** for guidance on the proper response to your symptoms. This number will direct your call to the nearest poison center, which is staffed on a 24-hour basis.

2,4-Dichlorophenoxyacetic Acid

2,4-Dichlorophenoxyacetic acid (2,4-D) is a common systemic pesticide / herbicide used in the control of broadleaf weeds. It is the most widely used herbicide in the world, and the third most commonly used in North America. 2,4-D is a synthetic auxin (plant hormone), and as such it is often used in laboratories for plant research and as a supplement in plant cell culture media such as MS medium.

2,4-D is a synthetic auxin, which is a class of plant hormones. It is absorbed through the leaves and is translocated to the meristems of the plant. Uncontrolled, unsustainable growth ensues, causing stem curl-over, leaf withering, and eventual plant death. 2,4-D is typically applied as an amine salt, but more potent ester versions exist as well.

All of this information comes from the USEPA.

Avert cockroach bait contains 0.05% Abamectin

Roach baits are formulations that are attractive to roaches and (when eaten by the insect) are lethal to roaches. There are different types of baits that can be used, depending on roach species and area to be baited. The basic baits covered in this article are bait stations, bait gels and granular baits. Roach bait stations can be used indoors or outdoors; indoor use is usually recommended. Roach bait gels can be used indoors and can also be used on the exterior surfaces of buildings. Granular baits are usually used outdoors (in mulched areas where larger roaches breed or hide) but can also be used in attics or wall voids. For best results, do not combine contact insecticides with baits. (A contact insecticide is a granule, liquid spray or aerosol that is used to directly kill targeted pests.)

Two bad things may happen when you use a contact insecticide in the same area where baiting programs are implemented: your bait is contaminated and any domino effect will be neutralized. If you contaminate your roach bait with another insecticide, the bait will no longer be attractive to the targeted roach population. If you kill a roach with an insecticide spray, it will die before it passes the bait on to the rest of the roach population, thus killing your domino effect. The same is true when baiting for ants. You want the foraging worker ants to carry your bait back to the nest where all ants will consume the bait.

Many people are concerned when they see the amount of active ingredients in an insect bait. These people think that they are not getting their money's worth because the amount of active ingredients (insecticide or killing agent) seems to be very low. When baiting roaches, ants, silverfish or crickets, you do not want to see large amounts of active ingredients in the formulation. If insecticide levels are too high (in an insect bait), the targeted pest will be repelled instead of being attracted to the bait. The low amount of active ingredients in a roach bait (or other insect baits) is an attractive property to many people who wish to use as little insecticides as possible.

Abamectin
Avid, which contains abamectin as the active ingredient, is an effective insecticide/miticide for many different mite species and is typically recommended for control of mites both indoors and outdoors. The active ingredient, which occurs naturally, is derived from the soil microorganism, Streptomyces avermitilis. Avid is labeled for control of two-spotted spider mite, European red mite, carmine spider mite, Southern red mite, spruce spider mite cyclamen mite, broad mite, and rust and bud mite. The product can be used to control mites in greenhouses, shadehouses, on field-grown ornamentals, Christmas tree plantations, and woody ornamentals. Avid is a contact and translaminar miticide. Translaminar is a term that refers to insecticides/miticides that penetrate the leaf tissue and form a reservoir of active ingredient within the leaf. Avid generally provides up to 28 days of residual activity. The label rate for all mite species is 4 fl. Oz. per 100 gal. Avid is active on the mobile life stages of mites, with no activity on eggs. Although the insecticide/miticide is slow acting, treated mites are immobilized after exposure. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Acephate
Acephate is an organophosphate foliar insecticide of moderate persistence with residual systemic activity of about 10-15 days at the recommended use rate. It is used primarily for control of aphids, including resistant species, in vegetables (e.g. potatoes, carrots, greenhouse tomatoes, and lettuce) and in horticulture (e.g. on roses and greenhouse ornamentals). It also controls leaf miners, caterpillars, sawflies and thrips in the previously stated crops as well as turf, and forestry. By direct application to mounds, it is effective in destroying imported fire ants. Acephate is sold as a soluble powder, as emulsifiable concentrates, as pressurized aerosol, and in tree injection systems and granular formulations.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Adjuvants
Much of the confusion surrounding adjuvants can be attributed to the lack of understanding of adjuvant terminology. For example, many people use the terms adjuvant and surfactant interchangeably. These terms can refer to the same product because all surfactants are adjuvants. However, not all adjuvants are surfactants.

A pesticide adjuvant is broadly defined as any substance added to the spray tank, separate from the pesticide formulation that will improve the performance of the pesticide.

Diluent: A substance used to dilute something.
Fillers: A diluent in Powder form.
Spreaders: A substance that is added to assist even distribution over the target.
Surfactants: Chemicals that physically alter the surface tension of a spray droplet.
Wetting Agent: A chemical added that could be added to a liquid to reduce its surface tension and make the chemical more effective in spreading over and penetrating surfaces.

Aldicarb

Aldicarb is a carbamate insecticide which is the active substance in the pesticide Temik. It is effective against thrips, aphids, spider mites, lygus, fleahoppers, and leafminers, but is primarily used as a nematicide. Aldicarb is a cholinesterase inhibitor which prevents the breakdown of acetylcholine in the synapse. In case of severe poisoning, the victim dies of respiratory failure. Aldicarb is effective where resistance to organophosphate insecticides has developed, and is extremely important in potato production, where it is used for the control of soil-borne nematodes and some foliar pests.

Its weakness is its high level of solubility, which restricts its use in certain areas where the water table is close to the surface. Aldicarb is a fast-acting cholinesterase inhibitor, causing rapid accumulation of acetylcholine at the synaptic cleft. It is widely used to study cholinergic neurotransmission in simple systems such as the nematode C. elegans.

Exposure to high amounts of aldicarb can cause weakness, blurred vision, headache, nausea, tearing, sweating, and tremors in humans. Very high doses can be fatal to humans because it can paralyze the respiratory system.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

Algaecides

Algae are microscopic single celled forms of plant life that are introduced into the water by wind and rain from the atmosphere. There are 30,000 different varieties of algae all containing chlorophyll. They are one of the hardiest and most widespread living organisms on this planet.

There are three main categories.

Green Algae

Usually floating algae though they sometimes cling to walls This is also the fastest growing algae and accounts for most 24 hr. algae blooms Pool water becomes turbid with a green growth that renders the pool uninviting and dangerous to use as it is difficult to see the bottom of the pool. Prior to the green coloration appearing, the sides of the pool have a slippery feel and the water becomes hazy and exhibits a high chlorine demand.

Mustard (Yellow) Algae

Appears as a yellow powdery deposit on the pool, usually on the shady side. Once established, it is chlorine resistant and can exist in the presence of 3-5 ppm free chlorine. This is also a common algae which grows in aquariums in areas that get little light.

Black (Blue-Green) Algae

Evident by the formation of 1 to 3cm sized black (or dark blue green) spots, tenaciously adhering to the pools surfaces. Black algae forms a layered structure where the first layer (which chlorine may kill) protects under layers from further destruction.

Black Algae

Black algae is similar to the black algae that is found on bathroom shower tiles and in silicone seams near the bath. It is also found in aquariums as dark blotching on the glass sides This form of algae is very slow growing but very hardy. It is extremely chlorine resistant.

Algae Bloom

An algae bloom can turn clear clean water into a green swamp overnight. The pH can climb (as algae consumes carbon dioxide which helps keep pH down), and the pool walls become slippery and hazardous underfoot. Once algae is visible a substantial problem exists. Algae takes in carbon dioxide and gives off oxygen like most other plants. Most bacteria found in swimming pools take in oxygen and give off carbon dioxide. Each consumes the by-products of the other for growth. It is desirable to use a chemical program that assures both bacterial and algae control.

There are three main groups of algaecides:

The following algaecides must not be used when the pool is fitted with an ORP controller. Ions in the algaecide can electrically plate onto the ORP electrode's platinum surface, reducing its readings. In any case, a correctly controlled pool should not develop an algae problem.

Quats

The largest selling, lowest priced algaecides. These are most often found in active concentrations of 5-10%. Such "quaternary ammonium salts" are surfactants and if added in excess, will cause foaming on the pool surface. Surfactants lower the surface tension of the water and "wet" algae cell walls. This "wetting" splits open the cell wall and kills the algae. Quats require lower concentrations and amounts than polyquats to achieve the same level of prevention. Quats are most often used as the preventative while polyquats are most often used to get rid of existing algae.

Polyquats
Are non- foaming algaecides sold in concentrations of 30 to 60%. While more costly than quats, polyquat algaecides are very effective not only on green algae but also with the chlorine resistant mustard and black algae and work well at destroying visible algae.

Copper Salts
Copper ion (Cu^{++}) is a very effective algaecide used in ponds, lagoons and pools to kill and prevent algae formation. Copper usage can cause stain formation. Over time, soluble copper salts can precipitate from pool water and deposit on pool walls, creating a "blueing" effect. In the presence of chlorine, these salts will turn to cupric oxide and cause grey to black staining of the pool walls.

Colloidal Silver
Silver is similar to copper in many ways, colloidal silver attaches itself to the pool walls and floor, giving these surfaces a residual and continuing algaecidal action. Silver can also cause a black staining to occur on pool walls if not carefully administered. Silver is also a very good bacteriostat that may reduce the need for chlorine. Some ionizers use copper and silver plates to produce both silver and copper ions in the water.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222.

If you wish to report a pesticide problem, please call 1-800-858-7378. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

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This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded.

No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Allelochemicals
Allelochemicals are semiochemicals that affect one or more species other than the producer. Of known allelochemicals, volatile compounds similar to those given off by food sources (plants or animals) are important in pest managements. Feeding attractants are examples of kairomones, allelochemicals produced by one species but used to advantage by another species. For example, carbon dioxide given off by humans and other animals is used as a kairomone by female mosquitoes seeking a blood meal. In contrast, allomones are allelochemicals that favor the producer. For example, secretions that deter predators are allomones.

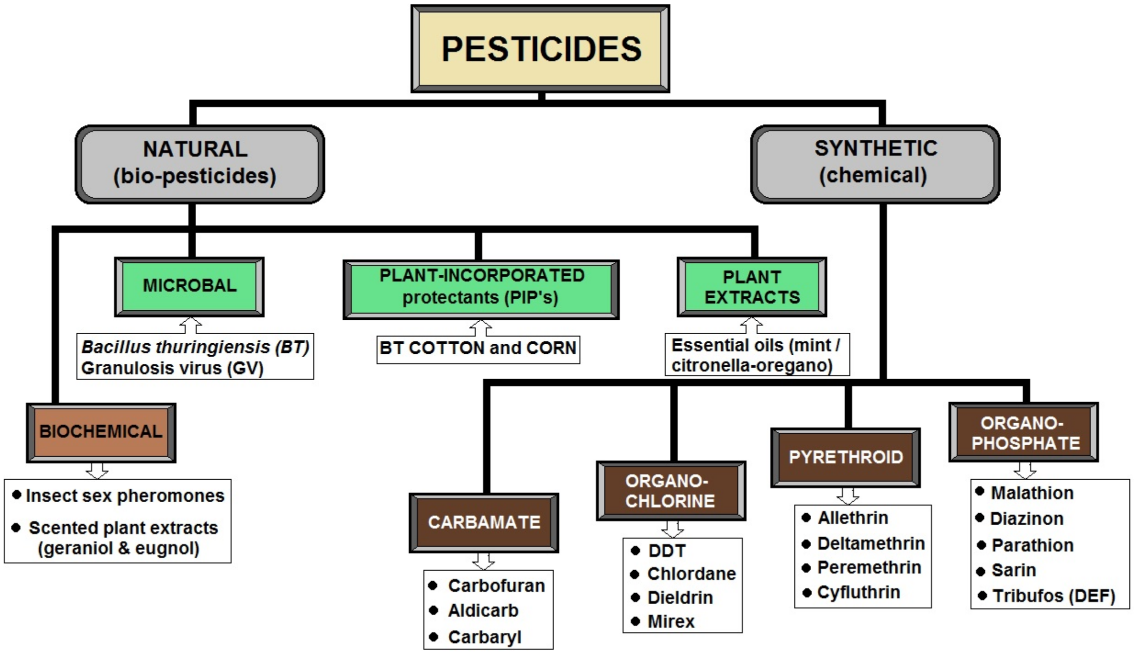
Antifouling Agents
Kill or repel organisms that attach to underwater surfaces, such as boat bottoms.

Antimicrobials
An anti-microbial is a substance that kills or inhibits the growth of microorganisms such as bacteria, fungi, or protozoans. Antimicrobial drugs either kill microbes (microbiocidal) or prevent the growth of microbes (microbiostatic). Disinfectants are antimicrobial substances used on non-living objects or outside the body.

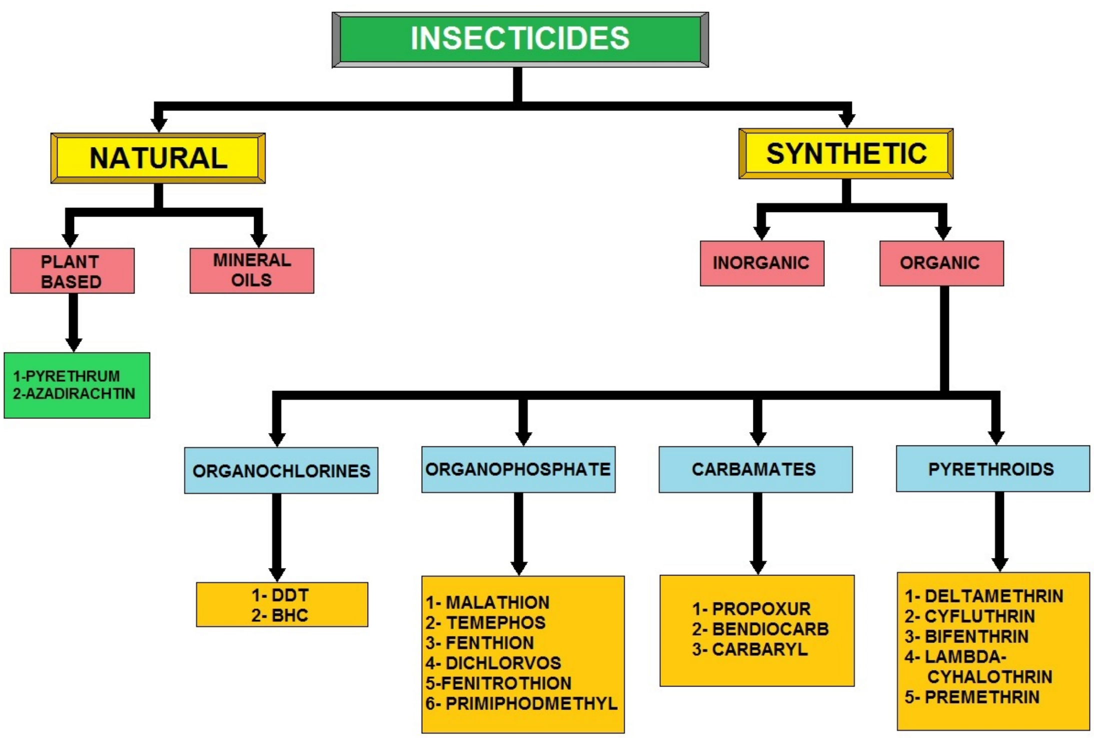
Pasteur and Joubert
The history of antimicrobials begins with the observations of Pasteur and Joubert, who discovered that one type of bacteria could prevent the growth of another. They did not know at that time that the reason one bacterium failed to grow was that the other bacterium was producing an antibiotic. Technically, antibiotics are only those substances that are produced by one microorganism that kill, or prevent the growth, of another microorganism. Of course, in today's common usage, the term antibiotic is used to refer to almost any drug that attempts to rid your body of a bacterial infection. Antimicrobials include not just antibiotics, but synthetically formed compounds as well.

Penicillin and Tetracycline
The discovery of antimicrobials like penicillin and tetracycline paved the way for better health for millions around the world. Before penicillin became a viable medical treatment in the early 1940s, no true cure for gonorrhea, strep throat, or pneumonia existed. Patients with infected wounds often had to have a wounded limb removed, or face death from infection. Now, most of these infections can be cured easily with a short course of antimicrobials.

Antimicrobial Nanotechnology
However, with the development of antimicrobials, microorganisms have adapted and become resistant to previous antimicrobial agents. The old antimicrobial technology was based either on poisons or heavy metals, which may not have killed the microbe completely, allowing the microbe to survive, change, and become resistant to the poisons and/or heavy metals. Antimicrobial nanotechnology is a recent addition to the fight against disease causing organisms, replacing heavy metals and toxins and may someday be a viable alternative. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.



DIFFERENT CLASSIFICATIONS OF PESTICIDES



PESTICIDES BASED UPON CHEMICAL COMPOSITION

Attractant Sub-Section

Insects use many different semiochemicals, chemicals that convey messages between organisms. (The Greek word "semeio" means sign.) Although semiochemicals may seem analogous to tastes or smells perceived by humans, the use of such compounds by insects is characterized by a high degree of sensitivity and specificity. Receptor systems that ignore or screen out countless irrelevant chemical messages are nonetheless able to detect messenger compounds at extremely low concentrations. Detection of a chemical message triggers very specific unlearned behaviors or developmental processes.

Volatile Chemicals

Chemicals that act as attractants or carry other messages across distances are volatile (quick to evaporate) compounds. When released into the air, they can be detected by certain insects (those receptive to a specific compound) a few inches to hundreds of yards away. Chemicals that carry messages over considerable distances are most often used in pest management.

Insect Traps

Insect traps are used to monitor or directly reduce insect populations. They typically use food, visual lures, chemical attractants and pheromones as bait and are installed so that they do not injure other animals or humans or result in residues in foods or feeds. Visual lures use light, bright colors and shapes to attract pests. Chemical attractants or pheromones may attract only a specific sex. Insect traps are sometimes used in pest management programs instead of pesticides but are more often used to look at seasonal and distributional patterns of pest occurrence. This information may then be used in other pest management approaches.

Trap Mechanisms or Baits

The trap mechanism or bait can vary widely. Light traps with ultraviolet attract certain insects. Designs differ according to the behavior of the insects being studied. Grasshoppers and some beetles are attracted to lights at a long range but are repelled by it at short range. Farrow's light trap has a large base so that it captures insects that may otherwise fly away from regular light traps. Flies and wasps are attracted by proteins. Mosquitoes and many other insects are attracted by bright colors, carbon dioxide, lactic acid, floral or fruity fragrances, warmth, moisture and pheromones. Synthetic attractants like Methyl eugenol are very effective with Tephritid flies. Yellow pan traps are used to monitor aphids and some other sap sucking insects. Pitfall traps are used for ground foraging and flightless insects such as beetles of the family Carabidae.

Sex Pheromones

Pheromones are semiochemicals that are produced and received by members of the same species. A range of behaviors and biological processes are influenced by pheromones, but pest management programs most often use compounds that attract a mate (sex pheromones) or call others to a suitable food or nesting site (aggregation pheromones). Other pheromones regulate caste or reproductive development in social insects (honey bees and termites for example), signal alarm (in honey bees, ants, and aphids), mark trails (ants), and serve other functions.

Allelochemicals are semiochemicals that affect one or more species other than the producer. Of known allelochemicals, volatile compounds similar to those given off by food sources (plants or animals) are important in pest managements.

Feeding attractants are examples of kairomones, allelochemicals produced by one species but used to advantage by another species. For example, carbon dioxide given off by humans and other animals is used as a kairomone by female mosquitoes seeking a blood meal. In contrast, allomones are allelochemicals that favor the producer. For example, secretions that deter predators are allomones.

Pheromone VS. Kairomone

Although terms such as pheromone or kairomone help describe the functions of message-carrying chemicals, these words often oversimplify the complexity of chemical communication. A single chemical signal may act as both a pheromone and a kairomone; for example, the compounds emitted by a bark beetle colonizing a host tree attract other bark beetles (functioning as an aggregation pheromone), but the same compounds also attract certain predators and parasites that attack these bark beetles (functioning as a feeding attractant or kairomone).

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Bacillus Thuringiensis

- Bacillus thuringiensis (Bt) is a naturally occurring bacterial disease of insects. These bacteria are the active ingredient in some insecticides.
- Bt insecticides are most commonly used against some leaf- and needle-feeding caterpillars. Recently, strains have been produced that affect certain fly larvae, such as mosquitoes, and larvae of leaf beetles.
- Bt is considered safe to people and nontarget species, such as wildlife. Some formulations can be used on essentially all food Crops.

Bacillus thuringiensis (Bt) is an insecticide with unusual properties that make it useful for pest control in certain situations. Bt is a naturally occurring bacterium common in soils throughout the world. Several strains can infect and kill insects. Because of this property, Bt has been developed for insect control. At present, Bt is the only "microbial insecticide" in widespread use. The insecticidal activity of Bt was first discovered in 1911. However, it was not commercially available until the 1950s. In recent years, there has been tremendous renewed interest in Bt. Several new products have been developed, largely because of the safety associated with Bt-based insecticides.

Kurstaki Strain
The greatest use of Bt involves the kurstaki strain used as a spray to control caterpillars on vegetable Crops. In addition, Bt is used in agriculture as a liquid applied through overhead irrigation systems or in a granular form for control of European corn borer. The treatments funnel down the corn whorl to where the feeding larvae occur. Many formulations (but not all) are exempt from pesticide tolerance restrictions and may be used up to harvest on a wide variety of Crops. This also makes Bt useful in applications where pesticide drift onto Gardens is likely to occur, such as treating trees and shrubs. The exceptional safety of Bt products also makes them useful where exposure to pesticides is likely during mixing and application.

Mosquito Control
To control mosquito larvae, formulations containing the israelensis strain are placed into the standing water of mosquito breeding sites. For these applications, Bt usually is formulated as granules or solid, slow-release rings or brickettes to increase persistence. Rates of use are determined by the size of the water body. Make applications shortly after insect eggs are expected to hatch, such as after flooding due to rain or irrigation. Bt persistence in water is longer than on sun-exposed leaf surfaces, but reapply if favorable mosquito breeding conditions last for several weeks. Although the israelensis strain is quite specific in its activity, some types of nonbiting midges, which serve as food for fish and wildlife, also are susceptible and may be affected.

Bt (Israelensis)
Use of Bt (israelensis) for control of fungus gnat larvae involves drenching the soil. Bt applied for control of elm leaf beetle or Colorado potato beetle (san diego/tenebrionis strain) is sprayed onto leaves in a manner similar to the formulations used for caterpillars. Bt does not control shore flies, another common fly found in greenhouses. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Insects Controlled by Bt
Kurstaki strain (Biobit, Dipel, MVP, Steward, Thuricide, etc.):

Vegetable insects
Cabbage worm (cabbage looper, imported cabbageworm, diamondback moth, etc.).
Tomato and tobacco hornworm.

Field and forage crop insects
European corn borer (granular formulations have given good control of first generation corn borers).
Alfalfa caterpillar, alfalfa webworm.

Fruit crop insects
Leafroller.
Achemon sphinx.

Tree and shrub insects
Tent caterpillar.
Fall webworm.
Leafroller.
Red-humped caterpillar.
Spiny elm caterpillar.
Western spruce budworm.
Pine budworm.
Pine butterfly.

Israelensis strains (Vectobac, Mosquito Dunks, Gnatrol, Bactimos, etc.)
Mosquito.
Black fly.
Fungus gnat.

San diego/tenebrionis strains (Trident, M-One, M-Trak, Foil, Novodor, etc.)
Colorado potato beetle.
Elm leaf beetle.
Cottonwood leaf beetle.

Insect Resistance Management
The potential for insects to develop resistance to the Bt protein poses a threat to the future use of Bt plant-incorporated protectants. Because plant-incorporated protectants are recognized as a safe method of pest control, EPA has imposed management requirements on registered plant-incorporated protectants that will prevent insects from developing resistance to Bt proteins. Insect resistance management (IRM) is the term used to describe such practices. As a condition of EPA's approval of the renewed registrations of Bt corn and cotton, EPA included numerous provisions to strengthen insect resistance management.

The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu. The pesticide label is your best guide to using pesticides safely and effectively. The directions on the label are there primarily to help you achieve “maximum” benefits—the pest control that you desire— with "minimum" risk. Both depend on following label directions and correctly using the pesticide.

Read the label. Read the label before buying the pesticide. Read the label before mixing or using the pesticide each time, and read the label before storing or disposing of the pesticide.

These provisions include the following items:

- Additional field research on pest biology;
- Monitoring for the development of resistance or increased tolerance to the Bt protein;
- Grower education;
- Development of a remedial action plan in case resistance is identified;
- Increased communication among growers, producers, researchers, and the public; and
- Use of refuges to provide non-resistant insects to dilute the genes of any resistant insects in the pest population.

Bifenazate

Floramite, which contains the active ingredient bifenazate, is labeled for control of a wide range of mites, including two-spotted spider mite, Pacific mite, strawberry mite, European red mite, citrus red mite, clover mite, southern red mite, spruce spider mite, and bamboo spider mite. It is not active on rust, broad, or flat mite.

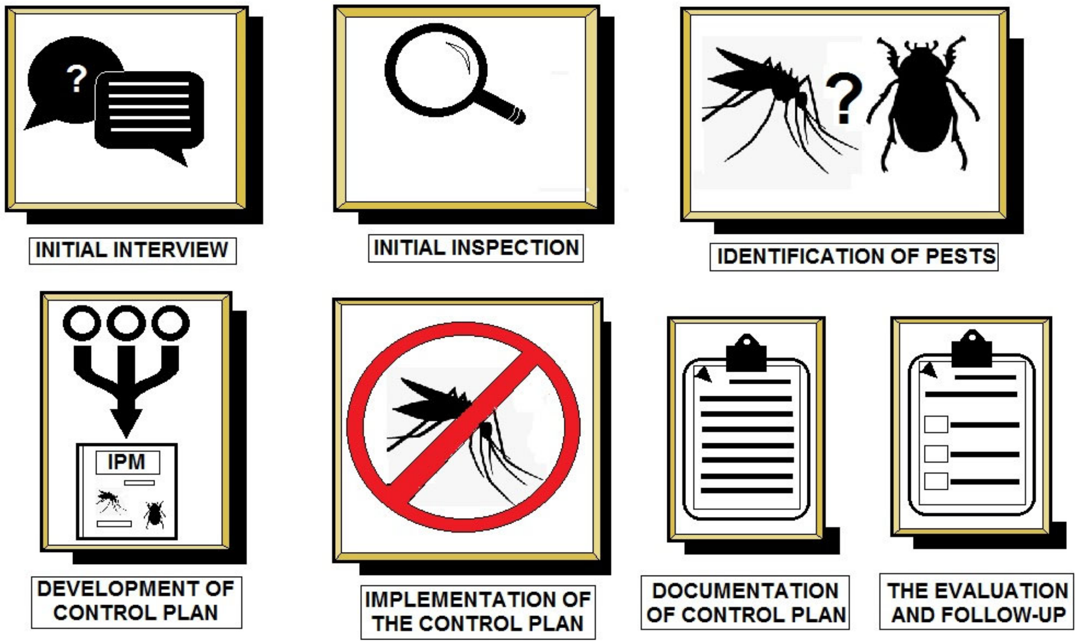
Floramite is labeled for use in greenhouses, shadehouses, nurseries, Christmas tree plantations, landscapes, and interiorscapes. This is a contact miticide, so thorough coverage of all plant parts is essential. This miticide is active on all mite life stages, including eggs. Floramite is fast acting and provides up to 28 days of residual activity. The label rate is 4 to 8 fl. Oz. per 100 gal.

Biochemical Pesticides

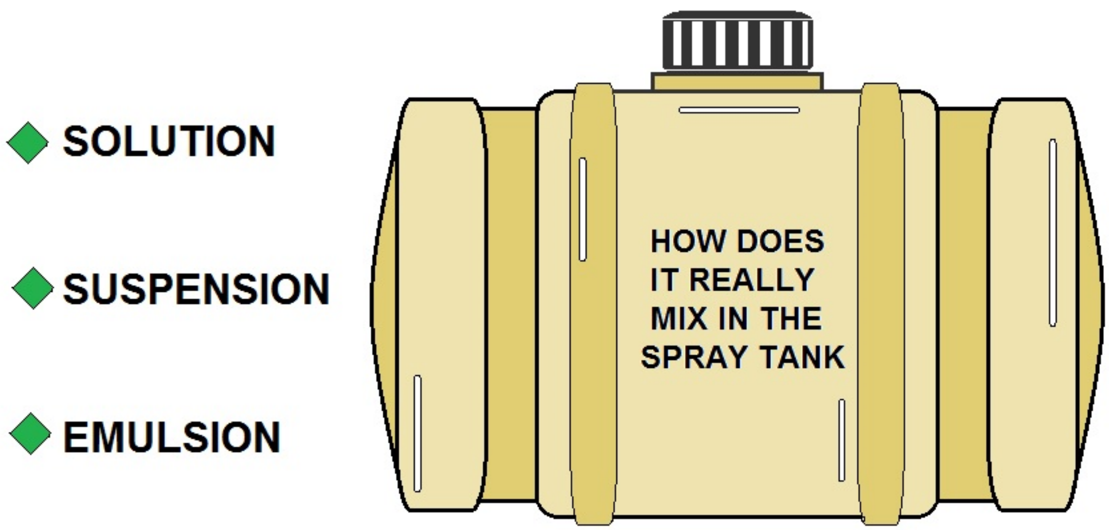
Biochemical pesticides are generally distinguished from conventional pesticides by their unique modes of action, low use volume, target species specificity or natural occurrence.

A biochemical pesticide is a pesticide that:

(1) Is a naturally-occurring substance or structurally similar and functionally identical to a naturally-occurring substance;
(2) Has a history of exposure to humans and the environment demonstrating minimal toxicity, or in the case of a synthetically derived biochemical pesticide, is equivalent to a naturally-occurring substance that has such a history; and
(3) Has a non-toxic mode of action to the target pest(s).



DEVELOPING AN INTEGRATED PESTICIDE MANAGEMENT PROGRAM (IPM)



SPRAY MIX TERMINOLOGY

Biocide Sub-Section

A biocide is a chemical substance or microorganism which can deter, render harmless, or exert a controlling effect on any harmful organism by chemical or biological means. Biocides are commonly used in medicine, agriculture, forestry, and industry. Biocidal substances and products are also employed as anti-fouling agents or disinfectants under other circumstances: chlorine, for example, is used as a short-life biocide in industrial water treatment but as a disinfectant in swimming pools. Many biocides are synthetic, but a class of natural biocides, derived from e.g. bacteria and plants, includes brassica oleracea, brassica oleracea gemmifera, and clostridium botulinum bacteria. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

A biocide can be:

- A pesticide: this includes fungicides, herbicides, insecticides, algaecides, molluscicides, miticides and rodenticides.
- An antimicrobial: this includes germicides, antibiotics, antibacterials, antivirals, antifungals, antiprotozoals and antiparasites.

Biocides can be added to other materials (typically liquids) to protect them against biological infestation and growth. For example, certain types of quaternary ammonium compounds (quats) are added to pool water or industrial water systems to act as an algaecide, protecting the water from infestation and growth of algae. It is often impractical to store and use poisonous chlorine gas for water treatment, so alternative methods of adding chlorine are used. These include hypochlorite solutions, which gradually release chlorine into the water, and compounds like sodium dichloro-s-triazinetrione (dihydrate or anhydrous), sometimes referred to as "dichlor", and trichloro-s-triazinetrione, sometimes referred to as "trichlor". These compounds are stable while solids and may be used in powdered, granular, or tablet form. When added in small amounts to pool water or industrial water systems, the chlorine atoms hydrolyze from the rest of the molecule forming hypochlorous acid (HOCl) which acts as a general biocide killing germs, micro-organisms, algae, and so on. Halogenated hydantoin compounds are also used as biocides.

Defoliants

A defoliant is any chemical sprayed or dusted on plants to cause its leaves to fall off. A classic example of a highly toxic defoliant is Agent Orange, which the United States armed forces used abundantly to defoliate regions of Vietnam during the Vietnam War from 1961 to 1970. Defoliants differ from herbicides in that the former seeks mainly to strip leaves from plants, and the latter is used to destroy or inhibit the growth of plants. Harvest aid chemicals are applied to cotton to increase the rate of leaf loss and desiccation before harvest. Use of these materials allows timely harvesting operations.

The primary goals of applying these materials are:

- Stimulate boll opening and maturation.
- Achieve more efficient mechanical harvesting at a time during good weather conditions and the availability of harvest equipment. It is critical to harvest before rain and fog conditions arrive.
- Maximize the collection of harvestable crop.
- Preserve high fiber quality to provide maximum economic returns.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

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Harvest Aid Chemicals

Determining which harvest aid chemicals to use is a complex management decision. Factors such as late-season crop vigor, nitrogen status, and plant water status exert a significant influence on the success of cotton defoliation and desiccation efforts in preparation for harvest. Decisions on whether one or more chemical materials should be used and proper rates and timing will vary according to crop conditions. Generally the process from application to harvest is a 14- to 21-day period. It can take longer with a delayed crop and cool fall weather.

Relative Efficacy

Weather conditions (principally air temperature), patterns of boll set and relative boll maturity, crop vigor, and desired harvest schedule also impact choice of materials and their relative efficacy. The basic categories of chemicals used as harvest aids include boll openers/ conditioners, boll openers/enhancers, true defoliants, desiccants, and regrowth inhibitors.

Some harvest aid chemicals impact the cotton plant in more than one of these ways.

- Boll openers/conditioners are often recommended in combination with a range of defoliant materials to increase the percentage of open bolls in preparation for a once-over harvest. They are often used with late-maturing crops when the weather may be too cool to provide enough heat units to open late bolls.
- Boll opener/enhancers have an effect similar to openers/conditioners but have been found in most cases to also reduce vegetative regrowth.
- Defoliants are chemicals that either impact plant hormonal activity related to leaf loss or cause direct injury to leaves, both at a level that promotes leaf drop (abscission). Their activity varies with chemical and conditions but takes days or weeks to remove leaves from the plants.

- Desiccants produce quick injury that is more severe than that seen with defoliants, causing leaf dehydration and death within one to several days. Desiccants are often applied as a follow up after application of defoliants.
- Regrowth inhibitors are applied primarily to inhibitlate vegetative growth (regrowth) or to enhance activity of defoliant materials.

Chlordimeform

Chlordimeform is effective as an ovicide/insecticide for control of bollworm and tobacco budworm in cotton. Effective also for the control of resistant mites and their eggs, and many lepidopterous insect pests but not on current U.S. label

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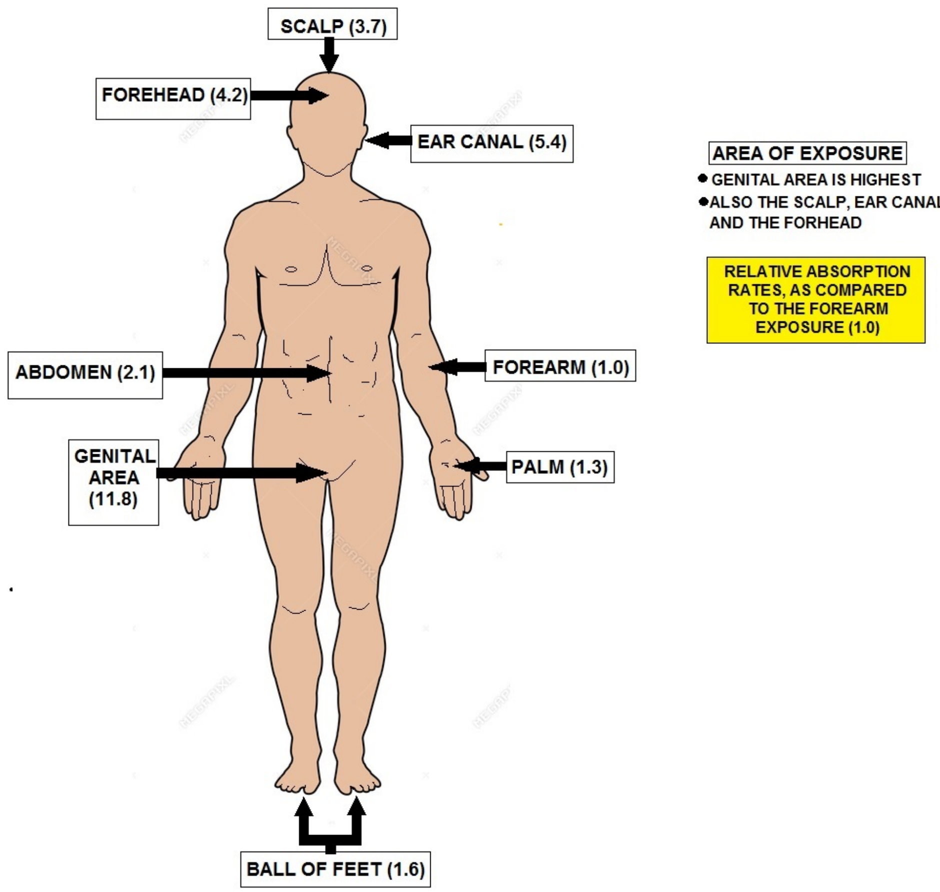
This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.



ABSORPTION RATES OF PESTICIDE EXPOSURE

	GLOVES	HARD HAT	APRON	COVERALLS	RESPIRATOR	FOOTWEAR	PROTECTIVE EYEWEAR
MIXING / LOADING	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
ENCLOSED CAB	NO	NO	NO	NO	NO	SHOES + SOCKS	NO
OPEN CAB	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO
CLEANOUT	CHEMICAL RESISTANT	NO	NO	YES + LONG SLEEVED SHIRT / LONG PANTS	NO	SHOES + SOCKS	NO

PESTICIDE HANDLING SAFETY REFERENCE (PPE)

Biocide First Aid

It is still important to recognize signs and symptoms of biocide poisoning. When in doubt, seek medical attention and be sure to bring the biocide label and SDS to the physician.

Poisoning Recognition
Certain biocides may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers.

Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific biocide involved and the level of exposure. If you have been working with biocides and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The herbicide label or SDS will have a telephone number to contact in case of a medical incident.

Procedures

- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Safety Data Sheet (SDS) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Biocide on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Biocide in Eye
Eye exposure to biocides can be serious. Always pour, measure, or mix biocides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If biocide contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Biocides in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Biocide in Mouth or Swallowed

Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator's clothing becoming contaminated.
- "Spill kits" are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material.

Biological Controls

Microscopic pathogens such as fungi, bacteria, and viruses control pests. An example is milky spore disease, which attacks Japanese beetles. A number of these biological pesticides are available commercially at hardware and garden stores. Biochemical pesticides include pheromones and juvenile insect hormones. Pheromones are chemical substances released by various organisms (including insects) as means of communicating with others of the same species, usually as an aid to mating. Pheromones lure pests inside a trap. Juvenile insect hormones interfere with an insect's normal growth and reproductive functions by mimicking the effects of compounds that occur naturally in the pest.

Beneficial predators such as purple martins and other birds eat insects; bats can eat thousands of insects in one night; lady beetles (ladybugs) and their larvae eat aphids, mealybugs, whiteflies, and mites. Other beneficial bugs include spiders, centipedes, ground beetles, lacewings, dragonflies, big-eyed bugs, and ants. You can install a purple martin house in your yard. You can also buy and release predatory insects. They are available from sources such as gardening catalogs and magazines. Contact your County Cooperative Extension Service, a nursery, or a garden association for information on how to attract and protect beneficial predators.

Biopesticide Repellents

Biopesticides are certain types of pesticides derived from such natural materials as animals, plants, bacteria, and certain minerals.

Oil of Lemon Eucalyptus
Oil of Lemon Eucalyptus is found naturally in eucalyptus leaves and twigs. It was first registered in 1948 as an insecticide and miticide (kills insects and mites) and today is found in both lotion and spray insect repellents. As with most plant oils, no adverse effects to humans are expected. Products contain a range of 30 to 40 percent of the active ingredient.

p-Mentane-3,8-diol
p-Mentane-3,8-diol is the chemically synthesized version of oil of lemon eucalyptus. It is applied to skin or to clothing to repel specific insects including mosquitoes, biting flies, and gnats. According to the Centers for Disease Control and Prevention, when repellents containing p-Mentane-3,8-diol were tested against mosquitoes found in the U.S., the p-Mentane-3,8-diol products provided protection similar to repellants with low concentrations of DEET. Products contain a range of 8 to 10 percent of the active ingredient.

Methyl Nonyl Ketone
Methyl nonyl ketone was originally registered in 1966 as a dog and cat repellent/training aid and an iris borer deterrent. Methyl nonyl ketone is currently found in only one insect repellent in the form of both a lotion and a spray. Methyl nonyl ketone is a dog and cat repellent/training aid and iris borer deterrent. The pesticide is used in households, paths, patios, solid waste containers and on ornamental plants. Methyl nonyl ketone is formulated as a pressurized liquid, granular, liquid ready-to-use (pump/sprayer), solid (crystalline), and liquid for reformulating use only. EPA assumes that the volume of use of this pesticide is relatively low.

Product Labeling Changes Required
All methyl nonyl ketone end-use products must comply with EPA's current pesticide product labeling requirements and with the following conditions as described below.

Entry Restrictions
The Agency is establishing the following entry restrictions for all homeowner uses of methyl nonyl ketone end-use products.

For liquid applications:
"Do not allow persons or pets to enter the treated area until sprays have dried."

For dry applications:
"Do not allow persons or pets to enter the treated area until dusts have settled."

Application Requirements:
EPA is requiring the following application requirements on all end-use products containing methyl nonyl ketone:
"Do not apply this product in a way that will contact any person or pet, either directly or through drift. Keep people and pets out of the area during application."

User Safety Requirements:
EPA is requiring the following user safety requirements on all end-use products containing methyl nonyl ketone:
"Follow manufacturer's instructions for cleaning/maintaining personal protective equipment. If no such instructions for washables, use detergent and hot water. Keep and wash personal protective equipment separately from other laundry."

User Safety Recommendations:
EPA is requiring the following user safety recommendations on all end-use products containing methyl nonyl ketone:

"Users should wash hands before eating, drinking, chewing gum, using tobacco, or using the toilet."

"Users should remove clothing immediately if pesticide gets on or inside clothing. Then wash thoroughly with detergent and hot water separately from other laundry and put on clean clothing."

"Users should remove personal protective equipment immediately after handling this product. Wash the outside of gloves before removing. As soon as possible, wash thoroughly and change into clean clothing."

IR3535
IR3535 (chemical name, 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester), also called Merck 3535, is used as an insect repellent against mosquitoes, deer ticks, and biting flies. This biopesticide was registered as an active ingredient in 1999. Before it was registered with EPA, IR3535 had been used as an insect repellent in Europe for 20 years with no significant harmful effects. Products contain a range of 7.5 to 20.07 percent of the active ingredient.. Products containing this active ingredient are applied to exposed human skin. No harmful effects to humans or the environment are expected from this use of 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester.

Description of the Active Ingredient
3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester is structurally related to -alanine, which occurs naturally. The active ingredient is a liquid at room temperature. OPP Chemical Code: 113509 (CAS # 52304-36-6)
Use Sites: Target Pests, and Application Methods
Use Sites: Human skin.
Target Pests: Mosquitoes, deer ticks, body lice, and biting flies.
Application Methods: Apply product to skin according to label directions.

Assessing Risks to Human Health
IR3535 has been used as an insect repellent in Europe for 20 years with no substantial adverse effects. Toxicity tests show that the IR3535 is not harmful when ingested, inhaled, or used on skin. Eye irritation could occur if the chemical enters a person=s eyes. Any allergic reactions are required to be reported to EPA.

Assessing Risks to the Environment
Because the active ingredient is used only in products applied to human skin, no risks to the environment are expected.

Regulatory Information
3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester was registered (licensed for sale) as an active ingredient in February 1999. As of January 2000, there was one end product containing this active ingredient.

Products for Use Against Public Health Pests
EPA defines a public health pest as any organism that can cause or transmit human disease, or can cause human discomfort or injury. Examples include mosquitoes, ticks, germs, and rats. To help protect the public's health, EPA requires registrants of products used against public health pests to demonstrate that the products meet specific standards for effectiveness as well as for safety. The product currently registered with 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester as the active ingredient has met the applicable standards.

Oil of Citronella
Oil of Citronella comes from dried, cultivated grasses, and has a distinctive odor that masks the CO2 or lactic acid on our bodies that mosquitoes and other pests find attractive. It has been used for over 50 years as an insect repellent. However, oil of citronella is included on the list of chemicals that may not require EPA registration in some cases. Unless a product containing citronella is EPA-registered, it has not been subject to EPA review and EPA cannot corroborate its safety and effectiveness. Oil of citronella products are commonly sold as repellent candles but only skin applied products offer some protection in certain circumstances. Most skin-applied products contain about 5 percent oil of citronella.

Area Repellents and Repellents Used on Clothing
Permethrin
Permethrin is registered for use as both an insecticide and a repellent. Permethrin products are used on clothing, shoes, bed nets, and camping gear. Permethrin-impregnated clothing such as pre-treated shoes, socks, and pants repel and kill ticks, mosquitoes, and other insects and retain this effect after repeated laundering. Permethrin is also found in treated tents, tarps, bed nets, sleeping bags, and mattresses.

Allethrin
Allethrin is an outdoor area-wide repellent that is used for the control of mosquitoes. Heating causes allethrin to vaporize from mosquito coils, mats, and oil formulations. It is also used frequently in commercially available tabletop candles and lanterns. See Docket EPA-HQ-OPP-2006-0986 for information about Alletherin at Regulations.gov.

Metofluthrin
Metofluthrin is also an outdoor area-wide repellent that is used for the control of mosquitoes. This recently EPA-registered active ingredient is currently found in strip devices. Metofluthrin "strip devices" are multilayer paper or plastic devices that you hang up as an area repellent. No heating is necessary to vaporize the metofluthrin after the strips are removed from the packaging.

Which Mosquito Repellents Work Best
A wide variety of insect repellent products are available. CDC recommends the use of products containing active ingredients which have been registered with the U.S. Environmental Protection Agency (EPA) for use as repellents applied to skin and clothing. When EPA registers a repellent, they evaluate the product for efficacy and potential effects on human beings and the environment. EPA registration means that EPA does not expect a product, when used according to the instructions label, to cause unreasonable adverse effects to human health or the environment. Of the active ingredients registered with the EPA, two have demonstrated a higher degree of efficacy in the peer-reviewed, scientific literature.

Products containing these active ingredients typically provide longer-lasting protection than others:
- ✓ DEET (Chemical Name: N,N-diethyl-m-toluamide or N,N-diethly-3-methyl-benzamide)
- ✓ Picaridin (KBR 3023, Chemical Name: 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester)

Products containing these active ingredients typically provide reasonably long-lasting protection:
- ✓ Oil of Lemon Eucalyptus or PMD (Chemical Name: para-Menthane-3,8-diol) the synthesized version of oil of lemon eucalyptus
- ✓ IR3535 (Chemical Name: 3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)

Oil of Lemon Eucalyptus
Oil of lemon eucalyptus [p-menthane 3,8-diol (PMD)], a plant based repellent, is also registered with EPA. In two recent scientific publications, when oil of lemon eucalyptus was tested against mosquitoes found in the US it provided protection similar to repellents with low concentrations of DEET.

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Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

In addition, certain products which contain permethrin are recommended for use on clothing, shoes, bed nets, and camping gear, and are registered with EPA for this use. Permethrin is highly effective as an insecticide and as a repellent. Permethrin-treated clothing repels and kills ticks, mosquitoes, and other arthropods and retains this effect after repeated laundering. the permethrin insecticide should be reapplied following the label instructions. Some commercial products are available pretreated with permethrin. Permethrin is not to be used directly on skin.

How Often You Should Re-apply Repellents
Follow the directions on the product you are using. Sweating or getting wet may mean that you need to re-apply more frequently.

How the Percentage of Active Ingredient in a Product Relates to Protection Time
In general, the more active ingredient (higher percentage) it has, the longer a repellent will protect you from mosquitoes. For example, DEET products are available in many formulations--something with 30% DEET will protect you longer than one with 5% DEET. You cannot directly compare the percentage of one active ingredient to another, however. Use your common sense. Re-apply repellent if you start to get bitten and follow the label instructions.

As a "rule of thumb":

- For many hours outside (over 3-4 hours) and/or where biting is very intense—look for a repellent containing more than 20% DEET. Products with more than 50% DEET do not offer additional protection.
- For shorter periods of time, repellents containing less than 20% DEET, the repellent currently available with 7% picaridin or one of the products containing oil of lemon eucalyptus may provide adequate protection. there are other products available, but they may not protect as long as those named here.
- Even if you're going out for 10 minutes use a repellent —that's long enough to get bitten!

Hint: Applying permethrin to your clothing ahead of time will give you even greater protection.

Remember—if you're getting bitten, do something about it! Choose a repellent that you will use consistently. Also, choose a product that will provide sufficient protection for the amount of time that you will be spending outdoors. Product labels often indicate the length of time that you can expect protection from a product. If you are concerned about using insect repellent, consult your health care provider for advice. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

General Considerations for Using Repellents Safely

- Always follow the instructions on the product label.
- Apply repellents only to exposed skin and/or clothing (as directed on the product label.) Do not use repellents under clothing.
- Never use repellents over cuts, wounds or irritated skin.
- Do not apply to eyes or mouth, and apply sparingly around ears. When using sprays, do not spray directly on face—spray on hands first and then apply to face.
- Do not allow children to handle the product. When using on children, apply to your own hands first and then put it on the child. You may not want to apply to children's hands.
- Use just enough repellent to cover exposed skin and/or clothing. Heavy application and saturation are generally unnecessary for effectiveness. If biting insects do not respond to a thin film of repellent, then apply a bit more.
- After returning indoors, wash treated skin with soap and water or bathe. this is particularly important when repellents are used repeatedly in a day or on consecutive days. Also, wash treated clothing before wearing it again. (this precaution may vary with different repellents—check the product label.)
- If you or your child gets a rash or other bad reaction from an insect repellent, stop using the repellent, wash the repellent off with mild soap and water, and call a local poison control center for further guidance. If you go to a doctor because of the repellent, take the repellent with you to show the doctor.

Note that the label for products containing oil of lemon eucalyptus specifies that they should not to be used on children under the age of three years. Other than those listed above, EPA does not recommend any additional precautions for using registered repellents on pregnant or lactating women, or on children. For additional information regarding the use of repellent on children, please see CDC's Frequently Asked Questions about Repellent Use. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

DEET-based repellents applied according to label instructions may be used along with a separate sunscreen. No data are available at this time regarding the use of other active repellent ingredients in combination with a sunscreen.

Borates

"Borate" is a generic term for compounds containing the elements boron and oxygen. Boron never occurs alone naturally but as calcium and sodium borate ores in several places in the world. Borax and other sodium borates are used in numerous products such as laundry additives, eye drops, fertilizers, and insecticides. Though the mechanisms of toxicity are not fully understood, boron is very toxic to insects and decay fungi that commonly damage wood in structures. At low levels, however, boron is only minimally toxic, and perhaps beneficial, to humans, other mammals, and growing plants. Use of borate-treated wood for construction of homes and their wood-based contents appears to offer many advantages to today's environmentally sensitive world.

Unlike most other wood preservatives and organic insecticides that penetrate best in dry wood, borates are diffusible chemicals—they penetrate unseasoned wood by diffusion, a natural process. Wood moisture content and method and length of storage are the primary factors affecting penetration by diffusion. Properly done, diffusion treatments permit deep penetration of large timbers and refractory (difficult-to-treat) wood species that cannot be treated well by pressure. The diffusible property of borates can be manipulated in many ways; suitable application methods range from complex automated industrial processes to simple brush or injection treatments. Application methods include momentary immersion by bulk dipping; pressure or combination pressure/diffusion treatment; treatment of composite boards and laminated products by treatment of the wood finish; hot and cold dip treatments and long soaking periods; spray or brush-on treatments with borate slurries or pastes; and placement of fused borate rods in holes drilled in wood already in use. This publication contains pesticide recommendations that are subject to change at any time.

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Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

In December of that year, FMC Corp., the sole US manufacturer of carbofuran, announced that it had voluntarily requested that the United States Environmental Protection Agency cancel all but 6 of the previously allowed uses of that chemical as a pesticide. With this change, carbofuran usage in the US would be allowed only on maize, potatoes, pumpkins, sunflowers, pine seedlings and spinach grown for seed. However, in May 2009 EPA cancelled all food tolerances, an action which amounts to a de facto ban on its use on all crops grown for human consumption.

Buffers or pH Modifiers

Most pesticide solutions or suspensions are stable between pH 5.5 and pH 7.0 (slightly acidic to neutral). Above pH 7.0 (alkaline or basic), the pesticide may be subject to degradation. Once a pesticide solution becomes alkaline, the risk exists that the pesticide degrades. Buffers and acidifiers are adjuvants that acidify and stabilize the water in the spray tank. Buffers must be added to the tank mix water first. The water must be neutralized or slightly acidified prior to adding pesticides and adjuvants.

Brassinosteroids

Brassinosteroids (BRs) are a class of polyhydroxysteroids that have been recognized as a sixth class of plant hormones. These were first explored nearly forty years ago when Mitchell et al. reported promotion in stem elongation and cell division by the treatment of organic extracts of rapeseed (Brassica napus) pollen. Brassinolide was the first isolated brassinosteroid in 1979 when it was shown that pollen from Brassica napus could promote stem elongation and cell divisions, and the biologically active molecule was isolated. The yield of brassinosteriods from 230 kg of Brassica napus pollen was only 10 mg. Since their discovery, over 70 BR compounds have been isolated from plants. BRs have been reported to counteract both abiotic and biotic stress in plants. Application of brassinosteroids to cucumbers was demonstrated to increase the metabolism and removal of pesticides, which could be beneficial for reducing the human ingestion of residual pesticides from non-organically grown vegetables

The BR is biosynthesised from campesterol. The biosynthetic pathway was elucidated by Japanese researchers and later shown to be correct through the analysis of BR biosynthesis mutants in Arabidopsis thaliana, tomatoes, and peas. The sites for BR synthesis in plants have not been experimentally demonstrated. One well-supported hypothesis is that all tissues produce BRs, since BR biosynthetic and signal transduction genes are expressed in a wide range of plant organs, and short distance activity of the hormones also supports this. Experiments have shown that long distance transport is possible and that flow is in an acropetal direction, but it is not known if this movement is biologically relevant. Brassinosteroids are recognized at the cell membrane, although they are membrane-soluble.

Brodifacoum

Brodifacoum is a highly lethal vitamin K antagonist anticoagulant poison. In recent years, it has become one of the world's most widely used pesticides. It is typically used as a rodenticide but is also used to control larger mammalian pests such as possum. Brodifacoum has an especially long half-life in the body, which ranges to several months, requiring prolonged treatment with antidotal vitamin K for both human and pet poisonings.

Bromethalin

Bromethalin is a rodenticide which poisons the central nervous system by uncoupling mitochondrial oxidative phosphorylation, which causes a decrease in adenosine triphosphate (ATP) synthesis. Decreased ATP ultimately results in increased intracranial pressure, which damages neuronal axons. This damage to the central nervous system can cause paralysis, convulsions, and death.

Calciferols

Vitamin D is a group of fat-soluble secosteroids. In humans Vitamin D is unique both because it functions as a prohormone and because when sun exposure is adequate the body can synthesize it (as Vitamin D3). Measures of the serum levels reflect endogenous synthesis from sun exposure as well as intake from the diet and it is believed that synthesis may contribute generally to the maintenance of adequate serum concentrations. The evidence indicates that the synthesis of vitamin D from sun exposure works in a feedback loop that prevents toxicity but, because of uncertainty about the cancer risk from sunlight, no recommendations are issued by the Institute of Medicine for the amount of sun exposure required to meet vitamin D requirements. Accordingly the Dietary Reference Intakes for Vitamin D assume that no synthesis occurs and that all of a person's vitamin D is from their diet.

When synthesized in the kidneys, calcitriol circulates as a hormone, regulating the concentration of calcium and phosphate in the bloodstream and promoting the healthy growth and remodeling of bone. Vitamin D prevents rickets in children and osteomalacia in adults, and, together with calcium, helps to protect older adults from osteoporosis. Vitamin D also affects neuromuscular function, inflammation, and influences the action of many genes that regulate the proliferation, differentiation and apoptosis of cells.

Several forms (vitamers) of vitamin D exist. The two major forms are vitamin D2 or ergocalciferol, and vitamin D3 or cholecalciferol, vitamin D without a subscript refers to either D2 or D3 or both. These are known collectively as calciferol. Vitamin D2 was chemically characterized in 1932. In 1936, the chemical structure of vitamin D3 was established and resulted from the ultraviolet irradiation of 7-dehydrocholesterol.

Chemically, the various forms of vitamin D are secosteroids; i.e., steroids in which one of the bonds in the steroid rings is broken. The structural difference between vitamin D2 and vitamin D3 is in their side chains. The side chain of D2 contains a double bond between carbons 22 and 23, and a methyl group on carbon 24.

Vitamin D3 Cholecalciferol

Vitamin D3 (cholecalciferol) is produced by ultraviolet irradiation (UV) of its precursor 7-dehydrocholesterol. This molecule occurs naturally in the skin of animals and in milk. Vitamin D3 can be made by exposure of the skin to UV, or by exposing milk directly to UV (one commercial method).

Vitamin D2

Vitamin D2 is a derivative of ergosterol, a membrane sterol named for the ergot fungus, which is produced by some organisms of phytoplankton, invertebrates, and fungi. The vitamin ergocalciferol (D2) is produced in these organisms from ergosterol in response to UV irradiation. D2 is not produced by land plants or vertebrates, because they lack the precursor ergosterol. The biological fate for producing 25(OH)D from vitamin D2 is expected to be the same as for D3, although some controversy exists over whether or not D2 can fully substitute for vitamin D3 in the human diet.

This course contains EPA’s federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA’s regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Carbaryl

Carbaryl (1-naphthyl methylcarbamate) is a chemical in the carbamate family used chiefly as an insecticide. It is a white crystalline solid commonly sold under the brand name Sevin, a trademark of the Bayer Company. Union Carbide discovered carbaryl and introduced it commercially in 1958. Bayer purchased Aventis CropScience in 2002, a company that included Union Carbide pesticide operations. It remains the third most-used insecticide in the United States for home gardens, commercial agriculture, and forestry and rangeland protection. Approximately 11 million kilograms were applied to U.S. farm crops in 1976

Carbofuran

Carbofuran is one of the most toxic carbamate pesticides. It is marketed under the trade names Furadan, by FMC Corporation and Curater, among several others. It is used to control insects in a wide variety of field crops, including potatoes, corn and soybeans. It is a systemic insecticide, which means that the plant absorbs it through the roots, and from here the plant distributes it throughout its organs where insecticidal concentrations are attained. Carbofuran also has contact activity against pests.

Carbofuran usage has increased in recent years because it is one of the few insecticides effective on soybean aphids, which have expanded their range since 2002 to include most soybean-growing regions of the U.S. The main global producer is the FMC Corporation. Carbofuran is banned in Canada and the European Union. In 2008, the United States Environmental Protection Agency (EPA) announced that it intends to ban carbofuran.

Chlorine

Chlorine is a naturally occurring element normally used in industry and found in some household products. It is normally found as a greenish-yellow gas with a strong, irritating odor like household bleach. Chlorine gas can also be stored under pressure as a liquid for transportation and storage. Although chlorine gas is not flammable, it reacts explosively with many common chemicals (such as alcohols, ammonia, and gasoline) and may ignite some objects (such as wood, paper, oil, and clothing).

Chloropicrin

By far the greatest portion of multi-purpose soil fumigants used are formulations of methyl bromide with varying concentrations of chloropicrin. All methyl bromide products used for soil fumigation should contain a small percentage (0.5 - 2%) chloropicrin to warn of free fumigant in the atmosphere, such as from torn plastic tarps, equipment leaks, etc. Methyl bromide is deadly but has no odor itself; chloropicrin is a powerful tear gas that is easily detected in low concentrations.

Higher proportions of chloropicrin are usually chosen to increase fungicidal activity, since it is a far better fungicide than is methyl bromide. All methyl bromide products are extremely toxic and must be handled with utmost respect and care to avoid injury to those who used them or come near areas where they are used. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Combinations
Combining two or more pesticides and applying them at the same time is convenient and cost effective. Most pesticide manufacturers sell some of their products as premixes, but often you must still combine two or more pesticides at the time of application. When you combine mixtures of two or more pesticides and/or fertilizers at the time of application, you create a tank mix. A common tank mix involves combining fungicides with insecticides as a spray for tree fruit crops.

Another involves combining two or more herbicides to increase the number of weed species controlled. Some people mix pesticides with micronutrients or fertilizers. This practice saves money by reducing the time, labor, and fuel required for multiple applications. Tank mixes reduce equipment wear and decrease labor costs. They lessen the mechanical damage done to crops and soil by heavy application equipment. Combinations may, however, affect the toxicity and the physical and chemical properties of any of the components of the tank mix increase residues, and damage or injure the target site, plant, or animal. If you mix DANGER—POISON pesticides with WARNING or CAUTION pesticides, treat the mixture as a DANGER—POISON pesticide. You must use the required safety equipment and follow all other label restrictions found on the label having the greatest restrictions.

Compatibility Agents
Pesticides are commonly combined with liquid fertilizers or other pesticides. Certain combinations can be physically or chemically incompatible, which causes clumps and uneven distribution in the tank. Occasionally the incompatible mixture plugs the pump and distribution lines resulting in expensive cleanup and repairs. A compatibility agent may eliminate these problems. Read product label directions carefully before adding a compatibility agent to a spray mix. You may wish to do a compatibility test in a quart jar to determine the stability of the mixture. After adding the desired pesticides and the compatibility adjuvant to the jar, shake the mixture and then check for clumping, separation, thickening, and heat release. Any one of these signs indicates an incompatibility problem.

Coumaphos
Coumaphos is a non-volatile, fat-soluble phosphorothioate with ectoparasiticide properties: it kills insects and mites. It is well known under manufacturer brand-names as a dip or wash, used on farm and domestic animals to control ticks, mites, flies and fleas. It is also used to control varroa mites in honey bee colonies, though in many areas it is falling out of favor as the varroa develop resistance and as the residual toxicity effects are becoming better understood.

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Cypermethrin (Common Bee Control Treatment Chemical)
Cypermethrin is a synthetic pyrethroid used as an insecticide in large-scale commercial agricultural applications as well as in consumer products for domestic purposes. It behaves as a fast-acting neurotoxin in insects. It is easily degraded on soil and plants but can be effective for weeks when applied to indoor inert surfaces. Exposure to sunlight, water and oxygen will accelerate its decomposition. Cypermethrin is highly toxic to fish, bees and aquatic insects, according to the National Pesticides Telecommunications Network (NPTN). It is found in many household ant and cockroach killers, including Raid and ant chalk.

How does Cypermethrin Work?
Cypermethrin kills insects that eat or come into contact with it. Cypermethrin works by quickly affecting the insect's central nervous system.

What are some products that contain cypermethrin?
- ✓ Termiticides
- ✓ household insecticides
- ✓ outdoor insecticides
- ✓ AmmoTM
- ✓ CybushR
- ✓ Cynoff TM
- ✓ Cyperkill
- ✓ DemonR

How Toxic is Cypermethrin?
Animals
- Cockroach brain cells exposed to very small doses (up to 0.02 micrograms per gram of brain weight or cg/g) of cypermethrin exhibited a nervous system response, which in cockroaches, would result in restlessness, incoordination, prostration, and paralysis.
- Mice exposed to small doses (0.3 to 4.3 cg/g) of cypermethrin displayed symptoms including writhing, convulsions, and salivation.
- Rats exposed to cypermethrin exhibited similar symptoms including tremors, seizures, writhing, and salivation as well as burrowing behavior.
- Cypermethrin may be a weak skin sensitizer in guinea pigs.
- Newborn rats were more sensitive to cypermethrin than adult rats. The liver enzymes that break down cypermethrin in the body are not completely developed in the newborn rats.

Humans
People handling or working with pyrethrins and pyrethroids (including cypermethrin) sometimes
developed tingling, burning, dizziness, and itching.

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Cytokin
Cytokines (Greek cyto-, cell; and -kinos, movement) are small cell-signaling protein molecules that are secreted by the glial cells of the nervous system and by numerous cells of the immune system and are a category of signaling molecules used extensively in intercellular communication. Cytokines can be classified as proteins, peptides, or glycoproteins; the term "cytokine" encompasses a large and diverse family of regulators produced throughout the body by cells of diverse embryological origin.

The term "cytokine" has been used to refer to the immunomodulation agents, such as interleukins and interferons. Biochemists disagree as to which molecules should be termed cytokines and which hormones. As we learn more about each, anatomic and structural distinctions between the two are fading. Classic protein hormones circulate in nanomolar (10-9) concentrations that usually vary by less than one order of magnitude. In contrast, some cytokines (such as IL-6) circulate in picomolar (10-12) concentrations that can increase up to 1,000-fold during trauma or infection. The widespread distribution of cellular sources for cytokines may be a feature that differentiates them from hormones. Virtually all nucleated cells, but especially endo/epithelial cells and resident macrophages (many near the interface with the external environment) are potent producers of IL-1, IL-6, and TNF. In contrast, classic hormones, such as insulin, are secreted from discrete glands (e.g., the pancreas). As of 2008, the current terminology refers to cytokines as immunomodulating agents. However, more research is needed in this area of defining cytokines and hormones.

Part of the difficulty with distinguishing cytokines from hormones is that some of the immunomodulating effects of cytokines are systemic rather than local. For instance, to use hormone terminology, the action of cytokines may be autocrine or paracrine in chemotaxis and endocrine as a pyrogen. Further, as molecules, cytokines are not limited to their immunomodulatory role. For instance, cytokines are also involved in several developmental processes during embryogenesis.

Defoaming Agents
Some pesticide formulations create foam or a frothy “head” in spray tanks. This is often the result of both the type of surfactant used in the formulation and the type of spray tank agitation system. The foam usually can be reduced or eliminated by adding a small amount of a defoaming agent.

Deltamethrin (Delta Dust or Drione Dust)
Deltamethrin is an insecticide belonging to the pyrethroid family. Pyrethroids are the man-made versions of pyrethrins, natural insecticides from chrysanthemum flowers. Deltamethrin is used outdoors on lawns, ornamental gardens, golf courses, and indoors as a spot or crack and crevice treatment. In its purest form, deltamethrin is colorless or white to light beige crystals that have no odor.

Deltamethrin is in a variety of products used to kill a wide range of insects. Deltamethrin can be formulated in insecticide products as aerosols, sprays, dusts, granules and wettable powders. The illegal, unregistered product known as “Chinese Chalk” or “Miraculous Chalk” often contains deltamethrin as the active ingredient. “Chinese Chalk”, “Miraculous Chalk”, and products like them are not registered for use in the United States and illegal products such as these should be avoided at all times.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

How does Deltamethrin work?
Deltamethrin can kill insects by direct contact or if they eat it. It disrupts their normal nervous system function. It is less toxic to mammals due to their higher body temperature, larger body size, and decreased sensitivity to the chemical.

How might I be exposed to Deltamethrin?
You can be exposed to deltamethrin if you touch, eat, or breathe it in. As an example, it could be breathed in if a fine mist or dust containing deltamethrin gets in the air you breathe. Exposure to deltamethrin can be limited by reading and following label directions.

Demeton
Demeton is a phosphorothioate insecticide with the chemical formula $C_8H_{19}O_3PS_2$.

Demeton-S-methyl
Demeton-S-methyl is an organic compound with the molecular formula $C_6H_{15}O_3PS_2$. It is used as an acaricide and insecticide; more specifically it is an organothiophosphate acaricide and an aliphatic organothiophosphate insecticide, respectively. It is flammable.

Desiccants
Desiccating or drying. A substance, such as calcium oxide, that absorbs water and is used to remove moisture; a drying agent.

Desiccant Insecticides
Borates, Silica Gel
Insecticides that have a desiccant action on bugs are used in pest control to kill a variety of pests, including fleas, ticks, bedbugs and cockroaches. Insects are invertebrates, having an external skeleton commonly known as an exoskeleton. This exoskeleton not only gives support and structure (as does our internal skeleton network of bones) but protects insects from drying out. Desiccants or desiccant insecticides have the ability to dry out bugs and kill them. Not all insects are immediately killed by a desiccant, due to the thickness or hardness of their cuticle or outer shell. Pest control operators will use desiccant materials that are especially formulated to safely kill targeted pests in homes and other buildings.

Amorphous Silica
Diatomaceous earth is a form of amorphous silica that kills certain insects. Drione Dust is a professional insecticide dust that contains amorphous silica gel, natural pyrethrins and Piperonyl Butoxide. Piperonyl Butoxide is a synergist that enhances the action of pyrethrins and other insecticides. Borates such as boric acid, Flea Stoppers) are also desiccants.

Borates
Flea Stoppers, boric acid and Mop Up are examples of borates used in pest control. These special boric acid products have two modes of action: desiccation and slow acting stomach poison. Flea Stoppers is a great example of an insecticide that kills bugs by desiccation or drying them out.

The eggs and larvae of fleas are soft and pliable, making them an easy target for a desiccant. Larvae that eat foods in areas treated with Flea Stoppers are also killed by the other mode of action: stomach poison. Feeding on adult flea droppings that have been coated with Flea Stoppers kills the larvae from the inside while direct contact with the insecticide kills them from the outside. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Silica Gel
Amorphous Silica Gel is another desiccant that pest control operators feel that is safe to use in homes that have infestations of ticks, bed bugs and other unwanted creatures hiding in wall voids, attics, cracks and crevices. Drione Dust contains two active ingredients (Amorphous Silica Gel and Pyrethrins) and a synergist (Piperonyl Butoxide).

This combination gives Drione Dust multiple modes of action: desiccation and internal action from silica gel as well as the well-known knock down power of natural pyrethrins. PyGanic Dust also contains Silica Gel and Pyrethrins. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Borates
No matter which desiccant insecticide you choose, always follow label instructions. Not all borates are labeled for the same uses. For example: boric acid powder can be used in cracks and crevices but not in carpets. Flea Stoppers is a very tiny boric acid type granule that can be safely broadcast on carpets but cannot be used to preserve and protect wood from wood destroying organisms. Timbor is designed to spray wood for termite and powderpost beetle protection but cannot be broadcast on carpets to kill fleas. Bora-Care kills termites and powderpost beetles in wood for many years but is not used to spray on baseboards to kill spiders. Desiccant insecticides that kill bugs by desiccant mode of action are generally considered safer to use than an insecticide dust that contains a heavy organophosphate pesticide. In other words, Drione Dust has far less possible hazards to humans and pets than Diazinon Dust; Permethrin, Talstar and Onyx are much lower risks than Lindane (a chlorinated hydrocarbon); Flea Stoppers is safer for mammals than Dursban flea sprays.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

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NiBan - FG

Another commonly found pesticide product is NiBan -FG. Niban FG (e.g. Orthoboric acid 5.0 %): Weather resistant bait for the control of ants, carpenter ants, cockroaches, crickets, mole crickets, and silverfish for both interior and exterior use, for use in and around Homes, Apartments, Garages, Public and Private Institutions, Schools, Hotels, Hospitals, Warehouses, Supermarkets, Restaurants, and Food Processing Plants. Apply at a rate of 4 pounds per 1000 square feet (6 ounces per 100 square feet) of surface area. Spread evenly in crawl spaces, attics, and drop ceilings, cellars with dirt or gravel floors.

In warehouses, garages and basements, concentrate application along walls and baseboards. Apply in inaccessible areas such as cracks and crevices where insects may hide. Reapply as necessary. Always have a backup backpack. Always follow the pesticide label's instructions and not my comments or suggestions. Some of my suggestions may be illegal in some areas.

When baiting for roaches, crickets or silverfish in cracks and crevices, Niban FG is easy to apply with a Crusader Duster. This professional duster enables you to penetrate deep into the hiding places of insect pests. When baiting outdoors only, Niban G is the best. Niban G is a larger granule, capable of withstanding outdoor conditions for longer periods. When treating for carpenter ants outdoors, consider using the larger granule size.

Disinfectants and Sanitizers
Antimicrobial pesticides are substances or mixtures of substances used to destroy or suppress the growth of harmful microorganisms whether bacteria, viruses, or fungi on inanimate objects and surfaces. Antimicrobial products contain about 275 different active ingredients and are marketed in several formulations: sprays, liquids, concentrated powders, and gases. Today, approximately one billion dollars each year are spent on a variety of different types of antimicrobial products. More than 5000 antimicrobial products are currently registered with the U.S. Environmental Protection Agency (EPA) and sold in the marketplace. Nearly 60% of antimicrobial products are registered to control infectious microorganisms in hospitals and other health care environments. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Antimicrobial Pesticides Major Uses

Antimicrobial pesticides have two major uses:
1. Disinfect, sanitize, reduce, or mitigate growth or development of microbiological organisms;
2. Protect inanimate objects (for example floors and walls), industrial processes or systems, surfaces, water, or other chemical substances from contamination, fouling, or deterioration caused by bacteria, viruses, fungi, protozoa, algae, or slime. These uses do not include certain pesticides intended for food use; but do encompass pesticides with a wide array of other uses.

For example:
Antimicrobial pesticides act as preserving agents in paints, metalworking fluids, wood supports, and many other products to prevent their deterioration.

Types of Antimicrobial Products
Antimicrobial products are divided into two categories based on the type of microbial pest against which the product works:

Non-public health products are used to control growth of:
Algae, odor-causing bacteria, bacteria which cause spoilage, deterioration or fouling of materials and microorganisms infectious only to animals. This general category includes products used in:
- cooling towers, jet fuel, paints, and treatments for textile and paper products.

Public health products are intended to control microorganisms infectious to humans in any inanimate environment. The more commonly used public health antimicrobial products include the following:

Sterilizers (Sporicides):
Used to destroy or eliminate all forms of microbial life including:
- fungi, viruses, all forms of bacteria and their spores.

Spores are considered to be the most difficult form of microorganism to destroy. Therefore, EPA considers the term Sporicide to be synonymous with "Sterilizer." Sterilization is critical to infection control and is widely used in hospitals on medical and surgical, instruments and equipment.

Types of sterilizers include:

- steam under pressure (autoclaving)
- dry heat ovens (used primarily for sterilization of medical instruments)
- low temperature gas (ethylene oxide) (used primarily for sterilization of medical instruments)
- liquid chemical sterilants (used primarily for delicate instruments which cannot withstand high temperature and gases).

Disinfectants
Used on hard inanimate surfaces and objects to destroy or irreversibly inactivate infectious fungi and bacteria but not necessarily their spores.

Disinfectant products are divided into two major types:
Hospital type disinfectants are the most critical to infection control and are used on:

- Medical and dental instruments, floors, walls, bed linens, toilet seats, and other surfaces

General use disinfectants are the major source of products used in:

- Households, swimming pools, water purifiers.

Sanitizers
Used to reduce, but not necessarily eliminate, microorganisms from the inanimate environment to levels considered safe as determined by public health codes or regulations.

Sanitizers include: Food contact products - These products are important because they are used on sites where consumable food products are placed and stored. Sanitizing rinses for surfaces such as:
Dishes and cooking utensils, equipment and utensils found in:

- Dairies, food-processing plants, eating and drinking establishments

Non-food contact products - Non-food contact surface sanitizers include:

- Carpet sanitizers, air sanitizers, laundry additives, in-tank toilet bowl sanitizers.

Antiseptics and Germicides: Used to prevent infection and decay by inhibiting the growth of microorganisms. Because these products are used in or on living humans or animals, they are considered drugs and are thus approved and regulated by the Food and Drug Administration (FDA).

Diazinon

Diazinon (IUPAC name: O,O-Diethyl O-[4-methyl-6-(propan-2-yl)pyrimidin-2-yl] phosphorothioate), a colorless to dark brown liquid, is a thiophosphoric acid ester developed in 1952 by Ciba-Geigy, a Swiss chemical company (later Novartis and then Syngenta). It is a nonsystemic organophosphate insecticide formerly used to control cockroaches, silverfish, ants, and fleas in residential, non-food buildings. Diazinon was heavily used during the 1970s and early 1980s for general-purpose gardening use and indoor pest control. A bait form was used to control scavenger wasps in the western U.S. Residential uses of diazinon were outlawed in the U.S. in 2004 but it is still approved for agricultural uses.

Diazinon kills insects by inhibiting acetylcholinesterase, an enzyme necessary for proper nervous system function. Diazinon has a low persistence in soil. The half-life is 2 to 6 weeks. The symptoms associated with diazinon poisoning in humans include weakness, headaches, tightness in the chest, blurred vision, nonreactive pinpoint pupils, excessive salivation, sweating, nausea, vomiting, diarrhea, abdominal cramps, and slurred speech.

In 1988, the Environmental Protection Agency prohibited the use of Diazinon on golf courses and sod farms because of decimation of bird flocks that congregated in these areas. In the United States as of December 31, 2004, it became unlawful to sell outdoor, non-agricultural products containing diazinon. It is still legal for consumers to use diazinon products purchased before this date, provided that they follow all label directions and precautions

Dicrotophos

Dicrotophos is an organophosphate acetylcholinesterase inhibitor used as an insecticide. Some common brand names for dicrotophos include Bidrin, Carbicron, Diapadrin, Dicron and Ektafos.

Difethialone

Difethialone is an anticoagulant used as a rodenticide. It is considered a second generation agent. In May 2008 the United States Environmental Protection Agency promulgated a decision that would ban the use of difethialone in consumer-use rodenticide products.

Dimethoate

Dimethoate is a widely used organophosphate insecticide used to kill insects on contact. It was patented and introduced in the 1950s by American Cyanamid. Like other organophosphates, dimethoate is an anticholinesterase which disables cholinesterase, an enzyme essential for central nervous system function.

Drift Control Additives

Drift is a function of droplet size. Small, fine drops with diameters of 100 microns or less tend to drift away from targeted areas. Drift control additives, also known as deposition aids, improve on-target placement of the pesticide spray by increasing the average droplet size. Drift reduction can be very important near sensitive sites and may well be worth the small reduction in efficacy that may result from the change in droplet size.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Emulsifiable Concentrates

An emulsifiable concentrate is simply a liquid concentrate that is added to water to create your pesticide solution. In most cases, EC is the designation for an emulsifiable insecticide (or fungicide) concentrate product. Examples of this type of pesticide formulation: Demon EC, Cynoff EC, Permethrin Pro, Catalyst.

Many herbicides are not soluble in water, but are soluble in organic (hydrocarbon) solvents. The solvents most often used are high boiling point aromatic solvents. Emulsifiers must be added so that the formulation will mix easily with water in the spray tank (producing the characteristic milky-white emulsion), and so that the emulsion will be stable. Wetting agents are generally not included, but are added to the spray tank as required. Emulsifiable concentrates normally have few problems in use, but it must also be remembered that they can be flammable.

Pesticides are formulated in a variety of processes such as being dissolved in a solution or dispersed in a suspension or an emulsion. Many liquid and dry formulations are available, including emulsifiable concentrates (EC), solutions (S), flowables (F), dusts (D), baits (B), and soluble powders (SP), to mention a few. Other formulations are available that cannot be clearly classified as either liquid or dry/solid pesticide formulations. These products, such as microencapsulated materials and water-soluble packets, have special properties that make them preferable for certain pest control situations. Understanding the relative advantages and disadvantages of the various formulation types helps the applicator decide which one is best to use in a given pest control situation.

Adjuvants are added to pesticide formulations to improve the pesticide's ability to control pests, although the adjuvants themselves do not possess pesticidal activity. For example, surfactant type adjuvants function as wetting agents or spreaders that improve pesticide coverage over an area such as a leaf surface. The pesticide handler should know how and when to use an adjuvant. Always read the pesticide label carefully to determine whether adding an adjuvant is recommended for use with the pesticide product.

There are other emulsifiable products that are not insecticides. A good example is Gentrol, an IGRin liquid concentrate form. Roundup, Vantage and Imageare examples of liquid concentrate herbicides. Emulsifiable concentrates usually dry clear and give 28 to 31 days residual. These products are also cheaper to use for jobs requiring a large volume of pesticide spray. When treating a cedar siding home or other such structure for carpenter bees, Demon EC or Cynoff EC save a great deal of money over wettable powder products that would leave a visible residue on such dark surfaces.

In summary, the pesticide user must consider several factors when selecting a pesticide formulation, such as the risks associated with the formulation type, the practicality of using the formulation on the target site or pest, and whether it will provide effective control. Having a basic understanding of formulation types before using pesticides helps the user avoid mistakes and accidents in choosing, mixing, loading, and applying the product.

Endosulfan

Endosulfan is an off-patent organochlorine insecticide and acaricide that is being phased out globally. Endosulfan became a highly controversial agrichemical due to its acute toxicity, potential for bioaccumulation, and role as an endocrine disruptor. Because of its threats to human health and the environment, a global ban on the manufacture and use of endosulfan was negotiated under the Stockholm Convention in April 2011. The ban will take effect in mid-2012, with certain uses exempted for 5 additional years. More than 80 countries, including the European Union, Australia and New Zealand, several West African nations, the United States, Brazil and Canada had already banned it or announced phase outs by the time the Stockholm Convention ban was agreed upon. It is still used extensively in India, China, and few other countries. It is produced by Makhteshim Agan and several manufacturers in India and China.

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Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

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Etoxazole

TetraSan contains the active ingredient etoxazole and is actually a growth regulator for mites, inhibiting the molting process. TetraSan is labeled for control of the following mites: two-spotted spider mite, citrus red mite, European red mite, Lewis spider mite, Pacific spider mite, Southern red mite, and spruce spider mite. TetraSan can be used to control mites in greenhouses, lath houses, shadehouses, and interiorscapes and on outdoor ornamentals. Similar to abamectin (Avid) (described previously), TetraSan is a contact and translaminar miticide providing up to 28 days of residual activity from a single application. The label rate for controlling mites is 8 to 16 oz. per 100 gal. The product is active on the egg, larvae, and nymphal stages. It has minimal effect on adult mites. However, adult female mites that are treated do not produce viable eggs.

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Extenders

Some adjuvant manufacturers have named their products "extenders." Extenders function like stickers by retaining pesticides longer on the target area, slowing evaporation, and inhibiting degradation by sunlight.

Fenthion

Fenthion is an organothiophosphate insecticide, avicide, and acaricide. Like most other organophosphates, its mode of action is via cholinesterase inhibition. Due to its relatively low toxicity towards humans and mammals, fenthion is listed as moderately toxic compound in U.S. Environmental Protection Agency and World Health Organization toxicity class

Fenthion is a contact and stomach insecticide used against many sucking, biting pests. It is particularly effective against fruit flies, leaf hoppers, cereal bugs, stem borers, mosquitoes, animal parasites, mites, aphids, codling moths, and weaver birds. It has been widely used in sugar cane, rice, field corn, beets, pome and stone fruit, citrus fruits, pistachio, cotton, olives, coffee, cocoa, vegetables, and vines. Based on its high toxicity on birds, fenthion has been used to control weaver birds and other pest-birds in many parts of the world. Fenthion is also used in cattle, swine, and dogs to control lice, fleas, ticks, flies, and other external parasites.

Amid concerns of harmful effects on environment, especially birds, Food and Drug Administration no longer approves uses of fenthion. However, fenthion has been extensively used to control adult mosquitoes. After preliminary risk assessments on human health and environment in 1998 and its revision in 1999, USEPA issued an Interim Reregistration Eligibility Decision (IRED) for fenthion in January 2001. The EPA has classified fenthion as Restricted Use Pesticide (RUP), and warrants special handling because of its toxicity.

Some common trade names for fenthion are Avigel, Avigrease, Entex, Baytex, Baycid, Dalf, DMPT, Mercaptophos, Prentox, Fenthion 4E, Queletox, and Lebaycid. Fenthion is available in dust, emulsifiable concentrate, granular, liquid concentrate, spray concentrate, ULV, and wettable powder formulations.

Fenitrothion
Fenitrothion (IUPAC name: O,O-Dimethyl O-(3-methyl-4-nitrophenyl) phosphorothioate) is a phosphorothioate (organophosphate) insecticide. In experiments fenitrothion at sublethal doses affected the motor movement of marsupials, and at acute dose levels it reduced the energy of birds.

In chronic (low) dose tests, unexpectedly only the lowest concentration (0.011 microgram/liter) of fenitrothion depressed the growth of an algae, though all of the chronic dose levels used were toxic in other ways to the algae. Just half of fenitrothion's minimally effective dose altered the thyroid structure of a freshwater murrel (the snakehead fish).

Fenvalerate
Fenvalerate is an insecticide. It is a mixture of four optical isomers which have different insecticidal activities. The 2-S alpha (or SS) configuration is the most insecticidal active isomer. Fenvalerate consists of about 23% of this isomer.

Fenvalerate is an insecticide of moderate mammalian toxicity. In laboratory animals, central nervous system toxicity is observed following acute or long-term exposure. Fenvalerate has applications against a wide range of pests. Residue levels are minimized by low application rates. Fenvalerate is most toxic to bees and fish. It is found in some emulsifiable concentrates, ULV, wettable powders, slow release formulations, insecticidal fogs, and granules. It is most commonly used to control insects in food, feed, and cotton products, and for the control of flies and ticks in barns and stables. Fenvalerate does not affect plants, but is active for an extended period of time. Fenvalerate may irritate the skin and eyes on contact, and is also harmful if swallowed

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Fungicides
Fungicides are chemical compounds or biological organisms used to kill or inhibit fungi or fungal spores. Fungi can cause serious damage in agriculture, resulting in critical losses of yield, quality and profit. Fungicides are used both in agriculture and to fight fungal infections in animals. Chemicals used to control oomycetes, which are not fungi, are also referred to as fungicides as oomycetes use the same mechanisms as fungi to infect plants.

Contact, Translaminar or Systemic
Fungicides can either be contact, translaminar or systemic. Contact fungicides are not taken up into the plant tissue, & only protect the plant where the spray is deposited; translaminar fungicides redistribute the fungicide from the upper, sprayed leaf surface to the lower, unsprayed surface; systemic fungicides are taken up & redistributed through the xylem vessels to the upper parts of the plant. New leaf growth is protected for a short period.

Forms of Fungicides
Most fungicides that can be bought retail are sold in a liquid form. A very common active ingredient is sulfur, present at 0.08% in weaker concentrates, and as high as 0.5% for more potent fungicides. Fungicides in powdered form are usually around 90% sulfur and are very toxic. Other active ingredients in fungicides include neem oil, rosemary oil, jojoba oil, and the bacterium Bacillus subtilis.
Fungicide residues have been found on food for human consumption, mostly from post-harvest treatments. Some fungicides are dangerous to human health, such as vinclozolin, which has now been removed from use.

Chemical Defenses
Plants and other organisms have chemical defenses that give them an advantage against microorganisms such as fungi. Some of these compounds can be used as fungicides:

- ✓ Tea tree oil
- ✓ Cinnamaldehyde
- ✓ Cinnamon essential oil
- ✓ Jojoba oil
- ✓ Neem oil
- ✓ Rosemary oil
- ✓ Monocerin
- ✓ Milk
- ✓ Ampelomyces quisqualis AQ10, CNCM I-807

Whole live or dead organisms that are efficient at killing or inhibiting fungi can sometimes be used as fungicides:

- The bacterium Bacillus subtilis
- Kelp (powdered dried kelp is fed to cattle to protect them from fungi in grass)

The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Fungicide First Aid

It is still important to recognize signs and symptoms of fungicide poisoning. When in doubt, seek medical attention and be sure to bring the fungicide label and SDS to the physician.

Poisoning Recognition
Certain fungicides may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers.

Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific herbicide involved and the level of exposure. If you have been working with fungicides and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The fungicide label or SDS will have a telephone number to contact in case of a medical incident.

Procedures

- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Material Safety Data Sheet (SDS) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Fungicides on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Fungicides in Eye
Eye exposure to fungicides can be serious. Always pour, measure, or mix fungicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Fungicides contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Fungicides in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Fungicides in Mouth or Swallowed

Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator's clothing becoming contaminated.

"Spill kits" are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material.

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Fumigants Sub-Section

The most effective way to reach pests in their most remote hiding places is through fumigation, the use of poisonous gases to kill pests in an enclosed area. To be effective, fumigants must reach target pests as gases. Fumigation continues to play a valuable role in many pest control operations; however, both the concepts and procedures for controlling insects and other organisms are changing. Fumigants have unique properties and capabilities that permit use in numerous situations where other forms of control are not feasible or practical.

A practical example is a warehouse. Fumigation and pest management takes care of insects and pests infestation and fumigants exist in gaseous and has sufficient concentration on intended insects and pests. The chemical insecticides and pesticides are made to penetrate into material and areas being fumigated and diffuse afterward, hence making your home or office congenial. The adaptability of fumigation technique, fumigants can often provide effective economical control where other forms of pest control are not feasible. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Fumigants are pesticides that form poisonous gases when applied. Some active ingredients are liquids when pack aged under high pressure and change to gases when they are released. Other active ingredients are volatile liquids when enclosed in an ordinary container and therefore are not formulated under pressure.

Others are solids that release gases when applied under conditions of high humidity or in the presence of water vapor. Fumigants are used for structural pest control, in food and grain storage facilities, and in regulatory pest control at ports of entry and at state and national borders. In agricultural pest control, fumigants are used in soil, greenhouses, granaries, and grain bins.

Advantages

- Toxic to a wide range of pests.
- Can penetrate cracks, crevices, wood, and tightly packed areas such as soil or stored grains.
- Single treatment usually kills most pests in treated area.

Disadvantages

- The target site must be enclosed or covered to prevent the gas from escaping.
- Non-specific—highly toxic to humans and all other living organisms.
- Require the use of specialized protective equipment, including respirators specifically approved for use with fumigants.

Wide-Spectrum

Fumigants are "wide-spectrum" pesticides, killing all species of arthropods and rodents that are likely to be found in a building. They are also volatile pesticides whose vapors enter the insect's body through the body wall or breathing system. Fumigants penetrate to many areas of a building not reached by sprays or dusts, even penetrating to the burrows of wood-infesting insects, as well as to the center of tightly packed commodities, such as tobacco in hogsheads, bales, cases or grain in large silos or bulking bins. A fumigant gas generally does not leave unsightly, odorous, or hazardous residues.

Fumigation also has certain disadvantages. Highly skilled, experienced, and licensed are required since all fumigants are extremely hazardous to use. The application of fumigants is limited to areas, spaces,
items, or commodities that can be tightly enclosed. Fumigated structures must be sealed as air tight as possible and their occupants must leave, sometimes for seven days or longer. Some fumigants may damage items in the area being fumigated. Also, fumigation generally costs more than other pest control procedures, and fumigants leave no protective residue so that is possible immediately after treatment.

Restricted-Use Pesticides

Fumigants are Restricted-Use pesticides because of their high acute toxicity, primarily by inhalation. They can act as respiratory poisons, anesthetics or narcotics, or enzyme poisons. Because of their gaseous nature and acute inhalation toxicity, fumigant products are labeled as Toxicity Category I and all fumigants will have warnings such as "***Danger... .. Keep Out of Reach of Children ... .. Poison***," and the skull and symbol. The label contains information on using the product correctly, obtaining practical pest control, storing the product safely, and disposing of the containers and residue of the fumigant correctly. The label also states antidotes and first-aid treatment, in case a human should be poisoned during fumigation. Any use of a fumigant in a manner inconsistent with the label may be in violation of the law. If a person violates the Federal Insecticide, Fungicide, and Act : he or she may be subjected to civil penalties as much as $5,000 for each offense, or criminal penalties as much as $25,000 or one year in prison, or both. It is unlawful to transfer a fumigant from its original container to another unmarked container.

Highly Toxic
All fumigants are highly toxic and require trained personnel for application. Anyone handling fumigants should be thoroughly familiar with application procedures, safety equipment, first-aid treatment, and disposal procedures. At least two people should always be present when using fumigants and both should have the proper respiratory equipment for the particular fumigant being used. The ideal fumigant should not change or impair the treated commodity in any way, nor should it leave any residue which could be hazardous during processing or harmful to the consumer. The EPA has determined the amount of pesticide residue that may safely remain in or on agricultural products as well as processed foods. This is called "tolerance."

The EPA has also established exposure limits, which are the levels of fumigant concentration above which it is not safe for people (workers) to be exposed. The quantity of a fumigant to be applied in sealed buildings, vacuum chambers, rail cars, and to packed commodities under tarpaulins is determined by the volume (cubic feet) of the space. In most cases, no allowances are made for the space occupied by the commodities.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

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Hazards
Fumigant pesticides form gases or vapors toxic to plants, animals, and microorganisms. Aluminum and magnesium phosphide products for controlling burrowing rodents are formulated as tablets and pellets that are rapidly transformed to highly toxic phosphine gas when exposed to moisture. Phosphine fumigants have been associated with accidental poisoning incidents, and their use is restricted to specially trained pesticide applicators (Figure 2).

The Salt Lake Tribune

THURSDAY, April 8, 2010

Second Layton girl dies in case of possible pesticide poisoning

Layton family: 'We are heartbroken'

By Erin Alberty And Jason Bergreen
The Salt Lake Tribune

Updated: 04/07/2010 05:15:24 PM MDT

A Layton family has lost its second daughter since toxic pesticide fumes apparently wafted into their home last weekend.

Rachel Toone, 15 months, died Tuesday at Primary Children's Medical Center. Three days earlier her 4-year-old sister, Rebecca, died at Davis Hospital after she had begun struggling to breathe in the family's home.

"We are heartbroken," the Toone family wrote in a press statement announcing Rachel's death. Rachel's health deteriorated after heart failure early Monday, the family wrote.

Authorities suspect the toxic gas phosphine sickened the family. Investigators say the gas may have entered into the family's home after an exterminator dropped Fumitoxin aluminum phosphide pellets in burrow holes in the lawn Friday to kill small rodents known as voles.

Rebecca Toone died Saturday after she grew sick in the family's home. Her parents and siblings also were hospitalized with flu-like symptoms the same day. They were all discharged Sunday, but Rachel fell ill again later that day.

Bugman Pest placed about 1½ pounds of Fumitoxin aluminum phosphide pellets alongside a sidewalk leading to the Toone's front porch, coming within about 7 feet of the front door and 3 feet of the garage, according to a hazardous materials cleanup team from the Utah National Guard.

Related

Toone family tragedy

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- Exterminator owner: 'I have told the family ... out'

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- Killer pesticide? Laytor toddler sister hospitali
- What you need to kno phosphine

Feb 7:

Figure 2. Media report of phosphide poisoning.

Expanded Restrictions

To increase public safety by reducing potential exposure to phosphine fumigants, the EPA expanded the restrictions and is requiring clearer label directions and precautions for aluminum and magnesium phosphide products that are used in rodent burrow fumigation. Indoor use of such products has long been prohibited.

The EPA has expanded and clarified the outdoor use restrictions for these products as follows:

- Use is strictly prohibited around all residential areas, including single and multi-family residential properties, nursing homes, schools (except athletic fields, where use may continue), day care facilities, and hospitals.
- The products must only be used outdoors for control of burrowing pests, and are for use only on agricultural areas, orchards, non-crop areas (such as pasture and rangeland), golf courses, athletic fields, parks and recreational areas, cemeteries, airports, rights-of-way, earthen dams, and other non-residential institutional or industrial sites.
- Products must not be applied in a burrow system within 100 feet of a building that is or may be occupied by people or domestic animals. This buffer zone for treatment around non-residential buildings that could be occupied by people or animals has been increased from 15 feet to 100 feet.
- When this product is used in athletic fields or parks, the applicator must post a sign at entrances to the treated site containing the signal word DANGER/PELIGRO, skull and crossbones, the words DO NOT ENTER/NO ENTRE, FIELD NOT FOR USE, the name and EPA registration number of the fumigant, and a 24-hour emergency response number. Signs may be removed two days after the final treatment.

- When this product is used out-of-doors in a site frequented by people, other than an athletic field or park, the applicator shall post a sign at the application site containing the signal word DANGER/PELIGRO, skull and crossbones, the name and EPA registration number of the fumigant, and a 24-hour emergency response number. Signs may be removed two days after the final treatment.

Fumigant management plans must be written before all applications of phosphine products, including all burrowing pest fumigations. A fumigant management plan is a written description of the steps designed to plan for a safe, legal, and effective fumigation. The certified applicator and owner of the property to be fumigated must characterize the area to be treated and include all safety requirements in the plan before application.

Fumigant First Aid

It is still important to recognize signs and symptoms of fumigant poisoning. When in doubt, seek medical attention and be sure to bring the fumigants label and SDS to the physician.

Poisoning Recognition
Certain Fumigants may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers. Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific chemical or product involved and the level of exposure. If you have been working with fumigants and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The fumigant label or SDS will have a telephone number to contact in case of a medical incident.

Procedures

- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Safety Data Sheet (SDS) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Fumigants on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Fumigants in Eye
Eye exposure to fumigants can be serious. Always pour, measure, or mix herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Fumigants contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Fumigants in the Lungs
Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Fungicides in Mouth or Swallowed
Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator’s clothing becoming contaminated.

Glyphosate

Glyphosate (N-(phosphonomethyl) glycine) is a broad-spectrum systemic herbicide used to kill weeds, especially annual broadleaf weeds and grasses known to compete with crops grown widely across the Midwest of the United States. Initially patented and sold by Monsanto Company in the 1970s under the trade name Roundup, its U.S. patent expired in 2000. Glyphosate is the most used herbicide in the USA, where every year, 5–8 million pounds (2,300–3,600 tons) are used on lawns and yards and another 85–90 million pounds (39,000–41,000 t) are used in agriculture.

Glyphosate's mode of action is to inhibit an enzyme involved in the synthesis of the aromatic amino acids: tyrosine, tryptophan and phenylalanine. It is absorbed through foliage and translocated to growing points. Because of this mode of action, it is only effective on actively growing plants; it is not effective as a pre-emergence herbicide. Some crops have been genetically engineered to be resistant to it (i.e. Roundup Ready, also created by Monsanto Company). Such crops allow farmers to use glyphosate as a post-emergence herbicide against both broadleaf and cereal weeds, but the development of similar resistance in some weed species is emerging as a costly problem. Soy was the first Roundup Ready crop.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Imidacloprid

Imidacloprid is a nicotine-based, systemic insecticide, which acts as a neurotoxin and belongs to a class of chemicals called the neonicotinoids. Although it is now off patent, the primary manufacturer of this chemical is Bayer CropScience, (part of Bayer AG). It is sold under the trade names Kohinor, Admire, Advantage (Advocate) (flea killer for pets), Gaucho, Mallet, Merit, Nuprid, Prothor, Turfthor, Confidor, Conguard, Hachikusan, Premise, Prothor, Provado, and Winner. Imidacloprid is one of the most widely used insecticides and can be applied by soil injection, tree injection, application to the skin, or broadcast foliar or ground application as a granular or liquid formulation or as a pesticide-coated seed treatment.

In France, beekeepers reported a significant loss of honeybees in the 1990s, which they attributed to the use of imidacloprid (Gaucho). See Imidacloprid effects on bee population. In response to this loss of bees called "mad bee disease," the French Minister of Agriculture convened a panel of expert scientists (Comite Scientifique et Technique) to examine the impact of imidacloprid on bees.

After reviewing dozens of laboratory and field studies conducted by Bayer CropScience and by independent scientists, the panel concluded that there was a significant risk to bees from exposure to imidacloprid on sunflowers and maize (corn), the only crops for which they had exposure data. Following the release of this report, the French Agricultural Ministry suspended the use of imidacloprid on maize and sunflowers. Italy, Germany, and Slovenia have also suspended certain uses of the neonicotinoids based on concerns for bees

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Incompatibility

Incompatibility is a condition that prevents pesticides from mixing together properly to form a uniform solution or suspension. The formation of flakes, crystals, or oily clumps, or severe separation is unacceptable. Such incompatible mixtures clog application equipment and limit even distribution of the active ingredient in the spray tank. The cause of incompatibility may be the chemical nature of the materials you are mixing. Impurities in the spray tank or water also may affect compatibility.

Even the order in which you mix pesticides in the spray tank is important. Sometimes the types of formulations being mixed influence compatibility. Pesticide formulations of the same type are rarely incompatible with one another because they usually contain many of the same inert ingredients and solvents.

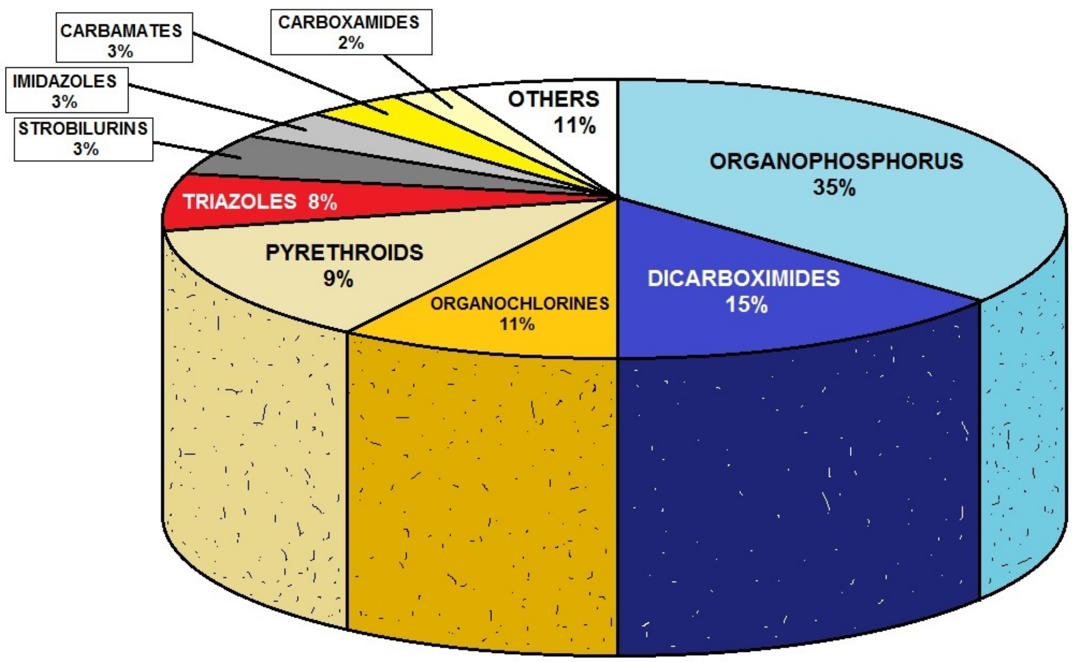
Sometimes tank mixes seem compatible during testing and after mixing in the spray tank, but problems arise during application. This is known as field incompatibility. The temperature of the water in the tank can cause this problem. It could also be due to water impurities. Water pH (acidity vs. alkalinity) also may unexpectedly change for some unknown reason. Sometimes the amount of time the spray mixture has been in the tank causes field incompatibility.

Adjuvants are chemicals that do not possess pesticidal activity. Adjuvants are either premixed in the pesticide formulation or added to the spray tank to improve mixing or application or to enhance pesticidal performance.

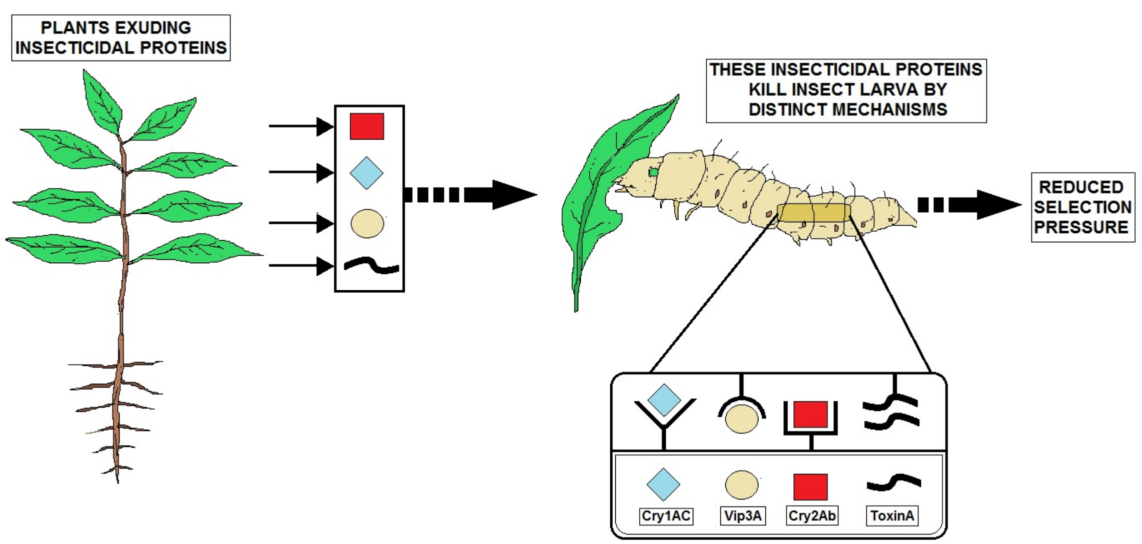
They are used extensively in products designed for foliar applications. Adjuvants can be used to customize the formulation to specific needs and compensate for local conditions. The right adjuvant may reduce or even eliminate spray application problems, thereby improving overall pesticide efficacy. Because adjuvants themselves have no pesticidal properties, they are not registered by the EPA. As a result, there is no set of standards for composition and quality, although some states have modified registration requirements for these chemicals and may require labels, technical data sheets, and efficacy information.

Before using any adjuvant, consult the pesticide label. Many registered pesticide products have very specific recommendations on their labels for use with one or more adjuvants. Failure to follow these instructions is as much a violation of the product label as inappropriate use of the pesticide. If you have questions about the specific properties of an adjuvant, contact the manufacturer before attempting to use it.

Companies that produce adjuvants can provide labels, technical data sheets, SDS, supplemental labeling, and promotional literature about their products. Adjuvants are designed to perform specific functions, including wetting, spreading, sticking, reducing evaporation, reducing volatilization, buffering, emulsifying, dispersing, reducing spray drift, and reducing foaming. No single adjuvant can perform all these functions, but compatible adjuvants often can be combined to perform multiple functions simultaneously.



PERCENTAGE OF PESTICIDE BY CHEMICAL CLASSIFICATION



PEST RESISTANT PLANT VARIETY EXAMPLE

Insect Growth Regulators Sub-Section

An insect growth regulator (IGR) is a substance (chemical) that inhibits the life cycle of an insect. IGRs are typically used to control populations of harmful pests, such as cockroaches or fleas. As an insect grows, it undergoes a process called molting, where it grows a new exoskeleton under its old one and sheds the old one. The new one then swells to a new size and hardens. IGRs prevent an insect from reaching maturity by interfering with the molting process. This in turn curbs infestations because immature insects cannot reproduce. Because IGRs work by interfering with an insect's molting process, they take longer to kill than traditional insecticides. Death typically occurs within 3 to 10 days, depending on the product, the insect, its life stage when the product is applied and how quickly the insect develops. Some IGRs cause insects to stop feeding long before they die.

Anti-juvenile Hormone Agents
Anti-juvenile hormone agents cancel the effect of juvenile hormone by blocking juvenile hormone production. For example, an early instar treated with an anti-juvenile hormone agent molts prematurely into a nonfunctional adult. A disadvantage of these chemicals is that they are so selective that they may not be economic for a manufacturer to develop.

Chitin Synthesis Inhibitors
Chitin synthesis inhibitors work by preventing the formation of chitin, a carbohydrate needed to form the insect's exoskeleton. With these inhibitors, an insect grows normally until it molts. The inhibitors prevent the new exoskeleton from forming properly, causing the insect to die. Death may be quick, or take up to several days depending on the insect. Chitin synthesis inhibitors can also kill eggs by disrupting normal embryonic development. Chitin synthesis inhibitors affect insects for longer periods of time than hormonal IGRs. These are also quicker acting but can affect predaceous insects, arthropods and even fish. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Methoprene
When used indoors, Methoprene (the active ingredient in Precor, Precor 2000 and others) will prevent the egg and larvae stages of fleas from developing, with a 3 to 7 month residual. Use alone for prevention or tank mix with an approved insecticide (Suspend SC, Permethrin Pro) for existing problems. Precor also works on Cigarette Beetles. Methoprene (or Precor) is not photostable and is for indoor use, only. Available in liquid concentrate and aerosol formulations for indoor flea control. Methoprene can also be found in Frontline Plustopical flea and tick treatments for dogs and cats. Methoprene is combined with Fipronil in Frontline Plus products. Fipronil kills and repels ticks and adult fleas as the Methoprene inhibits the growth of immature fleas. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Nylar
The IGR Nylar is the active ingredient in Archer, Flea Fix and others. This material is photostable (can be used outdoors and indoors) and inhibits the growth of fleas and roaches. Nylar has a 3 to 6 month residual indoors and can last 30 days when used outdoors. This IGR can be used alone (for roach and flea prevention) or tank mixed with an approved adulticide. Cypermethrin insecticides or Orthene work best for roaches;

Suspend SC or Permethrin Pro work best for fleas. Available in liquid concentrate and aerosol formulations. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Hydroprene

This IGR is the active ingredient used in Gentrol, Gentrol Point Source, Gentrol Aerosol. Hydroprene is not photostable and is for indoor use, only. Use this IGR when eliminating, controlling or preventing cockroaches (roaches) and many pantry pests. Cigarette Beetles are not affected by Hydroprene; use Methoprene instead. Can be tank mixed with adulticides (insecticides) or used alone. Available in liquid concentrate, aerosol and in solid dispensers.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

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Jasmonates

Jasmonate (JA) and its derivatives are lipid-based hormone signals that regulate a wide range of processes in plants, ranging from growth and photosynthesis to reproductive development. In particular, JAs are critical for plant defense against herbivory and plant responses to poor environmental conditions and other kinds of abiotic and biotic challenges. Jasmonates are produced from fatty acids and seem to promote the production of defense proteins that are used to fend off invading organisms. They are believed to also have a role in seed germination, and affect the storage of protein in seeds, and seem to affect root growth.

Karrikins

Karrikins are a group of plant growth regulators found in the smoke of burning plant material. For many years scientists have known that smoke from forest fires had the ability to stimulate the germination of seeds. In 2004, after studying the thousands of chemical compounds found in smoke, it was discovered that a series of butenolides were responsible for this effect. A member of the research team looking at these compounds, David Nelson, consulted a professor of Linguistics at University of Western Australia, who advised that the first recorded Noongar word for 'smoke' from the Perth area in the 1830s, is 'karrik'. This led to these compounds being named karrikins. Currently, there are four known karrikins which are designated KAR1, KAR2, KAR3,and KAR4.

Malathion

Malathion is an organophosphate parasympathomimetic which binds irreversibly to cholinesterase. Malathion is an insecticide of relatively low human toxicity, however recent studies have shown that children with higher levels of malathion in their urine seem to be at an increased risk of attention deficit hyperactivity disorder. Malathion is a pesticide that is widely used in agriculture, residential landscaping, public recreation areas, and in public health pest control programs such as mosquito eradication. In the US, it is the most commonly used organophosphate insecticide.

Malathion was used in the 1980s in California to combat the Mediterranean Fruit Fly. This was accomplished on a wide scale by the near weekly aerial spraying of suburban communities for a period of several months. Formations of three or four agricultural helicopters would overfly suburban portions of Alameda County, San Bernardino County, San Mateo County, Santa Clara County, San Joaquin County, Stanislaus County, and Merced County releasing a mixture of malathion and corn syrup, the corn syrup being a bait for the fruit flies. Malathion has also been used to combat the Mediterranean fruit fly in Australia.

Malathion was sprayed in many cities to combat West Nile virus. In the Fall of 1999 and the Spring of 2000, Long Island and the five boroughs of New York City were sprayed with several pesticides, one of which was malathion. While it was claimed by some anti-pesticide groups that use of these pesticides caused a lobster die-off in Long Island Sound, there is as of yet no conclusive evidence to support this. Malathion is also used in conjunction with diesel fuel to fog an area where there is an infestation of mosquitoes. By diluting the mixture, it becomes much weaker. It is possible to dilute the mixture to the point where mosquitoes are not killed, but become more resistant to the mixture, making it less effective in subsequent foggings.

Malathion itself is of low toxicity; however, absorption or ingestion into the human body readily results in its metabolism to malaoxon, which is substantially more toxic. Chronic exposure to low levels of malathion have been hypothesized to impair memory, but this is disputed. According to the United States Environmental Protection Agency there is currently no reliable information on adverse health effects of chronic exposure to malathion.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

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Acute exposure to extremely high levels of malathion will cause body-wide symptoms whose intensity will be dependent on the severity of exposure. Possible symptoms include skin and eye irritation, cramps, nausea, diarrhea, excessive sweating, seizures and even death. Most symptoms tend to resolve within several weeks. Malathion present in untreated water is converted to malaoxon during the chlorination phase of water treatment, so malathion should not be used in waters that may be used as a source for drinking water, or any upstream waters.

In 1981, B. T. Collins, Director of the California Conservation Corps, publicly swallowed and survived a mouthful of dilute Malathion solution. This was an attempt to demonstrate Malathion' s safety following an outbreak of Mediterranean fruit flies in California. Malathion was sprayed over a 1,400 sq. miles area to control the flies.

In 1976, numerous malaria workers in Pakistan were poisoned by isomalathion, a contaminant that may be present in some preparations of malathion. It is capable of inhibiting carboxyesterase enzymes in those exposed to it. It was discovered that poor work practices had resulted in excessive direct skin contact with isomalathion contained in the malathion solutions. Implementation of good work practices, and the cessation of use of malathion contaminated with isomalathion led to the cessation of poisoning cases.

Malathion breaks down into Malaoxon. In studies of the effects of long-term exposure to oral ingestion of malaoxon in rats, malaoxon has been shown to be 61 times more toxic than malathion.

If malathion is used in an indoor, or other poorly ventilated environment, it can seriously poison the occupants living or working in this environment. A possible concern is that malathion being used in an outdoor environment, could enter a house or other building; however, studies by the EPA have conservatively estimated that possible exposure by this route is well below the toxic dose of malathion. Regardless of this fact, in jurisdictions which spray malathion for pest control, it is often recommended to keep windows closed and air conditioners turned off while spraying is taking place, in an attempt to minimize entry of malathion into the closed environment of residential homes.

Although current EPA regulations do not require amphibian testing, a 2008 study done by the University of Pittsburgh found that "cocktails of contaminants", which are frequently found in nature, were lethal to leopard frog tadpoles. They found that a combination of five widely used insecticides (carbaryl, chlorpyrifos, diazinon, endosulfan, and malathion) in concentrations far below the limits set by the EPA killed 99% of leopard frog tadpoles.

A May 2010 study found that in a representative sample of US children, those with higher levels of organophosphate pesticide metabolites in their urine were more likely to have attention-deficit/hyperactivity disorder. Each 10-fold increase in urinary concentration of organophosphate metabolites was associated with a 55% to 72% increase in the odds of ADHD. The study was the first investigation on children's neurodevelopment to be conducted in a group with no particular pesticide exposure

Methiocarb

Methiocarb is a chemical mainly used as a bird repellent, as an insecticide and as molluscicide. It is toxic to humans, not listed as a carcinogen, is toxic to reproductive organs, and a potent neurotoxin. Methiocarb can also cause acute toxicity in humans if anyone is exposed to it for long periods of time. Methiocarb is also a known poison to water organisms.

Methidathion

Methidathion is an organophosphate insecticide.

Methoxychlor

Methoxychlor is used to protect crops, ornamentals, livestock, and pets against fleas, mosquitoes, cockroaches, and other insects. It was intended to be a replacement for DDT, but has since been banned based on its acute toxicity, bioaccumulation, and endocrine disruption activity. The amount of methoxychlor in the environment changes seasonally due to its use in farming and foresting. It does not dissolve readily in water, so it is mixed with a petroleum-based fluid and sprayed, or used as a dust. Sprayed methoxychlor settles on the ground or in aquatic ecosystems, where it can be found in sediments. Its degradation may take many months. Methoxychlor is ingested and absorbed by living organisms, and it accumulates in the food chain. Some metabolites may have unwanted side effects. The use of methoxychlor as a pesticide was banned in the United States in 2003 and in the European Union in 2002.

Methomyl
Methomyl is a carbamate insecticide. It was introduced in 1966, but its use is restricted because of its high toxicity to humans. Its current primary use is on alfalfa for forage.

Parathion
Parathion, also called parathion-ethyl or diethyl parathion, is an organophosphate compound. It is a potent insecticide and acaricide. It was originally developed by IG Farben in the 1940s. It is highly toxic to non-target organisms, including humans. Its use is banned or restricted in many countries, and there are proposals to ban it from all use. Closely related is "methyl parathion".

Methyl Jasmonate
Methyl jasmonate (MeJA) is a substance used in plant defense and many diverse developmental pathways such as seed germination, root growth, flowering, fruit ripening and senescence. Methyl jasmonate is derived from jasmonic acid and the reaction is catalyzed by S-adenosyl-L-methionine: jasmonic acid carboxyl methyltransferase. Plants produce jasmonic acid and methyl jasmonate in response to many biotic and abiotic stresses (particularly herbivory and wounding), which build up in the damaged parts of the plant. The methyl jasmonate can be used to signal the original plant's defense systems or it can be spread by physical contact or through the air to produce a defensive reaction in unharmed plants. The unharmed plants absorb the airborne MeJA through either the stomata or diffusion through the leaf cell cytoplasm.

An herbivorous attack on a plant causes it to produce MeJA both for internal defense and for a signaling compound to other plants.

- MeJA can induce the plant to produce multiple different types of defense chemicals such as photoalexins (antimicrobial), nicotine or proteinase inhibitors. MeJA activates the proteinase inhibitor genes (a defensive reaction within plants) through a receptor mediated signal transduction pathway. The proteinase inhibitors interfere with the insect digestive process and discourage the insect from eating the plant again.
- MeJA has been used to stimulate traumatic resin duct production in lodgepole pine trees. This can be used as a defense against many insect attackers as a type of vaccine.
- MeJA is also a plant hormone involved in tendril (root) coiling, flowering, seed and fruit maturation. An increase of the hormone affects flowering time, flower morphology and the number of open flowers. MeJA induces ethylene-forming enzyme activity, which increases the amount of ethylene to the amount necessary for fruit maturation.
- Increased amounts of methyl jasmonate in plant roots have shown to inhibit their growth. It is predicted that the higher amounts of MeJa activate previously unexpressed genes within the roots to cause the growth inhibition.

Methyl jasmonate induces cytochrome c release in the mitochondria of cancer cells leading to cell death, but does not harm normal cells. Specifically, it can cause cell death in chronic lymphocytic leukemia (CLL) cells taken from human patients with this disease and then treated in tissue culture with methyl jasmonate. Treatment of isolated normal human blood lymphocytes did not result in cell death.

Topic 6 — Advanced Safety Competency Part 1
Common Pesticide/Herbicides A-L Section Post Quiz
Answers are found after the Glossary Section

1. An anti-microbial is a substance that kills or inhibits the growth of microorganisms such as______________________.

Volatile Chemicals

2. Chemicals that carry _____________over considerable distances are most often used in pest management.

Poisoning Recognition

3. Certain biocides may cause _____________in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person.

4. Which missing term is simply a liquid concentrate that is added to water to create your pesticide solution? In most cases, EC is the designation for an emulsifiable insecticide (or fungicide) concentrate product. Examples of this type of pesticide formulation: Demon EC, Cynoff EC, Permethrin Pro, Catalyst.

5. Adjuvants are added to pesticide formulations to improve the pesticide's ability to control pests, although the adjuvants themselves do not possess__________________.

6. Which term is usually dry clear and give 28 to 31 days residual? These products are also cheaper to use for jobs requiring a large volume of pesticide spray.

7. Which term have unique properties and capabilities that permit use in numerous situations where other forms of control are not feasible or practical?

8. Which term is a written description of the steps designed to plan for a safe, legal, and effective fumigation? The certified applicator and owner of the property to be fumigated must characterize the area to be treated and include all safety requirements in the plan before application.

9. Which term affect insects for longer periods of time than hormonal IGRs? These are also quicker acting but can affect predaceous insects, arthropods and even fish.

10. Which term is not photostable and is for indoor use, only? Use this IGR when eliminating, controlling or preventing cockroaches (roaches) and many pantry pests. Cigarette Beetles are not affected by this missing term.

Topic 7 — Advanced Safety Competency Part 2
Common Pesticide/Herbicides M-Z Section

Alphabetical Order M through Z Names, Types, Classifications, Pesticide Formulations, Trade Names and Classes

Topic 7 - Section Focus: You will learn the basics of conventional and commonly used pesticides including tradename, formulations and pesticide classes. This section will focus on pesticides in the alphabetical order from the letters M-Z. At the end of this section, the student will be able to understand and describe common pesticides, herbicides and fungicides, tradenames and usages. There is a post quiz at the end of this section to review your comprehension and a final examination in the Assignment for your contact hours.

Section Scope: You will master commonly found agricultural and structural pesticides, insecticides, herbicides and fungicides. Some of this information will repeat because of the different products, functions and uses. In addition, there are many different pesticide purposes and formats of pesticide application. We want you to keep this course as a pesticide "bible" for any type of pesticide emergency. Use the Table of Contents to assist in finding your concern. Remember to always follow the label's instructions.

All of this information comes from the USEPA.

Miticides
Miticides are substances that kill mites. Ixodicides are substances that kill ticks. As a practical matter, though, mites are a paraphyletic grouping, and mites and ticks are usually treated as a single group.

Examples include:
- ✓ Permethrin can be applied as a spray. The effects are not limited to mites: lice, cockroaches, fleas, mosquitos, and other insects will be affected. Permethrin, however, is not known to seriously harm most mammals or birds, as it has a low mammalian toxicity and is poorly absorbed by skin.
- ✓ Ivermectin can be prescribed by a medical doctor to rid humans of mite and lice infestations and there are agricultural formulations for birds and rodents that are infested.
- ✓ Antibiotic miticides
- ✓ Carbamate miticides
- ✓ Formamidine miticides
- ✓ Organochlorine
- ✓ Organophosphate miticides
- ✓ Diatomaceous earth will also kill mites by disrupting the cuticle, which dries out the mite.
- ✓ Dicofol, a compound structurally related to the insecticide DDT, is a miticide that is effective against the red spider mite Tetranychus urticae.
- ✓ Lime sulfur is effective against sarcoptic mange. It is made by mixing hydrated lime, sulfur, and water and boiling for about 45 minutes. Lime can bond with as

much as 4 times its weight of sulfur. The strongest concentrate is diluted 1:32 before saturating the skin (avoiding the eyes); applied at six-day intervals.

- ✓ Non-pesticide miticide acting by desiccation but not a diatomaceous earth (which contain crystalline silica, potentially dangerous by inhalation), but made from a patented mix of food-grade components, one to breach the cuticle and one to ensure rapid, reliable desiccation. Can be dusted as powder or sprayed in aqueous solution.

Abamectin
Avid, which contains abamectin as the active ingredient, is an effective insecticide/miticide for many different mite species and is typically recommended for control of mites both indoors and outdoors. The active ingredient, which occurs naturally, is derived from the soil microorganism, Streptomyces avermitilis. Avid is labeled for control of two-spotted spider mite, European red mite, carmine spider mite, Southern red mite, spruce spider mite, cyclamen mite, broad mite, and rust and bud mite. The product can be used to control mites in greenhouses, shadehouses, on field-grown ornamentals, Christmas tree plantations, and woody ornamentals. Avid is a contact and translaminar miticide. Translaminar is a term that refers to insecticides/miticides that penetrate the leaf tissue and form a reservoir of active ingredient within the leaf. Avid generally provides up to 28 days of residual activity. The label rate for all mite species is 4 fl. Oz. per 100 gal. Avid is active on the mobile life stages of mites, with no activity on eggs. Although the insecticide/miticide is slow acting, treated mites are immobilized after exposure. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Bifenazate
Floramite, which contains the active ingredient bifenazate, is labeled for control of a wide range of mites, including two-spotted spider mite, Pacific mite, strawberry mite, European red mite, citrus red mite, clover mite, southern red mite, spruce spider mite, and bamboo spider mite. It is not active on rust, broad, or flat mite. Floramite is labeled for use in greenhouses, shadehouses, nurseries, Christmas tree plantations, landscapes, and interiorscapes. This is a contact miticide, so thorough coverage of all plant parts is essential. This miticide is active on all mite life stages, including eggs. Floramite is fast acting and provides up to 28 days of residual activity. The label rate is 4 to 8 fl oz. per 100 gal. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Chlorfenapyr
Pylon is a miticide that is can be used only in greenhouses. It contains the active ingredient chlorfenapyr. Pylon is labeled for control of various mites, including two-spotted spider mite, broad mite, cyclamen mite, citrus bud mite, and rust mite. Pylon is a contact and translaminar miticide. In addition, it works as a stomach poison when ingested. Pylon is only active on the mobile life stages, including larvae, nymphs, and adults. It has no activity on mite eggs. The product can provide up to 28 days of residual activity. The label rate is 2.6 to 5.2 fl oz. per 100 gal. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Etoxazole
TetraSan contains the active ingredient etoxazole and is actually a growth regulator for mites, inhibiting the molting process. TetraSan is labeled for control of the following mites:

two-spotted spider mite, citrus red mite, European red mite, Lewis spider mite, Pacific spider mite, Southern red mite, and spruce spider mite.
TetraSan can be used to control mites in greenhouses, lath houses, shadehouses, and interiorscapes and on outdoor ornamentals. Similar to abamectin (Avid) (described previously), TetraSan is a contact and translaminar miticide providing up to 28 days of residual activity from a single application. The label rate for controlling mites is 8 to 16 oz. per 100 gal. The product is active on the egg, larvae, and nymphal stages. It has minimal effect on adult mites. However, adult female mites that are treated do not produce viable eggs. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Fenbutatin-oxide
Vendex is one of the older miticides and contains the active ingredient fenbutatin-oxide. The miticide is labeled for control of two-spotted spider mite, clover mite, Southern red mite, and spruce spider mite. Vendex can be used in greenhouses, on outdoor ornamentals, and on established landscape ornamentals and nurseries. This is a contact miticide, so it is important to thoroughly spray all plant parts during application. Vendex is slower acting than most miticides, taking 7 to 10 days to eventually kill mites. However, it provides long-lasting control--about 30 days of residual activity. The label rate is 8 to 16 oz. per 100 gal. Vendex is a warm-weather miticide providing better control when the ambient air temperature is above 70 degrees F. This product is a restricted-use pesticide. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Miticide First Aid

It is still important to recognize signs and symptoms of Fumigant/ Miticide poisoning. When in doubt, seek medical attention and be sure to bring the fumigant/ miticide label and SDS to the physician.

Poisoning Recognition
Certain fumigant/ miticide may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers. Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific fumigant/ miticide involved and the level of exposure. If you have been working with herbicides and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The fumigant/ miticide label or SDS will have a telephone number to contact in case of a medical incident.

Procedures

- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Material Safety Data Sheet (SDS (formerly MSDS)) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Fumigants/Miticides on Skin

Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Fumigants/Miticides in Eye

Eye exposure to herbicides can be serious. Always pour, measure, or mix herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Fumigant/Miticides contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Fumigants/Miticides in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Fungicides in Mouth or Swallowed
Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator’s clothing becoming contaminated.

“Spill kits” are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material

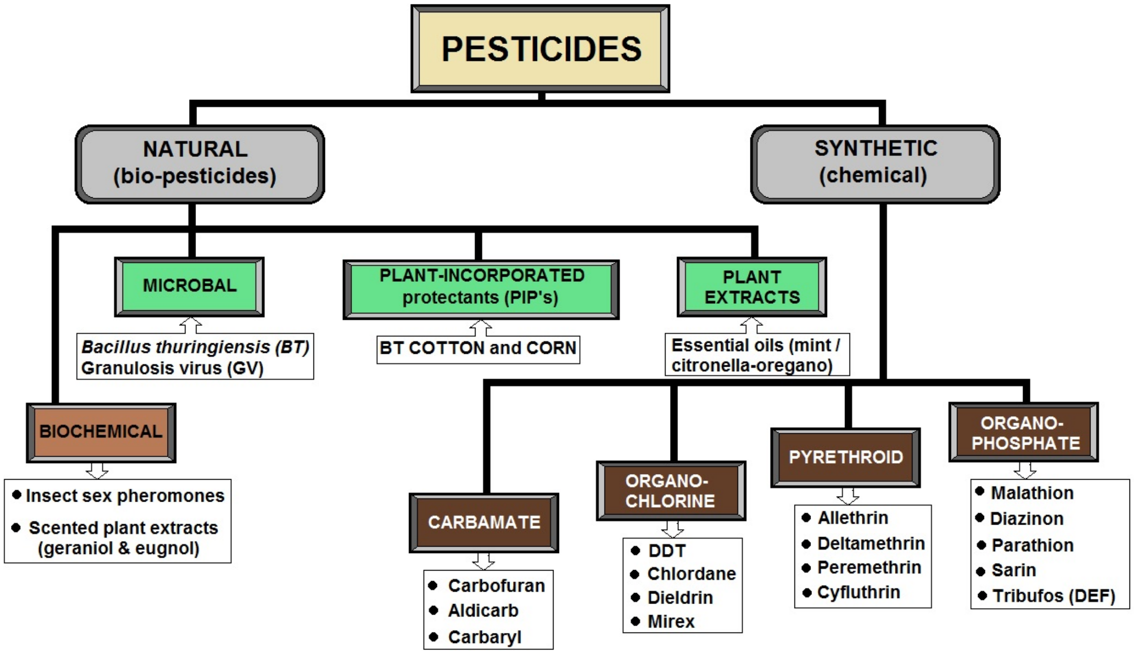
Microbial Pesticides

Microbial pesticide is a microbial agent intended for preventing, destroying, repelling, or mitigating any pest, or intended for use as a plant regulator, defoliant, or desiccant, that:
(1) Is a eucaryotic microorganism including, but not limited to, protozoa, algae, and fungi;
(2) Is a procaryotic microorganism, including, but not limited to, Eubacteria and Archaebacteria; or
(3) Is a parasitically replicating microscopic element, including, but not limited to, viruses.

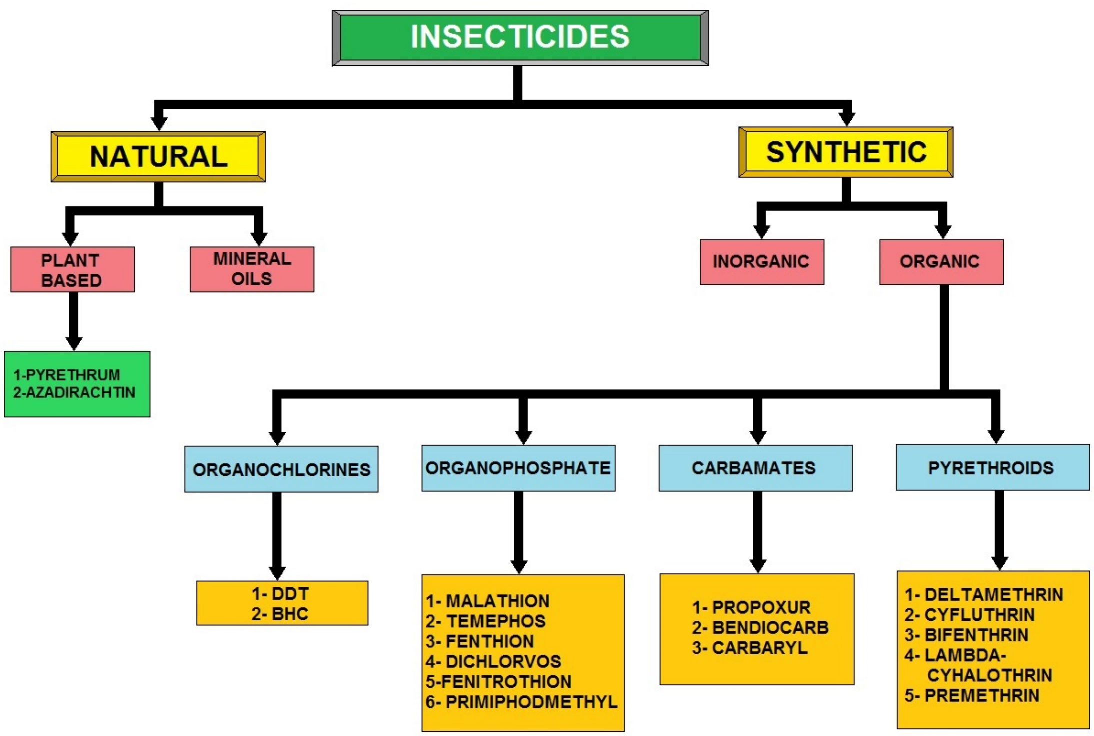
Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them.



DIFFERENT CLASSIFICATIONS OF PESTICIDES



PESTICIDES BASED UPON CHEMICAL COMPOSITION

Molluscicides

Molluscicides also known as snail baits and snail pellets, are pesticides against mollusks, which are usually used in agriculture or gardening to control gastropod pests like slugs and snails that can damage crops by feeding on them.

Molluscicide are usually belonging to three main classes:

- ✓ Metal salts such as iron phosphate and aluminum sulfate, relatively non-toxic, also used in organic gardening.
- ✓ Metaldehyde
- ✓ Acetylcholinesterase inhibitors, highly toxic to other animals and humans, acts also as a contact poison.

Metal Salt-Based Molluscicides

Metal salt-based molluscicides are not toxic to higher animals while metaldehyde-based and especially acetylcholinesterase inhibitor-based products are highly toxic and have resulted in many deaths of pets and humans. Some products contain a bittering agent that reduces but does not eliminate the risk of accidental poisoning. Anticholinergic drugs such as atropine can be used as an antidote for acetylcholinesterase inhibitor poisoning. There is no antidote for metaldehyde, the treatment is symptomatic.

Metaldehydes and Methiocarbs

There are many different varieties of snail baits on the market, but we can generally group them into two main categories: the metaldehydes and the methiocarbs. Sometimes we can differentiate them by their color: the metaldehydes (e.g. Defender™) are usually green, while the methiocarbs (e.g. Baysol™) are blue.

They each work in different ways, and require different treatments. Iron phosphate is more effective than Metaldehyde because Metaldehyde ceases to be functional when it gets rained on or if you water the garden, whereas Iron phosphate remains active even with repeat wettings, easily up to two weeks.

Iron phosphate is completely safe for pets or beneficial insects, & is safe to use around vegetables. Sluggo & Escar-Go brands are two named brands. It's not as cheap as Metaldehyde, but then it's not money wasted as it is with other slug baits, & it's a garden nutrient rather than a toxic chemical, so worth a little more. Because Iron phosphate remains active longer, it requires less to kill more slugs, so in fact it is more cost-effective.

Snails frequently recover from Metaldehyde poisoning if there is rainfall or access to wet locations where they will not fully dehydrate & die. A slug can lose half its body weight & shrink to a third its size from Metaldehyde poisoning or by covering it in salt, but if it can get itself to wet soil fast enough, or if it rains, it will recover. By contrast they never recover from Iron phosphate.

Metaldehyde is known to be fatally poisonous to dogs & wildlife even in the weak (4%) mixes sold as slug poison. Plus it is sufficiently toxic to humans that if it gets on vegetables, it would be illegal to sell them. By contrast, Iron phosphate is non-toxic to dogs or wild animals, & can be used legally even around commercial crops. EPA's Office of Pesticide Program states that iron phosphate "has no unreasonable adverse effects to human health [nor] toxicity to birds, fish, and insects."

If a garter snake ate a slimy slug that was dying from ingesting Iron phosphate, the garter snake would not be harmed, but if the same garter snake, or a dog, ate a dehydrating slug that had been exposed to Metaldehyde, it could be bad news for the health of an unhappy diner.

Metaldehyde products after being dampened no longer work, but they do mold & invite plant pathogens. Iron phosphate not only remains active after damped, but any that remains uneaten by slugs just breaks down into iron & phosphate which the plants take in like any other fertilizer. Or you can have a non-toxic bait that is a plant nutrient harmless to animals & people, safe on vegetables, with long-lasting effectively unaffected by temperature or wetness -- i.e., any Iron phosphate product.

The baits work differently. Metaldehyde poison dehydrates the snail or slug rather rapidly if it eats the poison on a warm day (though of course snails & slugs aren't usually about on warm dry days which is one reason it has limited effect; on a chill or a wet day slugs will not dehydrate, but will often recover from the toxin). Iron phosphate on the other hand induces extreme mucus production in mollusks, so that the snail or slug is no longer able to eat while more slowly its cells break down; it works at any temperature & the slugs will not recover due to rainfall.

Metaldehyde Poisoning
Signs of metaldehyde poisoning (Defender™) may be seen immediately, or can be delayed for up to 3 hours. Your dog may begin to behave strangely, may not be able to walk or balance normally, show trembling in its muscles or have convulsions/fits. Other possible symptoms are an increased heart and breathing rate, salivating, vomiting (sometimes stained green from the bait), large pupils and a fever. However the most important factor that will help us diagnose snail bait poisoning is knowing whether your dog had access to it. Without treatment death will occur in 4 - 12 hours after eating the bait. The prognosis depends on the amount ingested. Unfortunately, there is no specific medication which will reverse the signs.

Methiocarb poisoning (Baysol™) causes very similar symptoms to metaldehydes, including fits, vomiting and increased salivation. However, there may also be diarrhea, pin-point pupils, difficulty breathing and eventually, paralysis. For this type of poisoning, there is an antidote called atropine, which may reverse the effects of the poison. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Handy Hints
- ✓ Don't trust your dog to read the labels! Many snail baits have a bitter agent added to make them less attractive to dogs, but dogs will still eat them.
- ✓ There is no such thing as a 'safe' snail bait for pets.
- ✓ If you must use snail baits in your garden, use them only in areas in which your pets have no access and follow the directions on the packet. Always scatter the pellets, rather than leaving piles of them lying around.
- ✓ The top of the barbecue is not the place to store snail bait packets. Locked away and out of reach of canine mouths and paws is best.

Molluscicide First Aid

It is still important to recognize signs and symptoms of molluscicide poisoning. When in doubt, seek medical attention and be sure to bring the molluscicides label and SDS to the physician.

Poisoning Recognition
Certain molluscicides may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers. Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific chemical or product involved and the level of exposure. If you have been working with fumigants and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The Molluscicide label or SDS will have a telephone number to contact in case of a medical incident.

Procedures

- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Safety Data Sheet (SDS) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Molluscicides on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Molluscicides in Eye
Eye exposure to molluscicides can be serious. Always pour, measure, or mix herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Molluscicides contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Molluscicides in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Molluscicides in Mouth or Swallowed

Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator's clothing becoming contaminated.

"Spill kits" are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material

Nematicides

A nematicide is a type of chemical pesticide used to kill parasitic nematodes. One common nematicide is obtained from neem cake, the residue obtained after cold-pressing the fruit and kernels of the neem tree. Known by several names in the world, the tree was first cultivated in India in ancient times and is now widely distributed throughout the world. The root exudate of marigold (Tagetes) is also found to have nematicidal action. Nematophagous fungi, a type of carnivorous fungi, can be useful in controlling nematodes, Paecilomyces being one example. Besides chemicals, soil steaming can be used in order to kill nematodes. Superheated steam is induced into the soil which causes almost all organic material to deteriorate.

Since the 1960's, a completely different group of products, usually termed "non-fumigant" nematicides, has been developed. All are organo-phosphate or carbamate pesticides; most have significant insecticidal and/or acaricidal properties.

Most are extremely toxic to humans (acute oral and dermal toxicities). In contrast to the fumigants, these chemicals depend heavily on initial mixing with the soil and local redistribution in solution in the soil water. Some are systemically absorbed and redistributed within plants. They are commonly formulated as granules to which the active ingredient has been adsorbed onto the surface of a sand, clay, or organic grit of a specific particle size at a rate of 5% to 20% of the total weight of the formulated product. Many are also available in more concentrated emusifiable or water-soluble spray liquids.

Land preparation is important to success with any nematicide. The soil should be turned, tilled, or thoroughly disked at least 4 to 6 weeks before treatment, to encourage decay of roots and other plant trash that could protect nematodes from the chemical and interfere with application equipment. Intact organic matter can also directly adsorb ("tie up") soil fumigants so that not the entire product applied to the soil is actually free for pest control.

Soil should be worked deeper than the actual intended depth of treatment, to be sure that no compaction layer interferes with nematicide movement. Heavier soils may need to be worked again about 1 week before treatment or planting, to be sure that there are no soil clods that might interfere with uniformity of fumigant diffusion or incorporation of a non-fumigant nematicide. Soil should be in good seedbed condition, with adequate but not excessive moisture through the entire tilled depth when either fumigant or non-fumigant nematicides are applied to the soil. Irrigate during the week before treatment if necessary to achieve this. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Multi-Purpose Soil Fumigants
These products are intended to reduce populations of other soil-borne pathogens, insects, and weed seeds in addition to nematodes (activity against different kinds of pests often depends on the application rate). Offsetting their wider spectrum of activity are greater expense per acre, more complicated application equipment and methods, and greater potential hazard. Because of their costs, they are generally used where the crops have especially high value (seedbeds, golf course greens and tees, nurseries, some fruit and vegetable crops).

Chloropicrin
By far the greatest portion of multi-purpose soil fumigants used are formulations of methyl bromide with varying concentrations of chloropicrin. All methyl bromide products used for soil fumigation should contain a small percentage (0.5 - 2%) chloropicrin to warn of free fumigant in the atmosphere, such as from torn plastic tarps, equipment leaks, etc. Methyl bromide is deadly but has no odor itself; chloropicrin is a powerful tear gas that is easily detected in low concentrations. Higher proportions of chloropicrin are usually chosen to increase fungicidal activity, since it is a far better fungicide than is methyl bromide. All methyl bromide products are extremely toxic and must be handled with utmost respect and care to avoid injury to those who used them or come near areas where they are used.

Methyl Bromide/Chloropicrin Formulations
A range of methyl bromide/chloropicrin formulations are registered for various crops, planting media, and planting sites. Not all brands of any given formulation are registered for all of the same uses, so this table is only a guide to available mixtures. It is the user's responsibility to be sure that a product is legally registered for the crop/site for which it is being applied.

Because of their great volatility at normal temperatures, most methyl bromide products and concentrated chloropicrin formulations are sold and handled in gas cylinders.

Small quantities (1 or 1.5 lb.) of 98% methyl bromide/2% chloropicrin are sold in sealed cans that are used for treating small areas of seedbed or individual planting sites.

Multi-purpose fumigants other than methyl bromide/chloropicrin mixtures include dazomet, metam and mixtures of 1,3-D with chloropicrin. These products, less volatile than methyl bromide, are usually applied as liquids from drums and bulk containers rather than gas cylinders. Dazomet is a granular product that must be mixed mechanically with the soil.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator’s legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Nitric Oxide (NO)

Nitric oxide (common name) or nitrogen monoxide (systematic name) is a chemical compound with chemical formula NO. This diatomic gas is an important cell signaling molecule in mammals, including humans. It is also an extremely important intermediate in the chemical industry. Nitric oxide is an air pollutant produced by combustion of substances in air, like in automobile engines and fossil fuel power plants. In mammals, NO is an important cellular messenger molecule involved in many physiological and pathological processes. Low levels of NO production are important in protecting an organ such as the liver from ischemic damage. Chronic expression of NO is associated with various carcinomas and inflammatory conditions including juvenile diabetes, multiple sclerosis, arthritis and ulcerative colitis.

Nitric oxide should not be confused with nitrous oxide (N_2O), an anesthetic and greenhouse gas, or with nitrogen dioxide (NO_2), a brown toxic gas and a major air pollutant. However, nitric oxide is rapidly oxidized in air to nitrogen dioxide. Humphrey Davy discovered this to his discomfort, when he inhaled the gas early in his career.

Ovicides

A substance, especially an insecticide that kills eggs.

Larvin

An insecticide/ovicide provides highly effective control of a broad spectrum of hard-to-control Lepidopteran pests including loopers, armyworms, bollworms and budworms.

Applied at the ovicidal rate, Larvin provides three-way control. First, Larvin kills eggs on contact. Second, the residual activity of Larvin kills eggs that are newly laid on spray residue. And third, Larvin delivers powerful control of neonate larvae by ingestion of egg membrane. Since Larvin is a selective insecticide ovicide, it won't trigger secondary pest flare-ups such as aphids.

Chlordimeform

Chlordimeform is effective as an ovicide/insecticide for control of bollworm and tobacco budworm in cotton. Effective also for the control of resistant mites and their eggs, and many lepidopterous insect pests but not on current U.S. label

Apollo SC

Apollo SC ovicide/miticide is the keystone to an economical, effective and flexible program to break and control mite development. Mite pressures and timing can change from year to year, but with the flexibility of Apollo SC ovicide, you can adapt your mite control program to meet the challenge. A highly selective mode of action makes Apollo SC perfect for IPM programs while being safe to predacious mites, bees and other beneficial insects.

Paraquat

Paraquat is the trade name of one of the most widely used herbicides in the world. Paraquat, a viologen, is quick-acting and non-selective, killing green plant tissue on contact. It is also toxic to human beings and animals, and is linked to the development of Parkinson's disease.

Paraquat is used as a quaternary ammonium herbicide, one of the most widely used herbicides in the world. It is quick-acting, non-selective, and kills green plant tissue on contact. It is redistributed within the plant, but does not harm mature bark. Being a herbicide, paraquat protects crops by controlling a wide range of annual and certain perennial weeds that reduce crop yield and quality by competing with the crop for water, nutrients, and light.

The key characteristics that distinguish the non-selective contact herbicide paraquat from other active ingredients used in plant protection products are:

- It is non-selective, which means it kills a wide range of annual grasses and broad-leaved weeds and the tops of established perennial weeds.
- It is very fast-acting.
- It is rain-fast within minutes of application.
- It becomes biologically inactive upon contact with soil.

In the United States, paraquat is available primarily as a liquid in various strengths. It is classified as "restricted use," which means that it can be used only by licensed applicators. As with many chemicals, caution must be exercised during use. In the European Union, paraquat has been forbidden since July 11, 2007

Permethrin

General Information

Permethrin is a broad-spectrum pyrethroid insecticide. It is available in dusts, emulsifiable concentrates, smokes, ULV concentrates, and wettable-powder formulations. The historical development of the synthetic pesticides called pyrethroids is based on the pyrethrins, which are derived from chrysanthemums. Pyrethrins are a "natural" environmental product that is of low toxicity to mammals. They are highly photolabile and degrade quickly in sunlight, and the cost of reapplying them has limited their widespread agricultural use. Pyrethroids have been synthesized to be similar to pyrethrins yet more stable in the environment. Evidence suggests that they have a very large margin of safety when used as directed by the label (Aldridge, 1990; Chen et al., 1991; Snodgrass, 1992).

Commercial pyrethroid products commonly use petroleum distillates as carriers. Some commercial products also contain OP or carbamate insecticides because the rapid paralytic effect of pyrethrins on insects ("quick knockdown") is not always lethal (Cheremisinoff and King, 1994). Pyrethroids are formulated as emulsifiable concentrates, wettable powders, granules, and concentrates for ULV application.

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Pesticide/Fertilizer Combinations

Pest managers frequently use insecticides, fungicides, and herbicides in combination with fertilizers. This provides a convenient way of controlling pests while fertilizing crops or lawns. Homeowners commonly use these combinations, although the unit cost of pesticide in these formulations is usually high. In commercial applications, dealers or growers custom mix pesticides with fertilizers to meet specific crop requirements.

Pheromones

The term "pheromone" was introduced by Peter Karlson and Martin Lüscher in 1959, based on the Greek word pherein (to transport) and hormone (to stimulate). They are also sometimes classified as ecto-hormones. They were researched earlier by various scientists, including Jean-Henri Fabre, Joseph A. Lintner, Adolph Butenandt, and the prominent ethologist Karl von Frisch who called them various names like "alarm substances." These chemical messengers are transported outside of the body and result in a direct developmental effect on hormone levels or behavioral change. They proposed the term to describe chemical signals from conspecifics that elicit innate behaviors soon after the German Biochemist Adolf Butenandt characterized the first such chemical, bombykol (a chemically well-characterized pheromone released by the female silkworm to attract mates). Pheromones are semiochemicals that are produced and received by members of the same species. A range of behaviors and biological processes are influenced by pheromones, but pest management programs most often use compounds that attract a mate (sex pheromones) or call others to a suitable food or nesting site (aggregation pheromones). Other pheromones regulate caste or reproductive development in social insects (honey bees and termites for example), signal alarm (in honey bees, ants, and aphids), mark trails (ants), and serve other functions.

Detected by Antennae
In insects, these pheromones are detected by the antennae on the head. The signals can be effective in attracting faraway mates, and in some cases, can be very persistent, remaining in place and active for days. Long-lasting pheromones allow marking of territorial boundaries or food sources. Other signals are very short-lived, and are intended to provide an immediate message, such as a short-term warning of danger or a brief period of reproductive readiness. Pheromones can be of many different chemical types, to serve different functions. As such, pheromones can range from small hydrophobic molecules to water-soluble peptides.

Three Main uses of Pheromones
There are three main uses of pheromones in the integrated pest management of insects. The most important application is in monitoring a population of insects to determine if they are present or absent in an area or to determine if enough insects are present to warrant a costly treatment. This monitoring function is the keystone of integrated pest management. Monitoring is used extensively in urban pest control of cockroaches, in the management of stored grain pests in warehouses or distribution centers, and to track the nationwide spread of certain major pests such as the gypsy moth, Medfly, and the Japanese beetle. With major increases in worldwide trade, exotic pests are being brought into ports of entry in cargo containers and packing materials (ship dunnage).

Sometimes containers from ships are transferred uninspected to semi-trailers and trucked far inland. When the containers are opened and packaging materials are removed, the exotic insect pests are able to disperse without the usual level of scrutiny provided at ports of entry.

Pheromone Traps
Pheromone traps are currently in use to monitor the movement of such exotic insect pests into most major North American ports of entry. A second major use of pheromones is to mass trap insects to remove large numbers of insects from the breeding and feeding population. Massive reductions in the population density of pest insects ultimately help to protect resources such as food or fiber for human use. Mass trapping has been explored with pine bark beetles and has resulted in millions of insects attracted specifically into traps and away from trees. Relatives of bark beetles called ambrosia beetles have been mass trapped from log sorting and timber processing areas. These trapping operations have reduced damage to the wood in raw logs and newly cut boards.

Mass trapping has also been used successfully against the codling moth, a serious pest of apples and pears. Another common example of mass trapping involves yellowjackets, which can become bothersome at the end of the summer season. However, mass trapping of yellowjackets in colorful yellow-green traps is carried out with a food attractant, rather than a pheromone bait.

A third major application of pheromones is in the disruption of mating in populations of insects. This has been most effectively used with agriculturally important moth pests.

In this scenario, synthetic pheromone is dispersed into crops and the false odor plumes attract males away from females that are waiting to mate. This causes a reduction of mating, and thus reduces the population density of the pests. In some cases, the effect has been so great that the pests have been locally eradicated.

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Phosmet
Phosmet is a phthalimide-derived, non-systemic, organophosphate insecticide used on plants and animals. It is mainly used on apple trees for control of coddling moth, though it is also used on a wide range of fruit crops, ornamentals, and vines for the control of aphids, suckers, mites, and fruit flies.

Phosphamidon *Not to be confused with phosphoramidon.*
Phosphamidon is an organophosphate insecticide first reported in 1960. It acts as a cholinesterase inhibitor.

Pirimicarb
Pirimicarb is a carbamate insecticide used to control aphids on vegetable, cereal and orchard crops by inhibiting acetylcholinesterase activity. It was originally developed by Imperial Chemical Industries Ltd., now Syngenta, in 1970.

CATEGORY	NONREFILLABLE CONTAINERS	REFILLABLE CONTAINERS	REPACKING PESTICIDE PRODUCTS	CONTAINER LABELING	CONTAINMENT STRUCTURES
WHO MUST COMPLY	REGISTRANTS	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS REFILLERS (Retailers, Distributors)	REGISTRANTS PESTICIDE USERS (Must Follow New Directions)	AG RETAILERS AG COMMERCIAL APPLICATORS AG CUSTOM BLENDERS
MAJOR REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • CONTAINER DISPENSING CAPABILITY • STANDARD CLOSURES • RESIDUAL REMOVAL • RECORDKEEPING	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• DOT CONTAINER DESIGN, CONSTRUCTION AND MARKING STANDARDS • SERIAL NUMBER MARKING • ONE-WAY VALVES OR TAMPER-EVIDENT DEVICES • STANDARD CONTAINER REQUIREMENTS	• IDENTIFY CONTAINER AS NONREFILLABLE OR FILLABLE (All) • STATEMENTS TO PROHIBIT REUSE AND OFFER FOR RECYCLING; BATCH CODE (All Nonrefillables) • CLEANING INSTRUCTIONS • CLEANING INSTRUCTONS BEFORE FINAL DISPOSAL	•SECONDARY CONTAINMENT STRUCTURES (Dikes) AROUND STATIONARY TANKS •CONTAINMENT PADS FOR PESTICIDE DISPENSING AREAS •GOOD OPERATING PROCEDURES •MONTHLY INSPECTION OF TANKS AND STRUCTURES •RECORDKEEPING
COMPLIANCE DATE	AUGUST 17, 2009	AUGUST 17, 2011	AUGUST 17, 2011	AUGUST 16, 2011 (Based on the October 8, 2010 Final Rule)	AUGUST 17, 2009

PESTICIDE CONTAINER AND CONTAINMENT RULE

Technical Learning College

Plant Growth Regulators

Plant hormones (also known as phytohormones) are chemicals that regulate plant growth. Plant hormones are signal molecules produced within the plant, and occur in extremely low concentrations. Hormones regulate cellular processes in targeted cells locally and when moved to other locations, in other locations of the plant. Hormones also determine the formation of flowers, stems, leaves, the shedding of leaves, and the development and ripening of fruit. Plants, unlike animals, lack glands that produce and secrete hormones; instead each cell is capable of producing hormones.

Plant hormones shape the plant, affecting seed growth, time of flowering, the sex of flowers, senescence of leaves and fruits. They affect which tissues grow upward and which grow downward, leaf formation and stem growth, fruit development and ripening, plant longevity, and even plant death. Hormones are vital to plant growth and lacking them, plants would be mostly a mass of undifferentiated cells.

Natural Growth Regulators

Several naturally occurring hormones work in the cotton plant to adjust plant growth. When plant growth regulators are applied to the cotton plant, they work in much the same way as the natural regulants already present. In many ways, they supplement or destroy the natural hormone. They often will work together in ratios and concentrations to regulate growth. Some naturally occurring hormones are auxins, gibberellins and cytokinins. Some of the more common plant growth regulators are composed of these hormones or combinations of them.

The auxin family serves a number of functions in plants, such as cell and stem elongation, leaf expansion, increased rooting and changes in fruit abscission. Some yield response has been noted when certain auxins have been applied to cotton, probably due to greater boll retention. Other reports have shown no yield response. The gibberellins are associated with stem elongation and some leaf enlargement, but have been shown to increase fruit retention in cotton. Yield responses when applied alone to cotton have been mixed, with some data showing smaller bolls and no yield response.

Cytokinins can promote cell division and enlargement of stems, leaves and fruit. They have also been shown to reduce fruit abscission in cotton, but this is probably an indirect result of making the fruit a better competitor for nutrients. Cytokinins can also delay aging of leaves, allowing longer photosynthetic activity. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Synthetic Growth Regulators

The number of synthetic plant growth regulators available to cotton growers is increasing. Pix has been the most widely used material due to its ability to reduce excessive cotton growth and put more emphasis on boll development. Mepichlor has more recently entered the market with the same active ingredient as Pix, Mepiquat Chloride. PGR IV is the first labeled plant growth regulator for cotton that promotes cotton growth. Maxxon has most recently followed in the same market track as PGR IV, with the same hormones. Cytokin has also entered the market with a different hormone than PGR IV or

Maxxon, Pix and Mepichlor
Pix (Mepiquat Chloride) is the first plant growth regulator in cotton production to make a significant impact on cotton growth and yield. Since its introduction by BASF Corporation in the early 1980s, it has been widely studied and frequently used in the major cotton growing areas.

Pix is an anti-gibberellin, meaning that it reduces the production of gibberellin in the plant, which normally would enlarge plant cells. Mepichlor is produced by Micro Flo and contains the same active ingredient as Pix; therefore it is used in much the same way. Research on the use of Mepichlor is limited; therefore this publication will focus primarily on Pix. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Pix applications are most successful when applied near the early bloom stage of development and again within 3 to 4 weeks on cotton that is subject to rapid and excessive vegetative growth. Not all cotton fields will benefit from Pix applications. It works best on healthy, non-stressed cotton when conditions favor rank growth. Many times, these conditions occur when water through irrigation and rainfall has been abundant, high nitrogen rates have been used, and large, indeterminate varieties have been planted. The primary effect that Pix has on cotton production is that it takes energy away from leaf and stem development and directs it toward boll development and retention. For this reason, it is crucial for cotton growers to understand their individual field conditions and make or omit applications as conditions dictate. As a result of a Pix application at the appropriate times of development, lint is more efficiently produced due to decreased plant height, branch length and leaf size. This provides for a more open canopy that increases boll retention and reduces boll rot; consequently, bolls are given greater potential to produce. However, yield response will depend on the necessity of Pix in a particular field.

Five Major Classes of Plant Hormones
In general, it is accepted that there are five major classes of plant hormones, some of which are made up of many different chemicals that can vary in structure from one plant to the next. The chemicals are each grouped together into one of these classes based on their structural similarities and on their effects on plant physiology. Other plant hormones and growth regulators are not easily grouped into these classes; they exist naturally or are synthesized by humans or other organisms, including chemicals that inhibit plant growth or interrupt the physiological processes within plants. Each class has positive as well as inhibitory functions, and most often work in tandem with each other, with varying ratios of one or more interplaying to affect growth regulation.

The five major classes are:
Abscisic acid
Abscisic acid also called ABA, was discovered and researched under two different names before its chemical properties were fully known, it was called dormin and abscicin II. Once it was determined that the two latter compounds were the same; it was named abscisic acid. The name "abscisic acid" was given because it was found in high concentrations in newly abscissed or freshly fallen leaves.

This class of PGR is composed of one chemical compound normally produced in the leaves of plants, originating from chloroplasts, especially when plants are under stress. In general, it acts as an inhibitory chemical compound that affects bud growth, seed and bud dormancy.

It mediates changes within the apical meristem causing bud dormancy and the alteration of the last set of leaves into protective bud covers. Since it was found in freshly abscissed leaves, it was thought to play a role in the processes of natural leaf drop but further research has disproven this. In plant species from temperate parts of the world it plays a role in leaf and seed dormancy by inhibiting growth, but, as it is dissipated from seeds or buds, growth begins. In other plants, as ABA levels decrease, growth then commences as gibberellin levels increase.

Without ABA, buds and seeds would start to grow during warm periods in winter and be killed when it froze again. Since ABA dissipates slowly from the tissues and its effects take time to be offset by other plant hormones, there is a delay in physiological pathways that provide some protection from premature growth. It accumulates within seeds during fruit maturation, preventing seed germination within the fruit, or seed germination before winter. Abscisic acid's effects are degraded within plant tissues during cold temperatures or by its removal by water washing in out of the tissues, releasing the seeds and buds from dormancy.

In plants under water stress, ABA plays a role in closing the stomata. Soon after plants are water-stressed and the roots are deficient in water, a signal moves up to the leaves, causing the formation of ABA precursors there, which then move to the roots. The roots then release ABA, which is translocated to the foliage through the vascular system and modulates the potassium and sodium uptake within the guard cells, which then lose turgidity, closing the stomata. ABA exists in all parts of the plant and its concentration within any tissue seems to mediate its effects and function as a hormone; its degradation, or more properly catabolism, within the plant affects metabolic reactions and cellular growth and production of other hormones.

Plants start life as a seed with high ABA levels, just before the seed germinates ABA levels decrease; during germination and early growth of the seedling, ABA levels decrease even more. As plants begin to produce shoots with fully functional leaves - ABA levels begin to increase, slowing down cellular growth in more "mature" areas of the plant. Stress from water or predation affects ABA production and catabolism rates, mediating another cascade of effects that trigger specific responses from targeted cells. Scientists are still piecing together the complex interactions and effects of this and other phytohormones.

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Auxins

Auxins are compounds that positively influence cell enlargement, bud formation and root initiation. They also promote the production of other hormones and in conjunction with cytokinins, they control the growth of stems, roots, and fruits, and convert stems into flowers. Auxins were the first class of growth regulators discovered. They affect cell elongation by altering cell wall plasticity. They stimulate cambium, a subtype of meristem cells, to divide and in stems cause secondary xylem to differentiate.

Auxins act to inhibit the growth of buds lower down the stems (apical dominance), and also to promote lateral and adventitious root development and growth.

Leaf abscission is initiated by the growing point of a plant ceasing to produce auxins. Auxins in seeds regulate specific protein synthesis, as they develop within the flower after pollination, causing the flower to develop a fruit to contain the developing seeds. Auxins are toxic to plants in large concentrations; they are most toxic to dicots and less so to monocots. Because of this property, synthetic auxin herbicides including 2,4-D and 2,4,5-T have been developed and used for weed control. Auxins, especially 1-Naphthaleneacetic acid (NAA) and Indole-3-butyric acid (IBA), are also commonly applied to stimulate root growth when taking cuttings of plants. The most common auxin found in plants is indoleacetic acid or IAA. The correlation of auxins and cytokinins in the plants is a constant (A/C = const.).

Cytokinins

The cytokinin zeatin, Zea, in which it was first discovered in immature kernels. Cytokinins or CKs are a group of chemicals that influence cell division and shoot formation. They were called kinins in the past when the first cytokinins were isolated from yeast cells. They also help delay senescence or the aging of tissues, are responsible for mediating auxin transport throughout the plant, and affect internodal length and leaf growth. They have a highly synergistic effect in concert with auxins and the ratios of these two groups of plant hormones affect most major growth periods during a plant's lifetime. Cytokinins counter the apical dominance induced by auxins; they in conjunction with ethylene promote abscission of leaves, flower parts and fruits. The correlation of auxins and cytokinins in the plants is a constant (A/C = const.).

Ethylene

Ethylene is a gas that forms through the Yang Cycle from the breakdown of methionine, which is in all cells. Ethylene has very limited solubility in water and does not accumulate within the cell but diffuses out of the cell and escapes out of the plant. Its effectiveness as a plant hormone is dependent on its rate of production versus its rate of escaping into the atmosphere. Ethylene is produced at a faster rate in rapidly growing and dividing cells, especially in darkness. New growth and newly germinated seedlings produce more ethylene than can escape the plant, which leads to elevated amounts of ethylene, inhibiting leaf expansion (see Hyponastic response). As the new shoot is exposed to light, reactions by phytochrome in the plant's cells produce a signal for ethylene production to decrease, allowing leaf expansion. Ethylene affects cell growth and cell shape; when a growing shoot hits an obstacle while underground, ethylene production greatly increases, preventing cell elongation and causing the stem to swell.

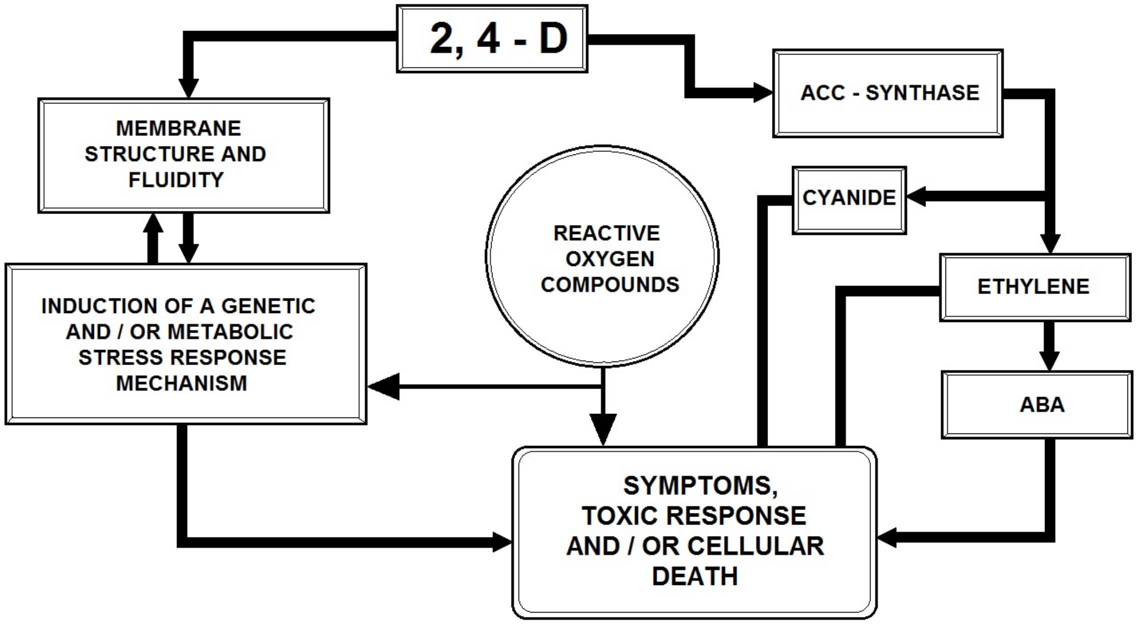
The resulting thicker stem can exert more pressure against the object impeding its path to the surface. If the shoot does not reach the surface and the ethylene stimulus becomes prolonged, it affects the stems natural geotropic response, which is to grow upright, allowing it to grow around an object. Studies seem to indicate that ethylene affects stem diameter and height: When stems of trees are subjected to wind, causing lateral stress, greater ethylene production occurs, resulting in thicker, sturdier tree trunks and branches.

Ethylene affects fruit ripening: Normally, when the seeds are mature, ethylene production increases and builds-up within the fruit, resulting in a climacteric event just before seed dispersal. The nuclear protein Ethylene Insensitive2 (EIN2) is regulated by ethylene production, and, in turn, regulates other hormones including ABA and stress hormones. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Gibberellins
Gibberellins, or GAs, include a large range of chemicals that are produced naturally within plants and by fungi. They were first discovered when Japanese researchers, including Eiichi Kurosawa, noticed a chemical produced by a fungus called Gibberella fujikuroi that produced abnormal growth in rice plants. Gibberellins are important in seed germination, affecting enzyme production that mobilizes food production used for growth of new cells. This is done by modulating chromosomal transcription. In grain (rice, wheat, corn, etc.) seeds, a layer of cells called the aleurone layer wraps around the endosperm tissue.

Absorption of water by the seed causes production of GA. The GA is transported to the aleurone layer, which responds by producing enzymes that break down stored food reserves within the endosperm, which are utilized by the growing seedling. GAs produce bolting of rosette-forming plants, increasing internodal length. They promote flowering, cellular division, and in seeds growth after germination. Gibberellins also reverse the inhibition of shoot growth and dormancy induced by ABA.



2, 4-D TOXIC HERBICIDE

Other Known Hormones
Other identified plant growth regulators include:

Brassinosteroids
Brassinosteroids are a class of polyhydroxysteroids, a group of plant growth regulators. Brassinosteroids (BRs) are a class of polyhydroxysteroids that have been recognized as a sixth class of plant hormones. These were first explored nearly forty years ago when Mitchell et al. reported promotion in stem elongation and cell division by the treatment of organic extracts of rapeseed (Brassica napus) pollen. Brassinolide was the first isolated brassinosteroid in 1979 when it was shown that pollen from Brassica napus could promote stem elongation and cell divisions, and the biologically active molecule was isolated. The yield of brassinosteriods from 230 kg of Brassica napus pollen was only 10 mg.

Since their discovery, over 70 BR compounds have been isolated from plants. BRs have been reported to counteract both abiotic and biotic stress in plants. Application of brassinosteroids to cucumbers was demonstrated to increase the metabolism and removal of pesticides, which could be beneficial for reducing the human ingestion of residual pesticides from non-organically grown vegetables

The BR is biosynthesised from campesterol. The biosynthetic pathway was elucidated by Japanese researchers and later shown to be correct through the analysis of BR biosynthesis mutants in Arabidopsis thaliana, tomatoes, and peas. The sites for BR synthesis in plants have not been experimentally demonstrated. One well-supported hypothesis is that all tissues produce BRs, since BR biosynthetic and signal transduction genes are expressed in a wide range of plant organs, and short distance activity of the hormones also supports this. Experiments have shown that long distance transport is possible and that flow is in an acropetal direction, but it is not known if this movement is biologically relevant. Brassinosteroids are recognized at the cell membrane, although they are membrane-soluble.

BRs have been shown to be involved in numerous plant processes:
- Acceleration of senescence in dying tissue cultured cells; delayed senescence in BR mutants supports that this action may be biologically relevant
- Can provide some protection to plants during chilling and drought stress.
- Is necessary for pollen elongation for pollen tube formation.
- It has an unclear role in cell division and cell wall regeneration.
- Promotion of cell expansion and cell elongation; works with auxin to do so.
- Promotion of vascular differentiation; BR signal transduction has been studied during vascular differentiation.

Lychnis viscaria
Extract from the plant Lychnis viscaria contains a relatively high amount of Brassinosteroids. Lychnis viscaria is said to increase the disease resistance of surrounding plants. In Germany, extract from the plant is allowed for use as a "plant strengthening substance."

Aegle marmelos Correa
24-Epibrassinolide (EBL), a brassinosteroid isolated from Aegle marmelos Correa (Rutaceae), was further evaluated for the antigenotoxicity against maleic hydrazide (MH)-induced genotoxicity in Allium cepa chromosomal aberration assay.

It was shown that the percentage of chromosomal aberrations induced by maleic hydrazide (0.01%) declined significantly with 24-epibrassinolide treatment.

Brassinosteroids have been recognized as a sixth class of plant hormones that stimulate cell elongation and division, gravitropism, resistance to stress and xylem differentiation. They inhibit root growth and leaf abscission. Brassinolide was the first identified brassinosteroid and was isolated from organic extracts of rapeseed (Brassica napus) pollen in 1970. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Cytokin

Cytokines (Greek cyto-, cell; and -kinos, movement) are small cell-signaling protein molecules that are secreted by the glial cells of the nervous system and by numerous cells of the immune system and are a category of signaling molecules used extensively in intercellular communication. Cytokines can be classified as proteins, peptides, or glycoproteins; the term "cytokine" encompasses a large and diverse family of regulators produced throughout the body by cells of diverse embryological origin.

The term "cytokine" has been used to refer to the immunomodulating agents, such as interleukins and interferons. Biochemists disagree as to which molecules should be termed cytokines and which hormones. As we learn more about each, anatomic and structural distinctions between the two are fading. Classic protein hormones circulate in nanomolar (10-9) concentrations that usually vary by less than one order of magnitude. In contrast, some cytokines (such as IL-6) circulate in picomolar (10-12) concentrations that can increase up to 1,000-fold during trauma or infection. The widespread distribution of cellular sources for cytokines may be a feature that differentiates them from hormones. Virtually all nucleated cells, but especially endo/epithelial cells and resident macrophages (many near the interface with the external environment) are potent producers of IL-1, IL-6, and TNF. In contrast, classic hormones, such as insulin, are secreted from discrete glands (e.g., the pancreas). As of 2008, the current terminology refers to cytokines as immunomodulating agents. However, more research is needed in this area of defining cytokines and hormones.

Part of the difficulty with distinguishing cytokines from hormones is that some of the immunomodulating effects of cytokines are systemic rather than local. For instance, to use hormone terminology, the action of cytokines may be autocrine or paracrine in chemotaxis and endocrine as a pyrogen. Further, as molecules, cytokines are not limited to their immunomodulatory role. For instance, cytokines are also involved in several developmental processes during embryogenesis.

Cytokin was recently released by Plant and Bioregulator Technologies, Inc. for cotton production. The primary component of Cytokin is cytokinin. The product has shown some favorable results in university trials across the Cotton Belt, particularly when used in combination with Pix. MU research in southeastern Missouri has shown a yield advantage over the control treatment with the use of Cytokin applied at match head square and at early bloom. When applied in a tank mix with Pix, a greater lint increase was observed. This synergism was not noted with the combination of Pix and PGR IV or Maxxon. Though university research on Cytokin is limited, the manufacturer recommends applying 2 to 4 ounces per acre beginning at match head square and applying weekly for a total of four applications. The hormone cytokinin is produced in the roots of plants. Under periods of plant stress, especially stress affecting the roots, cytokinin is likely to be inhibited.

Cytokin is believed to replenish the plant's cytokinin supply during these periods. Unlike the other plant growth regulators mentioned, Cytokin may be most beneficial under stressed conditions to maintain proper boll set and retention, promote earliness and develop a better root system.

Cytokin or combinations of Cytokin and Pix have the potential for higher cotton yields, though growers are encouraged to use most plant growth regulators judiciously and on a limited basis at first, testing them under their own field conditions.

Jasmonates

Jasmonate (JA) and its derivatives are lipid-based hormone signals that regulate a wide range of processes in plants, ranging from growth and photosynthesis to reproductive development. In particular, JAs are critical for plant defense against herbivory and plant responses to poor environmental conditions and other kinds of abiotic and biotic challenges. Jasmonates are produced from fatty acids and seem to promote the production of defense proteins that are used to fend off invading organisms. They are believed to also have a role in seed germination, and affect the storage of protein in seeds, and seem to affect root growth.

Reminiscent of talking trees in fiction, some JAs can also be released as volatile organic compounds (VOCs) to permit communication between plants in anticipation of mutual dangers. The isolation of methyl jasmonate from jasmine oil derived from Jasminum grandiflorum led to the discovery of the molecular structure of jasmonates and their name.

Pseudomonas syringae causes bacterial speck disease in tomatoes by hijacking the plant’s jasmonate (JA) signaling pathway. This bacteria utilizes a type III secretion system to inject a cocktail of viral effector proteins into host cells. One of the molecules included in this mixture is the phytotoxin coronatine (COR). JA-insensitive plants are highly resistant to P. syringae and unresponsive to COR; additionally, applying MeJA was sufficient to rescue virulence in COR mutant bacteria.

Infected plants also expressed downstream JA and wound response genes but repressed levels of pathogenesis-related (PR) genes. All these data suggest COR acts through the JA pathway to invade host plants. Activation of a wound response is hypothesized to come at the expense of pathogen defense. By activating the JA wound response pathway, P. syringae could divert resources from its host’s immune system and infect more effectively.

Jasmonates, like most of the other plant hormones, are implicated in a bewildering variety of functions. In one species or another, they:

- affect seed germination
- are needed for the production of viable pollen
- drive the coiling of tendrils
- inhibit root growth
- promote the development and opening of flowers
- promote the ripening of fruit (perhaps working upstream of ethylene)
- promote the secretion of nectar in flowers

Some of these functions have been demonstrated by the application of jasmonates to the plant and may not present an accurate picture of the role played by the jasmonates produced within the plant itself.

One function that is clearly mediated by endogenous jasmonate synthesis and translocation is the plant's response to damage, for example, by herbivorous insects feeding on it or by pathogens (e.g. fungi) invading it. In this case the response is to turn on the expression of genes that encode a variety of defenses against the damaging agent.

Karrikins

Karrikins a group of plant growth regulators found in the smoke of burning plant material that have the ability to stimulate the germination of seeds. Karrikins are a group of plant growth regulators found in the smoke of burning plant material. For many years scientists have known that smoke from forest fires had the ability to stimulate the germination of seeds. In 2004, after studying the thousands of chemical compounds found in smoke, it was discovered that a series of butenolides were responsible for this effect. A member of the research team looking at these compounds, David Nelson, consulted a professor of Linguistics at University of Western Australia, who advised that the first recorded Noongar word for 'smoke' from the Perth area in the 1830s, is 'karrik'. This led to these compounds being named karrikins. Currently, there are four known karrikins which are designated KAR1, KAR2, KAR3,and KAR4.

Nitric Oxide (NO)

Nitric oxide (common name) or nitrogen monoxide (systematic name) is a chemical compound with chemical formula NO. This diatomic gas is an important cell signaling molecule in mammals, including humans. It is also an extremely important intermediate in the chemical industry. Nitric oxide is an air pollutant produced by combustion of substances in air, like in automobile engines and fossil fuel power plants. In mammals, NO is an important cellular messenger molecule involved in many physiological and pathological processes. Low levels of NO production are important in protecting an organ such as the liver from ischemic damage. Chronic expression of NO is associated with various carcinomas and inflammatory conditions including juvenile diabetes, multiple sclerosis, arthritis and ulcerative colitis.

Nitric oxide should not be confused with nitrous oxide (N_2O), an anesthetic and greenhouse gas, or with nitrogen dioxide (NO_2), a brown toxic gas and a major air pollutant. However, nitric oxide is rapidly oxidized in air to nitrogen dioxide. Humphrey Davy discovered this to his discomfort, when he inhaled the gas early in his career. Nitric oxide (NO) serves as signal in hormonal and defense responses.

This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.

Plant Growth Regulators First Aid

It is still important to recognize signs and symptoms of plant growth regulator poisoning. When in doubt, seek medical attention and be sure to bring the plant growth regulator label and SDS to the physician.

Poisoning Recognition
Certain plant growth regulators may cause an allergic reaction in a sensitive person. It is important to know the signs and symptoms most likely to be caused by the products you use. Symptoms such as nausea or headache are noticeable only to the affected person. Other people can see signs, such as vomiting, sweating, sluggishness, staggering, swelling, or rash development. Know what your own symptoms might mean and what signs of poisoning to look for in your coworkers. Chemical products that are chemically similar to one another often cause the same type of symptoms. They may be mild or severe, depending on the specific chemical or product involved and the level of exposure. If you have been working with fumigants and some signs or symptoms begin to develop, let your co-workers know, and get medical attention quickly. The plant growth regulator label or SDS will have a telephone number to contact in case of a medical incident.

Procedures
- Get medical attention quickly if you or any of your fellow workers experience unusual or unexplained symptoms that start during work hours or later the same day.
- Do not allow yourself or anyone else to become extremely sick before calling a physician or going to a hospital.
- Read the first aid instructions on the product label or the Safety Data Sheet (SDS) for each product.
- Follow the instructions, and avoid becoming exposed while trying to help another person.
- Give the label and SDS to the physician or emergency personnel. Most labels have a telephone number to contact in case of medical emergencies involving the product. You should provide this number to medical personnel.
- Most of the following recommendations are useful for most types of pesticide exposure. Always read the label for more specific instructions.

Plant Growth Regulator's on Skin
Wash the chemical product from skin with soap and water. This should be adequate in most instances of skin exposure. You should have a ready supply of soap and clean water on the spray equipment to wash your hands or protective equipment after working on the sprayer or coming in contact with the spray solution. Seek medical treatment if there are skin burns or an irritation persists.

Plant Growth Regulators in Eye
Eye exposure to plant growth regulators can be serious. Always pour, measure, or mix herbicides with the containers held below eye level to avoid splashing the product into your eyes. Wettable powders and granules are abrasive and may damage your eyes. Always wear eye protection when mixing.

If Plant Growth Regulators contact your eye(s)

- Remove any protective equipment and wash the eyes quickly but gently.
- Hold the eyelid open and wash with a gentle stream of clean running water.
- Wash for 15 minutes or more.
- Do not use chemicals or eye wash solutions in the wash water because they may increase the extent of the injury.
- Seek medical attention if irritation or burning in the eyes persists.

Plant Growth Regulators in the Lungs

Because these chemical treatments and products are used outdoors, inhalation is not a common route of exposure. However, there are situations with potential inhalation exposure, such as while mixing wettable powders and handling chemical in a storage room or rail car.

- Stand where the wind blows across your body so the wind will carry any chemical dust away from you.
- Cutting the bags, rather than tearing them, avoids stirring up any dust from the product.

Plant Growth Regulators in Mouth or Swallowed

Rinse the mouth with plenty of water. If chemical is swallowed read and carefully follow all instructions on the product label regarding treatment. Induce vomiting only if instructed to do so if on the label. Get medical attention.

Supplies

- A standard first aid kit is important for treating cuts and scrapes associated with working around equipment.
- A supply of clean water for emergency eye flushing should be readily available at the storage facility, on the application equipment, and at the job site. This water should NOT be contaminated in any way. Special eye washing kits that contain water and eye cups can be purchased from safety supply stores.
- Soap and water for routine hand washing should be kept with each piece of equipment, especially if crews eat on location. When using waterless hand cleaners for routine cleanup, you should rinse the cleaner off with water when available.
- Also consider a Tyvek suit that can be worn in the event of an applicator's clothing becoming contaminated.

"Spill kits" are available commercially and include absorbent materials that will help contain a minor jobsite spill until you can properly dispose of the material

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Plant Peptide Hormones

Plant peptide hormones encompasses all small secreted peptides that are involved in cell-to-cell signaling. These small peptide hormones play crucial roles in plant growth and development, including defense mechanisms, the control of cell division and expansion, and pollen self-incompatibility.

Peptide signaling plays a significant role in various aspects of plant growth and development and specific receptors for various peptides have been identified as being membrane-localized receptor kinases, the largest family of receptor-like molecules in plants. Signaling peptides include members of the following protein families.

Systemin - is a small polypeptide functioning as a long-distance signal to activate chemical defenses against herbivores. It was the first plant hormone proven to be a peptide. Systemin induces the production of protein defense compound called protease inhibitors. Systemin was first identified in tomato leaves. It was found to be an 18-amino acid peptide processed from the C-terminus of a 200-amino acid precursor, which is called prosystemin.

CLV3/ESR-related ('CLE') peptide family - CLV3 encodes a small secreted peptide that functions as a short range ligand to the membrane-bound CLV1 receptor like kinase that together with CLV2 (a receptor-like protein) function to maintain stem cell homeostasis in Arabidopsis shoot apical meristems. Although the maize embryo-surrounding region protein (ESR) and CLV3 are very different, they are both members of the CLE peptide family given that they share a short conserved 14-amino acid sequence at the carboxy terminal region. To date, more than 150 CLE signaling peptides are identified. This proteolytically processed bioactive region is important for both promoting and inhibiting cellular differentiation in both apical and cambial meristems.

ENOD40 - is an early nodulin gene, hence ENOD, that putatively encodes two small peptides, one of 12 and the other of 18 amino acid residues. Controversy exists on whether the mRNA or peptides themselves are responsible for bioactivity. Both peptides have been shown "in vivo" to bind to the 93 kDa subunit of sucrose synthase, an essential component in sucrose metabolism. Sucrose degradation is a key step in nitrogen fixation, and is a pre-requisite for normal nodule development.

Phytosulfokine (PSK) - was first identified as a "conditioning factor" in asparagus and carrot cell cultures. The bioactive five amino acid peptide (PSK) is proteolytically processed from an ~80 amino acid precursor secreted peptide. PSK has been demonstrated to promote cellular proliferation and transdifferentiation. It has been demonstrated that PSK binds to a membrane bound LRR receptor like kinase (PSKR.

POLARIS (PLS) - The PLS peptide has a predicted length of 36 amino acids however possesses no secretion signal, suggesting that it functions within the cytoplasm. The PLS peptide itself has not yet been biochemically isolated; however loss-of-function mutants are hypersensitive to cytokinin with reduced responsiveness to auxin. Developmentally it is involved in vascularization, longitudinal cell expansion and increased radial expansion.

Rapid Alkalinization Factor (RALF) - is 49 amino acid peptide that was identified whilst purifying systemin from tobacco leaves, it causes rapid medium alkanalization and does not activate defense responses like systemin.

Tomato RALF precursor cDNA encodes a 115 amino acid polypeptide containing an amino-terminal signal sequence with the bioactive RALF peptide encoded at the carboxy terminus. It is not known how mature RALF peptide is produced from its precursor, but a dibasic amino acid motif (typical of recognition sites of processing enzymes in yeast and animals) is located two residues upstream from the amino terminus of mature RALF. RALF has been identified to bind to potential membrane bound receptors complex containing proteins 25 kDa and 120 kDa in size.

SCR/SP11- are small polymorphic peptides produced by the tapetal cells of anthers and is involved in self-incompatibility of Brassica species. This secreted polypeptide is between 78 and 80 amino acid residues in length. Unlike other peptide hormones, no further post-translational processing occurs, except for the removal of the N-terminal signal peptide. SCR/SP11 like other small peptide hormones binds to a membrane bound LRR receptor like kinase (SRK).

ROTUNDIFOLIA4/DEVIL1 (ROT4/DVL1) - The ROT4 and DVL1 are peptides of 53 and 51 amino acids respectively, which have a high degree of sequence homology. They are two members of 23 member peptide family. ROT4 and DVL1 are involved in regulating polar cell proliferation on the longitudinal axis of organs.

Inflorescence deficient in abscission (IDA) - a family of secreted peptides identified to be involved in petal abscission. The peptides are 77 amino acids in length and possess an amino-terminal secretions signal. Like the CLE peptide family these proteins have a conserved carboxy-terminal domain that is bordered by potentially cleavable basic residues. These proteins are secreted from cells in the floral abscission zone. Studies suggest that the HAESA membrane-associated LRR-RLK is likely to be this peptide's receptor as it too is expressed in the zone of floral organ abscission.

Polyamines

Polyamines are strongly basic molecules with low molecular weight that have been found in all organisms studied thus far. They are essential for plant growth and development and affect the process of mitosis and meiosis A polyamine is an organic compound having two or more primary amino groups $-NH_2$. This class of compounds includes several synthetic substances that are important feedstocks for the chemical industry, such as ethylene diamine $H_2N-CH_2-CH_2-NH_2$, 1,3-diaminopropane $H_2N-(CH_2)3-NH_2$, and hexamethylenediamine $H_2N-(CH_2)6-NH_2$. It also includes many substances that play important roles in both eukaryotic and prokaryotic cells, such as putrescine $H_2N-(CH_2)4-NH_2$, cadaverine $H_2N-(CH_2)5-NH_2$, spermidine $H_2N-((CH_2)4-NH-)2-H$, and spermine $H_2N-((CH_2)4-NH-)3-H$. As of 2004, there had been no reports of any geminal diamine, a compound with two or more unsubstituted $-NH_2$ groups on the same carbon atom. However, substituted derivatives are known, such as tetraethylmethylenediamine, $(C_2H_5)2N-CH_2-N(C_2H_5)2$. Cyclen is the main representative of a class of cyclic polyamines. Polyethylene amine is a polymer based on aziridine monomer.. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Salicylic Acid
Salicylic acid - activates genes in some plants that produce chemicals that aid in the defense against pathogenic invaders. Salicylic acid (from Latin salix, willow tree, from the bark of which the substance used to be obtained) is a monohydroxybenzoic acid, a type of phenolic acid and a beta hydroxy acid. This colorless crystalline organic acid is widely used in organic synthesis and functions as a plant hormone.

It is derived from the metabolism of salicin. In addition to being a compound that is chemically similar to but not identical to the active component of aspirin (acetylsalicylic acid), it is probably best known for its use in anti-acne treatments. The salts and esters of salicylic acid are known as salicylates.

Salicylic acid (SA) is a phenolic phytohormone and is found in plants with roles in plant growth and development, photosynthesis, transpiration, ion uptake and transport. SA also induces specific changes in leaf anatomy and chloroplast structure. SA is involved in endogenous signaling, mediating in plant defense against pathogens. It plays a role in the resistance to pathogens by inducing the production of pathogenesis-related proteins. It is involved in the systemic acquired resistance (SAR) in which a pathogenic attack on one part of the plant induces resistance in other parts. The signal can also move to nearby plants by salicylic acid being converted to the volatile ester, methyl salicylate.

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Strigolactones
Strigolactones are plant hormones that have been implicated in inhibition of shoot branching. Strigolactones are carotenoid-derived and trigger germination of parasitic plant seeds (for example Striga from which they gained their name) and stimulate symbiotic mycorrhizal fungi. Strigolactones contain a labile ether bond that is easily hydrolyzed in the rhizosphere meaning that there is a large concentration gradient between areas near the root and those further away. Strigolactones implicated in the inhibition of shoot branching.

Potential Medical Applications
Plant stress hormones activate cellular responses, including cell death, to diverse stress situations in plants. Researchers have found that some plant stress hormones share the ability to adversely affect human cancer cells. For example, sodium salicylate has been found to suppress proliferation of lymphoblastic leukemia, prostate, breast, and melanoma human cancer cells. Jasmonic acid, a plant stress hormone that belongs to the jasmonate family, induced death in lymphoblastic leukemia cells. Methyl jasmonate has been found to induce cell death in a number of cancer cell lines.

Hormones and Plant Propagation
Synthetic plant hormones or PGRs are commonly used in a number of different techniques involving plant propagation from cuttings, grafting, micropropagation, and tissue culture. The propagation of plants by cuttings of fully developed leaves, stems, or roots is performed by gardeners utilizing auxin as a rooting compound applied to the cut surface; the auxins are taken into the plant and promote root initiation. In grafting, auxin promotes callus tissue formation, which joins the surfaces of the graft together.

In micropropagation, different PGRs are used to promote multiplication and then rooting of new plantlets. In the tissue-culturing of plant cells, PGRs are used to produce callus growth, multiplication, and rooting.

Seed Dormancy

Plant hormones affect seed germination and dormancy by acting on different parts of the seed. Embryo dormancy is characterized by a high ABA/GA ratio, whereas the seed has a high ABA sensitivity and low GA sensitivity. To release the seed from this type of dormancy and initiate seed germination, an alteration in hormone biosynthesis and degradation towards a low ABA/GA ratio, along with a decrease in ABA sensitivity and an increase in GA sensitivity needs to occur.

ABA controls embryo dormancy, and GA embryo germination. Seed coat dormancy involves the mechanical restriction of the seed coat, this along with a low embryo growth potential, effectively produces seed dormancy. GA releases this dormancy by increasing the embryo growth potential, and/or weakening the seed coat so the radical of the seedling can break through the seed coat. Different types of seed coats can be made up of living or dead cells and hormones can influence both types; those composed of living cells are acted upon after seed formation while hormones can influence the seed coats composed of dead cells during the formation of the seed coat.

ABA affects testa or seed coat growth characteristics, including thickness, and effects the GA-mediated embryo growth potential. These conditions and effects occur during the formation of the seed, often in response to environmental conditions. Hormones also mediate endosperm dormancy: Endosperm in most seeds is composed of living tissue that can actively respond to hormones generated by the embryo. The endosperm often acts as a barrier to seed germination, playing a part in seed coat dormancy or in the germination process. Living cells respond to and also affect the ABA/GA ratio, and mediate cellular sensitivity; GA thus increases the embryo growth potential and can promote endosperm weakening. GA also affects both ABA-independent and ABA-inhibiting processes within the endosperm.

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

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Plant Penetrants
These adjuvants have a molecular configuration that enhances penetration of some pesticides into plants. An adjuvant of this type may increase penetration of a pesticide on one species of plant but not another. Enhanced penetration increases the activity of some pesticides.

Polyamines
A polyamine is an organic compound having two or more primary amino groups $-NH_2$. This class of compounds includes several synthetic substances that are important feedstocks for the chemical industry, such as ethylene diamine $H_2N-CH_2-CH_2-NH_2$, 1,3-diaminopropane $H_2N-(CH_2)3-NH_2$, and hexamethylenediamine $H_2N-(CH_2)6-NH_2$.

It also includes many substances that play important roles in both eukaryotic and prokaryotic cells, such as putrescine $H_2N-(CH_2)4-NH_2$, cadaverine $H_2N-(CH_2)5-NH_2$, spermidine $H_2N-((CH_2)4-NH-)2-H$, and spermine $H_2N-((CH_2)4-NH-)3-H$. As of 2004, there had been no reports of any geminal diamine, a compound with two or more unsubstituted $-NH_2$ groups on the same carbon atom. However, substituted derivatives are known, such as tetraethylmethylenediamine, $(C_2H_5)2N-CH_2-N(C_2H_5)2$. Cyclen is the main representative of a class of cyclic polyamines. Polyethylene amine is a polymer based on aziridine monomer.

Proconvertin
Factor VII (formerly known as proconvertin) is one of the proteins that causes blood to clot in the coagulation cascade. It is an enzyme (EC 3.4.21.21) of the serine protease class. A recombinant form of human factor VIIa (NovoSeven, eptacog alfa [activated]) has U.S. Food and Drug Administration approval for uncontrolled bleeding in hemophilia patients. It is often used unlicensed in severe uncontrollable bleeding, although there has been safety concerns.

Propoxur
Propoxur (Baygon®) is a carbamate insecticide and was introduced in 1959. Propoxur is a non-systemic insecticide with a fast knockdown and long residual effect used against turf, forestry, and household pests and fleas. It is also used in pest control for other domestic animals, Anopheles mosquitoes, ants, gypsy moths, and other agricultural pests. It can also be used as a molluscicide.

Several US states have petitioned the Environmental Protection Agency (EPA) to use propoxur against bedbug infestations, but EPA been reluctant to approve indoor use because of its potential toxicity to children after chronic exposure.

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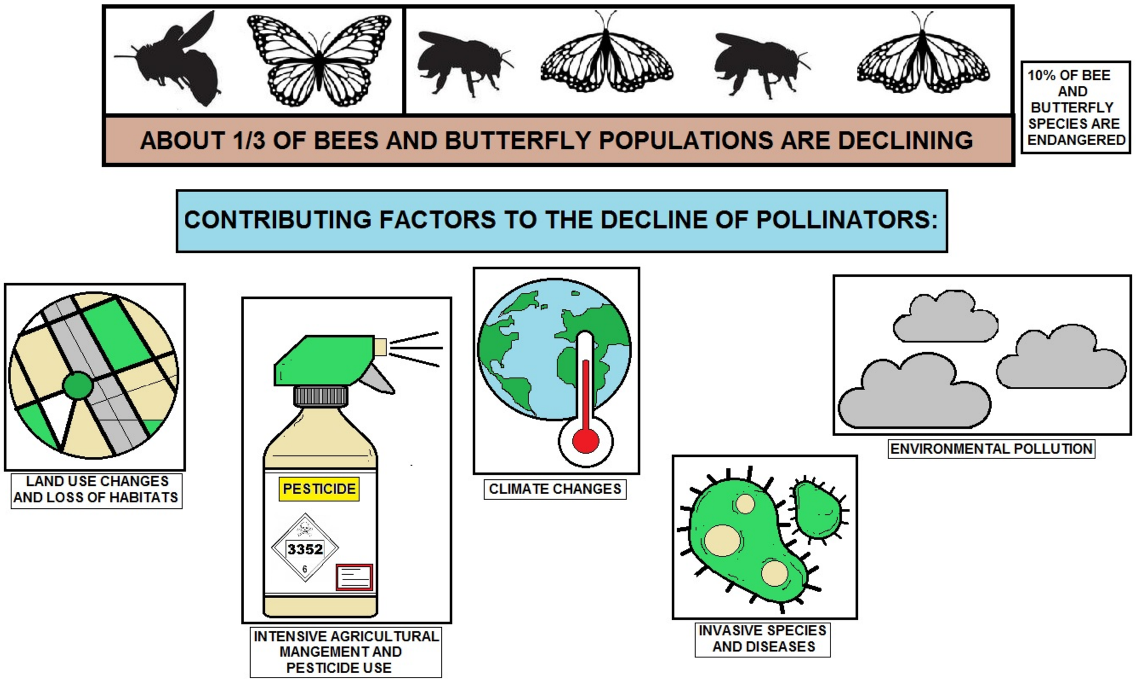

VERGE OF EXTINCTION FOR POLLINATORS

Pyrethroids

To mimic the insecticidal activity of the natural compound pyrethrum another class of pesticides, pyrethroid pesticides, has been developed. These are non-persistent, which is a sodium channel modulators, and are much less acutely toxic than organophosphates and carbamates. Compounds in this group are often applied against household pests.

The pyrethroids are a large family of modern synthetic insecticides similar to the naturally derived botanical pyrethrins. They are highly repellent to MOST INSECTS AND ESPECIALLY termites, which may contribute to the effectiveness of the termiticide barrier. They have been modified to increase their stability in the natural environment. They are widely used in agriculture, homes, and gardens. Some examples are bifenthrin, cyfluthrin, cypermethrin, deltamethrin, and permethrin. They may be applied alone or in combination with other insecticides. Pyrethroids are formulated as emusifiable concentrates (EC), wettable powders (WP), granulars (G), and aerosols. Certain pyrethroids exhibit striking neurotoxicity in laboratory animals when administered by intravenous injection, and some are toxic by the oral route. Systemic toxicity by inhalation and dermal absorption are low, however—there have been very few systemic poisonings of humans by pyrethroids. Though limited absorption may account for the low toxicity of some pyrethroids, rapid biodegradation by mammalian liver enzymes (ester hydrolysis and oxidation) is probably the major factor responsible. This course contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Delta Dust (i.e. Deltamethrin .05%) we are not here to endorse this product, but we have found great success inside wall voids. It will kill cockroaches and ants and that is good enough for me. This odorless, non-staining product is the world's only waterproof insecticide dust!

Besides indoor and outdoor applications, it can also be used on ornamental plants. When left undisturbed, Delta Dust kills crawling insects up to eight months. Because it is waterproof, this insecticide dust will not absorb moisture (which destroys other dusts) and it will not clump. Provides quick control of ants, bees (especially carpenter bees), cockroaches, fleas, silverfish, ticks, and numerous stored product pests. Also an invaluable tool for controlling Boxelder Bugs, Ladybugs, White Footed Ants and Pavement Ants. Deltamethrin is a synthetic pyrethroid insecticide.

Most pyrethroid metabolites are promptly excreted, at least in part, by the kidney. In response to dermal exposure, some persons may experience a skin sensitivity called paresthesia. The symptoms are similar to sunburn sensation of the face and especially the eyelids. Sweating, exposure to sun or heat, and application of water aggravate the disagreeable sensations. This is a temporary effect that dissipates within 24 hours. For first aid, wash with soap and water to remove as much residue as possible, and then apply a vitamin E oil preparation or cream to the affected area. Paresthesia is caused more by pyrethroids whose chemical makeup includes cyano- groups: fenvalerate, cypermethrin, and fluvalinate. In addition to protecting themselves from future exposure, persons who have experienced paresthesia should choose a pyrethroid with a different active ingredient, as well as a wettable powder or microencapsulated formulation.

About These Pesticides
Pyrethrins and pyrethroids are insecticides included in over 3,500 registered products, many of which are used widely in and around households, including on pets, in mosquito control, and in agriculture. The use of pyrethrins and pyrethroids has increased during the past decade with the declining use of organophosphate pesticides, which are more acutely toxic to birds and mammals than the pyrethroids. This change to less acutely toxic pesticides, while generally beneficial, has introduced certain new issues. For example, residential uses of pyrethrins and pyrethroids may result in urban runoff, potentially exposing aquatic life to harmful levels in water and sediment.

Pyrethrins are botanical insecticides derived from chrysanthemum flowers most commonly found in Australia and Africa. They work by altering nerve function, which causes paralysis in target insect pests, eventually resulting in death. Pyrethroids are synthetic chemical insecticides whose chemical structures are adapted from the chemical structures of the pyrethrins and act in a similar manner to pyrethrins. Pyrethroids are modified to increase their stability in sunlight. Most pyrethrins and some pyrethroid products are formulated with synergists, such as piperonyl butoxide and MGK-264, to enhance the pesticidal properties of the product. These synergists have no pesticidal effects of their own but enhance the effectiveness of other chemicals.

Pyrethrins, a single pesticide active ingredient, contain six components that have insecticidal activity: pyrethrin 1, pyrethrin 2, cinerin 1, cinerin 2, jasmolin 1, and jasmolin 2

ExciteR
We do not endorse any product but ExciteR is one of my cricket killers of all time. Once you spray this product, you will see every type of critter run for its life. This is a 6% concentrate of liquid pyrethrin used for fogging and spraying.

Using 1 to 4 ounces per gallon, Exciter can be used alone (in a fogger, mister or pump sprayer) and can be used as an additive to other insecticides (Malathion, Permethrin, Cypermethrin) for the quick knockdown of insect pests. When used alone, Exciter does not have a long residual.

Always have a backup backpack. Always follow the pesticide label's instructions and not my comments or suggestions. Some of my suggestions may be illegal in some areas.

Pyrethroids include:
Allethrin stereoisomers, Bifenthrin, Beta-Cyfluthrin, Cyfluthrin, Cypermethrin, Cyphenothrin, Deltamethrin, Esfenvalerate, Fenpropathrin, Tau-Fluvalinate, Lambda-Cyhalothrin, Gamma Cyhalothrin, Imiprothrin, 1RS cis-Permethrin, Permethrin, Prallethrin, Resmethrin, Sumithrin (d-phenothrin), Tefluthrin, Tetramethrin, Tralomethrin, and Zeta-Cypermethrin

Synergists include:
MGK-264 and Piperonyl butoxide

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Repellents
An insect repellent is a substance applied to skin, clothing, or other surfaces which discourages insects (and arthropods in general) from landing or climbing on that surface. There are also insect repellent products available based on sound production, particularly ultrasound (inaudibly high frequency sounds). These electronic devices have been shown to have no effect as a mosquito repellent by studies done by the EPA and many universities. Insect repellents help prevent and control the outbreak of insect-borne diseases such as malaria, Lyme disease, dengue fever, bubonic plague, and West Nile fever. Pest animals commonly serving as vectors for disease include the insects flea, fly, and mosquito; and the arachnid tick.

Common Insect Repellents
- ✓ Bog Myrtle
- ✓ Citronella oil
- ✓ DEET (N,N-diethyl-m-toluamide)
- ✓ Essential oil of the lemon eucalyptus (Corymbia citriodora) and its active compound p-menthane-3,8-diol (PMD)
- ✓ Icaridin, also known as picaridin, Bayrepel, and KBR 3023
- ✓ IR3535 (3-[N-Butyl-N-acetyl]-aminopropionic acid, ethyl ester)
- ✓ Neem oil
- ✓ Nepetalactone, also known as "catnip oil"
- ✓ Permethrin
- ✓ Permethrin is different in that it is actually a contact insecticide.

Active Ingredients in Insect Repellents
Conventional Repellents
DEET
DEET (chemical name, N,N-diethyl-meta-toluamide or N,N-diethly-3-methyl-benzamide) is the active ingredient found in many insect repellent products. It is used to repel biting pests such as mosquitoes and ticks, including ticks that may carry Lyme disease. Products containing DEET currently are available to the public in a variety of liquids, lotions, sprays, and impregnated materials (e.g., wrist bands).

Formulations registered for direct application to human skin contain from 4 to 100 percent DEET. Additional information on DEET. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

Picaridin
Picaridin (chemical name, 2-(2-hydroxyethyl)-1-piperidinecarboxylic acid 1-methylpropyl ester) is a colorless, nearly odorless liquid active ingredient that is used as an insect repellant against biting flies, mosquitoes, chiggers, and ticks. Picaridin products were sold in Europe and Australia for several years before being introduced to the U.S. market in 2005. Products contain a range of 5 to 20 percent of the active ingredient.

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Resmethrin
Resmethrin is a pyrethroid insecticide with many uses, including control of the adult mosquito population. The resmethrin molecule has four stereoisomers determined by cis-trans orientation around a carbon triangle and chirality. Technical resmethrin is a mixture of (1R,trans)-, (1R,cis)-, (1S,trans)-, (1S,cis)- isomers, typically in a ratio of 4:1:4:1. The 1R isomers (both trans and cis) show strong insecticidal activity, while the 1S isomers do not. The (1R,trans)- isomer is also known as Bioresmethrin,(+)-trans-Resmethrin, or d-trans-Resmethrin; although bioresmethrin has been used alone as a pesticide active ingredient, it is not now registered as a separate Active Ingredient (AI) by the U.S. EPA. The (1R,cis)- isomer is known as Cismethrin, but this is also not registered in the U.S. for use alone as a pesticide AI. Commercial trade names for products that contain resmethrin are Chrysron, Crossfire, Pynosect, Raid Flying Insect Killer, Scourge, Sun-Bugger #4, SPB-1382, Synthrin, Syntox, Vectrin and Whitmire PT-110

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

Rodenticides
Rodenticides are a category of pest control chemicals intended to kill rodents. Single feed baits are chemicals sufficiently dangerous that the first dose is sufficient to kill. Rodents are difficult to kill with poisons because their feeding habits reflect their place as scavengers. They will eat a small bit of something and wait, and if they don't get sick, they continue. An effective rodenticide must be tasteless and odorless in lethal concentrations, and have a delayed effect.

Keep in mind these important tips when controlling a rodent infestations in your home or business:

- Always read and follow label directions for any pesticide product, including rodent baits. It's the law.
- Always store pesticides in a cool, dry place that's not accessible to children and pets. Rodent baits, in particular, can be attractive and dangerous to kids, pets and wildlife.
- Many rodenticide baits have the potential to be toxic to wildlife if the product is eaten, or if an animal eats a rodent that was recently poisoned. If you suspect an animal may have been poisoned, please contact NPIC at 1-800-858-7378 to talk with a pesticide specialist.
- It's important to know which species of rodent you're dealing with; they have different capabilities and preferences. The first step in any effective control program is proper pest identification. For help identifying your rodent infestation, try using this rodent information, or try contacting your local Cooperative Extension Service.
- Many experts recommend an IPM approach, which stands for Integrated Pest Management. This kind of approach emphasizes prevention, sanitation and exclusion, and utilizes pesticides only as a last resort when other options have been exhausted

Common Abbreviations for Pesticide Formulations

A= Aerosol
AF= Aqueous flowable
AS= Aqueous solution or aqueous suspension
B = Bait
C= Concentrate
CM= Concentrate mixture
CG = Concentrate granules
D= Dust
DF= Dry flowables
DS= Soluble dust
E= Emulsifiable concentrate
EC= Emulsifiable concentrate
F= Flowable (liquid)
G = Granules
GL= Gel
L= Liquid (flowable)
LC= Liquid concentrate or low concentrate
LV = Low volatile
M= Microencapsulated
MTF= Multiple temperature formulation
P = Pellets
PS= Pellets
RTU= Ready-to-use
S= Solution
SD= Soluble dust
SG = Soluble granule
SP = Soluble powder or soluble packet
ULV = Ultra low volume
ULW = Ultra low weight or ultra-low wettable
W = Wettable powder
WDG = Water-dispersible granules
WP = Wettable powder
WS= Water soluble
WSG = Water-soluble granules
WSL= Water-soluble liquid
WSP = Water-soluble powder or water-soluble packet

Rodenticide Formulation Process

Regardless of their source, pesticide active ingredients have a range of solubilities. Some dissolve readily in water; others, only in oils. Some active ingredients may be relatively insoluble in either water or oil. Solubility characteristics and the intended use of the pesticide generally define which formulations best deliver the active ingredient. Usually, an active ingredient is combined with appropriate inert materials prior to packaging. The brief review of basic chemical terminology below should prove helpful in understanding differences among the various types of formulations.

Solution
A solution results when a substance is dissolved in a liquid. The components of a true solution cannot be mechanically separated. Once mixed, a true solution does not require agitation to keep its various parts from settling. Solutions are frequently transparent, although if they are dark colored, this may not be the case.

Suspension
A suspension is a mixture of finely divided, solid particles dispersed in a liquid. The solid particles do not dissolve in the liquid, and the mixture must be agitated to keep the particles evenly distributed. Most suspensions will have a cloudy, murky appearance. The label directs the user to shake well before using. Such products also form suspensions when mixed with water for application as a spray. Explicit label information describes the need for sufficient agitation to keep the solid particles of the product dispersed in the spray tank.

Emulsion
An emulsion occurs when one liquid is dispersed (as droplets) in another liquid. Each liquid retains its original identity. Some degree of agitation generally is required to keep the emulsion from separating. Emulsions usually have a milky appearance. The active ingredient is dissolved in an oil-based solvent. When the product is mixed with water, an emulsion (oil in water) is formed. An emulsifying agent (often called an emulsifier) formulated into product helps prevent the emulsion from separating. Familiarity with these terms and processes leads to a greater understanding and appreciation of the advantages and disadvantages of many commonly used pesticide formulations. Liquid formulations are generally mixed with water, but in some instances labels may permit the use of crop oil, diesel fuel, kerosene, or some other light oil as a carrier.

Emulsifiable Concentrates (EC or E)
An emulsifiable concentrate formulation usually contains a liquid active ingredient, one or more petroleum-based solvents (which give EC formulations their strong odor), and an agent that allows the formulation to be mixed with water to form an emulsion. Most ECs contain between 25 and 75 percent (2 to 8 pounds) active ingredient per gallon. ECs are among the most versatile formulations. They are used against agricultural, ornamental and turf, forestry, structural, food processing,

Liquid Formulations
For retail sale and use only by certified applicators or persons under the direct supervision of and only for those uses covered by the certified applicator's certification. Livestock, and public health pests. They are adaptable to many types of application equipment, from small, portable sprayers to hydraulic sprayers, low-volume ground sprayers, mist blowers, and low-volume aircraft sprayers.

Advantages

- Relatively easy to handle, transport, and store.
- Little agitation required—will not settle out or separate when equipment is running.
- Not abrasive.
- Will not plug screens or nozzles.
- Little visible residue on treated surfaces.

Disadvantages

- High a.i. concentration makes it easy to overdose or underdose through mixing or calibration errors.
- May cause damage to desirable plants (phototoxicity).
- Easily absorbed through skin of humans or animals.
- Solvents may cause rubber or plastic hoses, gaskets, and pump parts and surfaces to deteriorate.
- May cause pitting or discoloration of painted finishes.
- Flammable—should be used and stored away from heat or open flame.
- May be corrosive.

Solutions (S)

Some pesticide active ingredients dissolve readily in a liquid carrier such as water or a petroleum-based solvent. When mixed with the carrier, they form a solution that does not settle out or separate. Formulations of these pesticides usually contain the active ingredient, the carrier, and one or more other ingredients. Solutions may be used in any type of sprayer, indoors or outdoors.

Ready-to-use Low-concentrate Solutions (RTU)

Low-concentrate formulations are ready to use and require no further dilution before application. They consist of a small amount of active ingredient (often 1 percent or less per unit volume) dissolved in an organic solvent. They usually do not stain fabrics or have unpleasant odors. They are especially useful for structural and institutional pests and for household use. Major disadvantages of low-concentrate formulations include limited availability and high cost per unit of active ingredient. Many organic solvents are harmful to foliage, so they often cannot be used as plant sprays.

Ultra-low Volume (ULV)

These concentrates may approach 100 percent active ingredient. They are designed to be used as is or to be diluted with only small quantities of a specified carrier and are used at rates of no more than 1/2 gallon per acre. These special purpose formulations are used mostly in outdoor applications, such as in agricultural, forestry, ornamental, and mosquito control programs.

Advantages

- Relatively easy to handle, transport, and store.
- Remain in solution; little agitation required.
- Not abrasive to equipment.
- Will not plug screens and nozzles.
- Leave little visible residue on treated surfaces.

Disadvantages

- Difficult to keep pesticide on target—high drift hazard.
- Specialized equipment required.
- Easily absorbed through skin of humans or animals.
- Solvents may cause rubber or plastic hoses, gaskets, and pump parts and surfaces to deteriorate.
- Calibration and application must be done very carefully because of the high concentration of active ingredient.

Invert Emulsions

An invert emulsion contains a water-soluble pesticide dispersed in an oil carrier. Invert emulsions require a special kind of emulsifier that allows the pesticide to be mixed with a large volume of petroleum-based carrier, usually fuel oil. Invert emulsions aid in reducing drift. With other formulations, some spray drift results when water droplets begin to evaporate before reaching target surfaces; as a result, the droplets become very small and light. Because oil evaporates more slowly than water, invert emulsion droplets shrink less; therefore, more pesticide reaches the target. The oil helps to reduce runoff and improves rain resistance. It also serves as a sticker-spreader by improving surface coverage and absorption. Because droplets are relatively large and heavy, it is difficult to get thorough coverage on the undersides of foliage. Invert emulsions are most commonly used along rights-of-way where drift to susceptible non-target plants or sensitive areas can be a problem.

Flowables (F)/Liquids (L)

A flowable or liquid formulation combines many of the characteristics of emulsifiable concentrates and wettable powders. Manufacturers use these formulations when the active ingredient is a solid that does not dissolve in either water or oil. The active ingredient, impregnated on a substance such as clay, is ground to a very fine powder. The powder is then suspended in a small amount of liquid. The resulting liquid product is quite thick. Flowables and liquids share many of the features of emulsifiable concentrates, and they have similar disadvantages. They require moderate agitation to keep them in suspension and leave visible residues, similar to those of wettable powders.

Flowables/liquids are easy to handle and apply. Because they are liquids, they are subject to spilling and splashing. They contain solid particles, so they contribute to abrasive wear of nozzles and pumps. Flowable and liquid suspensions settle out in their containers. Always shake them thoroughly before pouring and mixing. Because flowable and liquid formulations tend to settle, manufacturers package them in containers of 5 gallons or less to make remixing easier.

Aerosols (A)

These formulations contain one or more active ingredients and a solvent. Most aerosols contain a low percentage of active ingredients. There are two types of aerosol formulations—the ready-to-use type commonly available in pressurized sealed containers, and those products used in electrical or gasoline-powered aerosol generators that release the formulation as a “smoke” or “fog.”

Ready-to-Use Aerosols
These formulations are usually small, self-contained units that release the pesticide when the nozzle valve is triggered. The pesticide is driven through a fine opening by an inert gas under pressure, creating fine droplets. These products are used in greenhouses, in small areas inside buildings, or in localized outdoor areas. Commercial models, which hold 5 to 10 pounds of pesticide, are usually refillable.

Advantages:
- Ready to use.
- Portable.
- Easily stored.
- Convenient way to buy a small amount of a pesticide.
- Retain potency over fairly long time.

Disadvantages:
- Practical for only very limited uses.
- Risk of inhalation injury.
- Hazardous if punctured, overheated, or used near an open flame.
- Difficult to confine to target site or pest.

Formulations for Smoke or Fog Generators
These aerosol formulations are not under pressure. They are used in machines that break the liquid formulation into a fine mist or fog (aerosol) using a rapidly whirling disk or heated surface. These formulations are used mainly for insect control in structures such as greenhouses and warehouses and for mosquito and biting fly control outdoors.

Advantages:
- Easy way to fill entire enclosed space with pesticide.

Disadvantages:
- Highly specialized use and equipment.
- Difficult to confine to target site or pest.
- May require respiratory protection to prevent risk of inhalation injury.

Liquid Baits
An increasing number of insecticides and rodenticides are being formulated as liquid baits. Liquid rodenticides are mixed with water and placed in bait stations designed for these products. They have two major benefits. Liquid rodenticides are effective in controlling rodents, especially rats, in areas where they cannot find water. They are also effective in areas of poor sanitation where ready availability of food renders traditional baits ineffective.

Liquid insecticide baits are used primarily by the structural pest control industry for controlling ants and, to a lesser extent, cockroaches. They are packaged as ready-to-use, sugar-based liquids placed inside bait stations. Liquid insecticide ant baits have a number of advantages. They are very effective against certain species of sugar-feeding ants. These ants typically accept and transfer liquid baits into the ant colonies. However, some ants will not feed on liquid baits. Liquid baits also must be replaced often.

Dry Formulations
Dry formulations can be divided into two types: ready-to-use and concentrates that must be mixed with water to be applied as a spray.

Dusts (D)
Most dust formulations are ready to use and contain a low percentage of active ingredients (usually 10 percent or less by weight), plus a very fine, dry inert carrier made from talc, chalk, clay, nut hulls, or volcanic ash. The size of individual dust particles varies. A few dust formulations are concentrates and contain a high percentage of active ingredients. Mix these with dry inert carriers before applying. Dusts are always used dry and can easily drift to non-target sites. They are widely used as seed treatments and sometimes for agricultural applications. In structures, dust formulations are used in cracks and crevices and for spot treatments to control insects such as cockroaches. Insects ingest poisonous dusts during grooming or absorb the dusts through their outer body covering. Dusts also are used to control lice, fleas, and other parasites on pets and livestock.

Advantages:

- Most are ready to use, with no mixing.
- Effective where moisture from a spray might cause damage.
- Require simple equipment.
- Effective in hard-to-reach indoor areas.

Disadvantages:

- Easily drift off target during application.
- Residue easily moved off target by air movement or water.
- May irritate eyes, nose, throat, and skin.
- Will not stick to surfaces as well as liquids.
- Dampness can cause clogging and lumping.
- Difficult to get an even distribution of particles on surfaces.

Tracking Powders
Special dusts known as tracking powders are used for rodent and insect monitoring and control. For rodent control, the tracking powder consists of finely ground dust combined with a stomach poison. Rodents walk through the dust, pick it up on their feet and fur, and ingest it when they clean themselves. Tracking powders are useful when bait acceptance is poor because of an abundant, readily available food supply. Non-toxic powders, such as talc or flour, often are used to monitor and track the activity of rodents in buildings.

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Baits (B)
A bait formulation is an active ingredient mixed with food or another attractive substance. The bait either attracts the pests or is placed where the pests will find it. Pests are killed by eating the bait that contains the pesticide. The amount of active ingredient in most bait formulations is quite low, usually less than 5 percent. Baits are used inside buildings to control ants, roaches, flies, other insects, and rodent control. Outdoors they sometimes are used to control snails, slugs, and insects such as ants and termites. Their main use is for control of vertebrate pests such as rodents, other mammals, and birds.

Advantages:
- Ready to use.
- Entire area need not be covered because pest goes to bait.
- Control pests that move in and out of an area.

Disadvantages:
- Can be attractive to children and pets.
- May kill domestic animals and non-target wildlife outdoors.
- Pest may prefer the crop or other food to the bait.
- Dead vertebrate pests may cause odor problem.
- Other animals may be poisoned as a result of feeding on the poisoned pests.
- If baits are not removed when the pesticide becomes ineffective, they may serve as a food supply for the target pest or other pests.

Specific Rotencide Poisons

Anticoagulants
Anticoagulants are defined as chronic (death occurs after one to two weeks after ingestion of the lethal dose, rarely sooner), single-dose (second generation) or multiple-dose (first generation) rodenticides, acting by effective blocking of the vitamin K cycle, resulting in inability to produce essential blood-clotting factors — mainly coagulation factors II (prothrombin), VII (proconvertin), IX (Christmas factor) and X (Stuart factor).

In addition to this specific metabolic disruption, massive toxic doses of 4-hydroxycoumarin or 4-hydroxythiacoumarin and indandione anticoagulants cause damage to tiny blood vessels (capillaries), increasing their permeability, causing diffuse internal bleedings (haemorrhagias). These effects are gradual, developing over several days, but claims that they are painless are unfounded: in humans both warfarin poisoning and haemophilia commonly cause moderate to severe pain from bleeding into muscles and joints. In the final phase of the intoxication, the exhausted rodent collapses in hypovolemic circulatory shock or severe anemia and dies calmly. However, because of the duration of discomfort and pain before death it has been suggested that the use of rodenticides can be considered as inhumane. The main benefit of anticoagulants over other poisons is that the time taken for the poison to induce death means that the rats do not associate the damage with their feeding habits. The National Pesticide Information Center (NPIC) can also provide information through a toll-free number, 1-800-858-7378 or http://npic.orst.edu.

First generation rodenticidal anticoagulants generally have shorter elimination half-lives, require higher concentrations (usually between 0.005% and 0.1%) and consecutive intake over days in order to accumulate the lethal dose, and less toxic than second generation agents.

Second generation agents are far more toxic than first generation. They are generally applied in lower concentrations in baits — usually on the order of 0.001% to 0.005% — are lethal after a single ingestion of bait and are also effective against strains of rodents that became resistant to first generation anticoagulants; thus, the second generation anticoagulants are sometimes referred to as "superwarfarins".

Class Examples
Coumarins/4-hydroxycoumarins

First generation: Warfarin, Coumatetralyl
Second generation: Difenacoum, Brodifacoum, Chlorophacinone, Pindone Flocoumafen, Bromadiolone, 1,3-indandiones and Diphacinone

These are harder to group by generation. According to some sources, the indandiones are considered second generation. However, according to the U.S. Environmental Protection Agency, examples of first generation agents include chlorophacinone and diphacinone.

Superwarfarins
Warfarin (also known under the brand names Coumadin, Jantoven, Marevan, Lawarin, Waran, and Warfant) is an anticoagulant. It is most likely to be the drug popularly referred to as a "blood thinner," yet this is a misnomer, since it does not affect the thickness or viscosity of blood.

Instead, it acts on the liver to decrease the quantity of a few key proteins in blood that allow blood to clot. It was initially marketed as a pesticide against rats and mice and is still popular for this purpose, although more potent poisons such as brodifacoum have since been developed. A few years after its introduction, warfarin was found to be effective and relatively safe for preventing thrombosis and embolism (abnormal formation and migration of blood clots) in many disorders. It was approved for use as a medication in the early 1950s and has remained popular ever since; warfarin is the most widely prescribed anticoagulant drug in North America.

Vitamin K
Despite its effectiveness, treatment with warfarin has several shortcomings. Many commonly used medications interact with warfarin, as do some foods (particularly fresh plant-based foods containing vitamin K), and its activity has to be monitored by blood testing for the international normalized ratio (INR) to ensure an adequate yet safe dose is taken. Warfarin and related 4-hydroxycoumarin-containing molecules decrease blood coagulation by inhibiting vitamin K epoxide reductase, an enzyme that recycles oxidized vitamin K to its reduced form after it has participated in the carboxylation of several blood coagulation proteins, mainly prothrombin and factor VII. For this reason, drugs in this class are also referred to as vitamin K antagonists. When administered, these drugs do not anticoagulate blood immediately. Instead, onset of their effect requires about a day before clotting factors being normally made by the liver have time to naturally disappear in metabolism, and the duration of action of a single dose of racemic warfarin is 2 to 5 days. Under normal pharmacological therapy

Indirect
Sometimes, anticoagulant rodenticides are potentiated by an antibiotic or bacteriostatic agent, most commonly sulfaquinoxaline. The aim of this association is that the antibiotic suppresses intestinal symbiotic microflora, which are a source of vitamin K. Diminished production of vitamin K by the intestinal microflora contributes to the action of anticoagulants. Added vitamin D also has a synergistic effect with anticoagulants.

Vitamin K1
Vitamin K1 has been suggested, and successfully used, as antidote for pets or humans accidentally or intentionally (poison assaults on pets, suicidal attempts) exposed to anticoagulant poisons. Some of these poisons act by inhibiting liver functions and in advanced stages of poisoning, several blood-clotting factors are absent, and the volume of circulating blood is diminished, so that a blood transfusion (optionally with the clotting factors present) can save a person who has been poisoned, an advantage over some older poisons.

Calciferols
Vitamin D is a group of fat-soluble secosteroids. In humans Vitamin D is unique both because it functions as a prohormone and because when sun exposure is adequate the body can synthesize it (as Vitamin D3). Measures of the serum levels reflect endogenous synthesis from sun exposure as well as intake from the diet and it is believed that synthesis may contribute generally to the maintenance of adequate serum concentrations. The evidence indicates that the synthesis of vitamin D from sun exposure works in a feedback loop that prevents toxicity but, because of uncertainty about the cancer risk from sunlight, no recommendations are issued by the Institute of Medicine for the amount of sun exposure required to meet vitamin D requirements.

Accordingly, the Dietary Reference Intakes for Vitamin D assume that no synthesis occurs and that all of a person's vitamin D is from their diet.

When synthesized in the kidneys, calcitriol circulates as a hormone, regulating the concentration of calcium and phosphate in the bloodstream and promoting the healthy growth and remodeling of bone. Vitamin D prevents rickets in children and osteomalacia in adults, and, together with calcium, helps to protect older adults from osteoporosis. Vitamin D also affects neuromuscular function, inflammation, and influences the action of many genes that regulate the proliferation, differentiation and apoptosis of cells. Several forms (vitamers) of vitamin D exist (see table). The two major forms are vitamin D2 or ergocalciferol, and vitamin D3 or cholecalciferol, vitamin D without a subscript refers to either D2 or D3 or both. These are known collectively as calciferol. Vitamin D2 was chemically characterized in 1932. In 1936, the chemical structure of vitamin D3 was established and resulted from the ultraviolet irradiation of 7-dehydrocholesterol.

Chemically, the various forms of vitamin D are secosteroids; i.e., steroids in which one of the bonds in the steroid rings is broken. The structural difference between vitamin D2 and vitamin D3 is in their side chains. The side chain of D2 contains a double bond between carbons 22 and 23, and a methyl group on carbon 24.

Vitamin D3 Cholecalciferol
Vitamin D3 (cholecalciferol) is produced by ultraviolet irradiation (UV) of its precursor 7-dehydrocholesterol. This molecule occurs naturally in the skin of animals and in milk. Vitamin D3 can be made by exposure of the skin to UV, or by exposing milk directly to UV (one commercial method).

Vitamin D2
Vitamin D2 is a derivative of ergosterol, a membrane sterol named for the ergot fungus, which is produced by some organisms of phytoplankton, invertebrates, and fungi. The vitamin ergocalciferol (D2) is produced in these organisms from ergosterol in response to UV irradiation. D2 is not produced by land plants or vertebrates, because they lack the precursor ergosterol. The biological fate for producing 25(OH)D from vitamin D2 is expected to be the same as for D3, although some controversy exists over whether or not D2 can fully substitute for vitamin D3 in the human diet.

Metal Phosphides
Metal phosphides have been used as a means of killing rodents and are considered single-dose fast acting rodenticides (death occurs commonly within 1-3 days after single bait ingestion). A bait consisting of food and a phosphide (usually zinc phosphide) is left where the rodents can eat it. The acid in the digestive system of the rodent reacts with the phosphide to generate the toxic phosphine gas.

This method of vermin control has possible use in places where rodents are resistant to some of the anticoagulants, particularly for control of house and field mice; zinc phosphide baits are also cheaper than most second-generation anticoagulants, so that sometimes, in the case of large infestation by rodents, their population is initially reduced by copious amounts of zinc phosphide bait applied, and the rest of population that survived the initial fast-acting poison is then eradicated by prolonged feeding on anticoagulant bait.

Inversely, the individual rodents, that survived anticoagulant bait poisoning (rest population) can be eradicated by pre-baiting them with nontoxic bait for a week or two (this is important to overcome bait shyness, and to get rodents used to feeding in specific areas by specific food, especially in eradicating rats) and subsequently applying poisoned bait of the same sort as used for pre-baiting until all consumption of the bait ceases (usually within 2-4 days). These methods of alternating rodenticides with different modes of action gives actual or almost 100% eradications of the rodent population in the area, if the acceptance/palatability of baits are good (i.e., rodents feed on it readily).

Zinc Phosphide
Zinc phosphide (Zn_3P_2) is an inorganic chemical compound. Metal phosphides have been used as rodenticides. A mixture of food and zinc phosphide is left where the rodents can eat it. The acid in the digestive system of the rodent reacts with the phosphide to generate the toxic phosphine gas. This method of vermin control has possible use in places where rodents immune to many of the common poisons have appeared. Other pesticides similar to zinc phosphide are aluminum phosphide and calcium phosphide. Zinc phosphide is typically added to rodent baits in amount of around 0.75-2%. The baits have strong, pungent garlic-like odor characteristic for phosphine liberated by hydrolysis. The odor attracts rodents, but has a repulsive effect on other animals; birds, notably wild turkeys, are not sensitive to the smell. The baits have to contain sufficient amount of zinc phosphide in sufficiently attractive food in order to kill rodents in a single serving; a sub-lethal dose may cause aversion towards zinc-phosphide baits encountered by surviving rodents in the future.

Rodenticide-grade zinc phosphide usually comes as a black powder containing 75% of zinc phosphide and 25% of antimony potassium tartrate, an emetic to cause vomiting if the material is accidentally ingested by humans or domestic animals. However, it is still effective against rats, mice, guinea pigs and rabbits, all of which do not have a vomiting reflex.

Zinc phosphide is typically added to rodent baits in a concentration of 0.75% to 2.0%. The baits have strong, pungent garlic-like odor characteristic for phosphine liberated by hydrolysis. The odor attracts (or, at least, does not repulse) rodents, but has repulsive effect on other mammals. Birds, notably wild turkeys, are not sensitive to the smell, and will feed on the bait, and thus become collateral damage.

The tablets or pellets (usually aluminum, calcium or magnesium phosphide for fumigation/gassing) may also contain other chemicals which evolve ammonia, which helps to reduce the potential for spontaneous ignition or explosion of the phosphine gas. Phosphides do not accumulate in the tissues of poisoned animals, so the risk of secondary poisoning is low.

Before the advent of anticoagulants, phosphides were the favored kind of rat poison. During World War II, they came into use in United States because of shortage of strychnine due to the Japanese occupation of the territories where strychnine-producing plants are grown (Strychnos nux-vomica, in Southeast Asia).

Phosphides are rather fast-acting rat poisons, resulting in the rats dying usually in open areas, instead of in the affected buildings.

Phosphides used as rodenticides are:

- aluminum phosphide (fumigant only)
- calcium phosphide (fumigant only)
- magnesium phosphide (fumigant only)
- zinc phosphide (in baits)

Hypercalcemia

Calciferols (vitamins D), cholecalciferol (vitamin D3) and ergocalciferol (vitamin D2) are used as rodenticides. They are toxic to rodents for the same reason they are important to humans: they affect calcium and phosphate homeostasis in the body. Vitamins D are essential in minute quantities (few IUs per kilogram body weight daily, only a fraction of a milligram), and like most fat soluble vitamins, they are toxic in larger doses, causing hypervitaminosis. If the poisoning is severe enough (that is, if the dose of the toxin is high enough), it leads to death. In rodents that consume the rodenticidal bait, it causes hypercalcemia, raising the calcium level, mainly by increasing calcium absorption from food, mobilizing bone-matrix-fixed calcium into ionized form (mainly monohydrogencarbonate calcium cation, partially bound to plasma proteins, $[CaHCO_3]+$), which circulates dissolved in the blood plasma.

After ingestion of a lethal dose, the free calcium levels are raised sufficiently that blood vessels, kidneys, the stomach wall and lungs are mineralized/calcificated (formation of calcificates, crystals of calcium salts/complexes in the tissues, damaging them), leading further to heart problems (myocardial tissue is sensitive to variations of free calcium levels, affecting both myocardial contractibility and excitation propagation between atrias and ventriculas), bleeding (due to capillary damage) and possibly kidney failure. It is considered to be single-dose, cumulative (depending on concentration used; the common 0.075% bait concentration is lethal to most rodents after a single intake of larger portions of the bait) or sub-chronic (death occurring usually within days to one week after ingestion of the bait). Applied concentrations are 0.075% cholecalciferol and 0.1% ergocalciferol when used alone.

There is an important feature of calciferols toxicology, that they are synergistic with anticoagulant toxicants, that means, that mixtures of anticoagulants and calciferols in same bait are more toxic than a sum of toxicities of the anticoagulant and the calciferol in the bait, so that a massive hypercalcemic effect can be achieved by a substantially lower calciferol content in the bait, and vice-versa, a more pronounced anticoagulant/hemorrhagic effects are observed if the calciferol is present. This synergism is mostly used in calciferol low concentration baits, because effective concentrations of calciferols are more expensive than effective concentrations of most anticoagulants.

The first application of a calciferol in rodenticidal bait was in the Sorex product Sorexa D (with a different formula than today's Sorexa D), back in early 1970s, which contained 0.025% warfarin and 0.1% ergocalciferol. Today, Sorexa CD contains a 0.0025% difenacoum and 0.075% cholecalciferol combination. Numerous other brand products containing either 0.075-0.1% calciferols (e.g. Quintox) alone or alongside an anticoagulant are marketed.

Other

Difethialone is considered a second generation anticoagulant rodenticide.

The Merck Veterinary Manual states the following:
Although this rodenticide [cholecalciferol] was introduced with claims that it was less toxic to nontarget species than to rodents, clinical experience has shown that rodenticides containing cholecalciferol are a significant health threat to dogs and cats. Cholecalciferol produces hypercalcemia, which results in systemic calcification of soft tissue, leading to renal failure, cardiac abnormalities, hypertension, CNS depression and GI upset. Signs generally develop within 18-36 hours of ingestion and can include depression, anorexia, polyuria and polydipsia. As serum calcium concentrations increase, clinical signs become more severe. ... GI smooth muscle excitability decreases and is manifest by anorexia, vomiting and constipation. ... Loss of renal concentrating ability is a direct result of hypercalcemia. As hypercalcemia persists, mineralization of the kidneys results in progressive renal insufficiency."

Additional anticoagulant renders the bait more toxic to pets as well as human. Upon single ingestion, solely calciferol-based baits are considered generally safer to birds than second generation anticoagulants or acute toxicants.

A specific antidote for calciferol intoxication is calcitonin, a hormone that lowers the blood levels of calcium. The therapy with commercially available calcitonin preparations is, however, expensive.

Other chemical poisons include:

- ANTU (naphthylthiourea, specific against Brown rat, Rattus norvegicus)
- Arsenic
- Barium (a toxic metal) compound
  - ✓ Barium carbonate
- Bromethalin (which affects the nervous system, no antidote)
- Chloralose (narcotic acting condensation product of chloral and glucose)
- Crimidine (2-chloro-N, N,6-trimethylpyrimidin-4-amine; a synthetic convulsant poison, antivitamin B6)
- 1,3-Difluoro-2-propanol ("Gliftor" in the former USSR)
- Endrin (organochlorine cyclodiene insecticide, used in the past for extermination of voles in fields during winter by aircraft spraying)
- Fluoroacetamide ("1081")
- Phosacetim (a delayed-action organophosphorous rodenticide)
- White phosphorus
- Pyrinuron (an urea derivative)
- Scilliroside
- Sodium fluoroacetate ("1080")
- Strychnine
- Tetramethylenedisulfotetramine ("tetramine")
- Thallium (a toxic heavy metal) compounds
- Zyklon B (hydrogen cyanide absorbed in an inert carrier)

Combinations
In some countries, fixed three-component rodenticides, i.e., anticoagulant + antibiotic + vitamin D, are used. Associations of a second-generation anticoagulant with an antibiotic and/or vitamin D are considered to be effective even against most resistant strains of rodents, though some second generation anticoagulants (namely brodifacoum and difethialone), in bait concentrations of 0.0025% to 0.005% are so toxic that resistance is unknown, and even rodents resistant to other rodenticides are reliably exterminated by application of these most toxic anticoagulants.

Prevent Rodent Infestations
To discourage rodent infestations and avoid contact with rodents, remove the food sources, water, and items that provide them shelter.

- Seal holes inside and outside the home to prevent entry by rodents. This may be as simple as inserting steel wool in small holes, or patching holes in inside or outside walls.
- Trap rodents outside the home to help reduce the rodent population within.
- Clean up potential rodent food sources and nesting sites.
- More prevention tips from the Centers for Disease Control and Prevention (CDC)

Identify Rodent Infestations
If preventive measures alone do not work, control of a rodent infestation will rely on identifying the problem's source in order to choose an appropriate treatment method. Unless an infestation is severe, you may never physically see a mouse or rat.

Some signs of rodent infestation may include:

- Evidence of damaged structures providing entry points into the home; and
- Evidence of gnawing and chewing on food packaging or structures;
- Nesting material such as shredded paper, fabric, or dried plant matter;
- Rodent droppings around food packages, in drawers or cupboards, and/or under the sink;
- Stale smells coming from hidden areas.

Pictures of and information about rodents commonly found in the United States are available through CDC and the National Pest Management Association (NPMA)

Treat Rodent Infestations
To remove rodents, you will need to use traps or rodenticides.

Traps include:

- Lethal traps - such as snap traps, are designed to trap and kill rodents.
- Live traps - such as cage-type traps, capture rodents alive and unharmed, but the rodents must then be released or killed. Unless you have sealed the entry points into the house, live rodents released outside may find their way back into the house.
- Rodenticides are products intended to kill rodents, and are typically sold in bait or tracking powder form.

Rodenticides include:

- Always place traps and baits in places where children and pets cannot reach them.
- Baits - combine rodenticides with food to attract rodents. They may be formulated as blocks or paste, and may be enclosed in a bait station.
- Be sure to select traps that are appropriate to the type and size of rodent (i.e., mouse vs. rat).
- In both cases, the rodents die after consuming the chemical contained in the bait or tracking powder. Because they may pose risks to human health, some rodenticides (including tracking powders) may only be legally applied by certified pesticide applicators.
- Tracking powders - rodenticides combined with powdery material. The powder sticks to their feet and fur, and is swallowed when the animals groom themselves.
- Use all products according to label directions and precautions.

Safely Use Rodent Control Products

Rodent control products, if misused, can potentially poison or otherwise harm you, your children, or your pets. For this reason, it is important to read the product label and follow all directions when using a rodenticide or any other pest control product. EPA requires all pesticide labels to list important use instructions and precautions to ensure that pesticides and pest control devices are used safely and effectively, and to prevent harmful exposure. You must always read and understand all label information before using any pest control product. EPA also recommends that you store pesticides and pest control devices away from children and pets, in a locked utility cabinet or garden shed. Any traps or baits should also be set in locations where children or pets cannot access them.

EPA, along with CDC and many rodent control professionals, believes that preventing pest problems is the most effective way to control rodent populations. Relying on preventive measures (e.g., cleaning up food and water sources and sealing entry points) and reduced-risk treatment methods (e.g., trapping) can reduce the reliance on, and therefore the corresponding risk from, the use of chemical rodenticides. This combination of approaches is generally known as Integrated Pest Management (IPM).

Always follow label instructions and take steps to avoid exposure. If any exposures occur, be sure to follow the First Aid instructions on the product label carefully. For additional treatment advice, contact the Poison Control Center at 1-800-222-1222. If you wish to report a pesticide problem, please call 1-800-858-7378.

NOTE: When pesticides are used, it is the applicator's legal responsibility to read and follow directions on the product label. Not following label directions, even if they conflict with information provided herein, is a violation of federal law.

This publication contains pesticide recommendations that are subject to change at any time. These recommendations are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. Due to constantly changing labels and product registration, some of the recommendations given in this writing may no longer be legal by the time you read them. If any information in these recommendations disagrees with the label, the recommendation must be disregarded. No endorsement is intended for products mentioned, nor is criticism meant for products not mentioned. The author and Technical Learning College (TLC) assume no liability resulting from the use of these recommendations.

Salicylic Acid

Salicylic acid (from Latin salix, willow tree, from the bark of which the substance used to be obtained) is a monohydroxybenzoic acid, a type of phenolic acid and a beta hydroxy acid. This colorless crystalline organic acid is widely used in organic synthesis and functions as a plant hormone. It is derived from the metabolism of salicin. In addition to being a compound that is chemically similar to but not identical to the active component of aspirin (acetylsalicylic acid), it is probably best known for its use in anti-acne treatments. The salts and esters of salicylic acid are known as salicylates.

Salicylic acid (SA) is a phenolic phytohormone and is found in plants with roles in plant growth and development, photosynthesis, transpiration, ion uptake and transport. SA also induces specific changes in leaf anatomy and chloroplast structure. SA is involved in endogenous signaling, mediating in plant defense against pathogens. It plays a role in the resistance to pathogens by inducing the production of pathogenesis-related proteins. It is involved in the systemic acquired resistance (SAR) in which a pathogenic attack on one part of the plant induces resistance in other parts. The signal can also move to nearby plants by salicylic acid being converted to the volatile ester, methyl salicylate.

Spray Adjuvants

Spray adjuvants can contribute substantially to safe and effective pest control. Many spray adjuvants are available, each formulated to solve problems associated with a particular type of application. Check pesticide and adjuvant labels to make sure adjuvants are suitable for the site you plan to spray, the target pest, your equipment, and, of course, the pesticide you plan to use.

Remember, many pesticide products already contain an adjuvant. If a pesticide is already formulated properly for your crop, using an additional wetting agent, for example, may not give better spreading or coverage; instead, it could increase runoff, reduce deposit, and even severely damage the target plants.

A pesticide formulation consists of both active and inert ingredients. The active ingredient (a.i.) functions as the pesticide; the inert ingredient includes the carrier and adjuvants. The active ingredient includes always listed on the product label. The type of formulation may also be given. Persons handling pesticides must become familiar with the active ingredients and formulation types to better understand the nature of the products.

Stickers

A sticker is an adjuvant that increases the adhesion of solid particles to target surfaces. These adjuvants can decrease the amount of pesticide that washes off during irrigation or rain. Stickers also can reduce evaporation of the pesticide, and some slow down the degradation of pesticides by sunlight. Many adjuvants are formulated as spreader-stickers to make a general-purpose product.

Strigolactones

Strigolactones are plant hormones that have been implicated in inhibition of shoot branching. Strigolactones are carotenoid-derived and trigger germination of parasitic plant seeds (for example Striga from which they gained their name) and stimulate symbiotic mycorrhizal fungi. Strigolactones contain a labile ether bond that is easily hydrolyzed in the rhizosphere meaning that there is a large concentration gradient between areas near the root and those further away.

Surfactants

Surfactants, also called wetting agents and spreaders, physically alter the surface tension of a spray droplet. For a pesticide to perform its function properly, a spray droplet must be able to wet the foliage and spread out evenly over a leaf. Surfactants enlarge the area of pesticide coverage, thereby increasing the pest's exposure to the chemical. Surfactants are particularly important when applying a pesticide to waxy or hairy leaves. Without proper wetting and spreading, spray droplets often run off or fail to cover leaf surfaces adequately. Too much surfactant, however, can cause excessive runoff and reduce pesticide efficacy.

Surfactants are classified by the way they ionize or split apart into electrically charged atoms or molecules called ions. A surfactant with a negative charge is anionic. One with a positive charge is cationic, and one with no electrical charge is nonionic. Pesticidal activity in the presence of a nonionic surfactant can be quite different from activity in the presence of a cationic or anionic surfactant. Selecting the wrong surfactant can reduce the efficacy of a pesticide product and injure the target plant. Anionic surfactants are most effective when used with contact pesticides (i.e., pesticides that control the pest by direct contact rather than being absorbed systemically). Cationic surfactants should never be used as stand-alone surfactants because they usually are phytotoxic.

Nonionic Surfactants

Nonionic surfactants, often used with systemic pesticides, help pesticide sprays penetrate plant cuticles. Nonionic surfactants are compatible with most pesticides, and most EPA-registered pesticides that require a surfactant recommend a nonionic type.

Superwarfarins

Warfarin (also known under the brand names Coumadin, Jantoven, Marevan, Lawarin, Waran, and Warfant) is an anticoagulant. It is most likely to be the drug popularly referred to as a "blood thinner," yet this is a misnomer, since it does not affect the thickness or viscosity of blood. Instead, it acts on the liver to decrease the quantity of a few key proteins in blood that allow blood to clot. It was initially marketed as a pesticide against rats and mice and is still popular for this purpose, although more potent poisons such as brodifacoum have since been developed.

A few years after its introduction, warfarin was found to be effective and relatively safe for preventing thrombosis and embolism (abnormal formation and migration of blood clots) in many disorders. It was approved for use as a medication in the early 1950s and has remained popular ever since; warfarin is the most widely prescribed anticoagulant drug in North America.

Vitamin K
Despite its effectiveness, treatment with warfarin has several shortcomings. Many commonly used medications interact with warfarin, as do some foods (particularly fresh plant-based foods containing vitamin K), and its activity has to be monitored by blood testing for the international normalized ratio (INR) to ensure an adequate yet safe dose is taken. Warfarin and related 4-hydroxycoumarin-containing molecules decrease blood coagulation by inhibiting vitamin K epoxide reductase, an enzyme that recycles oxidized vitamin K to its reduced form after it has participated in the carboxylation of several blood coagulation proteins, mainly prothrombin and factor VII. For this reason, drugs in this class are also referred to as vitamin K antagonists.

When administered, these drugs do not anticoagulate blood immediately. Instead, onset of their effect requires about a day before clotting factors being normally made by the liver have time to naturally disappear in metabolism, and the duration of action of a single dose of racemic warfarin is 2 to 5 days. Under normal pharmacological therapy

Thickeners
As the name suggests, thickeners increase the viscosity (thickness) of spray mixtures. These adjuvants are used to control drift or slow evaporation after the spray has been deposited on the target area. Slowing evaporation is important when using systemic pesticides because they can penetrate the plant cuticle only as long as they remain in solution.

How to Choose the Right Adjuvant
Many factors must be considered when choosing an adjuvant for use in a pest management program. Following are some guidelines:

- Use only adjuvants manufactured and marketed for agricultural or horticultural uses. Do not use industrial products or household detergents with pesticides because they may interfere with pesticide performance.
- Remember, there are no miracle adjuvants. It is generally wise to be skeptical of such claims as “keeps spray equipment clean” or “causes better root penetration” unless the manufacturer has supporting evidence to back up such claims.
- Make sure the adjuvant has been thoroughly tested and proven effective for your intended use. Test questionable products on a limited area before proceeding with full-scale use.
- Certain pesticides and application procedures require certain types of adjuvants. Determine the correct type and use only an adjuvant of that type. For example, do not substitute an anionic surfactant when a nonionic surfactant is recommended.
- A particular pesticide label may require one or more adjuvants for a certain use yet prohibit any adjuvant for another use. Read the pesticide label carefully.
- Using an adjuvant is not always necessary. It is just as important to know when not to use an adjuvant as it is to know when to use one.

Zinc Phosphide

Zinc phosphide (Zn_3P_2) is an inorganic chemical compound. Metal phosphides have been used as rodenticides. A mixture of food and zinc phosphide is left where the rodents can eat it. The acid in the digestive system of the rodent reacts with the phosphide to generate the toxic phosphine gas. This method of vermin control has possible use in places where rodents immune to many of the common poisons have appeared.

Other pesticides similar to zinc phosphide are aluminum phosphide and calcium phosphide. Zinc phosphide is typically added to rodent baits in amount of around 0.75-2%. The baits have strong, pungent garlic-like odor characteristic for phosphine liberated by hydrolysis. The odor attracts rodents, but has a repulsive effect on other animals; birds, notably wild turkeys, are not sensitive to the smell. The baits have to contain sufficient amount of zinc phosphide in sufficiently attractive food in order to kill rodents in a single serving; a sub-lethal dose may cause aversion towards zinc-phosphide baits encountered by surviving rodents in the future.

Rodenticide-grade zinc phosphide usually comes as a black powder containing 75% of zinc phosphide and 25% of antimony potassium tartrate, an emetic to cause vomiting if the material is accidentally ingested by humans or domestic animals. However, it is still effective against rats, mice, guinea pigs and rabbits, all of which do not have a vomiting reflex.

Topic 7 – Advanced Safety Competency
Common Pesticide/Herbicides M-Z Section Post Quiz
Answers are found after the Glossary Section

Nematicides

1. A nematicide is a type of chemical pesticide used to kill parasitic nematodes. One common nematicide is obtained from________________, the residue obtained after cold-pressing the fruit and kernels of the neem tree.

Chloropicrin

2. By far the greatest portion of multi-purpose soil fumigants used are formulations of _______________with varying concentrations of chloropicrin.

3. Which term is used as a quaternary ammonium herbicide, one of the most widely used herbicides in the world?

Plant Growth Regulators

4. Plant hormones (also known as________________) are chemicals that regulate plant growth.

Plant Penetrants

5. These adjuvants have a _______________________that enhances penetration of some pesticides into plants. An adjuvant of this type may increase penetration of a pesticide on one species of plant but not another. Enhanced penetration increases the activity of some pesticides.

6. Propoxur (Baygon®) is a carbamate insecticide and was introduced in 1959. Propoxur is a non-systemic insecticide with a _________________used against turf, forestry, and household pests and fleas.

7. Rodenticides are a category of pest control chemicals intended to kill rodents. Single feed baits are chemicals sufficiently dangerous that the first dose is sufficient to___________.

8. Anticoagulants are defined as chronic (death occurs after one to two weeks after ingestion of the lethal dose, rarely sooner), single-dose (second generation) or multiple-dose (first generation) rodenticides, acting by effective blocking of the __________________cycle, resulting in inability to produce essential blood-clotting factors — mainly coagulation factors II (prothrombin), VII (proconvertin), IX (Christmas factor) and X (Stuart factor).

9. Which term have been used as a means of killing rodents and are considered single-dose fast acting rodenticides (death occurs commonly within 1-3 days after single bait ingestion)?

10. A mixture of food and ________________is left where the rodents can eat it. The acid in the digestive system of the rodent reacts with the phosphide to generate the toxic phosphine gas.

Pesticide/Insect Glossary

Acaricide: A pesticide used to control mites and ticks. Same as miticide.
Adhesive: A substance which will cause a spray material to stick to the sprayed surface, e.g., sticking agent.
Adjuvant: Any substance added to pesticide which improves the activity of the active ingredient. ***Examples***: Penetrates, spreader-stickers and wetting agents.
Adventive: Located outside habitat, though an reproductive population may not be established.
Alates: Winged forms of insects.
Anthocorids: A true bug in the family Anthocoridae.
Aphid: An insect in the family Aphididae which is sometimes called plant lice.
Algaecide (Algicide): A pesticide used to kill or inhibit the growth of algae.
Alien: Same as non-native.
Anti-Transpirant: A chemical applied directly to a plant which reduces the rate of transpiration, or water loss, by the plant.
Avicide: A chemical used to kill birds.
Bactericide: Chemical used to kill bacteria.
Band Application: The application of a pesticide or other material to a limited area such as in or beside a crop row rather than over the entire field area.
Beneficial insect: Any insect that has a life style that is advantageous to man. Insects that preserve the balance of nature by feeding on others, pollinators, and recyclers are examples of beneficial insects.
Cephalothorax: Head (ceph) and chest (thorax) area.
Cerci: Paired appendages on the end of the abdomen of many insects which are used for sensing, defense or mating.
Chewing (mouth parts): Any mouth part that literally bites to feed; other mouth part types are sucking and rasping.
Clavus: The enlarged terminal antennal segments that form a club.
Collophore: A tube-like structure on the underside of the first abdominal segment (folds under the body) of Collembola (e.g. springtails) which is used as a spring action for leaping.
Broad Spectrum Application: General purpose pesticides which can be used against a large number of pests on a wide range of crops.
Broadcast Application: The application of a pesticide or other material over the entire field or area.
Calibrate: To determine the amount of pesticide that will be applied to the target area.
Colonizing: An ant species which is successful at creating nests in new areas. While some exotic ants are successful colonizers, many colonizing species are not exotic -- and many exotics are not colonizers.
Compound eyes: The large multi-faceted eyes of insects.
Coreids: A member of the family Coreidae, which are leaf footed bugs**.**
Corium: The elongate, thickened basal portion of the fore wing of Hemiptera.
Cornicles: Tubular structure on each side of abdominal region from which pheromones or honeydew is expelled.
Coxa (pl.=coxae): Basal portion of the leg.
Crepuscular: Having activity periods during low light levels at dawn and evening.
Cursorial: Adapted for running.
Coverage: Spread of a pesticide chemical over a surface such as the leaves, fruit, stem, etc.

Dactyl: Literally, a finger or fingerlike projection on an insect body part.
Dealates: Winged forms that have shed their wings, like reproductive termites or ants.
Defoliate, defoliation: Removal of foliage from plants, often by chewing insects.
Detritivore: Any organism that eats decaying organic matter.
Diapause: An insect resting stage, usually induced by environmental signals or extreme conditions like winter or summer.
Dimorphic: Having two distinct forms.
Defoliant: A chemical which causes the leaves or foliage to drop from a plant.
Desiccant: A chemical that promotes drying or loss of moisture.
Drift: The airborne movement of a pesticide spray or dust from the target area to an area not intended to be treated.
Dust: A finely ground, dry pesticide formulation usually containing a small amount of active ingredient and a large amount of inert carrier or dilutent such as clay or talc.
Emulsifiable Concentrate: A pesticide formulation produced by dissolving the active ingredient and an emulsifying agent in a suitable solvent. When added to water, an emulsion (milky mixture) is produced.
Endosperm: A portion of a seed which contains most of the energy reserves for germination.
Estivation (aestivation) : A resting stage (quiescence) resulting from continued high temperature or xeric conditions; diapause; hibernation.
Exoskeleton: The outer portion of an insect body which may be relatively soft like a caterpillar or hardened like many beetles.
Femora: A segment of an insect leg; usually the largest segment.
Filiform: Linear shaped, as the antennae of ground beetles.
Forbs: Any broadleaf non-woody (herbaceous) plant.
Frass: Solid larval insect excrement; plant fragments made by wood-boring insects, usually mixed with excrement.
Furculum (plural: furcula): The elongate fork-like appendage on the end of the abdomen.
Exotic: Same as non-native.
Eradication: The complete elimination of either weeds, insects, disease organisms, or other pests from an area.
Fumigant: A chemical that forms vapors (gases) which is used to destroy weeds, plant pathogens, insects or other pests.
Fungicide: A chemical that kills or inhibits fungi.
gpm: Gallons per minute.
Genera: Plural of genus; A genus is a group of plants or animals with similar characteristics. Animals (insects) are classified by kingdom, phylum, class, order, family, genus, species, and author's name. For example, the honey bee is classified as Animal (kingdom), Arthropoda (phylum), Insecta or Hexapoda (class), Hymenoptera (order), Apidae (family), *Apis* (genus), *mellifera* (species), Linnaeus (author's name). The genus and species are always italicized.
Girdle, girdling: Damage of a plant that circles the stem or branch cutting off the connective plant tissue.
Grigology: The study of crickets, grasshoppers and katydids.
Hemelytron: The first wing of a true bug (Hemiptera) which has the base more thickened than the membranous outer portion.
Hopperburn: Leaf damage caused by leafhopper feeding, which is a yellowing of the leaves.
Herbicide A pesticide used for killing or preventing plant growth. A weed or grass liquid.
Imago: The adult stage of an insect.
Instar: An insect stage between molts; molting is growth.

Internode: The part of a plant stem between the nodes. Nodes mark the point of attachment of leaves, flowers, fruits, buds and other stems.
Insecticide: A pesticide that is used to kill, inhibit, repel or otherwise prevent damage by pests.
Introduced: Same as non-native.
Invasive: A species which is spreading its geographic range into niches occupied by other species. Documentation of an invasive species requires an ecological study to demonstrate the displacement of other ants.
Larval stage (larva, larvae): An immature insect, sometimes used to include all immature stages, even eggs. Usually this term refers more specifically to the feeding stages of insects with complete metamorphosis like grubs, caterpillars, and maggots.
Maggot: In most Diptera (flies), legless larva lacking a distinct head, with cephalic (head) end pointed and caudal (rear) end blunt.
Mesophyll: Fleshy plant tissue inside a leaf or stem.
Metamorphosis: **-** change in form during an insect's growth and development.
Gradual metamorphosis - incomplete metamorphosis in which there is no pupal stage and the immatures and adults look similar excluding the wings of the adults.
Incomplete metamorphosis - any metamorphosis type that does not include the pupal stage. Incomplete metamorphosis is present in Orthoptera (grasshoppers), Hemiptera (true bugs), and several other orders.
Simple metamorphosis - any metamorphosis that occurs in insect groups where they are not winged and have no pupal stage. Insect groups with simple metamorphosis include the Collembola (springtails) and Thysanura (silverfish).
Metathorax: The second section of the insect thorax which houses the second pair of legs and the first pair of wings.
Mite: A member of the order Acari (ticks and mites)
Molt, molting process: In insects, as in snakes, the process of shedding the exoskeleton.
Naiad: A term for immature insects that are aquatic from the orders Plecoptera, Odonata, and Ephemeroptera. This term is becoming archaic and is now replaced by the more general term "***immature***" insect.
Necrosis: Death of tissue in plants or animals.
Nymphs: An immature stage of hemimetabolous insects (those with incomplete metamorphosis).
Microbial Pesticide: Bacteria, viruses, fungi and other microorganisms used to destroy or control pests.
Miticide: See acaricide.
Molluscicide: A chemical used to kill or control snails and slugs.
Native: These definitions do not necessarily define *where* a species is native. How do I define where a species is native? Sometimes the non-native status of a species is clear from previous collections and existing knowledge from biogeography and systematics. Other times, boundaries are a lot blurrier. Is a species non-native if it has been there for 400 years?
Nematicide: A pesticide that kills or otherwise controls nematodes.
Non-indigenous: Same as non-native.
Non-native: A species which is established outside its native habitat. With respect to ants, ants with an established reproducing colony.
Oothecae: A bean-like hardened egg capsule produced by female cockroaches.
Osmeterium (pl.=osmeteria): Scent-producing area behind the tibia.
Overwinter: Time spent during the winter months. Insects are often in hibernation or at least rather immobile in the colder temperatures.

Ovipositor: The egg laying apparatus of an insect. The stinger of a bee is actually a modified ovipositor.
Parthenogenesis: Egg development without fertilization.
Pedipalps: Second pair of appendages of the cephalothorax corresponding to the mandibles of insects.
Petiole: Attachment of a leaf to stem.
Phloem and xylem: Vascular tubes that allow fluid transport in plants. It is the way plants receive and distribute nutrients, hormones and water.
Photosynthesis: The chemical process that plants use to convert carbon dioxide and water to sugars and ultimately to energy.
Phyto- (prefix): Plant.
Phytophagous: Plant eating; an insect using plants as a food source.
Phytotoxemia: A toxic reaction in plants.
Poikilotherm: A cold-blooded organism.
Proboscis: A nose, or, in the case of butterflies, the coiled sucking mouthpart.
Pronotum: The plate on top of the prothorax.
Prothorax: The front part of an insect thorax which includes the attachment points for the front legs.
Protozoan: A microorganism in the kingdom Protozoa.
Pseudergates: Caste found in the lower termites (Isoptera), comprised of individuals having regressed from nymphal stages by molts eliminating the wing buds, or being derived from larvae having undergone non-differentiating molts, serving as the principle elements of the worker caste, but remaining capable of developing into other castes by further molting.
Psocids: Any insect in the order Psocoptera, which includes booklice and barklice.
Psyllid yellows: A virus disease of potatoes, tomatoes, peppers, and eggplant. See purple top.
Pupal stage (pupa): The stage in complete metamorphosis between larva and adult like the cocoon in moths.
Purple top: A purple discoloration of foliage tips caused by insect transmitted virus.
Pustulate: Pus-forming, as in spider bites.
Pesticide: A chemical or other agent used to kill or otherwise control pests.
Pisicicide: A chemical used to kill undesirable fish.
Postmergence: After the plants have appeared through the soil.
Protectant: A pesticide applied to a plant or animal prior to the appearance or occurrence of the pest in order to prevent infection or injury by the pest.
Repellant: A compound that keeps or drives away insects, rodents, birds or other pests from plants, domestic animals, buildings or other treated areas.
Rhopalid: An insect in the family Rhopalidae in the order Hemiptera (true bugs).
Rosetting: Malformation of a plant resulting in a bunched irregular growth of the leaves.
Rodenticide: A pesticide, or mixture of pesticides, used to kill or control rodents.
Scutellum: A triangular shaped section on the back of Hemiptera and some Coleoptera. It is often the identifying characteristic of Hemipterans or "***true bugs***".
Secondary reproductive: A caste of subterranean termite; also called supplemental reproductives. If these termites develop from nymphs, they are called secondary reproductives (primary reproductives are the king and queen). If they develop from pseudergates, they are called tertiary reproductives. Supplementals may be responsible for most of the egg production in the colony.
Spinneret: A small tubular appendage from which silk threads by spiders and many larval insects are excreted.
Stippling (leaf): A speckled appearance of a leaf, usually yellowish spots on a green leaf.

Stolon: An underground portion of a plant that grows horizontally, like a grass root.
Subgroup: A subset of a group with related characters. The term group is a general and non-specific collection of similar organisms regardless of taxonomic hierarchy.
Subimago: The first winged stage of a mayfly. This is the only group to have a winged stage that molts. The final stage is the imago, or adult.
Silvicide: A pesticide used to destroy woody shrubs and trees.
Soluble Powder: A finely ground, solid material which will dissolve in water or some other liquid carrier.
Space Spray: A pesticide which is applied as a fine spray or mist to a confined area either indoors or outside.
Target: The plants, animals, structure, areas or pests to be treated with a pesticide application.
Tarsi: A foot. Insect feet are made of several segments and may have pads, hairs, or hooks.
Tegmina: Plural of tegmen, a hardened covering like the forewing of many Orthoptera and Hemiptera.
Tenaculum: A minute two-pronged structure on the underside of the third abdominal segment of Collembola (springtails) which holds the furcula (appendage used for jumping) before it is released to jump.
Termite: Any wood-eating insect in the order Isoptera.

> **soldier termite -** a caste of termites with specific structures to defend the colony, such as large mandibles or nasute mouths that produce sticky defensive substances.
> **worker termite -** a caste of termites that do most of the work in the colony. Worker termites can be all immature termites and forms that do not develop into reproductive forms or soldiers.

Tertiary reproductive termite: See secondary reproductive.
Tettigoniid: A family of Orthoptera, often called long-horned grasshoppers, which includes katydids.
Thorax: The second body segment of an insect. The thorax has all of the wings and legs attached to it.
Tip burn: A yellow or dried tip on a branch or leaf caused by insect feeding or a plant physiology disorder.
True bugs: Insects in the order Hemiptera. They are usually characterized by a scutellum, a triangular shaped section on the back.
Tramp: A widespread ant species spread by human commerce with a specific syndrome of life history characteristics: extreme polygyny, unicolonial or highly polydomous nest structure and colony reproduction by budding (sensu Passera 1994).
Transferred: Collected outside native habitat, without knowledge of established nests.
Transported: Same as transferred; often refers to animals found in quarantine inspection.
ULV: Ultra Low Volume. No water is applied with this pesticide formulation. Spray concentrates are frequently used in ULV applications.
Venation: The pattern of veins in the insect wing.
Wettable Powder: A solid (powder) pesticide formulation which forms a suspension when added to water.

Post Quiz Answers

Topic 1 - Pesticide Safety Introduction Post Quiz
1. 80%, 2. Food chain, 3. True, 4. Broad-Spectrum, 5. A pesticide adjuvant, 6. Persistence 7. Photodegradation, 8. Chrysanthemums 9. Eradication 10. Hydrolysis

Topic 2 – Proper Pesticide Handling Section Answers
1. True 2. False, 3. The pesticide mixing and loading area, 4. False 5. Environmental contamination, 6. True, 7. 100 percent, 8. False, 9. Quarter (1/4) mile, 10. Syrup of ipecac

Topic 3 – Personal Protection Section Post Quiz
1. True, 2. True, 3. True, 4. True, 5. True, 6. True, 7. True, 8, True, 9. True, 10. True

Topic 4 – Environmental Effects Post Quiz
1, True, 2. False, 3. False, 4. False, 5. False, 6. True, 7. True, 8. True, 9. False, 10. False

Topic 5 –Hazard Communication Section Answers
1. Hazard Communication Standard, 2. Hazard communication standard (HazCom), 3. Hazard classification, 4. Degree of hazard, 5. Data used for classification, 6. Hazard classification, 7. Nonflammable, 8. Extremely flammable, 9. Oxidizing gas, 10. Combustion of other material

Topic 6 – Advanced Safety Competency Post Quiz Answers
1. Bacteria, fungi, or protozoans, 2. Messages, 3. An allergic reaction, 4. An emulsifiable concentrate, 5. Pesticidal activity, 6. Emulsifiable concentrates, 7. Fumigants, 8. A fumigant management plan, 9. Chitin synthesis inhibitors, 10. Hydroprene

Topic 7 — Advanced Safety Competency Post Quiz Answers
1. Neem cake, 2. Methyl bromide, 3. Paraquat, 4. Phytohormones, 5. Molecular configuration, 6. Fast knockdown and long residual effect, 7. Kill, 8. Vitamin K, 9. Metal phosphides, 10. Zinc phosphide

Information Centers

The OPPTS Chemical Library supports programs under the Toxic Substances Control Act (TSCA) and the Emergency Planning and Community Right-to-Know Act (EPCRA). The Library's special collections include works on specialty subjects such as pollution prevention, biotechnology, and risk assessment.

A list of other libraries in the EPA National Library Network
OPP's Freedom of Information Act site provides information on FOIA and procedures for requesting a document from the EPA through the Act.

The OPP Public Regulatory Docket provides the public with access to pesticide related information produced by the EPA. Three individual dockets--Federal Register, Special Review, and Special Programs dockets--house regulatory notices, background documents and public comments on OPP activities.

The National Service Center for Environmental Publications (NSCEP) is a central repository for all EPA documents with over 5500 titles in paper and/or electronic format, available for distribution. You can browse and search the National Publications Catalog and order EPA Publications online or by telephone at 1-800/490-9198.

Resources

Government Agencies

- CDC, Center for Disease Control & Epidemiology http://www.cdc.gov/
- CPSC, Consumer Product Safety Commission http://www.cpsc.gov/
- EPA-OAR, EPA Office of Air & Radiation http://www.epa.gov/oar/
- EPA-OPP, EPA Office of Pesticide Programs http://www.epa.gov/pesticides/
- FDA, Food and Drug Administration http://www.fda.gov
- NCID, National Center for Infectious Disease http://www.cdc.gov/ncidod/ncid.htm
- NCSICP, North Carolina Statewide Infection Control Program http://www.unc.edu/depts/sicp/
- NIH, National Institutes of Health http://www.nih.gov/index.html
- NTP, National Toxicology Program http://ntp-server.niehs.nih.gov/default.html/
- OSHA, Occupational Safety and Health Administration http://www.osha.gov
- USDA, United States Department of Agriculture, http://www.usda.gov

Educational/Research Groups

- ChemFinder, Cambridge Software http://chemfinder.cambridgesoft.com/
- EXTOXNET, Extension Toxicology Network http://ace.orst.edu/info/extoxnet/
- NPIC, National Pesticide Information Center http://ace.orst.edu/info/nptn/

Chemicals

- Emergency Care Information (*Alcohols): http://www.embbs.com/cr/alc/alc.html
- Ethylene Oxide: http://ntp-server.niehs.nih.gov/htdocs/ARC/ARC_RAC/Ethylene-oxide.html
- Toxicology and Carcinogenesis Studies of Ethylene Oxide: http://ntp-server.niehs.nih.gov/htdocs/LT-studies/tr326.html
- Formaldehyde: http://www.pp.okstate.edu/ehs/training/oshafhyd.htm

- TR-490 Toxicology and Carcinogenesis Studies of Glutaraldehyde: http://ntp-server.niehs.nih.gov/htdocs/LT-studies/tr490.html
- (*Hypochlorites & Chlorine) Use of Bleach in Prevention of Transmission of HIV in Health Care Settings: http://www.cdc.gov/od/ohs/biosfty/bleachiv.htm

Chemical Searches

- Chemfinder Webserver: http://chemfinder.camsoft.com/
- EXTOXNET http://ace.ace.orst.edu/info/extoxnet
- Various Factsheets http://www.state.nj.us/health/eoh/rtkweb/rtkhsfs.htm

Bloodborne Pathogen Standard

- OSHA Occupational Safety and Health Standards 1910: http://www.osha-slc.gov/OshStd_toc/OSHA_Std_toc_1910.html
- OSHA Bloodborne Pathogen Standard 1910.1030: http://www.osha-slc.gov/OshStd_data/1910_1030.html
- Interpretation-Compliance Letter, Bleach Solutions: http://www.osha.gov/OshDoc/Interp_data/I19920728A.html
- Bloodborne Pathogens and Acute Care Facilities (Many regional contacts): http://www.osha-slc.gov/Publications/OSHA3128/osha3128.html

Disinfection SDS (formerly MSDS):

- http://www.pp.okstate.edu/ehs/modules/SDS (formerly MSDS).htm

Pathogens

- All the Virology on the WWW: http://www.tulane.edu/~dmsander/garryfavweb.html
- The Bad Bug Book: http://vm.cfsan.fda.gov/~mow/intro.html

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