WEED IDENTIFICATION AND CONTROL COURSE

PROFESSIONAL DEVELOPMENT
CONTINUING EDUCATION COURSE

Technical Learning College

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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.

Some States and many employers require the final exam to be proctored.

Do not solely depend on TLC’s Approval list for it may be outdated.

Important Information about this Manual

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

This manual will cover general laws, regulations, required procedures and accepted policies relating to the use of pesticides and herbicides. 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 course manual will provide 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 informational manual 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 should be used 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 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 chemicals to the property or plants being treated. Avoid drift onto neighboring properties, especially gardens containing fruits and/or vegetables ready to be picked. 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.

Copyright Notice

Melissa Durbin, Author and TLC's Dean of Instruction.

Our goal is to assist you in identification and control of unwanted plants. Please call me or my staff for any course assistance or support. I love to teach this course and have been teaching agronomy and botany for several years. Here I am with Thistle Poppy *Argemone sp*. (this plant was once used by the ancient Greeks to treat cataract eye disease). Most of you think Thistles are known to have purple flowers, think again. Notice the unusual shape of the petals of this specimen.

What is a weed? "*A plant whose virtues have not been discovered."* – Emerson

Where do weeds originate from?

Genesis 3:17
17 To Adam he said, "Because you listened to your wife and ate from the tree about which I commanded you, 'You must not eat of it,'

"Cursed is the ground because of you;
through painful toil you will eat of it
all the days of your life.

18 It will produce thorns and thistles for you, and you will eat the plants of the field.

Thank Adam for all the weeds and the business you get spraying them.

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.)

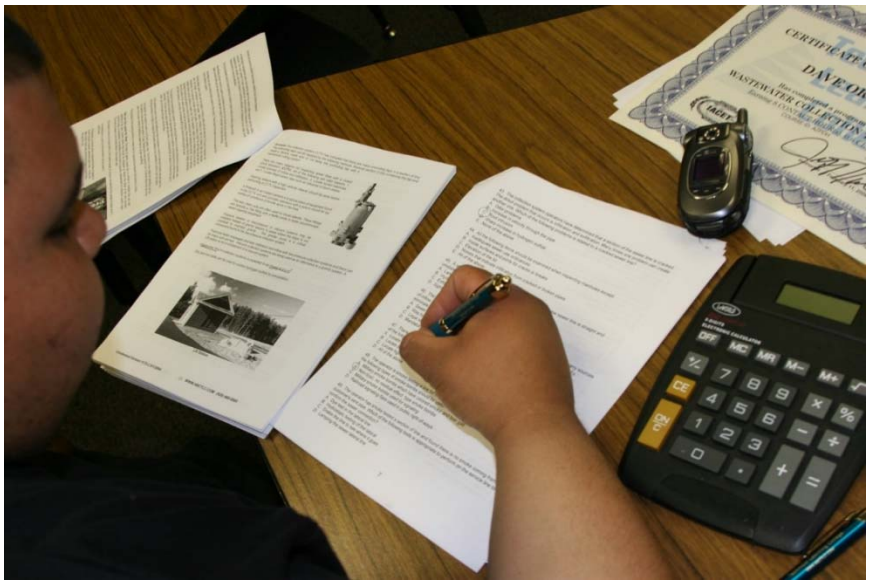
Students have direct contact with their instructor—primarily by e-mail or telephone. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling; i.e., 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 either by 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.

We welcome you to complete the assignment in Word.

Once we grade it, we will mail a certificate of completion to you. Call us if you need any help.

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

Weed Identification and Control CEU Training Course Description

Welcome to the world of terrestrial weed identification and control. The purpose of this course is to help you learn about the highly specialized area of terrestrial pest management. Only by being properly prepared can you expect to perform your duties safely and effectively.

As a member of the weed application industry, you need to develop the knowledge and skills to recognize:

- If an organism is a pest.
- What caused the pest to become a nuisance?
- The life cycle of the pest.
- Which life stage of the pest is susceptible to your management strategies.
- Various management techniques and tools, including pesticides, suitable for aquatic uses.
- How nontarget organisms may react to a proposed management strategy.
- The changing conditions of the aquatic environment in which you work.

Rag Weed

Course Procedures for Registration and Support

All of Technical Learning College's 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 immediate and prompt service. All students will be tracked by an unique number assigned to the student.

Instructions for Written Assignments

The Weed Identification and Control training distance learning course uses a fill-in-the-blank and multiple choice style answer key. 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 front of the assignment.

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 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.

Pesticide and Herbicide Terms, Abbreviations, and Acronyms
TLC provides a glossary that defines, in non-technical language, commonly used pesticide and herbicide terms appearing in publications and materials. It also explains abbreviations and acronyms used throughout the EPA and other governmental 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 five years. It is your responsibility to give the completion certificate to the appropriate agencies. TLC will complete and return to you the forms necessary for your certificate renewal.

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.

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 graded assignment or quiz results within two or three weeks after submitting, 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.

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% or better is necessary to pass this course. If you should need any assistance, please email all concerns or call us. If possible e-mail the final test to info@tlch2o.com or fax (928) 468-0675.

Course Objective: To provide continuing education training in terrestrial weed identification, weed control, effective, safe herbicide applications, biological and mechanical treatment methods.

Here is one of TLC's students during a field trip. He was able to find this beautiful Yellow Nightshade Groundcherry, ***Physalis crassifolia*****, part of the potato family. Poison!**

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 with opportunities to apply and understand the theory and skills needed for pesticide certification,

To provide opportunities for TLC students to learn and practice environmental educational 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 education,

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

Always be careful of over spraying your chemical or spraying near water. This fellow sprayed all the way into the water without thinking of the harm he has done and could care less. Also be careful of the possibility of runoff from rain or stormwater. Pesticide applicators like this man above, give all of us a bad name. He is one reason that we have a huge amount of laws and rules.

Daisy Fleabane, above

Dandelion

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Important Points to Remember

This CEU training course is designed as a quick and ready reference of weed control practices used in various cropping systems. Because chemical regulation of plant growth is complex and requires considerable knowledge, a large portion of the handbook is devoted to registered uses of herbicides, crop desiccants, and some plant growth regulators. In all cases, authors have made every effort to list only registered herbicides and to ensure that the information conforms with product labels and company recommendations.

This CEU training course is not intended as a complete guide to weed control or herbicide use.

- Before using any herbicide, read the label on the container. Before a herbicide can be recommended for a specific use, it must be thoroughly tested. The recommendation on the manufacturer's label, when followed, can prevent many problems arising from the improper use of a chemical.
- Information is supplied here with the understanding that no discrimination is intended and no endorsement by the Cooperative Extension Service is implied. Trade names (brand names) of some commercial pesticides are used in portions of this handbook to help identify the common name used by the Weed Science Society of America (WSSA). Authors have assembled the most reliable information available to them at the time of publication.
- Due to constantly changing laws and regulations, authors can assume no liability for the recommendations. Any use of a pesticide contrary to instructions on the printed label is not legal or recommended.

Pesticide Precautionary Statement
Pesticides used improperly can be injurious to humans, animals, and plants. Follow the directions and heed all label precautions.

Store pesticides in the original containers under lock and key—out of reach of children and animals—and away from food and feed.

Apply pesticides so that they do not endanger humans, livestock, crops, beneficial insects, fish, and wildlife.

Do not apply pesticides when there is danger of drift, when honeybees or other pollinating insects are visiting plants, or in ways that may contaminate or leave illegal residues.

Avoid prolonged inhalation of pesticide sprays or dust; wear protective clothing and equipment if specified on the label.

If your hands become contaminated with a pesticide, do not eat or drink until you have washed them.

If a pesticide is swallowed or gets in the eyes, follow the first aid treatment given on the label, and get prompt medical attention. If a pesticide is spilled on your skin or clothing, remove clothing immediately and wash thoroughly.

Do not clean spray equipment or dump excess spray material near ponds, streams, or wells. Because it is difficult to remove all traces of herbicides from equipment, do not use the same equipment for insecticides or fungicides that you use for herbicides.

Dispose of empty pesticide containers promptly and in accordance with all applicable Federal, State, and local laws.

NOTE: Some States have restrictions on the use of certain pesticides. Check your State and local regulations. Also, because registrations of pesticides are under constant review by the U.S. Environmental Protection Agency, consult your State forestry agency, county agricultural agent or State extension specialist to be sure the intended use is still registered.

Use of trade names is for reader's information and does not constitute official endorsement or approval by (TLC) Technical Learning College to the exclusion of any suitable product or process.

Agricultural plant means any plant grown or maintained for commercial, research, or other purposes. Included in this definition are food, feed and fiber plants, trees, turf grass, flowers, shrubs, ornamentals, and seedlings (40 CFR).

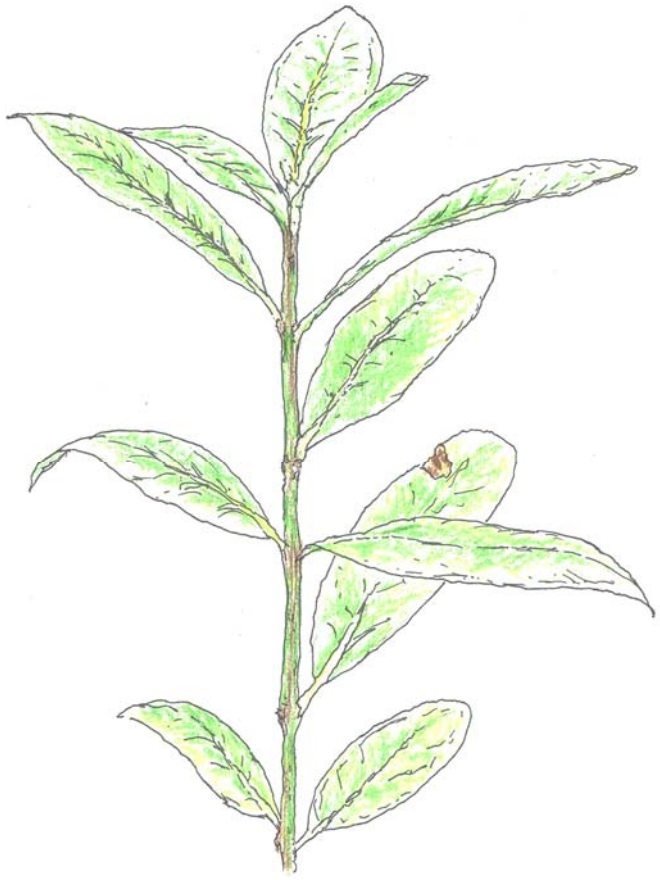
Farm means any operation, other than a nursery or forest, engaged in the outdoor production of agricultural plants (40 CFR, Section 170.3).

Common Weed Identification Terms

Alternate- Leaves that are arranged singly up the stem; not opposite each other.
Annual- Plant that germinates, flowers, seeds, and dies during one growing season.
Anther- Structure in a flower in which pollen is formed
Auricle- Lobe-like structure at the collar of a grass leaf.
Awn- Slender bristle at the tip of grass seed structures.
Axil- The angle formed between a leaf and a stem.
Basal- At the base of a plant or plant part.
Bi-ennial- Plant that germinates in one growing season, then flowers, seeds, and dies during the next year.
Bract- Leaf-like structure at the base of flowers or leaves.
Calyx- All the flower leaves together, normally green in color.
Clasping leaves- Leaves that appear to wrap around the stem at their base.
Compound leaves- Leaves with 2 or more distinct leaflets.
Cotyledons- The first leaf-like structures that appear after germination; seed leaves.
Crown- The structure formed where leaves, stems, and roots grow together.
Dissected- Deeply and repeatedly divided into smaller parts.
Entire- Not toothed or otherwise cut.
Glumes- The 2 bracts surrounding a grass spikelet.
Head- A group of flowers borne tightly together.
Leaflets- Leaf-like structures within a compound leaf.
Ligule- The structure at the collar of a grass leaf between the sheath and the stem.
Linear- Long, narrow, and slender.
Lobed- A cut into a leaf from the edge toward the center; greater than toothed, but not quite compound.
Margin- The edge of a leaf.
Membranous- Thin and flexible, usually not green.
Midrib- The center and usually most prominent vein on a leaf.
Nodding- A flower that is not pointed upward, but bent downward or sidewise to the stem.
Opposite- Leaves situated directly across the stem from each other.
Ovate- Egg shaped in outline.
Panicle- A much-branched inflorescence.
Perennial- A plant that lives for more than 2 growing seasons.
Petiole- A leaf stalk.
Pinnate- With 2 rows of leaflets, like a feather.
Plume- A hair-like or feather-like structure, often on a seed.
Pubescence- The hairs on a leaf, stem or flower.
Rhizome- A creeping, underground stem.
Rosette- A circular, normally basal, clump of leaves.
Sheath- The extension of leaf tissue surrounding a stem.
Simple leaf- One with a blade in one piece; not compound.
Spike- A narrow, non-spreading inflorescence.
Spikelet- A single or group of floral structures in a grass.
Spur- A hollow appendage on a flower.
Stolon- A creeping stem along the surface of the ground.
Succulent- Fleshy and juicy.
Taproot- A thick, central root with minimal branching.
Trifoliate leaf- A leaf made of 3 leaflets; clover-like.
Whorled- 3 or more similar structured arranged as spokes on a wheel.

Plant / Animal Abbreviations

A - adjective
alt. - alternative name (synonym)
AS. - Anglo-Saxon
Comb. Form. - Combining form
Dan. - Danish
Dim. - diminutive
E. - English
esp. - especially
Fr. - French
fr. - from
G. - German
Gael. - Gaelic
Goth. - gothic
Gr. - Greek
Icel. - Icelandic
i.e. - for example
Ir. - Irish
It. - Italian
L. - Latin
LL. - Low Latin, Late Latin
MD. - Middle Dutch
ME. - Middle English
n. - noun
NL. - New Latin
OE. - Old English
O.Fr. - Old French
OHG. - Old High German
ON. - Old Norse
perh. - perhaps
pl. - plural
pp. - past participle
prob. - probably
pres. part. - present participle
Scand. - Scandinavian
Skt. - Sanskrit
Sp. - Spanish
specif. - specifically
Sw. - Swedish
vt. - verb transitive
W. - Welsh



HEMP DOGBANE

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.

What is a Weed?

Generally, the term weed is used to describe any plant that is unwanted and grows or spreads aggressively. Terms such as invasive, exotic or non-native are used somewhat interchangeably to refer to weeds that infest large areas. Free from the natural controls present in their native lands, these weeds grow quickly and overtake native plants.

Noxious Weed
Millions of acres of once healthy, productive rangelands, forestlands and riparian areas have been overrun by noxious or invasive weeds. They are invading recreation areas, public lands, National Parks, State Parks, roadsides, stream banks, Federal, state, and private lands.

Invasive or noxious weeds:

- destroy wildlife habitat
- reduce opportunities for hunting, fishing, camping, and other recreational activities
- displace many Threatened and Endangered Species
- reduce plant and animal diversity because of weed monocultures-single plant species that over-run all others in an area
- disrupt waterfowl and neo-tropical migratory bird flight patterns and nesting habitats
- cost millions of dollars in treatment and loss of productivity to private land owners.

What is a noxious weed?
The term "weed" means different things to different people. In the broadest sense, it is any plant growing where it is not wanted. Weeds can be native or non-native, invasive or non-invasive, and noxious or not noxious. Legally, a noxious weed is any plant designated by a Federal, State or county government as injurious to public health, agriculture, recreation, wildlife or property. (Sheley, Petroff, and Borman,1999) A noxious weed is also commonly defined as a plant that grows out of place (i.e. a rose can be a weed in a wheat field) and is "competitive, persistent, and pernicious." (James, et al, 1991).

The noxious weeds mandated for control are plants non-native to North America. Consequently, these plants do not have the natural checks as found in their native land, such as insects, diseases, and herbivores that would keep the plant population in check. Due to the competitive aggressive ability of these plants, coupled with no natural controls, these plants will develop mono-culture stands. Not only are many crops out competed by these weeds, but native vegetation and the wildlife associated with it will be replaced. Consequently, identifying the weeds when they first become established and developing an integrated weed management plan to control them is critical in maintaining healthy, productive land. The term noxious weed is used to describe a legal designation for plant species that have been determined to be especially undesirable or difficult to control. These weeds are subject, by law, to certain restrictions. Regulated by the U.S. Department of Agriculture, there are 90 federal noxious weeds. Please see the Federal Listing of Noxious and Alien weeds in this course for more information.

Are invasive plants the same as noxious weeds?
No. Invasive plants include not only noxious weeds, but also other plants that are not native to this country. Plants are considered invasive if they have been introduced into an environment where they did not evolve. As a result, they usually have no natural enemies to limit their reproduction and spread (Westbrooks, 1998). Some invasive plants can produce significant changes to vegetation, composition, structure, or ecosystem function. (Cronk and Fuller, 1995).

What is an Invasive Species?
An 'invasive species' is defined as a species that is 1) non-native (or alien) to the ecosystem under consideration and 2) whose introduction causes or is likely to cause economic or environmental harm or harm to human health. (Executive Order 13112).

COFFEE SENNA

JIMSON WEED
POISONOUS PLANTS

Weed Identification Section

	PLANT EXAMPLE	BENEFIT EXPLANATION
List 1 HIGHEST PRIORITY PLANTS FERTILE CAPEWEED		HIGHLY INVASIVE AND TYPICALLY NOT TO WIDESPREAD. CONTROL OR EVEN ERADICATION IS FEASIBLE
List 2 HIGH PRIORITY PLANTS CAPE IVY		HIGHLY INVASIVE AND USUALLY MORE COMMON THAN List 1 SPECIES, STILL FEASIBLE TO CONTROL IN MANY PLACES
List 3 MEDIUM PRIORITY PLANTS SWEET FENNEL		USUALLY VERY WIDESPREAD AND DIFFICULT TO CONTROL AT PARK SCALE, OR SPECIES OF CONCERN THAT REMAIN SCARCE
List 4 LOWER PRIORITY PLANTS RATTLESNAKE GRASS		ALL OTHER EXOTIC PLANTS NOT Lists 1 - 3. TYPICALLY UBIQUITOUS AND BEYOND CONTROL, OR VERY RARE AND UNLIKELY TO PERSIST.

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INVASIVE PLANT SPECIES

A weed is any plant growing in an area where it is not wanted. We try to control weeds because they compete with crops for light, moisture, space and nutrients. Certain weed species can harbor plant diseases and insect pests and can be a serious threat to the ecosystem's health. Other species may be poisonous, allergenic or an irritant to humans and/or livestock. Medical and economic problems such as illness, death, rash, hayfever, or a reduction in quality of fur, meat and milk products may result.

Weeds have many unique characteristics which make them extremely difficult to control. Most produce a tremendous number of seeds. The seeds of some weed species may be dormant for many years, with only a small percentage germinating each year. Some seeds will not germinate without intense heat, like from a wild fire. Weeds generally mature earlier than the crop and often seeds will be dropped before crop harvest and remain in the field. Weeds are generally more competitive than crops and can often survive under unfavorable growing conditions.

Weeds may conveniently be divided into two classes based on the way in which they emerge from the seed. Monocots emerge with a single seed leaf whereas dicots emerge with two seed leaves. Most monocot weeds found in turfgrass are from the family Gramineae and are termed **weedy grasses**. Examples include crabgrass, annual bluegrass, tall fescue, and quackgrass. Dicots, on the other hand, are termed **broadleaf weeds** and include such plants as dandelion, clover, ground ivy, knotweed, and plantain.

Weedy grasses and broadleaf weeds are further divided into groups according to the plants' length of life. **Perennial weeds** have a life of more than two years, though new seeds may be produced every year. **Biennial weeds** have a life of two years, generally storing up food reserves in the leaves and roots the first year and producing seed in the second year. The biennial weeds are often grouped with perennial weeds since control is similar.

Annual weeds germinate from seed, grow, flower, and produce seed in less than one year.

Summer annuals (AKA warm season annuals) germinate in the spring and mature in the fall, whereas **winter annuals (AKA cool season annuals)** germinate in fall or late winter and mature in late spring.

Summer annuals complete their lifecycle from seed to maturity in less than one year. They germinate in the spring, mature, set seed and die in the fall. Winter annuals germinate in the fall, overwinter as seedlings or small rosettes and mature, set seed and die the following spring or early summer. Some weeds are capable of both summer and winter annual lifecycles.

Biennials
Biennials complete their lifecycles in less than two years. Germination and the production of an overwintering rosette of leaves occur the first year. The second year flowering, seed production, and plant death occur. Control is best obtained during the first year.

Perennials
Perennials live for more than two years. They reproduce vegetatively from roots, rhizomes, buds, or tillers, or from seed, or both. They can be especially difficult to control because of their persistent root systems.

Early identification of emerged weed species is critical for choosing the best weed control methods. This guide will enable you to identify weeds at three growth stages.

Effective control of weeds in turf is based on correct identification. Many books and charts are available to help in identifying common lawn weeds. For additional help in weed identification, inquire at your county extension service.

Understanding Weed Terms

Biodiversity: Biodiversity is, simply put, all life on earth, even that which has yet to be discovered. More specifically, it includes the millions* of diverse species, from bacteria to whales, that share the earth's lands and waters with us. Each year, many thousands of species are being extinguished as a result of human activities, such as habitat destruction and exotic species introductions.

- *The actual number of species in existence is unknown and can only be estimated because we really only know about the species that botanists, entomologists and other scientists have been able to collect, process and identify to date.

Biological Management: Biological control is the deliberate use of the pest's natural enemies - predators, parasites, and pathogens - to reduce the pest population below damage levels.

Chemical Control: When exploring chemical control options, you should select the lowest risk and most effective products. The key is to use pesticides in a way that complements rather than hinders other elements in the strategy and which also limits negative environmental effects. It is important to understand the life cycle of a pest so that the pesticide can be applied when the pest is at its most vulnerable – the aim is to achieve maximum effect at minimum levels of pesticide.

Cultivar: Short for “cultivated variety.” A plant “variety” developed by man via plant selection and/or genetic manipulation to exhibit a set of plant characteristics. Cultivars are maintained via controlled pollination or vegetative means, so that cultivar characteristics are passed to ensuing generations.

Cultural management: Cultural practices are a manipulation of the habitat environment to increase pest mortality or reduce rates of pest increase and damage. There are many different cultural practices that can help to reduce pest impact such as selection of pest resistant varieties of crops, mulching, winter cover crops, changing planting dates to minimize insect impact, burning, flooding, crop rotations that include non-susceptible crops, moisture management, addition of beneficial insect habitat, or other habitat alterations.

Ecovar: Short for “ecological variety.” A plant “variety” developed by man from a collection of plants of a native species that were selected from several to many natural populations in a specific region. The purpose is to have high genetic diversity in the parent collection, which reflects the natural diversity within that species in the defined region. To maintain genetic diversity in ensuing generations, little to no selection is done during the ecovar development process. An ecovar is an intermediate step between a wild-growing plant and a cultivar.

Exotic (introduced) plant: A plant species that exists in a region because it was brought to that region by man, during and since settlement of the region. We are still introducing exotic plants, by intention or by accident.

Exotic invasive plant: An exotic plant species that is able to invade and overrun native ecosystems. Some native plants can become invasive under certain conditions, but most invasive species are introduced (exotic).

Growth Habit – Invasiveness: The most important aspect of an alien plant is how it responds to a new environment. An invasive species is one that displays rapid growth and spread, allowing it to establish over large areas. Free from the vast and complex array of natural controls present in their native lands, including herbivores, parasites, and diseases, exotic plants may experience rapid and unrestricted growth in new environments.

Invasiveness is enhanced by features such as strong vegetative growth, abundant seed production, high seed germination rate, long-lived seeds, and rapid maturation to a sexually reproductive (seed-producing) stage. Invasive plants reproduce rapidly, either vegetatively or by seed. Their phenomenal growth allows them to overwhelm and displace existing vegetation and form dense one-species stands.

Not all exotic species are considered harmful. For example, a small number of non-invasive alien plants (e.g., corn, wheat, oats) form the basis of our agricultural industry and pose little to no threat to our natural ecosystems. However, each alien plant is one less native host plant for our native insects, vertebrates and other organisms that are dependent upon them.

Ornamental plant: A plant species or cultivar that is grown for its beauty (in its end use), rather than commercial or production reasons.

Integrated Pest Management (IPM): Is a comprehensive, environmentally sensitive approach to managing pests that includes a combination of strategies that pose the least hazard to people, property, and the environment. The simple philosophy is that control will be more effective, and resistance will be less likely to build up, when a range of measures is deployed against a pest. These measures can include, cultural, mechanical or physical, biological, and chemical methods for managing the pest.

Some of the key components to a successful IPM program include the following:

- Identify current and potential pest species, their biology, and conditions conducive to the pest(s) (air, water, food, shelter, temperature and light).
- Understand the physical and biological f actors that affect the number and distribution of pests and their natural enemies.
- Conserve natural enemies.
- Prevent, Avoid, and Monitor potential pest species.
- Establish “Action Thresholds” (such as a certain number of pests per acre) at which point an approved management strategy will be implemented.
- Review available Tools and Best Management Practices for the management of the identified pest(s).

Tools can include:

1) No action. This alternative may be chosen if the pest numbers are low enough that they don't interfere with management goals;
2) Physical (manual & mechanical) management;
3) Cultural management;
4) Biological management; and,
5) Chemical management strategies.

- Select the most effective, low risk pest management strategies in accordance with applicable laws, regulations, and policies.
- Build consensus with stakeholders-occupants, decision-makers and technical experts (ongoing throughout the process).
- Document decisions and maintain records.
- Obtain approval, define responsibilities and implement selected best management strategies.
- Evaluate results of management strategies; determine if objectives have been achieved; modify strategy if necessary.

The pest issues affecting Service trust resources are broad and complex. The competition and predation of nonnative species poses risks to approximately 50% of threatened and endangered species. Some of the top pest issues affecting Service trust resources include the Norway rat, arctic fox, northern pike, European starling, European green crab, Chinese mitten crab, Canada and musk thistle, purple loosestrife, saltcedar (tamarisk), Chinese tallow tree, Russian knapweed, spotted knapweed, buffel grass, ox-eye daisy, orange hawkweed, Johnson grass, field bindweed, leafy spurge, Russian olive, Dalmatian and yellow toadflax, salvinia molesta, and soybean aphid.

Mechanical or Physical Management: Mechanical or physical control methods involve using barriers, traps, or physical removal to prevent or reduce pest problems. Tactics may include using row covers or trenches to prevent insects from reaching the crop, baited or pheromone traps to capture insects, or cultivation or mowing for weed control.

Native plant: A plant species that is found in a region because it developed and evolved in that region over thousands of years. Plants that existed in a region prior to settlement.

Naturalized plant: An exotic plant that was introduced into an area, escaped from cultivation and reproduces on its own (includes exotic invasive plants). Many plants commonly thought to be natives were actually introduced by early settlers.

Noxious Weeds: The term noxious is a legal designation used specifically for plant species that have been determined to be major pests of agricultural ecosystems and are subject, by law, to certain restrictions. The U.S. Department of Agriculture regulates noxious weeds. Plants can also be designated as "noxious weeds" by states and counties, usually through "noxious weed boards". Many noxious weeds designated for their impacts to agriculture also threaten natural areas. Melaleuca (Melaleuca quinquen-ervia), a tree from Australia, aggressively invades seasonal wetlands in the Everglades National Park in Florida and has been designated a federal noxious weed. Additional listings of exotic pest plants affecting natural ecosystems are expected, as their ecological and economic impacts continue to grow.

Pest: Any living organism (plant or animal) that occurs where it is not wanted or that causes damage to crops or humans or other animals.

Source-identified seed: Off-spring of plants collected from a single defined natural population of a native species for production of seed. No selection is done during the collection and subsequent seed increase steps, so as to conserve genetic diversity. The genetic diversity is less than for an ecovar.

Variety: Within a species, a naturally occurring sub-group of plants that have one or more minor characteristics that set it apart from the rest of the species. Ex.: Solidago odora var. chapmanii.

Weeds, Wildlands and Natural Areas: The term weed is a subjective word used to describe any plant considered to be "out of place." In other words, weeds can include native and non-native plants alike, growing wherever someone wishes they weren't. Invasive exotic plants of natural ecosystems are often referred to as natural areas weeds. A natural area is generally an area of land or water with predominantly native vegetation or natural geological features that is allowed to respond to the forces of nature with little to no direct human interference. The term wildlands is also used to describe these areas.

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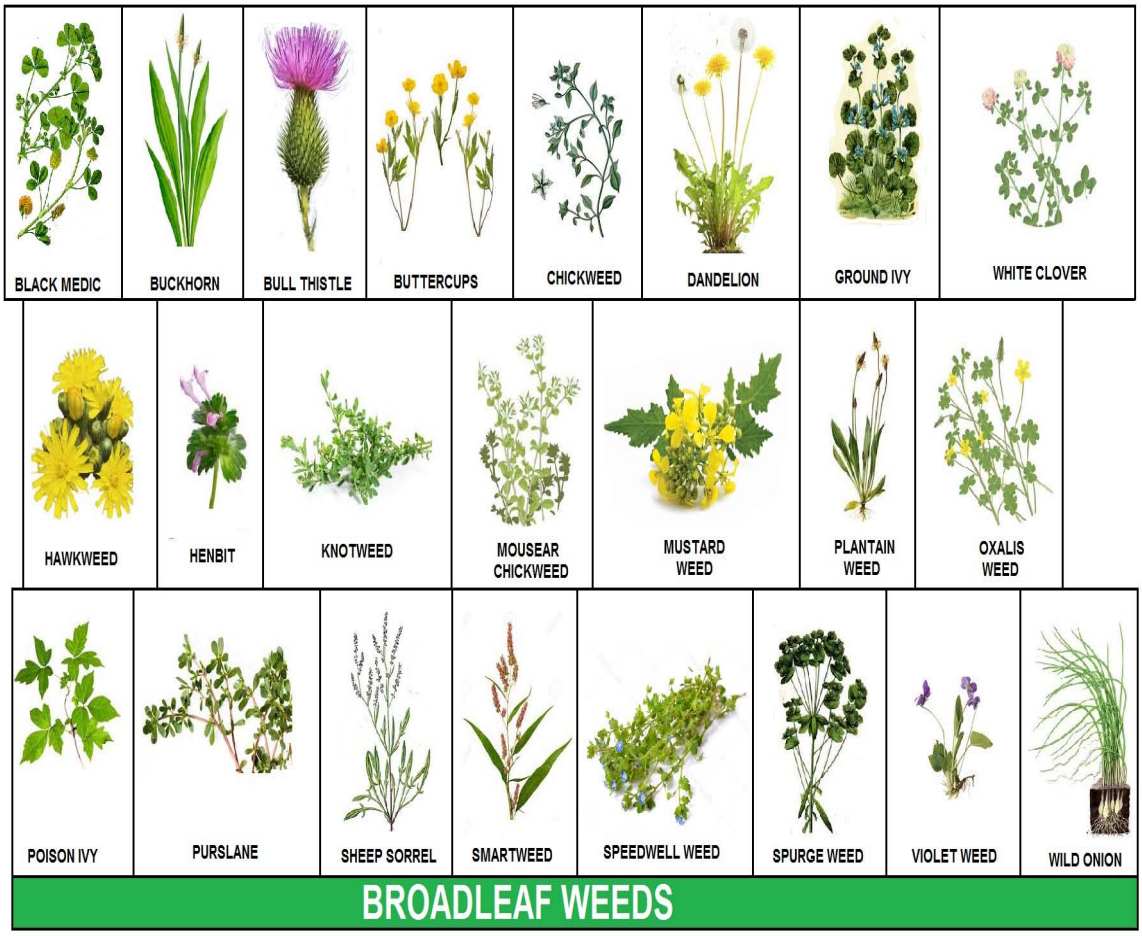
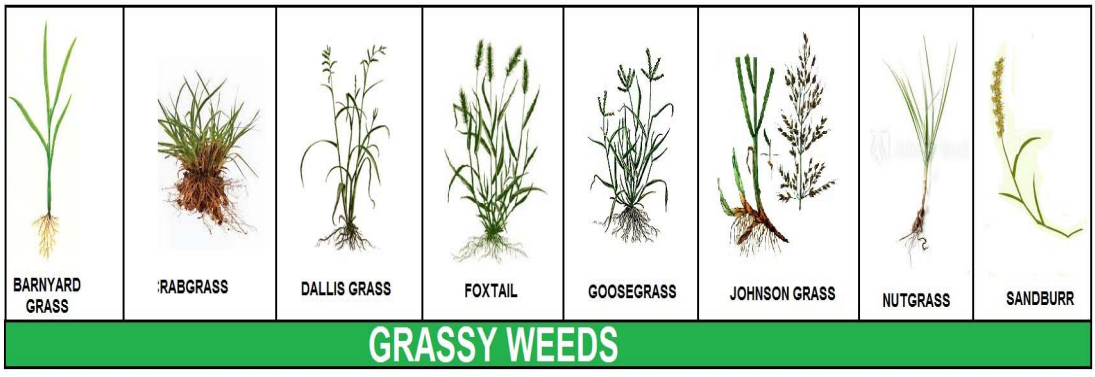
This course contains EPA's federal rule requirements. Please be aware that each state implements pesticide regulations that may be more stringent than EPA's regulations and these are frequently changed. Check with your state environmental/pesticide agency for more information.





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TYPES OF WEEDS

The Invasive Problem

Invasive Species

The term “native” is used to describe plants that were growing here before the arrival of Europeans. Exotics are those that do not naturally occur in an area but have been introduced by people. Many exotic species pose no threat, but some are invasive and grow out of control — displacing native plants which provide food and shelter for an assortment of native wildlife. Unfortunately, it is not always possible to predict if or when a species will become a pest plant (for example, Japanese honeysuckle was planted as an ornamental for 80 years before it escaped cultivation!), but a red flag should run up at any non-native with fleshy fruits dispersed by birds.

Impacts of Invasive Alien Plants

Invasive non-native organisms are one of the greatest threats to the natural ecosystems of the U.S. and are destroying America's natural history and identity. These unwelcome plants, insects and other organisms are disrupting the ecology of natural ecosystems, displacing native plant and animal species, and degrading our nation's unique and diverse biological resources. Aggressive invaders reduce the amount of light, water; nutrients and space available to native species, alter hydrological patterns, soil chemistry, moisture-holding capacity, and erodibility, and change fire regimes (Randall 1996). Some exotics are capable of hybridizing with native plant relatives, resulting in unnatural changes to a plant's genetic makeup; others have been found to harbor plant pathogens, such as bacterial leaf scorch (Xylella fastidiosa) that can affect both native and non-native plants, including ornamentals (McElrone, et al., 1999). Still others contain toxins that may be lethal to certain animals. For example, garlic mustard has been found to contain compounds that are lethal to a native butterfly species.

Exotic organisms have been referred to as biological pollution (Westbrooks 1991). In some cases, exotic plant invaders are driving our rarest species closer to extinction. According to the U.S. Fish and Wildlife Service, an estimated 42% of the nation's endangered and threatened species have declined as a result of encroaching exotic plants and animals. And management of these species is expensive. Each year, the National Park Service and the Fish and Wildlife Service spend an estimated 2 and 10 million dollars, respectively, on controlling exotic plants (Westbrooks, 1998). Invasive plants also cause great economic losses and expenditures each year, measured in billions of dollars, for agriculture, forestry, range lands and roadways management (Westbrooks 1998).

Impacts to Native Fauna

Our native fauna, including insects, birds, mammals, reptiles, fish and other animals, is dependent on native plants for food and shelter. While some animals have a varied diet and can feed on a wide number of plant species, others are highly specialized and may be restricted to feeding on several or a single plant species. For example, caterpillars of the monarch butterfly have evolved to feed primarily on plants in the genus Asclepias (milkweeds) that contain special chemicals. The term host plant is generally used to describe a plant species that is required food for at least one stage of an insect or other animal. As exotic plants replace our native flora, fewer host plants are available to provide the necessary nutrition for our native wildlife.

Approximately 4,000 species of exotic plants (Kartesz and Morse 1997) and 500 exotic animals (Office of Technology Assessment 1993) have established free-living populations in the United States. Nearly seven hundred are known to cause severe harm to agriculture at a cost of billions of dollars annually. Over 1,000 exotic plant species have been identified as a threat to our native flora and fauna as a result of their aggressive, invasive characteristics.

Some of the known ecological impacts of invasive plants are summarized below, and include:

- ✓ Alterations to the frequency and intensity of natural fires.
- ✓ Changes to natural ecological processes such as plant community succession.
- ✓ Disruption of native plant-animal associations such as pollination, seed dispersal and host-plant relationships.
- ✓ Loss of and encroachment upon endangered and threatened species and their habitat.

- ✓ Loss of food sources for wildlife.
- ✓ Loss of habitat for native insects, birds, and other wildlife.
- ✓ Reduction of biodiversity

Invasive Alien Plants:

- ✓ Alter hydrological flows and conditions.
- ✓ Change characteristics of the soil structure and chemistry.
- ✓ Compete with and replace rare and endangered species.
- ✓ Disrupt insect-plant associations necessary for seed dispersal of native plants.
- ✓ Disrupt native plant-pollinator relationships.
- ✓ Encroach upon limited habitat of rare and endangered species.
- ✓ Hybridize with native plant species, altering their genetic makeup.
- ✓ Increase erosion along stream banks, shorelines and roadsides.
- ✓ Increase the incidence of plant disease and stress in forested areas.
- ✓ Kill trees and shrubs through girdling.
- ✓ Prevent seedling establishment of native trees and shrubs.
- ✓ Reduce and eliminate host plants for native insects and other wildlife.
- ✓ Reduce or eliminate localized or specialized native plant communities, such as spring ephemeral plant communities.
- ✓ Reduce the amount of space, water, sunlight and nutrients that would be available to native species.
- ✓ Reduce vigor of mature trees through shading.
- ✓ Replace nutritious native plant foods with lower quality sources.
- ✓ Serve as host reservoirs for plant pathogens and other organisms that can infect and damage desirable native and ornamental plants.

Disturbance Effects

Invasive species are especially problematic in areas that have been disturbed by human activities such as road building, residential development, forest clearing, logging operations, grazing, mining, ditching of marshes for mosquito control, mowing, erosion control and fire prevention and control activities. Natural disturbances, such as fires, floods, tornadoes, landslides, and tree falls also provide avenues for invasive species to get started. The enormity of change wrought upon the American landscape over the past few hundred years has thrown things out of balance. Lacking exotic species, native species and ecosystems benefit from natural disturbances that provide opportunities for genetic mixing and nutrient recycling, and reduce fuel loadings.

Some native plants display invasive growth tendencies in their native ranges, often as a response to natural or human-caused disturbances. For example, native grape vines in forests may grow vigorously in response to a tree fall or selective timber cut that opens the canopy and brings abundant sunlight into previously shaded areas. This "invasive" growth spurt is usually temporary though, and slows down again as trees and other plants fill in and the forest canopy is recovered. The best way to reduce plant invasions is to focus on preventing non-native species introductions, managing existing infestations, minimizing disturbance to forests, wetlands, barrens and other natural communities.

Importance of Native Plants
Approximately 18,000 plants are native to the ecosystems of North America. Our native flora (i.e., all U.S. native plants) provides the foundation of the historic American landscape and defines the various ecosystems and regions of the country. These plants also provide natural sources of food and fiber, and were the essential sources of nutrition and other materials for native American Indians.

The populations of many native plants have been greatly reduced as a result of human encroachment which has destroyed many millions of acres of natural habitat. In the U.S. alone, about 200 native plant species have become extinct since the 1800's and 5,000 species are considered to be at risk. Invasions of non-native plants are the second greatest threat to native species after direct habitat destruction.

FIELD BINDWEED

Recognize the major plant characteristics used to identify weeds.

Auricle- An appendage that grows from the edge of the collar and may wrap around the stem.

Blade- The upper part of the leaf.

Collar- Located where the blade and the sheath meet.

Crown- Region of nodes with tightly compacted internodes.

Internode- The region between the nodes.

Ligule- A structure that grows from the collar area on the inner side of the leaf.

Node- Enlarged areas at intervals along the stem and also the part of the plant where buds are attached.

Rhizomes- Underground stems that grow laterally.

Roots- Attachment of the plant to the soil that absorbs minerals and water needed for the plants survival.

Sheath- Lower part of the leaf that is attached to the node.

Shoot- The aboveground parts of the plant.

Stolons- Aboveground stems that grow laterally.

Vernation- Characteristic of the grass that describes how the new blades emerge from the sheath as growth occurs.

Broadleaves (dicots), Grasses (monocots), and Sedges

Weeds can be classified into three primary categories: broadleaves (dicots), grasses (monocots), and sedges. To identify broadleaf seedlings, it is common to look first at the cotyledons or seed leaves. The cotyledons are the first pair of leaves that open after emergence. Cotyledons have various shapes and sizes; they may be linear-, egg-, round- or butterfly-shaped or have variations of each. Look at other features of the weed, such as the true leaves (leaves emerging after cotyledons) and stems. Leaf shape can vary dramatically and is a consistent key to plant identification. The leaves may be alternately or oppositely arranged along the stem. Some leaves may be attached to a short stem, known as the petiole, while others may lack a petiole. Check the leaf surfaces for the presence of hair and the amount of waxiness. Stems can also assist in identifying a weed; they have various shapes and amounts of hair, if any. Finally, dig or carefully remove the roots from the soil and look for the presence of rhizomes, creeping roots, or other structures such as tubers. Rhizomes are underground vegetative stems from which new plants are generated. The presence of these vegetative structures will indicate that the weed's life cycle is perennial.

Native Range

Every species of plant, animal, fungi, bacteria and other organism has a home in some part of the world, where it has existed for thousands of years as a result of natural forces and influences like climate, storms, moisture, fire, soils and species interactions. Over long periods of time, these and other physical and biological factors direct the distributions of organisms in nature. A native (indigenous) species is one that occurs in a particular region, ecosystem, and habitat without direct or indirect human actions (Kartesz and Morse, 1997). Species native to North America are generally recognized as those occurring on the continent prior to European settlement. Endemic is used to describe populations of native animals, plants or other organisms, that are have relatively restricted distributions and are confined to certain environments.

Organisms are considered non-native (alien, exotic, foreign, introduced, non-indigenous) when they occur artificially in locations beyond their known historical natural ranges. Non-native can refer to species brought in from other continents, regions, ecosystems and even other habitats. Species exotic to the U.S. include those transported from Europe, Asia, Africa, South America, Australia and other parts of the world. It also includes any species moved by people from one locality in the U.S. to a new one.

For example, black locust (Robinia pseudoacacia) is native to the southern Appalachian region of the eastern U.S. Because of its rapid growth and hardiness, it was planted all around the U.S. during this century for living fences, erosion control, wind breaks and other purposes. Even though it is native to the U.S., black locust is considered exotic anywhere it occurs outside its known historical natural range of southern Appalachia.

Once an Exotic, Always an Exotic! European settlers brought hundreds of plants to North America from their home lands, for food, medicinal, ornamental, and other purposes. Introductions of exotic plants continue today, and are increasing due to an exploding human population, increased international travel, and the intentional and accidental movement of large numbers of species between continents as a result of expanded international trade.

Many introduced plants have become naturalized across the continent and some are replacing North American native plant species. These naturalized plants, however much a part of our current landscapes and ecosystems, are nonetheless exotic, since they were moved here by people rather than by natural means. Because the historical distributions of some species are unknown or unclear, research continues to attempt to unravel the tangle of human and natural influences responsible for their current ranges.

BARNYARD GRASS

MUSK THISTLE

Weed Classifications

Most common weeds fit into two large general classifications: broadleaves and grasses. Broadleaves and grasses may be further divided into annuals and perennials. Annual and perennial weeds may be even further subdivided by the seasons in which they germinate and grow.

(1) **Annuals**
Annual plants complete their life cycle in less than one year. Normally, they are considered easy to control. This is true for any one crop of weeds. However, because of an abundance of dormant seed and fast growth, annuals are very persistent. They actually cost more to control than perennial weeds. Most common field weeds are annuals. There are two types; summer and winter annuals.

(a) **Summer Annuals**
Summer annuals germinate in the spring, make most of their growth during the summer, and the plants mature and die in the fall. The seeds lie dormant in the soil until next spring.

(b) **Winter Annuals**
Winter annuals geminate in the fall and winter and usually mature seed in the spring or early summer before the plants die. The seeds often lie dormant in the soil during the summer months. In this group, high soil temperatures (125°F or above) have a tendency to cause seed dormancy. These are most troublesome in fall and early spring in ornamental plant areas.

(2) **Biennials**
A biennial plant lives for more than 1 year but not more than 2 years. Only a few troublesome weeds fall in this group. There is confusion between biennials and winter annuals, because the winter annual group normally lives during 2 calendar years and during 2 seasons.

(3) **Perennials**
Perennials live for more than 2 years and may live almost indefinitely. Most produce by seed and many are able to spread vegetatively. They are classified according to their method of reproduction as simple and creeping.

(a) **Simple Perennials**
Simple perennials spread by seed. They have no natural means of spreading vegetatively. However, if injured or cut, the cut pieces may produce new plants. For example a dandelion or dock root cut in half longitudinally may produce two plants. The roots are usually fleshy and may grow very large.

(b) **Creeping Perennials**
(1) Creeping perennials reproduce by creeping roots, creeping above ground stems (stolons), or creeping below-ground stems (rhizomes). In addition, they may reproduce by seed.

(2) Some weeds maintain themselves and propagate by means of tubers, which are modified rhizomes adapted for food storage. Nutsedge (nutgrass) and Jerusalem artichoke are examples.

(3) Once a field is infested, creeping perennials are probably the most difficult group of weeds to control. Cultivators and plows often drag pieces about the field.

Continuous and repeated cultivations, repeated mowing for 1 or 2 years, or persistent herbicides are often necessary for control. Cultivation, in combination with herbicides, is proving effective on some creeping perennials. An effective eradication program also requires the killing of seedlings.

b. Types of Weeds:

(1) **Broadleaf Weeds**

(a) **Annuals**
(1) **Summer Annuals** (Warm Season Annuals):
(a) Beggarticks
(b) Chickweed
(c) Wooly Croton
(d) Lambsquarters
(e) Redroot Pigweed
(f) Rough Pigweed
(g) Prostrate Pigweed
(h) Tumbling Pigweed
(i) Prickly Lettuce
(j) Annual Morning-glory
(k) Bedstraw
(l) Prostrate Spurge
(m) Spotted Spurge
(n) Puncture vine
(o) Purslane
(p) Common Ragweed
(q) Common Sunflower
(r) Annual Sow thistle

Prickly Lettuce

(2) **Winter Annuals:** (Cool Season Annuals): *Dicamba works well on most of these.*
(a) Bur Buttercup
(b) Pennycress
(c) Henbit
(d) Kochia
(e) Tansy Mustard
(f) Purple Mustard
(g) Fieldcress
(h) Flixweed
(i) Jim Hill Mustard
(j) Common Mustard
(k) Wild Mustard
(l) Larkspurs
(m) Wooly Locoweed
(n) Hoary Pea (Goatsrue)
(o) Mayweed
(p) Field Madder
(q) Russian Thistle
(r) Shepherd's Purse
(s) Tumble Mustard
(t) Yellow Rocket (Mustard)

Kochia

(b) **Biennials:**
(1) Bur Clover
(2) Burdock
(3) Cocklebur
(4) Chamomile
(5) Wild Carrot
(6) Spotted Knapweed
(7) Mullein
(8) Prickly Poppy
(9) Bull Thistle
(10) Musk Thistle
(11) Common Sow Thistle
(12) Yellow Star Thistle

(c) **Perennials**

(1) **Simple Perennials:**
(a) Jerusalem Artichoke
(b) Catnip
(c) Chickory
(d) Yellow Clover
(e) Dandelion
(f) Broadleaf Dock
(g) Curly Dock
(h) Narrow leaf Goldenrod
(i) Groundcherry
(j) Gumweed
(k) Broadleaf plantain
(l) Mallow (Cheeseweed)
(m) Milkweed
(n) Texas blueweed
(o) Prickly pear
(2) **Creeping Perennials:**
(a) Field Bindweed
(b) Wild Buckwheat
(c) Canada Thistle
(d) Russian Knapweed
(e) Mouse ear Chickweed
(f) Virginia Creeper

(2) **Grasses**

(a) **Annuals**
(1) **Summer Annuals:**
(a) Crabgrass
(b) Foxtails
(c) Barnyard grass
(d) Goose grass
(e) Sandbur
(f) Witchgrass
(g) Wild oats

Wild Carrot

Gumweed

Goosegrass

(2) **Winter Annuals:**
(a) Annual Bluegrass
(b) Foxtail Barley
(c) Fall Panicum
(d) Rescue grass
(e) Downy Brome
(f) Wild Rye

Rescuegrass

(b) **Perennial Grasses**

(1) **Simple Perennials:**
(a) Buffalo grass
(b) Rice Cutgrass
(c) Orchard Grass
(d) Gramma Grass
(e) Common Rush
(f) Perennial Ryegrass
(g) Reed Canarygrass

(2) **Creeping Perennials:**
(a) Bentgrass
(b) Bermuda Grass
(c) Dallisgrass
(d) Johnson grass
(e) Bluegrass
(f) Yellow Nutsedge
(g) Purple Nutsedge
(h) Quackgrass

Additional classifications may place weeds that occur in any of the above categories special categories. Weeds in special categories may require special practices to control them. Special categories have particular distinguishing features. Such distinguishing features may include special toxins dangerous to humans or livestock, woody stems, or aquatic habitats.

(1) **Toxic Plants:**
(a) African rue
(b) Woody Aster
(c) Foxglove
(d) Castor plant
(e) Poison Hemlock
(f) Hemp Dogbane
(g) Locoweed (Stemless, Wooly, etc.)
(h) Bitterweed
(i) Jimson Weed
(j) Silverleaf Nightshade
(k) Black Nightshade
(l) Groundcherry
(m) Perennial Broomweed
(n) Goldenrod
(o) Buffalo Bur

Jimson Weed

Toxic Plants Injurious to Humans
(1) Poison Ivy
(2) Poison Sumak
(3) Poison Oak

(4) Spurge (Bull) Nettle
(5) Stinging Nettle
(6) Slender Nettle

Stinging Nettle

(2) **Woody plants and brush:**
(a) Elm Species
(b) Creosote
(c) Greasewood
(d) Coniferous trees & shrubs: Juniper, Cedars, Pine, Fir, and Spruce
(e) Maple Species
(f) Mesquite
(g) Oak Species
(h) Rose Species
(i) The Willow & Cottonwood Family

(3) **Aquatic Plants** *See TLC's Aquatic Environment's Course*

(a) **Algae:**
(1) Single celled Algae
(2) Filamentous Algae
(3) Chara

Submerged Seed Plants
(1) Water Milfoil
(2) Hornwort
(3) Coontail
(4) Water Weed
(5) Pond Weed

Floating Weeds
(1) Water lilies (yellow & white)
(2) Water Hyacinth
(3)Duckweeds

Emergent Weeds
(1) Arrowhead
(2) Pipewort
(3) Cattails
(4) Bulrushes

Spurge (Bull) Nettle

Roundup-Resistant Weeds

Roundup-resistant weeds like horseweed and giant ragweed are forcing farmers to go back to more expensive techniques that they had long ago abandoned. There is a particularly tenacious species of glyphosate-resistant pest called Palmer amaranth, or pigweed, whose resistant form has begun to seriously infesting farms. Pigweed can grow three inches a day and reach seven feet or more, choking out crops; it is so sturdy that it can damage harvesting equipment. In an attempt to kill the pest before it becomes that big, plow fields and mixing herbicides into the soil. That threatens to reverse one of the agricultural advances bolstered by the Roundup revolution: minimum-till farming. By combining Roundup and Roundup Ready crops, farmers did not have to plow under the weeds to control them. That reduced erosion, the runoff of chemicals into waterways and the use of fuel for tractors.

- The term "weed" means different things to different people. In the broadest sense, it is any plant growing where it is not wanted. Weeds can be native or non-native, invasive or non-invasive, and noxious or not noxious. Legally, a noxious weed is any plant designated by a federal, state or county government as injurious to public health, agriculture, recreation, wildlife or property. A noxious weed is also commonly defined as a plant that grows out of place (i.e. a rose can be a weed in a wheat field) and is "competitive, persistent, and pernicious."

- The noxious weeds mandated for control are plants non-native to North America. Consequently, these plants do not have the natural checks as found in their native land, such as insects, diseases, and herbivores that would keep the plant population in check. Due to the competitive aggressive ability of these plants coupled with no natural controls, these plants will develop mono-culture stands. Not only are many crops out competed by these weeds but native vegetation and the wildlife associated with it will be replaced. Consequently, identifying the weeds when they first become established and developing an integrated weed management plan to control them is critical in maintaining healthy, productive land. The term noxious weed is used to describe a legal designation for plant species that have been determined to be especially undesirable or difficult to control.

Common Broadleaf Weeds *with some suggested remedies and classification.*

Arrowhead	*Sagittaria montevidensis*
Balloonvine	*Cardiospermum halicacabum Annual can be Perennial in some areas*
Beggarweed	*Desmodium spp. Perennial*
Bindweed, field **(noxious)**	*Convolvulus arvensis Perennial*
Bindweed, hedge	*Convolvulus sepium Perennial*
Bittercress, smallflowered	*Cardamine parviflora*
Black nightshade	*Solanum spp. Halosulfuron, Rimsulfuron Annual*
Broadleaf plantains	*Plantago spp. 2,4D, 2,4DP, Cloryralid, Dicamba, MCPA, Triclopyr*
Buckhorn plantain	*Plantago lanceolata Perennial*
Buffalobur	*Solanum rostratum Perennial*
Bull thistle	*Cirsium vulgare Biennial 2-4D*
Burcucumber	*Sicyos angulatus Annual Beacon , Banvel, Clarity or Marksman*
Bushy wallflower	*Erysimum repandum Annual Maverick*
Buttercups	*Ranunculus spp. Perennial*
Butterweed	*Senecio glabellus Annual*
Canada thistle	*Cirsium arvense*
Carolina geranium	*Geranium carolinianum*
Carpetweed	*Mollugo verticillata Annual*
Chicory	*Cichorium intybus Perennial*
Clammy groundcherry	*Physalis heterophylla Annual and/or Perennial*
Common burdock	*Arctium minus Annual*
Common chickweed	*Stellaria media Annual*
Common cocklebur	*Xanthium strumarium Annual*
Common groundsel	*Senecio vulgaris Annual*
Common lambsquarters	*Chenopodium album Annual*
Common milkweed	*Asclepias syriaca Perennial Amitrol, Roundup Tordon*
Common mullein	*Verbascum thapsus Perennial Roundup, Garlon, Triclophr*
Common pokeweed	*Phytolacca Americana Perennial Glyphosate for control*
Common purslane	*Portulaca oleracea Annual 2,4D, MCPP and banvel (Dicamba)*
Common ragweed	*Ambrosia artemisiifolia Annual Tenran*
Common sunflower	*Helianthus annuus Annual Clopyralid for control*
Common teasel	*Dipsacus fullonum Perennial 2,4D, MCPP and Banvel or Dicamba*
Common waterhemp	*Amaranthus rudis Annual Sahara (Imazapyr and Diuron)*
Common yarrow	*Achillea millefolium P 2,4D, 2,4DP, Clopyralid MCPP Banvel Dicamba*
Compass plant	*Silphium laciniatum Perennial*
Corn gromwell	*Lithospermum arvense Annual*
Cornflower	*Centaurea cyanus Annual Picloram*
Croton, tropic	*Croton glandulosus*
Croton, woolly	*Croton capitatus*
Cup plant	*Silphium perfoliatum Perennial Glyhospate*
Curly dock	*Rumex crispus Perennial 2,4D, MCPP and Banvel or Dicamba*

Cut-leaf teasel **(noxious)**	*Dipsacus laciniatus B 2,4D, 2,4DP, MCPP and Banvel or Dicamba*
Cutleaf eveningprimose	*Oenothera laciniata A & P Oxyfluorfen, 2,4D +Paraquat*
Daisy fleabane	*Erigeron annuus Annual Sahara (Imazapyr and Diuron)*
Deadnettle, purple	*Lamium purpureum*
Dewberry	*Rubus spp. Perennial*
Eclipta	*Eclipta prostrate Annual and Perennial*
Field dodder	*Cuscuta campestris Perennial*
Field pansy	*Viola rafinesquii Annual*
Giant ragweed	*Ambrosia trifida Annual*
Goldenrod	*Solidago spp. Annual and Perennial*
Greenbriar	*Smilax spp. Perennial*
Hairy nightshade	*Solanum sarrachoides*
Hemp dogbane	*Apocynum cannabinum*
Hemp sesbania	*Sesbania exaltata*
Henbit	*Lamium amplexicaule*
Honeysuckle	*Lonicera spp. Perennial Sahara (Imazapyr and Diuron)*
Honeyvine milkweed	*Cynanchum leave Perennial Garlon 4 (Triclopyr)*
Hophornbeam copperleaf	*Acalypha ostryaefolia Annual Roundup*
Horsenettle	*Solanum carolinense A & Biennial Sahara (Imazapyr and Diuron)*
Horseweed	*Erigeron canadensis*
Illinois bundleflower	*Desmanthus illinoensis Perennial Roundup*
Ironweed	*Vernonia spp. Perennial Saber- Sahara (Imazapyr and Diuron)*
Japanese hedgeparsley	*Torilis arvensis Annual Roundup*
Japanese hops	*Humulus japonicus Annual Perennial Glyphospate*
Japanese knotweed	*Polygonum cuspidatum P Cut Stump treatment Glyphosate-Triclopyr*
Jerusalem artichoke	*Helianthus tuberosus*
Jimsonweed	*Datura stramonium Annual Perennial Bentazon for control*
Kochia	*Kochia scoparia Annual Dicamba*
Kudzu **(noxious)**	*Pueraria lobata Perennial Glyhospate*
Marijuana **(noxious)**	*Cannabis sativa*
Morning-glory, bigroot	*Ipomoea pandurata Perennial Sahara Imazapyr and Diuron*
Morning-glory, ivyleaf	*Ipomoea hederacea Annual Sahara Imazapyr and Diuron*
Morning-glory, tall	*Ipomoea purpurea Annual Sahara Imazapyr and Diuron*
Morning-glory, pitted	*Ipomoea lacunose Annual Sahara Imazapyr and Diuron*
Mouse ear chickweed	*Cerastium vulgatum Annual Dicamba*
Mousetail	*Myosurus minimus Annual 2-4D*
Multiflora rose **(noxious)**	*Rosa multiflora Perennial Dicamba*
Musk thistle **(noxious)**	*Carduus nutans*
Nodding spurge	*Euphorbia nutans Annual 2-4D Diphenylether*
Oxeye daisy	*Chrysanthemum leucanthemum P Sahara Imazapyr and Diuron*
Palmer amaranth	*Amaranthus palmeri Annual Sahara*
Partridgepea	*Cassia chamaecrista Annual 2-4D*
Pennycress, field	*Thlaspi arvense Annual 2-4D, Sahara*

Perilla mint	*Perilla frutescens Annual 2-4D, Sahara*
Pigweed, prostrate	*Amaranthus blitoides Annual Sahara (Imazapyr and Diuron)*
Pigweed, redroot	*Amaranthus retroflexus Annual Sahara (Imazapyr and Diuron)*
Pigweed, tumble	*Amaranthus albus Annual Sahara (Imazapyr and Diuron)*
Pineapple weed	*Matricaria matricarioides Annual Sahara (Imazapyr and Diuron)*
Poison hemlock	*Conium maculatum Biennial Tebuthiuron (Spike 20P) Glean FC, Velpar*
Prickly lettuce	*Lactuca serriola Annual STOMP*
Prickly pear	*Opuntia compressa Perennial Tordon 22K Picloram*
Prickly sida	*Sida spinosa Annual/Perennial Sahara (Imazapyr and Diuron)*
Prostrate knotweed	*Polygonum aviculare*
Puncturevine	*Tribulus terrestris Annual Sahara (Imazapyr and Diuron)*
Purple ammannia	*Ammannia coccinea*
Purple loosestrife **(noxious)**	*Lythrum salicaria Pernnial Roundup or Rodeo*
Purslane speedwell	*Veronica peregrina*
Rattlesnake master	*Eryngium yuccifolium*
Redvine	*Brunnichia ovata*
Rosinweed	*Silphium integrifolium*
Scotch thistle **(noxious)**	*Onopordum acanthium A or B Piclram, dicamba + 2,4-D, Metsulfuron*
Sericea lespedeza	*Lespedeza cuneata Perennial Triclohr*
Shepherd's purse	*Capsella bursa-pastoris A 2,4-D, 2,4DP;chlorsulfuron, dicamba, MCPA*
Sicklepod	*Senna obtusifolia*
Smartweed, ladysthumb	*Polygonum persicaria*
Smartweed, pale	*Polygonum lapathifolium*
Smartweed, Pennsylvania	*Polygonum pensylvanicum*
Smartweed, swamp	*Polygonum coccineum Perennial 2-4D Dicamba Rodeo*
Smooth groundcherry	*Physalis subglabrata*
Smooth sumac	*Rhus glabra*
Snow-on-the-mountain	*Euphorbia marginata*
Spanish needles	*Bidens bipinnata*
Spiny amaranth	*Amaranthus spinosus*
Spiny sowthistle	*Sonchus asper*
Spurge, leafy	*Euphorbia esula*
Spurge, nodding	*Euphorbia nutans*
Spurge, prostrate	*Euphorbia humistrata*
Spurge, toothed	*Euphorbia dentata*
Spurred anoda	*Anoda cristata*
Tall thistle	*Cirsium altissimum*
Tansy mustard	*Descurainia pinnata*
Trumpetcreeper	*Campsis radicans*
Unicorn-plant	*Proboscidea louisianica*
Velvetleaf	*Abutilon theophrasti*
Venice mallow	*Hibiscus trionum*
Venuslookingglass	*Triodanis perfoliata*

Vervain, blue	*Verbena hastata*
Vervain, hoary	*Verbena stricta*
Vetch	*Vicia spp.*
Virginia copperleaf	*Acalypha virginica*
Virginia creeper	*Parthenocissus quinquefolia*
Virginia pepperweed	*Lepidium virginicum*
Water hemlock	*Cicuta maculata*
Western salsify	*Tragopogon dubuis*
White heath aster	*Aster pilosus*
White snakeroot	*Eupatorium rugosum*
Wild buckwheat	*Polygonum convolvulus*
Wild carrot	*Daucus carota*
Wild indigo	*Baptisia spp.*
Wild lettuce	*Lactuca serriola*
Wild mustard	*Brassica kaber*
Yellow rocket	*Barbarea vulgaris*

Author's Note: There are several weed databases that you can utilize for weed identification. Here are a couple of great websites: Plants.USDA.Gov/WeedsofCalifornia and PSU.Missouri.Edu.

I would like to mention that scientific names of weeds and plants do change over time. If there is any doubt on your assignment, utilize the federally listed name or the name that is used in this manual.

Johnson grass, *Sorghum halapense* (L.) Pers. - non-native

A monocot in the Poaceae family. It is said to have been brought here in the early 1900's from Europe as a feed grain for stock. It was grown in great quantities until it was determined it had very little nutritional value. By then it had naturalized and was out of control. It can grow to the height of 7-8 feet. It propagates itself by heavy seeding and by underground rhizomes (thick root sections like iris bulbs).

Winter and Early Spring Broadleaf Plant Identification Key

I. Plants with spines
Spines on midveins - prickly lettuce
Short spines on stems - catchweed bedstraw
II. Plants with an ocrea
Twining growth habit - wild buckwheat
Plant forms dense mats - prostrate knotweed
Plant forms a rosette
>Leaves have wavy margin - curly dock
>Leaves are wide and lobed at base - broadleaf dock
III. Plants with square stems
Shorts spines on stems - catchweed bedstraw
Stems without spines, pink to purple flowers, upright growth habit - henbit or purple deadnettle
Stems without spines, pink to purple flowers, sprawling growth habit forming dense mats - ground ivy
IV. Plants with milky sap
Spines on midvein - prickly lettuce
No spines - dandelion, western salsify or venuslookingglass
V. Plants with finely dissected leaves
Fernlike appearance - tansy mustard
Sweet aroma - pineapple weed
VI. Plants covered with hair
Long, loose, white hair - cornflower
Hairy, reddish, highly branched stems - cutleaf eveningprimrose
Hairy, notched leaves opposite on upper parts of plant - corn speedwell
More of less hairy with erect growth habit - horseweed or corn gromwell
VII. Dense, short, fuzzy hair
>Young seedling plants form a basal rosette - kochia
>Large gray-green leaves form a rosette, flannel-like feel - common mullein
>Small leaves, plant forms a mat - mouseear chickweed
>Leaves clasp around the stem - daisy fleabane
VIII. Plants form dense mats
Plant has an ocrea - prostrate knotweed
Plant without an ocrea
>Small, opposite pubescent leaves - mouseear chickweed
>Small, opposite smooth leaves; upper leaves lack petioles - common chickweed
>Hairy, notched leaves opposite on upper parts of plant - corn speedwell
>Alternate leaves lack petioles; hairy on both surfaces - corn gromwell
X. Plants with a basal rosette
Leaves deeply cut or toothed - buttercups, Carolina geranium, dandelion, prickly lettuce, shepherd's-purse, small flowered bittercress, tansy mustard, Virginia pepperweed, wild mustard or pineapple weed
Leaves irregularly cut or toothed - daisy fleabane, purslane speedwell, shepherd's-purse, wild mustard, curly dock, broadleaf dock, cutleaf eveningprimrose, butterweed or field pansy
Leaves not cut - kochia, common mullein, broadleaf plantains, buckhorn plantain or venuslookingglass
Leaves may or may not be cut - bushy wallflower, field pennycress or yellow rocket

The fate of pesticides released into the environment is unknown. Releases may be followed by a very complex series of events which can transport the pesticide through the air or water, into the ground or even into living organisms. The medium for movement (air, water, soil, organisms) and the degree of movement (local or long distance distribution) will be different for each pesticide.

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.

Summer Broadleaf Plant Identification Key

I. Cotyledons lanceolate or linear
First true leaves alternate
Ocrea present where petiole joins stem
>>Leaves heart-shaped - wild buckwheat
>>Leaves not heart-shaped - Pennsylvania smartweed, pale smartweed, ladysthumb smartweed, swamp smartweed, prostrate knotweed or Japanese knotweed
No ocrea present
>>Linear cotyledons with prominent midvein, foul odor when crushed - jimsonweed
>>No foul odor, first leaves have notch in tips
>>>Leaves and stems lack hair, erect growth habit
>>>>Plant has stiff spines - spiny amaranth
>>>>Plant lacks spines - common waterhemp or Palmer amaranth
>>>Leaves and stems lack hair, prostrate growth habit - prostrate pigweed
>>>Upper stems hairy, erect growth habit, flower spikes compact and thick - redroot pigweed
>>>Stems and leaves with sharp spines - buffalobur
First true leaves opposite, subsequent leaves alternate
Cotyledons are thick and fleshy, hypocotyls are reddish in color and leaves have coarse texture with 3 prominent veins - common cocklebur
Cotyledons are small and linear
>>Stems and leaves lack hair; leaves appear "frosted" - common lambsquarters
>>Stems and leaves lack hair; leaves thick and succulent, some opposite – common purslane

II. Cotyledons ovate
Leaf surfaces hairy
>Leaf hairs very sticky - hairy nightshade
>Leaf hairs not sticky, stems very hairy -
>>Compact growth habit - clammy groundcherry
>>Erect, columnar growth habit - horseweed
Leaf surfaces nearly lacking or lacking hair
>Plant rhizomatous perennial - smooth groundcherry
>Plant annual - black nightshade

III. Cotyledons round to heart-shaped
Heart-shaped leaves covered with dense, fuzzy pubescence, margins entire - velvetleaf
Leaves with hair on both surfaces, irregularly lobed, purple veins - spurred anoda
Leaves with 3 - 7 coarsely toothed lobes, smooth on upper surface, hairy on lower surface - Venice mallow
Leaves are finely serrated along margins
>Fleshy spine projections in leaf axils, leaves - prickly sida
>Leaves ovate in shape with heart-shaped base and terminal tips - hophornbeam copperleaf
Leaves lack hair, compound with 4 - 6 leaflets - sicklepod
Leaves are rounded and have toothed margins - common mallow
First leaves are opposite, subsequent leaves alternate with sparse hair - Virginia copperleaf

IV. Cotyledons spatulate or oval
First leaves alternate
>Compound leaves with many small leaflets - hemp sesbania
>Large 5-sided leaves with 3 primary lobes, vining growth habit - burcucumber
>Whorled leaves; plant roots at nodes - carpetweed

First leaves opposite, later leaves may be alternate

>Small cotyledons, leaves finely divided - common ragweed
>Large cotyledons, first leaves simple, subsequent leaves have 3 major lobes - giant ragweed
>Leaves glandular hairy with foul odor - unicorn plant
>Stems have milky sap - prostrate spurge, nodding spurge or toothed spurge
>Leaf surfaces rough textured with 3 prominent veins
>>Plant annual - common sunflower
>>Plant perennial from underground tubers, petioles are winged - Jerusalem artichoke

First and subsequent leaves opposite

>Leaf margins with irregular teeth, lack petioles, succulent reddish-brown stems - eclipta

V. Cotyledons butterfly-shaped

Cotyledons with pointed tips cut at approximately 90 degrees - pitted morningglory
Cotyledons with rounded tips cut less than 90 degrees
>Ivy-shaped leaves - ivyleaf morningglory
>Heart-shaped leaves
>>Plant annual - tall morningglory
>>Plant perennial from tuberous root - bigroot morningglory

VI. Cotyledons kidney-shaped

Leaves hairy with wavy, uneven margins - wild mustard
Leaves arrowhead-shaped, plant perennial, vining habit
>Leaf bases have sharp lobes that point outward - hedge bindweed
>Leaf bases have rounded lobes - field bindweed

Wild Mustard

Common Weeds of Field Crops and Pastures

Common Name	Scientific Name
Barley, little	*Hordeum pusillium*
Barnyardgrass	*Echinochloa crus-galli*
Bermudagrass	*Cynodon dactylon*
Bluegrass, annual	*Poa annua*
Broadleaf signalgrass	*Brachiaria platyphylla*
Brome, downy	*Bromus tectorum*
Cheat	*Bromus secalinus*
Crabgrass, large	*Digitaria sanguinalis*
Crabgrass, smooth	*Digitaria ischaemum*
Dallisgrass	*Paspalum spp.*
Dayflower	*Commelina spp.*
Fall panicum	*Panicum dichotomiflorum*
Field horsetail	*Equisetum spp.*
Foxtail barley	*Hordeum jubatum*
Foxtail, Carolina	*Alopecurus carolinianus*
Foxtail, giant	*Setaria faberi*
Foxtail, green	*Setaria viridis*
Foxtail, yellow	*Setaria glauca*
Goosegrass	*Eleusine indica*
Johnsongrass	*Sorghum halepense*
Orchardgrass	*Dactylis glomerata*
Quackgrass	*Elytrigia repens*
Rush	*Juncus spp.*
Ryegrass, perennial	*Lolium perenne*
Sandbur	*Cenchrus longispinus*
Shattercane	*Sorghum bicolor*
Star-of-Bethlehem	*Ornithogalum umbellatum*
Wild garlic	*Allium vineale*
Wild onion	*Allium canadense*
Witchgrass	*Panicum capillare*
Woolly cupgrass	*Eriochloa villosa*

Coneflower

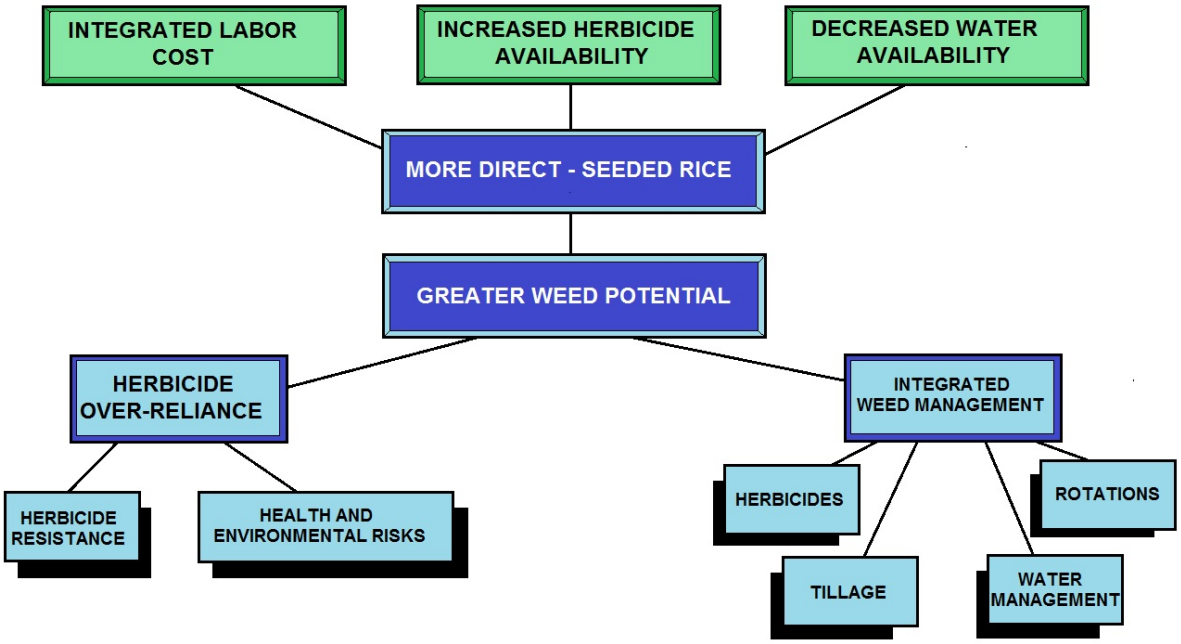
Buckwheat

Jimsonweed *Datura stramonium*

Common Grasses and their Scientific Names

Common Name	Scientific Name
Annual bluegrass	*Poa annua*
Barnyard grass	*Echinochloa crus-galli*
Bermuda grass	*Cynodon dactylon*
Crabgrass, large	*Digitaria sanguinalis*
Crabgrass, smooth	*Digitaria ischaemum*
Dallis grass	*Paspalum spp.*
Dayflower	*Commelina spp.*
Foxtail, giant	*Setaria faberi*
Foxtail, green	*Setaria viridis*
Foxtail, yellow	*Setaria glauca*
Goosegrass	*Eleusine indica*
Nimblewill	*Muhlenbergia schreberi*
Ryegrass, perennial	*Lolium perenne*
Quackgrass	*Elytrigia repens*
Sandbur	*Cenchrus longispinus*
Star-of-Bethlehem	*Ornithogallum umbellatum*
Wild garlic	*Allium vineale*
Wild onion	*Allium canadense*
Yellow nutsedge	*Cyperus esculentus*

Star-of-Bethlehem *Ornithogallum umbellatum*



Technical Learning College

MANAGING WEEDS

Grass and Grasslike Plant Identification Key

Leaves arise from bulb - wild onion, wild garlic or Star-of-Bethlehem
Stems triangular - yellow nutsedge
Leaves form sheath at stem, blue-purple flowers - dayflower
Ligule absent - barnyardgrass
Ligule membranous

Blade or sheath with dense hairs

>First leaf wide and short, decumbent growth habit - large crabgrass
>Leaf blades distinctly twisted, winter annual - downy brome

Blade and sheath hairless or sparsely hairy

>Blades wide, short
>>Sparse hairs near collar, decumbent growth habit - smooth crabgrass
>>Prominent veins, sheath flat with whitish base - goosegrass
>Blades narrow and erect
>>Auricles present, smooth white rhizomes - quackgrass
>>Auricles absent
>>>Winter annual, forms clumps, blade tips prow-shaped - annual bluegrass
>>>Perennial with rhizomes, seed oblong-shaped - Johnson grass
>>>Summer annual, resembles Johnson grass but has no rhizomes, large shiny black ovate seed - shattercane

Ligule hairy Blade with hair

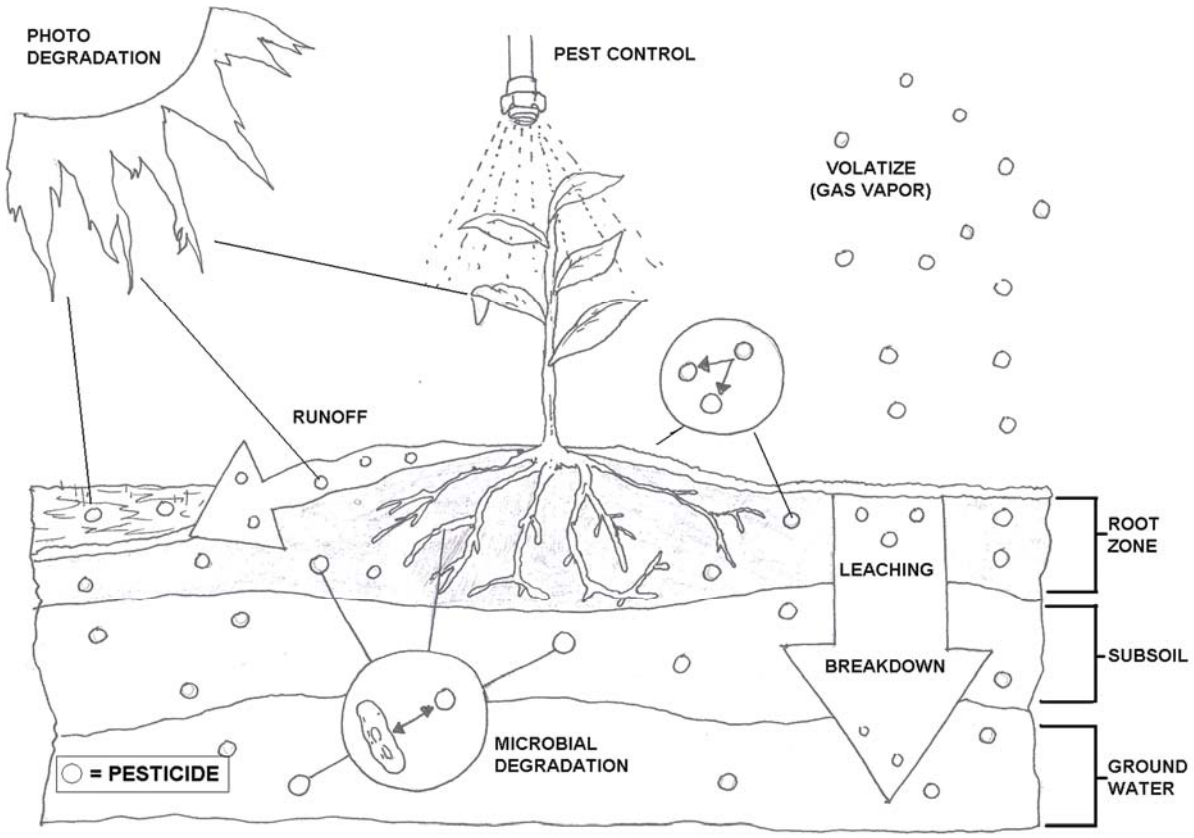
>Short hair on upper surface - giant foxtail
>Long hair on upper leaf surface near base of blade - yellow foxtail
>Blades and sheath covered with dense short hair, sheath hair at 90 degree angle to stem -witchgrass
>Very short dense hair on blades, first leaf horizontal, blade margin often crimped, large seed - woolly cupgrass

Blade with little or no hair

>Sheath margin hairy - green foxtail

Sheath margin usually hairless or with a few hairs

>>Perennial, rhizomes and stolons present, roots at nodes, decumbent growth habit - bermudagrass
>>Sheath round, hair on underside of first leaf, later leaves smooth, prominent white midvein - fall panicum
>>Sheath flattened, usually reddish in color, large spiny seed - field sandbur



SOIL DEGRADATION FROM PESTICIDES

Federal Weed Rule 7 CFR 360.100 Definitions.

(a) As used in this part, words in the singular form shall be deemed to import the plural and vice versa, as the case may require.

(b) As used in this part, the terms as defined in section 3 of the Act (7 U.S.C. 2802) shall apply with equal force and effect. In addition and except as may be provided otherwise in this part the following words shall be construed, respectively, to mean:

Department. The U.S. Department of Agriculture.

Deputy Administrator. The Deputy Administrator of the Plant Protection and Quarantine Programs of the Animal and Plant Health Inspection Service of the Department, or any other officer or employee of the Plant Protection and Quarantine Programs to whom authority has heretofore been delegated or may hereafter be delegated to act in his stead.

Plant Protection and Quarantine Programs. The Plant Protection and Quarantine Programs, Animal and Plant Health Inspection Service of the Department. [41 FR 49988, Nov. 12, 1976]

360.200 Designation of noxious weeds.

{1} One or more common names of weeds are given in parentheses after most scientific names to help identify the weeds represented by such scientific names; however, a scientific name is intended to include all weeds within the genus or species represented by the scientific name, regardless of whether the common name or names are as comprehensive in scope as the scientific name.

Pursuant to the provisions of section 10 of the Federal Noxious Weed Act of 1974 (7 U.S.C. 2809) the Secretary of Agriculture, after publication of the required notice of proposal and after public hearing on the proposal when requested by any interested person, has determined based upon the information received at any such hearing and other information available to the Secretary, that the following plants are within the definition of a ``noxious weed'' in section 3(c) of the Act (7 U.S.C. 2802(c)) and that their dissemination in the United States may reasonably be expected to have, to a serious degree, an effect specified in said section 3(c) of the Act:

(a) Aquatic weeds

Azolla pinnata R. Brown (mosquito fern, water velvet)
Eichornia azurea (Swartz) Kunth (anchored waterhyacinth, rooted waterhyacinth)
Hydrilla verticillata (Linnaeus f.) Royle (hydrilla)
Hygrophila polysperma T. Anderson (Miramar weed)
Ipomoea aquatica Forsskal (water-spinach, swamp morning-glory)
Lagarosiphon major (Ridley) Moss
Limnophila sessiliflora (Vahl) Blume (ambulia)
Melaleuca quenquinervia (Cav.) Blake (broadleaf paper bark tree).
Monochoria hastata (Linnaeus) Solms-Laubach
Monochoria vaginalis (Burman f.) C. Presl
+Ottelia alismoides (L.) Pers.
Sagittaria sagittifolia Linnaeus (arrowhead)
Salvinia auriculata Aublet (giant salvinia)
Salvinia biloba Raddi (giant salvinia)
Salvinia herzogii de la Sota (giant salvinia)
Salvinia molesta D.S. Mitchell (giant salvinia)
Sparganium erectum Linnaeus (exotic bur-reed)

(b) Parasitic weeds:

Aeginetia spp.
Alectra spp.
Cuscuta spp. (dodders), other than following species:
Cuscuta americana Linnaeus
Cuscuta applanata Engelmann
Cuscuta approximata Babington
Cuscuta attenuata Waterfall
Cuscuta boldinghii Urban
Cuscuta brachycalyx (Yuncker) Yuncker
Cuscuta californica Hooker & Arnott
Cuscuta campestris Yuncker
Cuscuta cassytoides Nees ex Engelmann
Cuscuta ceanothii Behr
Cuscuta cephalanthii Engelmann
Cuscuta compacta Jussieu
Cuscuta corylii Engelmann
Cuscuta cuspidata Engelmann
Cuscuta decipiens Yuncker
Cuscuta dentatasquamata Yuncker
Cuscuta denticulata Engelmann
Cuscuta epilinum Weihe
Cuscuta epithymum (Linnaeus) Linnaeus
Cuscuta erosa Yuncker
Cuscuta europaea Linnaeus
Cuscuta exalta Engelmann
Cuscuta fasciculata Yuncker
glabrior (Engelmann) Yuncker
Cuscuta globulosa Bentham
Cuscuta glomerata Choisy
Cuscuta gronovii Willdenow
Cuscuta harperi Small
Cuscuta howelliana Rubtzoff
Cuscuta indecora Choisy
Cuscuta jepsonii Yuncker
Cuscuta leptantha Engelmann
Cuscuta mitriformis Engelmann
Cuscuta nevadensis I. M. Johnston
Cuscuta obtusiflora Humboldt, Bonpland, & Kunth
Cuscuta occidentalis Millspaugh ex Mill & Nuttall
Cuscuta odontolepis Engelmann
Cuscuta pentagona Engelmann
Cuscuta planiflora Tenore
Cuscuta plattensis A. Nelson
Cuscuta polygonorum Engelmann
Cuscuta rostrata Shuttleworth ex Engelmann
Cuscuta runyonii Yuncker
Cuscuta salina Engelmann
Cuscuta sandwichiana Choisy
Cuscuta squamata Engelmann
Cuscuta suaveolens Seringe
Cuscuta suksdorfii Yuncker
Cuscuta tuberculata Brandegee
Cuscuta umbellata Humboldt, Bonpland, & Kunth
Cuscuta umbrosa Beyrich ex Hooker
Cuscuta vetchii Brandegee

Field Dodder
Parasitizing red clover. The plant has a Cuscuta yellowish coloration and a spaghetti-string appearance.

Field Dodder
Parasitizing field bindweed.

Cuscuta warneri Yuncker
Orobanche spp. (broomrapes), other than the following species:
Orobanche bulbosa (Gray) G. Beck
Orobanche californica Schlechtendal & Chamisso
Orobanche cooperi (Gray) Heller
Orobanche corymbosa (Rydberg) Ferris
Orobanche dugesii (S. Watson) Munz
Orobanche fasciculata Nuttall
Orobanche ludoviciana Nuttall
Orobanche multicaulis Brandegee
Orobanche parishii (Jepson) Heckard
Orobanche pinorum Geyer ex Hooker
Orobanche uniflora Linnaeus
Orobanche valida Jepson
Orobanche vallicola (Jepson) Heckard
Striga spp. (witchweeds)

(c) Terrestrial weeds:

Ageratina adenophora (Sprengel) King & Robinson (crofton weed)
Alternanthera sessilis (Linnaeus) R. Brown ex de Candolle (sessile joyweed)
Asphodelus fistulosus Linnaeus (onionweed)
Avena sterilis Linnaeus (including Avena ludoviciana Durieu) (animated oat, wild oat)
Borreria alata (Aublet) de Candolle
Carthamus oxyacantha M. Bieberstein (wild safflower)
Chrysopogon aciculatus (Retzius) Trinius (pilipiliula)
Commelina benghalensis Linnaeus (Benghal dayflower)
Crupina vulgaris Cassini (common crupina)
Digitaria scalarum (Schweinfurth) Chiovenda (African couchgrass, fingergrass)
Digitaria velutina (Forsskal) Palisot de Beauvois (velvet fingergrass, annual conchgrass)
Drymaria arenarioides Humboldt & Bonpland ex Roemer & Schultes (lightning weed)
Emex australis Steinheil (three-cornered jack)
Emex spinosa (Linnaeus) Campdera (devil's thorn)
Galega officinalis Linnaeus (goatsrue)
Heracleum mantegazzianum Sommier & Levier (giant hogweed)
Imperata brasiliensis Trinius (Brazilian satintail)
Imperata cylindrica (Linnaeus) Raeuschel (cogongrass)
Ipomoea triloba Linnaeus (little bell, aiea morning-glory)
Ischaemum rugosum Salisbury (murainograss)
Leptochloa chinensis (Linnaeus) Nees (Asian sprangletop)
Lycium ferocissimum Miers (African boxthorn)
Melastoma malabathricum Linnaeus
Mikania cordata (Burman f.) B. L. Robinson (mile-a-minute)
Mikania micrantha Humboldt, Bonpland, & Kunth
Mimosa invisa Martius (giant sensitive plant)
Mimosa pigra Linneaus var. pigra (catclaw mimosa)
Nassella trichotoma (Nees) Hackel ex Arechavaleta (serrated tussock)
Opuntia aurantiaca Lindley (jointed prickly pear)
Oryza longistaminata A. Chevalier & Roehrich (red rice)
Oryza punctata Kotschy ex Steudel (red rice)
Oryza rufipogon Griffith (red rice)
Paspalum scrobiculatum Linnaeus (Kodo-millet)
Pennisetum clandestinum Hochstetter ex Chiovenda (kikuyugrass)
Pennisetum macrourum Trinius (African feathergrass)
Pennisetum pedicellatum Trinius (kyasumagrass)
Pennisetum polystachion (Linnaeus) Schultes (missiongrass, thin napiergrass)

Prosopis alpataco R. A. Philippi
Prosopis argentina Burkart
Prosopis articulata S. Watson
Prosopis burkartii Munoz
Prosopis caldenia Burkart
Prosopis calingastana Burkart
Prosopis campestris Griseback
Prosopis castellanosii Burkart
Prosopis denudans Bentham
Prosopis elata (Burkart) Burkart
Prosopis farcta (Solander ex Russell) Macbride
Prosopis ferox Grisebach
Prosopis fiebrigii Harms
Prosopis hassleri Harms
Prosopis humilis Gillies ex Hooker & Arnott
Prosopis kuntzei Harms
Prosopis pallida (Humboldt & Bonpland ex Willdenow) Humboldt, Bonpland, & Kunth
Prosopis palmeri S. Watson
Prosopis reptans Bentham var. reptans
Prosopis rojasiana Burkart
Prosopis ruizlealii Burkart
Prosopis ruscifolia Grisebach
Prosopis sericantha Gillies ex Hooker & Arnott
Prosopis strombulifera (Lamarck) Bentham
Prosopis torquata (Cavanilles ex Lagasca y Segura) de Candolle
Rottboellia exaltata Linnaeus f. (itchgrass, raoulgrass)
Rubus fruticosus Linnaeus (complex) (wild blackberry)
Rubus moluccanus Linnaeus (wild raspberry)
Saccharum spontaneum Linnaeus (wild sugarcane)
Salsola vermiculata Linnaeus (wormleaf salsola)
Setaria pallide-fusca (Schumacher) Stapf & Hubbard (cattail grass)
Solanum torvum Swartz (turkeyberry)
+Solanum viarum Dunal (tropical soda apple)
Tridax procumbens Linnaeus (coat buttons)
Urochloa panicoides Beauvois (liverseed grass)

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.

Commonly Found Weed Section
A-Z Common Names

African Rue *Peganum harmala*

Other common names: Wild rue, rue weed, and Syrian rue.

Description: African rue is a multi-branched and bushy perennial. A member of the Caltrop family it is a succulent plant, with bright green alternating leaves that are smooth and finely divided with long, narrow segments. Plants grow 1.5 feet tall and 3-4 feet in diameter. Flowers are white with five individual petals and are present in spring to early fall. Fruit is a located in a leathery capsule 2-4 celled which contains 45-60 seeds. Seeds are angular, dark brown and have a distinctive smell. When crushed, the stems also have a disagreeable odor. The base of this plant is woody and roots can branch and reach 20 feet in depth. African rue prefers distributed environments such as roadsides, fields and rangelands in desert and semi-desert areas. It is often found in soils with high salinity and most parts of the plant contain allelopathic chemicals that reduce growth of other vegetation.

Impacts: African rue contains at least four poisonous alkaloids. It is toxic to people and livestock. The seeds and fruit of the plant are the most toxic part with a lethal dose being 0.15 percent of an animal's body weight. Young leaves are less toxic then seeds with a lethal dose of about 1.0 percent of the animals' weight, while mature leaves are less toxic. Dry leaves are apparently nontoxic. This noxious weed is extremely drought tolerant and displays robust vegetative growth expanding into desert rangelands replacing native plants like saltbrush and grasses. It has a competitive advantage over native plants as it germinates earlier in the spring.

Introduction: African rue is native to the deserts of Africa and southern Asia. There are known sites in New Mexico, Arizona, Texas, California, Oregon and Washington. Introduced from the Mediterranean region and Middle East. The plant was first recognized in the United States in 1920 near Deming New Mexico and has naturalized in parts of southwestern United States including Arizona, New Mexico, and parts of west Texas. Dehulled seeds yield edible oil similar to cottonseed oil. Plants have been used medicinally and produce red dye in the Middle East.

Artichoke, Jerusalem *Helianthus tuberosus*

Family: Daisy Family (Compositae)
Other Names: Canada potato, earth-apple, girasole, sunflower artichoke, sunroot, tuberous sunflower.
Origin and Distribution: Jerusalem artichoke is native to North America and may have originated in the Ohio and Mississippi River valleys. The first written account of the plant was a report issued in 1605 by Champlain, a European explorer, who observed Native Americans growing Jerusalem artichoke along with corn and beans in a Cape Cod garden. The species was introduced to Europe in 1612 where it gained popularity as both human and animal food. Its current range in North America extends from the East Coast to the Midwest and from southern Canada to Georgia. This native plant inhabits riverbanks, roadsides, fencerows, and agronomic fields, preferring rich, moist soils.

Plant Description: It is nearly impossible to distinguish Jerusalem artichoke from annual sunflowers based on above-ground growth. Jerusalem artichoke has a coarse, 5- to 10-foot tall stem, large leaves with a rough upper surface, and bright yellow sunflower-like flowers. However, Jerusalem artichoke can be easily distinguished from annual sunflowers by its below-ground growth that includes fleshy tubers resembling thin, knotty potatoes. Reproduction of Jerusalem artichoke is by seeds, rhizomes (horizontal underground stems), and tubers.

Root system - The root system is fibrous with thin cord-like rhizomes (horizontal underground stems) that grow as long as 50 inches. Usually apparent at the tips of rhizomes are whitish to pinkish tubers that are irregular in size and shape and resemble a slender potato with knots.
Seedlings & Shoots - The first leaves to emerge (cotyledons) have a united base in the shape of a short tube. Young leaves are elliptic, dull green, and covered with short stiff hairs.
Stems - Jerusalem artichoke stems grow as tall as 12 feet, and are stout, rough, hairy, ridged. Stems can become woody over time. Branches vary from none to many.
Leaves - Leaves are opposite (2 leaves per node) on the lower part of the stem, and alternate (1 leaf per node) near the top of the stem. Leaves are 4 to 10 inches long and nearly heart-shaped with a broad oval base and pointed tip. The thick leaves have 3 distinct main veins, coarsely-toothed margins, and attach to the stem by way of a winged stalk (petiole). The upper leaf surface has coarse hairs while the lower surface has soft hairs.
Flowers - Flower heads occur alone or in groups at the ends of main stems and axillary branches. Each flower head is 2 to 3 inches wide and made up of many small, yellow, tubular disk flowers in the center, surrounded by 10 to 20 yellow ray flowers (typically thought of as the petals).
Fruits & Seeds - Seeds are smooth, wedge-shaped, and gray or brown with black mottling.

Similar Species: Common sunflower (Helianthus annuus) is an annual that shares many above-ground characteristics with Jerusalem artichoke but below ground, it lacks rhizomes and tubers. Black-eyed Susan (Rudbeckia spp.) is generally a much smaller and bushier plant, although its flowers are very similar in appearance to those of Jerusalem artichoke.

Biology: Jerusalem artichoke is sometimes cultivated for its edible tubers, but it can become an aggressive weed that is very difficult to control. Plants flower from August to October. Seeds are usually produced in low numbers, so tubers are the primary mechanism by which plants reproduce. Tubers are also the means by which plants survive winter, since the foliage dies back after frost. Tubers sprout in late spring and are capable of forming shoots even if buried 12 inches deep in soil. As many as 6 shoots may emerge from one tuber.

New tuber formation begins just before flowering. A single Jerusalem artichoke plant can produce 200 tubers in one growing season, but typically plants produce around 75 tubers. Jerusalem artichoke is a competitive plant when growing with row crops, where just a few plants can significantly reduce yields. However, because it is highly nutritious, its presence may be desirable in pastures. Foliage is used to make silage and tubers are fed to livestock.

Pigs are especially fond of the tubers, and commonly dig up and eat buried tubers, which helps control the plant's spread. Although tubers are the primary means of reproduction, they only survive a couple of years in soil. Therefore, preventing tuber formation by repeatedly applying control measures for 2 years will generally control Jerusalem artichoke. Application of selective herbicides at the pre-bloom stage generally results in good control.

Toxicity: None known.

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 herbicides 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.

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Asparagus, Wild *Asparagus officinalis*

Family: Lily Family (Liliaceae)

Other Names: asparagus, asparagus fern, garden asparagus.

Origin and Distribution: Wild asparagus is native to coastal regions of Europe and Asia, and was brought to North America by European settlers in the 1700's. It is commonly cultivated in gardens, and often escapes, becoming established in waste places, along roadsides and fencerows. This species is tolerant of drought and salinity.

Plant Description: Wild asparagus is an herbaceous perennial, well-known for its edible young shoots. Mature plants have a distinctive fern-like appearance, and reproduce by seed.

Root system - Wild asparagus produces a thick mat of fleshy roots that can grow 3 feet deep.

Seedlings & Shoots - Young shoots (commonly called spears) are green, succulent and tender. Several shoots are produced from previously established rootstocks.

Stems - Stems are smooth, green and 4 to 6 feet tall, with many green primary branches. Slender, green, needle-like secondary branches are produced in bundles off the main branches, appearing more like leaves than branches.

Leaves - Inconspicuous, reduced, scale-like leaves (bracts) occur at the tips of young shoots and at the bases of primary and secondary branches along mature stems. (Note: The bundles of green, needle-like structures along the main branches are actually finer branches).

Flowers - Wild asparagus is dioecious, producing male and female flowers on separate plants. Flowers are greenish, bell-shaped, and situated on slender flower stalks in groups of 1 to 3 arising from the leaf bases.
Fruits & Seeds - Round, bright red berries are produced on female plants, and each berry contains several black seeds.

Biology: Young shoots emerge in early spring. The fine, needle-like secondary branches are the main site of photosynthesis, a role typically played by leaves.

Toxicity: Raw young shoots, older stalks, roots and other structures of wild asparagus are reported to be mildly toxic. Contact with young stems can cause skin irritation.

Aster, White-Heath *Aster pilosus*

Family: Daisy Family (Compositae)
Other Names: awl-aster, Michaelmas daisy, nailrod, steelweed, subulate-bracted aster.
Origin and Distribution: White heath aster is a common weed throughout the eastern half of the U.S. It grows in old fields, orchards, pastures, roadsides, waste places, and sometimes no-tillage agronomic fields. The species prefers to grow in the open on dry sandy or gravelly soils.

Plant Description: White heath aster is a perennial weed that can frequently be seen growing by the side of the road as a clump of upright stems with wand-like spreading branches. In late August, small white flowers cover the top half of the plant. The flowers, which are similar to those produced by other plants in the Compositae Family, are actually head-like clusters made up of many individual flowers that may be different shapes and colors. In the case of white heath aster, there are yellow disk flowers in the center of each head surrounded by 16 to 35 white ray flowers. Reproduction is by seeds.
Root system - Fibrous roots originate at the base of a perennial, woody crown.
Seedlings & Shoots - Young leaves are alternate (1 leaf per node) with a green upper surface, grayish lower surface, and hairs on the edges and leaf stalks (petioles).
Stems - Stems are erect, 1 to 4 feet tall, and either smooth or with long, soft hairs. Stems are much-branched, especially in the upper half of the plant. Several erect, branched stems often emerge from the same root crown forming a clump.

Leaves - Leaves are usually hairy. Lower leaves are lance-shaped, leaves located mid-way up the stem are more linear and lack petioles, and uppermost leaves are small, narrow, pointed, and numerous.

Flowers - Flowers are grouped into heads that are 1/2 to 3/4-inch-wide and located at the ends of branched stems. In the center of each flower head are yellow disk flowers that are surrounded by 16 to 35 white ray flowers (typically thought of as the petals).

Fruits & Seeds - Fruits are light to dark brown, cone-shaped, and have a tuft of silky hairs (pappus) attached to the top. Each fruit contains a single seed.

Similar Species: New England aster (Aster novae-angliae) is one of several other aster species that are similar in appearance and distribution to white heath aster. However, New England aster has purple flowers and its leaves are larger than those of white heath aster. Fleabanes (Erigeron spp.) have white flowers that look similar to white heath aster flowers. However, fleabanes are annuals that begin to flower about 3 months before white heath aster. Also, compared with those of white heath aster, the white ray flowers surrounding the centrally-located yellow disk flowers are more numerous and narrower.

Biology: Flowering begins in late summer and continues until autumn. White heath aster is easily controlled by cultivation.

Toxicity: None known.

Austrian Peaweed *Sphaerophysa salsula*

Other common names: Swainsonpea

Identification: Perennial; flowers from May to July. A creeping plant with compound leaves; numerous leaflets oval and covered in hair. Flowers 1/4 to 1 inch long and orange-red. Many seeds in bladder-like translucent pods.

Impacts: This plant was introduced from Asia and is commonly found in western states in irrigated fields as well as moist soil in waste places along roadsides and fences. It is a potential threat to grain and alfalfa growing areas. The seed is a contaminant in alfalfa seed production; it is the same size, shape and weight, making it impossible to separate.

Introduction: This plant was introduced from Asia and is commonly found in western states along roadsides and fences. It is a potential threat to grain and alfalfa growing areas; the seed is a contaminant in alfalfa seed which is the same size, shape and weight, making it impossible to separate.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
• Elimination of weed debris
• Control of annual weeds
• Suppression of perennial weeds
• Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

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Bamboo *Phyllostachys*

Bamboo *Phyllostachys angusta*

Bamboo - Phyllostachys: From the Greek "*phyllon*", leaf, and "*stachys*", a spike, referring to the leafy bloom spike (inflorescence). Subfamily: ***Bambusoideae*** A diverse genus of about 15 species of evergreen running bamboo primarily native to temperate and subtropical China and Japan, ***Phyllostachys*** includes several popular bamboo of gardens as well as varieties valued for timber and for edible shoots. The rounded culms display distinctive grooves or compressed areas on the branching sides, making this genus fairly easy to recognize and distinguish from other bamboo. Their dense evergreen foliage, attractively marked and colored culms, and fast growth have made these running bamboos favorites for creating large groves, for screening and hedging, and for stabilizing rough slopes or streamsides. On small properties the spreading roots of ***Phyllostachys*** may be confined as desired by installing appropriate barriers at planting.
Culture: ***Phyllostachys*** species thrive in sun or light shade if provided with abundant moisture and rich soil. Where drought may be expected or in hot interior climates, some shading would be beneficial for most varieties. Established plants withstand flooding.

Control: Bamboo can be controlled in a small area (a normal city yard) simply by mowing or stepping on the young shoots. New shoots could also be used for culinary purposes and cooked, much like asparagus. Keep in mind that running bamboo only puts up new shoots for a short time each year, and when they are "shooting", the new plants are very fragile and easy to destroy. To really slow the spread of the rhizomes, the grove can be root pruned at any time. (Best time seems to be in the fall or early winter). This is done with a sharp, narrow spade (8" wide, flat spade works quite well) by "trimming" the rhizomes on all sides which need to be controlled. Push the shovel straight down to its maximum depth so as to cut through any rhizomes encountered, (8-10 inches is usually sufficient).

Keep moving the spade one width at a time to the right or left, cutting a line until all the rhizomes have been cut. Yes, you may miss a few, but you can get them next year. You do not have to dig up the whole root system and rhizomes. Once you have severed it from the mother plant and cut off any new shoots, you will have deprived it of all food sources and it will die off. Glyphosate (Roundup, Kleenup) Systemic type: Controls a wide range of annual and perennial grasses and broadleaf plants, but in many cases requires very precise timing to be effective.

Bedstraw, Smooth *Galium mollugo*

Family: Madder Family (Rubiaceae)
Other Names: beggar-lice, chicken weed, cleavers, robin-run-ahead, whip-tongue, white bedstraw, white hedge bedstraw, wild madder.
Origin and Distribution: Smooth bedstraw is native to Eurasia
. Smooth bedstraw can be a persistent weed in lawns, pastures, fields, riverbanks, and along roadsides. It prefers gravelly or sandy loam soils.

Plant Description: There are at least 30 different bedstraws in North America, and many are perennials like smooth bedstraw that produce sprawling tangled mats from which a few erect stems arise. The typical bedstraw leaf is linear and formed in whorls consisting of as many as 8 leaves at nodes on the stem. Smooth bedstraw is the only white-flowered form with 8 leaves at each node on main stems and 6 to 8 leaves at nodes on branches. Reproduction is by seeds and underground, spreading rhizomes (horizontal underground stems).
Stems - Stems are smooth, wiry, 4-angled, branched, and up to 3 feet long. Stems initially grow upright, but over time they become spreading and matted.
Leaves - Leaves are 1/3 to 1 inch long, linear, bright green, and whorled (usually, there are 8 leaves per node on main stems and 6 or 7 leaves per node on branches).
Flowers - Flowers are about 1/6 inch wide, white, and consist of tiny, 4-lobed petals. Flowers form in branched clusters at the ends of stems and branches throughout the plant.
Fruits & Seeds - Seeds are kidney-shaped, hairless, and dark brown.

Similar Species: Smooth bedstraw can be distinguished from other perennial bedstraws that are also found such as Clayton's bedstraw (Galium tinctorium), lanceleaf wild liquorice (G. lanceolatum), northern bedstraw (G. boreale), northern marsh bedstraw (G.palustre), shining bedstraw (G. concinnum), small bedstraw (G. trifidum), and yellow bedstraw (G. verum) because it is the only species with white flowers that has 8 leaves per node. Catchweed bedstraw (Galium aparine) is similar in appearance but its life cycle is that of an annual so its roots do not persist for more than one season as it establishes each year from seeds. Also, its stems, leaves, and fruits are prickly and its leaves are larger than those of smooth bedstraw.

Biology: Plants produce flowers from June through August.

Toxicity: None known.

Related Information:

- The genus name, 'Galium' is from the Greek word for milk and refers to an old use for the plant to curdle milk in making cheese.

- The common name 'bedstraw' has two possible origins: the dried plant was used to stuff mattresses; it is said that bedstraw was placed in the manger at Bethlehem when Jesus was born.

- Small chickens get caught in this weed, hence the common name 'chicken weed'.

Biddy-biddy *Acaena novae-zelandiae*

Acaena novae-zelandiae (Bidi-bidi or Biddy-biddy or Bidgee-widgee) is an ornamental plant native to New Zealand and Australia. It can also be found elsewhere as an introduced species, and is considered a noxious weed in some areas, such as Hawaii and California.
Description: Perennial that grows four to eight inches tall. Biddy-biddy spreads by stolons that root at the nodes and plants form large mats where individual plants are indistinguishable. The plant stems are prostrate to erect depending on conditions. Leaves alternate and compound, with mature plants having 5 to 11 leaflets 1/4-2/3 inches long. Flower heads spherical, and turn into a round bur that disperses as a unit when mature.

Impacts: This plant prefers open, disturbed, well-drained sites, including stable dunes, open scrub, grassy areas, and trampled sites in coastal habitats where some summer moisture is available and frosts are infrequent. Plants thrive on poor soils and compete poorly with established vegetation.

Introduction: It is believed that this plant first spread from New Zealand to other countries in contaminated shipments of wool.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
• Elimination of weed debris
• Control of annual weeds
• Suppression of perennial weeds
• Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

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Bindweed, Field *Convolvulus arvensis*

Field Bindweed *Convolvulus arvensis*

Field bindweed can be spread by seed, root fragments, farm implements, infested soil adhering to the roots of nursery stock, root growth from infested areas, and by animals. Field bindweed has a deep root system that competes with crop plants for water and nutrients. Vines climb on plants and shade crops, cause lodging of small grains, and make harvesting difficult by clogging machinery. Dense field bindweed infestations may reduce crop yields by 50 to 60 percent. Land infested with field bindweed is reduced in value.

Field bindweed is a long-lived perennial which produces a dense ground cover. The twining stems vary from 1.5 to 6 feet or more in length. Leaf size and shape are variable, but generally the leaves are 1 to 2 inches long, smooth, and shaped like an arrowhead. Flowers are funnel-shaped, about 1 inch diameter, and white or pink in color. The flower stalk has two small bracts located ½ to 2 inches below the flower. The bracts, along with leaf shape and smaller flower size, distinguish field bindweed from hedge bindweed.

Control: Herbicides such as glyphosate can be painted on bindweed leaves. Repeat applications will be needed. Herbicides such as 2,4-D combinations can be sprayed on bindweed foliage; repeat applications may be needed. The most effective times for herbicide application are during flowering, or in August/September. Always read the label before applying any pesticide.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:

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Bindweed, Hedge *Calystegia sepium*

Family: Morning-glory Family (Convolvulaceae)
Other Names: Convolvulus sepium, bracted bindweed, devil's-vine, great bindweed, hedge-lily, hedge morning-glory, lily-bind, Rutland beauty, wild morning-glory.

Origin and Distribution: Hedge bindweed is a native of eastern North America. Currently, its range extends throughout the U.S. and includes Europe and Asia. Hedge bindweed is a common weed. It is found in a variety of habitats including stream banks, riverbanks, swamps, marshes, ditches, gardens, fields, thickets, fencerows, and roadsides. The plant flourishes in most any soil type but prefers rich, moist lowland areas in full sun.

Plant Description: Hedge bindweed is a twining perennial vine. Characteristics distinguishing it from other vines include arrowhead-shaped leaves that have pointed tips, pinkish petals fused into funnel-shaped flowers, the presence of large bracts enclosing the base of each flower, and creeping perennial roots. The plant reproduces by seeds and creeping roots.
Root system - Roots of hedge bindweed tend to be shallow but 10 feet or more in length.
Seedlings & Shoots - Young plants have dull red stems, thin leaves, a strong smell, and an unpleasant taste. The slender leaf stalks (petioles) have a deep groove on the upper side. Initially, leaves are smooth edged while later-emerging leaves are wavy-edged.
Stems - Stems are viney, twining, hairless, 3 to 10 feet in length, and either trailing along the ground or climbing over objects.
Leaves - Leaves are alternate (1 leaf per node), 2 to 5 inches long, triangular-shaped, and have short hairs on the upper and lower surfaces. At the base of each leaf are 2 lobes, one on either side of the petiole, that are squared. The outline of a typical leaf narrows gradually upward such that its sides are nearly parallel. Leaf tips are pointed. Leaves attach to stems by way of long petioles.
Flowers - Flowers of hedge bindweed are funnel-shaped, white to pinkish, and more than 1 inch across. Flowers arise singly at the end of long stalks arising from the stem at the leaf axils. Attached to the stalk and enclosing the base of each flower are 2, large, leaf-like bracts.
Fruits & Seeds - Fruits are egg-shaped capsules containing 2 to 4 seeds. The blackish-brown seeds are 3-angled with 1 rounded side and 2 flat sides. Their shape is similar to that of a quartered orange.

Similar Species: Other weedy vines such as field bindweed (Convovulus arvensis), honeyvine milkweed (Ampelamus albidus), and wild buckwheat (Polygonum convolvulus) can be distinguished from hedge bindweed by the appearance of their leaves and flowers. Field bindweed leaves are smaller and they have more pointed lobes and rounded tips than hedge bindweed leaves. Field bindweed flowers are smaller than those of hedge bindweed and, instead of large bracts enclosing the base of each flower, there are 2 small bracts located about an inch below the flower. Honeyvine milkweed leaves are opposite (2 leaves per node) and heart-shaped while hedge bindweed leaves are alternate (1 leaf per node) and arrowhead-shaped. Hedge bindweed flowers are funnel shaped, pinkish, and much larger than those of either honeyvine milkweed, which are vase-shaped and clustered, or wild buckwheat, which are greenish and inconspicuous. In addition, wild buckwheat is an annual lacking perennial creeping roots. Flowers of annual and perennial morninglories (Ipomoea spp.), including bigroot morninglory (Ipomoea pandurata), are shaped similarly to those of field bindweed but their leaves are heart-shaped rather than arrowhead-shaped.

Biology: Flowers bloom from May through September. Hedge bindweed roots are shallow and tend to be less tolerant of drought than more deeply rooted relatives such as field bindweed. The most effective control measure is weeding by hand.

Bindweed, Japanese *Calystegia hederacea*

Family: Morning-glory Family (Convolvulaceae)
Other Names: Colvolvulus japonicus, Convolvulus pellitus, California rose.
Origin and Distribution: A native of eastern China, Japanese bindweed was likely brought to North America as an ornamental or it is possible that it entered as a contaminant of nursery plants. The weedy form found growing in the U.S. is from a cultivated variety in which the number of flower petals was doubled. It is often found along roadsides and railroad right-of-ways.

Plant Description: Japanese bindweed is a creeping perennial. Its appearance is similar to that of hedge bindweed except it has smaller flowers and the bracts enclosing the base of each flower are smaller. The weedy form that escaped cultivation has a distinctive double flower. Compared with other bindweed flowers, this is a unique flower in that it has twice the number of petals and looks similar to a rose or carnation. No plants studied so far have produced seeds, so it is assumed that reproduction is vegetative by way of spreading roots.

Root system - Roots are perennial and spreading.

Stems - Stems are usually hairless.

Leaves - Leaves are alternate, triangle-shaped, and hairless. At the base of each leaf are 2 lobes, one on either side of the leaf stalk (petiole).

Flowers - Most naturalized individuals have double the number of petals so they appear to have a flower inside of a flower. Flowers are funnel-shaped, pink, and 1 to 2 inches long. Attached to the stalk and enclosing the base of each flower are 2, small, leaf-like bracts.

Biology: There is no evidence of seed formation in field- or greenhouse-grown plants. It is possible that other conditions may produce seed-bearing plants; however, the primary means of reproduction seems to be vegetative by way of spreading roots. It was determined that Japanese bindweed found infesting a potato field likely arose from roots contaminating the tubers.

Toxicity: There is little information about this plant. However, other morning glory species are not poisonous to humans, although their seeds can be dangerous if consumed in large quantities.

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Birdsfoot Trefoil *Lotus corniculatus*

Family: Pea Family (Leguminosae)

Other Names: bloom-fell, cat's-clover, crow-toes, deer vetch, devil's-claw, ground honeysuckle, hop o'my thumb, sheep-foot, yellow trefoil.

Origin and Distribution: This weed was introduced from Europe into North America, possibly as early as mid-1700, where it is still valued as an agronomic crop although it is capable of escaping cultivation and becoming a bothersome weed. Several cultivars are commercially available for planting as ground cover, pasture, hay, and silage. Plants that have escaped cultivation can be found inhabiting large areas in lawns, meadows, and waste places throughout the northeastern U.S. and southern Canada. Compared with other legumes, the species tolerates a wide variety of moisture conditions and soil types and is frequently found on drought-prone soils that have low fertility. It does not grow well in shade.

Plant Description: Birdsfoot trefoil has a perennial root crown and stems that die back each winter. The species is characterized by compound leaves consisting of 3 clover-like leaflets at the tip separated by a short stem from 2 smaller leaflets at the base. Its flowers are yellow, clover like, and in groups of 2 to 6. They are arranged such that, when pods form, they resemble a bird's foot. Reproduction is by seeds and plants spread by modified stems (stolons) and rhizomes (horizontal underground stems). Because roots arise from buds at the nodes of older stems, it is possible to propagate plants by stem cuttings. Also, new shoots arise from root crowns.

Root system - Birdsfoot trefoil produces a long taproot that may extent over 3 feet. Also, a fibrous mat appears near the soil surface as the result of formation of secondary roots, rhizomes (horizontal underground stems), and stolons.

Seedlings & Shoots - Seedlings are small and slow-growing and do not compete very successfully with other plants.

Stems - Many branched stems can emerge from a single root crown and may be either erect or prostrate and up to 3 feet long. The lower portion of each stem is round in cross section, while the upper portion is square. Stems may be smooth or hairy, and can become woody with age.

Leaves - Leaves are alternate (1 leaf per node) and compound with 5 leaflets. Leaflets are generally oval and less than 1 inch long. At the top of each leaf are 3, clover-like leaflets separated by a short stem from 2 smaller leaflets attached directly to the stem at its base.

Flowers - Clover-like flowers are about 1/2 inch wide and bright yellow, although they may be streaked with red. Flowers form in groups of 2 to 6 at the end of a long stalk (peduncle) arising from an upper leaf axil. Flower clusters are shaped like flat-topped umbrellas (umbels).

Fruits & Seeds - Pods are approximately 1 inch long, cylindrical, and brown to almost black. Seeds are 1/20 inch long, rounded or oval, flat, shiny, and olive green to nearly black.

Similar Species: Birdsfoot trefoil is similar in appearance to some clovers (*Trifolium* species) and medics (*Medicago* species) except the serrated edges of clover and medic leaflets differ from those of birdsfoot trefoil, which are smooth.

All of the yellow-flowering clovers and medics have numerous flowers arranged in a rounded head whereas birdsfoot trefoil has only 2 to 6 flowers grouped in an umbel. Clusters of birdsfoot trefoil flowers give rise to umbel-shaped groups of pods that resemble those of crownvetch (*Coronilla varia*). However, birdsfoot trefoil can be distinguished by its compound leaves with 5 leaflets, 2 of which are smaller and nearer the base than the 3 clover-like leaflets located at the tip.

Biology: Seeds germinate primarily in spring but also in fall. Flowers are produced from late June until frost. On average, 10 to 20 seeds form in each pod. Pods rupture when mature in such a manner that seeds are ejected. Birdsfoot trefoil is a valuable forage crop that will grow under many soil conditions including drought, flood, saline, acidic, and low fertility. It is planted along highway right-of-ways as a ground cover and in pastures to increase productivity. Once established, it tolerates heavy grazing but does not cause bloat in livestock feeding on it. However, it tends to escape cultivation becoming an undesirable weed. Frequent mowing (more than once every 3 weeks) at a height less than 2 inches is required to control birdsfoot trefoil. It can also be controlled by pre-emergence applications of herbicide or by applying selective herbicides to seedlings.

Toxicity: Plants contain toxic amounts of cyanogenic substances. Although reports of poisoning of livestock and humans are lacking, grazing by insect pests may be deterred by the toxin.

Related Information:

- 'Birdsfoot' refers to the manner pods attach at right angles to the peduncle giving the appearance of a 'bird's foot'.

- Birdsfoot trefoil seeds are one of the most common impurities of white clover seeds as well as some commercially-available grasses.

- As most plants in the pea family, birdsfoot trefoil adds nitrogen to soil and for this reason, it is useful for improving poor pasture land.

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Blackberry, Armenian (Himalaya) *Rubus armeniacus* (R.procerus & R.discolor)

USDA Symbol: RUDI2
Description: Perennial; blooms June to August. Root buds produce trailing reddish stems with sharp spines that can grow more than 20 ft. per season. Leaves alternate, palmate and compound with serrate margins. Flowers five petaled, white to light pink. Fruits aggregate.

Impacts: Armenian blackberry is the most widespread and economically disruptive of all the noxious weeds in western Oregon. It aggressively displaces native plant species, dominates most riparian habitats, and has a significant economic impact on right-of-way maintenance, agriculture, park maintenance and forest production. It is a significant cost in riparian restoration projects and physically inhibits access to recreational activities. It reproduces at cane apices (tips) and by seeds, which are carried by birds and animals. This strategy allows it to expand enmass across a landscape or to jump great distances and create new infestations. Any control strategy can be considered short-lived unless projects are planned and funded for the long-term.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
• Elimination of weed debris
• Control of annual weeds
• Suppression of perennial weeds
• Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

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Black Medic *Medicago lupulina*

Black medic *Medicago lupulina*

Black medic is an annual, biennial or short-lived perennial. A legume, it is closely related to alfalfa. It is most often found in lawns having low fertility. Often called Japanese clover, this plant has small yellow flowers and a deep taproot. It can be pulled from moist soil without difficulty. Keeping your lawn healthy and dense with proper watering, mowing, and fertilization will discourage invasion by black medic. Often confused with Black Medic, Oxalis, White Clover or Wild Alfalfa.

Keeping your lawn healthy and dense with proper watering, mowing, and fertilization will discourage invasion by black medic.

Control: Triclopyr + 2,4-D combination herbicides or other 2,4-D combination herbicides are more effective than 2,4-D alone.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:

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Blue Mustard *Chorispora tenella*

Blue Mustard *Chorispora tenella*

Blue mustard is a winter annual that germinates in the fall and produces a rosette with deeply lobed leaves, similar in appearance to a dandelion. Blue mustard bears purple or blue flowers at the top of the plant in March through April. Leaves on the flowering stems are coarsely toothed and have wavy margins. The plant may grow from 1 to 1 1/2 feet in height. Two-inch long, bean-like seedpods (siliques) that resemble "beaks" mature in early summer.

Control: Herbicides are most effective if applied before weeds start to bolt in the spring. In the spring, while it is actively growing, this weed can be controlled with an application of 2,4-D.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:

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Bouncingbet Saponaria officinalis

Family: Pink Family (Caryophyllaceae)
Other Names: bruisewort, chimney pink, crowsoap, dog's cloves, fuller's herb, hedge pink, lady-by-the-gate, latherwort, London pride, my lady's washbowl, mock-gilliflower, old maid's pink, ragged sailor, scourwort, sheepweed, soaproot, soapwort, sweet betty, wild sweet william, wood's phlox, world's wonder.

Origin and Distribution: Bouncingbet was introduced from Europe for its ornamental, medicinal and soap like properties, and is now common in eastern North America and along the West Coast. This species typically grows in thick patches in waste places like old building sites, along roadsides, railroads and ditch banks, and occasionally in fields and pastures.

Plant Description: Bouncingbet is a perennial characterized by smooth leafy stems, a dense show of fragrant phlox-like flowers in summer, and the tendency to form large patches. Stems, leaves and roots contain a thick juice that forms a soap like lather when mixed with water. Bouncingbet reproduces by seeds and spreading underground stems (rhizomes).

Root system - Bouncingbet produces short, coarse, almost woody rhizomes.

Seedlings & Shoots - The two seed leaves (cotyledons) are long, narrow, and joined at the base to form a collar around the stem. Subsequent pairs of leaves are lance-shaped to oval, and like the first leaves, are united around the stem.

Stems - The stout, erect stems are smooth, thick-jointed, leafy and usually unbranched. Stems often grow in a cluster and are usually 1 to 2 1/2 feet tall (sometimes up to 4 feet tall).

Leaves - Leaves are opposite, smooth and oval to lance-shaped (2 to 3inches long, 1 inch wide), tapering towards both ends. Leaves lack petioles (leaf stalks). Instead, the bases of the leaf pairs are united to form a collar around the stem, giving the stem joints a swollen appearance. Three to 5 lengthwise veins are prominent on the undersides of the leaves.

Flowers - Fragrant, showy, pale pink to whitish flowers are borne in dense, compact, branched clusters at the tops of stems. Flowers are 1 inch wide and have 5 blunt-ended, slightly notched petals, which point back, away from the flower center. Occasionally, double flowers are produced. The sepals (floral leaves beneath the flower) fuse to form a smooth, tube-like calyx (3/4 inch long), from which the petals emerge. Approximately 20 thin veins run lengthwise along the calyx and 5 small teeth surround the opening. The calyx turns reddish as the flower matures.

Fruits & Seeds - A cylindrical to oblong, pointed seedpod is formed within the calyx, which disintegrates as the seedpod matures. Once mature, the seedpod splits open at the top, forming 4 teeth. Each seedpod contains numerous seeds (1/16 inch long), which are rough, dull black, flattened and kidney-shaped.

Similar Species: White campion (Silene pratensis) can be distinguished from bouncingbet by its hairy stems and leaves. Bladder campion (Silene vulgaris) can be distinguished by its deeply lobed flower petals and papery, bladder-like calyx. In addition, white campion and bladder campion do not grow in large, dense patches like bouncingbet.

Biology: Flowering occurs from July to September. Flowers have a sweet fragrance that tends to get stronger after dusk, attracting night moths for pollination.
Bouncingbet often forms large dense colonies. For small areas, hand removal is the best method of control. For large areas, repeated mowing just before the plants begin to flower can provide reasonable control.

Toxicity: The soap like action of bouncingbet when crushed in water is attributed to natural chemicals called saponins (types of glycosides) that are poisonous to livestock and humans. All parts of the plant are toxic, especially the seeds and roots. Ingestion of bouncingbet may cause severe gastrointestinal irritation, and lead to destruction of red blood cells if the saponins are absorbed in the bloodstream. Signs of poisoning include vomiting, abdominal pain and diarrhea. Animals usually avoid eating bouncingbet because of its bitter taste. Poisonings most often occur when prepared feeds are contaminated with bouncingbet seeds or foliage (the toxic properties remain in dried plant material).

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Brackenfern *Pteridium aquilinum*

Family: Fern Family (Polypodiaceae)
Other Names: Pteris aquilina, bracken, brake, female fern, fiddlehead, hog brake, pasture-brake.
Origin and Distribution: Brackenfern is a native species common throughout northeastern and central North America. It occurs in many habitats, including full sun, partial shade, woods, old pastures, roadsides and thickets, preferring acidic soils. Unlike most ferns, brackenfern is less common in rich, moist, limey areas, and thus is an indicator of poor soil.

Plant Description: Brackenfern is a large, coarse, perennial fern that has almost horizontal leaves and can grow 1 1/2 to 6 1/2 feet tall (sometimes up to 10 feet). Unlike our more typical broadleaf perennials, this primitive perennial lacks true stems. Each leaf arises directly from a rhizome (horizontal underground stem), and is supported on a rigid leaf stalk. In addition, brackenfern does not produce flowers or seeds. Instead, it reproduces by spores and creeping rhizomes. This species often forms large colonies.
Root system - The black, scaly, creeping rhizomes (horizontal underground stems) are 1/2 inch thick, and can grow as much as 20 feet long and 10 feet deep. Stout, black, wide-spreading roots grow sparsely along the rhizomes.
Seedlings & Shoots - The curled leaves (fiddleheads) emerging from rhizomes in the spring is covered with silvery gray hair.
Stems - The leaf stalk (not a true stem) is tall (about the same length as the leaf), smooth, rigid and grooved in front. It is green when young, but turns dark brown later in the season.
Leaves - The leaf stalk supports a broad (3 feet long, 3 feet wide), triangular, dark green, leathery, coarse-textured leaf that often bends nearly horizontal. The leaf is divided into 3 parts, 1 terminal and 2 opposite. Each of the leaf parts is triangular and composed of numerous oblong, pointed leaflets, which are in turn composed of narrow, blunt-tipped subleaflets.
Flowers - None.
Fruits & Seeds - A continuous line of spore cases (spore-producing structures) is formed along the underside edge of leaflets, but the spore cases are partially or completely covered by inrolled leaf margins and are difficult to see. Spore cases produce minute, brown spores.

Similar Species: None.

Biology: Spores of brackenfern are produced August through September. Brackenfern is one of the earliest ferns to appear in spring or after a fire. It sometimes forms large colonies of nearly solid stands. In the fall, it is one of the first plants to be killed by frost, resulting in large patches of crisp, brown foliage. Brackenfern is resistant to many herbicides and is tolerant of various forms of mechanical control. However, effective control has been obtained by repeated removal of aboveground growth, which eventually exhausts the food reserves in the rhizomes.

Brambles *Rubus spp.*

Family: Rose Family (Rosaceae)
Other Names: blackberry, briars, dewberry, raspberry.
Origin and Distribution: The term 'brambles' is used as a generic name referring to the numerous blackberry, dewberry, raspberry and other Rubus species that grow as weeds. Brambles are native to North America and can be found throughout the northeastern U.S. Dense thickets of brambles are often seen at forest edges and can also be found in abandoned fields, pastures, and roadsides. Brambles have become increasingly common in reduced tillage, where they compete with crops and interfere with harvest.

Plant Description: Brambles are a diverse group of perennial herbs, shrubs or trailing vines, that are noted for their prickly stems and berry-like, usually edible fruits. They can reproduce by many different methods including seeds, root sprouts, underground stems (rhizomes), and branches that root at the tips (stolons). In some species, individual stems live only two years, but new stems are continually produced. In all species, roots are perennial.
Root system - The root system is usually very extensive, and many species form underground stems (rhizomes). Roots can live for many years.
Stems - Stems may be upright, arching, or trailing along the ground. Those that arch to the ground can root at their tips. Stems are red or green and often prickly, and can vary from smooth to hairy. The prickles on the stems can be few or numerous, and can range from semi-soft bristles to hard, stout thorns. For shrubby species, stems live for two years – stems are vegetative during the first year of growth, they branch, flower and bear fruit during the second year, and then die after the second year.
Leaves - Leaves are alternate (one per node) and composed of 3 to 5 (sometimes 7) toothed leaflets. Specific features of the leaflets (shape, number of lobes, presence of hairs, etc.) vary with species. For shrubby species, leaves on one-year-old stems often have 5 leaflets, while those on two-year old stems often have 3 leaflets. Leaflet shape may also differ between the one-year-old and two-year-old stems.
Flowers - Flowers typically have 5 white petals and are approximately 1 inch in diameter.
Fruits & Seeds - Fruits vary in color from black to purple to red, and can be round, cylindrical, or gumdrop-shaped. Each fruit is composed of many small, round, fleshy segments. Fruits are often edible.

Similar Species: Roses (Rosa spp.), in general, can be distinguished from brambles by their perennial stems, which can live for many years. Multiflora rose (Rosa multiflora), a shrubby, invasive rose with prickly, arching stems and white flowers, can be confused with brambles. However, the leaves of multiflora rose are composed of 7 to 9 leaflets, and its smooth, red, oval fruits ('rosehips') are not composed of many small, fleshy divisions like those of brambles.

Biology: Some species begin flowering in June. Seeds are generally short-lived and have low viability. Seed survival is favored by low levels of soil disturbance and residue cover. Brambles do not tolerate mowing, especially when stems are soft.

Toxicity: None known.

Related Information:

- ✓ The word 'bramble' was derived from 'brambel' or 'brymbyl', both of which mean prickly.
- ✓ A study of bramble-infested areas showed that goats were more effective than sheep or cattle at controlling brambles. The thorny vegetation did not deter goats, which reduced bramble populations after one season and nearly eliminated them after two seasons. In areas grazed by goats, grass, clover, and alfalfa increased, while in areas grazed by cattle and sheep, bull thistle and Canada thistle became more common.
- ✓ Bramble fruits are often used to enhance the flavor of red wine, brandy, and rum.
- ✓ Fruits are used as a decoction for bowel complaints, and leaves are used as an astringent.
- ✓ Brambles can be useful in controlling soil erosion, and provide food and cover for many species of wildlife.

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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.

Broadleaf Plantain *Plantago major*

Broadleaf Plantain *Plantago major*

Broadleaf Plantain is a low growing perennial. It has broad leaves with prominent veins. The leaves are arranged in a rosette and may smother lawn grass. The flowering spikes normally grow taller than the foliage but may develop below mowing height. Vigorous, thick turfgrass is less susceptible to invasion.

Control Triclopyr + 2,4-D or 2,4-D alone or 2,4-D combination herbicides should control plantain. Always read the label before applying any pesticide.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:

- Elimination of weed debris
- Control of annual weeds
- Suppression of perennial weeds
- Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

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Brome, Smooth *Bromus inermis*

Family: Grass Family (Gramineae)
Other Names: Austrian brome, brome, bromegrass, Hungarian brome, Russian brome, smooth bromegrass.

Origin and Distribution: Smooth brome was introduced as a forage grass into California from Europe in the early 1880's. It is still cultivated in some parts of the U.S., and has become naturalized in the northern half of the country, as well as in southern Canada. It is relatively common, and can be found in fields, waste places and roadsides. Smooth brome tolerates drought and extreme temperatures, and can grow in a variety of soil types, preferring well-drained, fertile soils.

Plant Description: Smooth brome is a sod-forming, perennial grass, distinguished by long, slender, bronze- or purple-tinted flower clusters that make up the flower head. This species spreads by seeds and dark-colored rhizomes (horizontal underground stems).
Root system - Smooth brome forms an extensive underground system of rhizomes (horizontal underground stems) and roots. Rhizomes are covered with a dark brown to black, scaly sheath. Roots are produced at the joints (nodes) of the rhizomes.
Stems - Stems are erect, leafy, round, and mostly smooth, and can grow 1 to 3 1/2 feet tall (sometimes up to 5 feet).
Leaves - Leaves are rolled in the bud. The LEAF BLADE (free part of the leaf) is 4 to 16 inches long and 1/5 to 1/2 inch wide. Blades are generally smooth, flat and pointed, with rough margins. Some blades have a light green mark in the shape of a "W" near the middle. Blades tend to point upwards. The LEAF SHEATH (part of the leaf surrounding the stem) is round and usually smooth. Margins of the sheath are fused except for a notch at the top. The ligule (projection on the inside of the leaf at the junction of the blade and sheath) is membranous and relatively short (1/32 to 1/16 inch). AURICLES (appendages at the top of the sheath) are usually absent, but if present, are very short (1/50 inch long) and rounded.
Flowers - Flowers occur in smooth, slender clusters within a branched flower head, 4 to 8 inches long, at the top of the stem. Branches of the flower head are spreading when young, but become erect and aligned with the stem at maturity. Each flower cluster is approximately 1 inch long, and may be tinged with bronze or purple.
Fruits & Seeds - Seeds are 3/8 inch long, narrow and golden or tan.

Similar Species: Smooth brome may be confused with quackgrass (Elytrigia repens). However, smooth brome lacks the prominent claw-like appendages (auricles) that clasp the stem at the top of the sheath in quackgrass.

Biology: Smooth brome flowers from late May to September. It produces a prolific amount of seed, which can be spread by wind, water, birds and mammals. Evidence shows that seeds can survive passage through the digestive tract of animals. This species can also spread rapidly through rhizome production.

Smooth brome is extensively used as a forage grass, because it produces large amounts of high quality forage early and late in the season, and it resists trampling. This species is also planted along roads and banks to control erosion. Problems occur when the grass spreads from desired areas or persists after cultivation, sometimes overrunning fields, lawns and even woods. Smooth brome is also threatening native grassland and wooded habitats, especially in Canada.

Broom, French *Genista monspessulana* (L.) L.Johnson)

USDA Symbol: GEMO2

Description: Perennial; blooms April to June. Grows three to ten feet tall. Evergreen shrub similar to Scotch broom except plants do not grow as erect, leaves are retained the entire year, leaves trifoliate and more numerous, and yellow flowers smaller.

Impacts: This plant, an aggressive pioneer species, takes advantage of land disturbances to establish and spread. In California, large infestations displace native plant species and significantly increase the costs of reforestation in commercial timberlands. During the dry summer months, thick stands create a severe fire hazard by providing an avenue for ground fire to reach into forest canopies and spread. Annual costs for right-of-way maintenance on roadways, power lines, and private property reach millions of dollars a year because of the persistent nature of this species. The brooms are also unpalatable to most livestock, and anecdotal evidence indicates that they may be slightly toxic.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
• Elimination of weed debris
• Control of annual weeds
• Suppression of perennial weeds
• Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

Broom, Portuguese Cytisus striatus

USDA Symbol: CYST7

Other common names: striated broom and hairy-fruited broom.
Description: Perennial; blooms April to June. Grows 3 to 10 ft. tall. Evergreen shrub similar to Scotch broom except pods inflated and hairy all over, giving appearance of pussy willow buds. Stems more silvery, but difficult to distinguish until leaves and flowers fall off.

Impacts: Portuguese broom is similar to Scotch broom in growth form except for two major differences: it grows much larger and lives longer.

Introduction: Native to Europe, Portuguese broom was introduced to North America for landscaping and soil stabilization uses.

Broom, Scotch *Cytisus scoparius*

USDA Symbol: CYSC4

Description: Perennial; blooms April to June. Grows 3 to 10 feet tall. Evergreen shrub with many slender, erect, dark green angled branches with small, simple leaves. Abundant small, yellow, pea-shaped flowers. Easily confused with Spanish broom. Spanish broom (S. Junceum) has round stems, very few leaves, and larger yellow flowers.

Impacts: Scotch broom is a pioneer species known to displace native plant species and increase the costs of timber production. It readily invades disturbed sites, natural areas, dunes and public and private forest lands. Maintenance of rights-of-way, facilities, parkland and private property costs millions of dollars each year because of rapid growth of young plants and the plant's persistent nature.

Seeds of Scotch broom are long-lived (50 years plus) and mature plants are prolific seed producers, establishing persistent seed banks requiring long-term management objectives. The largest costs attributed to scotch broom come from additional inputs needed to establish trees in commercial and public timberlands.

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Broom, Spanish *Spartium junceum*

USDA Symbol: SPJU2

Description: Perennial; blooms April to June. Grows 3 to 10 ft. tall. Similar to Scotch broom except stems thicker and rougher, it has very few leaves, and flowers larger and fewer in number.

Impacts: The least abundant of weedy brooms in Oregon, Spanish broom is adapted to dryer sites where its lack of leaves and thick waxy stems resist desiccation. Like other broom species, it offers strong competition to other plants and contributes to increased maintenance costs on lands where it becomes established. Dry summer plants create a severe fire hazard. Just like other brooms, Spanish broom is unpalatable to most livestock. Seeds can remain viable in soil for more than 80 years.

Introduction: Spanish broom is a native of the Mediterranean regions. It was sold as an ornamental in California in the mid-1800s.

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Broomsedge *Andropogon virginicus*

Family: Grass Family (Gramineae)
Other Names: beard grass, broomsedge bluestem, sedge grass, whiskey grass.
Origin and Distribution: Broomsedge is a native North American grass species that occurs primarily in the eastern half of the U.S. and California. It is found in dry meadows, pastures, fields, roadsides, waste places and other areas with low-fertility soils.

Plant Description: Broomsedge is a clump-forming perennial grass that is most noticeable in the fall, when its stems and leaves turn a distinctive orangish-tan to reddish-brown color. It reproduces by seed and short rhizomes (horizontal underground stems).
Root system - Dense, fibrous roots are produced from short rhizomes (horizontal underground stems).
Stems - The smooth, erect, slightly flattened stems are 1 to 4 feet tall (sometimes up to 5 feet) and branched in the upper part. Unlike the hollow stems of most grass species, stems of broomsedge are filled with a white pith. Stems become stiff with age.
Leaves - Leaves are folded in the bud. Mature leaves often have a whitish or bluish cast. The LEAF BLADE (free part of the leaf) is 6 to 12 inches long (sometimes up to 16 inches), 1/12 to 1/3 inch wide, and has rough margins. The base of the blade (where it attaches to the stem) is folded and covered with coarse, stiff hairs. The LEAF SHEATH (part of the leaf surrounding the stem) is smooth and flattened, with a distinct fold (especially the lower sheaths). Sheath margins may or may not have hairs. The ligule (projection on the inside of the leaf at the junction of the blade and sheath) is short (up to 1/32 inch long), membranous and fringed with hairs. AURICLES (appendages at the top of the sheath) are absent.
Flowers - Each flower head is composed of 2 to 4 unbranched flower stalks (3/4 to 1 1/2 inches long). Flower stalks originate from the sheaths of upper leaves and remain partially tucked within the leaves. Flowers are arranged in clusters along the flower stalks, and are surrounded by long, silky, white hairs, giving them a feathery appearance.
Fruits & Seeds - Seeds are yellowish-green to brown, linear, flattened on one side, and bearded with silky white hairs. The seeds are approximately 1/16 to 1/8 inch long, with long awns (bristles) 1 to 1 1/2 inches long.

Similar Species: Little bluestem (Andropogon scoparius), a characteristic prairie species, closely resembles broomsedge, but its longer flower stalks hold the flowers completely free of the upper leaves. In addition, little bluestem flower stalks occur singly, rather than in groups of 2 to 4 like broomsedge.

Biology: Flowering occurs between July and September. Broomsedge clumps turn a distinctive orangish-tan to reddish-brown color when dry, and persist into winter.

Toxicity: None known.

Related Information:

- ✓ Broomsedge is a poor forage grass, and is common on overgrazed pastures, especially where soil pH and fertility are low.

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Buffalo Bur *Solanum rostratum*

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Buffalo bur, sometimes called Kansas thistle and prickly nightshade, is a tap rooted annual weed. It bears long, yellow spines on stems, leaves, and flower heads and can grow up to 2 feet high. Drought resistant, its highest occurrence is in dry, exposed soil. The oblong leaves are 2-3 inches long with deep rounded lobes and are covered with very dense, stiff, and sharp spines. Bright yellow flowers can be seen in summer. In the fall, berries up to 3/8 inch in diameter are enclosed in the dried flower parts and are filled with black, wrinkled, flat pitted seeds. Control of this plant is important, as it is a host for the Colorado potato beetle. When mature, the main stem breaks near the ground and the plant rolls like tumbleweed, widely scattering the 8500 seeds that each plant produces. Buffalo bur can be pulled when the soil is moist. Be sure to wear gloves to avoid injury from the spines.
Control Herbicides should be applied between late bud to early flower. Dicamba, Triclopyr and 2,4-D can be effective in controlling Buffalo bur. Glyphosate in a 2% solution can be applied as a spot treatment.

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Control

Herbicides should be applied between late bud to early flower. Dicamba, Triclopyr and 2,4-D can be effective in controlling Buffalo bur. Glyphosate in a 2% solution can be applied as a spot treatment.

Butterfly Bush *Buddleja davidii*

USDA Symbol: BUDA2

Other common names: summer lilac

Description: Perennial shrub; flowers mid to late summer. Grows up to 10 feet tall. Leaves narrow, opposite and green to blue-gray. Flower heads lilac-like but come to a more definite point. Flowers small and purple.

Impacts: This plant is a pioneering species that dominates open habitats. It poses an ecological threat to dry-land meadows, open slopes and dunes, dominating these sites as much as Scotch broom has historically. It also invades reforested sites, resulting in a loss of forest productivity.

Introduction: Butterfly bush is native to northwestern China and Japan.

Bugloss, Common *Anchusa officinalis*

USDA Symbol: ANOF

Other common names: Common anchusa, alkanet, bee bread, ox's tongue, starflower, common borage, orchanet, Spanish bugloss, enchusa, lingua bovina, and blue bugloss.

Description: Perennial herb; flowers May to October. Grows one to two feet tall. Stems and leaves fleshy; overall plant is coarsely hairy. Basal leaves are narrowly oblong; mid leaves are progressively smaller up the stem, and the upper leaves are sessile (no petiole) or clasping. Blue to purple flowers with white throats. Petals are five equal lobes, forming an uncurved tube. Flowers found in coiled clusters at the end of stems. As the flowers open, coils unfold. Fruit is a four-chambered nutlet; each nutlet contains one seed.

Impacts: This plant invades alfalfa fields, pastures, pine forests, rangeland, riparian and waste areas. The fleshy stalks can cause hay bales to mold. Large, very dense stands can occur, offering strong competition to native plant communities.

Introduction: Common bugloss originated in the Mediterranean. It was cultivated in medieval gardens and is now naturalized all over Europe and in much of eastern North America. It's considered invasive in the Pacific Northwest. This herb has numerous medicinal uses as well as a dyeplant.

Bull Thistle *Cirsium vulgare (Savi) Tenore*

Asteraceae (Sunflower family)
Origin: Eurasia, Northern Africa
Location: lawns, roadsides, waste areas, waterways, cropland, pastures, overgrazed rangeland, woodland, and grassland.

Occurrence: The majority of bull thistle seeds germinate in late summer or early autumn, although occasionally seeds will germinate in spring. Seedlings form a rosette which often grows slowly throughout winter and develops a sturdy tap root. In the second year, a flowering stalk is produced by early summer. Flowering generally occurs from mid-to-late summer, followed closely by seed production. The plant then dies and turns brown and brittle.

Description: An upright biennial. Young seedling leaves are oblong in shape, but mature rosette leaves are saw-toothed and spiny with cottony hairs on the undersurface. Rosette leaves generally grow 2 - 12 inches long and 3/4 - 4 inches wide. Leaves are dark green and are arranged alternately along the rigid flower stalk, that grows 1 - 5 feet tall and can be highly branched. Stem leaves have distinctly pointed, spine-tipped lobes, with bases that clasp the stem to form spiny wings. Purplish/pink flower heads, 1 to 2 inches diameter, are borne on branch tips, and are subtended by an egg-shaped cluster of spiny bracts. Flower heads give rise to seed heads that contain many single-seeded fruits, each topped by a plume of feathery white hairs.

Weedy Characteristics: Bull thistle reproduces solely by seed. Each plant can produce between one and several hundred seed heads, and seed heads produce an average of 100 seeds each. Seeds are dispersed by wind and water, animals, vehicles or farm equipment, and as a contaminant in hay. Some seeds can remain viable in the soil for up to 5 years.

Control: Bull thistle is favored by open, disturbed ground, and heavily used areas. It does not tolerate shade or competition well. Maintaining healthy, vigorous, desirable vegetation with little to no bare soil will discourage bull thistle establishment.

Preventing seed production is important, and tilling, hoeing, digging, or hand-pulling (with gloves) are effective methods of control, especially before a flower stalk is produced. When complete removal cannot be achieved, the root can be severed below the soil surface. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Bull thistle has formidable armor, but is nonetheless edible, once spines are removed. Roots, leaves and young stems can be cooked, and flower heads can be eaten fresh. The plant has also been used for various medicinal purposes. Many insects visit bull thistle flowers, and rodents and birds eat its seeds. However, bull thistle is known to host viral and fungal diseases that can affect crops and ornamentals. Its physical presence in crops can reduce crop yield and quality, and its seed can be a troublesome contaminant in pasture grass seed. Most grazing animals avoid bull thistles, and when present in significant numbers in pastures, it can displace desirable plants and cause animal weight loss. Bull thistle is legally noxious in nine U.S. states, in Manitoba and Ontario, Canada, and is invasive in several other U.S. states.

Other Common Names: common thistle, spear thistle

Burdock, Common *Arctium minus*

Family: Daisy Family (Compositae)
Other Names: Lappa minor, bardane, beggar's buttons, beggar's lice, burdock, burs, clotbur, cockle-button, cockleburs, cuckold dock, cuckoo-button, hardock, hurr bur, lappa, lesser burdock, love leaves, personata, petite bardane, smaller burdock, stick button, sticktight, thorny bur, wild burdock, wild rhubarb.
Origin and Distribution: Common burdock originated in Europe and was likely brought to North America by early French and English colonists. By 1663, it was so widespread in the U.S. that a botanist mistakenly referred to it as a native species. Common burdock can be found throughout the U.S., with the exception of a few states along the southern border, and in southern Canada. Common burdock grows in a wide range of soils from sandy clay to moist loam. The species prefers nitrogen-rich soils.

Plant Description: Common burdock is a biennial that grows as a rosette of leaves the first year and then produces a 5-foot-tall, erect, bushy flowering stem. Rosette leaves are distinctive due to their large size, heart-shaped base, wooly undersurface, and hollow leaf stalks (petioles). Stem leaves are similar to but smaller than rosette leaves. Located at the ends of branches or at leaf axils on the flower stem are flower heads comprised of a bur with hooked bristles beneath a closely packed cluster of tubular, purplish flowers. The weed is best known for the hooked bristles on its burs that stick to fur and clothing. The only means by which common burdock reproduces are its seeds.
Root system - The root system is a very large, thick, fleshy taproot that has a brown, corky, shredded surface.
Seedlings & Shoots - First to emerge are two leaves (cotyledons) that are large, spoon-shaped, and have a waxy surface. Subsequent leaves are alternate, egg-shaped, flocked with short hairs, puckered between the veins, and bitter tasting. Attached to each leaf is a flared stalk (petiole) that clasps the basal stem of the rosette.
Stems - During the rosette stage of growth, the stem remains compressed and close to the soil surface. As flowering is initiated, the stem elongates producing an erect flower stem that is 2- to 6-feet tall, much-branched, rough-hairy, hollow, and grooved lengthwise or angular.
Leaves - The large rosette leaves are 20 inches long, 12 inches wide, and attached to the stem by way of hollow petioles that may be purple-tinged. The upper leaf surface is dark green and coarse while the underside is pale gray-green and wooly. Rosette leaves have a heart-shaped base and wavy edges. Stem leaves are alternate (1 leaf per node). Lower stem leaves resemble rosette leaves except they are smaller. Leaves gradually become smaller, less heart-shaped, and tapered at both ends as their location progresses up toward the tip of the stem. Also, their petioles become shorter and solid rather than hollow.
Flowers - Each flower head consists of bristles with hooked tips that form a round, 3/4-inch-wide bur beneath a closely packed cluster of many individual, tube-shaped, reddish-purple flowers. Flowers appear alone or grouped on short stalks attached to the end of main branches or at leaf axils on the stem.
Fruits & Seeds - In each bur are many single-seeded, 1/4-inch-long, brown, oblong, angular fruits having a short, stiff bristle at one end.

Similar Species: Cotyledons of common burdock and giant ragweed (Ambrosia trifida) are similar, but giant ragweed cotyledons are smaller. As young seedlings, broadleaf dock (Rumex obtusifolius) and curly dock (Rumex crispus) can be confused with common burdock except they do not have hairs on the underside of the leaves. As a rosette, common burdock resembles cultivated rhubarb (Rheum rhabarbarum), but the leaves of rhubarb do not have wooly undersides and its petioles are solid and tinged red. Common burdock flowers are similar to those of bull thistle (Cirsium vulgare), but bull thistle stems and leaves have spines and its leaves are deeply lobed. Great burdock (Arctium lappa) is similar in appearance to common burdock except it grows to 9 feet tall, has larger flower heads arranged in flat-topped clusters, and the petioles of its rosette leaves are not hollow.

Biology: During the first year, common burdock grows slowly and it is not uncommon for a rosette to consist of only a couple of leaves. Rosette leaves die over winter, so new basal leaves form in spring. Flowering stems emerge in June. Flowers form from July to October. Plants usually flower during the second year, but sometimes the flowers do not emerge until the third or fourth year of growth. When burs dry, their hooked bristles attach to fur or clothing and the bur separates from the plant thereby dispersing its seeds. Dispersal of burs and seeds begins in September and continues throughout winter and into the following spring. A single plant produces 15,000 seeds on average, but yields of 200,000 to 400,000 seeds have been reported. Common burdock is associated with several microorganisms that cause powdery mildew (infects cucurbits and composites like lettuce, sunflower, and Chrysanthemum) and root rots (infecting many species including cotton and sugarbeets). The plant does not tolerate frequent cultivation.

Toxicity: Common burdock is considered toxic due to potential diuretic effects, and there are reports of allergic reactions when the hooked bristles of burs lodge under the surface of the skin.

Related Information:

- ✓ The genus name Arctium was derived from the Greek word for 'bear' and likely refers to the scruffy, brown look of the burs.
- ✓ Common burdock fruit and roots were used to treat a variety of ailments ranging from coughs asthma, venereal diseases, rheumatism, lung and skin diseases, and scurvy.
- ✓ Velcro was inspired by the tiny hooks on the burs of this plant that stick to fur and clothing, similar to the sticky side of Velcro.
- ✓ Burs often stick to sheep reducing the value of the wool.
- ✓ The foliage can give milk a bitter taste if eaten in large enough quantities by cattle.
- ✓ Common burdock is reported to have a high mineral and vitamin content and is commonly found in health food stores in pill form.
- ✓ Native Americans used burdock roots as food in winter. The root of a related burdock species is widely cultivated in Japan as a vegetable and is known as 'gobo'.

Buttercup, Creeping *Ranunculus repens*

Family: Buttercup Family (Ranunculaceae)
Other Names: creeping crowfoot.
Origin and Distribution: Since its introduction from Europe, creeping buttercup has spread throughout the northern U.S. and Canada, and is especially abundant in the Pacific Northwest. This weed is found in poorly drained areas including marshes, meadows, pastures, roadsides, and lawns, and in disturbed sites such as gardens and fields used to grow grains or forages. Creeping buttercup grows well in heavy clay and muck soils, but can thrive in sand or gravel if moist. It is rarely encountered on light, well-drained soil.

Identification

- ✓ Perennial with short swollen stems and creeping stolons that root at the nodes
- ✓ Can be distinguished from other buttercup species such as tall buttercup (*Ranunculus acris*) by the creeping stolons
- ✓ Can grow up to one foot tall but are often shorter in mowed areas
- ✓ Leaves are dark green with light patches and are divided into three toothed leaflets, the central leaflet on a stalk
- ✓ Pale patches on the leaves distinguish creeping buttercup from similar looking plants such as hardy geraniums
- ✓ Basal leaves have long petioles (stalks), leaves higher up the plant have shorter or no petioles
- ✓ Leaves and stems are somewhat hairy
- ✓ Flowers usually have five (sometimes ten) glossy, bright yellow petals and grow singly on long grooved stalks
- ✓ Bloom time is usually from March to August
- ✓ Fruits are clusters of 20-50 achenes on globe-shaped heads. Achenes have a short hooked beak and are light brown to blackish brown when mature with an unevenly pitted surface

Plant Description: Creeping buttercup is a low-growing, rosette-forming, spreading perennial. It is characterized by 3-parted leaves and creeping horizontal stems (stolons) that root at the nodes to form new rosettes. This species reproduces primarily by stolons, but can also reproduce by seeds. Because of its spreading, strawberry-like growth habit, creeping buttercup can rapidly form large patches.
Root system - Many stout roots are produced by the rosette. Roots can form at the nodes of horizontal stems (stolons).
Seedlings & Shoots - The 2 seed leaves (cotyledons) are smooth, dark green, and oblong. The true leaves of young plants are triangular and shallowly lobed, and form a rosette.
Stems - Tough, non-flowering stems grow horizontally along the ground. Flowering stems grow upright (1/2 to 1 foot tall, sometimes up to 2 feet). Both stem types are usually notably hairy, but can sometimes vary from smooth to only somewhat hairy.
Leaves - Leaves are alternate (1 per node), hairy, and dark green, sometimes with pale spots. They are borne on long, hairy leaf stalks (1/2 to 10 inches long). Leaves are triangular or heart-shaped in general outline (1/2 to 2 1/2 inches long, 3/4 to 3 inches wide), and are divided into 3 segments like a three-leaf clover. Each segment is deeply lobed and toothed. The middle leaf segment has a distinct stalk, while the 2 side segments may or may not have a short stalk. Leaves in the upper portion of flower stems attach directly to the stem, and tend to be narrow and unlobed.

Flowers - Showy, 1-inch wide flowers are produced singly or sometimes in clusters along an erect flowering stem. Each flower is borne on a long, hairy stalk (3/4 to 4 inches long), and is composed of 5 to 7 petals. Petals are glossy yellow, wedge-shaped and about 1/2 inch long. Directly below the petals are 5 hairy, green floral leaves (sepals) that are much shorter than the petals.
Fruits & Seeds - Seeds are produced in a spherical seedhead. Each seedhead is composed of 20 to 50 seeds. Seeds are light to dark brown, flattened, egg-shaped in outline, and 1/8 inch long, with a short hooked tip.

Similar Species: Creeping buttercup may be confused with other buttercup species. Tall buttercup (Ranunculus acris) can be distinguished from creeping buttercup by its upright growth habit. In addition, the leaves of tall buttercup are deeply lobed and toothed, but are not divided into 3 distinct segments like the leaves of creeping buttercup. Bulbous buttercup (Ranunculus bulbosus), a perennial, has 3-parted leaves like creeping buttercup, but has an erect growth habit. In addition, the stem of bulbous buttercup is swollen at the soil surface to form a bulb-like base and the sepals below the flowers droop towards the stem. Smallflower buttercup (Ranunculus abortivus) is an annual or biennial, and can be distinguished from creeping buttercup by its erect growth habit, much smaller flowers, smooth leaves and stems, drooping sepals, and very shallowly lobed basal leaves.

Biology: Creeping buttercup overwinters as a rosette or seed. In the spring, overwintered rosettes produce new leaves, and seeds may germinate. Horizontal creeping stems (stolons) develop from leaf axils. Stolons root at the nodes to form new rosettes that are genetically identical to the parent. Stolon development continues throughout the summer, but by late summer or early fall, the stolons connecting parent and daughter rosettes wither. Because of this growth habit, creeping buttercup can rapidly spread to form large patches.

Flowering occurs from April to August. One to five glossy, golden yellow flowers are produced on an erect flower stem. Flowers are pollinated by a wide variety of insects, and 20 to 50 single-seeded fruits are produced in a spherical seed head. These seeds are spread by wind, birds, rodents and humans. Seeds can remain viable in the seedbank for several years and tend to be highly dormant, with only a few seeds germinating in a given spring.

Because of its low growth form, creeping buttercup escapes control by mowing. However, established plants can be controlled by repeated tillage. This species persists in no-till and perennial crops such as strawberry and asparagus. Its growth habit and flowering pattern resemble that of strawberry, a crop in which it is particularly troublesome.

Toxicity: Creeping buttercup contains a bitter, irritating oil called protoanemonin that is toxic to grazing livestock (especially cattle). Toxicity varies with plant age, growing conditions, and freshness of foliage. The toxic oil is released when fresh leaves and stems are grazed, causing irritation to the skin and the lining of the mouth and digestive tract. In severe cases, gastric irritation progresses to paralysis, convulsions, and death. Because the fresh foliage of creeping buttercup is distasteful, animals tend to avoid it if better forage is available. The toxic oil evaporates quickly, so hay containing dried buttercup foliage is not harmful.

Related Information:

- ✓ The common name 'buttercup' was derived from the golden yellow color of the flower.
- ✓ The common name 'crowfoot' refers to the resemblance of the leaf to a large bird’s foot.
- ✓ The genus name, Ranunculus, means 'little frog', and likely refers to the plant's affinity for bogs and other moist places.

Control
Be sure to have a long-term plan to ensure success, protect native and beneficial species while doing the control, and start in the least infested areas first and then move into the more heavily infested areas.

Prevention and cultural control

- ✓ In lawns and pastures, promote healthy grass by overseeding, fertilizing as needed, and not over-grazing. Adding lime can improve grass health and keep buttercup from re-establishing. However, lime won't control buttercup that is already well-established.

- ✓ It also helps to improve soil drainage. Reduce compaction by aerating and avoid trampling when soils are wet.

- ✓ Clean mowers and other equipment to avoid spreading buttercup seeds to un-infested areas.

Manual
Dig out with a sharp trowel or fork-type tool, removing all of the runners, roots and growing points. Digging is most effective from fall to spring while the soil is moist and roots won't break off as much.
Cultivating or incomplete digging may increase the buttercup population because it can sprout from nodes along stem and root fragments.
Disturbance of the soil can increase seed germination. Seeds stay viable for 20 years or more and the number of seeds in infested soils can be immense compared to the number of plants present, especially in long-term pastures and woodland ecosystems.

Mechanical
Creeping buttercup's growing point is at soil level, so plants resist mowing and quickly re-sprout when cut.

Regular cultivation can kill the buttercup but plants buried by cultivation can grow back up through deep soil and re-establish themselves and long-lived seeds in the soil can germinate and re-infest the area once cultivation ceases.

Chemical
Herbicides can be used if allowed and appropriate for the site and land use. Follow all label directions to ensure safe and effective use.

Glyphosate (e.g. Roundup, Aquamaster) can be applied to actively growing plants before they seed. Keep spray off of grass and other plants. Re-seed or re-plant bare areas after removing buttercup to keep it from re-infesting the area.

Broadleaf herbicides can be applied over grassy areas infested with creeping buttercup to selectively kill the buttercup and not the grass. Products containing the active ingredient MCPA are most effective on buttercup. Metsulfuron (Escort, Ally) is also effective but can harm some grasses. Follow label directions on timing and rates.

It will probably take at least two or three applications to eradicate creeping buttercup because of the seed bank and because some mature plants will generally recover.

Monitor the treated area for re-growth and pull up any new seedlings before they establish runners.

Buttercup, Tall *Ranunculus acris*

Family: Buttercup Family (Ranunculaceae)
Other Names: blister plant, butter flower, butterrose, common buttercup, crazy weed, field buttercup, gold cup, meadow buttercup, tall crowfoot, tall field buttercup, upright meadow crowfoot.
Origin and Distribution: Since its introduction from Eurasia, tall buttercup has become widespread throughout the U.S., excluding an area between central Montana and eastern Minnesota. It can be found in a variety of habitats, including wet lowlands and rich woodlands and is a common weed in pastures, meadows, and along roadsides. It usually does not persist in cultivated fields. Tall buttercup prefers heavy, moist soils.

Plant Description: Tall buttercup is a perennial weed characterized by erect stems and deeply lobed leaves. This species reproduces only by seeds.
Root system - Tall buttercup produces a short, thick rootstalk with many fibrous, coarse, spreading roots.
Seedlings & Shoots - The 2 seed leaves are egg-shaped (about 1/2 inch long) and have 3 to 5 noticeable veins. Young plants form a rosette. The first true leaves are hairy, round to heart-shaped in general outline, and shallowly lobed and toothed. True leaves have long leaf stalks that are hairy except at the base.
Stems - Stems are erect, hairy, branched in upper portion, and 1 to 3 1/2 feet tall. A single root crown generally produces several stems in a cluster.
Leaves - Leaves are produced both at the base of the plant and alternate (1 per node) along the stem. Leaves are softly hairy, triangular to round in general outline (1 to 4 inches wide), and deeply cut into 3 to 5 lobes. The lobes are coarsely toothed and radiate from a common point like fingers of a hand. Basal and lower stem leaves have long, hairy stalks and resemble middle leaves, which attach directly to the stem. Upper leaves are smaller and have fewer lobes and teeth.
Flowers - Flowers (1 inch wide) are borne on long stalks in branched clusters at the tops of stems. The 5 to 7 petals are glossy yellow (sometimes cream), and about 1/2 inch long. Directly below the petals are 5 hairy, green floral leaves (sepals) that are much shorter than the petals.
Fruits & Seeds - Numerous seeds are clustered in a round seedhead. Seeds are dark brown, flattened, egg-shaped in outline, and 1/8 inch long, with a short, slightly curved tip.

Similar Species: Tall buttercup may be confused with several other buttercup species. Creeping buttercup (Ranunculus repens) can be distinguished from tall buttercup by its distinctly 3-parted leaves, and horizontal growth habit with creeping stems that root at the nodes. Bulbous buttercup (Ranunculus bulbosus), an upright perennial, also has distinctly 3-parted leaves. In addition, the stem of bulbous buttercup is swollen at the soil surface to form a bulb-like base and the sepals below the flowers droop towards the stem. Smallflower buttercup (Ranunculus abortivus) is an upright annual or biennial, and can be distinguished from tall buttercup by its much smaller flowers, smooth leaves and stems, drooping sepals, and very shallowly lobed basal leaves.

Biology: Tall buttercup blooms from late May to September. Flowers are pollinated by a variety of insects. This weed will not survive cultivation and prefers moist soil conditions. Therefore, plowing a field or meadow and/or improving drainage in an area will help control the weed.

Impacts
Tall buttercup can dominate a pasture or meadow given the opportunity, especially with acid soils and/or over-grazing. It could hinder colonization by native species in a prairie or grassland habitat if it were allowed to invade and spread.

The main impact is to livestock. Fresh buttercup plants are toxic to grazing animals, who can suffer from salivation, skin irritation, blisters, abdominal distress, inflammation, and diarrhea. Fortunately, buttercup has a strong, bitter taste so animals generally try to avoid it if more palatable forage is available. Also, the toxin *protoanemonin* is not very stable and loses its potency when dry, so buttercup is not generally toxic in hay.

Unfortunately, livestock occasionally develop a taste for buttercup and consume fatal quantities. It is safest to keep populations of buttercup under control on grazed pastures and offer plenty of healthy forage.

Growth and reproduction
Tall buttercup spreads only by seed and is a short-lived perennial. It blooms from late May to September and is pollinated by a variety of insects. Seeds are dispersed by wind, birds, farm animals, small rodents, clothes and tires. Seed germination is usually in spring and generally requires open soil.
Tall buttercup can be found in a variety of habitats, including wet lowlands and rich woodlands and is a common weed in pastures, meadows, and along roadsides. It usually does not persist in cultivated fields. Tall buttercup prefers heavy, moist soils but can grow in sandy or gravelly soil is there is sufficient moisture available.

Control
Prevention and cultural control
In lawns and pastures, promote healthy grass by overseeding, fertilizing as needed, and not over-grazing. Adding lime can improve grass health and keep buttercup from re-establishing. However, lime won't control buttercup that is already well-established.

It also helps to improve soil drainage. Reduce compaction by aerating and avoid trampling when soils are wet.

Clean mowers and other equipment to avoid spreading buttercup seeds to un-infested areas.

Manual
Pull or dig up plants, removing all of the roots. Digging is most effective in the spring and early summer while the soil is moist and roots won't break off as much.
Disturbance of the soil can increase seed germination.

Mechanical
This weed will not survive cultivation so plowing a field or meadow will help control it.

Chemical
Herbicides can be used if allowed and appropriate for the site and land use. Follow all label directions to ensure safe and effective use.

Broadleaf herbicides can be applied over grassy areas infested with creeping buttercup to selectively kill the buttercup and not the grass. Products containing the active ingredient MCPA are most effective on buttercup. Metsulfuron (Escort, Ally) is also effective but can harm some grasses. Follow label directions on timing and rates.

Glyphosate (e.g. Roundup, Aquamaster) can be applied to actively growing plants before they seed. Keep spray off of grass and other plants. Re-seed or re-plant bare areas after removing buttercup to keep it from re-infesting the area.

It will probably take at least two or three applications to eradicate tall buttercup because of the seed bank and because some mature plants will generally recover.
Monitor the treated area for re-growth and pull up any new seedlings before they establish runners.

Toxicity: Tall buttercup contains a bitter, irritating oil called protoanemonin that is toxic to grazing livestock and other animals (especially cattle). Toxicity varies with plant age, growing conditions, and freshness of foliage. The toxic oil is released when fresh leaves and stems are grazed, causing irritation and blistering of the skin and the lining of the mouth and digestive tract. In severe cases, gastric irritation progresses to paralysis, convulsions, and death. Because the fresh foliage of tall buttercup is distasteful, animals tend to avoid it if better forage is available. The toxic oil evaporates quickly, so hay containing dried buttercup foliage is not harmful.

Related Information:

- ✓ The common name 'buttercup' was derived from the yellow color of the flower. It was also believed that the richness of butter's yellow color was the result of the number of buttercups in the pasture; however, this was only a myth since tall buttercup is so bitter that cattle avoid eating it.
- ✓ The common name 'crowfoot' refers to the resemblance of the leaf to the foot of a large bird.
- ✓ The common name 'blister plant' comes from the blistering that occurs in the mouth and intestinal tract when cattle eat the plant.
- ✓ The genus name, Ranunculus, means 'little frog', and likely refers to the plant's affinity for bogs and other moist places.
- ✓ The species name, acris, means 'bitter', describing the very pungent taste of tall buttercup foliage.
- ✓ According to superstition, holding a tall buttercup flower against one's neck on the night of a full moon, or simply smelling the flower, causes insanity, hence the folk name 'crazyweed'.
- ✓ It is also customary to hold the flower under one's chin; if the skin shines yellow then the person loves butter.
- ✓ Flowers tend to track the daily movement of the sun in the sky.
- ✓ Beggars used to blister their skin purposefully with buttercup juice to arouse the sympathy of passersby.
- ✓ Fishermen of the 1800's poured buttercup tea on the ground to bring worms to the surface.

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 herbicides 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.

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Camelthorn *Alhagi pseudalhagi*

USDA Symbol: ALMA12

Other common names: Caspian manna.

Description: Perennial; flowers June to July. Grows 1 1/2 to 4 feet tall. Stems greenish with slender spines 1/4 to 1 3/4 inches long. Leaves wedge-shaped, hairless on the upper surface, 1/4 to 1 1/4 inches long. Flowers small, pea-like, pinkish purple to maroon, occur on short, spine-tipped branches along the upper portion of the plant. Reddish-brown jointed seed pods curved upward, deeply indented with each seed clearly outlined in the pod.

Impacts: This plant grows well on dry or moist sites and is reported to spread rapidly along streams and canals. Camelthorn is strongly competitive with other plants. Its rapid and aggressive growth allows it to out compete both native vegetation and cultivated crops. Because of its rhizomatic growth habit, dense stands may form that are impenetrable because of its spiny stems. It is especially troublesome in cereal and horticultural croplands, where repeated cultivation aids its spread.

Known hazards: Camelthorn is unpalatable to most livestock and is also a potential contaminant for alfalfa seed crops.

Introduction: Camelthorn is a native of the Turanian Desert and the Iranian Plateau. The common name is derived from the high affinity that camels have for eating the plant in its native range. It was introduced to the United States in 1915 in shipments of alfalfa seed from Turkestan and in camel dung packing around date palm offshoots.

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Campion, White *Silene pratensis*

Family: Pink Family (Carophyllaceae)
Other Names: Lychnis alba, Melandrium album, Silene alba, Silene latifolia, Silene latifolia ssp. alba, bull rattle, evening lychnis, snake cuckoo, thunder flower, white cockle, white robin.
Origin and Distribution: White campion was introduced into North America from Europe in the early 1800's most likely in contaminated crop seeds. This species is now widespread in the northern half of the U.S. and southern Canada. It is commonly found in grain, legume and vegetable crops, as well as in other disturbed sites, including field edges, roadsides, shorelines, wood edges and waste areas. White campion grows best in full sun on rich, well-drained soils.

Plant Description: White campion can be a winter or summer annual, biennial, or short-lived perennial. This species is characterized by downy foliage and showy white flowers, whose petals emerge from a green, inflated, bladder-like structure (calyx). Reproduction is primarily by seeds, although fragmented segments of the root crown can give rise to new plants.
Root system - White campion produces a fleshy taproot and thick lateral roots.
Seedlings & Shoots - The two seed leaves (cotyledons) are yellow-green and lance-shaped. Young plants form a rosette of pale green, lance-shaped to oval, downy leaves.
Stems - When rosettes bolt, erect stems are produced that grow 1 to 4 feet tall. Stems are round, leafy, branched, have swollen nodes, and are covered with short hairs. The upper portion of the stem may be slightly sticky. Several stems often arise from a single taproot and may become woody with age.
Leaves - Leaves are opposite (2 per node), 1 to 4 1/2 inches long, lance-shaped to oval, and taper to a point. Short hairs cover the upper and lower surfaces and margins. Leaf margins may be slightly wavy. Upper leaves attach directly to the stem but lower leaves taper into long leaf stalks (petioles).
Flowers - Showy, sweet-scented flowers are borne on long stalks, either in open clusters at the tops of stems or singly from the bases of upper leaves. Flowers are 1 inch wide with 5 white (or rarely pink) petals. Petals are deeply notched at the tips. Male and female flowers occur on separate plants, and are distinguished by the tube-like structure (calyx) from which the petals emerge: the female calyx is inflated, spherical, and green, with 20 lengthwise veins, while the male calyx is more slender, cylindrical, and purplish-green, with 10 lengthwise veins.
Fruits & Seeds - A vase-shaped capsule (seedpod) forms in the inflating female calyx. The calyx disintegrates after the capsule is fully developed. The mature capsule is smooth, shiny, and light brown, with an opening at the top surrounded by 10 teeth. Each capsule contains numerous small seeds (1/20 inch wide). The brownish-gray seeds are rounded to kidney-shaped, slightly rough and flattened on one side.

Similar Species: Corn cockle (Agrostemma githago) is similar but has red to purplish red flowers and narrower leaves. Night-flowering catchfly (Silene noctiflora), a summer annual, can be distinguished from white campion by its very coarse lower stem hairs, very sticky upper stem hairs, 6-toothed seedpods, and flower color (pink on top and yellow below). Bouncingbet (Saponaria officinalis) and bladder campion (Silene vulgaris) can be distinguished from white campion by their hairless stems and leaves. The rosettes of some asters (Aster spp.) resemble those of white campion but their stem leaves are alternate.

Biology: Seedlings emerge in mid- to late spring and again in late summer. Biennial and winter annual forms remain as a rosette through winter and produce a flowering stem the following season. Short-lived perennial forms remain as a rosette for more than one season before producing a flowering stem. White campion blooms and sets seeds from late May until September. Flowers open at night and release a sweet scent, attracting moths for pollination. Each capsule contains approximately 500 seeds and one plant may produce 50 capsules in one season. Seeds require light to germinate, so it is possible that burying seeds in soil will decrease the number that germinate.

White campion can be difficult to control because of its high seed production and resistance to commonly used herbicides. Young plants do not tolerate cultivation. Regular cultivation may provide some control, but care should be taken to prevent any surviving plants from going to seed.

Comments: The flowers of Evening Campion are lovely when illuminated by a night light. Among the *Silene spp.* occurring in Illinois, Evening Campion is unique in having plants with either all male or all female flowers. The female flowers usually have 5 styles, whereas most other *Silene spp.* have 3 styles. The seed capsule has 5 cleft teeth that resemble 5 pairs of teeth (or 10 teeth), whereas the seed capsules of other *Silene spp.* usually have 5 teeth that aren't cleft. These two sets of features are useful in distinguishing Evening Campion from another introduced species, *Silene noctiflora* (Night-Flowering Campion), which has a similar appearance. Unfortunately, Evening Campion has been the subject of several taxonomic revisions, acquiring several scientific names in the process, including *Melandrium album, Lychnis alba*, *Silene alba*, *Silene pratense*, *Silene pratensis*, and *Silene latifolia*. Another common name for this species is White Campion.

Toxicity: None known.

Related Information:

- ✓ Members of the genus Silene were used in Elizabethan England to make a concoction with sugar and wine. This mixture was supposed to be soothing to the heart. The roots were used as worm medicine.

- ✓ Extracts from roots and leaves of white campion are extremely toxic to mosquito larvae.

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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.

Canada Goldenrod *Solidago canadensis*

Family: Daisy Family (Compositae)
Other Names: common goldenrod, tall goldenrod.
Origin and Distribution: The genus Solidago includes approximately 100 species of goldenrods that are mostly native to North America. Canada goldenrod is also well established in the northeastern and north central U.S. and southern Canada. The species does not tolerate frequent disturbances, so it is mainly found growing in perennial crops, abandoned fields, ditches, roadsides, riverbanks, creek margins, open woodlands, and floodplains. It prefers moist conditions and medium textured soils. Canada goldenrod usually does not establish on very wet or dry sites, and it is fairly intolerant of shade.

Plant Description: Canada goldenrod is a perennial distinguished by numerous small yellow flowers located in pyramid-shaped clusters at the top of individual, unbranched, leafy stems. Flowers are crowded onto numerous backward-curved stalks that originate at a central axis and are arranged more or less horizontally. Leaves are lance-shaped, tapered at both ends, hairless on the upper surface, hairy underneath, and sharply toothed on the edge. Leaves are described as being 3-nerved, meaning the midrib and 2 parallel lateral veins are prominent. Plants reproduce by way of short rhizomes (horizontal underground stems) emerging from the base of aerial stems and by wind dispersed seeds.
Root system - The extensive root system is very deep and fibrous with 2- to 5-inch-long rhizomes (horizontal underground stems) emerging at the base of aerial stems. Rhizomes are often reddish.
Seedlings & Shoots - Seed leaves (cotyledons) are small and elliptical. Young leaves are round, bluish green, pale beneath, and bitter tasting. The first leaves produced are basal and hairless or with a few hairs on the edge. Later leaves are rough due to hairs on the edge and underneath on the veins. Young leaves are 3-nerved, meaning the midrib and 2 parallel lateral veins are prominent. Young stems are purple-stained.
Stems - Stems are 1 to 5 feet tall, leafy, mostly unbranched, slender, hairless in the lower half, and have small soft hairs in upper half below the flowers.
Leaves - Leaves are alternate (1 leaf per node), narrow, lance-shaped, tapered at both ends, sharply toothed around the edge, hairless on the upper surface, and hairy beneath especially on the veins. Leaves are described as being 3-nerved, meaning the midrib and 2 parallel lateral veins are prominent. Basal leaves form but fall off early leaving only stem leaves that are all nearly the same size. Leaves lack stalks (petioles), so bases attach directly to the stem.
Flowers - Flower heads form in dense, elongated, pyramid-shaped clusters. Each flower head consists of 9 to 17 yellow ray flowers surrounding fewer than 10 yellow disk flowers. Flower heads are less that 1/8-inch wide.
Fruits & Seeds - Single-seeded fruits are orange, approximately 1/20 inch long, and tipped with a tuft of white hairs (pappus).

Similar Species: Other goldenrod species (Solidago spp) are very similar, and taxonomists have not yet agreed on a single taxonomic treatment. However, several characteristics can be used to identify Canada goldenrod such as its lack of large basal leaves, which form early but then fall off leaving only stem leaves that are all about the same size.

Other distinguishing features include the manner that flower stalks attach to a central axis, hairs on the upper half of the stem below the flowers, and 3-nerved leaves.

Biology: Flowering begins in mid-August and continues through October. Plants usually do not flower until the second year of growth. A pappus at the tip of each seed aids in wind dispersal; goldenrod seeds released 3 feet off the ground traveled an average of 2 feet in a 5-mph wind. Rhizomes are usually not produced until after the first year of growth. Several rhizomes grow outward from the same root crown resulting in a circular cluster of stems between 2 to 5 inches apart. Patches of shoots produced by rhizomes arising from a single root system were observed growing up to 8 feet wide. To control, the site should be shallowly plowed in autumn and a crop planted the following year that tolerates cultivation. In Europe, biological control measures are used to control this introduced pest from North America.

Toxicity: None known. Goldenrods are often blamed for causing hayfever because they flower during allergy season. However, the true culprits are ragweeds (Ambrosia spp.). Goldenrod flowers are mainly insect pollinated, so the flowers are showy to attract insects and pollen is relatively heavy and sticky compared to that of ragweed. It is unlikely that the wind-blown allergens affecting hayfever sufferers include appreciable amounts of goldenrod pollen.

Related Information:

- ✓ 'Solidago' was taken from the Latin 'solidus' meaning 'whole' and likely referring to the supposed healing properties of this genus.

- ✓ Young Canada goldenrod shoots remain connected by way of rhizomes for up to 4 years.

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Canada Thistle *Cirsium arvense (L.) Scop.*

Canada thistle *Cirsium arvense*

Canada thistle (*Cirsium arvense*) is an aggressive, creeping perennial weed that infests crops, pastures, rangeland, roadsides and non-crop areas. Generally, infestations start on disturbed ground, including ditch banks, overgrazed pastures, tilled fields or abandoned sites. Canada thistle reduces forage consumption in pastures and rangeland because cattle typically will not graze near infestations. Canada thistle is a creeping perennial that reproduces from vegetative buds in its root system and from seed. It is difficult to control because its extensive root system allows it to recover from control attempts. Combining control methods is the best form of Canada thistle management. Persistence is imperative so the weed is continually stressed, forcing it to exhaust root nutrient stores and eventually die.

Asteraceae (Sunflower family)
Origin: Eurasia
Location: gardens, waste areas, roadsides, cropland, pastures, rangeland, waterways, and native plant communities.

Occurrence: Germination takes place mainly in the spring, but some germination also occurs in the autumn. Autumn seedlings form a rosette and overwinter in that stage. Spring seedlings start emerging when temperatures average 40ºF. In late spring, rosettes produce a flowering stalk, and approximately 2 months after seedling emergence, flower buds develop. Flowering occurs from mid-to-late summer, and seeds mature 8-10 days after flowers open. Shoots are also produced from the roots throughout the season. Aboveground vegetation dies with hard frost.

Description: An upright creeping perennial. Mature leaves are strongly serrated or have deep, irregular lobes with stiff, spiny tips. Stems are occasionally sparsely hairy, grow 1 - 4 feet tall, are branched above, and bear leaves in an alternate arrangement. Leaves are 1 - 6 inches long, 1/4 - 2 inches wide, and clasp the stem with no stalk. Small, faded purple to pink (rarely white) flower heads, which are 1/2 - 3/4 inch in diameter, develop at branch tips, often in clusters of one to five flower heads. Flower heads give rise to seed heads that contain many 1/8 inch long, golden-brown, single-seeded fruits with fluffy, tan hairs loosely attached to the top of each fruit.

Weedy Characteristics: Canada thistle spreads mainly by producing shoots from aggressive, creeping roots. The root system grows both horizontally and vertically, usually remaining in the top 2 feet of soil,

but a portion may penetrate to 20 feet in depth. Horizontal growth can be 13- 20 feet in a single season. The plant can form dense colonies, and one plant might spread to cover a 115 foot diameter area. Canada thistle is quite adaptable and its extensive root system makes it possible for the plant to survive in almost any soil. The plant will tolerate saline soil and dry or wet (but not saturated) conditions. Plants can produce about 1500 seeds each, which are dispersed via wind, water, birds that consume them, in crop seed and hay, on machinery, and on human and animal feet. Seeds can remain viable in the soil for up to 20 years. Canada thistle may secrete chemicals that inhibit the growth of nearby plants.

Control: Canada thistle seeds and seedlings require light, open environments and readily establish on bare ground. Maintaining healthy, competitive desirable vegetation can help prevent Canada thistle colonization. Thick mulch will discourage germination of seeds. Digging or hoeing young seedlings within 2 weeks of emergence is highly effective, since plants do not develop perennial root characteristics until the third week. Mature plants are much more difficult to manage. Seed production can be prevented by hand-cutting or mowing tops at least three times in the season. However, one or two seasons after above ground parts are destroyed, new shoots can still generate from the extensive root system. Any flower heads that have been open much more than 1 week are capable of setting seed, even after being cut from the parent plant. These should be removed completely. Digging, hoeing, and tilling mature plants fragments the extensive root system, stimulating new growth. Even very small root fragments can produce new plants within about 2 weeks. Nevertheless, consistent use of these methods for at least 2 years can exhaust Canada thistle root reserves enough to achieve some control. For current chemical or biological methods, consult your local state or county weed specialist.

Herbicides such as glyphosate can be painted on thistle leaves. Repeat applications will be needed. Herbicides such as triclopyr + clopyralid or 2,4-D combinations can be sprayed on thistle foliage; repeat applications may be needed at 6 week intervals. The most effective times for herbicide applications are spring, just after the green shoots appear, or in August/September. Always read the label before applying any pesticide.

General Facts: Young Canada thistle shoots and roots have been eaten by some native peoples, and the plant has been used for several traditional medicinal purposes, including as a mouthwash. Bees use Canada thistle as a source of nectar and pollen, and some wildlife will feed on it, but most domestic livestock will not eat it, and will not even graze near it for its spines. Its presence can cause crop yield loss and reduce recreational land use, it can interfere with harvesting operations, and its seed can contaminate small grain stocks. The plant can also serve as an alternate host for insects and other pests that cause crop disease. Canada thistle is considered noxious or invasive in every U.S. state, and also in six Canadian provinces.

Other Common Names: Californian thistle, creeping thistle, field thistle

Canarygrass *Phalaris arundinacea*

Family: Grass Family (Gramineae)
Other Names: bride's-laces, doggers, lady-grass, London-lace, spires, sword-grass.
Origin and Distribution: Reed canarygrass is a highly adaptive weed that is native to Europe and Asia. It was introduced to North America in the mid-1800 for forage, and is now widely distributed throughout southern Canada and the northern half of the U.S. This species is adapted to wet environments, and prefers poorly drained and frequently flooded soils, such as those of roadsides, lowland areas, wetlands, shores and irrigation ditches. However, it can grow in well-drained areas, and is relatively drought tolerant. Although it is tolerant of acidic soil, reed canarygrass is susceptible to winterkill. Despite this fact, reed canarygrass is still one of the highest yielding perennial forage grasses.

Plant Description: Reed canarygrass is a tall, coarse, sod-forming, cool-season perennial, characterized in summer by its two-tone appearance of golden seedheads atop green foliage. It reproduces through seeds and more typically by vigorous rhizomes (horizontal underground stems). This species tends to grow in clumps 3 feet or more in diameter, and can form large, dense colonies.
Root system - Reed canarygrass has short, stout, scaly, creeping rhizomes (horizontal underground stems). Roots develop from the joints (nodes) of the rhizomes to form a thick, fibrous root mass.
Stems - Stems are erect, round, stout, leafy, smooth and bluish-green, growing 2 to 5 feet tall (sometimes up to 8 feet).
Leaves - Leaves are rolled in the bud. The LEAF BLADE (free part of the leaf) is flat, hairless and rough along the edges. Blades are 4 to 14 inches long and 1/4 to 3/4 inch wide, and the base of the blade appears broad in contrast to the sheath. The LEAF SHEATH (part of the leaf surrounding the stem) is smooth and rounded, and the sheath margins mostly overlap except for a "V" at the top. The ligule (projection on the inside of the leaf at the junction of the blade and sheath) is membranous, and 1/8 to 1/4 inch long. AURICLES (appendages at the top of the sheath) are absent.
Flowers - Compact clusters of flowers are borne on short branches within a dense, narrow flower head (2 to 8 inches long, sometimes up to 12 inches) produced at the top of the stem. Flower branches are spreading at the onset of flowering, but close up next to the stem at maturity, giving the flower head a spike-like shape. The flower head gradually changes from green to purple to golden tan when seeds are formed.
Fruits & Seeds - Seedheads normally extend well above the leaves of the plants and are golden tan at maturity. As the seedheads first mature, the remaining foliage is usually still green, resulting in a striking clump of green with golden tops. The shiny seeds (1/8 inch long) may vary from tan to gray-black and resemble a narrow teardrop.

Noteworthy Characteristics
A rigorous, variegated, invasive, bamboo-like ornamental grass with upright stems typically growing 2-4' tall (when in flower). Features flat, arching, green and white striped leaf blades (2/3" wide) which grow 6-12" long and panicles of whitish to pale pinkish flowers which bloom well above the foliage in early summer. Flowers are quite conspicuous but not particularly showy. Grass is extremely attractive in spring to early summer, but turns an unattractive brown by late summer. If cut back hard (e.g., 6" from the ground), it will produce fresh, variegated foliage. Lacks the winter interest that many other ornamental grasses provide. Sometimes commonly called ribbon grass, reed canary grass or gardener's garters.

Problems
No serious insect or disease problems. Extremely invasive spreader that is difficult to eradicate once established because any tiny segment of root or rhizome left behind can sprout and spread. Use of soil barriers should be considered at the time of planting to prevent rhizomes from traveling into unwanted areas.

Similar Species: Reed canarygrass may be confused with common reed (Phragmites australis), which grows in similar habitats. However, common reed grows much larger, 6 to 14 feet tall, and has a hairy rather than membranous ligule. A cultivated variety of reed canarygrass, often referred to as ribbon grass (Phalaris arundinacea var. picta), is frequently used as an ornamental in gardens, and sometimes escapes cultivation. This form has green leaves that are striped with white or cream.

Biology: Shoots begin to emerge in mid-April. Reed canarygrass flowers between late May and August. The golden tan mature seedheads are a striking contrast to the green foliage below them. Seeds can germinate immediately upon maturation or the following season. This species can form persistent, single-species stands, and over time, the seedbank may actually become devoid of other plant species. Reed canarygrass is commonly spread by transporting rhizome-infested soil from riverbanks and other wet areas, often resulting in large, dense colonies.

Reed canarygrass can be a very profitable forage grass, and is often used for erosion control along waterways and around ponds. However, it can become troublesome when it invades fields and chokes out less competitive crops. This species has also become a serious threat to native wetland plant communities. It does not tolerate repeated close mowing and frequent cultivation.

Toxicity: Reed canarygrass contains several potentially toxic alkaloids. Poisonings have been reported in New Zealand and Norway for sheep that have fed on reed canarygrass, resulting in a condition referred to as "phalaris staggers". However, no poisonings have been reported in North America.

Related Information:

- ✓ Grasses of the genus Phalaris have been collected from every major landmass with the exception of Antarctica and Greenland.
- ✓ Canarygrass (Phalaris canariensis), an annual relative of reed canarygrass, is used to produce commercial canary seed, and is native to the Canary Islands.
- ✓ Reed canarygrass is an important tool for removing nitrogen and other nutrients from soil treated with wastewater effluents.

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Carrot, Wild *Daucus carota*

Family: Parsley Family (Apiaceae)
Other Names: bee's nest, bird's nest, devil's plague, lace flower, Queen Anne's lace, rantipole.
Origin and Distribution: Wild carrot is native to Europe. It entered the United States about 250 years ago, probably as a contaminant of cultivated carrot seeds, and was reported in Canada about 150 years later. It has since spread throughout most of North America. Wild carrot grows in roadsides, waste places, meadows, pastures, and no-tillage fields. It prefers well-drained or dry soils and grows best in full sun. The plant is often associated with lime-rich soils.

Plant Description: Wild carrot is a biennial that looks and smells similar to cultivated carrot. Its distinctive fern-like foliage forms a rosette during the first year. During the second year of growth, it produces a succession of hairy flower stalks that terminate in umbrella-shaped clusters of small white flowers. A distinctive feature of wild carrot is the appearance of a dark purple flower (rarely several flowers) in the center of most flower clusters. Once flowers mature and seeds begin to develop, the flower cluster closes forming a cuplike bird's nest. Wild carrot reproduces by seeds.
Root system - Wild carrot forms a long, slender, white taproot with fibrous secondary roots that become woody with age. The outer layer of root tissue often splits due to continued growth.
Seedlings & Shoots - Emerging first are 2 seed leaves (cotyledons) that are less than an inch long and linear. The first true leaf that appears is compound with 3 main divisions. Then, highly dissected leaves are formed that grow as a basal rosette during the first year.
Stems - The stem is compressed during the rosette stage and elongates during the second year of growth to form an upright flower stalk that is 1 to 3 feet tall, branched, hollow, grooved, and hairy. The base of the stalk may appear reddish. Usually, there are few leaves on the stem.
Leaves - Leaves are alternate (1 leaf per node), compound with many divisions, and have a carrot-like taste and smell. Divisions are further dissected giving leaves a feathery appearance. Leaves attach to stems by way of long leaf stalks (petioles) with broad bases that encircle the stem at each node.
Flowers - Flowers are small and have 5 white petals. They form in terminal, umbrella-shaped clusters that are between 2 to 5 inches in diameter. Often, one to several dark purple flowers appears in the center of each cluster. As flowers mature, the cluster curls inward forming a cuplike bird's nest.
Fruits & Seeds - The brownish seeds are less than 1/8 inch long, ribbed, and have bristly hairs. They usually have one flattened side and the other side is noticeably rounded.

Similar Species: Mayweed chamomile (Anthemis cotula) foliage appears similar to that of wild carrot but its flower stalks are leafier and its flowers resemble small daisies. Common yarrow (Achillea millefolium) also looks similar but can be distinguished from wild carrot by its leaves, which are more finely dissected and do not have a carrot-like odor, and its root system that is perennial and includes rhizomes. Wild carrot belongs to a very large family of plants with thousands of wild and cultivated species. Among the naturalized species that have a similar appearance and may be confused with wild carrot is poison hemlock (Conium maculatum), which is said to be one of the most poisonous plants in the world. Poison hemlock grows nearly 10 feet tall compared with wild carrot that reaches 3 feet or less. The stems of poison hemlock lack hairs but are covered with purple mottling. Also, wild carrot has a carrot-like odor while poison hemlock has a mouse-like odor. Although water hemlock (Cicuta maculata) looks similar, it grows in wet habitats while wild carrot prefers well-drained soils. The distribution of wild parsnip (Pastinaca sativa) is generally the same as that of wild carrot but it is a stouter plant, its leaves are not as finely dissected, and it has yellow flowers.

Biology: Seedlings emerge in spring and again in fall forming a basal rosette of leaves that remains green throughout winter. Flowers are produced from July to September during the second year of growth. Flower stalks are produced in succession until the first heavy frost when the plant dies. As a result, one plant may produce up to 100 flowers and between 1,000 to 40,000 seeds. Seeds have hooked spines that attach to clothing and animal fur thereby aiding in dispersal. Carrots were grown in Asia in the 10th century and spread throughout Europe in the Middle Ages. A palatable Afghanistan biotype of wild carrot with a purple root is believed to be the ancestor of cultivated carrots. The orange-yellow carrot was developed in the 1600's in the Netherlands. When young, wild carrot is generally susceptible to selective herbicides. However, it can be difficult to control populations using herbicides because they are usually composed of plants of various ages. Wild carrot generally does not survive cultivation.

Toxicity: Exposure to leaves may cause irritation to the skin in some people. Cows that have eaten large amounts of wild carrots may produce milk with an undesirable flavor.

Related Information:

- ✓ Daucus' is from 'daukos', which is Greek for carrot.
- ✓ 'Carrot' is Celtic meaning 'red of color'.
- ✓ There are numerous legends about how this plant became associated with and was named after Queen Anne, wife of King James I of England.
- ✓ Devil's plague was a common name given by farmers who found this weed difficult to control; rantipole means rude and reckless.
- ✓ It is not known if there are benefits associated with having a purple flower located in the center of some flower clusters. A study showed that insects were neither attracted nor repelled by the presence or absence of the flower.
- ✓ The first year roots of wild carrot are reported to be edible, but care must be taken to not mistake poison hemlock for wild carrot.

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Catnip *Nepeta cataria*

Family: Mint Family (Labiatae)
Other Names: catmint, catnep, catrup, cat's-heal-all, cat's-wort, field-balm, nep, nip.
Origin and Distribution: It is uncertain if catnip is a native of Europe or Asia, but it is agreed that it was introduced to North America from Europe. The plant grows best in rich soils, but it readily establishes in a variety of habitats. It can be found in pastures, fence rows, barnyards, stream banks, and waste places such as dumps and parking lots as well as growing along roadsides and railroads.

Plant Description: Catnip is an erect perennial best known for the minty odor emitted by its leaves and stems when they are crushed or wilted. The odor is very attractive to cats. Other distinctive characteristics are downy foliage and the serrated appearance of the leaf edges, which resembles the toothed edge of a saw. The flower shape is common among members of the mint family consisting of 2 lips, and flower color is white with unusual purple dots. Along with most members of the Mint Family, catnip has square stems. This species reproduces by seeds and it also produces short rhizomes (horizontal underground stems).
Root system - The root system forms a taproot and eventually short rhizomes (horizontal underground stems).
Seedlings & Shoots - Initially emerging are 2 seed leaves (cotyledons) that have downy hairs covering their upper surface, edge, and leaf stalk (petiole) and a hairless lower surface. Thereafter, leaves and petioles are covered with hairs.
Stems - Stems are erect, 1 to 3 feet tall, square, pale green, branched, and covered with short white hairs.
Leaves - Leaves are opposite (2 leaves per node), hairy, triangular or heart-shaped, and have pointed tips. The upper surface is pale green and the lower surface is so densely covered with hairs that it appears whitish. Leaf edges are serrated in such a manner that they resemble the toothed edge of a saw blade. Leaves attach to stems by way of long slender petioles. If crushed or wilted, leaves give off a characteristic minty odor.
Flowers - Flowers are 1/2 inch long and have 5 petals united into a 2-lipped tube. The upper lip consists of 2 lobes while the lower lip has 3-lobes and is larger and more spotted than the upper lip. Flowers are white to pale lavender with purple spots. Dense whorled clusters of flowers form at the ends of stems and branches.
Fruits & Seeds - Each flower produces a pod containing 4 seeds. Seeds are oval, smooth, red-brown, and have 2 white spots at one end.

Similar Species: None.

Biology: Catnip flowers between June and October. The plant can be controlled using clean cultivation. In areas where cultivation or hoeing is not possible, repeated mowing can be used to control the weed. Mowing should begin in the spring and be repeated often enough to prevent shoot growth.

Toxicity: None known.

Related Information:

- ✓ Latin's named the plant 'Nepeta' after an old Italian town called Nepete where the plant either was encountered for the first time or grew in great profusion.

- ✓ 'Cataria' is thought to be derived from the Latin word for cat.

- ✓ Historically, catnip has served a number of uses. It was a common home remedy used to treat complaints of pregnant women, childhood colic, fevers, and pneumonia. Today, catnip is entered in the U.S. Pharmacopoeia as a mild aromatic.

- ✓ The minty smell of catnip is very appealing to cats, many of whom respond with a unique pattern of behavior. Legend states that a leaf from the plant will turn a touchy old cat into a frolicking kitten. Cats are attracted to catnip plants that are bruised or withered. However, not all cats respond to catnip and the attraction has been shown to be inherited.

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Catsear, Common Hypochaeris radicata

Family: Daisy Family (Compositae)
Other Names: Hypochaeris radicata, cat's-ear, coast dandelion, false dandelion, flatweed, gosmore, hairy cat's-ear, hairy wild lettuce, long-rooted cats'-ear, spotted cat's-ear.
Origin and Distribution: The native range of common catsear includes much of Europe, Asia, and North Africa. Following its introduction, the plant became established throughout the eastern half of North America as well as in the Pacific Northwest. Common catsear is a weed of lawns, golf courses, pastures, and waste places. It tends to be more common on sandy or gravely soils.

Plant Description: Common catsear is a perennial with a growth form similar to that of dandelion; its leaves form a basal rosette and it produces yellow head-like flowers at the tips of upright stems. Leaves of common catsear are typically lance-shaped with irregular rounded lobes and hairs on both the upper and lower surfaces. Emerging from the rosette are wiry hairless stems that usually have leaf-like bracts and branches. At the tips of the branches are 1-inch-wide flower heads composed of many tubular, yellow flowers. Common catsear reproduces by seeds and vegetatively by way of buds formed on the crown that can produce new plants if separated.
Root system - Common catsear has a deep, fibrous root system that includes enlarged roots resembling taproots.
Seedlings & Shoots - Cotyledons are spoon shaped and have a rough surface. Young seedlings resemble dandelions except they have thick, rough-surfaced leaves with wavy margins. Seedlings form a rosette of basal leaves.
Stems - Stems are 8 to 16 inches tall, stiff, wiry, smooth, and often branched. Located at the tip of each branch is a solitary flower head. There may be a few scattered, small, leaf-like bracts upon the stem. Stems contain a milky sap.
Leaves - Leaves formed in a basal rosette are lance-shaped with irregular, rounded lobes. The upper and lower leaf surfaces and margins are covered with coarse hairs.
Flowers - A single, dandelion-like flower head is produced at the end of each branch. The yellow flower heads are flat and 3/4 to 1 1/2 inches in diameter. Each flower head is composed of many individual petal-like flowers.
Fruits & Seeds - The one-seeded, spindle-shaped fruits are 1/5 inch long, narrow, red-brown, and have a long ridge and an elongated beak making up at least half their length. Located at the end of the beak is a persistent, feathery, white plume of hairs (pappus).

Similar Species: Common catsear and dandelion (Taraxacum officinale) are easily confused due to similarities in their flowers and leaves. However, dandelion leaves are hairless and have pointed lobes and its flowering stems do not branch, lack bracts, and are often tinged with red. Yellow hawkweed (Hieracium pratense) produces hairy leaves in a rosette and yellow flowers similar to those of common catsear.

However, hawkweed leaves lack lobes and its stems are bristly while common catsear leaves have irregularly lobed edges and its stems are smooth. All three of the above-mentioned species exude a milky sap when cut or bruised.

Biology: Although flowers form anytime from May until autumn, it is most common to see common catsear blooming after September. The plant grows rapidly and is capable of producing mature flowering plants from seeds in about two months. Plants produce, on average, 20 flower heads during a single season with 40 or more seeds in each head. Because of its palatability, nutrient content, and productivity, common catsear is a valued grassland plant in New Zealand and Australia. Sheep, pigs, and some wildlife often prefer the plant over more traditional pasture species. Common catsear can be controlled by hand digging in early spring. On large areas, common catsear can be managed by plowing and cultivating for one to two years. Rapid spread of the weed was noticed in the 1960's, possibly because it was tolerant to some of the more common herbicides used on lawns. However, there are selective herbicides available that will control common catsear.

Toxicity: Potentially allergenic compounds are associated with this genus.

Related Information:

- ✓ There are reports of pigs eating the long fleshy roots and therefore, 'Hypochoeris' was derived from the Greek word for a 'young pig'.

- ✓ The common name comes from the hairy leaf surface that was thought to resemble a cat's ear. Otherwise, the plant bears little resemblance to felines.

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Chickweed, Mouseear *Cerastium vulgatum*

Family: Pink Family (Caryophyllaceae)
Other Names: Cerastium fontanum.
Origin and Distribution: Mouseear chickweed was introduced from Europe and is now common throughout the North America. It is common in waste places, roadsides, woods, lawns, pastures, and abandoned cropland. It can be a troublesome weed in wheat and oat crops.

Plant Description: Mouseear chickweed is a creeping, mat-forming species that normally behaves as a perennial; however, it is possible for it to exist as an annual. Plants reproduce by seeds and roots growing from the nodes of stems. It tends to form dense patches.
Root system - Roots are shallow with fibrous branching from a central, but not large, taproot.
Seedlings & Shoots - The seedlings of mouseear chickweed are hairy.
Stems - Stems are mostly prostrate, reaching upwards at the ends, and ranging from 6 inches to 2 feet in length. The stems are slender, sticky-hairy, with swollen nodes. Stems range in color from green to red-purple. In lawns, mouseear chickweed can form a mat that excludes other plants.
Leaves - Mouseear chickweed leaves are oblong to spatula shaped, with smooth edges and a pointed tip. Like the stems, the leaves are covered with long clammy hairs on the upper surface and on the veins of the lower surface. Leaves are opposite (two per node) and attached directly to the stem, the leaf bases often overlapping in a shallow cup around the stem.
Flowers - Mouseear chickweed flowers are small (about 1/4-inch wide), white, with five petals sometimes so deeply clefted that they can appear as 10 petals. Petals are sometimes absent. The sepals (green structures covering the closed flower) are hairy and nearly as long as the flower petals. Flowers are solitary or in small groups at the end of branches, blooming from May to October.
Fruits & Seeds - Fruits are small, cylindrical, tan to reddish-brown pods that contain many small, brown, irregularly-knobbed round seeds.

Similar Species: Mouseear chickweed can be distinguished from similar species by mostly prostrate growth and hair-covered stems and leaves. Common chickweed (Stellaria media) has only a single line of hairs along the stem and thymeleaf speedwell (Veronica serpyllifolia) has no hairs on leaves or stem.

Biology: Mouseear chickweed is considered a short-lived perennial that thrives in various habitats, from dry waste areas, disturbed soil, and sandy shores to moist woods and damp ground. The weed does not tolerate cultivation but persists in lawns and gardens. Germination is variable throughout the year, occurring mostly in late summer, fall and early spring. Mouseear chickweed is not drought tolerant, but can remain green even under the snow in winter.

Toxicity: None known.

Related Information:
- ✓ Some members of the chickweed family produce flowers than never open but still produce seed.
- ✓ The leaves of mouseear chickweed can be boiled and eaten as greens.

Chicory Cichorium intybus

Family: Daisy Family (Compositae)
Other Names: blue daisy, blue dandelion, blue sailors, blue weed, bunk, coffeeweed, common chicory, cornflower, hendibeh, horseweed, ragged sailors, succory, wild bachelor's buttons, wild endive, witloof.
Botanical description: Chicory has a long fleshy root filled with a milky sap, much like that of its sister dandelion. Leaves form a basal rosette along the ground with a tough branched stem that is hard to break. Upper leaves are small and insignificant; lower leaves are large and toothed. The flowers are usually blue, although on some rare occasions they are white or pink. They are ray flowers with fringed edges and are about 1 inches in diameter. They face toward the rising sun in the morning and by afternoon are faded and withered, to be replaced by a new set of flowers the next morning. Chicory is easily recognizable during its flowering season by the daisy-like blue flowers that seem to be in constant supply; when the flower is gone, the leaves and arrangement do resemble dandelion but are distinguishable because they have tiny hairs on them, while dandelion leaves are hairless.

Origin and Distribution: Chicory originated in the Mediterranean and became distributed throughout much of the world where it was grown for centuries as a salad green. Its cultivation in North America began in the 1700's and ended in about 1950 when it became more economical to import chicory. During that time, chicory escaped cultivation and naturalized populations spread throughout southern Canada and the U.S., where it is most commonly found it in the north and west. Chicory grows abundantly besides roads and highways. It can also be found in lawns, pastures, fields, and waste places. The plant favors lime-rich soils but tolerates a variety of soil types.

Plant Description: Chicory is a perennial that initially grows as a rosette of irregularly-toothed basal leaves. Then, later in the season, leafless stems emerge with sky-blue daisy-like flowers scattered along their length. Flowers open each morning and close as sunlight increases in intensity around noon. Only a few flower heads open at a time and each head opens for a single day. Chicory reproduces by seeds.
Root system - Plants produce a thick, deep, sturdy taproot containing a very bitter and milky juice.
Seedlings & Shoots - Young leaves are oblong to egg-shaped, pale green, shiny, and contain a bitter and milky juice in the midvein.
Stems - The erect, round, hollow, nearly leafless stems produce stiff spreading branches that can grow 1 to 5 feet tall. Lower portions of stems are hairy. Upper portions are generally without leaves making stems appear straggly. Stems exude a milky sap if cut.

Leaves - Rosette leaves are 2 to 6 inches long, oblong or lance-shaped, and covered with rough hairs on both the upper and lower surfaces. Margins of basal leaves are either deeply dissected with pointed lobes or they may be shallowly toothed. Stem leaves are small, sparse, alternate (1 leaf per node), lance-shaped, and clasping. Stem leaves have smooth or slightly toothed edges.
Flowers - The showy flowers are clustered in heads that are 1 to 1 1/2 inches wide, short-stalked or stalkless, and borne in clusters of 1 to 4 on the upper branches. Each flower head consists of many individual, bright blue, petal-like flowers that are squared-ended and toothed.
Fruits & Seeds - The single-seeded fruits are about 1/8 inch long, dark brown, wedge-shaped, and 5-angled.

Similar Species: Rosette leaves of chicory closely resemble those of dandelion (Taraxacum officinale); however, basal leaves of chicory are coarser and have more prominent hairs compared with dandelion leaves.

Biology: Flowering occurs from June through September. Flowers generally bloom in the morning, track the sun, and close when sunlight is brightest at mid-day. The average plant produces about 3000 seeds. Chicory does not tolerate cultivation.

All in the family: Chicory is a member of the composite family, a large group of wildflowers that includes dandelions, purple coneflower, daisies, and endive.
Cultural uses: Traditionally, chicory juice was used as part of a remedy for headaches. The Romans used chicory as a vegetable or in salads. The root was ground and used as a caffeine-free coffee substitute. It is still used that way today, and is the special ingredient in Luzianne coffee, a mellow blend of coffee and chicory that is sold in Louisiana.
A tea made from the flowers and leaves is good for the liver and gall bladder, and is used to treat jaundice, dyspepsia, loss of appetite and mild laxative, especially good for children. Chicory is also taken for gout and rheumatic conditions.
Toxicity: None known. However, chicory sometimes causes contact dermatitis in humans.

Related Information:

- ✓ 'Intybus' was derived from the Egyptian word for January, which was when chicory was harvested and eaten many thousands of years ago in Egypt.
- ✓ Chicory is considered a salad green rather than a weed in Europe; fresh leaves are sold as radicchio in Italy and the French produce a green they call whitloof chicory, Belgian endive, or French endive by forcing chicory roots to sprout while deprived of light.
- ✓ It is common to roast the roots and use them as a coffee substitute or additive. Roots can also be eaten raw or boiled, or they can be dried, ground, and used as seasoning.
- ✓ Chicory is a productive and high quality forage crop that functions well in rotational grazing systems.
- ✓ The flowers were once used to make a yellow dye while the leaves made a blue dye.
- ✓ Folk remedies used chicory roots for jaundice, spleen problems, and constipation and a tea made from foliage supposedly promoted bile production and released gallstones.
- ✓ In one legend telling of chicory's origin, a beautiful maiden refused the advances of the Sun and was turned into a chicory flower that had to stare at the Sun each day and always faded in the presence of its might.

Cinquefoil, Rough *Potentilla norvegica*

Family: Rose Family (Rosaceae)
Other Names: Potentilla monspeliensis, Norway cinquefoil, strawberry-weed, upright cinquefoil, yellow cinquefoil.
Origin and Distribution: Rough cinquefoil is native to North America and Europe. It is distributed throughout the eastern half of the U.S. and in the northwestern states. Rough cinquefoil prefers open sites with dry, sandy soil, and is commonly found in fields, meadows, pastures, and roadsides.

Plant Description: Rough cinquefoil behaves as either an annual if growing in cultivated ground, a biennial when growing in less disturbed sites, or a short-lived perennial. It grows as a rosette at the beginning of the season, but later forms an upright, hairy, robust stem with yellow flowers. Leaves consist of 3 coarsely-toothed, hairy leaflets. Rough cinquefoil reproduces by seeds.
Root system - Rough cinquefoil has a simple, vertical taproot. Adventitious roots appear at the base of the crown.
Seedlings & Shoots - Seedlings form a rosette of leaves. The first true leaves are coarsely toothed but not divided until about the fifth leaf when 3 distinct lobes appear.
Stems - Stems are upright, branched, hairy, and about 1 to 2 feet tall. As the plant ages, stems become woody and change from green to dull purplish-red. Biennial and perennial forms may have several stems emerging from a single crown.
Leaves - Rosette and stem leaves are green and hairy on both sides, and consist of 3 oval, coarsely-toothed leaflets. Stem leaves are alternate (1 leaf per node). Lower leaves attach to stems by way of long stalks (petioles), while leaves along the upper part of the stem have very short stalks. A pair of leaf-like appendages (stipules) are located at the base of each petiole where it attaches to the stem.
Flowers - Flowers appear in clusters at the ends of branches. Flowers are about 1/4 inch wide consisting of 5 yellow petals.
Fruits & Seeds - Pale brown seeds are oval, less than 1/25 inch long, and have shallow ridges running the length of the seed.

Similar Species: Rosettes of rough cinquefol may be confused with wild strawberry (Fragaria virginiana), which is a low-growing plant with 3-parted leaves. However, the edges of wild strawberry leaflets are generally smoother than rough cinquefoil leaflets, which have teeth all around the margins. Also, wild strawberry produces short, thin stems with white flowers versus the tall, robust stems and yellow flowers of rough cinquefoil. There are several species of cinquefoils that may be confused with rough cinquefoil. Sulfur cinquefoil (Potentilla recta) may be distinguished from rough cinquefoil by its generally unbranched stems and leaves made up of 5 to 7 leaflets. Sulfur cinquefoil stems may branch, but only above the point where flowers begin to emerge. In addition, its flowers are larger than those of rough cinquefoil. Silvery cinquefoil (Potentilla argentea) can be distinguished from rough cinquefoil by its 5- to 7-parted leaves, with leaflets that are very coarsely toothed and silvery below. Common cinquefoil (Potentilla canadensis) and oldfield cinquefoil (Potentilla simplex) can be distinguished from rough cinquefoil by their creeping stems (stolons) that can root at the nodes.

Biology: Seedlings emerge in mid- to late spring and also in late summer. Plants flower from June through September. Rough cinquefoil can produce over 13,000 seeds per plant. Seeds are wind dispersed. Mowing tends to result in shorter plants with more branches and spreading roots. Other cinquefoils are used as ornamentals or planted for soil erosion control.

Cinquefoil, Sulfur *Potentilla recta*

Family: Rose Family (Rosaceae)
Other Names: five-finger cinquefoil, rough-fruited cinquefoil, tall five-finger, tormentil, upright cinquefoil, yellow cinquefoil.
Origin and Distribution: Sulfur cinquefoil is a European native introduced into North America around 1900. It is most often found growing in the northern U.S. in fields, meadows, pastures, roadsides, and waste places. Sulfur cinquefoil prefers gravelly soil containing lime.

Plant Description: Sulfur cinquefoil is a perennial. It is an erect, hairy, generally unbranched plant with yellow flowers and leaves consisting of 5 to 7 coarsely-toothed leaflets. Leaflets are arranged such that they radiate from a common point like fingers on a hand. Sulfur cinquefoil reproduces by seeds.
Root system - Sulfur cinquefoil has a taproot that is short, branched, and becomes woody with age. The taproot produces coarse, fibrous roots.
Seedlings & Shoots - The first true leaves are coarsely toothed but not divided until about the fifth leaf, when leaves appear deeply divided into 3, coarsely-toothed leaflets.
Stems - Stems are leafy, upright, covered with hairs, and about 1 to 3 feet tall. Stems are typically unbranched, but may branch above the point where flowers begin to emerge. A circle of stems forms around the root crown as new shoots emerge over time. Stems can be induced to form roots at their nodes.
Leaves - Leaves are alternate (1 leaf per node), green and hairy on both sides, and consist of 5 to 7 coarsely-toothed leaflets. Leaflets are oblong, narrow, and 2 to 4 inches long. Leaflets are arranged so that they radiate from a common point like fingers on a hand. Lower leaves attach to stems by way of long stalks (petioles), but upper leaves have very short stalks. A pair of leaf-like appendages (stipules) are located at the base of each petiole where it attaches to the stem.
Flowers - Flowers appear in clusters at the top of stems. Flowers are 3/4 to 1 inch wide with 5, heart-shaped, pale to sulfur-yellow petals.
Fruits & Seeds - Dark brown seeds are about 1/20 inch in diameter and have a prominent, netlike surface.

Similar Species: The 5-parted leaves of sulfur cinquefoil resemble those of hemp or marijuana (Cannabis sativa); however, hemp is taller, has larger leaves, and its flowers do not resemble those of cinquefoil. There are several species of cinquefoils that may be confused with sulfur cinquefoil. Rough cinquefoil (Potentilla norvegica) may be distinguished from sulfur cinquefoil by its branched stems, leaves made up of 3 leaflets and smaller flowers. Silvery cinquefoil (Potentilla argentea) can be distinguished from sulfur cinquefoil by its very coarsely toothed leaflets that are silvery below. Common cinquefoil (Potentilla canadensis) and oldfield cinquefoil (Potentilla simplex) can be distinguished from sulfur cinquefoil by their creeping stems (stolons) that can root at the nodes.

Biology: Seedlings emerge in mid- to late spring and also in late summer. Plants flower from June through September. Each sulfur cinquefoil plant produces about 1,650 seeds. Seeds are wind dispersed. Mowing tends to result in shorter plants with more branches and spreading roots. Other cinquefoils are used as ornamentals or planted for soil erosion control.

Toxicity: None known.

Related Information:

- ✓ Potentilla means 'powerful' and refers to the astringent attributes of plants in this genus.
- ✓ The common name 'cinquefoil' was derived from the French term for 'five-leaved'.
- ✓ Sulfur cinquefoil was named for the sulfur-yellow color of its flowers.
- ✓ Cinquefoils are often a problem in the western U.S. because they tolerate drought and most animals avoid eating them.

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.

Colts Foot *Tussilago farfara*

Family: Daisy Family (Compositae)
Other Names: ass's foot, bullsfoot, butterbur, clayweed, cleats, colt-herb, coughwort, donnhove, dovedock, dummyweed, fieldhove, foalfoot, foalswort, ginger, ginger root, hallfoot, hoofs, horsefoot, horsehoof, son-before-father, sowfoot.
Origin and Distribution: Coltsfoot is a native of northern Europe and Asia that was brought to North America by early settlers. Currently, the species is naturalized throughout the northeastern U.S. Coltsfoot is adapted to poor soils and will grow on almost any unattended or denuded area including roadsides, pastures, open forests, stream banks, drainage ditches, and strip-mining cuts. The species prefers wet, clay soils and grows well in cool climates. Although it tolerates full sun, it grows best in part shade.

Plant Description: Coltsfoot is a yellow-flowered perennial. Its flowers are the same color, size, and shape as dandelion flowers, and the two species are easily confused while in bloom if viewed from a distance. However, coltsfoot blooms so early that the flowers have already come and gone by the time leaves emerge. Also, coltsfoot flowers appear at the tips of 1/8-inch-thick stems that are wooly and covered with scaly bracts giving them an appearance similar to that of asparagus spears. After flowers have matured, clumps of broad, heart-shaped leaves appear on short, wooly vegetative stems. Coltsfoot reproduces primarily by horizontal creeping rhizomes (horizontal underground stems) and also by seeds.
Root system - Coltsfoot forms an extensive system of thick white rhizomes (horizontal underground stems) that can spread over a large area in a very short time.
Seedlings & Shoots - Upper and lower surfaces of young leaves are covered with wooly hairs.
Stems - Stout, grayish-green flowering stems, covered with wooly hairs and purplish-red scaly bracts, emerge in early spring. Several flowering stems arise from one root crown. Stems are 2 to 6 inches tall when flowering begins and can reach 12 to 20 inches by the time seeds mature. After flowers mature, leaves are produced on short vegetative stems that also are covered with wooly hairs.
Leaves - The broad, hoof- or heart-shaped leaves are borne on long, erect leaf stalks (petioles) arising from short vegetative stems located nearby those producing flowers. Leaves grow in the form of a rosette. As leaves mature, hairs on their upper surface fall off while the underside retains its wooly hairs. Leaves are 2 to 7 inches long and broad with shallow lobes and angular teeth on their edges. Color varies from bright green to dark or bluish green. Leaf veins radiate out like spokes from the point where the petiole attaches to the leaf blade.
Flowers - Showy flower heads (1 to 1 1/4 inches wide) are borne singly at the top of scaly flower stems and consist of a disk of numerous long, narrow, petal-like, yellow ray flowers.
Fruits & Seeds - As flower heads mature, they turn into white balls of tufted seeds that resemble dandelions. Seeds are 1/8-inch long, cylindrical, and yellow or reddish-brown.

Similar Species: Coltsfoot and dandelion (Taraxacum officinale) flowers and seed-heads look similar, but dandelion flower stems are much more slender and smooth and its flowers appear at the same time rather than before leaves emerge. Coltsfoot rosettes can be distinguished from those of common burdock (Arctium minus) by the perennial rhizomes and broadly heart-shaped leaves with veins that radiate out like spokes from the point where the petiole attaches to the leaf.

Biology: Coltsfoot flowers in March. While developing, immature flower heads often droop toward the ground. At night and on cold or cloudy days, flower heads often close. The parachute-like tufts attached to seeds aid in wind dispersal. There are reports of seeds traveling by wind as far as 8 miles. Coltsfoot seeds are only viable for one year and usually germinate the season they are produced. Since leaves appear later than flowers, many people do not associate the leaves of coltsfoot with its flowers. Coltsfoot can form extensive underground rhizome systems with many rhizomes buried 10 or more feet in the soil. For this reason, it may be difficult to control the spread of coltsfoot rhizomes using only plowing or cultivation. More effective techniques for control are improved drainage, clean cultivation, and chemical treatments.

Toxicity: One source suggests that coltsfoot may have some toxic properties. Recent studies found that extracts produce cancer in rats.

Related Information:

- ✓ The common name refers to the shape of the leaf, which resembles a colt's hoof-print.
- ✓ The common name 'son before father' refers to the emergence of the flowers before leaves.
- ✓ The genus name 'Tussilago' is derived from the Latin word "tussis" meaning 'cough' for which the plant is supposed to provide a cure.
- ✓ Coltsfoot once served a number of medicinal uses. Leaves and roots were dried, ground, or boiled and used to make teas, candies, and tobaccos. However, recent studies in Japan found that coltsfoot flowers cause tumors in rats.
- ✓ Scottish Highlanders used the hairy tufts from the seeds as mattress stuffing.

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Comfrey, Common *Symphytum officinale*

Family: Borage Family (Boraginaceae)
Other Names: asses-ears, backwort, blackwort, boneset, bruisewort, consound, gumplant, healing herb, knitback, knitbone, slippery-root.
Origin and Distribution: A European species, common comfrey was introduced into North America as a medicinal herb. In the U.S., it is presently scattered throughout the eastern half of the country. This introduced herb is highly adaptable and has become a naturalized weed in ditches, meadows, abandoned gardens, and waste places. Common comfrey prefers rich soils containing lime and moist, shady sites.

Plant Description: Common comfrey is a perennial herb with lower leaves that are bristly, up to 12 inches long, and attached to winged leaf stalks (petioles) that emerge from the base of the plant. Smaller leaves that are also bristly but lack petioles are borne on 2- to 3-foot tall flowering stems. Flowers are bell shaped and either yellow or blue. They form in distinctive curled clusters having an appearance similar to that of a scorpion's tail. Reproduction is by way of seeds. Also, new plants can be propagated by dividing the roots of established plants.
Root system - Roots are branched, spindle-shaped, less than 1 inch in diameter, and more than 1 foot long. The outside is covered with black bark and the inside is white, fleshy, and juicy.
Seedlings & Shoots - None.
Stems - Stems are 2 to 3 feet tall, erect, angular, hollow, branched, and terminate in a cluster of flowers. Stems are covered with rough hairs and feel prickly.
Leaves - Both sides of leaves are covered with rough hairs. The undersides of leaves have conspicuous veins. Lower leaves emerging from the base of the plant are 3 to 12 inches long and have smooth edges. Their shape is such that they appear to narrow gradually at the base into long, succulent, winged leaf stalks (petioles). Leaves located on stems are alternate, lance-shaped, and smaller than basal leaves. Instead of attaching to the stem by way of petioles, they form wings that extend down around the stem.
Flowers - Flowers are 1/2-inch-long, bell shaped, and borne in 1-sided, curled clusters that resemble a scorpion's tail. Located nearest the stem is the most fully-expanded blossom and immature buds can usually be found at the extremity of the cluster. Flower color depends on variety and can be either white, creamy yellow, or pink fading to blue.
Fruits & Seeds - As flowers mature, 4 nutlike fruits develop that are brownish-black with a nearly smooth, somewhat shiny surface.

Similar Species: Common comfrey leaves appear similar to foxglove (Digitalis purpurea) leaves except their surface is covered by stiff hairs and their shape is more lanceolate than those of foxglove. Also, common comfrey flowers are about 1/2 inch long while foxglove flowers are large and showy.

Biology: Common comfrey blooms between May and August.

Common Groundsel S*enecio vulgaris*

Common Groundsel *Senecio vulgaris*

Common groundsel is an early season weed. A prolific seed producer, seeds are produced within several weeks of germination, and there are several generations within the same year. This weed likes moist soil and is often found in well-irrigated areas such as lawns and flower beds.

Control: A dense, healthy turf will prevent seeds from taking root in the lawn. Turf density can be increased with proper mowing, fertilization, watering, and other cultural practices. Good drainage will also help to discourage the growth of common groundsel. The plants can be easily pulled by hand from moist soil. Be sure to pull and dispose of them before they set seed, as seed can mature in opened flowers even after the plants have been killed. If there is heavy infestation, spot treat with a post-emergent herbicide containing glyphosate (Roundup, Kleenup).

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Common Lambsquarters *Chenopodium album*

Common Lambsquarters *Chenopodium album*

Common Lambsquarters is a broadleaf summer-annual weed that can be found anyplace the soil has been disturbed. The growth habits of the common lambsquarters vary with its location. If growing along the road or in an open field, it may reach three or four feet in height. Yet those plants found in lawns may produce seeds when only a couple of inches tall. Lambsquarters prefer rich soil and are often found in vegetable gardens. The first two true leaves that appear are opposite and ovate with smooth edges. Later leaves are alternate, arrowhead-shaped, and with unevenly-toothed edges. At the top of the plant, the leaves become long and narrow. All of the leaves are pale green and covered with white, mealy granules that give the appearance of frost. Stems are erect and often have light-green or red lines. Flowers are small, inconspicuous, yellow-green, and occur in clusters at the tips of branches and upper leaf axils. These flowers occur from July to September. Black seeds are contained in an utricle by a thin papery covering.

Control: The best methods of weed control in the home vegetable garden are mulching, handpulling, rototilling, hoeing and preventing the weeds from going to seed. Because of its short, branched taproot, lambsquarters can be easily hand-pulled from moist soil. The best methods of weed control in the home vegetable garden are mulching, hand pulling, rototilling, hoeing and preventing the weeds from going to seed. Because of its short, branched taproot, lambsquarters can be easily hand-pulled from moist soil. Prevention by use of good cultural habits should be the first line of defense in eliminating broadleaf weeds such as lambsquarters from lawns. Pre-emergent herbicides such as trifluralin (Preen) can be used to prevent germination of weed seeds. Post-emergent herbicides effective against broadleaf weeds are 2,4-D, MCPP and dicamba (sold under many brand names) and combination formulas (Trimec). Read labels to be sure the herbicide is effective against the weeds you want to eliminate and follow the directions carefully.

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Common Mallow *Malva neglecta*

Common Mallow *Malva neglecta*

Common mallow is most frequently found in newly seeded lawns or lawns that are stressed and lack density. It can be an annual or biennial. Mallow has a deep taproot but can be easily pulled from moist soil. The foliage resembles that of the geranium. The flowers of common mallow are pinkish-white and the fruits look like small, round cheeses.

Control Increasing turf density with proper mowing, fertilization, watering and other cultural practices can help in the control of this weed. Post-emergent herbicides are only marginally effective. Triclopyr + clopyralid or triclopyr alone are suggested.

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Common Mullein *Scrophulariaceae*

Common mullein, also known as wooly mullein, velvet dock, flannel leaf, Aaron's rod, torch plant, and miner's candle is a member of the figwort family.

Common mullein was brought over from Europe by early settlers. It was used as a medicinal herb in the treatment of coughs and diarrhea and as a respiratory stimulant for the lungs when smoked. A methanol extract from this plant has also been used an an insecticide for mosquito larvae.

A biennial, first year mullein plants are low-growing rosettes about 5 inches in width. The felt-like leaves are a bluish green in color. Flowering plants are produced the second year, growing 5 to 10 feet in height including the flowering spike. This leafy spike produces five-petaled flowers that bloom a few at a time all summer. The tiny seeds can germinate after lying dormant for several decades.
Mullein plants have shallow tap roots and are easily hand-pulled. Recently, weevils (Gymnetron tetrum) that feed on the seeds have been found effective in reducing seed production.

Control: When hand-pulling is not safe or practical, such as on a steep slope, herbicide control is an effective option. This is especially effective during the rosette stage. Because of the wooly nature of the leaves, herbicides should be mixed with a surfactant to facilitate uptake. A 2% solution of glyphosate or triclopyr and water, plus a non-ionic surfactant, can be applied using a hand sprayer. Use with care around desired plants as glyphosate is a non-selective herbicide. Always read and follow the directions carefully when using a herbicide.

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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Common Yarrow Achillea millefolium L.

(western yarrow: Achillea millefolium L. var occidentalis DC, Achillea lanulosa Nutt., Achillea millefolium ssp. lanulosa (Nutt.) Piper)

Asteraceae (Sunflower family)

Origin: common yarrow is an introduced variety from Eurasia, although western yarrow' which is almost indistinguishable from common yarrow--is native to the American continent.

Location: turfgrass, roadsides, waste areas, public parks, dry hillsides, overgrazed rangeland, open woodland, and grassland

Occurrence: Yarrow is dormant in the winter months, although leaves can remain green. Rhizomes resume growth in spring. Flower stalks develop by mid-summer, and flowers are generally produced from mid-summer through early fall, followed by mid-autumn seed maturation. Seeds can germinate immediately, especially if temperatures are between 65ºF and 75º F. Flower stalks subsequently dry out and become brittle.

Description: A low-growing, spreading perennial with upright flower stalks that can reach 3 feet in height. Each plant produces one to several flower stalks, which are often branched and covered by fine hairs. Leaves are featherlike, with tiny, fine leaflets lining each side of the leaf stem. Leaves are arranged along the stem at even intervals. Leaves grow between 1 and 6 inches long and 1/4 - 1 inch wide. Flower heads are borne in flattened or umbrella-shaped clusters at stem tops. Each individual flower head consists usually of five, 1/8 inch long, white to pinkish-white ray flowers surrounding 10-20 pale yellow disk flowers.

Weedy Characteristics: Yarrow is tolerant of a wide range of conditions, including drought and poor soil.
The plant spreads mostly by the development of rhizomes, producing new plants from rhizome tips. When fragmented, rhizome parts will produce new plants, even from as deep as 12 inches within the soil. Its rhizomatous habit allows yarrow to tolerate frequent mowing. Yarrow also reproduces by seed, producing thousands of seeds per flowering stalk. The seeds are distributed by wind, and remain viable in the soil at least 9 years.

Control: A well-fertilized lawn with soil that does not remain dry for long periods will have a competitive edge over yarrow. Digging and hoeing small patches of yarrow can be effective, but rhizomes must be completely removed for thorough control, as broken rhizomes can grow independently and produce new plants. Yarrow does not tolerate shade well, and will not thrive in the shade of healthy garden plants. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Yarrow has been used for many medicinal purposes, including fever and pain relief, and wound poultices (thus the common names "bloodwort" and "soldier's woundwort"). It is a food source for some wildlife, and is attractive to insects. Although not often grazed by domestic cows or horses, yarrow contains substances which would be harmful if ingested in large amounts, and cows that graze it produce poor-tasting milk.

The plant is used in flower arrangements, and the crushed leaves and flowers have a pungent fragrance. Yarrow has been used in erosion control projects, because of its rhizomatous growth habit. Closely related western yarrow is a native to North America, and is almost indistinguishable from common yarrow, especially because the two will hybridize with each other. Yarrow's seed is considered noxious in Alaska.

Crabgrass *Digitaria sanguinalis*

Crabgrass *Digitaria sanguinalis*

Crabgrass is a summer annual grass with wider blades and a lighter green color than bluegrass. It is low growing, prostrate, and often has reddish-purple stems. It forms seedheads below mowing height. The seedheads are composed of slender, fingerlike spikes. Crabgrass is less prevalent when turf has good density. In particular, mowing too low promotes crabgrass seed germination. Maintain mowing heights of 2.5 - 3 inches.

Control A pre-emergent herbicide (benefin + trifluralin, dithiopyr, DCPA, oxadiazon, pendimethalin, or prodiamine) applied correctly and at the proper time should provide control. Do not use a pre-emergent herbicide on a newly seeded or sodded lawn or when overseeding a lawn. Fenoxaprop and other post-emergent "crabgrass killer" (MSMA, DSMA, MAMA) sprays are not effective unless crabgrass plants are immature, young seedlings. Always read the label before applying any pesticide.

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Creeping buttercup

Control: Creeping buttercup is seen mostly as a problem in pastures, so this publication discusses controls only in a pasture environment.
• Most livestock owners seem unaware that buttercup is an undesirable plant. It's commonly allowed to increase until livestock become ill or die.
• Most pasture management techniques such as competitive planting, close mowing, or controlled grazing aren't effective against creeping buttercup.
• Because it's a creeping perennial, it grows low enough to escape control by mowing.

The continual movement and rooting of stems allows buttercup to gradually invade even the densest pasture.
• Buttercup is so irritating that it's avoided by grazing animals; thus, it's given an advantage over pasture species that are closely grazed.

Mechanical: Creeping buttercup is easy to kill by cultivation if the ground can be worked up and tilled several times during a fallow period. New plants will appear from seed when the land is again used as a pasture. Most of the pastures infested with creeping buttercup are in coastal areas where the land rarely gets dry enough to make repeated tillage an option.

Chemical: Creeping buttercup can be controlled in pastures containing grasses or clovers by using selective herbicides. Not all herbicide labels permit the same uses, even those with the same active ingredient. Be sure the label of the product you're considering permits use on the intended site. No herbicide may be used on a site or crop for which it's not labeled. However, the absence of a particular weed from the label doesn't prevent use of the herbicide on that weed. Herbicide registrations change frequently; therefore, this publication doesn't contain specific herbicide recommendations.

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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.

Creeper, Bearded *Crupina vulgaris*

USDA Symbol: CRVU2

Other common names: common crupina

Description: Winter annual; flowers June to July. Grows one to three feet tall. Leaves alternate, with a coarse, rough texture when touched. Cotyledons (seed leaves) have a dark purple vein. Flower heads narrow and topped with pink, lavender or purple flowers in groups of up to five. Seeds have a distinct ring of dark, stiff, bristles encircling broad end.

Impacts: Found in range, forest and disturbed non-crop lands. The primary Pacific Northwest habitat is southern slopes in steep canyon grasslands.

Introduction: Common crupina is a native to the Mediterranean region. The source and means of crupina's introduction into the U.S. is not known. The first population was discovered in Idaho in 1969.

Creeping Yellow Cress *Rorippa sylvestris*

USDA Symbol: ROSY

Other common names: yellow fieldcress

Description: Perennial; flowers June to August. Grows up to 20 in tall. Leaves 2 to 4 in long and pinnately divided into narrow, sharply toothed lobes. Flowers yellow with four small petals.

Impacts: A common pest of Netherland ornamental bulb production areas. This plant can reduce bulb crop value and marketability as a contaminate of nursery stock. It invades disturbed wetlands, and some evidence suggests that this species may be allelopathic.

Crownvetch, Trailing *Coronilla varia*

Family: Pea Family (Leguminosae)
Other Names: axseed, axwort, hive-vine, trailing crownvetch, trailing crown-vetch.
Origin and Distribution: Crownvetch is a European species that was introduced into North America in the 1950's as a groundcover. It was mainly planted along highways and on embankments to control soil erosion. However, it spread rapidly and is now naturalized in many locations throughout the northeastern U.S. including fields, roadsides, and waste areas. Crownvetch prefers to grow in full sun but can tolerate many soil types and is especially adept at growing on sloping land.

Plant Description: Crownvetch is a perennial characterized by compound leaves made up 11 or more small leaflets arranged in pairs and pinkish flowers resembling those of peas, beans, or clovers that are grouped into head-like clusters. Stems are long and trail along the ground, forming a tangled mass less than 2 feet tall. Reproduction is by seeds.
Root system - Roots form a perennial crown.
Stems - Trailing stems are generally branched and hairless.
Leaves - Leaves are 2 to 4 inches long and consist of 11 or more small leaflets arranged in pairs. Leaflets are broad, oval, and about 1/2 to 3/4 inch long.
Flowers - Each flower is comprised of a single upper petal (standard) that is predominantly pink and two side petals (wings) that are often white. Flowers are grouped in head-like clusters that are about 1 inch wide.
Fruits & Seeds - The pods of crownvetch are long and slender and look like miniature pea pods. Each pod contains several seeds. Seeds are smooth, brown and oblong.

Similar Species: Vetches (Vicia spp.) look similar except they have tendrils at the ends of their trailing stems and flowers that are either solitary or grouped in elongated rather than head-like clusters.

Biology: Plants flower between June to August. Because it is low-growing, crownvetch does not require mowing. Therefore, it is low maintenance and especially suited as a ground cover for use on sloping land. However, plants establish and spread quickly. Crownvetch inhibits growth of other species by climbing over and shading them. Therefore, do not plant crownvetch where its spread cannot be tolerated. Crownvetch will not invade shaded areas and it does not seem to survive cultivation. However, if only partially plowed, it can regenerate from buds on rootstocks. Growth may also be controlled through cautious use of selective herbicides.

Toxicity: The plant and its seeds are considered poisonous in Europe and elsewhere; however, there is little known about the possible toxic nature of the weed.

Related Information:

- ✓ Crownvetch has few natural insect predators, which can result in increased invasiveness.
- ✓ Crownvetch adds nitrogen to the soil and for this reason, it is frequently used to restore strip-mined soils.

Curlycup Gumweed *Grindelia squarrosa (Pursh) Dunal*

Asteraceae (Sunflower family)
Origin: North America
Location: waste areas, roadsides, overgrazed rangeland, and cropland
Occurrence: Most curlycup gumweed seeds germinate and begin growth in late spring, when daytime temperatures are between 62^{o} and 77^{o}F. Spring-germinating plants form a rosette the first year and remain in the rosette stage until the second year when stems and flowers are produced. Some seeds germinate in the fall, however, and behave like winter annuals, completing their life cycle the following season. Flowering takes place from mid-summer to early fall, and average length of bloom time is 41 days. Seed ripening takes place by mid-fall.

Description: An erect biennial or short-lived perennial with one to several green, reddish, or whitish branching stems. Stems grow 1-3 feet tall. Leaves are borne alternately along the stem, and typically clasp the stem, with no stalk. Leaves have an oval or linear shape with serrated margins, are 1/2 - 2 1/2 inches long, and are covered with glands that exude a sticky resin. Bright yellow flower heads are borne at the tip of each branch, held in bright green cups of tiny, resinous bracts that curl in hooks away from the flowers. Flower heads grow up to 1 inch across and are sticky with resin. As the plant matures, flowers are replaced by tiny, ridged, four-sided, off-white seeds, to which two to three bristles are attached at the tip.

Weedy Characteristics: Curlycup gumweed reproduces by seed. Healthy plants are capable of producing 30,000 seeds, which are dispersed by the wind. Due to a deep taproot and an extensive shallow root system, gumweed is quite drought resistant. It is also tolerant of most soil types, including saline soils. It is able to colonize, and even thrive, in areas that other plants cannot tolerate. In fact, the plant can form dense stands in dry conditions with poor soils.

Control: Young plants and small infestations can be eliminated by hand-pulling, digging, or hoeing. In addition, frequent tilling of the soil can control older plants. Curlycup gumweed does best in open, high-light situations, and its vigor can be reduced when a healthy desirable plant population imposes shade and competition on the plant. Mowing curlycup gumweed can prevent seed production, but it may adapt to repeated mowing by forming a more prostrate habit. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Because of its long bloom time and aromatic scent, curlycup gumweed has been used as an ornamental. Its seeds are eaten by sage grouse. Gumweed has been used traditionally to treat a wide array of medical conditions, and extracts of gumweed are used today to treat ailments such as asthma, whooping cough, and poison ivy rashes. The plant can absorb high levels of selenium in certain soils, which may cause chronic poisoning in livestock. However, the resins gumweed secretes cause it to have a bitter flavor, and many grazing animals avoid it. Due to this avoidance, curlycup gumweed increases in abundance on rangeland, and crowds out desirable plant species for livestock to graze.

Other Common Names: curlytop gumweed, gumplant, gumweed, rosinweed, sticky heads, tarweed.

Curly Dock *Rumex crispus See Dock, Curly*

Curly Dock *Rumex crispus*

Curly dock is a perennial weed in the buckwheat family. Fairly pleasant tasting, the leaves are very rich in vitamins, especially vitamins A and C, and can be eaten raw or cooked. The roasted seed has been used as a coffee substitute. It is also a very important food plant for the cater-pillars of many butterflies. In the spring, basal leaves emerge from a stout taproot. These elongated leaves have wavy margins, thus the name "curly" dock. In summer, the plant has reddish, rigid stems, 2-4 feet tall. Flower stems have greenish flowers.

This is a tenacious perennial weed that is found in lawns throughout the United States. Its large taproot grows deep into the soil, which enables it to thrive in times when grass may be suffering from heat and lack of moisture. In fall, winged fruits form on the flowering stems that are reddish-brown in color. Curly dock is not easily pulled because of the deep taproot, and portions of this root left in the ground will regenerate.

Control Combination herbicides containing mecoprop, dicamba and 2,4-D are effective in the control of Curly dock.

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Cutleaf Teasel *Dipsacus laciniatus*

USDA Symbol: DILA4

Other common names: cut-leaved teasel

Description: Biennial; flowers July to September. Grows up to seven feet tall. Rosette leaves ovid to oblong, mature leaves opposite, large, oblong and prickly. Upper stem leaves irregularly lobed. Stems tall and prickly. Flowers small, white and packed into ovate heads. Common teasel is similar, but has purple flowers and no lobes on upper leaves.

Impacts: Invasive in grasslands, savannahs and waste areas.

Introduction: Cutleaf teasel is a native of Europe and was introduced to North America in the 1700s. Teasel is currently used in horticultural plantings and dried flower arrangements.

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Daisy, Oxeye *Chrysanthemum leucanthemum*

Family: Daisy Family (Compositae)
Other Names: Leucanthemum leucanthemum, Leucanthemum vulgare, butter daisy, dun daisy, Dutch curse, field daisy, golden flower, goldens, gowan, grand marguerite, great ox-eye, horse daisy, horse gowan, kellup-weed, marguerite, Maudlin daisy, Maudlinwort, moon daisy, poorland flower, poverty-weed, sheriff-pink, thunderflower, white daisy, white flower, white-weed.
Origin and Distribution: After ox-eye daisy was introduced into North America from its native Europe, it became regarded by some people as an attractive flowering plant while others viewed it as nothing more than a noxious weed. The plant is now naturalized throughout the U.S. It typically grows in patches in fields, roadsides, railroads, waste places, open woods, and disturbed areas such as lawns and gardens. It rarely grows in wet soil.

Plant Description: Ox-eye daisy is a clump-forming perennial distinguished by lower leaves that are dark green, hairless, somewhat fleshy, and coarsely toothed and conspicuous daisy-like flowers with white rays and yellow centers. Rhizomatous roots are another identifying feature. The plant reproduces by seeds and short rhizomes (horizontal underground stems).
Root system - The root system is generally composed of shallow unbranched roots and rhizomes (horizontal underground stems).
Seedlings & Shoots - The first two leaves that emerge (cotyledons) are oval. Following these seed leaves are young leaves that are smooth, dull above, pale beneath, and have shiny veins and dark green splotches on tissue between the veins. Young leaves emit a faint tansy odor if crushed.
Stems - Stems are slender, stiff, 1 to 3 feet tall, sometimes curving upwards, and usually unbranched but may be forked near the top. Many stems emerge from the rosette of leaves formed at the root crown, or a single stem can emerge at the end of an upturned rhizome.
Leaves - Rosette leaves are spoon-shaped, coarsely toothed or lobed around the edge, and attached to the stem by way of a long leaf stalk (petiole). Lower stem leaves are alternate (1 leaf per node), spoon-shaped, coarsely toothed or lobed, 6 inches long, dark green, glossy, fleshy, and attached to long petioles. Leaves located on the middle and upper portions of the stem are narrower than basal leaves, 3 inches long, alternate (1 leaf per node), and toothed or lobed. Petioles are gradually lost so upper leaves generally have clasping bases.
Flowers - Flowers are clustered into 1 to 2-inch-wide heads that form singly at the ends of stems and branches. Flowers consist of many yellow disk flowers densely packed into the center surrounded by 20 to 30 white ray flowers, each less that 1/2 inch long.
Fruits & Seeds - Ox-eye daisy produces oval seeds that are 1/16 inch long, curved, with one side straight and the other convex, and have a prominent knob-like projection on top. Seeds are black with 8 or 10 white ridges or ribs.

Similar Species: Mayweed chamomile (Anthemis cotula) and corn chamomile (A. arvensis) have similar flowers, but the leaves of both species are finely dissected.

Biology: Flowering begins in May or June and continues until autumn. Because spread is by way of short rhizomes, dense patches often form. To control mechanically, plants should be mown as soon as flowers appear.

Dalmatian toadflax *Linaria dalmatica*

Dalmatian toadflax *Linaria dalmatica*

Dalmatian toadflax, a native of the Mediterranean region, was introduced to the Americas in 1900 as an ornamental. The pioneers loved this plant because of its lavish, bright yellow flowers and its durability. Toadflax was easy to establish and homesteaders liberally landscaped their properties with this drought resistant plant, continually spreading it in their migration to the Western frontier. Also, burial sites were often adorned with toadflax to give everlasting beauty and tranquility. Their legacy has prevailed, proving to be notorious in nature.

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Dandelion, Common *Taraxacum officinale*

Dandelion *Taraxacum officinale*

The Dandelion is a perennial with an extensive taproot. Its yellow flowers can develop anytime between March and November and are followed by fluffy seed heads. More prevalent under low turf density, dandelion growth can be inhibited by increasing the turf density. Dandelions can be dug out with special tools, but any part of the root that is left is capable of regenerating a plant.

Control A 2,4-D or 2,4-D combination herbicide is most effective and should be used in spring and fall. Always read the label before applying any pesticide.

Asteraceae (Sunflower family)
Origin: Eurasia
Location: lawns, gardens, roadsides, waste areas, parks, cropland, orchards, overgrazed rangeland, pastures, and woodland
Occurrence: Seedlings emerge throughout the growing season. In the first year of growth dandelions generally form a rosette, but the plant does not flower. Flowers are produced in all subsequent years. Flowering begins in mid-spring and continues throughout the growing season, with most occurring at temperatures between 60º and 70ºF. Flower heads bloom for 3-4 days, and are open in sunny, warm conditions and close up in rainy or cold conditions. Seed heads develop within 2 weeks of flowering. Seeds are able to germinate immediately.

Description: A simple herbaceous perennial, which generally grows between 1 inch and 2 feet tall. Leaves are arranged in a low-growing rosette, and are 2-12 inches long and 1/2 - 4 inches wide. Leaf shape varies, from having wavy or toothed margins to having deep, pointed lobes. The rosette produces one or more hollow flower stalks that grow 2 - 24 inches tall, depending on conditions. A single, bright-yellow flower head develops at the apex of each stalk, and is 3/4 - 2 inches in diameter. The seed head is composed of many 1/8 inch-long rough, brown, oblong fruits with white hairs attached at the tip, collectively forming a globe shape.

Weedy Characteristics: Dandelion can tolerate a wide range of conditions and can live more than 10 years. The plant reproduces largely by seed, and seeds do not require pollination. Each seed head can produce hundreds of seeds, and in optimal conditions each plant can produce dozens of seed heads annually. The seeds are widely dispersed by the wind, but are also carried by water and grazing animals.

Although it thrives best in moist, sunny environments, dandelion can tolerate dry or partially shady sites. Its long taproot extends more deeply into the soil than grass roots, allowing it to absorb water and nutrients to its advantage. When cut, the taproot can regenerate within 2 weeks.

Dandelion's low-growing rosette enables it to survive frequent mowing and grazing. It also secretes chemicals that interfere with nearby plant growth and contribute to its competitiveness.

Control: Prevention of seed production is not an effective means of control, since plants produce seeds all year, and continue to produce seeds perennially. Dandelion populations can be reduced by digging, hoeing and tilling, although the plant is likely to regenerate if the taproot is not removed entirely. Such control measures are most productive in the fall, by which time most seedlings have emerged. In turf, encourage competitiveness with dandelion by maintaining a healthy lawn with adequate moisture, nutrients and light, and mowing at higher settings. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Dandelion exudes a milky juice when damaged. The plant is high in protein, beta carotene and minerals, and all parts of the plant are edible, fresh or cooked. Dandelion has been used in salads or soups, made into wine or tea, or used as a coffee substitute, among other things. It also has been used to treat a wide variety of medical conditions, and is a diuretic.

Dandelion can serve as an important food source for various wildlife and domestic animals, including bear, deer, birds, rodents, insects, sheep and cattle. It secretes chemicals that can interfere with the growth of other plants, but can beneficially inhibit the activity of some disease-causing organisms, as well. On the other hand, dandelion can serve as a host of detrimental viruses, bacteria, and insect pests. The plant can be a serious problem in some crops and cause reduced crop yields. The plant is noxious in Alaska and four Canadian provinces, and is considered invasive in several U.S. states.

Other Names: Lentodon taraxacum, bitterwort, blow-ball, cankerwort, clockflower, common dandelion, Irish daisy, lion's tooth, piss-in-bed, pissinlit, priest's crown, puffball, swine's snout, telltime, yellow gowan.

Origin and Distribution: Probably a native of Eurasia, dandelion is now widespread in North America (found in all 50 states and southern Canada) and over 60 countries throughout the world. It is common in lawns, pastures, roadsides, waste places, and is rapidly becoming a troublesome weed in agronomic fields under reduced tillage regimes. The species requires moist soil and sunlight in order to establish and thrive.

Range: throughout the United States; found in lawns, fields and meadows, along roadsides, cracks of sidewalks, and disturbed habitats.
Origin: Native of Europe and Asia

Botanical description: The common dandelion is a perennial, herbaceous plant with long, lance-shaped leaves that are deeply toothed. The leaves are 3 to 12 inches long and grow from a basal rosette. It has yellow composite flowers that are 1-2 inches wide and grow individually on hollow, purplish stalks 2 to 18 inches tall. Each flower head is made up of hundreds of tiny rays. Familiar to most viewers is the white, globular "seed head".

The dandelion has a thick, highly branched taproot. All parts of the plant contain a sticky, milky white sap.

Dandelions are generally easily recognizable in all seasons. The growth of leaves from the basal rosette, the leaf shape with its characteristic multi-toothed edges (although some dandelions exhibit less toothiness and a smoother, broader leaf these are generally found in shady areas) is easy to spot even in winter. If unsure, break a stem or leaf and the characteristic milky sap will emerge. When in bloom, dandelions are bright yellow and hard to miss.

What's in a name: The genus name of the dandelion comes from the Greek word taraxos, which means disorder, and akos, which means remedy. The species name, officinale, means that it is used medicinally. The common name may come from the Greek word leontodon, which means lion's tooth. Other sources claim the word dandelion comes from the old French word Dent-de-lion or from the Latin dens leonis, both also meaning lion's tooth or teeth.

All in the family: The common dandelion is a member of the Composite family, with relatives including Ecinachea (purple coneflower), chicory and other daisy-like flowers.

Cultural uses: Various Native American groups used dandelions for food, a dermatological aid, a gastrointestinal aid, a cure for sore throats, an analgesic, a blood purifier, a sedative, a laxative, an emetic, a love potion, and a general tonic for good health. The first use of the dandelion as a medicine was by Arabian physicians in the 10th and 11th centuries. References to the use of dandelion as a medicine was also found writings of physicians in Wales in the 13th century.

Today, dandelions are still used as food; many enjoy the dandelion leaves boiled like spinach or mixed in salads. Baby dandelion leaves are often found in haute cuisine. The root, when dried, has been used in coffee substitutes. But it is as a medicine that dandelion continues to shine. Dandelion leaves are used as a diuretic, but an unconventional one. While most diuretic preparations leach potassium from the body, dandelion leaves provide an abundant source of potassium. Leaves are also used to treat high blood pressure because of their ability to reduce the volume of fluid in the body. Dandelion root has been shown to stimulate bile production by the liver and is used to cleanse the liver. The root is also a gentle laxative. It is considered one of the most effective detoxifying herbs. It works on the liver, the kidneys and the gallbladder to accelerate the removal of toxins from the body. It also is used to relieve constipation, skin problems such as eczema and psoriasis, to prevent and possibly dissolve gallstones, and to treat osteoarthritis and gout. Parts of the dandelion may be consumed in a tea, a wine, an extract or tincture, or in combination with other medicinal herbs and flavorings in a reduced broth.

Active compounds: sesquiterpene lactones, triterpenes, vitamins A,B,C,D, coumarins, carotenoids, potassium and other minerals, taraxacoside, and phenolic acids

Research: Various clinical studies have demonstrated the legitimate use of dandelion as a diuretic, a bile production stimulant, a mild laxative, and an excellent source of potassium. Other studies have been only mildly indicative of any medicinal properties of dandelion, and those have been done in mice and rodents.
In lore, legend and life: Dandelions were actually brought to the United States from Europe to provide food for honeybees; now they grow wild worldwide and are more difficult to exterminate than almost any other weed.

Dandelions are used to make an herbal beer in England and Canada. Children use dandelion seed heads to make wishes by blowing the seeds away from the receptacle on which they are held.

Dandelion pollen causes severe allergic reactions in people who are sensitive to other pollens such as ragweed.

Young dandelion buds can be fried in butter and eaten; enthusiasts claim they taste like mushrooms.

Dandelions have been called "piss-a-beds" because of their strong diuretic properties.

Daylily, Tawny *Hemerocallis fulva*

Family: Lily Family (Liliaceae)
Other Names: common daylily, daylily, Eve's thread, orange daylily, tawny orange lily.
Origin and Distribution: Tawny daylily is a hybrid member of a genus native to the temperate regions of Asia. Legend indicates that it was brought to North America by sea captains, who presented the flowers to their wives after traveling the Orient. Following its introduction, tawny daylily was widely cultivated in North American gardens, and escaped plants may now be found scattered throughout temperate regions of the continent. Tawny daylily is especially troublesome in the northeastern U.S. It can be found growing weedy along roadsides and banks, and in neglected meadows and other waste areas. Plants grow best in rich, damp, gravelly soil, and can tolerate full sun to partial shade.

Plant Description: Tawny daylily is a clump-forming perennial, characterized by its beautiful orange flowers which line the roadsides in July. This species is not a true lily, as indicated by its unspotted blossoms and leafless stems. Tawny daylily reproduces primarily by rhizomes (horizontal underground stems) and tuber-like roots, and rarely by seeds.
Root system - Tawny daylily develops rhizomes (horizontal underground stems) and fleshy, tuberous, spindle-shaped roots, with thinner, fibrous roots growing from both to form a dense system.
Stems - Stems are smooth, round, leafless and branched at the top, growing 2 to 4 feet tall (sometimes up to 6 feet). A few small, leaf-like bracts may develop in the upper portion of the stem.
Leaves - Sword-like leaves are arranged in pairs and grow only at the base of the plant. The leaves are 1 to 3 feet long, narrow, smooth and slightly folded, with a central ridge running lengthwise down the back of the leaf.
Flowers - A few to several upward-facing flowers are borne in a branched cluster at the top of the stem. The blossoms are orange, funnel-shaped and unspotted. Each flower opens for only one day, and is composed of 3 petals with wavy margins and 3 petal-like sepals. The petals and sepals are fused below the middle to form a tube, but spread widely at the top to form a blossom 3 1/2 inches wide. The blossoms do not have a fragrance.
Fruits & Seeds - A 3-sectioned capsule is produced. Since this species is a hybrid, most plants do not produce seeds, but if produced, seeds are rarely viable.

Similar Species: The yellow daylily (also called lemon lily, Hemerocallis lilio-asphodelus, Hemerocallis flava) is another introduced species from Asia that has spread from cultivation. It can be distinguished from tawny daylily by its fragrant, yellow, spring- to summer-blooming flowers, and its smaller stature. Tawny daylily may be confused superficially with the native wood lily (Lilium philadelphicum), a true lily whose orange, upright flowers may be seen blooming along roadsides and in clearings. However, the wood lily has spotted flowers and leaves growing along the length of the stem.

Biology: The tawny daylily blooms from June through July. Flowers open in the morning and close around dark, never to open again. However, because there are many flower buds on each stem and many stems in a clump, plants may bloom for several weeks.
Tawny daylily is a hybrid species, and plants found in the U.S. tend not to produce seeds. Instead, plants spread by rhizomes and tuberous roots. Control of tawny daylily involves plowing and raking in the fall, followed by clean cultivation, or hand-removal of the root system for small infestations.

Toxicity: Although all parts of the plant are edible, some reports warn that consumption of large quantities of young shoots can be hallucinogenic and should be avoided.

Related Information:

- ✓ The genus name of tawny daylily, Hemerocallis, means 'beautiful for a day', and the species name, fulva describes the tawny orange color of the flower.

- ✓ All parts of the daylily are edible, and plants have been cultivated for thousands of years in Asia for food. The buds or new flowers are regularly cooked and eaten in China and Japan. In addition, the rhizomes can be chopped and cooked like potatoes, and are said to be as sweet as sweet corn. The tuberous roots have a nutlike flavor, and can be eaten raw or roasted. Young shoots have been prepared like asparagus, but consumption should be avoided (see Toxicity).

- ✓ Many new daylily hybrids have been or are being developed in this country, providing a wide variety of flower colors, shapes and sizes, as well as flowers that may last a week or more.

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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.

Dock, Broadleaf *Rumex obtusifolia*

Family: Smartweed Family (Polygonaceae)
Other Names: R. elongatus, bitter dock, blunt-leaved dock, celery seed, narrow-leaved dock, red-veined dock, sour dock, yellow dock, butter dock, wayside dock.
Origin and Distribution: Broadleaf dock is a native of Europe that is found on all continents as a weed of pastures, small grains, and reduced tillage cropland. It is also a weed in orchards, lawns, and home gardens as well as along roadsides and waste areas. It is usually found on floodplains, along borders of woods, around buildings, in poorly drained and nutrient rich soils, but is also common in some upland sites and on acid soils.

Plant Description: Broadleaf dock is a rosette-forming perennial with a deep taproot that can reach depths of up to 5 feet. It reproduces primarily by seeds, but there is limited regeneration from root tissues. The plants grow as a basal rosette with relatively large leaves. The hairless reproductive stem may reach heights up to 5 feet and will have smaller versions of the basal leaves arranged alternate. The smartweed family is characterized by a papery sheath (called the ocrea) that cover each node. Terminal clusters of small inconspicuous flowers with greenish petals (which turn red at maturity) are formed on the reproductive stems from June through September. Flowers do not contain any nectar and are wind-pollinated. Seedlings are capable of flowering in the first season. A cork-like 3-winged triangular fruit surrounds each seed; this fruit is buoyant and can be dispersed by water. One plant of curly dock can produce up to 60,000 seeds per year. In a long-term weed seed burial study, approximately 83% of the seeds of curly dock were still viable after 20 years. In a similar study started in 1879, about 2% of curly dock seeds were found to be viable after 80 years. Seeds are destroyed in passing through chickens and are relatively short-lived in silage. However, they can pass through other birds and cattle without loss of viability.
Root system - The root system is a stout, somewhat branched, yellow taproot that may extend as deep as 4 feet.
Stems - Stems are erect, tall (1 to 4 feet), and sparsely branched, arising solitary or in small groups from the root crown. A tall membranous sheath (ochrea) surrounds the stem above each node. Stems are smooth, sometimes ridged, and become red-brown with age. The erect rust-colored stems often persist into winter.
Leaves - Cotyledons are three times as long as wide; first true leaves are round. Subsequent leaves are broad, twice as long as wide, with heart-shaped basal lobes and somewhat wavy (but not curly) margins. Newly emerging leaves are distinctly laterally rolled. The petioles and veins on the underside are covered with short, white hairs. Rosette leaves are oblong, often with red veins and/or red spots on the upper surface. Upper leaves are smaller, lance-shaped, with pointed tips, and are arranged alternately on the stem (one per node).
Flowers - Flowers are not showy, but are made up of small, green sepals (no petals) that turn brown at maturity. They appear in loose whorls along the upper part of the elongating and branched stem. The flowers lack nectar and pollen is spread by wind.
Fruits & Seeds - The fruits of broadleaf dock are generally triangular, with jagged spreading teeth along the margins of the membranous 'wings' (sepals). Fruits contain a single glossy red-brown triangular seed enclosed in only one of the 3 sepals. A single plant may produce up to 60,000 seeds.

Similar Species: Curly dock (Rumex crispus) is a more widely distributed weed that is less tolerant of acid soil conditions. It is distinguished by relatively narrow curly-margined leaves, and membranous wings (sepals on fruits) that are not prominently toothed. At the seedling stage, the cotyledons of curly dock are longer and narrower than those of broadleaf dock. Common burdock (Arctium minus) also has broad leaves, but they are much larger, with hollow petioles, and a furry grey-green lower surface.

Biology: Seeds produced from a given plant vary greatly in their requirements for germination, which results in intermittent emergence in both spring and fall. Soil disturbance stimulates germination by exposing previously buried seeds to light and fluctuating temperatures, which are requirements for germination. Flower stalks are produced after about 35 days and regrowth from rootstocks is possible after about 50 days. Shoot regeneration occurs from shoot buds on the upper 3 inches of the taproot.

Plants emerging in fall form a rosette that overwinters, whereas plants emerging in spring can flower within 9 weeks and set seeds the first year. Broadleaf dock does not tolerate competition well, and if crowded will delay flowering until the second or third year. The plant's longevity is variable: some die after flowering and others live 3 to 5 years. The seeds are adapted for dispersal by wind, water, and animals. Winged sepals, made of cork-like tissue, are thought to aid in dispersal by allowing the fruit to move long distances by wind and to float along streams. The toothed wings allow the seeds to adhere to animals and machinery. In a buried seed study, 94% of seeds germinated after 3 years and 83% after 21 years. Seeds survive passage through digestive tracts of cattle and many birds (but not chickens). This weed is very commonly associated with moist situations; improved drainage has been suggested as an aid to management. It does not tolerate tillage, especially if it occurs within the first month and a half of growth or if the upper part of the taproot is destroyed.

Toxicity: Leaves may cause mild dermatitis in some individuals. These plants have been used as a laxative, astringent, and in cooking. The plants are generally not considered poisonous, however curly dock seeds are reported as being toxic to chickens. Cattle and horses can become ill if large quantities of leaves are consumed.

Related Information:

- ✓ The young leaves have been eaten as greens, but they become bitter early in the growing season. They may also have a laxative effect.
- ✓ Broadleaf dock leaves have been used to soothe burns, blisters, and nettle stings. A tea prepared from the root was thought to cure boils.
- ✓ An old name for broadleaf dock is 'butter dock' which derives from the use of the leaves to wrap butter for market.

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Dock, Curly *Rumex crispus*

Family: Smartweed (Polygonaceae) family
Other Names: Rumex elongatus, curled dock, sorrel, sour dock, yellow dock, narrow-leaved dock.
Origin and Distribution: Curly dock is a native of Europe, but today it occurs worldwide: above the Arctic Circle and on all continents. It is considered a weed in about 40 countries, making it one of the world's most successful non-cultivated colonizing plants. Curly dock is a common but not necessarily serious weed in 16 crops including pastures, hay crops, small grains, orchards, lawns, and home gardens. It is commonly found along roadsides and waste areas where it tolerates poor drainage but favors nutrient rich soils.

Plant Description: Curly dock is a herbaceous perennial with tall, erect stems. It reproduces by seeds and a thick fleshy taproot. It is a variable species that hybridizes with other dock species.
Root system - A stout, somewhat branched, yellow taproot may extend as deep as 4 feet, with side branches up to 3 feet long.
Stems - Stems are erect and tall (1 to 4 feet), arising solitary or in small groups from the root crown. Stems are smooth and sometimes ridged. A papery sheath surrounds the stem at each node. Stems turn red-brown at maturity and often persist into winter.
Leaves - Leaves of curly dock are long and relatively narrow, with curly or wavy margins resembling crisped bacon. Curly dock leaves sometimes have a bluish green color. Cotyledons are very narrow, grey-green, with a mealy surface, and first true leaves are mostly round. The base of rosette leaves is rounded to heart-shaped. Stem leaves are alternate (one per node), with a short petiole. Leaves decrease in size up the stem, the petioles flatten at the base and wrap around the stem.
Flowers - Flowers are not showy, but are small green three-winged sepals that become brown at maturity. They appear at the end of long, slender stalks (pedicles), attached in whorls (several per node) along the upper part of the elongating and branched stem. The flowers lack nectar and pollen is spread by wind.
Fruits & Seeds - Fruits of curly dock consist of three heart-shaped bracts or wings (sepals or valves) with smooth (not toothed) edges. One of the wings encloses a single, triangular, sharp-edged, glossy red-brown seed.

Similar Species: Broadleaf dock (Rumex obtusifolia), which has wide leaves with more-or-less smooth margins, is less widely distributed world-wide and in the United States than curly dock. In broadleaf dock, the sepals, and hence wings of the fruit, are irregularly toothed.

Biology: Curly dock is a cross-pollinated species that exhibits great variation in morphology and physiological characteristics. Seeds are released from dormancy at various times of the year, and germinate in response to light and fluctuating temperature. Seedlings that emerge early in the growing season produce flowers and seeds in the first year. Seedlings that emerge in autumn form an overwintering rosette and flower the following year. After about 40 days of growth, a seedling can produce shoots from the root crown. In springtime, shoots regenerate from buds at the upper 2 inches of the taproot. Flowers appear in May, about 9 weeks after shoot emergence, and can continue into October and November. Some plants flower twice a year. A single plant can produce 60,000 seeds, some of which germinate readily, while others can remain viable in the soil for over 80 years. Some plants flower and die in one seasons whereas others live 3 to 5 years. Curly dock establishes from seeds only at open, disturbed sites; it does not tolerate competition or tillage.

Toxicity: Ingestion of foliage or seeds has been responsible for several gastric disturbances and dermatitis in cattle and serious toxicity in poultry. Leaves contain soluble oxalates that can be toxic if consumed in large quantities or if not cooked properly.

Related Information:
- ✓ Dried fruit stalks have been used in flower arrangements and holiday wreaths. Native Americans reportedly used the seeds in flour and meal; they cooked a mush from the seeds, but only in times of need.

Dodder *Cuscuta and Grammica*

Dodder (Cuscuta and Grammica), is a twining yellow or orange plant sometimes tinged with purple or red. Occasionally it is almost white. The stems can be very thin and thread-like or relatively stout.

Description: Dodder is classified as a member of the Morning-Glory Family (Convolvulaceae) in older references, and as a member of the Dodder Family (Cuscutaceae) in the more recent publications. Dodder parasitizes various kinds of wild and cultivated plants, and is especially destructive to alfalfa, lespedeza, flax, clover and potatoes. Ornamentals attacked included chrysanthemum, dahlia, helenium, Virginia-creeper, trumpet-vine, English ivy and petunias.

The seedlings must attach to a suitable host within a few days of germinating or they die. Once the Dodder seedling finds a host plant, it quickly twines itself around the plant's stem. Dodder always twines in a counter-clockwise direction. Next, Dodder will lose its connection to the ground. It now totally depends upon its host. The basal part of the parasite soon shrivels away so that no soil connection exists. Its water, minerals and carbohydrates are absorbed from the host through haustoria that press up against the stem of the host plant and penetrate the tissue. In dodder the haustoria are modified adventitious roots. Dodder rarely kills its host plant, although it will stunt its growth.

The flowers are numerous, white, pink or yellowish, small (2 to 4 mm long depending on species), and can be borne in tight balls or in a loose cluster (again depending on species). Flowers normally appear from early June to the end of the growing season.

The fruit is about 1/8 th inch in diameter, with thin papery walls and contain 1 to 4 seeds. The seeds are yellow to brown or black, nearly round and have a fine rough surface with one round and two flat sides. These seeds drop to the ground and germinate the next growing season if a suitable host is present. If no suitable host is present, the seed may remain dormant for five years.

Other common names: love vine, strangleweed, devil's-guts , goldthread, pull-down, devil's-ringlet, hellbine, hairweed, devil's-hair, and hailweed. Dodder as a vector of disease

Phytoplasma, the cause of more than 200 so-called yellows diseases (previously thought to be caused by virus) are spread by several different vectors to include leafhoppers and dodder. Dodder has been shown to spread the yellows disease pear decline, aster yellows, tomato big bud, vinca virescence and elm phloem necrosis. In addition, phloem-inhabiting `rickettsialike' bacteria have been found to be present in dodder.

Allowing dodder to spread in a field or garden area is asking for an increase in the plant diseases this parasite is capable of spreading.

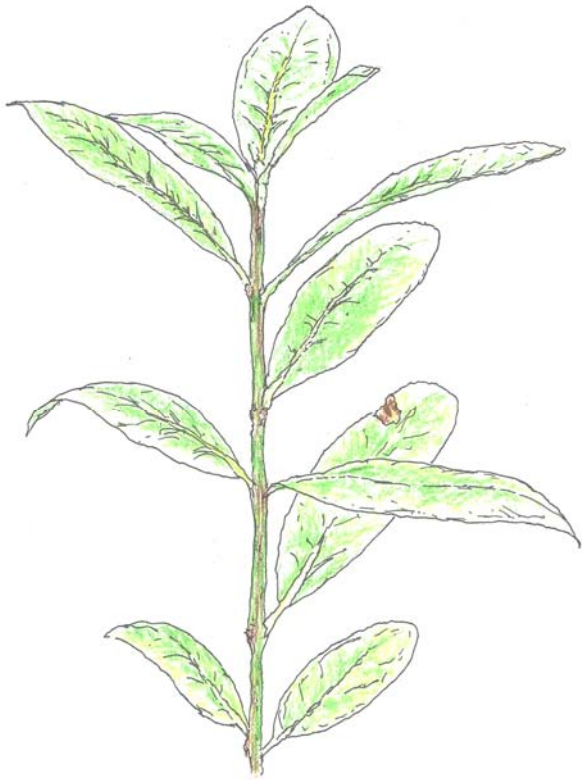
Control: Its wide host range and the long life of its dormant seeds make dodder hard to control and nearly impossible to eradicate. Dodder seed can be spread by irrigation water, in the manures of livestock that have eaten infested alfalfa, or along with the seed of crops that were infested with dodder.

Pulling and destroying dodder infected plants is recommended. Dodder must be destroyed before it produces seeds or infestations will spread.

Preemergent herbicides such as DCPA (Dacthal), applied to the soil in the spring prior to seed germination will prevent this pest. The use of a 2,4-D type herbicide or contact herbicide directed at infected hosts and dodder plants is effective in killing established parasitic plants (as well as the host). Always read and follow label directions when using herbicides.

Dogbane, Hemp *Apocynum cannabinum*

Family: Dogbane Family (Apocynaceae)
Other Names: American hemp, bowmans root, Choctaw root, dogsbane, Indian hemp, rheumatism weed, snake's milk.
Origin and Distribution: Hemp dogbane is a native of North America. Currently, its range extends throughout the continental U.S. Hemp dogbane is a weed of roadsides, thickets, open woods, wastelands, pastures, old fields, and cultivated fields. The species prefers gravelly soil and it often grows in moist habitats.



HEMP DOGBANE

Plant Description: Hemp dogbane is a stout perennial with a woody stem that is undivided at the base but becomes much-branched in its upper half. All parts of the plant exude a milky sap when cut, broken, or crushed. Hemp dogbane can be identified by its leaves, which are 2 to 6 inches long, opposite (2 leaves per node), elliptical, and smooth edged, and its small flowers that are greenish-white and form in clusters located at the ends of main stems and primary branches. Fruits are distinctive 4- to 8-inch-long pods that generally occur in pairs. Hemp dogbane reproduces by seeds, but the primary mode of reproduction of plants in agronomic fields is vegetative by way of creeping roots.
Root system - A characteristic of the root system is the ability to spread by way of horizontal creeping roots.
Seedlings & Shoots - Young leaves appear yellowish green with a powdery bloom beneath.
Stems - Stems are erect, slender, woody at the base, and marked with discontinuous purple lines.

Stems are covered with a fibrous bark and exude a milky sap if cut or crushed. Although stems are undivided at the base, they become much-branched in the upper half of the plant. Plants are usually less than 4 feet tall.

Leaves - Leaves are 2 to 6 inches long, opposite (2 leaves per node), and smooth-edged. Leaf shape resembles a slightly flattened egg. Leaves attach to stems by way of short leaf stalks (petioles). The underside of leaves may be finely hairy but the upper surface is usually smooth and pale or bluish green.

Flowers - Hemp dogbane flowers are small, bell-shaped, greenish-white, 5-petaled, and arranged in dense clusters. Flower clusters are located at the ends of main stems and principal branches.
Fruits & Seeds - Fruits are reddish-brown pods that are 4 to 8 inches long, sickle-shaped, smooth, narrow, and they generally occur in pairs. The brown seeds are thin, flat, and have a tuft of silky hairs at one end.

Similar Species: Spreading dogbane (Apocynum androsaemifolium) is a perennial that also spreads by underground creeping roots. It is distributed over the same general area as hemp dogbane but prefers drier habitat, is generally not as common, and is usually smaller. Spreading dogbane flowers are pinkish-white and form in clusters located on main stems, at the ends of principle branches, and at stem nodes where leaves attach to stems.

They are usually larger than hemp dogbane flowers, which are greenish-white and form in clusters that are always terminally located at the ends of main stems or principle branches. Hybrids having various combinations of these traits as well as intermediate characteristics commonly occur.

Common milkweed (Asclepias syriaca) and hemp dogbane share such characteristics as creeping roots, opposite leaves, and milky sap. However, young leaves of common milkweed are finely hairy while those of hemp dogbane are nearly hairless. Also, stems of hemp dogbane branch more than those of common milkweed, flowers differ in color, and pods of hemp dogbane are long and narrow while those of common milkweed and much broader.

Biology: Flowers are formed in June through August. Hemp dogbane shoots produced by creeping roots emerge from late May to mid-June. Creeping roots of a 2-year-old hemp dogbane plant were observed to grow 14 feet deep with a horizontal spread of 20 feet. Because plants spread by way of creeping horizontal roots, hemp dogbane plants often arise in patches.

Toxicity: There are no reported cases or direct experimental evidence of poisoning in humans, but hemp dogbane is considered by many to be poisonous to livestock. Several compounds possibly toxic to humans and other animals have been isolated but little is known about if or how they contribute to the toxic nature of the plant. There are reports of horses, cattle, and sheep poisoned from eating green or dried hemp dogbane. At one time, it was considered that 0.5 to 1 ounces of green or dry leaves could kill a horse or a cow. However, recent evidence suggests that this report was the result of an error.

Related Information:

- ✓ The fibrous stems and roots of hemp dogbane were used by Native Americans to make rope and clothing and they used the tough bark like hemp in basket making.
- ✓ Patches of hemp dogbane are capable of doubling in size during one growing season.
- ✓ Hemp dogbane is generally a problem weed in soybean (where data indicates that about 3 hemp dogbane shoots per square foot reduced yields up to 90%) compared with corn (where 10 to 15% yield losses have been reported).

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Dyers Woad *Isatis tinctoria*

USDA Symbol: ISTI

Other common names: Asp of Jerusalem

Description: Dyer's woad is a perennial or biennial that grows up to three feet tall. It has multiple stems that arise from the base. Foliage has distinctive blue-green cast with whitish glaze. The upper leaves are smaller and clasp the stem with ear like projections. Flowers are bright yellow, small and in clusters. Flowers have four spoon shaped petals. Fruits pods are flat and black or purplish brown. Flowering and the most vigorous growth will occur mainly in sandy, gravelly soils, and in marginal farmlands. Invades rangeland, grain fields, pastures, waste areas, roadsides, and fencerows. It can also be found in orchards and in rows of cultivated crops. Flowering and the most vigorous growth will occur mainly in sandy, gravelly soils, and in marginal farmlands. Invades rangeland, grain fields, pastures, waste areas, roadsides, and fencerows. It can also be found in orchards and in rows of cultivated crops.

Impacts: Dyer's woad forms dense stands in rangelands that crowds out native vegetation. This plant is highly competitive and often grows in dense colonies. It reduces forage availability by suppressing annual grasses and is low in palatability to grazing animals. It is allelopathic properties inhibit the growth of other plants around it.

Introduction: Dyers woad is native to Europe. it was introduced into the United States as a source of blue dye. Established in Virginia in colonial times. Its distribution in eastern United States is spotty. It has become widespread in the western part of the country. Its resurgence as a popular dye plant may greatly extend its range throughout the United States

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English holly *Ilex aquifolium*

English holly is a broadleaf evergreen tree/shrub that is grown ornamentally in the northwestern United States and Canada but is also commonly found escaping into forests in this region. English holly's native range is the British Isles to southern and central Europe. It is grown commercially in the Pacific Northwest and commonly used in decorations and floral arrangements as well as in landscapes.

Description

- ✓ Large, dense, slow-growing, evergreen tree or shrub, 15 to 50 feet tall and up to 15 feet wide or more
- ✓ Can grow as either a single-trunked tree or a multi-stemmed thicket.
- ✓ Leaves are thick, glossy, dark green and wavy, 1-3 inches long, alternate and simple.
- ✓ Leaves usually have sharp, stout spines along edges although may be smooth on older branches
- ✓ Flowers are small, whitish, inconspicuous, sweetly scented.
- ✓ Bunches of red, yellow or orange berries, poisonous to people but not to birds, borne on female trees in winter.
- ✓ Grows in shade or sun in well-drained soil.
- ✓ Creates deep shade under its canopy.

Reproduction and spread

- ✓ English holly is pollinated by bees so female trees must grow within bee range (100 feet or so) of a male to be pollinated.
- ✓ Holly berries are dispersed by birds.
- ✓ Also spreads by suckering and layering.

Impacts and distribution

English holly is carried by birds into forests where it can form dense thickets that dominate the tall shrub layer and suppress germination and growth of native tree and shrub species. English holly is reported as naturalized in Washington, Oregon, California, and Hawaii.

Control

- ✓ Small plants can be pulled or dug up when soil is moist.
- ✓ Mature trees have deep and extensive roots so digging is labor-intensive and results in considerable soil disturbance if all of the roots are removed.
- ✓ Cutting holly at the base usually results in re-sprouting from the crown, but with monitoring and follow up this can suppress the holly.
- ✓ Applying herbicide with the cut stump or frilling method are most effective. Foliar herbicide treatment is not very effective due to the thick, waxy leaves.

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 herbicides 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.

English laurel *Prunus laurocerasus*

English laurel, also called cherry laurel, is a large evergreen shrub or small tree often used for landscaping, usually as a hedge. Related to cherry trees, English laurel gets its common name from its resemblance to the true laurel tree. Native to southwestern Asia and southeastern Europe, this species has been widely introduced in Europe and North America, and has escaped cultivation in many areas, including the Pacific Northwest.

Description (see below for more photos)

- ✓ Tall, dense, spreading thicket-forming shrub or small tree, 10 to 30 feet tall (usually kept shorter by pruning), grows as either a single-trunked tree or a multi-stemmed shrub
- ✓ Evergreen leaves are dark green on top and pale underneath, thick, shiny, large (3 to 8 inches long), oblong, abruptly pointed at the tips, alternate on the stems, and have finely toothed edges and short leaf stalks
- ✓ Small white flowers in upright clusters (racemes) resemble cherry flowers, cup-shaped with 5 petals and fragrant, many yellow stamens
- ✓ Produces small, purplish-black, cone-shaped, cherry-type fruits, also in clusters
- ✓ Twigs green and smooth
- ✓ Poisonous parts include wilted leaves, stems, and seeds (may be fatal if eaten)

Reproduction and spread

- ✓ Reproduces through seeds, which are distributed by birds and possibly other animals
- ✓ Also spreads laterally by layering (growing roots from stems where they touch the ground)
- ✓ When cut, English laurel will sucker from the roots and re-sprout from cut stems
- ✓ Grows in sun or shade, moist or dry soils, but does best in moist, well-drained soils

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Control

Small plants can dug up when soil is moist (take care when handling because this plant is poisonous). To control larger plants, cut stems and trunks by hand or chainsaw, cutting as close to the ground as possible, and remove stems to make it easier to control re-growth. Stems can be chipped and used as mulch or taken to a landfill. Leaving stems on moist ground might result in some stem-rooting, but it is unlikely, and if stems are chipped this shouldn't be a problem.

After cutting, plants are very likely to re-grow. There are five main options for controlling the re-growth after cutting:

1. Dig out the stumps including as much root as possible. To avoid regrowth, stumps should be turned upside down and soil should be brushed off roots. Mature laurel trees have deep and extensive roots so digging is labor-intensive and may result in considerable soil disturbance. If the stumps are dug up, be sure to stabilize the area to prevent erosion and replant with appropriate trees and shrubs, especially on steep slopes. For large infestations or steep slopes, digging may not be the best method.
   -OR-

2. Monitor stems for re-growth and break off any new stems. This should be done regularly throughout the growing season over several years until the plant stops sending up new shoots. Some older plants won't re-sprout very much, but left alone, all English laurel will re-grow to some extent. Also, monitor the area for seedlings and pull them up. They are easy to spot with their thick, shiny leaves pointed at the tips. Applying mulch to the area will reduce seedling growth.
   -OR-

3. Immediately after cutting, treat stump by painting or spraying with glyphosate or triclopyr. Read the product label carefully for rate, timing and safety precautions. Herbicides may not be allowable in all locations, so contact your local jurisdiction about permitting requirements or restrictions.

4. Variations on the cut stump method that also work are frilling (chipping notches around the trunk and applying herbicide to the fresh cuts) or injecting herbicide into the trunk (this may require special injection tools). These methods can be used on large stems that have not been cut down, although it may be easier to first cut off smaller side stems and foliage to access the main trunk.
   -OR-

5. Spray re-growth and seedlings with triclopyr or glyphosate diluted according to the product label for controlling brush. Make sure to use an appropriate surfactant and follow the label recommendations on timing and safety precautions. As stated above, make sure to follow all local, state and federal rules regarding herbicide use at your site.

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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Evening Primrose *Oenothera biennis*

Family: Evening-Primrose Family (Onagraceae)
Other Names: coffee plant, cureall, fever plant, field primrose, four-o'clock, German-rampion, golden candlestick, king's cure-all, large rampion, night primrose, night willow-herb, sand lily, scabish, scavey, scurvish, speckled john, tree primrose, wild beet, yellow evening primrose.

Origin and Distribution: It is likely that common evening primrose, which is a North American native, was exported to Europe in the 1600's when written descriptions of it began appearing there. Now, it is naturalized all over Europe. In the U.S., its range includes an area between the east coast and North Dakota and it is located on the West Coast as well. Common evening primrose can be found growing in open disturbed areas such as fields, pastures, gardens, roadsides, and waste places. It prefers to grow in dry gravelly or sandy soil.

Plant Description: Common evening primrose is a biennial that produces a rosette of leaves the first year and flowers borne on an upright leafy stalk during the second year of growth. There are many biennial evening primroses that appear similar and can be difficult to distinguish. Most have 4-petaled yellow flowers that open at dusk. A few, including common evening primrose, have lance-shaped leaves without lobes. Leaves of common evening primrose usually appear thin and crinkled and may have a reddish midrib. Also, leaves on the lower portion of the stem are often purplish. Reproduction is by seeds.

Root system - The plant has a deep, yellow, fleshy taproot.
Seedlings & Shoots - The location on the stem where the first two seed leaves (cotyledons) attach is usually tinged bright red. Young plants grow as rosettes over the first winter. The midribs of rosette leaves are typically reddish.
Stems - Stems are upright, 1 to 6 feet tall, and woody. Branches form occasionally and always in the upper portion of the stem. The lower part of the stem is often tinged purple and somewhat hairy.
Leaves - Leaves are alternate (1 leaf per node), 4 to 8 inches long, and have edges that are wavy or slightly toothed. Leaves either attach directly to the stem or to a very short leaf stalk (petiole) connected to the stem. Leaf shape resembles the head of a lance. Leaves on the lower portion of the stem are often purplish and somewhat hairy. The midrib of each leaf may be reddish.
Flowers - Flowers are 1 to 2 inches wide, yellow, and have 4 oval-shaped petals. Flowers form at the tips of a long branches located on the upper part of the stem.
Fruits & Seeds - Fruits are woody cylindrical pods about 1 inch long that taper toward the end. Each capsule is divided by lengthwise partitions into 4 cells. When dry, seed pods split downward revealing 4 chambers and releasing numerous seeds. Seeds are dark reddish-brown, 1/16 inch long, have a rough surface.

Similar Species: Identification can be confusing because there is a large amount of variation within several very similar species in this genus. Therefore, an expert may be required if a definitive identification is needed. Similar species include cutleaf evening primrose (Oenothera laciniata) that looks similar to common evening primrose while young but has wavy or irregularly lobed leaves while those of common evening primrose have smooth edges. Meadow sundrops (Oenothera pilosella) shares many characteristics with common evening primrose except it has conspicuous soft hairs on the upper portion of its stems. Northern evening primrose (Oenothera parviflora) has thicker, narrow leaves compared with common evening primrose leaves, which are thinner and crinkled.

Biology: Flowering begins in June. Flowers open at dusk and generally wilt the following morning. Stalks continue growing throughout the season so there is a constant succession until about September. Woody stems and seed capsules often persist throughout winter. It is common to find 100 capsules on a plant and over 100 seeds in each capsule. Seeds can remain viable for more than 80 years if buried in soil. To eliminate common evening primrose from an area, the weed must be hoed while still in the rosette stage or mowed before seeds are produced. Response of common evening primrose to herbicide applications varies from tolerant to susceptible.

Toxicity: None known.
Related Information:

- ✓ It is thought that 'Oenothera' is Greek for 'wine scenting' and refers to the ancient use of evening primrose roots in scenting wine.
- ✓ The plant was likely named 'evening primrose' because its flowers open at dusk.
- ✓ Because flowers are open overnight, evening primrose flowers are usually pollinated by night-flying insects.
- ✓ Roots are edible if collected during the first year before the plant blooms.
- ✓ Common evening primrose has been assigned numerous medicinal properties. For example, researchers are experimenting with a rich oil extracted from the seeds for use as a treatment for burns and other skin wounds.

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.

False Brome *Brachypodium sylvaticum* (Huds.)Beauv.

USDA Symbol: BRSY

Other common names: slender false brome

Description: Perennial grass; forms short "squatty" bunches. Stems hollow with broad, flat one quarter to one third inch wide lax leaves and a leaf sheath open to the base. Leaf color a bright green that often remains through fall and part of winter. Leaf margins and lower stems hairy; ligules membranous . Flowers born in a true spike that droops noticeably, and spikelets with short or no stalks. False brome plants appear to be self-fertile producing few to a couple hundred seeds per plant. Isolated plants are observed to produce viable seeds and become new weed epicenters complicating control efforts. Seed movement by wildlife is locally important with both birds and small mammals transporting seeds. Deer and elk also are important vectors of localized spread. Long-distance dispersal is predominantly through logging activities, roadside maintenance equipment and recreational activities within infested areas.

Impacts: False brome can quickly become the dominant plant species in forest understories, demonstrating great shade and drought tolerance. It is able to grow in a wide variety of habitats and competes strongly for early season moisture. Its presence in commercial timberlands creates a perfect environment for rodents which damage tree seedlings. It can dominate oak savannah habitats and can be expected to severely restrict native oak regeneration. This weedy grass is also a serious threat to natural areas. There is concern from naturalists and native plant enthusiasts because of the ecological impacts brought on by brome invasion. The economic impact has received less attention and has been limited to private timberlands. Many acres of private timberland receive initial herbicide treatments to remove grass and other vegetation regardless if they are brome infested or not, therefore, no additional costs are attributed to false brome. The same cannot be said of public lands and it is on these where the greatest potential for economic harm exists. A secondary economic concern may involve false brome toxicity to livestock. The endophyte fungus Epichloe sylvatica has been identified in North American false brome populations. Existence of endophyte fungi in forage grasses has been linked to negative health effects in sheep and other livestock.

Introduction: This exotic perennial is native to Europe, Asia and North Africa, but is invading habitats in western Oregon, and elsewhere in our region at an alarming rate.

Four-o’ Clock, Wild *Mirabilis nyctaginea*

Family: Four-o'clock Family (Nyctaginaceae)
Other Names: Allionia nyctaginea, Oxybaphus nyctaginea, Oxybaphus nyctagineus, heart-leaf four-o'clock, heart-leaf umbrella-wort, snotweed, umbrella-wort.
Origin and Distribution: Wild four-o'clock is a native species of the Midwest and northern Great Plains, and has become locally naturalized in the northeastern states. Though its distribution as an agronomic weed is rare, reports indicate that it is becoming more common throughout the Midwest. This species is commonly found in pastures, prairies, roadsides, gardens and wasteplaces, but has recently been observed to invade no-till corn and soybean fields. Wild four-o’clock can grow in a variety of soil types, ranging from gravelly to rich.

Plant Description: Wild four-o'clock is an erect bushy perennial, characterized by its large fleshy taproot, swollen joints and smooth heart-shaped leaves that resemble lilac leaves. It reproduces by seeds.
Root system - The large, tough, fleshy taproot is branched, and can extend down more than 20 inches in the soil.
Seedlings & Shoots - Cotyledons are irregularly round, often flat-ended, somewhat concave and of unequal size. The underside of cotyledons and true leaves is often tinged with purple. The first true leaves are egg-shaped, but subsequent leaves are increasingly heart-shaped. True leaves have short hairs on the margin.
Stems - Several stems can emerge from a single taproot, and grow 1 to 4 feet tall (sometimes up to 6 feet). The smooth stems are highly branched, often 4-sided (though they are not as distinct as species in the mint family), and sometimes ridged. The swollen nodes along the stem are very distinctive, resembling a ball and socket joint. Stems typically separate at the nodes at the end of the season.
Leaves - The leaves are opposite, egg- to heart-shaped, pointed, and smooth on both sides and on the margins, resembling leaves of lilac. Leaves are 2 to 4 inches long and 1 to 3 inches wide. Leaf stalks are present on lower leaves, but may be absent on upper leaves.
Flowers - Flowers of wild four-o'clock are borne in clusters of 3 to 5 at the ends of branches. The small, tubular or bell-shaped flowers are composed of sepals (outer floral leaves), which are fused below and open above, and can be pink, purple, white or yellowish. Flowers lack true petals, and the petal-like structures are actually the upper ends of the sepals. Five large, veiny green bracts (specialized leaves) are fused to form a cup around the flower cluster. As seeds form, bracts enlarge and split open to almost 1 inch wide, becoming tan and papery.
Fruits & Seeds - The seeds (1/8 to 3/8 inch long) are egg-shaped, hairy and grayish brown, with 5 lengthwise ribs.

Biology: The small flowers of wild four-o'clock bloom from May to September, and are very short-lived. They open late in the afternoon, last through the night, and wither the next morning. Viable wild four-o'clock seeds are produced as early as mid-June. The papery bracts surrounding the seeds may aid in dispersal, especially by man-made vehicles. The swollen stem joints of wild four-o'clock resemble a ball and socket joint.

The lower stem forms the socket, or cup-like structure, that the upper stem, or ball, sits in. This joint structure is particularly noticeable at the end of the season when stems separate at the nodes.

Wild four-o'clock spreads to new places by its seeds, which can hitch rides on vehicles and infest crop seeds and livestock feed. This species is highly tolerant of 2,4-D. However, good control can be obtained using mechanical methods. For very small infestations, digging up plants is effective. Wild four-o'clock is nearly impossible to pull up, because the stems readily break off at the root crown, only to sprout again. One local Amish farmer reported that pigs fed on the taproots and could keep the weed controlled. When pigs were removed, the weed began to spread to corn and soybean fields. For larger infestations, repeated mowing reduces seed production and weakens plants over time. Effective control can be obtained by several years of clean cultivation.

Toxicity: The roots and seeds contain a toxic alkaloid, and can cause stomach pain, vomiting and diarrhea in children. However, a local Amish farmer reported that pigs are very fond of the fleshy taproot.

Related Information:

- ✓ The scientific name roughly translates to 'wonderful night-bloomer'. The common name, 'wild four-o'clock', refers to the time of day that this species will flower (around 4 pm).
- ✓ Another common name, 'umbrella-wort', refers to the large papery bracts which form an 'umbrella' around the flower clusters and seeds.
- ✓ Several Native American tribes used the root to reduce fever, cleanse wounds and relieve abdominal swelling.

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Foxtail *Setaria spp.*

Foxtail *Setaria glauca*

Foxtail is a summer annual grass with wider blades and a lighter green color than bluegrass. It is also faster growing than bluegrass. Seed heads may form despite regular mowing. Foxtail is much less prevalent when turfgrass has good density. Re-sod or reseed bare spots.

Control: A pre-emergent herbicide (benefin + trifluralin, dithiopyr, oxadiazon, pendimethalin or prodiamine) applied correctly and at the proper time should provide control. Do not use a pre-emergent herbicide on a newly-seeded or sodded lawn or when overseeding a lawn. Post-emergent herbicides that will kill foxtail seedlings: MSMA, DSMA, MAMA or fenoxaprop.

Fescue, Tall *Festuca arundinacea*

Family: Grass Family (Gramineae)
Other Names: Festuca elatior, alata fescue, coarse fescue, meadow fescue, reed fescue, taller fescue.
Origin and Distribution: A native of Europe, tall fescue was brought to North America by settlers in 1886, and is currently found throughout the U.S. It is a valuable grass species because it can grow in a variety of soil and climatic conditions. Since the 1940's, it has been used for forage, turf and erosion control. Unfortunately, it often escapes cultivation and can be found growing weedy in reduced-tillage crops, turf and fields, as well as in roadsides and waste areas. Although it prefers cool growing conditions, tall fescue will tolerate hot summers. In addition, this plant is tolerant of both drought and poorly drained areas.

Plant Description: Tall fescue is a coarse, clump-forming, cool-season perennial grass, characterized by its relatively wide, dark green, coarsely ridged leaves. This species reproduces by seeds and short rhizomes (horizontal underground stems). Clumps can expand by producing new shoots (tillers) from the base of existing stems. Tall fescue can form dense stands.
Root system - Tall fescue produces short rhizomes (horizontal underground stems) and tough, coarse roots that run deep into the soil.
Stems - Stems are smooth, erect and round, and grow 3 to 5 feet high.
Leaves - Leaves are rolled in the bud. The dark green leaf blade (free part of the leaf) is thick, flat, ridged on the upper surface due to coarse veins, and shiny on the lower surface. Blades are 4 to 24 inches long and 1/6 to 1/2 inch wide, and have rough margins and often a yellowish base (where it meets the stem). The leaf sheath (part of the leaf surrounding the stem) is round and smooth. The ligule (projection inside on the top of the sheath) is short and membranous. A pair of small, rounded appendages (auricles) are located at the top of the sheath, and are fringed with hairs.
Flowers - Clusters of flowers are borne in an open, many-branched flower head (2 to 12 inches long, sometimes up to 16 inches) at the top of the stem. Branches of the flower head are folded up against the stem before and after flowering, giving the flower head a spike-like appearance.
Fruits & Seeds - Seeds are 1/4 inch long, narrow and dark, with a purplish tinge.

Similar Species: Quackgrass (Elytrigia repens) and ryegrasses (Lolium spp.) may be distinguished from tall fescue by the long, claw-like projections (auricles) found at the top of sheath, which are highly reduced in tall fescue.

Biology: Flowering occurs between May and June. Tall fescue clumps can enlarge by tillering (producing new shoots from the base of stems).

Tall fescue is one of the most widely adapted weeds. Studies suggest that the endophytic fungus infecting many varieties of tall fescue (see Toxicity section) makes the grass more drought tolerant, as well as potentially toxic to nearby plant species (allelopathic), thus allowing tall fescue to replace native plant communities.

Toxicity: Tall fescue is often infected with an endophytic ("living within the plant") fungus that produces compounds toxic to cattle and horses. Cattle grazing on tall fescue may develop several conditions, including "fescue foot, fescue toxicosis ("summer slump"), and abdominal fat necrosis.

Garlic Mustard *Alliaria petiolata*

Nature: A biennial herb, in small to extensive colonies under forest canopies, with basal rosettes of leaves in the first year (remaining green during winter) becoming 2-4 ft. tall in the second year. Leaves broadly arrow-point shaped with wavy margins and flowers in terminal clusters having four white petals. All plant parts have an odor of garlic. Prolific seed producer and seeds lay dormant for 2-6 years before germination, with germination only in spring. Seeds spread by humans, animals and transported in fill-dirt.

Origin: Introduced from Europe in the 1800's.

Uses: None now, originally introduced as a medicinal herb.
Family: Mustard Family (Brassicaceae)
Other Names: Alliaria alliaria, Alliaria officinalis, Erysimum alliaria, Sisymbrium alliaria, Sisymbrium officinalis, garlic root, garlicwort, hedge garlic, Jack-by-the-hedge, poorman's-mustard, sauce-alone.
Origin and Distribution: Garlic mustard was brought to North America from Europe, most likely as a medicinal herb or green vegetable. It was first described in the U.S. on Long Island, New York in 1868. Since then, populations of garlic mustard have been reported in 30 states, mostly in the Northeast and Midwest. Garlic mustard is distributed in moist woods and swampy areas and along forest edges and stream banks. It also invades disturbed areas such as roadsides and railways and is becoming a troublesome weed in reduced tillage. This species is usually found in shaded conditions, but is becoming more and more common in full sun. It prefers to grow in moist, rich soil, but can tolerate drier sites.

Plant Description: Garlic mustard is a biennial that forms a rosette the first spring and an upright stem with small white flowers the second spring. It is characterized by triangular, coarsely toothed leaves and a slender taproot with a distinct S-curve just below the root crown. Young leaves give off a strong garlic odor when crushed, but the odor fades with leaf age and is nearly gone by fall. Garlic mustard reproduces only by seeds.
Root system - Garlic mustard has a slender, white taproot that curves into a distinctive S-shape just below the crown.
Seedlings & Shoots - Young plants form rosettes of dark green, kidney-shaped leaves that have scalloped edges and long hairy leaf stalks (petioles).
Stems - Stems are usually smooth (sometimes with sparse hairs) and unbranched. They can grow from 1/2 to 3 1/2 feet tall. One plant usually produces 1 to 2 stems (sometimes more).
Leaves - Rosette leaves are dark green, kidney- to heart- to egg-shaped, shallowly toothed, and 2 to 4 inches in diameter. Stem leaves are alternate (1 per node), coarsely toothed, and triangular to heart-shaped. Stem leaves are largest (2 to 4 inches wide and long) on the lower portion of the stem, and become smaller toward the top of the stem. Both rosette and stem leaves have long, hairy leaf stalks (petioles) (1/2 to 2 inches long).
Flowers - Flowers are borne in clusters at the tops of stems. Each flower consists of 4 white petals that are about 1/4 inch long and form the shape of a cross.
Fruits & Seeds - The fruit is a long, narrow pod (1 to 2 inches long). Each pod contains an average of 16 small, black, oblong seeds (1/4 inch long, 1/8 inch in diameter).

Similar Species: The rosettes of other species including violets (Viola spp.) and white avens (Geum canadense) may be confused with young rosettes of garlic mustard, but only garlic mustard gives off a strong garlic odor when crushed. The flowering stage of garlic mustard may be confused with dame's rocket (Hesperis matronalis), also a spring blooming mustard that forms upright flowering stems and white flowers (sometimes pink). However, the flowers of dame's rocket are much larger and showier than those of garlic mustard, its leaves are lance-shaped and crushed foliage does have a garlic odor.

Biology: Seeds of garlic mustard germinate from late February to mid-May, and form leafy rosettes that persist through the summer and winter. Surviving rosettes produce erect flowering stems the following March, and flowers appear from April to May. Seeds begin to ripen in mid-June and are shed continually through September. Only a few seeds germinate the first spring. Most seeds germinate the second spring after their production. Remaining seeds can stay viable in the seedbank for 5 to 6 years. The number of seed pods produced per plant varies greatly. The smallest plants may produce only 1 or 2 pods, while large plants can produce 150 pods or more. Each pod contains an average of 16 seeds. In dense patches of garlic mustard, over 20,000 seeds per square foot can be produced annually.

This weed is invasive and very difficult to control once established. It tends to form dense stands that crowd out herbaceous native flora. As a result, invasion of garlic mustard into forests tends to decrease the number of native spring species. Garlic mustard can be controlled by preventing new seed production for several years until the seedbank is depleted. Various methods can be used to prevent seed formation, including cutting plants at ground level just before or during flowering, hand pulling, burning, or spot application of herbicides (optimally in early spring or fall). When hand pulling, a significant portion of the root crown must be removed or else plants can resprout. However, the best management strategy is to prevent establishment.

Toxicity: None known.

Herbicide Control: Apply a glyphosate herbicide as a 2% solution in water (8 ounces in a 3-gal. sprayer) with a surfactant (or without a surfactant when near surface waters) to thoroughly wet all foliage in April through June (during flowering) to control two generations. Pulling plants before seed formation is recommended where herbicides cannot be used, while repeated annual prescribed burns in fall or early spring will control this plant.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
• Elimination of weed debris
• Control of annual weeds
• Suppression of perennial weeds
• Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

Related Information:

- ✓ The genus name of garlic mustard (Alliaria) is partly derived from the genus name for garlic (Allium) because of garlic mustard's strong garlic-like odor.

- ✓ Garlic mustard is also known as 'sauce-alone' because it was customary to use the plant in sauces and salads.

- ✓ Garlic mustard is higher in vitamins A and C than many commercially available fruits and vegetables.

Garlic, Wild *Allium vineale*

Family: Lily Family (Liliaceae)
Other Names: crow garlic, field garlic, scallions, wild onion.
Origin and Distribution: Wild garlic originated in Europe. It can be found in the eastern half of the U.S. and the western region of the Pacific Northwest. This species is drought tolerant, and can grow in a variety of soil types ranging from heavy, wet soils to dry, sandy or gravelly soils. Wild garlic is common in grain fields, pastures, meadows, lawns, gardens and waste places, as well as along roads, rivers and streams.

Plant Description: Wild garlic is a grass-like, bulb-forming perennial characterized by slender, erect stems and leaves, and a globe-like flower head produced at the top of each stem, composed mostly of tiny aerial bulblets rather than flowers. This species reproduces by underground and aerial bulblets, and less frequently by seeds (plants in the northern part of the range rarely produce seeds). When crushed, all parts of the plant give off a strong garlic odor.
Root system - The primary underground structure is a bulb (2/5 to 4/5 inch wide), which produces fibrous roots from the bottom surface. Bulbs are oval or rounded, and covered with a brittle, membranous, papery outer layer. Mature bulbs produce 2 types of underground bulblets at the base. Soft-coated bulblets (1/3 to 2/3 inch long) are white and teardrop-shaped, and can germinate the first autumn. Hard-coated bulblets (1/2 inch long) are light brown, oval and flattened on one side, and germinate the following spring or later.
Seedlings & Shoots - Seedlings produce grass-like, hollow, rounded leaves.
Stems - The smooth, waxy stems are erect, unbranched, slender and rounded, and can grow 1 to 3 1/2 feet high. Stems are solid, and become rigid with age.
Leaves - Basal leaves emerge from the bulb, and are 1/2 to 2 feet long, slender, smooth, hollow, and nearly round in cross section. Stem leaves are produced along the lower half of the stem, and are composed of a tubular sheath surrounding the stem and a smooth, hollow, grass-like blade. The blades are flattened at the base, but nearly round toward the end. The sheaths cover the lower half of the stem.
Flowers - Flowers and/or aerial bulblets are produced in dense spherical clusters (3/4 to 2 inches wide) at the tops of stems. Clusters are initially covered in a papery bract (spathe). Flowers are purplish to greenish (sometimes white), with 6 small petals, and are borne on short stalks above the bulblets. Aerial bulblets are commonly produced in place of some or all the flowers, and are oval or teardrop-shaped and very small (1/8 to 1/5 inch long). They are smooth, shiny, and often develop miniature, tail-like green leaves.
Fruits & Seeds - From the flowers, 2-seeded fruits are produced in egg-shaped capsules. Seeds are 1/8 inch long, flattened on one side, dull black, and wrinkled.

Similar Species: The native wild onion (sometimes called 'wild garlic', Allium canadense) can be distinguished from wild garlic by the fibrous-matted outer coating on the bulb, flattened solid leaves, star-shaped pink or whitish flowers and an onion-like taste. In addition, wild onion does not produce dormant hard-coated underground bulblets, and its stem leaves are attached to the lower 1/5 of the stem.

Biology: Basal leaves of wild garlic emerge in early spring. Flowering occurs from May to June. After flowering, the leaves die back, and the flower stems may remain standing through the summer and into fall. Aerial and soft-coated bulblets can germinate the same season they are produced, while hard-coated bulblets remain dormant through the winter and germinate the following spring or within the next 1 to 5 years. Sometimes aerial bulblets germinate in the stem-top clusters while the stems are still standing.

Wild garlic is a troublesome weed that is difficult to control. Aerial bulblets are similar in size to wheat grain, and are difficult to separate out of wheat contaminated during harvest. The bulblets can give flour a garlic flavor and odor. If wild garlic is used as forage by livestock and poultry, the resulting meat, milk and eggs can become tainted with a garlic odor and flavor. In large infested areas, a regime of fall tillage followed by spring tillage and a clean cultivated crop, if done for several years, will reduce the number of bulbs in the soil. For isolated patches of wild garlic, hand removal is the most effective method.

Toxicity: None known. However, its native relative, the wild onion, is toxic to livestock and humans.

Related Information:

- ✓ In Europe, wild garlic was used for flavoring food.
- ✓ Wild garlic arrived in America mixed in soil used for ballast on European ships. The weedy stowaway was dumped ashore to make room for the return cargo.

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Geranium, Shiny *Geranium lucidum*

USDA Symbol: GELU

Other common names: shiny-leaf geranium and shiny-leaf hawksbill

Description: Shiny geranium grows predominantly as an annual weed though it may become biennial depending on moisture conditions. In Europe, it is described as growing up to 0.5 meters high and being very shade intolerant. in the Pacific Northwest, it is predominantly a forest understory species, very shade tolerant and only seen up to 10 -12" high (Newhouse and Brainerd 2006). Stems are red colored growing from a weak central root. Leaves are rounded, deeply lobed with a waxy appearance that makes dense infestations easy to recognize. Flowers are pink, 5 petaled and grow interspersed with the leaves; rather than above them. Geranium lucidum sprouts in the late summer or early fall with the first heavy rainstorm of the season. By early spring, patches of G. lucidum are very pronounced. During April and May, dense low-lying patches form and flowering commences. By late June and July, seed formation is completed and the plant material melts back into the forest floor. The seeds are small and rapidly transported to uninfested areas on boots, vehicles, and by wildlife. Shiny geranium grows in the Pacific Northwest predominantly as an understory species intermixed with grasses, forbs, and moss. Oak woodlands and forest openings are ideal locations for G. lucidum to establish and dominate. Conifer forests offer suitable habitat for G. lucidum through dense second growth plantations often create excessive shade, limiting growth and density.

Impacts: Geranium lucidum has a limited distribution in Oregon and the Pacific Northwest though its effects in oak woodlands, seasonally wet ash forests and on forest edges are quite pronounced. Utilizing the abundance of early spring moisture, Geranium lucidum quickly establishes, then dominates sites pushing out many other early season wildflowers and seedlings of perennial plants. As soils dry few other plants are able to establish through the receding weed canopy. Sites dominated by heavy grass stands or false brome (another invasive plant) may be resistant to significant intrusion.

Introduction: The species has been used in herbal treatments for centuries primarily as a diuretic and an astringent. Such uses may still occur in Europe and Asia but it is less well known in North America. Geranium lucidum is common throughout much of Eurasia from the British Isles through the Middle East to the Himalayas and India. It also grows in North Africa.

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Goatgrass, Barbed *Aegilops triuncialis L.*

USDA Symbol: AETR

Description: Annual; grows 8 to 16 inches tall with few to many culms. Leaf sheaths contain white hairs when young, becoming more or less smooth once matured. The blades are rigid, sharp, pointed, and spreading. Grain 1/4 inch long, resembling a wheat kernel.

Impacts: Barbed goatgrass is a rangeland and dry land crop invader. This species, aside from dominating dryland pastures in California, readily crosses with wheat, producing sterile seed and unmarketable wheat. Aegilops spp. are closely related to wheat, making selective control of goatgrass difficult in cereal crop production. When mature, it is unpalatable for livestock. In grasslands, it reduces the abundance of native perennial grasses and competes with desirable plants as well as native forbs. Research refers to this plant being used in wheat breeding programs worldwide for specific characteristics. It is highly invasive in the sheep grazing area of northern California.

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Goatgrass, ovate *Aegilops ovata*

USDA Symbol: AEGE

Description: Winter annual; flowers May to July. Grows 10 inches tall. Similar to barbed and jointed goatgrass except spikes are ovate-cylindrical, disperse as units at maturity and do not break apart into joints

Impacts: Goatgrasses are rangeland and dryland crop invaders. This species, aside from invading dryland pastures in California, readily crosses with wheat producing sterile seed and unmarketable wheat.

Introduction: Introduced from the Mediterranean Europe and western Asia. Can be found in California.

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Goatsrue *Galega officinalis*

USDA Symbol: GAOF

Other common names: American garden rue, catgut, devil's shoestring, rabbit-pea, horey turkey peas, Virginia pea, Virginia tephrosia, professor weed

Description: Goatsrue is a deep-rooted perennial, regrowing each year from a crown and taproot reaching 2 to 6 feet tall by late summer. Plants may have up to 20 hollow stems. The first seedling leaves are large, oval and dark green. The mature leaves are alternate, odd-pinnate with 6 to 10 pairs of leaflets. The plant's stems and leaves contain a poisonous alkaloid, galegin, which renders the plant unpalatable to most livestock, and lethal in large quantities. The white and bluish to purplish pea-like blossoms are borne in terminal or axially racemes. Each blossom produces a straight, narrow, smooth pod, with 1 to 9 seeds per pod. A single plant may produce upwards of 15,000 pods. Goatsrue seeds are bean-shaped, dull yellow in color, and about 2 1/2 times the size of alfalfa seeds. Seeds drop on the ground when mature and may be spread by water, equipment, or animals. Seeds typically remain dormant until scarified and may remain viable for 10 years.

Impacts: Goatsrue is toxic to all ruminate animals, especially sheep. Livestock and wildlife losses would be expected to increase especially during dry years if animals graze in infested areas. Goatsrue replaces desirable vegetation in pastures and particularly along stream banks and irrigation canals. Some of the most productive lowland pastures, irrigated fields and moist meadows would be susceptible to invasion. Though it is cultivated for forage in Eurasia, it is not clear why toxicity problems are more prevalent here. Goats may be resistant to the toxins and are grazed in larger numbers there. Additional costs associated with goat’s rue involve control or eradication programs. Large investments in herbicide control have not yielded satisfactory results in several states. The plants’ large woody rootstock appears difficult to control. Alfalfa seed crops may become contaminated with goat’s rue seed. The seed size is larger than alfalfa seed but shape and coat are similar. A small amount of contaminant could serve to inoculate newly planted alfalfa fields causing economic harm to producers.

Introduction: Goatsrue is a federally listed noxious weed. A member of the legume family, it was introduced into Utah in 1891 as a potential forage crop. Escaping cultivation, it now occupies in excess of 60 square miles in Cache, County, Utah. Within this area, goatsrue infests cropland, fence lines, pastures, roadsides, waterways, and wet, marshy areas (Evans and Ashcroft 1982).

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Gorse *Ulex europaeus*

USDA Symbol: ULEU

Description: Perennial; blooms March to May. Grows one to nine feet tall. A stiff, spiny, much-branched shrub, often forming dense thickets. Branches dark green, spine-tipped, with clusters of yellow pea-like flowers near the ends.

Impacts: Gorse is a persistent, spinney, pioneer species adapted to a wide range of environmental conditions. Plant growth and stand density increase at a rapid rate, crowding out native plants, impacting forest production, inhabiting parklands and pastures, and rendering infested land unusable. Control costs are high and reinfestation is a constant problem. Gorse stands develop a long-lived persistent seed bank requiring long-term management of established sites. High levels of natural oils in the spines make this plant highly flammable and an extreme fire hazard.

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Groundcherries *Physalis spp.*

Family: Nightshade Family (Solanaceae)
Other Names: husk-tomato.
Origin and Distribution: Some groundcherries are perennials that are natives of eastern and central North America and among these, CLAMMY GROUNDCHERRY (Physalis heterophylla) and SMOOTH GROUNDCHERRY (Physalis subglabrata). The species grow in cultivated and reduced-tillage agronomic fields as well as pastures, old fields, open woods, roadsides, and waste areas. Groundcherries prefer well-drained conditions and it is not uncommon to find either of these species growing in stony, gravelly, or other poor soils.

Plant Description: Along with other close relatives, groundcherries have bell-shaped flowers and their fruits are berries resembling miniature tomatoes. Traits identifying perennial groundcherries are deeply-penetrating roots, yellow flowers with purplish centers, and fleshy berries enclosed in an inflated, bladder-like body that looks similar to a paper lantern. If the foliage is covered with sticky hairs, leaves are heart-shaped, and berries are yellow then the plant is probably CLAMMY GROUNDCHERRY while SMOOTH GROUNDCHERRY is more or less hairless and has diamond-shaped leaves and reddish berries. Both species reproduce by seeds and creeping roots.
Root system - Roots are deeply penetrating and widely spreading.
Seedlings & Shoots - Young groundcherry plants have hairy stems and leaves with hairs on the upper surface, edge, and along veins on the lower surface. Foliage emits an unpleasant nightshade odor when bruised.
Stems - Stems are 1 to 3 feet tall, hollow, ridged, and often woody. Stems grow upright at first but later branch resulting in a bushy plant with a spreading top. Located at each fork in the stem are a long stalk (petiole) attached to a single leaf and another stalk that is curved with a solitary flower dangling at the end. CLAMMY GROUNDCHERRY stems are covered with sticky hairs. Young stems of SMOOTH GROUNDCHERRY may be hairy but older stems are hairless.
Leaves - Leaves are alternate (1 leaf per node), 1 to 4 inches long, and coarse. Leaves of CLAMMY GROUNDCHERRY are heart-shaped and have a round base while those of SMOOTH GROUNDCHERRY are diamond-shaped with a base that tapers into a long petiole. Edges may be either smooth or irregularly toothed.
Flowers - Flowers consist of 5 fused petals that are greenish-yellow with a violet-spotted center. Flowers are in the shape of a bell and are about 3/4 inch long. Flowers are usually solitary and suspended from a curved stalk attached to the stem at the leaf axils.
Fruits & Seeds - Fruit is a fleshy 2-celled berry enclosed in a 5-sided, bladder-like pod that looks similar to a paper lantern. Berries of CLAMMY GROUNDCHERRY are yellow while those of SMOOTH GROUNDCHERRY are orange or red-purple. Fruits contain many flat, kidney-shaped seeds that are less than 1/10 inch in diameter and light yellow.

Similar Species: Several other annual and perennial nightshade species (Solanum spp.) have an appearance similar to that of groundcherries except their flowers are white or purple and clustered while groundcherry flowers are yellow and solitary.

Biology: Plants flower from June to September. There are reports of groundcherries producing up to 30,000 seeds per plant. If fragmented by tillage or other similar disturbance, roots can give rise to new plants. A study found that new plants emerged from root fragments as short as 1 inch, and even more plants emerged from 4-inch-long fragments, but fragments left on the soil surface generally did not survive.

Groundcherries cause indirect crop damage by hosting diseases and viruses of alfalfa, lettuce, tobacco, pepper, and potato and serving as an alternate host for several species of root knot nematodes. Tobacco budworm has been observed feeding on clammy groundcherry. Groundcherry species are reported to be relatively tolerant of 2,4-D.

Toxicity: Leaves and unripe fruits of groundcherries are poisonous and even fatal if ingested by humans. However, ripe fruits are not as toxic and can be made into jellies, jams, and sauces. Alkaloids from groundcherry plants are suspected to be poisonous to cattle, and there are reports that sheep and other animals were poisoned as the result of eating foliage and unripe berries. However, the plant is only toxic if ingested in large amounts and animals generally avoid eating groundcherries unless more palatable forage is not available, so poisonings are rare.

Related Information:

- ✓ The genus name 'Physalisa', is from the Greek 'Physa' meaning 'bladder' and refers to the inflated papery husk surrounding groundcherry fruit.

- ✓ Tomatillo or 'Mexican tomato' is a cultivated groundcherry.

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Groundsel, Common *Senecio vulgaris L.*

Asteraceae (Sunflower family)
Origin: Eurasia
Location: lawns, gardens, roadsides, waste areas, plant nurseries, cropland, and pastures
Occurrence: The majority of common groundsel seeds germinate in early to mid-spring and in autumn, although germination can take place throughout the growing season.

Flowering begins 5-6 weeks after seedling emergence. Seeds ripen within 5-11 days of flowering, and most are able to germinate immediately. It is possible for several generations of common groundsel to be produced in one season.

Description: An erect winter annual, occasionally biennial, that grows 6-18 inches tall. Stems are fleshy, ribbed, and hollow, with some cottony hairs. Stems are often purplish, especially at the lower end. Leaves are arranged alternately along the stem, lower leaves resting on a short stalk, upper leaves clasping the stem.

Mature leaves, 3/4 - 4 inches long and 1/4 - 1 3/4 inches wide, are fleshy and deeply lobed with notched margins. Veins on the underside of leaves are usually cottony-hairy. Upper stems branch and terminate in flower heads, which each consist of a tight, 1/4 - 1/2 inch diameter cluster of many tiny tubular disk flowers. The tips of the flowers are just visible above a 1/4 - 1/3 inch long, green, cylindrical cup of bracts with black tips. At maturity, the cup peels back, revealing many single-seeded, 3/4 inch-long brown fruits with soft white hairs at the tip, which collectively form a dandelion-like globe.

Weedy Characteristics: Common groundsel reproduces solely by seed. Under poor conditions, the plant can produce seed when only a few inches tall. An average plant will produce 1,800 seeds, and some vigorous plants can produce many thousands more. Some seeds will continue to ripen after plants have been uprooted. Most seeds are dispersed by wind, although some are carried in water, by animals, or birds. Common groundsel's early germination allows it to quickly establish in freshly disturbed soil, and its rapid growth and short life cycle allow it to outcompete more desirable plants that establish later.

Control: Maintaining a healthy plant population that is competitive early in the growing season, with as little bare ground as possible, will discourage common groundsel establishment. Germination can be inhibited by thick mulch, on condition that its surface is not perpetually moist. Soil solarization is also effective at reducing groundsel seed population in the soil. Common groundsel is a prolific seed producer, but most of its seeds do not remain viable past one year. To prevent seed production, seedlings can be destroyed in spring and fall by tilling, hoeing, and hand-pulling. Large infestations can be closely mowed prior to flowering. If it is flowering or producing seed, the entire plant must be removed completely. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Although many medicinal uses for common groundsel have been recorded, it is associated with poisoning of grazing animals, causing permanent liver damage, and even death. Its presence in hay fields can cause contamination problems, and it can serve as a host to nematodes and viruses that threaten a variety of crops. Common groundsel is noxious in Washington State and in Manitoba, Canada, and is considered invasive in Hawaii.

Halogeton *Halogeton glomeratus*

USDA Symbol: HAGL

Description: Annual; blooms July to September. Grows a few inches to 1 1/2 feet tall. Main stems branch from the base, spreading at first and then becoming erect. Plants blue-green in spring and early summer, turning red or yellow by late summer. Leaves small, fleshy, nearly tubular and tipped with a needle-like spine. Flowers inconspicuous and borne in the leaf axils.

Impacts: Halogeton is native to Asia with a wide distribution throughout the western United States. It thrives in dry alkaline rangelands as well as waste ground and roadsides, and is poisonous to livestock. Sheep appear to be one of the main dispersal agents of the plant and are often victims of its poison though they avoid it if other feed is available. Late in its growth stage it can break off and tumble across the landscape, spreading seeds as it rolls.

Known hazards: Halogeton glomeratus is toxic to cattle and sheep. Most losses occur when hungry or thirsty animals are allowed to consume large amounts of this succulent plant. The toxic substance in halogeton is soluble sodium oxalate and is found in fresh and dried plants. The toxic dose is 0.3 to 0.5% of the animal's body weight when consumed over a short period of time.

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Hawkweeds *Hieracium spp.*

Family: Daisy Family (Compositae)
Other Names: paintbrush. YELLOW HAWKWEED: Hieracium caespitosum, field hawkweed, king devil, yellow devil, yellow king-devil, yellow paintbrush. ORANGE HAWKWEED: bouquet rouge, devil's paintbrush, grimm the collier, king-devil, orange paintbrush. MOUSEEAR HAWKWEED: felon herb, mouse bloodwort.

Origin and Distribution: This is a highly variable genus and many species occur in North America, of which some are native and some are introduced from Europe. YELLOW HAWKWEED, ORANGE HAWKWEED and MOUSEEAR HAWKWEED are introduced species. Since their introduction, these hawkweeds have spread throughout the eastern half of the U.S. They have become especially troublesome in the north central U.S. They generally occur in undisturbed locations, such as lawns, fields, pastures and roadsides. Hawkweeds mainly grow in shallow, sandy or gravelly soils and prefer slightly acidic conditions.

Plant Description: Hawkweeds are perennials that have coarse hairs, grow as leafy rosettes, and produce dandelion-like flowers at the tips of erect stems. They also form horizontal stems (stolons) that creep along the soil surface rooting at the nodes and giving rise to new rosettes. Hawkweeds reproduce by air-borne seeds and stolons.

YELLOW HAWKWEED produces rosettes consisting of 10-inch-long leaves and bunches of yellow flowers at the tips of 3-foot-tall leafless stems.

Emerging from **ORANGE HAWKWEED** rosettes are 2-foot-tall leafless stems with terminal groups of orange flowers.

MOUSEEAR HAWKWEED rosettes are only about 3 inches across and 1 to 3 yellow flowers form at the tips of its 1-foot-tall leafless stems.
Root system - The root system of YELLOW HAWKWEED generally consists of fibrous roots and slender rhizomes.
ORANGE HAWKWEED and MOUSEEAR HAWKWEED have fibrous root systems.
Seedlings & Shoots - YELLOW HAWKWEED seed leaves (cotyledons) are rounded, notched at the tip, and attached to the stem by way of a short leaf stalk (petiole). The next several leaves that emerge are egg-shaped, smooth-edged, hairy, and tapered to a very short petiole.
Stems - YELLOW HAWKWEED stems are erect, 1 to 3 feet tall, hairy, and may have 1 to 3 small leaves attached near the base. Hairs along the upper portion of the stem are often black and gland-tipped. Emerging from the base are hairy stolons. Stems contain a milky juice.
ORANGE HAWKWEED stems are erect, slender, 6 to 24 inches tall, covered with stiff hairs, and leafless except for 2 bracts located near the base. Hairs along the upper portion of the stem are often black and gland-tipped. Emerging from the base are hairy stolons. Stems contain a milky juice.
MOUSEEAR HAWKWEED stems are erect, between 4 to 12 inches tall, leafless, and sticky-hairy. Hairs along the upper portion of the stem are often black and gland-tipped. At the stem bases are 1 to 3 slender stolons. Stems contain a milky juice.

Leaves - YELLOW HAWKWEED leaves are slender, 10 inches long, smooth-edged, and spatula-shaped with blunt tips. Both upper and lower surfaces are covered with long bristly hairs. On the underside, the midvein is generally white.
ORANGE HAWKWEED rosette leaves are smooth edged and covered with stiff hairs.
MOUSEEAR HAWKWEED leaves grow densely in rosettes that are about 3 inches across. The club-shaped leaves are hairy on top and white-wooly beneath.
Flowers - For YELLOW HAWKWEED, each 2/5-inch-wide, flat-topped flower head is a cluster of approximately 12 individual yellow flowers that are covered with black, gland-tipped hairs. The compact clusters form groups of 2 or more located at the tips of coarsely-hairy stems.
For ORANGE HAWKWEED, numerous individual orange-red flowers are tightly clustered onto heads that are 3/4 inch across and located at the tips of leafless stems. The green bracts (floral leaves) beneath the flowers are covered with black, gland-tipped hairs. As flowers dry, they turn deep red.
MOUSEEAR HAWKWEED has yellow flowers atop leafless stems. Flowers are either solitary or in groups no larger than 3. The green bracts (floral leaves) beneath the flowers are covered with black, gland-tipped hairs.
Fruits & Seeds - All hawkweed species have single-seeded fruits that are cylindrical, hairless, dark brown or black, ridged, and topped by a single row of bristles.

Similar Species: Common catsear (Hypochoeris radicata) has similar flowers on mostly leafless stems, but its leaf edges are irregularly lobed whereas those of hawkweeds are smooth.

Biology: Hawkweeds generally produce flowers from May or June until September. Because hawkweeds can reproduce and spread by various means, they are difficult to control. Patches of the weed can be controlled by repeated cultivation, or the shallow-rooted plants can be hand-dug. Close mowing can be used to prevent seed formation. Also, management practices that increase growth of more competitive species will generally result in decreased numbers of hawkweeds. Herbicides are available to selectively control the weed.

Toxicity: None known.

Related Information:

- ✓ The common name 'hawkweed' and the Latin name Hieracium (hierax means 'hawk') originated from a folk tale that hawks ate different parts of the plant to improve their eyesight. As a result, hawkweeds have also been called hawkbits and speerhawks.

- ✓ Several alternative common names for yellow and orange hawkweed contain the word 'devil'. These names originated with farmers who considered them troublesome weeds.

- ✓ Mouseear hawkweed got its common name because of the soft, wooly feel of its leaves.

- ✓ In past times, orange hawkweed was also called 'grimm the collier' (coalminer), because the black hairs on the stem brought to mind a coalminer after a long, dirty day of work.

- ✓ Hawkweeds were used in early Europe to treat lung disorders, stomach pains, cramps, and convulsions. They have also been used as beauty treatments.

- ✓ In the past, Native Americans used native hawkweeds for chewing gum.

Hawkweed, King Devil *Hieracium pratense*

USDA Symbol: HIPI2

Other common names: Tall hawkweed, yellow king devil hawkweed
Description: Perennial; flowers June to July in lower elevations. Grows 10 to 36 inches tall. Leaves are hairy, spatula shaped and almost exclusively basal. Flower heads are clustered, yellow, 1/2 wide, and number up to 30 per plant. Extensive stolons form dense mats of vegetation. King-devil hawkweed (H. piloselloides), yellow hawkweed (H. floribundum) and meadow hawkweed (H. pratense) are all very similar and difficult to classify. Native hawkweeds have numerous stem leaves, lack stolons and generally have solitary flowers.

Impacts: Plants of the hawkweed complex produce mats of rosettes that prevent desirable plants from establishing or surviving. Hawkweeds dominate sites by out-competing other species for water and nutrients and by releasing alleopathic compounds from their own decaying leaves. They grow well in moist sunny grassy areas, but do tolerate shade in some areas. They are becoming troublesome weeds in native meadows, prairies, pastures and lawns. Wilderness areas in the Pacific Northwest are at risk of invasion.

Hawkweed, Meadow *Hieracium pratense*

USDA Symbol: CEDE5

Description: Meadow hawkweed has stems and leaves that exudes milky juice when broken. The stems are bristly and usually leafless, although occasionally a small leaf appears near the midpoint. Stems can reach three feet tall and bear up to 30 half inch flower heads near the top. Flowers are yellow and appears in May - July depending on elevation.

Impacts: Plants of the hawkweed complex produce mats of rosettes preventing desirable plants from establishing or surviving. Hawkweeds dominate sites by out competing other species for water and nutrients and by releasing alleopathic compounds from their own decaying leaves. Plants grow well in moist grassy areas but do not tolerate shade well. Hawkweeds are becoming troublesome in native meadows, prairies, pastures and lawns. Wilderness areas in the Pacific Northwest are at risk of invasion. Meadow hawkweed tends to grow in places where there isn't constant grazing such as meadows, roadsides, pastures, lawns, and fields.

Hawkweed, Orange *Hieracium Aurantiacum*

USDA Symbol: HIAU

Other common names: Devil's paintbrush
Description: Orange hawkweed is a perennial weed with above-ground runners (stolons) that root at the tips. Roots are shallow and fibrous. The plant grows up to 12 inches tall and contains milky juice. The vibrant orange-red colored flowers are clustered at the top of a leafless stem. Stiff, black, glandular hairs cover flower stalks. Leaves are hairy, lance shaped, up to five inches long, and exclusively basal.

Impacts: Once established, hawkweed quickly develops into a patch that continues to expand until it covers the site with a solid mat of rosettes. A dense mat of hawkweed plants has the potential to eliminate other vegetation. It displaces native vegetation posing a serious threat to native plant communities and can dominate pastures, lawn and roadsides. It is unpalatable and crowds out more desirable species. This invader weed from Europe thrives in poor non cultivated and disturbed soils.

Orange hawkweed occurs on native meadows, gravel pits, forest openings, permanent pastures, roadsides, and hayfields. It prefers well-drained, coarse textured soils that are moderately low in organic matter. Hawkweeds do not persist in cultivation.

Introduction: Orange hawkweed is found from western Washington to Wyoming and is known to occur in eastern states. Due to its striking flowers, plant enthusiasts have assisted in the distribution of this weed.

Hawkweed, Yellow *Hieracium floribundum*

USDA Symbol: HIFL3
Description: Perennial; flowers June to July in lower elevations. Grows 10 to 36 inches tall. Leaves hairy, spatula shaped and almost exclusively basal. Flower heads clustered, yellow, 1/2 wide, and number up to 30 per plant. Extensive stolons form dense mats of vegetation. King-devil hawkweed (H. piloselloides), yellow hawkweed (H. floribundum) and meadow hawkweed (H. pratense) are all very similar and difficult to classify. Native hawkweeds have numerous stem leaves, lack stolons and generally have solitary flowers.

Impacts: These plants produce mats of rosettes that prevent other plants from establishing seedlings. They grow in grassy areas and do not tolerate shade well. They are becoming troublesome weeds in native meadows, prairies, pastures and lawns.

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Hawthorn, Common *Crataegus monogyna*

Common hawthorn, also called one seed or single-seed hawthorn, is an introduced tree that has naturalized in the Pacific Northwest. This small tree spreads readily by seed into woodlands and open fields, often creating a dense, thorny thicket. Its abundant red berries are attractive to birds and other animals, which help spread this tree far beyond where it is planted. Common hawthorn can also be a nuisance species in pastures and wildlife grazing areas and its removal from those areas is also recommended.

Identification
Thorny, deciduous small tree or shrub, 6 to 30 feet tall
Leaves 3 to 7-lobed, 1-2 inches long and nearly as broad, resemble mittens or paws

Flowers grouped in broad, dense, flat-topped clusters and resemble cherry or apple blossoms

Petals are usually white, sometimes pink

Fruit is a round, crimson berry that often persists into late winter

Similar to English hawthorn (*Crataegus laevigata*) and other ornamental hawthorn species and often forms hybrids that have intermediate characteristics

Reproduction and spread
Berries are dispersed by birds and other animals
A single tree can produce over 2,000 berries
Flowers in spring and develops fruit in the fall; berries often persisting into the winter
Seeds passing through an animal aids germination but isn't necessary
Germination occurs primarily in spring
Most vegetative growth occurs in spring and early summer, and normal growth rate is one to two feet a year

Impacts and distribution
Common hawthorn is carried by birds into forests and open fields where it can form dense, thorny thickets that outcompete native species and make passage of large animals difficult. Somewhat tolerant of shade as well as drought, common hawthorn invades both open fields and woodlands in Washington, Oregon and California. Common hawthorn has naturalized on both coasts of North America and in many of the states in central and eastern United States, as well as parts of Australia, New Zealand and South Africa. Although more common west of the Cascades, common hawthorn has spread in eastern Washington as well.

Control
Seedlings and young saplings can be pulled or dug up when soil is moist, but roots quickly become deep and stout and sharp thorns are present even on young seedlings.
Mature trees have deep and extensive roots so digging is labor-intensive and results in considerable soil disturbance if all of the roots are removed.

Common hawthorn often stump-sprouts, so removal by cutting alone is not usually effective.
Applying herbicide with the cut stump or frilling method is probably the most effective approach for plants that cannot be removed by digging or grubbing out the roots. Foliar herbicide treatment is another option but may result in spray drift to desirable vegetation.

Healall *Prunella vulgaris*

Family: Mint Family (Labiatae)
Other Names: Brunella vulgaris, blue curls, blue lucy, brownwort, brunella, carpenter's-weed, dragonhead, heart of the earth, Hercules woundwart, hook-heal, hookweed, panay, prunella, self-heal, sicklewort, slough-heal, thimble-flower, thimbleweed, wild sage.
Origin and Distribution: Some forms of heal-all in North America are native and others were introduced from Eurasia as ornamentals and then escaped cultivation. Heal-all is commonly encountered in such habitats as woods, fields, pastures, gardens, lawns, and roadsides. Although the plant prefers moist conditions, it can be found in a variety of sites from dry to swampy, open to shady, and disturbed to undisturbed.

Plant Description: Heal-all is a perennial that usually grows as a sprawling plant with upright flower clusters, but it can have an erect habit when growing in undisturbed areas. Characteristics it shares with other mints include square stems and opposite leaves. Features setting it apart include a lack of odor even if crushed, ovate-oblong leaves, relatively long leaf stalks (petioles), and roots emerging at stem nodes. Flowers are produced in erect, head-like spikes that are denser than those of most mints. Crowded among the flowers are hairy, green bracts. Plants reproduce by seeds and creeping stems that root at the nodes.
Root system - Roots are shallow, fibrous, and often formed at stem nodes.
Seedlings & Shoots - Young stems and petioles are covered with stiff hairs. The upper surfaces and edges of young leaves also have hairs.
Stems - Stems are up to 2 feet long, erect or prostrate, square, and branching. Young stems are rough-hairy but they tend to lose their hairs over time. Stem nodes coming in contact with soil often form roots at the nodes.
Leaves - Leaves are 1 to 4 inches long, opposite (2 leaves per node), oval to oblong, and may or may not be shallowly and irregularly toothed around the edge. Sometimes, leaves are purple-tinged and have hairs. Petioles attached to leaves at the base of the plant are longer than those attached to upper leaves.
Flowers - Flowers consist of 5 petals that are blue-purple or rarely white, less than 1/2 inch long, and united to form a 2-lipped tube consisting of a rounded upper lip and a 3-lobed lower lip. Sepals enclosing petals are purplish and fused into a toothed tube. Underneath each flower is a hairy bract. Flowers form in dense, terminal, head-like spikes. Spikes are short at first but elongate as flowers continue to open and may be over 3 inches long by the time all flowers are open. Flowering branches emerge from the stem at the axil of a broad, kidney-shaped bract. Usually, 3 such branches emerge from each axil.
Fruits & Seeds - Heal-all produces pods with 4 nutlets that are brown with dark vertical lines. Nutlets are slightly flattened, pear-shaped if viewed lengthwise, triangular in cross-section, and have 2 flattened sides and third side that is rounded.

Similar Species: Ground ivy (Glechoma hederacea) also is a low-growing perennial in the Mint Family and it has purple-blue flowers shaped similarly to those of heal-all. Compared with heal-all, ground ivy flowers form in much smaller clusters containing fewer than 6 flowers and its leaves are kidney-shaped rather than oblong.

Also, ground ivy stems creep over the soil surface forming a carpet-like, tangled mass. Red dead nettle and henbit (Lamium purpureum and L. amplexicaule) are winter annuals that flower in early spring. Vegetative growth of red dead nettle can be distinguished from heal-all by its reddish stems and triangular leaves. Henbit is easy to distinguish from heal-all by its upper leaves that, lacking petioles, encircle the stem.

Biology: Heal-all flowers form in June through September. Plants growing in lawns or other areas with lots of traffic that are frequently mowed tend to grow prostrate along the ground and produce roots at every node. Stems tend to be upright when growing in undisturbed or crowded conditions. Heal-all does not tolerate such crop management practices as cultivation.

Toxicity: None known.

Related Information:

- ✓ 'Brunella' was derived from brunellen, which was the common name that Germans called the plant because it cured an inflammation of the mouth found among soldiers called 'die Braeuen'.

- ✓ Among natives of North America, the Chippewas used heal-all to treat 'diseases of women', the Delaware and Mohegans made soothing body-washes to treat fevers, and several tribes found that a tea made of fresh leaves remedied dysentery.

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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.

Henbit *Lamium amplexicaule*

Henbit *Lamium amplexicaule*

Henbit is a winter annual occasionally found in lawns in early spring. The lower leaves have a stalk while the upper leaves clasp the stem. Stems are square, like other members of the mint family. All the leaves are coarsely toothed and opposite from each other.

Flowers appear in May and are about one-half inch long, trumpet-shaped, pinkish white to purple, and form just above upper leaves. This weed is more often found in buffalograss than in bluegrass. Newly-seeded bluegrass and established bluegrass lawns with poor density may have some henbit.

Control Henbit has a taproot and is easily pulled from moist soil. Heavy infestations can be controlled with triclopyr + clopyralid, 2,4-D or 2,4-D combination herbicides; at or prior to flowering.

Fall application of a pre-emergent herbicide (dithiopyr, isoxaben, pendimethalin or prodiamine) will prevent henbit germination

Herb Robert *Geranium robertianum*

USDA Symbol: GERO

Other common names: Herb Robert, Robert Geranium, Stinky Bob, Red Robin, Fox Geranium

Description: Herb Robert is a branching, low growing winter and spring annual. It has light green leaves that are deeply dissected and release a pungent odor making this plant easy to recognize. As the plants mature the foliage turns red. This red color is very noticeable under bright light conditions. The stems are highly pubescent, have multiple forks, and are brittle at the joints. The roots are shallow allowing for easy hand removal. The pink flowers are perfect and five petaled. The receptacle is elongated into a pointed structure called a "torus" or “storks bill”. Herb Robert reproduces only by seeds. Flowers are usually self-fertile creating uniform populations. Seeds are matured in elongated pointed capsules that eject their seeds up to 20 feet when disturbed. They can survive in the soil up to and probably beyond five years. (King county 2008) Herb Robert tolerates a wide range of light intensities thriving best in open canopied forests or along the edges of forests. It has been noted that this plant is also very happy under deeper shaded conditions. It can be highly competitive with native early spring forbs but less so against grasses. Often Herb Robert takes advantage of habitats that have been opened up through weed control activities such as English ivy or false brome removal.

Impacts: Two species, Geranium robertianum, and geranium lucidum have aggressively invaded habitats (oak and fir woodlands) only marginally impacted by serious weed invasion in the past. Today herb Robert is becoming one of the most common woodland invaders. An annual weed with a high reproductive potential, it has barely begun to infest all potential acreage available to it. Regionally, the species has been dispersed mainly by human activities into many if not most watersheds in Western Oregon. Locally, it is spreading by water movement, wildlife, recreationalists, gardeners, and through land disturbance activities. It can develop into populations of high density, up to 250 plants per meter square, pushing out native flora and impacting domestic gardens and parklands (Written Findings WSWB 2007).

The full impacts of herb Robert invasion on flora, soil faunal communities, and pollinators have not been examined. Invasive populations in parks and garden settings will increase landscape maintenance costs in some circumstances. Overall economic impact projected to be minor. Some increased costs related to invasive plant removal projects are probable. Competition to early spring forest forbs has been noted in the Pacific Northwest (King County 2009). The degree of impact this competition provides varies with the density of the weed population.

It is unclear whether native species are being completely excluded at some sites or just reduced. Impacts to soil fungus and organisms may occur in situations where monocultures exist. Insect populations especially native pollinators may be impacted as weed densities increase. Except in some ecologically significant locations, regional observations of infestations do not indicate that it is currently a serious ecological threat.

Introduction: Historical records indicate that several traditional remedies for cancer, toe, and fingernail maladies, toothache, dysentery, and nosebleed have been derived from herb Robert. (Wikipedia Jan. 2009) (iVillage Garden Web 10/2004) The species is common in forested areas throughout the continents of Eurasia and North Africa. (Falinska and Piroznikow 1983)

Hogweed, Giant *Heracleum mantegazzianum*

USDA Symbol: HEMA17

Description: Perennial; flowers May-July. Grows 10-15 feet tall. Stalk and flower head develop after two to four years, and then the plant dies back. Stalks are two to four inches in diameter, hollow, have reddish-purple blotches and pustules with a single erect hair in the center. Flower head is a large umbrella-like inflorescence up to two and one half feet in diameter. Leaves are three to five feet wide, compound and deeply incised. This plant closely resembles native cow parsnip which rarely exceeds six feet with a flower head 8-12 inches wide. Cow parsnip is a common native plant in the northwest and grows in riparian areas and roadsides. Giant hogweed is a member of the carrot or parsley family and its most impressive characteristic is its massive size.

Impacts: This plant is a health hazard to humans. Because of its invasive nature it soon becomes a pest within the garden and readily escapes. It has naturalized in many of the places where it was introduced, and is one of the most invasive weeds in Europe.

Known hazards: This plant is a public health hazard. Do not expose bare human skin to the plant or breathe the smoke from fires if it is being burned. The plant exudes a clear watery sap which sensitizes the skin to ultraviolet radiation. Humans often develop severe burns to the affected areas resulting in blistering and painful dermatitis. Blisters can later develop into purplish or blackened scars.

Introduction: Giant hogweed grows as a native in the Caucasus Mountains, a region of Asia between the Black and Caspian seas. Planted as a curiosity in arboretums and private gardens in Europe and North America early in the twentieth century, it soon escaped and naturalized in surrounding areas, especially riparian and urban sites.

It is reported to be a problem weed in Europe, England, Scotland, Scandinavia and Germany. In North America it grows in Ontario, British Columbia, Maine, Maryland, New York, Washington and now in Oregon.

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Hops Clover *Trifolium dubium*

Hops Clover *Trifolium dubium*

Trifolium dubium (formerly T. minus) goes by several common names, including Least Hops Clover, Small Hops Clover, Lesser Trefoil, Yellow Shamrock, & Kleiner Klee. The tiny flowers are said to resemble h Hops Clover hops.

It is a very common mat-forming weed which erupts on roadsides & empty lots early in spring in recently disturbed soil or wherever grass, including wild meadow grasses, was chopped short at the end of the previous year. It is only two to six inches tall, so tries to get a head start on larger plants, germinating its previous year's seeds in January or February.

It can be the dominant weed or miniature wildflower in April. Though it may still be blooming May through July, other plants will have grown so much as to hide it, & the early-spring mats will be overwhelmed by larger weeds & grasses. But it will still be seen until at least early July, popping up in cleared gardening areas.

It is easily mistaken for another common wildflower, Black Medick (Medicago lupulina, but Black Medic's wee yellow flowers turn into a cluster of tiny kidney-shaped black seeds, & its trifoil leaves have pointy tips. Black Medic's range is world-wide, & Least Hops Clover is only slightly less universal in its distribution. Both plants became distributed throughout the world at least a century ago, when sailing ships routinely picked up alfalfa bales from Eurasia & Central Asia to use as passing fill-in between more profitable shipments, then sold the bales to farmers in ports of the New World & Pacific Islands. Sundry knapweeds also spread throughout the world from this practice.

Like other clovers & legume family plants generally, Hops Clover helps bind nitrogen in poor soils. Though some people fight it as an unwanted weed, it is in reality doing the soil a good deed. Though adaptable to a wide range of conditions, it tends to die out of rich soils, & does not compete well with big perennials. But for the most part, it cannot be gotten rid of, so it might as well be appreciated for the real charm of so many teensy bright yellow flowers & miniature trifoil leaves. While Hops Clover annoys people who want perfection in their lawns, others never even notice it is all over the place. It is too small to make a particularly big display. It is one of the smallest of clovers, though even at that, the tiny flowers are actually made up of about two-dozen even more wee florets.

Horsenettle *Solanum carolinense*

Family: Nightshade Family (Solanaceae)
Other Names: apple-of-Sodom, ball nettle, bull nettle, devil's-potato, devil's-tomato, sand brier, wild tomato.

Origin and Distribution: Horsenettle is a native of southeastern U.S. with a current range extending north as far as Canada and west to Texas. Horsenettle can be found in old fields, pastures, orchards, roadsides, and waste places. Also, it is being encountered with increasing frequency in agronomic cropping systems. Horsenettle grows in a wide range of soil types, but it thrives in gravelly or sandy soils.

Plant Description: Characteristics distinguishing horsenettle from other nightshades are its perennial spreading roots and prickly stems and leaves. Another distinctive feature is the yellow fruit, which changes from plump and smooth-skinned to wrinkled as it matures. New plants arise from seeds and spreading underground roots, which generally produce numerous shoots in dense patches.

Root system - The root system is composed of deeply penetrating vertical roots, which grow as long as 10 feet, and spreading horizontal roots that extend up to 3 feet and are capable of producing new shoots.

Seedlings & Shoots - The first true leaves formed after a seedling emerges have short stiff hairs on the upper surface. Upper and lower surfaces of subsequent leaves are covered with prickles and star-shaped hairs. Stems of young plants are also covered with prickles and hairs. Foliage emits a characteristic potato odor when crushed.

Stems - Stems are 1 to 4 feet tall and covered with numerous star-shaped hairs and sharp yellowish prickles. Stems are either simple or have a few branches near the top.

Leaves - Leaves are alternate (1 leaf per node), egg-shaped, 2 to 5 inches long, and resemble a small poinsettia leaf. Both upper and lower leaf surfaces have star-shaped hairs and there are prominent yellowish spines on leaf veins, midribs, and stalks (petioles). Edges of some leaves are shallowly lobed.

Flowers - Flowers consist of 5 pale lavender (rarely white) petals that are united at the base, deeply 5-lobed and shaped like a star at the top, and less than 1 inch in diameter. Emerging from the center of each flower is a yellow column composed of fused anthers. Flowers attach laterally to the stem in clusters.

Fruits & Seeds - Fruits are yellow berries that are about 1/2 inch in diameter. When first formed, berries are smooth-skinned and resemble small, plump, yellow tomatoes. As they mature, berries become wrinkled. Berries are borne in clusters. Each berry contains between 40 and 170 yellow, disk-shaped seeds.

Similar Species: Buffalobur (Solanum rostratum) is also hairy and has prickles, but it is an annual that has leaves with much deeper lobes than horsenettle, bright yellow flowers, and brown spiny berries. Perennial groundcherries (Physalis spp.) are similar to horsenettle in appearance except they lack prickles, have yellow flowers, and form berries enclosed in papery pods.

Biology: Flowering begins in June and continues until frost. Wrinkled yellow berries may remain attached to stems throughout the winter. A single plant can produce up to 5000 seeds. Seeds buried in soil for up to three years were capable of germinating. New plants also arise from root fragments. Soil disturbances such as tillage and cultivation tend to fragment roots and increase the number of newly emerging plants. Horsenettle is fairly drought resistant because the penetrating roots can grow 10 feet deep. Deep roots also increase the likelihood of surviving over winter. Horsenettle causes indirect damage to crops by serving as an alternate host for diseases such as tomato leafspot and mosaic viruses of tomato and potato. It also serves as a secondary host for Colorado potato beetle. To control underground roots, deep hoeing is required.

Toxicity: Horsenettle fruits and foliage can poison livestock due to the presence of an alkaloid that must be digested before it becomes dangerous. Content of this toxin increases over the course of the growing season. Drying does not reduce its effect. Poisoning of cattle, sheep, and deer have been reported. However, livestock are rarely poisoned because large quantities must be eaten and horsenettle is too prickly to be relished unless more palatable herbage is unavailable. Symptoms vary among species and can lead to death. Mature fruits of horsenettle are toxic to humans. A child died a few years ago in Philadelphia as the result of eating horsenettle fruits.

Related Information:

- ✓ Horsenettle has been used medicinally to treat epilepsy, asthma, and bronchitis.

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Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Postemergence Herbicides

Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Horsetail, Field *Equisetum arvense*

Family: Horsetail Family (Equisetaceae)
Other Names: bottle-brush, common horsetail, equisetum, horsetail, horse-pipes, joint-grass, mare's-tail, meadow-pine, paddock-pipes, pine-grass, scouringrush, shave-grass, snakegrass.

Origin and Distribution: Field horsetail is a native species that can be found throughout the world. This species is most common in the temperate zones of North America, Europe and Russia. Field horsetail has been noted in 25 crops around the globe, predominantly in cereals and grasses, but it can also be found in vegetable crops, pastures, landscape settings, woodlands, waste areas, roadsides and along railroads. It can tolerate a range of soil conditions, but does best in sandy, gravelly or wet, poorly drained soils.

Plant Description: Field horsetail is a primitive plant, characterized by slender, jointed stems that are of two types, fertile (reproductive) and sterile (vegetative). The pale brown fertile stems appear in early spring, each producing a pinecone-like terminal fruiting head. Green sterile stems emerge later, and are highly branched, resembling a bottle-brush. Like ferns, field horsetail does not produce flowers or seeds. This species reproduces by spores and more commonly by creeping rhizomes (horizontal underground stems) and tubers.
Root system - Dark brown to blackish, creeping rhizomes (horizontal underground stems) form an extensive system 5 feet below the ground (sometimes as deep as 20 feet). Rhizomes are forked and covered with a brown felt. Small tubers are produced along the rhizomes.
Stems - Field horsetail produces two types of stems, fertile (reproductive) and sterile (vegetative). Both stem types are slender, hollow, jointed, vertically ridged and round in cross-section. FERTILE STEMS are whitish to pale brown, unbranched and somewhat succulent, with large, easily separated joints (nodes) and a terminal pinecone-like, spore-producing head (1 to 4 inches long). Fertile stems can grow 4 to 10 inches tall (sometimes up to 12 inches). STERILE STEMS are green, rough, wiry, and either erect or sagging at the base. Sterile stems can grow 4 to 20 inches tall (sometimes up to 25 inches). Whorls of 4-angled, green, needle-like, leafless branches (4 to 6 inches long) occur at the middle and upper joints. The branches may be horizontal or point upward. Sterile stems and branches are covered with rough silica deposits. The distance between joints is shorter for sterile stems than for fertile stems.
Leaves - Reduced, scale-like leaves are fused to form a tube-like, toothed sheath surrounding each joint of fertile and sterile stems (8 to 12 leaves per sheath). The upper edge of the sheath is black. Sheaths are more prominent on fertile stems. On sterile stems, the sheaths are located above the branch whorls.
Fruits & Seeds - The pinecone-like structure formed at the end of the fertile stem produces thousands of minute, pale green to yellowish spores.

Similar Species: Field horsetail may be confused with a related species, scouringrush (Equisetum hyemale). However, both the fertile and sterile stems of scouringrush are green and lack the whorls of branches characteristic of field horsetail.

Biology: Fertile stems emerge in mid-April, begin spore production in early May, and die soon after. Sterile stems emerge in late spring as the fertile stems wither, and persist until frost.

Rhizomes of field horsetail have been found to grow as much as 330 feet horizontally and 20 feet deep. New shoots can emerge from depths of 3 feet or more. The small tubers produced along the rhizomes are capable of surviving long periods in the soil. New plants can arise from both rhizome fragments and tubers. Field horsetail has the ability to selectively accumulate heavy metals from the soil in its tissues at a higher concentration than in the soil. The green sterile stems and branches are rich in chlorophyll, and take the place of leaves in conducting photosynthesis. The pale fertile stems lack chlorophyll.

Field horsetail is resistant to most agronomic herbicides, and can survive under many conditions because of its deep rhizomes and tubers. Rhizome fragments and tubers are easily spread to new areas in infested soil. As a result, this species is often difficult to control. It can be a strong competitor with crops, as well as a threat to grazing animals due to toxic compounds. In addition, field horsetail extracts can inhibit germination and reduce vigor of 30 grass species.

Toxicity: Field horsetail is reported as very toxic to livestock. Animals poisoned by this plant are said to have "equisetosis", a phenomenon documented on several continents and throughout the world. In monogastric animals such as horses, consumption of field horsetail can cause vitamin B1 deficiency. This species also contains high levels of toxic alkaloids. Sheep and cattle are more likely to be poisoned by fresh plants, while horses are more susceptible to poisoning from contaminated hay. General symptoms of poisoning include weakness, lack of coordination, and difficulty breathing.

Related Information:

- ✓ The genus name, Equisetum, translates to "horse-bristle" or tail, describing the appearance of the sterile stems.
- ✓ Deposits of silica cover the vegetative stems and branches of field horsetail. For this reason, the plant has been used to scour pots, pans, and articles containing silver (hence the common name 'scouringrush').
- ✓ Field horsetail may accumulate more gold than any other plant. Up to 4 1/2 ounces of gold per ton of fresh plant material has been recovered. Mining engineers consider field horsetail an indicator species of gold, but not a viable commercial source.
- ✓ Tubers of field horsetail are rich in starch and are eaten by wildlife. Native Americans consumed young fertile shoots.
- ✓ Field horsetail has been used medicinally as a diuretic and to control hemorrhaging.

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.

Houndstongue *Cynoglossum officinale*

USDA Symbol: CYOF

Other common names: Hounds tongue, gypsy flower, rats and mice, dog bur

Description: Biennial; blooms June to August. Grows 1 to 4 ft. tall; forms rosette first year and sends up flowering stalk second year. Leaves alternate, rough, hairy (resembling a hound's tongue) and 1 to 12 inches long. Flowers reddish purple and terminal. Seeds nutlets.

Impacts: Houndstongue can be a serious problem in rangeland and pasture. The weed is highly invasive and can significantly reduce forage. The plant produces barbed seeds, or burrs, which allow the plant to readily adhere to hair, wool, and fur and can in turn reduce the value of sheep wool. In addition houndstongue contains large quantities of pyrrolizidine alkaloids which are toxic to cattle and horses.

Known hazards: Houndstongue is toxic, containing pyrrolizidine alkaloids, causing liver cells to stop reproducing. Animals may survive six months or longer after they have consumed a lethal amount. Sheep are more resistant than cattle or horses.

Introduction: This plant was introduced to North America as a contaminant of cereal seed in the late 1800s.

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 herbicides 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.

Hydrilla *Hydrilla verticillata*

USDA Symbol: HYVE3

Description: Perennial aquatic plant. Grows rooted to the bottom with long stems that reach water's surface. Can be monoecious or dioecious. Leaves are 1/16 to 1/8 inch wide, 1/4 to 3/4 inch long and occur in whorls of five. Small, axillary leaf scales are found next to the stem and inserted at the base of the leaf, a character that distinguishes hydrilla from other family members. The nut-like turions (tubers) are a key identifying feature. Egeria densa is similar in appearance but has leaves in whorls of four and does not have turions.

Impacts: Hydrilla is the most serious threat to aquatic ecosystems in temperate climate zones. Dense stands of hydrilla provide poor habitat for fish and other wildlife altering water quality by raising pH, decreasing oxygen, and increasing temperature. Stagnant water created by mats provides good breeding grounds for mosquitoes. Hydrilla interferes with recreational activities such as swimming, boating, fishing, and water skiing and will clog irrigation ditches and intake pipes.

Introduction: Hydrilla was discovered in the United States in 1960 at two Florida locations, a canal near Miami and in Crystal River (Blackburn et al. 1969)

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Ironweed, Tall *Vernonia altissima*

Family: Daisy Family (Compositae)
Other Names: Vernonia gigantea.
Origin and Distribution: Tall ironweed is a native of North America. Its present range is generally confined to the eastern half of the U.S. The plant prefers to grow in areas such as meadows and pastures where the soil is fertile and conditions are moderately damp.

Plant Description: Tall ironweed is an upright perennial with a highly visible dark red stem that grows over 7 feet tall and is widely branched at the top. At the ends of branches in loose clusters are saucer-shaped, 1/4-inch-wide flower heads consisting of 30 or fewer purple disk flowers. Attached to the stem are 10-inch-long, lance-shaped, pointed leaves that have short downy hairs on the lower surface. Reproduction is primarily by way of seeds, but new shoots sometimes arise from the large root crown.
Root system - The root system consists of strong fibrous roots and rhizomes.
Stems - The tough erect stems grow between 6 to 10 feet tall and can be hairy. The upper portion is widely branched. Stems turn dark red as the plant matures.
Leaves - Leaves are alternate (1 leaf per node), 6 to 10 inches long, less than 3 inches wide, lance-shaped, pointed at the tip, and toothed along the edge. On the lower surface of each leaf is a distinct white midrib. The upper leaf surface is hairless and there are short, straight, downy, hairs on the lower surface with somewhat longer and denser hairs on the midrib.
Flowers - Large, loose, spreading, flat-topped, saucer-shaped clusters of flowers form at the ends of branches. Flower heads are 1/4 inch wide and made up of fewer than 30 red-purple disk flowers tipped with 5 lobes.
Fruits & Seeds - The single-seeded fruits are cylindrical with 10 prominent ribs running lengthwise. At one end of the seed are short purplish bristles (pappus).

The underside of its leaves lack hairs and its flower clusters are more compact than those of tall ironweed. Lower leaves of broad-leaved ironweed (V. glauca) are broader and more ovate than tall ironweed leaves. Missouri ironweed (V. missurica) is a weed of damp or dry open ground. Its flower heads are composed of more than 30 disk flowers whereas tall ironweed flower heads have fewer than 30 disk flowers. New York ironweed (V. noveboracensis) flower heads are surrounded at the base by bracts with hairy tips giving flowers a somewhat wooly appearance.

Biology: Flowers are produced from July to October. In an average year, a single plant can produce between 6000 to 19,000 seeds. Seeds buried in soil lose viability within the first 7 months. Stems tend to persist throughout winter. Research showed that 9 successive years of mowing on two dates during the year caused no significant stand reduction of tall ironweed. Herbicides controlled top growth of tall ironweed in the season of application but had little effect on regrowth from surviving roots.

Toxicity: None known.

Joepyeweed *Eupatorium spp.*

Family: Daisy Family (Compositae)
Other Names: gravel root, kidney root, marsh milkweed, quillwort, trumpet weed.

HOLLOW JOEPYEWEED: Queen of the meadow, tubular joepyeweed, hollow joepyeweed, common joepyeweed.

SPOTTED JOEPYEWEED: mottled joepyeweed.

SWEET JOEPYEWEED: purple joepyeweed, wide-leaved joepyeweed.

Origin and Distribution: Natives of North America, joepyeweeds are now distributed over an area extending from Canada to Florida. These weeds grow best in unattended areas on moist or somewhat dry soils.

Among the various species are several that occur including HOLLOW JOEPYEWEED (Eupatorium fistulosum), which prefers moist conditions and often grows in bottomlands or wet thickets. SPOTTED JOEPYEWEED (Eupatorium maculatum) also grows in moist soils. It frequently establishes in marshes, wet meadows, swampy woods, roadside ditches, lakeshores, stream edges, bogs, and other wet places. SWEET JOEPYEWEED (Eupatorium purpureum) grows in dry areas such as upland woods and fields.

Plant Description: Joe-Pye weeds are perennial herbs with leaves in whorls (3 to 6 leaves per node) and purplish flowers in terminal clusters. Stems of HOLLOW JOEPYEWEED are mostly hollow, there are usually 4 to 6 leaves in a whorl, and flower heads consist of fewer than 8 purple tubular flowers. Flower heads are arranged in a domed terminal cluster. Stems of SPOTTED JOEPYEWEED are purple or purple-spotted, there are 5 leaves in a whorl, and flower heads are pinkish-purple consisting of between 8 and 22 tubular flowers. Flower heads are arranged in flat-topped terminal clusters. SWEET JOEPYEWEED foliage smells like vanilla when crushed, stems are green with purplish nodes, there are 3 or 4 leaves in each whorl, and flower heads are dull pink consisting of fewer than 8 tubular flowers. Flower heads are arranged in dome-shaped terminal clusters. Joe-Pye weeds reproduce by rhizomes and seeds.

Root system - The root systems includes spreading rhizomes (horizontal underground stems).
Stems - HOLLOW JOEPYEWEED stems are hollow, often hairy, and usually unbranched below. SPOTTED JOEPYEWEED stems are purple or spotted with purple, erect, ridged, and usually unbranched below.

SWEET JOEPYEWEED stems are greenish with purple at or above the nodes and usually unbranched below.

Leaves - HOLLOW JOEPYEWEED leaves are positioned on the upper portion of the stem near the base of the flower heads are typically opposite (2 leaves per node). All other leaves are borne on the stem in whorls (4 to 6 leaves per node) and are generally serrated, oblong, and tapered.

SPOTTED JOEPYEWEED leaves are positioned on the upper portion of the stem near the base of the flower heads are typically opposite (2 leaves per node). All other leaves are borne on the stem in whorls (5 leaves per node). Leaves are 2 1/2 to 8 inches long, thick, broadly ovate, and tapering into a long tip

at the apex and a stalk (petiole) at the base. Leaf edges have teeth that vary from sharp and serrate to shallow and rounded.

SWEET JOEPYEWEED leaves are positioned on the upper portion of the stem near the base of the flower heads are typically opposite (2 leaves per node). All other leaves are borne on the stem in whorls (3 or 4 leaves per node). Leaves are also serrated, oblong, and tapered.

Flowers - HOLLOW JOEPYEWEED flower heads consist of fewer than 8 purple tubular flowers. Flower heads are grouped in slender, dome-shaped, terminal clusters.

With SPOTTED JOEPYEWEED each pinkish-purple flower head is about 1/3-inch-wide and consists of more than 8 and fewer than 22 tubular flowers. Between 9 to 15 flower heads are densely packed into compact, flat-topped, 4- to 5 1/2-inch-wide terminal cluster.

SWEET JOEPYEWEED flower heads consist of fewer than 8 dull-pink tubular flowers. Flower heads are grouped in dome-shaped terminal clusters.

Fruits & Seeds - HOLLOW JOEPYEWEED have single-seeded fruits that are ribbed, yellow to almost black, and tipped with purplish bristles (pappus).

SPOTTED JOEPYEWEED have single-seeded fruits that are linear, angled, black or dark brown, and tipped with bristles (pappus).

SWEET JOEPYEWEED have single-seeded fruits that are angular, almost black when mature, and tipped with bristles (pappus).

Similar Species: Eupatorium is a diverse genus with more than 50 species occurring in North America. Joepyeweeds can be distinguished from these other related species, which include bonesets, white snakeroot (Eupatorium rugosum), and thoroughworts, by the whorled leaves and purple flowers.

Biology: Joepyeweeds flower from August to September. Many insects, especially butterflies and bees, are attracted to the small tubular flowers. To control Joepyeweeds, plants should be mowed close to the ground several times during the season to prevent seed formation. Repeated cultivation and improved drainage are other measures that may help to control these weeds.

Toxicity: None known.

Related Information:

- ✓ There are more than forty species in this genus and many have medicinal uses; early American colonists used Joepyeweeds to treat various ailments and, according to folklore, an Indian called 'Joe Pye' used the plant to cure fevers.
- ✓ Joepyeweeds can grow up to 12 feet tall making them one of America's tallest herbs.
- ✓ 'Sweet joepyeweed' was given its common name because if bruised, the foliage smells like vanilla.

Johnsongrass *Sorghum halepense*

Family: Grass Family (Gramineae)
Other Names: Andropogon halepensis, Holcus halepensis, Sorghum miliaceum, Egyptian millet, Egyptian-grass, false guinea-grass, grass sorghum, means-grass, millet-grass, Morocco millet.
Origin and Distribution: Johnsongrass originated in southern Eurasia, and was brought to the southeastern U.S. in the 1800's as a forage crop. It was named after Colonel William Johnson, who introduced this species to his fertile river bottom farm in Alabama around 1840. Today, Johnsongrass is a weed in tropical and temperate climates throughout the world, and is considered among the world's 10 worst weeds. It has become naturalized throughout much of the U.S. and is spreading northward into Canada. Johnsongrass is a troublesome weed in where it grows in crop fields, pastures, roadsides and banks of ditches and irrigated canals, preferring areas with rich soils. However, this species can tolerate a wide range of soil types and environmental conditions.

Plant Description: Johnsongrass is a large, coarse, sod-forming perennial grass, characterized by its purplish, pyramidal flower heads and the prominent white midrib down the leaf blade. It reproduces by seeds and stout rhizomes (horizontal underground stems), and can form large, dense patches.
Root system - Johnsongrass forms an extensive system of stout, creeping, fleshy rhizomes (horizontal underground stems) that can grow over 6 feet long. Rhizomes are whitish to brownish and may have purplish spots. The joints (nodes) of the rhizomes are covered with brown, scaly sheaths.
Stems - Stems are stout, erect, round, hollow, unbranched (sometimes branched) and smooth, growing 3 to 8 feet tall (sometimes up to 10 feet).
Leaves - Leaves are rolled in the bud and bright green, sometimes tinged with purple pigments when under stress. The leaf blade (free part of the leaf) (8 to 24 inches long, 1/2 to 1 inches wide) is hairless (sometimes with a few hairs at the base near the ligule), flat, smooth above, and rough below and on the margins. A prominent white midrib runs down the upper surface of the leaf blade, forming a pronounced keel along the back of the blade. The sheath (part of the leaf surrounding the stem) is smooth and usually round, but sometimes can be slightly flattened. Margins of the sheath overlap. The ligule (projection inside on the top of the sheath) is prominent (1/8 to 1/4 inch long) and membranous, often with a fringe of hairs along the top. Auricles (appendages at the top of the sheath) are absent.
Flowers - The open, airy, pyramidal flower head (6 to 20 inches long, up to 8 inches wide) is composed of numerous whorls of branches, with the lower branches longer than the upper ones. Clusters of purplish flowers are produced along the branches. Initially, the branches are tight against the main stem, but spread open as the flower head matures.
Fruits & Seeds - Seeds are reddish-brown, oval, and 1/8 inch long.

Similar Species: Young plants of johnsongrass may resemble a narrow-leafed corn (Zea mays) plant. Seedlings of johnsongrass may be distinguished by the remnant seed attached to the root, and shoots may be distinguished by the presence of rhizomes. Johnsongrass and shattercane (Sorghum bicolor) are close relatives, but shattercane is an annual and does not produce rhizomes. In addition, the leaf blades of shattercane are much wider, and the seeds are larger and more rounded. Common reed (Phragmites australis) may resemble johnsongrass, but grows much taller and has dense, feathery flower heads and thin seeds.

Biology: Johnsongrass flowers from May to July. This species can produce a large amount of seed. Over 28,000 seeds were produced from a single plant growing free of competition. Sixty to 75% of the seeds may still be viable after 2 1/2 years in the soil.

Viable seeds can be found in cattle and bird droppings, though wind and water dissemination are probably the primary means of dispersal for this species. Most seedlings emerge from the top 3 inches of the soil, but emergence is possible from 6 inches.

With the aid of its rhizomes, johnsongrass can form dense, spreading patches. A single plant can produce up to 300 feet of rhizomes in one season. New stands readily establish from small pieces of rhizome.

Johnsongrass is very invasive and can reduce corn and soybean yields over 30% and 40% respectively, even with normal control efforts. Crop production is impossible in a dense johnsongrass stand if left uncontrolled. This species also serves as an alternate host for several insect, nematode and disease pests of desirable crops. Johnsongrass contains allelopathic compounds that inhibit the germination and development of various crop species. Some control may be obtained through repeated tillage and close mowing.

Johnsongrass is still used as a forage grass in the southeastern U.S. and other parts of the world. It can produce 2 or more crops of hay each year. It is similar to alfalfa in protein content and to timothy in feeding value. Forage quality increases with soil fertility and decreases with plant maturity. Its extensive rhizome system also makes it a valuable species for erosion control.

Toxicity: Johnsongrass can produce toxic amounts of cyanide if growing under stressful conditions, such as cold (i.e. frost), extreme heat or drought. Poisoning and death of grazing animals may occur if large quantities of the leaves and stems are ingested. Nitrates can also accumulate in johnsongrass, resulting in toxicity to cattle. The airborne pollen may contribute to hay fever in the summer.

Related Information:

- ✓ This species was the target of the first federal grant specifically for weed control in 1900.
- ✓ Over 55 varieties of johnsongrass have been identified growing in the U.S. and Caribbean countries.

Control: Although considerable information is available on controlling Johnson grass in agricultural settings, information on controlling Johnson grass in rangelands, natural areas, and other wildlands is lacking. The following information on Johnson grass control is extracted primarily from agricultural literature but may be applied to some wildland settings, particularly old fields. Research is needed on controlling Johnson grass in wildland settings.

Johnson grass control involves several steps: 1) preventing seed from ripening and dispersing, 2) killing seedlings, 3) killing existing rhizomes, and 4) preventing growth of new rhizomes. Control is most effective before plants have developed 5 leaves.

Prevention: The most efficient and effective method of managing invasive species such as Johnson grass is to prevent their invasion and spread. Preventing the establishment of nonnative invasive plants in wildlands is achieved by maintaining native communities and conducting aggressive surveying, monitoring, and any needed control measures several times each year. Monitoring efforts are best concentrated on the most disturbed areas in a site, particularly along potential pathways for Johnson grass invasion: roadsides, waterways, and old fields. Large plant size makes monitoring Johnson grass relatively easy in summer, and yearly summer monitoring helps managers assess the effectiveness of control programs.

Integrated management: A combination of complementary control methods may be helpful for rapid and effective control of Johnson grass. Integrated management includes not only killing the target plant, but establishing desirable species and discouraging nonnative, invasive species over the long term. Johnson grass control is rarely successful with only 1 method of control, but a combination of control methods can be effective. 50% frequency 3 years after treatments. Only trace amounts of Bermuda grass were present.

Biological: Biological control of Johnson grass is problematic, as known control agents that kill Johnson grass also kill crop grasses such as corn and sorghum. As of this writing (2004), there are no biocontrol agents approved for Johnson grass. Several biological agents are being tested for possible use. A smut (*Sphacelotheca holci*) has helped control Johnson grass in Louisiana croplands. In Florida field trials, a mixture of native fungal pathogens controlled Johnson grass and other weedy grasses in citrus (*Citrus* spp.) groves.

Heavy grazing over 2 or more years reduces Johnson grass by depleting rhizome reserves. Rhizome development is greatly reduced when plant height is kept below 12 to 15 inches (30.5-38 cm). Best control is offered when herbicide or winter plowing treatments follow grazing treatments. For example, in an unpublished study at the Patagonia/Sonoita Creek Preserve, Arizona, cow and horse summer grazing reduced density of Johnson grass. After 4 years of summer grazing, Johnson grass stem density had decreased 75% compared to pretreatment levels. Plots were then sprayed in late spring with glyphosate. Post-treatment restoration plantings gave mixed results. One to two months after spraying, native bunchgrasses were transplanted onto the study sites. Broadleaf weeds invaded the study plots after Johnson grass density was reduced by the grazing and herbicide treatments. After mowing treatments to control the broadleaved weeds, native bunchgrasses on some test plots were showing good growth. Other plots experienced Johnson grass reinvasion and pocket gopher herbivory, to the detriment of native bunchgrasses. Preserve managers are continuing weed control treatments to promote the native bunchgrasses.

Geese are sometimes used for Johnson grass control in croplands. Geese prefer young shoots, and do not graze Johnson grass over about 7 inches (18 cm) in height.

Chemical: Herbicides may provide initial control of a new invasion or a severe infestation, but used alone, they are rarely a complete or long-term solution to invasive species management. Herbicides are most effective on large infestations when incorporated into long-term management plans that include replacement of weeds with desirable species, careful land use management, and prevention of new infestations. Control with herbicides is temporary, as it does not change the conditions that allowed the invasion to occur in the first place.

The most effective chemical control of Johnson grass involves using systematic herbicides that translocate the active chemicals to rhizomes. A single application of herbicide generally does not control large infestations, and follow-up measures are needed for long-term control. Johnson grass control can be obtained using glyphosate, phenoxy (e.g., 2,4-D, fluazifop),, or halogenated aliphatic (e.g., dalapon) herbicides. Spot spraying with sodium chlorate or dalapon has been effective for small infestations. Spot control is not effective in the long term unless surrounding seed sources are also eliminated. Experiments in agricultural fields in Argentina showed best control when the herbicide (dalapon) was applied when rhizome biomass was low. Ghersa and others provide a model for predicting optimal spraying time based on minimum rhizome biomass. Although based on South American seasons, the model is easily adjustable for use in the northern hemisphere.

Postemergent herbicides are the most common method of Johnson grass control in agricultural systems, and are probably the best herbicide choice for wildland settings as well, since postemergent herbicides cause less damage to nontarget species. In a Maryland old-field study, foliar application of postemergence herbicide (DPX-V9360) was more effective in late-growth stages (>5 leaves) than early-growth stages (<5 leaves) when rhizomes had not fully expanded. Rosales-Robles and others discuss the relative effectiveness of several postemergent herbicides as influenced by application rate and Johnson grass growth stage.

Ecotypes may show differential response to herbicides. Populations in Kentucky and Mississippi show genetic resistance to fluazifop and other phenoxy herbicides. Virginia populations have resistance to enzyme acetyl-coenzyme A carboxylase inhibitors. In Greece, some populations show resistance to glyphosate.

Herbicide treatments greatly decreased Johnson grass cover in an Illinois bottomland old field. Restoration treatments included tillage, pre- or postemergent herbicide applications (sulfometuron or glyphosate, respectively), and green ash (*Fraxinus pennsylvanica*) plantings. Tillage had no significant impact on Johnson grass cover. Mean Johnson grass cover (%) was significantly lower after the 1st postspray year:

Treatment	Year 1	Year 2	Year 3
No herbicide	27.4 by*	0.5 ax	0.01 ax
sulfometuron	1.2 ay	1.3 ay	0.01 ay
glyphosate	7.3 ay	2.4 ay	0.01 ay

Columns followed by the same letter (a or b) are not significantly different. Rows followed by the same letter (x-z) are not significantly (*P*=0.05) different.

Cultural: Little information is available on cultural methods of control for Johnson grass. An Arizona study using integrated pest management, including native bunchgrass plantings, showed some success in controlling Johnson grass (see grazing in the Biological control section above). Additional studies incorporating cultural control of Johnson grass are needed.

Physical/mechanical: Johnson grass can be controlled by tilling, mowing, and flooding. Individual small plants or small clumps may be controlled by hand-pulling or solarization.

A consistent **tillage** program may provide effective control. Tilling is not practical on most wildlands due to damage to desirable native plant species, uneven terrain, erosion, and cost constraints. Tilling can be used on some sites such as bottomlands and old fields. Shallow plowing helps control Johnson grass by breaking up rhizome systems, exposing rhizomes to the sun or killing frosts, and depleting carbohydrate reserves. Optimal plow depth is 8 to 12 inches (20-30 cm). Several treatments are needed in hot climates. Killing sprouts early, before they form 5 leaves and start developing new rhizomes, gives best control. First plowing is in spring (May), followed by similar plowings every 3 weeks (in rainy weather) to 6 weeks (in dry weather). Plant heights of 12 or more inches (30 cm) are recommended before plowing again. In cold climates, Johnson grass is plowed in late October to expose rhizomes to frost. An exposure of 24 or more hours to temperatures below 25 °F (- 4 °C) kills rhizomes. A single plowing, or long intervals between plowings (≥4 years), is generally not effective because it stimulates growth, buries and protects rhizomes, and exposes deeply buried seeds to upper soil levels where they may germinate.

Because rhizomes may extend more than 20 inches (51 cm) below ground, cultivation alone may fail to kill Johnson grass rhizomes. After plowing, close grazing or mowing (so that the grass stays <12-15 inches (30-38 cm) tall) helps further reduce Johnson grass cover.

Even on old fields, tilling is a major soil disturbance that provides a favorable seedbed for pioneer species. Unless further rehabilitation efforts that include planting native herbaceous species are taken, it is likely that tilled fields will succeed to other invasive nonnatives.

Repeated, close **mowing** has the same inhibitory effect on growth as grazing. In Mississippi, mowing seedlings 13 days after emergence killed them. In an Alabama field experiment, multiple cuttings, starting when plants were 1 foot (0.3 m) high, slowed Johnson grass rhizome development. At the end of the growing season, plots cut 8 times averaged 15 dry-weight ounces (431 g) of Johnson grass top-growth and 0.3 dry-weight ounces (10 g) of rhizomes. Plants cut only twice had 67 ounces (1,909 g) top-growth and 26 ounces (739 g) of rhizomes. Plots were 4× 5 feet².

Flooding for 3 to 6 weeks in early spring, before rhizomes sprout, can effectively control Johnson grass. Replacing open irrigation ditches with culverts or pipes helps prevent reinfestation.

Hand-pulling Johnson grass usually leaves rhizome pieces behind in the soil, stimulating sprouting. It is not an effective control method unless all rhizomes are removed or new sprouts are controlled Best results are obtained in early spring when soil in moist and rhizomes are least likely to break.

Repeated solarization treatments (using a clear polyethylene tarp to trap solar heat in the soil) can control small Johnson grass infestations.

Seeds: Solarization of moist soil at 140 °F to 150 °F (60-70 °C) for 7 days kills most Johnson grass seeds. Solarization of dry soil does not kill Johnson grass seed. In Davis, California, soil watered and solarized for 9-12 weeks supported no Johnson grass. Untreated control plots showed 58% Johnson grass cover. For established plants, 30 days of solarization kills most Johnson grass. Remaining plants have grown rhizomes through and above the landscape fabric, but rhizomes above the landscape fabric were easily removed by hand-pulling. Composting Johnson grass seeds in cow manure for 3 days killed the seeds. Temperatures in the compost reached 120 °F (49°C). Ensiling for 21 days also killed Johnson grass seed.

Jointed Goatgrass *Aegilops cylindrica*

Description: Winter annual with deep blue-green foliage. Tends to lie flat prior to seed formation. Spikelets awned, the longest awns at the top of the spike. Seed heads break into individual segments at maturity.

Impacts: Jointed goatgrass grows best in cultivated fields, but it can also invade grasslands. It thrives in wheat fields, rangelands, roadsides, and fencerows. Ten jointed goatgrass plants per square yard can reduce cereal crop yields by 30 to 50%. Jointed goatgrass seed is a contaminant in cereal grain seed crops where it alters their milling characteristics and reduces the value of the grain. Jointed goatgrass (Aegilops cylindrica) is a native of southern Europe and western Asia. It is so closely related to wheat that both species can interbreed. Has been spread as a contaminate in equipment and seed.

Jubata Grass *Cortaderia jubata(Lemoine)*

USDA Symbol: COJU2

Other common names: pampas grass, Andes grass, selloa pampas grass, cortaderia, pink pampas grass, purple pampas grass.

Description: Jubata grass is a perennial grass that ranges six to twenty-three feet tall. Plants have long leaves arising from a tufted base or tussock. The flower cluster is a plumed panicle at the end of a very long stem. Stems generally are at least twice as long as the tussock. Plumes consist of hairy female flowers, deep violet when immature, turning pinkish or tawny cream-white at maturity. Jubata grass is easily confused with pampas grass (Cortaderia selloana). The two species are distinguished by stem height, leaf, plume, and spikelet color, florets, leaf tip, and presence of viable seed. The tussocks of jubata grass are less erect and more spreading and not fountain-like, when compared to tussocks of Cortaderia selloana.

Impacts: Jubata grass has the potential to greatly impact Oregon's coastal ecosystems. Escaped plants crowd out native vegetation and are very competitive in forestry operations. In forests, jubata grass can out-compete seedling trees and retard their establishment and growth. It creates a fire hazard with excessive build-up of dry leaves, leaf bases, and flowering stalks. Large clumps can complicate road access and fire management activities by blocking vehicle.

Introduction: Jubata grass is native to northern Argentina and the Andes of Bolivia, Peru, Chile, and Ecuador. In its native range it can be found from sea level to elevations greater than 11,000 feet. It was first cultivated in France and Ireland from seed collected in Ecuador (Costas-Lippmann 1977).

Kangaroo Thorn *Acacia paradoxa*

Acacia paradoxa is a plant in the Fabaceae family. Its common names include kangaroo thorn, prickly wattle, hedge wattle and paradox acacia. This is a large shrub up to 9 feet tall and wide. It is dense with foliage; the leaves are actually enlarged petioles known as phyllodes. They are crinkly and the new ones are covered in hairs. The bush is also full of long spines. It flowers in small, bright yellow spherical flower heads and the fruits are brown pods 4 to 7 cm long.

The spiny 'stipulles' which grow at the base of the phyllodes deter livestock from feeding on or too close to the plant.

Kangaroo thorn is widely spread across Australia, regenerating from seed after disturbances, such as bush fire. Small birds, including wrens, use this plant as shelter and dwelling, while it is relied upon as a food source for moths, butterfiles and other insects, and birds feed on its seeds.

This plant is native to Australia, but has been introduced to other continents. In the United States, kangaroo thorn is a well-known noxious weed in California

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:

- Elimination of weed debris
- Control of annual weeds
- Suppression of perennial weeds
- Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

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 herbicides 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.

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Knapweed, Diffuse *Centaurea diffusa*

Diffuse knapweed *Centaurea diffusa*

Diffuse knapweed is a member of the Aster family, Thistle tribe. Diffuse knapweed was introduced from Europe and is a biennial or short-lived perennial forb which reproduces only by seed. The plant usually produces a single main, much-branched stem that is 1-1/2 to 2 feet tall. It is known to have more than one stem produced from one rosette. A basal rosette of leaves is present in young plants with each leaf divided into narrow segments. When leaves are young, a thin nap is present.

Stem leaves in the mature plant become much reduced as you ascend to the tip and alternate one per node. Flowers are mostly white, sometimes purple, and are located on each branch tip. The bracts surrounding each flower bear 4 to 5 pairs of lateral spines and one, long terminal spine. Diffuse knapweed can resemble spotted knapweed with the black tipped bracts. The difference is the sharp spine at the end of the bract that is characteristic of diffuse knapweed.

USDA Symbol: CEDI3

Other common names: white knapweed, spreading knapweed, tumble knapweed

Description: Biennial; flowers midsummer to fall. Grows to 3 ft. tall. Single-stemmed plant with numerous lateral branches. Flowers white to rose, sometimes purplish. Flower heads slender with pointed, fringed bracts. Spreads by seed, aided by the tumbling of windblown mature plants.

Impacts: Diffuse knapweed will form dense stands on any open ground, excluding more desirable forage species. Once established, the necessary extensive control measures are often more expensive than the income potential of the land. Grows under a wide range of conditions, such as riparian areas, sandy river shores, gravel banks, rock outcrops, rangelands and roadsides.

Known hazards: There are possible health hazards from absorbing plant juice through bare hand pulling of plants. It is recommended that gloves are warn while handling plants.

Introduction: Diffuse is a member of a large genus of over 400 species, most originating in the Mediterranean region. Diffuse knapweed was first introduced to the Pacific Northwest at the turn of the century as a contaminant in alfalfa seed imported from Turkestan, Turkmenistan or hybrid alfalfa seed from Germany.

Knapweed, Meadow *Centaurea pratensis*

USDA Symbol: CEDE5

Description: Meadow knapweed blooms in midsummer to fall. It grows from woody root crown and up to 3 1/2 feet tall. The lower leaves are long-stalked, upper leaves have no stalk. Stems are many-branched and tipped by a solitary flower head up to one inch wide. Flower heads are pink to reddish purple, oval or almost globe-shaped.

A key identifying feature is the fringed bracts on the flower head. A hybrid of black and brown knapweeds. Its foliage is coarse and tough. However, because meadow knapweed is a hybrid, it traits can very.

Impacts: Meadow knapweed out-competes grasses and other pasture species, causing productivity to decline. It is susceptible to herbicide treatments, but control efforts must persist for the long-term. It has the potential to invade native prairie and oak savannah.

Meadow knapweed favors moist roadsides, sand or gravel bars, river banks, irrigated pastures, moist meadows, and forest openings. It also can invade industrial sites, tree farms, and grasslands.

Introduction: Native of Europe. Well distributed in the Pacific Northwest.

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Knapweed, Russian *Acroptilon repens*

USDA Symbol: ACRE3
Other common names: Turkistan thistle, creeping knapweed, mountain bluet, Russian cornflower, hardheads.

Description: Perennial; blooms summer to fall. Grows up to 4 feet tall. Forms dense colonies with stems that are erect and branched. Lower leaves deeply lobed, 2 to 4 inches long; upper leaves entire or serrate. Cone-shaped flowering heads 1/4 to 1/2 inch wide with one flower, pink to lavender, growing at each branchlet tip. Bracts below the flower rounded with papery margins.

Impacts: Once Russian knapweed is established, it can overrun native grasslands as well as irrigated crops. It has dense growth and spreads entirely by fragments of its creeping rootstocks or by seed. Russian knapweed can be successfully controlled with combinations of grazing and herbicides but control programs must persist for several years.

Introduction: This plant is an aggressive native of Eurasia that was introduced in North America in 1898. It can be found in every western state. Russian knapweed infests both native range and irrigated crop land. It is believed initial infestations were from contaminated alfalfa seed.

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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Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Postemergence Herbicides
Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Knapweed, Spotted *Centaurea stoebe* (C. maculosa)

USDA Symbol: CEBI2

Description: Biennial or short-lived perennial; blooms midsummer to fall. Grows up to 3 feet tall. Multi-stemmed plant with several stems arising from crown. Flowers purple or rarely cream colored. Tips of flower head bracts are usually black, thus the name "spotted." Seeds dispersed by wind, animals, and people.

Impacts: Spotted knapweed is one of the most dominant weed species in the western United States. Millions of acres of prime range and native habitat are infested throughout the northern Rocky Mountain States. Infested acres in Oregon is still limited but increasing and has caused economic losses of approximately $54 million dollars in the state. This species will form dense stands on any open ground, excluding more desirable forage species and native plants. On heavily infested range, the necessary control measures to recover the land are often more expensive than the income potential derived from grazing. Control success is hampered by seed longevity. Weeds of the Centaurea genus have more negative impacts to natural and agricultural ecosystems than any other.

Family: Daisy Family (Compositae)
Other Names: Centaurea bierbersteinii, Centaurea stoebe, bachelor's button, blue bottle, born flower, hard head, star thistle.
Origin and Distribution: Spotted knapweed is a native of Europe. After it was accidentally introduced into the U.S. during the late 1800's, spotted knapweed spread throughout the Northeastern and north central states as far west as Nebraska, the Pacific Northwest, and southern Canada. Spotted knapweed usually inhabits sites that are infrequently-disturbed such as roadsides, pastures, and rangelands. The species prefers to grow in dry, sterile, gravelly or sandy soils and full sunlight.

Plant Description: Spotted knapweed is a biennial or short-lived perennial. In its first year of growth, the plant produces a rosette of basal leaves that are deeply divided into numerous leaflets. Both upper and lower surfaces of leaflets are slightly wooly and covered with shiny specks and translucent dots. Several 3-foot-tall leafy stems emerge during the second year. At the ends of main stems and axillary branches are solitary rosy-purple flower heads surrounded by prickly bracts with a fringe of dark hairs at the tip. Spotted knapweed reproduces by seeds.
Seedlings & Shoots - Both the seed leaves (cotyledons) and first true leaves have rounded tips. Subsequent leaves gradually become narrower and more lance-shaped. Young leaves grow in the form of a basal rosette.
Stems - Stems are branched, wiry, softly hairy, 3 feet tall, and either erect or may appear fallen over. As many as 6 stems emerge from the same root crown during a single growing season. Sometimes, stems have green or purple stripes.
Leaves - Rosette leaves are alternate (1 leaf per node), 4 to 8 inches long, gray-green, slightly wooly, compound with deeply divided leaflets, and attached to the stem by way of a long leaf stalk (petiole). Leaflets may lack lobes or be irregularly lobed. Upper and lower surfaces of leaflets are covered with shiny specks interspersed with translucent dots. Leaves located on the lower and middle portions of the stem are similar in appearance to rosette leaves. Upper stem leaves are smaller, linear, and have fewer divisions. Petioles generally become shorter as the leaf position moves up the stem.

Flowers - Individual rosy-purple (rarely white) disk flowers are clustered onto flowers heads that are approximately 3/4 to 1 inch wide. Flower heads are surrounded by oval, dry, prickly bracts tipped with a fringe of dark hairs. Flower heads occur singly at the ends of main stems and axillary branches.
Fruits & Seeds - Single-seeded fruits are oblong, brownish, 1/8 inch long, and have a short tuft of bristles at the tip.

Similar Species: Cornflower (Centaurea cyanus) has a similar appearance except it is an annual with bright blue flowers. White-flowered knapweed (Centaurea diffusa) can be distinguished from spotted knapweed by its white flowers, but there is a pink-flowered form that is very difficult to separate. White-flowered and spotted knapweeds hybridize producing plants with characteristics intermediate between the parents.

Biology: Plants flower from July through August. A single rosette produces 1 to 6 flowering stems during the second year of growth. Perennial plants can have a main rosette and minor rosettes that form at the ends of lateral shoots extending horizontally just below the soil surface. A single plant produces 16 flower heads on average, and each flower head produces over 25 seeds. Once seeds mature, they are shed and germinate, providing conditions are sufficiently moist, and develop into a rosette by fall. Grazing animals generally pass over spotted knapweed in favor of more palatable native grasses and herbs. Light infestations can be controlled by hand pulling or mowing early in the flower stage. Plants are less likely to regrow if allowed to form flower stalks before cutting. All control methods must be repeated for several years until seeds stored in the soil seed bank become depleted. Spotted knapweed is resistant to some herbicides, likely due to wooly hairs limiting retention or penetration of product.

Toxicity: None known, but more mature plants have spines that can cause mechanical injury to the mouth and digestive tract of grazing animals.

Related Information:

- ✓ 'Knapweed' comes from the German word 'knobbe' meaning bump or button.
- ✓ In the past, young women wore spotted knapweed flowers to attract bachelors.
- ✓ Spotted knapweed is not known for its edible qualities, but North Africans claim to have fed the plant to their camels.

Livestock and Wildlife Concerns: The importance of spotted knapweed to livestock and wildlife depends upon the size and density of the infestation, the availability of other forage plants, and the season. Large-scale infestations of spotted knapweed can impede access to more desirable forage for livestock and wildlife, especially when the presence of old, dried knapweed stems creates a dense and spiny overstory. Large reductions in available forage and wildlife use have been reported on knapweed-infested range. Reports of forage losses for elk vary, and probably do not consider the possibility of elk using spotted knapweed as forage. In fact, the perception that spotted knapweed has minimal forage value and may even be toxic has changed since studies have shown that it has good nutritional value, and it is eaten by both livestock and wildlife.

Several reports from western Montana indicate some use of spotted knapweed by livestock. In general, use of spotted knapweed by livestock is highest during spring and early summer when plants are green and actively growing in the rosette and bolt stages. Use declines as spotted knapweed matures, and protein and digestibility decrease, although flowerbuds and seedheads may be grazed in the late summer. Domestic sheep may also graze rosettes when present (from regrowth and late season germination) in the fall. Cox observed domestic sheep eating large quantities of spotted knapweed in the spring and early summer in preference to grasses and other forbs. Olson and Wallander also report sheep readily grazing spotted knapweed in an infested pasture, although they grazed other plants as well and did not consistently graze one plant more than the others. Sheep grazed spotted knapweed leaves and avoided stems. In sagebrush steppe rangeland in southeastern Idaho, spotted knapweed was readily consumed by domestic sheep throughout the year. Grasses were consumed in amounts

similar to spotted knapweed, but native forbs were most commonly used. Sheep grazing has been proposed as a potential control method for spotted knapweed.

Reports on wildlife use of spotted knapweed are also varied. Bedunah cites several studies suggesting large potential losses of elk range to spotted knapweed, though he indicates that quantifying the effects of infestation on elk populations is complicated by their mobility. Spotted knapweed infestation is considered more detrimental to elk than to deer because spotted knapweed replaces grasses that are preferred by elk, while deer have a diet of predominantly shrubs and conifers that spotted knapweed does not replace. Elk use increased following removal of spotted knapweed with herbicides on sites in Montana. In a study in western Montana on 2 game ranges in the Bitterroot Valley, Willard and others report minimal use of spotted knapweed dominated sites by elk and mule deer. When used, mule deer consumed knapweed flowerheads from December through April, while elk consumed knapweed flowerheads only during winter. Spotted knapweed was preferred by deer and elk over other plant species on sites with dense knapweed cover. It was suggested that deer and elk did not frequently use the spotted knapweed sites in this study because cervid densities were relatively low and other forage was available. On spotted knapweed infested bunchgrass range in the Selway-Bitterroot Wilderness, Idaho, Wright and Kelsey report that elk, mule deer, and white-tailed deer used spotted knapweed infested range as much as or more than uninfested bunchgrass range from 1 December through 25 April. All cervid species consumed both rosettes and seedheads of spotted knapweed, with seedhead consumption greatest during periods of snow cover. The authors suggest that when estimating carrying capacity of a cervid range, spotted knapweed can be considered a potential food source, because when animal densities are high and food choices are limited, elk and deer will consume spotted knapweed. In British Columbia, deer and elk forage on diffuse and spotted knapweed rosettes in late fall and early winter, and again when snow cover recedes and spring green-up commences. Knapweed rosettes and bluegrass comprised 90% of mule and white-tail deer diets in February and early March.

In the Gilpin range, British Columbia, California bighorn sheep utilized diffuse and spotted knapweed seedheads as primary forage when snow depth was in excess of 8 inches (20 cm). As snow cover receded in January and February, knapweed basal rosettes were the largest component (80%) of their diet. Rocky Mountain bighorn sheep also utilized knapweed seedheads and basal rosettes throughout the year in the Robson/Syringa Park area, British Columbia.

Spotted knapweed is a nectar source for the endangered Karner blue butterfly in Wisconsin. Rodent utilization of spotted knapweed seed has been suggested. Deer mice have been observed eating larvae and seeds from spotted knapweed flowerheads infested with seedhead flies (introduced biocontrol agents).

Palatability: It has been suggested that the bitter tasting sesquiterpene lactone, cnicin, found primarily in the leaves of spotted knapweed, may make it unpalatable to mammalian herbivores. Wright and Kelsey were unable, however, to correlate changes in cnicin levels to changes in the amount of spotted knapweed consumed by mule deer, white-tailed deer, or elk. Furthermore, observations by Cox suggest that spotted knapweed is more palatable to domestic sheep than orchardgrass (*Dactylis glomerata*), timothy, quackgrass (*Elytrigia repens*), Kentucky bluegrass, sainfoin (*Onobrychis viciifolia*), or birdsfoot trefoil (*Lotus* spp.). In a cafeteria trial, domestic sheep readily consumed spotted knapweed in all growth stages, although they preferred rosette and bolting stages somewhat to the flowering stage. Robbins also observed cattle readily grazing spotted knapweed in the spring, though cattle prefer grasses when available. Mature spotted knapweed plants (with stems) are eaten less frequently than young plants (rosettes), and may be less palatable due to spininess and high fiber content.

Nutritional Value: Spotted knapweed has substantial nutritional value that compares favorably to the native plants with which it is commonly associated. By traditional measures of forage nutritive value (e.g., crude protein (CP), neutral detergent fiber (NDF), in-vitro dry matter digestibility (IVDMD), and total nonstructural carbohydrates (TNC)), spotted knapweed (especially leaves and flowerheads) is more nutritious than Idaho fescue. The following table provides measurements of nutritive value of spotted knapweed, harvested before flowering, as reported by Kelsey and Mihalovich:

CP (%)	NDF (% dry wt)	IVDMD (%)	TNC (%)	Ash (%)	Ether extract (%)
6.2-18.2	24.2-53.0	53.2-61.8	11.0-27.5	4.9-9.3	3.1-9.0

Values vary with season, plant part, age, and site. Nutritional value declines as summer progresses, with crude protein and nonstructural carbohydrates most concentrated during the spring. Spotted knapweed becomes more fibrous, with lower protein and carbohydrate levels, as stems mature over the summer. Seedheads are less nutritious than rosettes, but may be available above the snow. Willard and others measured crude protein, fiber, and lignin content in spotted knapweed flowers and recorded average values of 6.6%, 45.6%, and 14.5%, respectively. Crude protein was similar for open and forested sites, while fiber and lignin values were higher on forested sites than on open sties. Jones and others provide a detailed study of the forage value of spotted knapweed from a sagebrush/grassland site in southeastern Idaho, comparing different parts of mature and immature plants from May through September.

Secondary compounds in spotted knapweed, such as cnicin, can negatively affect activity and growth of anaerobic rumen microorganisms in domestic sheep, reducing digestibility of spotted knapweed.

Rehabilitation of Disturbed Sites: Watson and Renney noted that "the rapid establishment of (spotted knapweed) cover in the form of rosettes on barren soil prevents soil erosion and leads to accumulation of organic matter." Kelsey points out that "this characteristic is of marginal utility since the plants inhibit further succession and are difficult to replace with more desirable species." Furthermore, spotted knapweed establishment provides a seed source for invasion of adjacent lands and potential for reduction of native plant diversity. Lacey and others determined that surface water runoff and stream sediment yield were 56% and 192% higher, respectively, and infiltration rates lower, for spotted knapweed-dominated sites compared to bunchgrass-dominated sites.

Other Uses:
Kelsey and Locken cite studies indicating that the compound cnicin has antimicrobial properties, as well as being active against some human carcinoma cells and L-1210 leukemia. Knapweeds provide substantial pollen and nectar for domestic bees in interior British Columbia, the Intermountain West, and Michigan. Kelsey recommends short-term research to utilize spotted knapweed biomass for commercial products.

Other Management Considerations:
Spotted knapweed is considered a serious threat to rangelands in Montana, Washington, Idaho, Oregon, Wyoming, and British Columbia. Because of its affinity for the climate of western Montana, Chicoine and others predicted that spotted knapweed had the potential to invade 37 million acres (15 million ha) in that state alone, and Bedunah speculated that the foothill grasslands in western Montana (the primary habitat for spotted knapweed) are becoming an endangered vegetation type. The ill effects of spotted knapweed are manifold. Spotted knapweed infestations have been associated with reductions in forage production, plant species richness and diversity, cryptogam cover, soil fertility, and wildlife habitat, as well as increases in bare ground, surface water runoff, and stream sedimentation. Lesica and Shelly also found that spotted knapweed reduced seed germination and seedling establishment of a rare Montana endemic forb, Mt. Sapphire rockcress (*Arabis fecunda*).

Experimental evidence suggests that spotted knapweed gains dominance in part by its ability to out-compete native grasses for nutrients such as nitrogen and phosphorus. Other evidence suggests that as succession proceeds and nutrients become less available, the competitive advantage shifts from spotted knapweed to native plants such as bluebunch wheatgrass. Allelopathy, primarily from the compound cnicin, has been suggested as a growth inference mechanism in spotted knapweed. However, because cnicin concentration in soil is lower than that found to be toxic in in-vitro experiments, allelopathy was not considered as important as resource competition in determining the ecological success of spotted knapweed.

Allelopathic activity of cnicin may be enhanced, however, when large quantities of stem and leaf tissue from live or dead spotted knapweed plants come in direct contact with the soil surface, as when plants are trampled or mowed. This allelopathic activity could be minimized by burning or removing plant material before it comes in contact with the soil surface. More recent experimental evidence suggests that knapweed's advantage over its North American neighbors could be attributed to differences in the effects of its root exudates and how they, in turn, affect competition for resources, thus linking allelopathy and resource competition.

In many areas, eradication of spotted knapweed is no longer an option. Perhaps small patches can be eradicated with cultural practices or herbicides. Large infestations must be controlled or suppressed with cultural and biological methods, perhaps in conjunction with herbicides, to contain the weed and slow its spread. Before management plans for the control of spotted knapweed can be designed, land use objectives must be defined. A generalized objective may be to develop a plant community that is weed resistant and meets other land-use objectives. Desired plant communities can be designed to maximize niche occupation with desirable species that compete intensely, grow rapidly, and grow during much of the season. It is important that the successional effects of spotted knapweed control are considered in this manner to avoid replacing spotted knapweed with another weedy species.

Spotted knapweed control requires a sustained, site-specific commitment over a period of several years. Economic considerations for spotted knapweed control have been investigated, and Griffith provides a procedure for performing an economic evaluation for noxious weed management on rangeland, with spotted knapweed as an example.

Integrated weed management: Managers are encouraged to integrate different control methods that can complement one another in a given situation. Integrated management includes considerations of not only killing the target weed, but also of establishing desirable species and maintaining weed-free systems over the long-term. Factors to be addressed before a management decision is made include inventory and assessment to identify the target weed and determine the size of the infestations; assessment of non-target vegetation, soil types, climatic conditions and important water resources; and an evaluation of the benefits and limitations of control methods. Components of any integrated weed management program are sustained effort, constant evaluation, and the adoption of improved strategies.

Conceptual models can be developed to determine the probability that the weed management strategy will result in the desired plant community, based on the life histories and population dynamics of the species in the existing plant community. A weed management strategy may include designed disturbance (e.g., cultural or chemical control), controlled colonization (e.g., planting competitive species), and controlled species performance (e.g., biological control). Management strategies may include several approaches designed to disrupt the stages in a weed's life cycle that are most vulnerable to stress or control. Jacobs and Sheley identified juvenile, the transition from juvenile to adult, and adult as critical phases in the life history of spotted knapweed. The key processes associated with these stages are competition, growth, and reproductive allocation. Successful control practices must target one or more of these processes. Sheley and others provide examples of ecologically based spotted knapweed management systems.

Prevention: Prevention of spotted knapweed establishment is the most cost-effective control strategy. Prevention practices begin with the maintenance of healthy, desirable vegetation that is resistant to weed establishment. This includes minimizing soil disturbance in all activities and reestablishing desirable vegetation promptly whenever soil disturbance leaves areas of bare ground, with continued monitoring and immediate follow-up treatment of colonizing weeds, and/or revegetation with desirable species. In areas where it is critical to maintain native vegetation (e.g., national parks, nature preserves, wilderness), avoid building new roads and trails, since this is the primary habitat for many invasive species including spotted knapweed. Carefully monitor the intensity, frequency, and season of grass defoliation in grazing prescriptions so that grasses can tolerate grazing and resist weed invasion. One greenhouse study suggests that even moderate defoliation of competing grasses (30%) may allow greater spotted knapweed growth on Idaho fescue rangeland.

Another study found that spring defoliations increased spotted knapweed cover compared to summer defoliations; that grass defoliation greater than 60% caused an increase in spotted knapweed cover and density; and that more than one grass defoliation in a year increased spotted knapweed cover. The researchers suggest that a single, annual grass defoliation of 60% or less, regardless of the season, will not increase spotted knapweed invasion on rangeland. Rangeland managers must also consider the potential for livestock to introduce spotted knapweed seed in their feces or fur.

Regular removal of newly established spotted knapweed plants at trailheads, campsites and along road corridors is critical to prevent their spread into adjacent natural areas. Monitor for weed emergence annually, especially in areas where there is vehicle or livestock movement, in riparian areas, areas of wildlife concentration, public use areas, and locations where sand, gravel, or fill materials have been imported, soil has been disturbed, or vegetation or overstory has been removed. When spotted knapweed plants are found, remove them immediately.

The introduction of spotted knapweed seeds from infested areas to recently disturbed and/or uninfested areas can be limited by monitoring vehicle, livestock, and wildlife movement. Encourage public land users to avoid driving vehicles through or scheduling livestock use in existing spotted knapweed infestations when seeds are present, to inspect and clean vehicles of weeds and their seeds, to brush and clean animals, tack, and equipment before entering public lands, and to minimize soil disturbance by stock. Regulations promoting minimum impact camping and the use of weed-free feed, hay, straw, and mulch in natural areas may reduce spotted knapweed infestations. Encourage the use of certified weed-free feed for several days before entering backcountry.

A key component of prevention practices is education and awareness of managers, land owners, and public land users. In Montana, programs have been implemented such as a trust fund for weed research and weed management efforts, organized cooperative weed management programs for landowners, a curriculum for educating school children, and bounty programs. Examples of successful cooperative spotted knapweed control efforts have been reported in Canada and Wyoming.

Weed prevention and control can be incorporated into all types of management plans, including logging and site preparation, management of grazing allotments, recreation management, research projects, road building and maintenance, and fire management. When prevention fails, or spotted knapweed populations already exist, several management approaches can be used to eradicate small populations or to control larger infestations including cultural, biological and chemical control methods, or some combination of methods timed in such a way as to be complementary.

Physical and mechanical control: Manual control techniques may be preferred in some areas with spotted knapweed infestations. For example, on the Salmon River watershed in the Klamath National Forest in California, it is recognized that manual control methods offer less risk to the high quality waters and high value fisheries than do chemical applications. A cooperative effort among the local residents and land management agencies, orchestrated by the Salmon River Restoration Council (SRRC), has successfully employed the use of several manual control approaches including propane torching of seedlings early in the season, hand digging with small tools, mulching with black plastic, and mowing with weed eaters.

Spotted knapweed does not persist under annual cultivation or in irrigated alfalfa. This, however, does not present a widely applicable solution for infested wildland, rangeland or prairie. Mowing, hand-pulling, planting competitive species, and good range management may reduce the spread of spotted knapweed, but may not eliminate well established stands. Tillage can reportedly lead to the spread of spotted knapweed. This is especially likely in mature stands since tillage creates an ideal weed seed bed from which individuals in the seed bank may emerge. Tillage may be more successful if followed by seeding with a strongly competitive grass-legume mixture.

Consistent hand pulling can control spotted knapweed, although it is time and labor intensive. Entire plants must be removed before they produce seeds each year, and flowering plants should be removed from the site so no seeds are dispersed.

In greenhouse studies, only severe defoliation reduced spotted knapweed root, root crown, and aboveground growth. Some spotted knapweed plants produced flowers even when clipped monthly from June through September. Mowing diffuse and spotted knapweed in Canada at the bud stage, flowering stage, or once at bud stage and again at flowering, reduced the number of plants producing seed by 77%, 99%, and 96% compared to unmowed plants. The latter 2 treatments also reduced germination of the seeds by approximately 79%. Rinella and others found that a single mowing at the flowering or seed stage resulted in an 83-85% decrease in adult spotted knapweed density at 2 sites in western Montana. This reduction was as much as any treatment consisting of repeated mowing at both sites. The long-term effects on spotted knapweed densities are unknown, but Rinella and others hypothesize that repeated annual mowing may shift the competitive balance in favor of desired grasses. Rolling plots with a pasture roller, burning, mowing, or harrowing treatments had no effect on the spotted knapweed seedbank at 2 sites in Montana.

Biological control: The aim of biological control is to stress spotted knapweed and shift the competitive advantage away from the weed to desirable grasses and forbs. Biological control efforts for diffuse and spotted knapweed have been underway in North America since 1970. Wilson and McAffrey provide a discussion of considerations and safety issues in developing and implementing a biological control program. The objective of biological control efforts is to propagate and redistribute sufficient insect populations to hold spotted knapweed to population levels similar to their populations in Europe. It is believed that 4 agents are necessary to affect 1 plant species, and that 6 established agents would help control both diffuse and spotted knapweeds since most agents attack both plants. To date, 13 Eurasian insects have been introduced for the control of these knapweeds, several of which are demonstrating some impact against 1 or both species. Of these, 8 of the insects attack the flower heads, while 5 attack the roots. The idea is that these agents will work together to reduce viable seed production and stunt the overall growth and strength of the plants. In this sense, there is an additional ecological niche to be filled, since no agents attack the rosette foliage or root crown. These structures are vulnerable to attack for at least 1 year before the plant can reproduce.

Story and Piper provide a current assessment of the status of biocontrol agents on spotted knapweed. On sites in Montana where *Urophora affinis* and *U. quadrifasciata* coexist, spotted knapweed seed production is reduced by at least 50%, and Harris reports a 92% reduction in spotted knapweed seed production at locations in British Columbia. He also notes that *Agapeta zoenga* and *Cyphocleonus achates* are causing noticeable reductions in density and vigor of spotted knapweed at several locations in western Montana. Success has not been dramatic, and has not developed as expected. One partial explanation for the limited success of introduced biocontrol agents may be that biocontrol agents came from *C. maculosa*, which is native to central Europe, while it has been suggested that the plant that is invasive in North America is actually *Centaurea stoebe* ssp. *micranthos*, which is native to eastern Europe. Climatic analyses indicate that the climate of western Montana is more similar to the area in eastern Europe, from which *Centaurea stoebe* ssp. *micranthos* originated, than the area from which the bulk (12 of the 13) of biocontrol agents came. It is therefore suggested that future explorations in the area of origin of the target plant are necessary to find agents that are adapted to colder climates and a more vigorous plant.

Biological control efforts may also be hindered by indirect effects of herbivory on nontarget species. Callaway and others found that herbivory on spotted knapweed had substantial negative, indirect effects on Idaho fescue under 2 very different sets of experimental conditions. They hypothesized that moderate herbivory may have stimulated compensatory growth in spotted knapweed, induced the production of defense chemicals that also had allelopathic effects, or stimulated root exudates that altered the relationship between knapweed and Idaho fescue via soil microbes.

Additional indirect effects of biological control of spotted knapweed have been observed in west-central Montana. Gall fly larvae (*Urophora* spp.) released as biological control agents for spotted knapweed are the primary food item in native deer mouse diets for most of the year and made up 84-86% of their winter diet.

Knotweed, Giant *Polygonum sachalinense*

USDA Symbol: POSA4

Description: Perennial; blooms July to October. Grows over 12 feet tall. Closely related and similar to Japanese knotweed. Leaf cordate, or heart shaped; often exceeds one foot long. Inflorescence of creamy white flowers sparse and the flower size does not increase with maturity. Hybrids with Japanese knotweed are common. Japanese knotweed is smaller with truncate leaves.

Impacts: Giant knotweed is the largest of the knotweeds, enabling this species to dominate and out compete native or beneficial plants. It poses a significant threat to riparian areas where it prevents streamside tree regeneration. Research indicates that giant knotweed produces allelochemicals from the roots, which aid in its dominance and rapid colonization. Giant knotweed is a viable pollen source for Japanese knotweed, resulting in male fertile hybrids which are often confused with Japanese knotweed.

Knotweed, Himalayan *Polygonum polystachyum*

USDA Symbol: POPO5

Description: Perennial; blooms July to October. Grows to 6 ft. tall. Closely related to giant and Japanese knotweeds. Leaves lanceolate and 4 to 8 inches long, unlike Japanese and giant knotweeds which are ovate and cordate, respectively.

Impacts: This species is the least common of the three weedy knotweed species in the Pacific Northwest. Plants grow vigorously and create dense colonies that exclude native vegetation, but they are much shorter than related species and seem less adaptable to dense shade.

Established populations are persistent and difficult to eradicate due to their proximity to streams. It poses a significant threat to riparian areas, where it uses flood events for its dispersal by rapidly colonizing scoured shores and islands. It poses a significant threat to riparian areas where flood events can disperse and aid rapid colonization of new populations.

Knotweed, Japanese *Polygonum cuspidalum*

USDA Symbol: POCU6

Description: Perennial; blooms July to October. Grows four to nine foot tall and has long creeping rhizomes. Stout stems reddish-brown, nodes slightly swollen. Leaves short stalked, trucate, broadly ovate and 2-6" long by 2-4" wide. Flowers greenish-white to cream in large plume-like clusters at the ends of the stems. Hybrids with giant knotweed are common.

Impacts: Japanese knotweed is a native of Eurasia and was introduced to the United States as an ornamental. Plants grow vigorously along roadsides, waste areas, streams and ditch banks and create dense colonies that exclude native vegetation and greatly alter natural tree regeneration. Established populations are extremely persistent and do not respond to mowing/cutting. Large infestations can be eliminated with approved herbicides, but treatments are costly and time consuming. It poses a significant threat in riparian areas, where it disperses during flood events rapidly colonizing scoured shorelines, islands and adjacent forest land.

Family: Smartweed (Polygonaceae) family
Other Names: Fallopia japonica, Pleuropterus zuccarinii, Polygonum japonicum, P. zuccarinii, P. sieboldii de Vriese, Reynoutria japonica, Japanese bamboo, Mexican bamboo, Japanese polygonum, Japanese fleeceflower, false bamboo, Kontiki bamboo, bombascus.
Origin and Distribution: Japanese knotweed was introduced from eastern Asia in the late 1800s as an ornamental, but soon escaped from gardens to colonize disturbed areas. By the 1960s it had spread to local infestations from Maine south to Virginia and west to Indiana. Today it is found from Nova Scotia to the Carolinas and west to Minnesota and Iowa, as well as in Colorado, Utah, and coastal areas from Washington to Northern California. It is found in urban and suburban landscapes, roadsides, gullies, and waste areas. It is particularly troublesome along riverbanks, edges of ponds, and other wet areas. It is often associated with moist but well-drained sites with nutrient-rich soil, and it tolerates semi-shaded environments. It has also been planted in sandy sea-shore areas where it stabilizes soil and withstands salt and low nutrients.

Plant Description: Japanese knotweed is an erect, broad-leaved, semi-woody perennial that spreads by long rhizomes and occasionally by seeds. The plant forms dense clumps that exclude other plants, and radiates rapidly to form patches that can be as large as 1 to 3 acres. It is one of the most persistent, and hardy of weeds, and it tolerates many control measures. Japanese knotweed is an invasive plant that can overrun natural areas, gardens, yards, roadsides, and utility and railroad rights-of-way.

Root system - The root system is fibrous, but rhizomes are white when young, becoming brown, thick, and woody with age. Rhizomes have prominent nodes with dark papery sheaths. They may be shallow or deep, and are responsible for the spread and persistence of this weed.
Seedlings & Shoots - Young shoots are reddish, with mostly heart-shaped leaves. Because seed production is uncommon, true seedlings are uncommon. Most young shoots arise from rhizomes.
Stems - Stems are erect, tall (up to 10 or more feet for mature stands), and hollow except at the prominent, swollen, knot-like nodes. The stems are thought to resemble those of bamboo. Attached to each node and surrounding the stem is a light green to brown, hairless, papery sheath.
Stems are round and smooth, red-brown at the base, and mottled green toward the tip. Stems die back to the ground during winter, but semi-woody stem bases persist.

Leaves - Leaves are alternate (one per node), broad, flat to round at the base, tapering to a pointed tip, and attached by long petioles. The upper leaf surface is dark green and the lower surface is pale green.
Flowers - Small, greenish white flowers are clustered along branching panicles arising from upper leaf axils. Plants are unisexual, with male and female flowers on separate plants. Male flower stalks are mostly erect and female flower stalks are drooping. When blooming (July to September), the plant puts on an attractive floral display befitting the common name 'fleece flower'.
Fruits & Seeds - Rarely produced fruits have three triangular papery wings surrounding a single dry, brown, triangular seed. Fruits are rare because colonies seldom contain a mixture of male and female plants.

Similar Species: Japanese knotweed resembles bamboo because of the robust hollow stems with distinct nodes and internodes; however, true bamboo is a grass. The broad and pointed Japanese knotweed leaves can be mistaken for Broadleaf dock (Rumex obtusifolia), but docks lack rhizomes and the tall, spreading habit of Japanese knotweed. Other less invasive relatives (such as P. virginianum) grow from similar rhizomes and are difficult to eradicate.

Biology: Japanese knotweed shoots resume growth in early spring, reaching a fast pace (reportedly 2 to 4 inches in a single day) and attaining heights over 10 ft. by late summer. Plants form dense colonies, spreading by rhizomes that can extend up to 65 feet. New colonies can regenerate from as little as a 1-inch piece of rhizome, which can easily be transported wherever soil is moved. Rhizomes send out shoots from April to August, even from a depth of over 3 feet. Shoots can even be initiated from internode tissue. Japanese knotweed exhibits great tolerance to most herbicides. It is reported to be a poor invader into grass cover and can be crowded out by taller trees. It does not survive frequent mowing.

Toxicity: Japanese knotweed has been used as a folk medicine in eastern Asia; however, this species contains tannins that were found to be carcinogenic. Large quantities of tannins were found to inhibit digestive enzymes in rats. Some chemicals isolated from Japanese knotweed have antimicrobial properties; others have been used as antioxidants and antimutagens in cancer research. Other chemicals isolated from this plant have been used to promote healing of burns, and still others to enhance the immune system and cardiac functions.

Related Information:

- ✓ Dense stands of Japanese knotweed exclude native and other desirable vegetation and reduce wildlife habit. It decreases water flow through rivers and streams and thereby contributes to flooding. It is a long-term threat because it occupies edges of woods and waterways that are valued for biological and visual diversity. It is one of the most troublesome weeds along railway rights-of-way, and is said to create a fire hazard in the dormant season.
- ✓ Japanese knotweed is highly regarded for its attractive flowers and has been planted by beekeepers for its nectar. It is also prized for its tolerance of harsh conditions like rocky soils with limited nitrogen and low pH. It has been planted along highways to control soil erosion and has been used for revegetation of strip-mine spoil and to stabilize land affected by volcanoes.
- ✓ Japanese knotweed has caused damage to sidewalks and parking lots where shoots have been able to grow up through concrete.
- ✓ Fast-growing branch tips picked in spring are said to be have a unique almond-like flavor when prepared in the manner of rhubarb pie.

Kochia *Kochia scoparia (L.) Schrad.*

Chenopodiaceae (Goosefoot family)
Origin: Eurasia
Location: gardens, roadsides, waste areas, waterways, fence rows, cropland, pastures, and rangeland
Occurrence: Seeds can germinate at any temperature above 40ºF, and do so throughout the growing season. Kochia seedlings first appear in early spring, grow rapidly and mature by mid-summer. Plants flower and produce seed from mid-summer until the first hard frost.

Description: A summer annual that grows between 1 and 6 feet tall. Plants are highly branched and typically form a pyramidal shape. Stems may be green or reddish, sometimes striped, and young stems may be hairy. Leaves are linear, 1/2 to 2 inches long, pointed at the tip, and have three to five highly visible veins. Leaves are arranged alternately on stems, and leaf undersides and margins are occasionally hairy. Minute, petal-less, yellow or greenish-yellow flowers occur in spikes of varying lengths, which are covered with soft hairs. Small, linear bracts about 1/2 inch long protrude outward from the flower spikes, giving them a prickly appearance. Flower spikes are found at the tips of the stems and in leaf axils. Each flower produces a flattened bladder that contains a single seed. Seeds are teardrop shaped, rough, brown, flat and 1/16 inch long. Much of the plant turns red in autumn.

Weedy Characteristics: Each kochia plant can produce an average of 15,000 seeds. Rapid, long-distance dispersal takes place when dead plant stems break at the base and wind carries the plant as a tumbleweed. Seeds generally germinate within 1 year, or not at all. Kochia is highly competitive for a variety of other reasons, as well: mild frost tolerance, salt tolerance, drought tolerance, resistance to disease and insects, a deep tap root, and the secretion of substances that inhibit nearby plant growth.

Control: Kochia reproduces solely by seed. Since seeds don't generally stay viable past 1 year, prevention of seed production is highly effective. Remove seedlings in the spring by tilling, or mow prior to flowering. Kochia is also not likely to thrive in a healthy, competitive garden. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Kochia has been planted to reclaim land with poor soils, and to stabilize eroding soils. It is also considered a good forage crop in some situations. It has high levels of protein when young, and is more productive in a low water setting than alfalfa (thus the "poor man's alfalfa" name). However, kochia plants also accumulate varying levels of several different toxins, which can negatively affect grazing animals if ingested in large amounts, over long periods, or when animals graze solely on kochia. It is also a problem in crops that mature later in the growing season, crowding out the desirable plants and reducing crop yield. The plant serves as a host for disease-causing agents of potatoes and other crops. Kochia is considered noxious in three U.S. states and in British Columbia and Manitoba, Canada.

Other Common Names: (Mexican) burning bush, common kochia, (Mexican) fireweed, mock cypress, poor man's alfalfa, summer-cypress

Lambsquarters, Common *Chenopodium album L.*

Chenopodiaceae (Goosefoot family)

Origin: Eurasia, North America (ambiguous)

Location: gardens, lawns, roadsides, waste areas, cropland, and pastures
Occurrence: The majority of common lambsquarters seeds germinate in late spring to early summer, although germination can take place throughout the growing season. Plants grow vigorously, and flowering occurs from late summer to early fall, followed by seed production. Mature seeds fall to the ground or stay on the mother plant, and a small percentage of those that fall germinate immediately. The plant dies with frost.
Description: An upright, branched, summer annual that grows 4 inches to 6 feet tall. Branches generally arch upward, and stems are grooved, often purplish or with red stripes. Leaves are arranged alternately along branches, and are covered with tiny, white, granular scales. Leaf undersides and margins are sometimes purplish. Lower leaves are borne on stalks, have coarsely toothed margins or shallow lobes, and often resemble a goose's foot. Upper leaves do not have stalks and are narrow and linear. Leaves are 1/2 - 3 inches long and up to 1 1/4 inches wide. Tiny, petal-less, gray-green flowers occur in tightly clustered spikes at the ends of branches. Flowers are globular and are enveloped almost entirely by a cup of five green sepals. Flowers produce minute, smooth, circular black or brown seeds, covered with a thin, papery casing.

Weedy Characteristics: Lambsquarters reproduces solely by seed. The plant is a prolific seed producer, with an average of 72,000 seeds from a single plant. Seeds typically remain near the parental plant, but can be dispersed on mud that clings to vehicles and farm equipment, and are transported by birds and livestock that eat them. It is also distributed as a contaminant in crop and grass seed. Seeds can remain viable in the soil for over 20 years, and sometimes decades longer. Common lambsquarters is adaptable to most environmental conditions and can grow on almost any type of soil, but it does best

in open areas with well-drained soil. It is fairly tolerant of drought, although drought can cause early, lower seed production in the plant. Common lambsquarters competes aggressively with other plants and there is some evidence to suggest that the presence of lambsquarters residue may slow the growth of other plants.

Control: Maintaining a healthy perennial plant population or early establishment of annual plants can go a long way toward preventing common lambsquarters colonization. Soil solarization can be effective in reducing lambsquarters seed population in the soil.

Tilling, hoeing, or hand-pulling must be done repeatedly throughout the season to control the continual emergence of seedlings. To avoid compaction and give lawns a competitive edge over lambsquarters, traffic should be minimized and the soil aerated. Consistent mowing of lawns preferably before lambsquarters seed production can give highly effective control. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Common lambsquarters is abundant around the world, and the plant is widely eaten. Young leaves and stems are eaten fresh, boiled or fried, and the seeds are ground for mush, or used as flour for bread. The plant accumulates large amounts of ascorbic acid in its tissues, making it a valuable tool for fighting scurvy. It has been used for a myriad of medicinal uses, as well, such as for treating burns, painful limbs, and intestinal problems. Grazing animals will eat common lambsquarters when young, but as it matures it becomes woody and disagreeable. Under certain conditions, it can also accumulate nitrate, sulfate, and oxalates in its tissues and cause poisoning of livestock if eaten in large quantities. The plant can serve as a host of fungus and many different viruses that affect a wide variety of crops. Furthermore, its presence in crops can interfere with harvesting equipment and significantly reduce yields. Common lambsquarters is noxious in Minnesota and in Manitoba and Quebec, Canada. Netseed lambsquarters (Chenopodium berlandieri) is a very closely related species that is extremely difficult to distinguish from common lambsquarters without a microscope. They differ in that netseed lambsquarters' seeds are pitted, not smooth, whereas common lambsquarters' seeds are smooth. Common lambsquarters is more often found in gardens and agricultural settings, but netseed lambsquarters is more likely to be found in disturbed settings outside of agriculture.

Other Common Names: fat-hen, lambsquarters goosefoot, pigweed, white goosefoot

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 herbicides 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.

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Lesser Celandine *Ranunculus ficaria*

USDA Symbol: RAFI

Other common names: fig buttercup, bulbous buttercup, small crowfoot

Description: Lesser celandine is an herbaceous, perennial plant in the buttercup family (Ranunculaceae). Plants have a basal rosette of dark green, shiny, stalked leaves that are kidney to heart-shaped. The flowers open in March and April, have eight glossy, butter-yellow petals, and are borne singly on delicate stalks that rise above the leaves. Pale-colored bulblets are produced along the stems of the above ground portions of the plant, but are not apparent until late in the flowering period. When in bloom, large infestations of lesser celandine appear as a green carpet with yellow dots, spreading across the forest floor.

There are many varieties of lesser celandine including a double-flowered form with many crowded petals and dark green leaves mottled with silvery markings. The primary reproductive method is the formation of turions that are produced on the roots in large numbers. They survive for years and are easily moved in contaminated dirt or by water. Seeds may also play a role in plant dispersal. Lesser celandine prefers shaded to partially shaded sites though it can thrive in full sun with adequate soil moisture. Deciduous woods are an excellent habitat for this species enabling the plant to grow and bloom well before leaf initiation in the forest canopy.

Impacts: This species can impact forest environments by forming dense patches leading to the exclusion of many low-growing forbs especially early-blooming native wildflowers. To the private landowner or gardener, lesser celandine escaping from plantings quickly overwhelm flowerbeds and lawns. Contaminated garden loam applied to new lawns can create problems in a few short years.

Because of the bulbous nature of the root system, control can be difficult. Bulb fragments are easily overlooked during manual control, leading to re-infestation. Chemical control must be timed for optimal kill but the nonselective nature of certain herbicides can lead to non-target impacts on desirable plants. The bloom period for this species runs early March through May starting well before leaf formation in deciduous forests. Monotypic stands are formed under forest canopies pushing out native understory plants. Cultivars of lesser celandine continue to be sold through catalogs and nurseries nationwide.

Introduction: Lesser celandine is frequently found in many northeast states where it has escaped from gardens and has invaded surrounding deciduous forests. The species is currently found in 19 states and reported invasive in nine. Some National Parks in the eastern U.S are host to lesser celandine outbreaks. Infestations in the western states are mostly limited to urban parks and private yards where plantings have grown out of control. Planted originally as an ornamental species, lesser celandine escaped cultivation and now has spread throughout the Northeast, Midwest and into the Pacific Northwest states.

Leafy spurge *Euphorbia esula See under Spurge*

Leafy spurge *Euphorbia esula*

Leafy spurge (*Euphorbia esula L.*) is a creeping, herbaceous perennial weed of foreign origin that reproduces from seed and vegetative root buds. It can reduce rangeland cattle carrying capacity by 50 to 75 percent. About half of this loss is from decreased grass production. Cattle won't graze in dense leafy spurge stands and these areas are a 100% loss to producers. Leafy spurge is difficult to control. Its extensive root system has vast nutrient stores that let it recover from control attempts. Combine control methods into a system to achieve best results.

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Lettuce, Prickly *Lactuca serriola*

Family: Daisy Family (Compositae)

Other Names: Lactuca scariola, compass plant, horse thistle, milk thistle, wild lettuce, wild opium.
Origin and Distribution: Originally from Eurasia, prickly lettuce immigrated to North America from Europe around 1860. Later, it spread through southern Canada and over much of the U.S. except for areas in extreme northern Maine and southern Florida. Prickly lettuce grows along roads, railroads, and sidewalks and in alleys, vacant lots, waste areas, pastures, orchards, and cultivated fields. The plant prefers dry conditions, although it tolerates and can often be found growing on moist ground such as that in low areas or irrigated fields. Prickly lettuce grows most abundantly on nutrient-rich soils.

Plant Description: Prickly lettuce is an erect biennial (rarely an annual) that grows as a rosette of basal leaves during its first year. Each rosette gives rise to a solitary stem that is usually erect and sometimes branched, especially the top portion where small, daisy-like, yellow flowers are borne. Stem leaves are irregularly-lobed and have prickly edges and a distinctive row of stiff, sharp prickles on the underside of midribs. Nearly half of the length of each seed consists of a beak having a tuft of silky white hairs (pappus) at the tip. All plant parts exude a milky juice when cut or broken. The plant reproduces only by seeds.

Root system - Plants produce a large white taproot that exudes a milky juice if cut or crushed.
Seedlings & Shoots - Emerging first are two seed leaves (cotyledons) that are round and have short hairs scattered on the upper surface, lower surface, and edge. Subsequent leaves are club-shaped, light green above, paler green beneath, and have a few short hairs on the upper surface, lower surface,

and midvein. Short, knob-tipped hairs develop along the leaf edge. Young leaves form a rosette resembling that of dandelion.

Stems - Flowering stems are 2 to 7 feet tall, stiff, hollow, and filled with milky juice. Stems are usually leafy and may bear a few prickles on the lower portion. The stem surface is covered with a waxy coat giving it a whitish cast and it is sometimes flecked with red. Stems are typically erect, usually solitary, and frequently branched throughout the upper portion that becomes dotted with small, daisy-like, yellow flowers.

Leaves - Leaves are alternate (1 leaf per node), 6 to 12 inches long, coarse, and variable in size and shape. Basal leaves are larger than stem leaves. Leaves located on the lower part of the stem may be deeply or irregularly lobed or may lack lobes. Leaf bases typically consist of ear-like lobes that clasp the stem. The upper leaf surface is hairless, but there are prickles along the edge, and the midrib on the lower leaf surface is lined with sharp prickles. Prickles are generally absent from upper stem leaves, which are small, lance-shaped, and lack lobes. Leaves taste like lettuce and exude a milky juice when cut or crushed.

Flowers - Many small flower heads, each borne singly at the end of a short branch, are grouped in open terminal clusters. Unopened flower heads resemble a tight green teardrop. Opened flower heads are less than 1/2 inch wide and consist of 5 to 12 yellow ray flowers that often fade to blue as they dry.

Fruits & Seeds - The single-seeded fruits are oblong, about 1/10-inch long, brownish, and end with a slender beak that is nearly as long as the fruit. A soft white tuft of bristles (pappus) arises at the end of the beak.

Similar Species: Prickly lettuce can be confused with sowthistles (Sonchus spp.), which have prickly leaf margins but smooth midribs. Tall lettuce (Lactuca canadensis) and tall blue lettuce (Lactuca biennis) look similar to prickly lettuce except they have leaves with smooth edges and midribs without prickles.

Biology: Prickly lettuce is a highly variable plant that may be difficult to identify until the row of prickles on the underside of the leaf margin is evident. Experts sometimes distinguish two varieties of prickly lettuce based on the presence or absence of leaf lobes. The plant blooms from July until frost. Only about a third of the flower heads open at a time. Flowers mature into small, fuzzy seed heads from which pappus-bearing seeds disperse. The overall appearance of the reproductive plant resembles a tangled, feathery web.

Toxicity: Regrowth of plants in autumn has caused poisoning in cattle, but mature and dried plants appear to be harmless.

Related Information:

- ✓ 'Lactuca' refers to the white milky juice contained in this plant, which has been investigated as an alternative source of rubber.
- ✓ Basal leaves often twist and face the sun such that leaves point north and south, hence the origin for the common name 'compass plant'.
- ✓ The juice in prickly lettuce is reported to have narcotic properties and said to be useful for sunburn.

Lobelia Great-Blue *Lobelia siphilitica*

Family: Lobelia Family (Lobeliaceae)
Other Names: blue cardinal flower, great lobelia.
Origin and Distribution: Great blue lobelia is a native of North America with a current range that includes areas in southern Canada and eastern and north central U.S. The species typically grows on low wet ground along streams, rivers, ponds, lakes, and in swamps, marshes, food plains, ditches, moist fields, and woodlands. It prefers wet soils that are fertile.

Plant Description: Great blue lobelia is an erect perennial herb. It has showy flowers that are about 1 inch long and consist of bright blue petals united into a tube having an upper lip with 2 lobes and a 3-lobed lower lip striped with white. Flowers form at leaf axils on an erect stem that may grow over 3 feet tall. Stems and leaves contain a milky juice that is exuded if the foliage is crushed or cut. Reproduction is by seeds.

Seedlings & Shoots - Young leaves are thin, bright green, and exude a thick greenish juice when cut or torn.
Stems - Stems are erect, leafy, ridged, somewhat hairy, and usually unbranched.
Leaves - Leaves are alternate (1 leaf per node), oval to lance-shaped, and 2 to 6 inches long. Leaf edges can be either smooth or irregularly toothed.
Flowers - Flowers are about 1 inch long and consist of bright blue petals united into a tube having an upper lip and a lower lip. The upper lip has 2 lobes and the lower lip has 3 wider lobes and is striped with white. Flowers form on erect, leafy stems at the axils of modified leaves (bracts).
Fruits & Seeds - Fruits are 2-celled pods that are filled with seeds.

Biology: Flowering begins in July or August and continues until September or October.

Toxicity: Extracts of great blue lobelia roots, stems and leaves have been used in home remedies, although overdoses can be poisonous to humans. Animals have been poisoned if they consumed the plant while grazing.

Related Information:

- ✓ Great blue lobelia was given the Latin species name syphilitica because it was used to treat syphilis.

- ✓ Parts of the plant were used medicinally to treat dropsy, diarrhea and dysentery, although overdosing can be fatal.

London Rocket *Sisymbrium irio*

London Rocket *Sisymbrium irio*

London rocket is a European native weed belonging to the mustard family, and is one of the first winter weeds to appear. It is abundant in irrigated land in crops such as alfalfa and small grains, in gardens, citrus orchards, pastures, and along roadsides. London rocket is a bright green fleshy winter annual. The stems branch from the base 1 to 3 feet high. It has a coarse taproot. Small, yellow flowers are borne on slender stalks in small clusters at the stem tip.

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Loosestrife, Purple *Lythrum salicaria*

Family: Loosestrife Family (Lythraceae)
Other Names: blooming sally, bouquet-violet, braune weiderich, flowering sally, foxtail, grass-poly, kill-weed, long-purples, lysimaque rouge, lythrum salicaire, milk willow-weed, partyke, purple lythrum, purple willow herb, purplegrass, rainbow-weed, red sally rosy-strife, rother weiderich, sage-willow, salicaire, spiked loosestrife, spiked soldiers, spiked willow herb, willowweed.

Origin and Distribution: Purple loosestrife is a native of Europe that was likely brought to North America by accident in the early 1800's. It is currently distributed throughout the northeastern part of the United States and adjacent areas in Canada, and it is spreading. Purple loosestrife occurs in natural and disturbed wetland habitats such as marshes, wet meadows, riverbanks, lakeshores, ditches, flooded pastures, and bogs. Although the plant prefers and grows most aggressively in wet areas, it also survives drier conditions.

Plant Description: Purple loosestrife is a perennial plant that forms a dense bush consisting of up to 50 stems arising from a shallow root system, which includes a woody crown and rhizomes (horizontal underground stems). Location should be considered when characterizing this plant, as it is a much more aggressive weed when growing in wet areas. It can be identified while in bloom by its purple-magenta flowers that form on distinctive terminal spikes. Also, upper above-ground parts of the plant should appear densely hairy. Purple loosestrife reproduces by seeds and it spreads by rhizomes.
Root system - Roots are thick, fleshy and shallow and develop into a large woody crown.
Seedlings & Shoots - Young plants look like a small version of the adult.
Stems - Stems are upright and grow 2 to 6 feet tall. They are usually branched, have fine hairs, and are either square or 6-sided.
Leaves - There are 2 or sometimes 3 leaves at most lower stem nodes. Leaves near the top of the plant are smaller and alternate so there is usually a single leaf at each upper stem node. Leaves attach to stems directly rather than by way of leaf stalks (petioles). Leaves are 1 to 4 inches long, finely hairy, and lance-shaped except for larger leaves that have a heart-shaped base. Leaves turn red before falling off in autumn.
Flowers - Many flowers cluster together at the end of slender, upright stems forming long, showy, multi-flowered spikes. Flowers consist of 6 purple-magenta petals that are about 1/4 inch long.
Fruits & Seeds - Purple loosestrife forms small seedpods containing many tiny, reddish-brown seeds.

Similar Species: Numerous species in the Mint Family (Labiatae) also have opposite leaves and square stems but they usually smell minty. Also, petals of mint flowers are variously fused while purple loosestrife flowers have petals that are separate. Compared with those of mints, purple loosestrife seeds are much smaller and produced in greater numbers. Willowherbs (Epilobium spp.) often resemble young purple loosestrife plants except they are annuals so they do not form the woody root crowns and rhizomes that are characteristics of purple loosestrife.

Biology: Purple loosestrife is an attractive plant but it is also an invasive weed in wetlands. Once established, it crowds out other species forming dense monospecific stands that are impenetrable by boat and difficult to walk through. Such dense infestations can also clog irrigation systems. In many states, purple loosestrife has been declared a noxious weed and its sale is prohibited, but it is readily available for purchase in other states. Therefore, it is considered a noxious weed by some people who feel it should be eradicated while others value it as an ornamental, a medicinal plant, or a wildflower and proceed to plant in their gardens. Purple loosestrife begins blooming in July and continues through September. It is not uncommon to find 1 to 2 million seeds produced per plant and seeds can live for several years in the soil seed bank. This buried seed reserve along with its rhizomes enable purple loosestrife to spread rapidly once established. Early detection is essential to slow the spread of this prolific perennial. The most effective management is a combination of several practices in an integrated manner. Such measures may include frequent and continued mowing, hand pulling, cultivating, or herbicide applications. Care should be taken to remove any residue that is created as purple loosestrife stem fragments can root producing new plants. Biological control measures are currently being investigated that could aid in long-term management of this invader of wetland habitats.

Toxicity: None known.

Related Information:

- ✓ The name 'Lythrum' is from the Greek 'luthron' meaning blood and may refer to either the color of the plant's flowers or its medicinal use as an astringent to stop the flow of blood.
- ✓ 'Salicaria' means 'willow', and the shape of purple loosestrife leaves is similar to that of willows.
- ✓ The common name for purple loosestrife in French is 'salicaire', which likely gave rise to such common English names as blooming sally, red sally, and flowering sally.
- ✓ Purple loosestrife has been used in treating many ailments including diarrhea, dysentery, fevers, constipation, and cholera.
- ✓ Japanese beetles are fond of purple loosestrife, which may appear to attract these insect pests in a similar manner as many roses.

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Mallow, Common *Malva neglecta*

Family: Mallow Family (Malvaceae)
Other Names: button weed, cheese mallow, cheese weed, cheeses, dwarf mallow, garden mallow, low mallow, malice, round dock, round-leaved mallow, running mallow.
Origin and Distribution: A Eurasian species, common mallow can now be found growing throughout North America. This weed commonly occurs in disturbed sites such as roadsides, railroads, waste places, gravel pits, nurseries, gardens, and cultivated fields. It is frequently found growing in yards around homes, buildings, and barns.

Plant Description: Common mallow is a summer or winter annual that has been known to sprout a second year from a biennial root crown. Distinguishing characteristics are the fruits, which resemble tiny wheels of cheese, and kidney-shaped leaves that are shallowly lobed, appear slightly crinkled, have toothed edges, and attach to stems by way of long stalks (petioles). Reproduction is by seeds, but fragmented stems can root at the nodes if conditions remain sufficiently moist for a long enough period of time.

Root system - Common mallow has a straight taproot that can be various lengths. Plants also have a coarsely branched secondary root system.

Seedlings & Shoots - Young plants grow as basal rosettes. The first two leaves are smooth and heart shaped. Then, leaves are produced that are similar to those of adult plants. They are alternate (1 leaf per node), hairy, and appear crinkled with the tissue between veins puckered. Before they fully open, leaves are folded in bud to form an inverted cone. Petioles are long and hairy.

Stems - Stems are 4 to 34 inches long, branched, covered with short hairs, and usually trail along the ground until they turn upright at the end.

Leaves - Leaves are about 1 1/2 inches wide, alternate (1 leaf per node), kidney-shaped, toothed around the edge, and have between 5 to 9 shallow lobes. They have prominent veins that radiate from the center of the leaf. Also, leaves are covered on both sides by short hairs. Leaves attach to stems by way of long petioles.

Flowers - Flowers are about 1/2 inch wide and have 5 petals that are notched at their tip and range from white to rose to lavender. Flowers arise either alone or in clusters from stem axils. Common mallow flowers resemble tiny hollyhock flowers.

Fruits & Seeds - Fruits look like disks consisting of 10 to 20 rounded, flattened sections aggregated in such a manner that they form a ring. As fruits ripen and become dry, segments tend to separate. Each segment contains one seed. Seeds are nearly round and range from reddish brown to black.

Similar Species: Ground ivy (Glechoma helderacea) is easily distinguished from common mallow by its leaves that are opposite (2 leaves per node) and have edges with rounded teeth. Also, the stems of ground ivy are square in cross section and smell minty. It is more difficult to distinguish round-leaved mallow (Malva rotundifolia) from common mallow. The flowers of round-leaved mallow are about 1/4 inch wide, which is considerable smaller than those of common mallow. Also, round-leaved mallow fruits have an outer surface that is bumpy compared with common mallow fruits. In cross section, round-leaved mallow fruits are horse-shoe shaped while common mallow fruits are round. Round-leaved mallow and common mallow occur in similar habitats, but round-leaved mallow is not as wide spread.

Biology: The primary months of growth for common mallow are April through November. Seeds germinate continuously during this time. Flowers appear from May until October. Common mallow can be controlled by hand-weeding, hoeing, and clean cultivation. Plants with fruits should be removed and burned.

Toxicity: None known.

Related Information:

- ✓ Several common names for this weed include the word 'cheeses' in reference to the fruit, which is said to resemble a wheel of cheese.
- ✓ Fruits resemble a button, hence the common name 'button weed'.
- ✓ 'Malva' is said to refer to the emollient leaves.

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Mallow, Musk *Malva moschata*

Family: Mallow Family (Malvaceae)

Other Names: musk, musk plant.
Origin and Distribution: Musk mallow was originally introduced as an ornamental from its native Europe into North America where it was widely planted in perennial flower gardens. However, it escaped cultivation and became a weedy pest throughout much of northeastern and northwestern United States and adjacent areas in Canada. It is encountered in old gardens, dry grassy fields, waste places, roadsides, and railroads. It grows especially well on lime-rich soils.

Plant Description: Musk mallow is a perennial with an upright stem that can grow 3 1/2 feet tall and large pink flowers that have 5 petals and appear in clusters at the end of each stem or individually on long stalks attached to stem nodes. Leaves located at the base of the stem are rounded and slightly lobed while leaves located further up the stem are deeply dissected into 5 to 7 toothed sections. Leaves and flowers emit a strong musky odor in warm weather or when crushed. Reproduction is by seeds.

Seedlings & Shoots - Young plants grow as basal rosettes. The first two leaves are heart-shaped and have veins that are depressed above, prominent and shiny below.

Stems - Stems grow between 8 to 40 inches tall. They are erect, hairy, and often branched near the base.

Leaves - Leaves are alternate (1 leaf per node) and about 3 to 4 inches wide. Leaves appear either rounded with shallow lobes if located near the base of the stem or deeply divided into 5 to 7 sharply-toothed sections that appear to radiate from a common center like fingers from the palm of a hand if located further up the stem. Stalks (petioles) attached to basal leaves are long and slender while those

attached to leaves located mid-way up the stem are shorter and petioles are usually lacking on uppermost leaves.

Flowers - Flowers are about 2 inches wide and composed of 5 triangular petals that are notched along their outer edge. Petals are rosy or white with pink veins. Stamens (pollen-bearing structures) located in the center of each flower partially fuse into a bushy column approximately 1/3 inch long. Flowers form on long stalks and appear in clusters at the ends of stems or individually if attached to the stem at the leaf nodes.

Fruits & Seeds - Numerous dry fruits unite into a circle around a common center resembling a hairy donut. Each hairy section contains a brown, kidney-shaped seed, which is 1/12 inch long and has concave sides and rounded edges.

Similar Species: Basal and lower stem leaves of musk mallow resemble leaves of common mallow (Malva neglecta) and ground ivy (Glechoma hederacea), and upper stem leaves resemble the foliage of Venice mallow (Hibiscus trionum). Musk mallow can be distinguished by its stem leaves that are deeply divided into 5 to 7 parts while common mallow and ground ivy foliage is rounded and undivided and leaves of Venice mallow are divided into 3 parts. Also, ground ivy has opposite leaves (2 leaves per node), square stems, a creeping growth habit, and a minty odor. Common mallow flowers are much smaller than those of musk mallow and Venice mallow has yellow flowers.

Biology: Flowering occurs from late June to September. Suggested control measures include hand pulling or, if badly infested, mowing before seeds ripen.

Toxicity: None known.

Related Information:

- ✓ Leaves of musk mallow emit a strong, musky odor when crushed, hence its common name.
- ✓ Roots of musk mallow have been used to relieve inflammation; foliage has been used to treat colds and coughs.

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Matgrass *Nardus stricta*

USDA Symbol: NAST3

Description: Matgrass is a slow growing perennial bunchgrass that is densely tufted, and long-lived. It produces unbranched flower-spikes that carry the single-flowered spikelets along one side only. Leaves are hard and bristle-like, bluish green and up to 1/4 inch wide, appearing narrower because blades are tightly folded along the midrib. Stem tipped by inconspicuous spikes that bear all spikelets on one side of the stems and grows up to eight inches tall. This grass is tightly rooted therefore hard to remove.

Impacts: Matgrass is an uncommon non-native grass with the potential to out-compete desirable grasses in intensively grazed areas. Because it is a species of low palatability it is not favored by grazing animals, giving matgrass a competitive edge. It is difficult to eliminate because of the difficulty locating it in mixed grass stands. Untreated plants develop seeds and perpetuate infestations for decades. It occurs in damp areas near swamps, estuaries and watercourses. Generally found in seasonally saturated mountain meadows.

Introduction: Native to Eastern Europe. It reproduces mostly through transport of tufts in mud clinging to the hooves of grazing animals.

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Milkweed, Butterfly *Asclepias tuberosa*

Family: Milkweed Family (Asclepiadaceae)
Other Names: archangel, butterfly weed, Canada root, chigger flower, fluxroot, fly catcher, Indian paint, Indian plume, Indian posy, orange milkweed, orange root, pleurisy root, silkweed, swallowwort, white root, wind root, yellow milkweed.
Origin and Distribution: Butterfly milkweed is a native of North America. Currently, its range extends throughout the eastern U.S., around the Great Lakes, and along the Mississippi River. The plant's natural distribution includes dry fields, pastures, prairies, roadsides, waste places, and other open habitats. Also, it is sometimes available for purchase as a native wildflower for planting in home gardens. Butterfly milkweed prefers dry sandy soils and it grows best in full sun to light shade.

Plant Description: Butterfly milkweed is a perennial member of the Milkweed Family that looks similar to other family members except for its showy orange flowers and watery rather than milky sap. It has upright stems that are hairy, leafy, and branched near the top of the plant. Reproduction is by seeds.

Root system - The large root crown consists of a brittle taproot extending deep into the soil and massive tuberous roots.

Seedlings & Shoots - Young stems appear to shorten during growth resulting in below-ground burial of the leaf stalks (petioles) attached to the first two seed leaves (cotyledons) as well as buds in underground axils.

Stems - Stems emerge either alone or in clusters from a single root crown. They generally are upright, rough-hairy, and 1 to 3 feet tall. Stems are undivided at the base, branched at the apex, and usually very leafy.

Leaves - Leaves are scattered about the stem in pairs such that most of the time they are alternate (1 leaf per node) but sometimes they appear opposite (2 leaves per node). Leaves are 1 1/2 to 6 inches long, narrow, oval, and taper to a point at the tip. Leaf shapes vary considerably. The under sides of leaves are especially hairy while hairs are sometimes found on the upper sides. Leaves attach to stems by way of short petioles that are covered with soft, short hairs.

Flowers - Flowers consist of 5 curved-back petals that are bright orange to reddish-orange or yellowish-orange. Individual flowers are 3/8 inch wide and they are arranged in 2-inch-wide terminal clusters.

Fruits & Seeds - Seed pods are 2 to 4 inches long, upright, narrow, spindle-shaped, and hairy. Each pod splits when mature releasing numerous flat, brown seeds. Seeds are approximately 1/4 inch long and have tufts of silky hairs at one end.

Similar Species: Common milkweed (Asclepias syriaca) is similar in appearance to butterfly milkweed except it has pinkish flowers and its sap is milky rather than watery.

Biology: Flowering occurs between mid-June to early September. A characteristic of this species is the long taproot that allows it to survive dry conditions.

Toxicity: Most parts of the plant contain toxic compounds that can be poisonous to humans and other animals if consumed in large enough quantities. However, since butterfly milkweed is so distasteful, most livestock and other animals will not eat it. In humans, the sap can produce contact dermatitis.

Related Information:

- ✓ The plant got its common name because of its attractiveness to a wide variety of butterflies such as monarchs, swallowtails, sulphurs, coppers, hairstreaks and fritillaries.
- ✓ Another common name given this plant is 'pleurisy root', because the root has medicinal uses as an emetic and diuretic and was used to treat pleurisy.
- ✓ Native Americans found many uses for butterfly milkweed. The plant's fibers were used in textiles and bowstrings, a red dye could be extracted for basket and textile decoration, and they had many medicinal uses for the roots.

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Milkweed, Common *Asclepias syriaca*

Milkweed *Asclepias syriaca*

Milkweed plants, members of the Asclepias family, are the only host plant for the monarch and queen butterflies. The adult females seek out these plants on which they lay their eggs. The caterpillars that hatch will remain on the plants and eat the leaves until they enter the pupal stage, then emerge as adult butterflies. It is a perennial herb with long-spreading rhizomes. Stems are stout, erect, to 2 m tall, with short downy hairs and milky juice; leaves opposite, oblong, rounded, 1–2.6 dm long, 0.4–1.8 dm broad, with prominent veins; upper surface smooth, lower covered with short white hairs and strong transverse nerves. Flowers sweet-smelling, pink to white, in large, many-flowered, axillary and apical bell-like clusters; corolla lobes 6–9 mm long, hoods 3–4 mm high; follicle grayish, hairy, with soft spiny projections, 1–3 mm high, slenderly ovoid, 2.5– 3.5 cm thick. Seed brown, flat, oval, 6 mm long, 5 mm wide, with a tuft of silky white hairs apically (Reed, 1970)

Family: Milkweed Family (Asclepiadaceae)
Other Names: cottonweed, silkweed, Virginia silk, wild cotton.
Origin and Distribution: Common milkweed is a native of North America. Currently, its range includes the eastern half of the United States. Also, it has become naturalized in much of central and southern Europe. Plants grow in clumps or patches in meadows, fencerows, roadsides, railways, waste places, reduced-tillage fields, and other open habitats. Common milkweed prefers rich sandy or gravelly loam soils that are well drained. It grows best in full sunlight or light shade. There are reports that the species does not grow well where boron is limiting.

Plant Description: Common milkweed is a robust, erect perennial. Its stems and leaves exude a white milky sap if cut or crushed, which is a common characteristic of species in the Milkweed Family. It can be distinguished from other milkweeds by its purplish flowers that form ball-shaped clusters and large teardrop-shaped seed pods covered with warty bumps. After pods mature in autumn, they split lengthwise releasing numerous tufted seeds. Seed pods usually remain atop the dead stems throughout winter. The plant reproduces by seeds and creeping underground roots.
Root system - The root system includes a perennial crown and horizontal creeping roots.
Seedlings & Shoots - Young plants are covered with downy hairs. Young leaves are dark green, waxy, oblong, and have a pointed tip. Hairs present on the upper surface of young leaves are usually lost as the plant matures. All parts of the plant exude a milky sap when cut or crushed.
Stems - Stems emerge either alone or in clusters from a single root crown. Stems are round, hollow, stout, unbranched, covered with short downy hairs, and 2 to 6 feet tall.

Leaves - Leaves are opposite (2 leaves per node), 3 to 8 inches long, broadly oval, smooth edged, and have rounded to somewhat pointed tips and bases. The lower leaf surface is pale green and hairy compared with the upper surface, which may or may not have hairs. Leaves have a prominent white midrib and veins that resemble rungs of a ladder. Leaves attach to the stem by way of short, thick leaf stalks (petioles).

Flowers - Flowers consist of 5 downward-pointing petals and a 5-part central crown that are purplish, usually tinged with green, and have a sweet odor. Flowers are 1/2 inch wide and form 2-inch-wide, ball-shaped clusters located at the ends of stems or stalks attached to the stem at a node.

Fruits & Seeds - Seed pods are 3 to 5 inches long, 1 inch wide, gray-green, warty, and shaped like a long teardrop. As they mature, pods turn brown and split open lengthwise revealing a shiny yellow inner surface and releasing numerous brown seeds that are about 1/4 inch wide, flattened, and have a tuft of silky hair attached to one end.

Similar Species: Common milkweed is easily confused with hemp dogbane (Apocynum cannabinum), which is a related species. However, seedlings and young shoots of hemp dogbane are smooth whereas those of common milkweed are hairy. Also, the upper half of hemp dogbane plants is more branched and its leaves and flowers are smaller compared with those of common milkweed. In addition, hemp dogbane flowers are greenish-white while those of common milkweed are purplish. Butterfly milkweed (Asclepias tuberosa) is similar in appearance to common milkweed except it has orange flowers and its sap is watery rather than milky.

Biology: Common milkweed blooms from June to August. Seedlings do not flower until the second year. Usually, 1 or 2 flowers in each cluster mature into a seed pod. It has been estimated that a single common milkweed plant can produce 25 fruits and each fruit contains as many as 450 seeds. Seeds can float and fly and have been reported to survive at least 3 years buried in soil. Roots can grow 13 feet deep and the length of horizontal roots can increase up to 10 feet in a single season. A piece of root about 1 inch in length can produce a new plant.

A common milkweed density of just over one shoot per square foot reduced wheat yields 47%. In soybean and corn, common milkweed is reported to reduce yields 19 and 10%, respectively. Cultivation can fragment and spread underground roots, which generally increases shoot numbers and population size. However, frequent cultivation or mowing depletes food reserves and ultimately inhibits roots from sprouting. Seedlings can be controlled using pre-emergence herbicide applications and some post-emergence herbicides are effective on older plants.

Control Non-Cropland -- Established stands of common milkweed can be controlled with herbicides. On non-cropland (i.e., roadsides, railroad rights-of-way, etc., but not idle land or grazing land), Amitrol-T, Roundup or Tordon would provide control. Herbicide coverage of the common milkweed is incomplete with this method, resulting in reduced effectiveness compared to a sprayer. Used over several years, however, common milkweed populations can be reduced with Roundup applied in a wiper applicator. Controls: Amino Trizole; Amitrol-T, Roundup, 2,4-D+Banvel,and Tordon

Toxicity: All parts of the plant contain small quantities of potentially toxic substances. Common milkweed is toxic to poultry. Other livestock including sheep, goats, cattle, and horses can be poisoned if sufficient amounts of green or dry milkweed are consumed. Livestock usually avoid the plant unless other forage is unavailable. In humans, the plant is slightly toxic and only if eaten in very large quantities. However, it can cause contact dermatitis in some people.

Milkweed, Honeyvine *Ampelamus albidus*

Family: Milkweed Family (Asclepiadaceae)
Other Names: Cynanchum laeve, Gonolobus laevis, bluevine, climbing milkweed, dog's-collar, Enslen's-vine, honeyvine, peavine, sandvine, smooth anglepod, smooth swallow-wort.
Origin and Distribution: Honeyvine milkweed is a native species of North America. It is currently distributed throughout the eastern half of the U.S. The weed is usually found in cultivated fields, fencerows, thickets, low moist woods, along riverbanks, and other disturbed habitats. It prefers fertile, moist soil.

Plant Description: Honeyvine milkweed is a twining perennial vine. Characteristics distinguishing it from other perennial vines include opposite (2 leaves per node), heart-shaped leaves and whitish, vase-shaped flowers that form in axillary clusters. Also, foliage exudes a cloudy sap if crushed or cut. The plant reproduces by seeds and horizontal spreading roots.
Root system - The root system consists of a deep vertical taproot and many lateral roots. Roots are fleshy and brittle.
Seedlings & Shoots - Young stems are often pink-tinged and the surface of young leaves is shiny. Young plants exude a faintly cloudy sap when cut, crushed, or broken.
Stems - The viney stems are smooth, slender, twining, usually climbing but sometimes trailing, and up to 20 feet long.
Leaves - Leaves are opposite (2 leaves per node), 3 to 7 inches long, deep green, smooth, waxy, and thin. Leaves have deep, heart-shaped bases and elongated, pointed tips. They attach to the stem by way of long, slender leaf stalks (petioles).
Flowers - Flowers, which consist of 5, whitish, upright petals that are about 1/4 inch long, are vase-shaped and arise at leaf axils in clusters on short stalks.
Fruits & Seeds - Seed pods are 3 to 6 inches long, smooth, green, and usually paired. Pods split open along one side when mature releasing numerous seeds. Seeds are brown, oval, flattened, horseshoe-shaped, and have a tuft of silky-white hair attached to one end.

Similar Species: The perennial vines field bindweed (Convolvulus arvensis) and hedge bindweed (Calystegia sepium), and the annual vine wild buckwheat (Polygonum convolvulus) may be distinguished from honeyvine milkweed by leaf and flower shape. The leaves of the bindweeds and buckwheat are more arrow-shaped. Bindweed flowers are funnel-shaped, while those of wild buckwheat are inconspicuous. Annual and perennial morning glory species (Ipomoea spp.), including bigroot morning glory (Ipomoea pandurata), often have heart-shaped leaves and may also resemble honeyvine milkweed. However, morning glory species have funnel-shaped flowers. The seed pods of common milkweed (Asclepias syriaca), an upright perennial, are similar to those of honeyvine milkweed, but have soft, spine-like projections.

Biology: Flowering occurs between June and September. Each honeyvine milkweed plant can produce up to 50 pods. Roots often grow 6 feet deep. The twining, climbing habit of this species can cause serious problems during crop harvest. Systemic herbicides should be used for best control.

Toxicity: None known.

Control Non-Cropland -- Established stands of common milkweed can be controlled with herbicides. On non-cropland (i.e., roadsides, railroad rights-of-way, etc., but not idle land or grazing land), Amitrol-T, Roundup or Tordon would provide control. Herbicide coverage of the common milkweed is incomplete with this method, resulting in reduced effectiveness compared to a sprayer. Used over several years, however, common milkweed populations can be reduced with Roundup applied in a wiper applicator. Controls: Amino Trizole; Amitrol-T, Roundup, 2,4-D+Banvel,and Tordon

Active compounds: beta carotene, vitamin C, latex, alkaloids, asclepiadin, volatile oils
Cultural uses: Common milkweed has been used traditionally a tea prepared from its root as a diuretic for kidney stones, a laxative, and an expectorant. It has been used to treat asthma and bronchitis and it induces sweating. The sap has been used for chewing gum, which is considered very dangerous because of the presence of cardioactive compounds in the plant. The sap has also been used as a topical remedy for worts, ringworm and moles. Some Native Americans used milkweed as a contraceptive. It was also a folk remedy for cancer. Today, milkweed has limited medicinal use; other milkweed species, such as the swamp milkweed, have more widespread use. Parts of the milkweed plant can be eaten, but the similarity of this plant to toxic look-alikes would serve as a caution against this practice. It is used by some as an emetic, a potion to sooth the nerves, and as a stomach tonic. It is also believed to kill parasitic worms.

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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Milkweed, Swamp *Asclepias incarnata*

Family: Milkweed Family (Asclepiadaceae)
Other Names: flesh-colored milkweed, rabbit milk, rose milkweed, rose silkweed, silkplant, swamp silkweed, water nerve root, white Indian hemp.
Origin and Distribution: Swamp milkweed is a native of North America. It is currently distributed in marshes, swamps, fens, ditches, open woods, wet prairies, fields, thickets, and shores. Swamp milkweed prefers moist sites.

Plant Description: Swamp milkweed is a slender perennial. Its stems and leaves exude a white milky sap if cut or broken, which is a common characteristic of species in the Milkweed Family. It can be distinguished from other milkweeds by its habitat, as it is the only native milkweed species preferring wet ground. Reproduction is by way of seeds and weakly creeping roots.
Root system - Roots about 1 inch in diameter, knotty, and surrounded by rootlets and creeping roots.
Seedlings & Shoots - Stems of young plants are purple-tinged and their leaves have short hairs around the edges and on the prominent midveins located on the lower surface.
Stems - Stems emerge either alone or in clusters from a single root crown. Stems are generally upright, 1 to 4 feet tall, hairy, leafy, undivided at the base, and branched at the top.
Leaves - Leaves are opposite (2 leaves per node), 2 to 8 inches long, no more than 1 1/2 inches wide, numerous, and lance-shaped. Upper and lower leaf surfaces are usually hairless. Veins are clearly visible on the lower surface of the leaf.
Flowers - Flowers consist of 5, downward-pointing petals and a 5-part central crown that are dull pink to deep pinkish-purple. Flowers are 1/4 inch wide. They form small clusters of between 10 to 20 flowers.
Fruits & Seeds - Seed pods are 2 to 4 inches long, slim, rusty-green, and have elongated tips. Pods split lengthwise when mature releasing numerous flat, oval seeds. The brown seeds are 3/8 inch long and have winged margins and long, silky tufts of white hair at the tip.

Similar Species: Swamp milkweed is similar in appearance to other milkweed species (Asclepias spp.) except its leaves, flowers, and seed pods are more slender. Also, the sap of this wetland milkweed is less milky than that of other species in the family.

Biology: Swamp milkweed flowers from July through August. The plant is often found growing in several inches of water.

Toxicity: This species is poisonous to livestock and small children if ingested in sufficient quantities.

Related Information:

- ✓ 'Incarnata' was likely included in the name because it means flesh-colored or flushed with pink, which describes the color of swamp milkweed flowers.
- ✓ Pueblo Indians harvested fibers from this plant that they used to make fishing line and sewing thread.
- ✓ Roots of swamp milkweed were used in the treatment of various ailments.

Morningglory, Bigroot Ipomoea pandurata

Family: Morningglory Family (Convolvulaceae)
Other Names: man of the earth, man underground, morning-glory, wild potato vine, wild sweet potato.
Origin and Distribution: Bigroot morningglory is native to North America. Its current distribution is primarily throughout the eastern half of the U.S. The plant is commonly found in cultivated fields, old fields, fencerows, waste places, along roadsides, and in other disturbed areas. It prefers to grow in dry sandy soils.

Plant Description: Bigroot morningglory is a perennial that shares numerous characteristics with other morningglories including twining vines, funnel-shaped flowers, and heart-shaped leaves. Unlike its relatives, bigroot morningglory has a very large and deep taproot. Reproduction is by seeds and creeping roots.
Root system - The root system consists of a large, deep taproot and thick, yellowish-white creeping roots. The tuber-like taproot can measure 7 feet long and 4 or more inches in diameter.
Seedlings & Shoots - The first seedling leaves (cotyledons) are oval and emerge on long leaf stalks (petioles), with the point of attachment to the root remaining below ground.
Stems - Stems are purplish, usually hairless, and not often branched. The trailing or climbing stems emerge vertically from the ground for 1 to 2 feet and then extend horizontally across the soil surface. They grow up to 10 feet long. More than one shoot emerges from each root.
Leaves - Leaves are alternate, 2 to 6 inches long, and heart-shaped. The sides frequently contract giving the leaf a fiddle-like shape. Leaves attach to stems by way of long petioles. Leaves can be either hairy or hairless but petioles are usually hairless.
Flowers - Flowers are alternate, funnel-shaped, 2 to 3 inches across, and white with pinkish-purple stripes radiating from the center. Flowers form either in few- or several-flowered clusters at the end of stalks arising from the stem at the leaf axils. Flower stalks exude a milky sap if broken or crushed.

Fruits & Seeds - Fruits are egg-shaped capsules containing 2 to 6 seeds. Seeds are red-brown, flattened, oval, and covered with soft white hairs making them appear fringed.

Similar Species: Leaves and flowers of bigroot morning glory resemble those of annual morning glory species (Ipomoea spp.). However, annual morning glories have a small taproot, while bigroot morning glory has a large perennial taproot. Also, annual species are generally hairier than bigroot morning glory. Leaves may resemble honeyvine milkweed (Ampelamus albidus) leaves; however, honeyvine milkweed flowers are small and not funnel-shaped.

Biology: Growing without crop competition, bigroot morning glory can produce 3000 seeds per plant. Roots send up new shoots in mid-May to early June but seeds germinate throughout the growing season.

Flowering begins in mid-July for first-year plants, mid-June for older plants, and continues until the frost. Control is difficult because bigroot morningglory emerges late, has a large taproot that extends well below the plow line, and can reproduce from root cuttings. Post emergence herbicides generally provide good control.

Toxicity: There are no references indicating that this plant is poisonous; however, seeds of many morningglorys have been reported to be toxic to livestock and humans if consumed in large quantities.

Related Information:

- ✓ 'Morning-glory' was commonly used as a name for the plant because flowers open at night or in diffuse light.
- ✓ The large fleshy root of bigroot morningglory, which is closely related to cultivated sweet potato, can weigh over 66 pounds.

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Motherwort *Leonurus cardiac*

Family: Mint Family (Labiatae)
Other Names: common motherwort, cowthwort, lion's-ear, lion's-tail.
Origin and Distribution: Motherwort was introduced from Eurasia, and can now be found in southern Canada and east of Rocky Mountains in North America. Motherwort occurs in meadows, fields, yards, neglected gardens, open woods, floodplains, riverbanks, waste places and along roadsides. The species prefers moist, rich soils.

Plant Description: Motherwort is a stiff-stemmed perennial that can grow up to 5 feet tall. As with other mint species, it has square stems and its foliage emits a pungent odor if crushed. The pink to pale purple flowers are grouped in clusters of 6 to 15 at the axils where upper leaves attach to the stem. Sepals located directly beneath the flowers are distinctively prickly. The plant reproduces by seeds.

Root system - Motherwort has a shallow but extensive root system.
Seedlings & Shoots - Young leaves are puckered between the veins giving them a crinkly appearance.

Stems - Stems are 2 to 5 feet tall, erect, stiff, distinctly square, and may have short hairs along the corners. Stems sometimes branched near the top. Frequently, several stems arise from a single root crown.

Leaves - Leaves are opposite (2 leaves per node), between 2 to 4 inches long, dull green, and attached to the stem by way of long stalks (petioles). Lower leaves are divided into 3 (rarely 5) distinct lobes that appear to radiate out from a central point like fingers on a hand. Lobes are coarsely toothed. Compared with lower leaves, upper leaves are smaller, less deeply toothed, and have shorter petioles. Uppermost leaves are narrow with only a few teeth.

Flowers - Flowers are less than 1/2 inch long, pink to pale purple, and grouped in clusters of 6 to 15 at the axils where upper leaves attach to the stem. Flowers consist of a short tube and 2 lips. The upper lip is 2-lobed, arched, and hairy while the lower lip is 3-lobed. Sepals located directly beneath the flowers have dry prickly teeth.

Fruits & Seeds - Each flower produces 4 triangular brown nutlets that have hairs at one end.

Biology: Flowering occurs July through September. Roots are tenacious and can be hard to eradicate. Control options include improving drainage and mowing close to the ground every time shoots emerge. The plant generally does not survive cultivation.

Toxicity: Motherwort contains lemon-scented oil that causes photosensitivity if ingested, and leaves can produce contact dermatitis in people who are susceptible.

Related Information:

- ✓ The genus name 'Leonurus' means 'lion's tail' and came about because the plant or its ragged-edged leaves were thought to resemble the tip of a lion's tail.
- ✓ The species name 'cardiaca' means 'for the heart' and refers to its early medicinal use for heart ailments.
- ✓ Motherwort was used to remedy nervousness, dizziness and other disorders of women.

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Mugwort *Artemisia vulgaris*

Family: Daisy Family (Compositae)
Other Names: chrysanthemum weed, common mugwort, felon herb, mugwort wormwood, St. John's plant, wormwood.

Origin and Distribution: Mugwort was introduced from Europe into North America where it spread throughout northeastern U.S., into southern Canada, and along the Pacific Coast from Washington to central California. It is found growing in turfgrass, landscapes, waste places, shores, roadsides, and along railroads. The plant frequently establishes in sandy, open ground and prefers lime-rich soils.

Plant Description: Mugwort is one of several closely-related herbs with an erect growth form and dissected leaves that generally give off a strong odor. Mugwort can be distinguished by its dark-green leaves, which are hairless above and silvery-white beneath due to a covering of wooly hairs, and its sage-like odor. Also, it has inconspicuous flower clusters on upright branches located at leaf axils on the upper portion of the stem. New plants arise at the upturned ends of short, stout, horizontal rhizomes (horizontal underground stems). The plant rarely reproduces from seeds.

Root system - The root system is a mass of short, stout, horizontal, branched rhizomes (horizontal underground stems) from which adventitious roots are produced.

Seedlings & Shoots - Young leaves are opposite (2 leaves per node), rounded, unlobed, bristly-hairy, wooly underneath, and attached to the stem by way of a long leaf stalk (petiole). Often, the edges of young leaves are conspicuously toothed. Young shoots sprouting from rhizomes are erect, gray-green, and resemble chrysanthemums.

Stems - The erect stems are 2 to 6 feet tall and angular with longitudinal ridges or grooves and they become woody over time. Color ranges from green to green with purple ridges to entirely purple. Although stems are unbranched below, the upper part usually has branches. As many as 20 stems may emerge from the same root system.

Leaves - Leaves are alternate (1 leaf per node) with a smooth, dark green upper surface and a lower surface that appears silvery due to white-wooly hairs. Leaves on the lower part of the stem are divided into 3 or 4 unequal, pointed lobes with coarsely-toothed edges that are divided into even smaller segments. Lower leaves attach to the stem by way of long petioles, and on the stem at either side of the petiole are small leafy bracts (stipules). Middle leaves are divided once into coarsely-toothed pointed lobes. Upper leaves are usually unlobed with smooth edges and without petioles so they are attached directly to the stem.

Flowers - Each flower is composed of many yellowish disk flowers clustered onto a flat head that is about 1/10 inch wide. The inconspicuous flower heads are borne on upright branches arising from leaf axils on the upper part of the stem. The erect stem terminates in several to many flowering branches. Branches are often leafy, especially in the lower part.

Fruits & Seeds - The single-seeded fruit is brown, ridged, oblong with a narrow base, and tipped with tiny bristles. Seeds of plants growing in temperate climates are usually not viable.

Similar Species: The appearance of mugwort is similar to that of chrysanthemum species (Chrysanthemum spp.), tansy (Tanacetum vulgare), dogfennel (Eupatorium capillifolium), and horseweed (Conyza canadensis) except mugwort has dissected leaves that are white-wooly underneath, relatively inconspicuous flowers, and a sage-like aroma. Mugwort can be distinguished from other Artemisia species that are naturalized or cultivated by its leaves, which are smooth on top and so hairy on the bottom that they appear white-wooly. Also, it has twice-divided lower leaves with pointed lobes.

Biology: Mugwort blooms from July to September. Few germinable seeds are produced by plants growing in temperate regions in North America, so rhizomes are the main means by which mugwort reproduces. Cultivation and other practices that move soil tend to also move sections of rhizomes thus spreading and increasing the number of mugwort plants. The plant tolerates mowing. Therefore, it is relatively difficult to control this weed using only cultivation or mowing.

Toxicity: Mugwort is said to cause dermatitis resulting from contact with skin or from drinking tea made from the weed.

Related Information:

- ✓ The common name 'mugwort' likely comes from the use of the plant to flavor beer.
- ✓ Many superstitions surround this plant; it was believed to provide protection from fatigue, sunstroke, wild animals, and evil spirits.

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.

Mullein, Common *Verbascum Thapsus*

CAUTION!! THE SEEDS OF THIS PLANT ARE TOXIC!!

Common Name: common mullein (also called great mullein)
Range: throughout the United States; found in fields, pastures, along roadsides, in waste places and disturbed areas.
Origin: native to Europe and Asia, naturalized in the United States.

Botanical description: The common mullein is a biennial, which grows to a height of 1-8 feet. It has a tall, straight stem with large, oval, felt or flannel-like leaves and a long dense spike of yellow flowers near its top. The leaves become smaller and smaller as they near the top of the plant. The flowers are of two types; the upper flowers have hairy and short anthers while the lower flowers have longer, hairless anthers. The common mullein is unmistakable in its appearance; even when not in bloom its flannelly leaves and height are easily recognized.

What's in a name: The common name, mullein, comes from the German, meaning "king's candle" because of its scepter-like, candle-straight growth. The genus name, Verbascum, is thought to be a corruption of the Latin word barbascum, from barba (beard), referring to the plant's shaggy foliage.

All in the family: The common mullein is a member of the Figwort family, which includes foxglove, figworts, and another medicinal plant, eyebright.

Cultural uses: Traditionally, leaf and flower tea was used as an expectorant, an antispasmodic, a diuretic, for chest colds, asthma, bronchitis, coughs, and kidney infections. The leaves were made into a poultice for ulcers, tumors, and hemorrhoids; the flowers were soaked in olive or mineral oil and used as earache drops.

Asian Indians used the stalk for cramps, fevers and migraines. Today, a decoction of the flowers is still used as an emollient and treatment for ulcers, wounds and hemorrhoids and for relaxation of the digestive tract and mucous membranes. It also sooths the liver and gallbladder. The leaves have exhibited strong anti-inflammatory properties. Common mullein flowers are still used for coughs and colds as well as for eardrops.

Active compounds: Common mullein contains mucilage, flavonoids, triterpenoid saponins, volatile oils and tannin. It also contains rotenone and coumarin, considered dangerous by the FDA.

Mullein, Moth *Verbascum blattaria*

Family: Figwort Family (Schrophulariaceae)
Other Names: slippery mullein.
Origin and Distribution: Moth mullein is a native of Eurasia that was introduced into the eastern coast of North America and then spread west. It reached Pennsylvania by 1818 and was found growing in Michigan in 1840. Currently, moth mullein is distributed throughout the U.S. and southern Canada where it is found most abundantly in the east.

Moth mullein grows mainly in waste places and also in pastures, meadows, old fields, and open woods. It prefers rich soils and is tolerant of dry, sandy or gravelly soils.

Plant Description: Moth mullein is a biennial forming a basal rosette during the first year of growth after which it produces a flowering stalk. The rosette grows to 16 inches in diameter and is composed of dark green leaves that are deeply- and irregularly-toothed. The distinctive flowering stem is solitary, slender, erect, and 2 to 5 feet tall. Loosely clustered at the top of the stem are flowers attached to slender stalks that may be as long as the flower is wide. Flowers are 5-lobed, saucer-shaped, and white or yellow with a purplish base. Stamens emerging from the center of each flower are orange and have purple hairs. Reproduction is by seeds.
Root system - Moth mullein forms fibrous roots and a deep taproot.
Seedlings & Shoots - Young leaves are alternate, bright green, and have scattered minute hairs on the upper surface and edge. Veins are prominent on the lower surface. Leaves attach to the stem by way of flattened broad stalks (petioles). Young plants grow as a rosette of basal leaves.
Stems - Stems are erect, slender, between 2 to 5 feet tall, and may have short hairs near the top. Stems are usually solitary but they can have a few upright branches near the top.
Leaves - Leaves have irregularly toothed edges, prominent veins, lack hairs or are sparsely hairy, and are dark green. Rosette leaves are deeply toothed, oblong, up to 8 inches long, narrow at the base, and attached to the compressed stem of the rosette by way of short petioles. Leaves located on the flowering stem are alternate (1 leaf per node) and resemble rosette leaves except they are smaller, more shallowly toothed, and have sharply-pointed tips. Stem leaves lack petioles and are triangular with broad bases that clasp the stem.
Flowers - Flowers attach to the flowering stem by way of slender, 1-inch-long stalks. While in bud, flowers appear button-like. After opening, the white or yellow flowers are composed of petals that are united at the base and deeply 5-lobed at the top forming a saucer-like shape less than 1 inch in diameter. Emerging from the center of each flower are 5 stamens that are orange with purple hairs. Flowers are located in loose clusters at the top of the flower stem.
Fruits & Seeds - Fruits are downy capsules that are round and about 1/3 inch in diameter. Each capsule splits when mature into 2 cells filled with numerous tiny, dark brown seeds. The surface of each seed is marked with wavy ridges.

Similar Species: Common mullein (Verbascum thapsus) is a related species that is also a biennial and similar in appearance to moth mullein. However, common mullein is taller and more robust, its foliage is covered with hairs, and its leaves have smooth edges. Compared with moth mullein, flowers of common mullein are more densely packed at the top of the flowering stem. Seeds of common mullein and moth mullein are virtually indistinguishable.

Biology: Moth mullein blooms from June to September. There are yellow- and white-flowered forms. Flowering can be observed to move from the bottom of the cluster towards the top. Therefore, it is possible to find plants with mature fruits at the bottom of the flower cluster, open flowers in the middle, and unopened buds at the top. Each plant produces over 1000 capsules. Seeds of moth mullein have been found to remain viable for 90 years. To control, mow close to the ground, or hoe rosette below the crown in early spring or autumn.

Toxicity: None known.

Musk thistle *Carduus nutans See Thistle for more information*

Musk thistle *Carduus nutans*

Musk thistle is an aggressive weed of foreign origin that occurs in pastures, rangeland, roadsides and non-crop areas. It is a biennial weed, although occasionally it is an annual. Because musk thistle reproduces solely from seed, the key for successful management is to prevent seed production. Musk thistle is a biennial weed that reproduces only from seed.

The key to successful musk thistle control is to prevent seed production. Apply herbicides such as Tordon, Vanquish/Clarity or 2,4-D to musk thistle rosettes in spring or fall. Apply Ally or Telar up to the early flower growth stage. Combine control methods into a management system for best results. Germination and seedling establishment are correlated with moisture and light. Thus, more seeds germinate and establish plants in open pastures and other degraded areas. Vigorously growing grass competes with musk thistle, and fewer thistles occur in pastures where grazing is deferred. However, musk thistle also can become a problem in pasture or rangeland that is in good condition.

Seedlings normally emerge early in spring, develop into rosettes and spend the first season in this growth stage.

Seedling emergence also can occur in fall. All seedlings grow into rosettes and overwinter in that stage. Rosettes are usually large and compact with a large, corky taproot that is hollow near the crown. Leaves have consistent shape, sometimes expressing a frosted appearance around the leaf margins, and often have a cream-colored midrib.

Early in spring of the second year, overwintered rosettes resume growth. Shoots begin to elongate in late March through May, depending on weather and elevation. Musk thistle flowers and starts to produce seed 45 to 55 days after it bolts. Musk thistle has very large bracts beneath flowers that are armed with sharp spines and shoots beneath flowers are almost devoid of leaves.

Musk thistle dies after it sets seed. It spends approximately 90 percent of its life cycle in a vegetative growth stage. Musk thistle's tolerance to most herbicides increases after it bolts. Musk thistle is a prolific seed producer. One plant can set up to 20,000 seeds. However, only one-third of the seeds are viable. Musk thistle produces many heads. The terminal, or tallest, shoots flower first, then lateral shoots develop in leaf axils. A robust plant may produce 100 or more flowering heads.

Musk thistle flowers over a seven- to nine-week period. It begins to disseminate seed from a head about two weeks after it first blooms. It is common to observe musk thistle with heads in several stages of floral development and senescence. Thus, musk thistle sets seed over an extended time period.

Most seed is dispersed within the immediate vicinity of the parent plant. This leads to a clumped pattern of seedling development and results in intraspecific competition and mortality. Wind and water are good dissemination methods and seeds are also spread by animals, farm machinery and other vehicles. Less than 5 percent of seed remains attached to the pappus when it breaks off the flowering head and floats away on wind currents.

Management

Cultural control. Maintaining pastures and rangeland in good condition is a primary factor for musk thistle management. To favor pasture and rangeland grass growth, do not overgraze. Fertilize only when necessary and according to soil testing recommendations. To successfully manage musk thistle, prevent seed formation.

Mechanical control. Musk thistle will not tolerate tillage and can be removed easily by severing its root below ground with a shovel or hoe. Mowing can effectively reduce seed output if plants are cut when the terminal head is in the late-flowering stage. Gather and burn mowed debris to destroy any seed that has developed.

Chemical control. Several herbicides are registered in pasture, rangeland and noncrop areas to control musk thistle. Tordon 22K (picloram), Milestone, Transline, Banvel/Vanquish/Clarity (dicamba), 2,4-D, or Banvel/Vanquish/Clarity plus 2,4-D are commonly used. Apply these herbicides in spring or fall to musk thistle rosettes. Applications during the reproductive growth stages with these herbicides (bud through flowering) will not eliminate viable seed development.

Escort (metsulfuron) or Cimarron Extra (chlorsulfuron) also can be used in pastures, rangeland, and non-crop areas. Research from Colorado State University and the University of Nebraska shows that chlorsulfuron or metsulfuron prevents or dramatically reduces viable seed formation when applied in spring, up to early flower growth stages. The latest time to apply these herbicides is when developed terminal flowers have opened up to the size of a dime. Add a good agricultural surfactant at 0.25 percent v/v2 to Escort or Cimarron Extra treatments or control is inadequate (equivalent to 1 quart of surfactant per 100 gallons of spray solution).

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Nettle, Stinging *Urtica dioica var. procera*

Family: Nettle Family (Urticaceae)

Other Names: Urtica dioica spp. gracilis, Urtica gracilis, Urtica procera, Urtica viridis, American stinging nettle, slender nettle, tall nettle, tall wild nettle, wild nettle.
Origin and Distribution: Stinging nettle is a bristly, stinging perennial that is extremely variable in its morphology. Two varieties exist in North America. The most common variety (Urtica dioica var. procera) is native, while an uncommon and more bristly type (Urtica dioica var. dioica) was introduced from Europe, possibly for use as greens. It is difficult to distinguish between American and European varieties; however, the introduced variety is rarely encountered. Stinging nettle is widespread throughout the eastern U.S. This weed thrives in damp, nutrient-rich soil and does not grow well where soil nutrients, especially phosphorus, are low. It can be found in pastures, nurseries, orchards, neglected yards, waste places, roadsides, flood plains, stream banks and ditches, as well as along the edges of fields and woodlots where it tolerates partial shade. This species does not tolerate saline conditions.

Plant Description: Stinging nettle is an erect, herbaceous perennial that is widely known for its unpleasant stinging hairs on the stems and lower leaf surface. It reproduces by wind-dispersed seeds and creeping rhizomes (horizontal underground stems), and grows in dense clumps, often forming large colonies.

Root system - Stinging nettle has an extensive underground network of rhizomes (horizontal underground stems) that can spread 5 feet or more in a season. Fibrous roots are produced along the rhizomes.

Seedlings & Shoots - Cotyledons are oval, with a notch at the tip. The first leaves are opposite, oval to egg-shaped, thin and bright green. The toothed margins of the first few leaves are more rounded than in older plants. Young leaves and stems are covered with hairs and a few stinging hairs.
Stems - Stems are mostly unbranched, and grow 3 to 6 1/2 feet tall (sometimes up to 9 feet). They are covered with bristly stinging hairs (fewer in the upper part of the stem), and otherwise, are smooth or have a few soft hairs. Stems are slender and approximately square in cross section.
Leaves - The thin, bright to dark green leaves are opposite, with saw-toothed margins and infamous stinging hairs on the underside. Leaves are broadly to narrowly egg-shaped (2 to 6 inches long, 1 to 2 inches wide), with a rounded or heart-shaped base and a pointed tip. Aside from the stinging hairs, the upper and lower leaf surfaces are usually smooth (the lower surface may be slightly hairy). Pointed stipules (small leaf-like appendages) occur at the base of the leaf, but senesce early. Leaf stalks are 1/4 to 2/3 the length of the leaf.
Flowers - Tiny, greenish-white flowers are arranged in clusters on slender, branched spikes formed in the leaf axils (usually 4 spikes per node). Male and female flower clusters are produced on the same plant (monoecious), but usually from different leaf axils. Male flower spikes are longer than female flower spikes.
Fruits & Seeds - Stinging nettle produces a small, dry, oval-shaped, 1-seeded fruit (achene) that is yellow to grayish-tan. Fruits are clustered along drooping flower spikes.

Similar Species: The uncommon European variety of stinging nettle (Urtica dioica var. dioica or Urtica dioica spp. dioica, often referred to simply as Urtica dioica; European stinging nettle, common nettle, hokey pokey, devil's leaf, naughty man's plaything) is more branched and sprawling, with more densely hairy leaves and stinging hairs abundant on stems and both leaf surfaces. Leaves of the European variety are much broader and heart-shaped. Unlike the native stinging nettle, the European type is dioecious, meaning its male and female flowers are found on separate plants. Small stinging nettle seedlings might be confused with mints, which also have opposite, serrated leaves and square stems, but no stinging hairs.

Biology: Flowers of stinging nettle are produced between May and October, and are wind-pollinated. A greater proportion of early season flowers are male, while flowers in the summer are predominantly female. Over 20,000 seeds can be produced on a single plant growing in the sun. Seeds remain attached to the spikes until frost, and have little or no dormancy. Because seeds lack dormancy, germination can occur soon after seeds are shed, but most germination is seen in early spring when soil temperatures are above 40° F. Seeds can live 10 or more years in the soil.

Stinging nettle has an extensive underground network of rhizomes that facilitate spread, as well as regrowth in springtime or following mowing. New plants are often established from rhizome fragments that have been spread by machinery.

The weediness of stinging nettle is attributed to its spread by rhizomes, allowing it to form dense colonies that exclude other species. Eradicating an established colony is difficult because the subterranean system expands yearly and cannot be suppressed by mowing. This species does not compete well with grasses, but is able to establish and spread among legumes or other forbs. Stands of stinging nettle are thought to persist for 50 years. Distribution of this species is limited by its intolerance of poor fertility, dense shade and frequent disturbance. Some control may be obtained through repeated tillage and cultivation over several years.

Toxicity: Stinging hairs on the stem and leaves of stinging nettle cause irritation upon contact with skin. The toxins are located at the base of each stinging hair. When skin brushes against the stinging hairs, the bulbous tip of each hair readily breaks off, forming a sharp shaft that acts like a hypodermic needle to inject the toxins into the skin, causing localized pain, reddish swelling, itching and numbness. Toxins thought to be involved include formic acid (also found in ants), histamine, acetylcholine and 5-hydroxytryptamine. The symptoms caused by these chemicals will last for a few minutes to a few hours, and then resolve on their own. Airborne pollen, which is shed in large amounts when stinging nettle is in flower, is an important contributor to hay fever.

Related Information:

- ✓ Relief from stinging nettle's burn comes by rubbing inflamed skin with juice from the leaves of dock, jewelweed, rosemary, mint, sage or even crushed leaves of stinging nettle itself!
- ✓ The fiber in stinging nettle stems is very similar to that of hemp and flax, and for this reason, has historically been an important ingredient in a variety of items, from sailcloth and fishing nets to clothing and paper.
- ✓ Europeans cook stinging nettle, removing the stinging hairs by boiling, and find it a good source of vitamins A and C, protein and iron.
- ✓ Pulling up stinging nettle by the roots while calling out a sick person's name was believed to drive away a fever.
- ✓ Urtication, the process of beating the skin with nettles, was formerly used to treat certain diseases.
- ✓ Hunting dogs have died from extreme exposure to stinging nettle.

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Postemergence Herbicides

Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Nightshade, Bittersweet *Solanum dulcamara*

Family: Nightshade Family (Solanaceae)
Other Names: bitter nightshade, bittersweet, blue nightshade, climbing bittersweet, climbing nightshade, deadly nightshade, dogwood, dulcamara, European bittersweet, felonwood, felonwort, poison berry, scarlet berry, shooting star, violetbloom, woody nightshade.

Origin and Distribution: After it was introduced into North America from Eurasia as a cultivated ornamental, bittersweet nightshade spread throughout the U.S. becoming most abundant in the eastern and north-central states. The species can be found in thickets, hedgerows, ditches, stream banks, marshes, swamp forests, deciduous woods, waste areas, roadsides, railroads, orchards, and along the edges of agronomic fields. Bittersweet nightshade prefers rich soils in areas that tend to be moist or even waterlogged for a portion of the year. The weed tolerates shade.

Plant Description: Bittersweet nightshade is a perennial climbing or trailing vine that reproduces by seeds and rooting at the nodes of the prostrate stems. It can be distinguished from other viney plants by its hollow stems that are woody at the base and oval leaves with pointed tips. Attached to the leaf stalk (petiole) at the base of larger leaves are 2 opposite lobes, which are absent in smaller leaves. Therefore, the plant has 2 leaf forms that, along with its blue-violet flowers and bright red berries, can be useful to distinguish bittersweet nightshade from other nightshade species. All parts of the plant give off a disagreeable odor when bruised.

Seedlings & Shoots - Young stems and leaves are generally hairy.

Stems - Stems are hollow, slender, slightly hairy, and woody at the base. They may be green, dark red, or black and can grow up to 10 feet long. Stems either climb or trail along the ground. Prostrate stems are capable of rooting at the nodes.

Leaves - Leaves are oval with a pointed tip. Larger leaves have 2 lobes or leaflets at the base while smaller leaves lack such lobes. Leaves are alternate (1 leaf per node), 2 to 5 inches long, dark green with a purple tinge, and attached to stems by way of long leaf stalks (petioles). Leaf edges are smooth. Foliage emits a strong unpleasant odor when bruised.

Flowers - Flowers consist of 5 blue-violet (rarely white) petals that are united at the base, deeply 5-lobed and shaped like a star at the top, and about 1/2 inch wide. Emerging from the center of each flower is a yellow column composed of fused anthers. Flowers appear in branched, drooping clusters that attach to the main stem opposite the leaves.

Fruits & Seeds - Fruits are oval, thin-skinned, juicy, bright red berries that are about 3/8 inch wide and contain many disk-shaped, light yellow seeds.

Similar Species: Annual nightshade species (Solanum spp.) look similar vegetatively but they have white flowers and blackish berries while bittersweet nightshade flowers are blue-purple and its berries are bright red.

Biology: Flowering occurs in May to September. In areas where winters are severe, plants usually die back close to the ground; but, in areas with milder winters, stems can persist becoming thick and woody. Bittersweet nightshade does not survive cultivation. Because it serves as an alternate host for such generalized pests as the Colorado potato beetle, bittersweet nightshade can cause indirect damage to crops.

Toxicity: Leaves are considered moderately poisonous if ingested, and there is much disagreement over the toxicity of the berries. Some say that paralysis can result in humans that have eaten as few as 6 berries. Cases of poisoning in cattle, horses, and sheep have been documented. Concentrations of toxic compounds within plants may vary with growth stage, and chemical components may vary from one individual to the next. Regardless, leaves and berries of the plant should be regarded as toxic.

Related Information:

- ✓ 'Solanum' was derived from the same Latin root word as 'solace', and was likely given as a name for this weed because of its many medicinal uses.
- ✓ 'Dulcamara' is a combination of Latin words meaning "sweet-bitter".
- ✓ The common name refers to a toxin in bittersweet nightshade that is said to leave a bitter and then sweet taste if ingested.
- ✓ Bittersweet nightshade was used to treat asthma, bronchitis, jaundice, kidney problems, rheumatism, skin diseases, syphilis, and to counteract witchcraft.

Nimblewill *Muhlenbergia schreberi*

Family: Grass Family (Gramineae)
Other Names: drop-seed, wire-grass.
Origin and Distribution: Nimblewill is native grass that occurs in the eastern half of North America. Nimblewill survives best on moist, rich, gravelly soil, and is often troublesome in pastures, lawns, orchards, nurseries and gardens. It is also common in waste places and roadsides.

Plant Description: Nimblewill is a fine textured, mat-forming perennial grass. This species is characterized by its slender stems and erect early season growth, with short, narrow leaves that jut out horizontally in different directions. Nimblewill patches turn a distinctive tan color in winter. This species reproduces by seeds and stolons (horizontal stems at the surface of the ground that root at the nodes).

Root system - Nimblewill has a fine, fibrous root system.

Stems - Stems are slender, wiry, round and smooth (1/2 to 2 feet long). Early season stems are erect, but sag toward the ground and become spreading with age. Mature stems can root at the nodes and are branched. Branches are short and hug the stems.

Leaves - Leaves are rolled in the bud. The smooth, grayish- to bluish-green leaf blades (free part of the leaf) are narrow, pointed, flat, and short (1/2 to 2 inches long). Leaf blades are horizontal or point slightly upward. A few hairs are present at the base of the blade near the ligule. The leaf sheath (part of the leaf surrounding the stem) is flattened, hairless and loose. The ligule (projection inside on the top of the sheath) is membranous and short. Auricles (appendages at the top of the sheath) are absent.

Flowers - Inconspicuous flowers are borne in fine, slender flower heads (2 to 7 inches long) at the ends of branches and from the axils of leaves.

Fruits & Seeds - The chestnut-brown seeds are 1/20 inch long, and spindle-shaped (swollen in the middle and narrower towards each end).

Similar Species: Nimblewill may be distinguished from wirestem muhly (Muhlenbergia frondosa) by its lack of rhizomes, delicate appearance and shorter stature.

Biology: Nimbewill flowers between August and October. This species can form dense, sprawling patches, which turn a light brown after a killing frost. Nimblewill's spring and early summer growth, consisting of short, erect stems and horizontally extended leaves, is very different from its later season growth as the stems become spreading. In turf, where nimblewill is mowed, the plants are more compact and resemble early season growth.

Nimblewill naturally occurs in open woodlands and stream bottomlands. It has moved out of these native habitats, and can be a problem in agronomic crops, where it tolerates some grass herbicides. This species does not tolerate conventional tillage practices.

Toxicity: None known.

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Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

Related Information:

- ✓ Nimblewill's common name, originally spelled 'nimble Will', refers to the speed with which the grass was thought to overtake new areas.
- ✓ Livestock do not find nimblewill palatable.

Nutsedge, Yellow *Cyperus esculentus*

Family: Sedge Family (Cyperaceae)
Other Names: chufa, coco, cocosedge, earth almond, edible galinglae, edible nutgrass, ground almond, northern nutgrass, rush nut, tiger nut, watergrass, yellow nutgrass.
Origin and Distribution: Yellow nutsedge is native to North America and Eurasia, but is found throughout the world. Although it is of subtropical origin, this species has spread north into temperate regions. Prior to 1950, is found mostly in native habitats, but today it is considered one of the world's worst weeds. Yellow nutsedge is especially troublesome in the northcentral and northeastern U.S. It is common in marshes and along riverbanks and lakeshores, and as a weed in cultivated fields, turf and gardens. It is especially common in poorly drained areas, but can tolerate upland sites as well. This species tolerates a wide range of soil types from sand to clay.

Plant Description: Yellow nutsedge is an erect, grass-like perennial, characterized by its shiny yellowish-green leaves, triangular stem, golden-brown flower head and shallow rhizomes (horizontal underground stems) that produce many nut-like tubers. Young seedlings are often confused with grasses. This species reproduces primarily by tubers and less often by seeds. Rhizomes help to enlarge patches.
Root system - Yellow nutsedge forms a complex, shallow underground system composed of fine fibrous roots, thin scaly rhizomes (horizontal underground stems), hard spherical tubers and basal bulbs (swelled rhizome tips which produce stems and leaves). Roots are produced from rhizomes, tubers and basal bulbs. Two types of rhizomes are formed. Short rhizomes are produced from germinating tubers, and end in basal bulbs. Long wiry rhizomes are produced from basal bulbs, and can grow 2 to 8 inches long (sometimes up to 24 inches). Long rhizomes can end in either tubers or basal bulbs. Tubers (1/5 to 4/5 inch long) are white at first, turning brown and eventually black at maturity.
Stems - Stems (1/3 to 3 feet tall) are erect, hairless, unbranched and triangular in cross-section.

Leaves - The leaves are light yellowish-green (4 to 12 inches long or longer, 1/8 to 1/2 inch wide) with a prominent mid-vein, a waxy surface and a gradually tapering, pointed tip. Leaves are arranged in 3's and form a sheath around the stem. Most leaves are produced toward the base of the plant. A set of 3 specialized leaves (bracts) (1 to 8 inches long, 1/8 to 1/2 inch wide) occurs just below the flower head.
Flowers - Inconspicuous flowers are arranged into numerous, flat, narrow, straw-colored clusters within a branched, umbrella-shaped flower head at the top of the stem.
Fruits & Seeds - Fruits are oval, 3-angled, single-seeded, and yellowish brown.

Similar Species: Small yellow nutsedge plants or young shoots are often confused with young annual grasses, but can be distinguished by triangular stems that are apparent if you roll the stem between your finger and thumb or look at the stem in cross section near the base of the plant. Grass stems are flat or round. A related species, purple nutsedge (Cyperus rotundus), can be distinguished from yellow nutsedge by its generally darker leaves and red-brown to purple flower clusters. Unlike yellow nutsedge, which produces tubers only at rhizome tips, purple nutsedge produces a chain of tubers along the length of the rhizome.

Biology: Flowering occurs from July to September. Seed germination begins in May. Tuber germination typically begins as soil temperatures reach about 54 Fahrenheit degree (12 Celsius) (in May), and shoots continue to emerge through mid-July. Tuber formation begins in late July and continues through the rest of the growing season.

Yellow nutsedge reproduces and spreads primarily by tubers, which are the only structures (besides seeds) that can survive the winter. All foliage, rhizomes, roots and basal bulbs die with the first hard frost. Viable seeds are produced, but tend not to be an important means of reproduction since seedling survival is low. When a tuber germinates in the spring, several short rhizomes are formed, ending in a basal bulb near the soil surface. Basal bulbs generate stems and leaves above the ground and fibrous roots and long rhizomes in the soil. Long rhizomes produce basal bulbs or tubers at their tips (usually basal bulbs are produced early in the season and tubers late in the season as the day length shortens). Basal bulbs sprout immediately to form new shoots, roots and rhizomes, and rhizomes go on to produce more basal bulbs (which germinate immediately) and tubers. This process continues throughout the season. Tubers remain dormant over the winter, and many germinate the following spring. Most tubers remain viable for no more than 3 years (rarely 10 years). Basal bulbs are usually found 3/4 to 2 inches below the surface, and over 75% of tubers are formed within the top 6 inches of the soil. Shaded conditions severely limit tuber production. Tubers are easily spread by farm equipment and on crop transplants. Since rhizomes lack buds, new plants cannot be produced from rhizome fragments.

Yellow nutsedge is especially troublesome in agriculture because it is adapted to many crops and tillage systems. Some herbicides commonly used in corn and soybeans are not very effective on yellow nutsedge and serve only to eliminate other competing weeds, thus allowing yellow nutsedge to survive and spread. This species is also troublesome because it competes with crops for water, nutrients and light, and suppresses crop growth by producing toxic compounds in the soil (allelopathy). With high populations of yellow nutsedge, allelopathy can suppress the growth of young corn, soybean, and other crop plants. A density of about 10 yellow nutsedge plants per square foot reduces corn yields about 8%. Each plant can produce hundreds to thousands of tubers per season, and in densely infested fields, this adds up to 10 to 32 million tubers per acre. Rhizomes can penetrate potato tubers. Control of yellow nutsedge may be aided by improved drainage, crop rotation, several years of fallow, or shallow cultivation throughout the growing season (while tubers are sprouting) to prevent the formation of new tubers.

Toxicity: None known.

Oblong Spurge *Euphorbia oblongata*

USDA Symbol: EUOB4

Other common names: Egg leaf spurge

Description: Oblong spurge is a weedy escaped ornamental species of Euphorbia. This plant is an exotic perennial herb that produces up to 20 stems on a woody rootstalk with the plants reaching nearly three feet in height. The alternate, oblong leaves are glabrous (smooth and hairless) with finely toothed margins. Leaves and stems exude a milky sap when cut; skin contact should be avoided. Numerous yellowish-green bracts and flowers typical to most spurges develop at terminal tips. Seedpods have a waxy appearance, and when mature, ripened pods forcefully eject their seeds for localized dispersal.

Impacts: In western Oregon this plant thrives in moist grassy bottomland even with significant competition. In other states, infestations appear to be spreading more aggressively, perhaps the result of it establishing on drier sites with little competition. Oblong spurge has a great capacity to infest riparian areas in Washington and Oregon. It is well adapted to a wide range of shrub and pine forest environments. In California it has been found associated with French broom, blackberry and in dry drainages along roadsides.

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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.

Old Man's Beard *Clematis vitalba*

USDA Symbol: CLVI6

Other common names: Traveler's joy

Description: Perennial; blooms most of summer. Woody deciduous vine with stems growing up to thirty yards long. Leaves opposite and compound, usually with five leaflets. Flowers are small, greenish white and found in clusters in the upper leaf axils. Long feathery styles that produce a mass of white during the seed stage are responsible for the plant's name. The characteristic feathery seed heads give this climber its name. Young vines are ribbed and often purple in color. Older vines are woody, often gray/brown in color. Older vines flake when bent.

Impacts: In areas where this creeper has naturalized, it blankets shrubs and native trees over 60 feet tall. Once a tree collapses, the plant continues to grow along the ground in layers that are several feet thick, preventing the regeneration of any vegetation below it. It affects the ecosystem by killing trees and increasing the amount of dead material in the forest. By killing native woody plants, Old man's beard destroys food sources for native species, including birds, lizards and insects. Each plant can produce more than 100,000 seeds in a year. This destructive garden escapee spreads quickly along river margins, but will establish in any area not intensively managed or grazed. The habitat of this creeper includes roadsides, river banks, gardens, hedges, shelter belts, disturbed forest and forest edges.

Introduction: This European native was introduced as a garden plant in the United States. It is a pest in northwestern Oregon. Spread to the rest of the state is likely to occur due to its excellent dispersal methods. It spreads mainly by seeds being transported by wind, water and in soil or gravel. Fragments of the vines are also spread as garden waste that can take root and form new plants.

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Orchardgrass *Dactylis glomerata*

Family: Grass Family (Gramineae)
Other Names: cock's foot, cocksfoot, cocksfoot grass.
Origin and Distribution: Orchardgrass was introduced to North America from Europe as a forage grass over 200 years ago. Since then, it has spread through much of the U.S. and is still cultivated for hay and pasture. It can be found in fields, waste areas, orchards and roadsides. Orchardgrass is distributed throughout the state, and is cultivated in the southern regions. This grass is shade and drought tolerant, and does well in both rich and poor soils. However, it does not tolerate flooding.

Plant Description: Orchardgrass is a coarse, clump-forming, cool-season perennial grass that starts growing early in the spring. It produces a very characteristically shaped flower head, consisting of rounded clumps of flowers that are borne on a few, stiff branches which jut out to the sides. This species reproduces by seeds, and clumps can expand by producing new shoots (tillers) from the base of existing stems.
Root system - Orchardgrass produces an extensive, fibrous root system.
Stems - Stems are erect, round and smooth, and grow 1 1/2 to 3 feet tall (sometimes up to 5 feet).
Leaves - Leaves are folded in the bud. The leaf blade (free part of the leaf) is light green to dark blue-green, hairless, somewhat rough on the upper and lower surfaces and margins, and sharply folded (V-shaped in cross-section). Leaf blades can be 3 to 12 inches long (or more) and 1/8 to 1/3 inch wide. The leaf sheath (the part of the leaf surrounding the stem) is hairless, rough, and flattened, forming a sharp crease. The ligule (projection inside on the top of the sheath) is membranous, finely toothed, rounded to pointed and relatively long (1/6 to 1/3 inch long). Auricles (appendages at the top of the sheath) are absent.
Flowers - The flower head (2 to 8 inches long) is produced at the top of the stem and is composed of a few stiff branches that bear dense, coarse-looking, irregularly rounded clusters of flowers. The lower branches of the flower head are longer and more branched than the ones near the top. Branches of the flower head are spreading at bloom, but close up around the stem during seed production.

Fruits & Seeds - Seeds are narrow, pointed and 1/3 inch long.

Biology: Orchardgrass begins growth early in the spring. Flowering occurs in May and June, sometimes continuing into September. Clumps of orchardgrass can enlarge by tillering (producing new shoots from the base of existing stems).

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Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

Toxicity: None known. Pollen is an important contributor to early season hay fever.

Related Information:
- ✓ Orchardgrass is shade tolerant and is common in many shady areas such as orchards, hence its common name.
- ✓ The alternate common name, 'cocksfoot', is in reference to the shape of the flower head, with its long lower flowering branches that stick out to the side during bloom.
- ✓ The species name, glomerata, means 'gathered in bunches', referring to the dense, irregularly rounded flower clusters.

Oxalis *Oxalis corniculata*

Oxalis *Oxalis corniculata*

Description: The leaves of oxalis, also called creeping woodsorrel, have a shamrock appearance and the plant is often mistaken for a clover. At night, or on cloudy days, the leaves may fold up. With the arrival of cooler weather in the fall, leaves turn purplish in color. Occasionally, some plants may have purple leaves all year round.

Oxalis is a prostrate, creeping perennial weed with stems that will take root where they touch the ground. Flowers are small and yellow. When mature, fruits explode, scattering seed several feet away.

This plant is more common in thin, less vigorous turfgrass that is given too-frequent, light irrigation. It can be discouraged by increasing the density of turfgrass using good cultural practices.

Control: Often confused with Black Medic, White Clover or Wild Alfalfa. 2,4-D combination herbicides applied in spring and/or fall give marginal levels of control. Triclopyr + clopyralid control is fair to good. Pre-emergent herbicides (pendimethalin, dithiopyr, isoxaben, prodiamine) applied 2-3 successive years in late March - early April can provide some control.

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 herbicides 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.

Parsnip, Wild *Pastinaca sativa*

Family: Parsley Family (Apiaceae)

Other Names: harts-eye, madnip, yellow parsnip.
Origin and Distribution: Parsnip is a native of Europe that was introduced into North America as a root crop. Wild parsnip is the naturalized form, which escaped cultivation and is now widespread throughout North America. Wild parsnip grows in roadsides, waste places, old fields, meadows, and along railroad tracks. It grows primarily on rich heavy soils.

Plant Description: Wild parsnip is a biennial or sometimes a perennial that looks and smells similar to cultivated parsnip. The plant forms a rosette of leaves during the first year of growth and a large edible taproot. During the second year, it produces erect stems that grow 5 feet tall and terminate in umbrella-shaped clusters of small yellow flowers. Wild parsnip reproduces by seeds.
Root system - Wild parsnip forms a thick, white to yellowish taproot.
Seedlings & Shoots - Emerging first are 2 linear seed leaves (cotyledons). The first true leaves are small, ovate, and attached to the stem by way of long leaf stalks (petioles). Then, compound leaves are formed that grow as a basal rosette during the first year.
Stems - The stem is compressed during the rosette stage of growth and elongates during the second year to form an upright flowering stalk that is 2 to 5 feet tall, branched, hollow except at the nodes, grooved, and somewhat hairy. Stem leaves are smaller than but similar in appearance to basal leaves.
Leaves - Leaves are alternate (1 leaf per node) and compound with 5 to 11 leaflets. Leaflets are yellowish-green, shiny, oblong, coarsely-toothed, and either mitten- or diamond-shaped. Leaves have a parsnip-like taste and smell and they appear similar to celery leaves. Leaves attach to the stem by way of long petioles with broad bases that encircle the stem at each node. Petioles have 2 ridges on the upper surface and 3 more on the lower surface.
Flowers - Flowers are small and have 5 yellow petals. They form in terminal, umbrella-shaped clusters that are between 4 to 8 inches in diameter.

Fruits & Seeds - The straw colored seeds are less than 1/3 inch long, round, flat, and winged.

Similar Species: Wild parsnip belongs to a very large family of plants with thousands of wild and cultivated species. Among the naturalized species that have a similar appearance and may be confused with wild parsnip is poison hemlock (Conium maculatum), which is said to be one of the most poisonous plants in the world. Poison hemlock grows nearly 10 feet tall compared with wild carrot that reaches 5 feet or less. The stems of poison hemlock are covered with purple mottling. Also, wild parsnip has a parsnip-like odor while poison hemlock has a mouse-like odor. Although water hemlock (Cicuta maculata) looks similar, it grows in wet habitats while wild parsnip prefers drier soils. The distribution of wild carrot (Daucus carota) is generally the same as that of wild parsnip but it is a smaller plant, its leaves are more finely divided, and it has white flowers.

Biology: Flowers are produced from May to October. Although the plant is sometimes thought to be poisonous, it is not. The fleshy taproots can be eaten raw or boiled.

Toxicity: Contacting the sap of this plant may increase the sensitivity of some people's skin to sunlight. The resulting dermatitis is more like a burn than a rash and is sometimes referred to as false or artificial sunburn.

Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

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Related Information:
- ✓ Irish beer is often made from the roots of parsnips boiled in water with hops.

Parrots Feather *Myriophyllum aquaticum*

USDA Symbol: MYAQ2

Other common names: Brazilian water milfoil

Description: Parrot's feather is an attractive aquatic plant with feathery lime-green leaves arranged in whorls on long stems (rhizomes). Flowers are small and white. The submersed leaves are limp and often appear to be decaying but the stems are very robust. The surface parts of the plants are the most distinctive trait as they can grow up to a foot above the water and look almost like small fir trees. Parrot's feather is found in freshwater lakes, ponds, streams, and canals and appears to be adapted to high nutrient environments. It tends to colonize slowly moving or still water rather than in areas with higher flow rates. The emergent stems can survive on wet banks of rivers and lakeshores, so it is well adapted to moderate water level fluctuations.

Impacts: The main impacts of the plant result from the dense mats it forms on the surface of water. Heavily infested waters face reductions in native plant diversity and community structure, reduction in recreational use, loss of fish production and alterations of water chemistry resulting from high levels of decaying vegetation. Irrigation canal systems in California, experience flow restrictions and increased maintenance costs due to plant removal efforts. Mosquito populations are documented to increase significantly in infested waters.

Introduction: Native to South America and the Amazon River basin. Was introduced into the US in the late 1800s for use in aquariums and water gardens. This species has been reported in the Pacific Northwest since the 1940's and can now be found in many slow-moving waterways, lakes, ponds and sloughs.

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Paterson's Curse *Echium plantagineum*

USDA Symbol: ECPL

Other common names: Salvation Jane and Riverina bluebell

Description: An erect annual or biennial member of the borage family (Boraginaceae) generally 1-3 feet tall. Plants are often multi-branched with an abundance of stout hairs on stems and leaves. Reproduction and spread is by seed.

Stem - erect, light-green, bristly, stout, branching mainly toward the top.

Leaves - green to light-green, alternate, hairy and thick.

Flowers - most often blue-purple in color, but may be pink or white. Flowers are borne on a fiddleneck-like inflorescence. Blooming usually starts in June, but some flowering plants can be found at any time of the year. Two of the five stamens in the flower, are longer and project significantly from the joined corolla.

Seeds - each flower produces four brown or gray nut let seeds surrounded by a husk covered in bristles giving them a fuzzy appearance.

Impacts: Paterson's curse is poisonous to grazing animals and a threat to natural areas. The plant contains pyrrolizidine alkaloids that cause chronic liver damage and death to susceptible animals. Paterson's curse is a prolific seed producer enabling rapid spread and displacement of pasture, range and desirable plants. It is a threat to native habitat with the potential to invade oak woodland, native prairie, and dry upland slopes. Handling plants can cause mild to severe skin irritation and hay fever in some individuals.

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Perennial Peavine *Lathyrus latifolius*

USDA Symbol: LALA4

Other common names: everlasting peavine, everlasting-pea, perennial pea, perennial sweetpea

Description: Perennial peavine is a widely established European native identified in every state except Florida and North Dakota. Annual growth emerges from perennial roots each spring growing to a length of 2-7 feet. Stems are broadly winged with long, well developed tendrils. Pea-like flowers are one inch long and can be white, red or pink. Leaflets are well-developed stipules that are 1-2 inches long. Growth becomes very dense often completely covering all other low-growing vegetation. Vines are often found growing up into trees and shrubs. Seeds are brown colored, produced in pods and are 2/3 smaller than the common edible garden pea. This plant occupies a wide range of climactic conditions thriving in the warm wet environment of the Pacific Northwest to the cold dry conditions of the Rocky Mountain States. Little information has been published on this species and it is often overlooked as an invader.

I**mpacts**: Perennial peavine is increasingly a problem in rights-of-way, forested regions and natural areas. In small patches it does provide a good food source for upland game birds and other wildlife but as infestations increase in size, large areas are smothered and native plant cover reduced. Increased awareness and treatment are critical at this time to prevent further encroachment into forested areas.

Introduction: Perennial peavine is a widely established European native identified in every state except Florida and North Dakota. This plant was sold in wildflower mixes it has been used in the past for erosion control, restoration and flower plantings

Perennial Pepperweed *Lepidium latifolium*

USDA Symbol: LELA2

Other common names: Tall white top

Description: Perennial; blooms May to September. Grows 1 to 6 ft. tall. Basal leaves larger than upper leaves, lanceolate, bright green to gray green, entire to toothed. Flowers white, very small, and form dense clusters near the ends of branches; flowers produce a distinctive odor. Seed very small, flattened, slightly hairy, and reddish brown,

Impacts: Perennial pepperweed establishes and colonizes rapidly. It degrades nesting habitat for wildlife and displaces desirable species in natural areas and hay meadows. It lowers digestibility and protein content of hay and inhibits grazing. Infestation can be so damaging that they significantly affect crop land values. This weed can be found in disturbed areas or bare soil, such as agricultural land, rangeland, graded roadside ditches, and irrigation ditches. The weed survives in a wide range of environmental habitats and soil types.

Introduction: Native to southern Europe and western Asia but now widely distributed in the U.S. Introduction in the U.S. is thought to be in sugar beet seed in the 1930s.

Pineappleweed *Matricaria discoidea DC*

(Chamomilla suaveolens Pursh Rydb., Matricaria matricarioides (Less.) Porter)

Asteraceae (Sunflower family)

Origin: Northwestern North America

Location: lawns, gardens, walkways, pavement cracks, roadsides, waste areas, waterways, and cropland

Occurrence: Pineappleweed seeds begin germinating in early spring and continue germination throughout the growing season. Flowering occurs all season as well, beginning in late spring.
Description: A summer annual that grows 3-16 inches tall, but is most commonly shorter than 6 inches. Seedlings form a feathery rosette and become bushy and highly branched with maturity. Branches are 1/2 - 4 inches long. Finely dissected leaves, growing 3/8 - 2 1/2 inches long and 1/16 - 3/4 inches wide, are arranged alternately on branches. At mature branch tips, many greenish-yellow flowers form dome- or cone-shaped heads, 3/16 - 3/8 inch in diameter, with no petals. Flower heads are cradled by a cup of bracts with dry, papery margins. Each flower in the head is replaced by a light-brown, single-seeded fruit.

Weedy Characteristics: Pineappleweed thrives in areas most plants cannot tolerate. It is often found in poor, compacted soils and high traffic areas. It does well in drought conditions, and will adapt to mowing by producing shorter stems. Seeds can become sticky when wet and be dispersed by adhering to vehicle tires and animal or human feet. Seeds can also be distributed by water, and are able to remain viable in the soil for up to 20 years.

Control: As an annual, pineappleweed reproduces solely by seed, and therefore prevention of seed production is important. This can be done with hand-pulling, hoeing, tilling, and digging. However, single plants can regenerate from root fragments, so removing the entire plant is necessary for full control.

Pineappleweed is not successful in shady environments, and also does not colonize undisturbed soil. A healthy, competitive garden, with little to no bare ground, and thick turf, with well-aerated soil are likely to exclude pineapple weed from establishing. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: The common name “pineappleweed” refers to the sweet, pineapple-like scent the plant gives off when crushed. Pineappleweed leaves are edible before flowering occurs, at which time the leaves become bitter. The flower head has been eaten as a finger food, or used to make herbal tea. Pineappleweed has also been used medicinally to treat such things as digestive troubles. Additionally, it appears to possess some beneficial bactericidal properties. However, it can harbor some plant viral diseases, and is considered invasive in several U.S. states.

Other Common Names: disc mayweed, rayless chamomile, rounded chamomile

Plantain, Blackseed *Plantago rugelii*

Family: Plantain Family (Plantaginaceae)
Other Names: common plantain, pale plantain, purple-stemmed plantain, Rugel's plantain, silk plant.
Origin and Distribution: A native of the eastern U.S. that has expanded its range north into southern Canada and as far west as North Dakota and Texas.

Plant Description: Blackseed plantain is a perennial that frequently inhabits turfgrass, where it survives repeated mowing by growing as ground-hugging rosettes. Blackseed plantain has large, oval, strongly ribbed leaves and small, inconspicuous flowers appearing in clusters on solitary, erect flower stems. Blackseed plantain leaves are thin, light green, and attached to leaf stalks (petioles) that have purplish bases. Seeds are the primary means by which this species reproduce, although it is capable of reproducing vegetatively from root fragments.
Root system - Roots are mostly fibrous with a short taproot.
Seedlings & Shoots - First 2 leaves that emerge (cotyledons) are spatula-shaped and have 3 parallel veins. Subsequent leaves are oval, have 3 to 5 prominent veins, and develop into a basal rosette.
Stems - The erect flowering stems (scapes) are 6 to 12 inches tall, leafless, unbranched, and terminate in a cluster of small, inconspicuous flowers.
Leaves - Mature leaves are thin, broad, oval, up to 12 inches long, and have 3 or more prominent veins running parallel to the leaf edge. Leaves are distinctive because of their light green color and tapered tip. The leaf edge may be wavy-toothed. Leaves attach to the compressed stem of the rosette by way of a narrow leaf stalk (petiole) with a dark red or purple base that is about the same length as the leaf blade.
Flowers - Inconspicuous greenish or white flowers are clustered in long, narrow spikes at the end of the flowering stem.
Fruits & Seeds - Fruits are cylindrical capsules about 1/4 inch long and split across the lower half into 2 unequal cells containing 4 to 10 dull black seeds. Seeds are larger and smoother than those of broadleaf plantain and have a scar near the center on one side.

Similar Species: Buckhorn plantain (Plantago lanceolata) is a similarly-appearing relative that has narrower, lance-shaped leaves tapering to a short petiole and a much more compressed flower cluster. Broadleaf plantain (Plantago major) is another similar species that has a petiole having a green base, rather than the purplish base that blackseed plantian has. Hoary plantain (Plantago media) is also similar in appearance except its leaves are elliptic, thick, and covered with wooly hairs.

Biology: Both plantain species flower from June through September. Seeds are dispersed by wind, birds, or human activity. When wet, seeds develop a sticky mucilaginous cover that causes them to stick on soil particles and adhere to animals. BROADLEAF PLANTAIN can produce up to 14,000 seeds per plant per year and seeds may remain viable for up to 60 years. Seeds germinate in late spring, through midsummer, and again in early fall.

Toxicity: None known.

Related Information:
- ✓ 'Plantain' is from the French word meaning 'sole of the foot' referring to the plant's flat leaves.
- ✓ Plantains were once highly esteemed medicinal herbs. Leaves were used to treat bites, stings, cuts, sore feet, and ailments of the eyes, tongue, and mouth.
- ✓ Young plantain leaves are used in China and Japan as a vegetable similar to spinach.
- ✓ Birds are fond of plantain seeds, which contain a higher percentage of oil than many seeds and are grown commercially and included in some bird seed mixtures.

Plantain, Broadleaf *Plantago major*

Family: Plantain Family (Plantaginaceae)
Other Names: Plantago asiatica, common plantain, cuckoo's bread, doorweed, dooryard plantain, Englishman's-foot, great plantain, plantain, ripple grass, roundleaf plantain, slan-lus, snake-plant, snakeweed, waybread, waybroad, weybroed, whiteman's-foot.

Origin and Distribution: Originated in Eurasia and is currently distributed throughout the world. A botanist found broadleaf plantain so widespread in New England in 1798 that he classified it as a native. It is rarely found in wet or shaded sites. Both species are common in areas where the soil is compacted or disturbed including turfgrass, landscapes, orchards, nurseries, waste places, and cultivated fields. The plants grow on a wide range of soils from sand to clay loams, but they prefer rich, moist soils. Plantains tolerate constant disturbance such as mowing and trampling.

Plant Description: Broadleaf plantain is a perennial that frequently inhabits turfgrass, where it survives repeated mowing by growing as a ground-hugging rosette. The species has large, oval, strongly ribbed leaves and small, inconspicuous flowers appearing in clusters on solitary, erect flower stems. Broadleaf plantain leaves are thick, leathery, and taper to a petiole having a green base. Seeds are the primary means by which this species reproduce, although it is capable of reproducing vegetatively from root fragments.
Root system - Roots are mostly fibrous with a short taproot.
Seedlings & Shoots - First 2 leaves to emerge (cotyledons) are spatula-shaped, covered with a powdery coating, and have 3 parallel veins. Subsequent leaves are oval, have 3 to 5 prominent veins, and develop into a basal rosette.
Stems - The erect flowering stems (scapes) are less than 12 inches tall, leafless, unbranched, and terminate in a cluster of small, inconspicuous flowers.
Leaves - Mature leaves are thick, leathery, broad, oval, up to 12 inches long, and have 3 or more prominent veins running parallel to the leaf edge. Leaf edges are either smooth or irregularly toothed. Leaves attach to the compressed stem of the rosette by way of a thick green petiole that is about as long as the leaf blade.
Flowers - Inconspicuous greenish or white flowers are clustered in long, narrow spikes at the end of a flowering stem.
Fruits & Seeds - Fruits are egg-shaped capsules less than 1/4 inch long and split across the middle into 2 equal segments containing 6 to 20 brown, glossy, ridged seeds.

Similar Species: Buckhorn plantain (Plantago lanceolata) is a similarly-appearing relative that has narrower, lance-shaped leaves tapering to a short petiole and a much more compressed flower cluster. Blackseed plantain (Plantago rugelli) is another similar species that has a petiole having a puplish base, rather than the green base that broadleaf plantian has. Hoary plantain (Plantago media) is also similar in appearance except its leaves are elliptic, thick, and covered with wooly hairs.

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- ✓ Birds are fond of plantain seeds, which contain a higher percentage of oil than many seeds and are grown commercially and included in some bird seed mixtures.

Cultural uses:
In Gaelic, plantain is known as the “healing herb” because it was used in Ireland to treat wounds and bruises. Plantain was hailed by Pliny as a cure for the “madness of dogs”, and Erasmus claimed it to be an antidote for spider bite toxins. It was also said that if someone was bitten by a mad dog, rubbing plantain on the bite would heal it. Native Americans used it as an antidote to snakebite venom by rubbing its juices on the wound. It was listed as one of the nine sacred herbs in Anglo-Saxon medicine because of its healing powers. It was used as a cure for disorders of the kidney, a remedy for worms, a diuretic, and a cure for hemorrhoids, as well as a laxative.

Current use of plantain is the commercially significant extraction of its mucilage a carbohydrate fiber that is used in gentle laxatives. Ironically, plantain infusions can be used to halt diarrhea. Mucilage also acts as an appetite suppressant and reduces intestinal absorption of fat and bile. It reduces LDL cholesterol and triglyceride levels in the blood. Plantain is commonly used as an astringent; its juice, when rubbed on an insect bite or bee sting, immediately sooths the area and begin the healing process. Plantain may also stop poison ivy from blistering and itching if applied to the skin immediately after contact. Plantain is still considered a diuretic; in addition, it is used as an expectorant and decongestant. It is also thought to sooth the throat and is taken to relieve laryngitis. Finally, when chewed, plantain acts as a breath freshener. If eaten early enough in the spring, plantain leaves are said to make a tasty cooked vegetable dish.

Active compounds: beta carotene, mucilage, calcium, monoterpene alkaloids, glycosides, sugars, triterpenes, linoleic acid, iridoids, and tannins.

Research: Clinical studies have verified plantain’s astringent properties; research has been conducted into the possible connection between allergic responses and the inhalation or ingestion of psyllium (see Arlian, Vyszenski-Moher, Lawrence, Schrotel, Ritz; 1992).

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Poison Hemlock *Conium maculatum*

Family: Parsley Family (Apiaceae)
Other Names: California fern, deadly hemlock, Nebraska fern, poison parsley, poison stinkweed, snakeweed, spotted hemlock, wode whistle.
Origin and Distribution: Poison hemlock is native to Eurasia. It was introduced into North America as an ornamental but escaped cultivation and became naturalized throughout much of the United States and adjacent areas in Canada. Poison hemlock typically grows in pastures, roadsides, ditches, waste areas, marshy areas, stream banks, and it has begun to appear as a weed in no-tillage fields. The species prefers rich soils and frequently grows in low or poorly drained areas.

Plant Description: Poison hemlock is a biennial that produces leaves in a basal rosette during its first year and forms an upright flower stalk when it bolts during the second year of growth. Poison hemlock has dissected leaves, which resemble those of parsley, and umbrella-shaped clusters of small white flowers that are similar to flower clusters produced by many other species in this family. However, the stems and leaf stalks (petioles) of poison hemlock differ from other family members in that they are hairless and have distinctive purple spots or blotches. Also, if bruised, the plant emits a disagreeable mouse-like odor. Poison hemlock reproduces by seeds.
Root system - Poison hemlock produces a long white taproot and fibrous secondary roots.
Seedlings & Shoots - Two linear seed leaves (cotyledons) emerge first. The first true leaves are compound with 3 main divisions and often purple at the base. Then, highly dissected leaves are formed that grow as a basal rosette during the first year. Stems of young plants are purple-tinged.
Stems - The stem is compressed during the rosette stage and elongates during the second year to form an upright flower stalk that is 2 to 8 feet tall, rigid, branched, hollow except at the nodes, grooved, and hairless. Stems are light green with distinctive purplish blotches.
Leaves - Leaves are 1 to 16 inches long, alternate (1 leaf per node), compound, finely dissected, and fern-like in appearance. Leaflets are minute; lance shaped, glossy green, darker on the upper side, and have serrated edges. Leaves attach to stems by way of leaf stalks (petioles) marked with purplish spots or blotches. Petioles broaden at their base and encircle the stem at each node. Leaves have a parsnip-like taste and a mouse-like odor.
Flowers - Flowers are small (1/12 to 1/6 inch across) and have 5 white petals. They form in terminal, umbrella-shaped clusters that are between 1 to 3 inches in diameter.
Fruits & Seeds - The pale-brown seeds are between 1/12 to 1/8 inch long, oval, flattened on one side, and have conspicuous wavy ribs.

Similar Species: Wild carrot (*Daucus carota*) looks similar to poison hemlock except its stems and petioles are hairy while those of poison hemlock are hairless and have purple mottling. Wild carrot has a carrot-like taste and smell while poison hemlock tastes somewhat like parsnip and has a mouse-like smell. Wild parsnip (*Pastinaca sativa*) lacks purple mottling on its stems and petioles, although it is otherwise very similar in appearance to poison hemlock. Water hemlock (*Cicuta maculata*) shares many characteristics with poison hemlock including hairless stems that have purple mottling and compound leaves. Unlike poison hemlock, water hemlock usually has a cluster of fleshy taproots at its base. Also, habitat may help to distinguish the two as water hemlock grows in marshes and other very wet sites and is generally confined to the central plains and mountainous areas of North America. Giant hogweed (*Heracleum mantegazzianum*) is generally taller and has leaves as long as 3 feet and large white flower clusters, although its stems are also purple-spotted.

Control: The large, fleshy white taproot can be easily pulled from moist ground when plants are small. Several herbicides are effective in controlling Poison Hemlock. Glyphosate (Roundup) can be used on newly emerged sprouts. Other post-emergents that are most effective in early spring are 2,4-D, 2,4-DB and MCPA. 2,4-D should be combined with a wetting agent when applied. Because of the large number of seeds that may have been produced, repeated herbicide applications may be necessary. The frequency of application varies with the herbicide. Read labels carefully and follow directions as given.

Biological control has been effective using the Hemlock moth (Agonopterix alstroemericana). The larvae of this moth feed on the leaves, young stem tissue, flowers and seeds of Hemlock plants causing severe defoliation and death of the plant.

Biology: Flowers appear in June and continue to form through August. A single plant may produce over 38,000 seeds. However, few of these seeds will remain viable after 5 years of storage in the soil seed bank. Poison hemlock is easily controlled with herbicides.

Toxicity: All parts of the plant contain toxic substances that cause respiratory failure in humans and other animals if ingested. Seeds and roots are more toxic than foliage; also, toxins are present in greater amounts in plants grown under sunny compared with moist conditions. The taste of leaves and seeds of poison hemlock is reported to be unpleasant, so toxic quantities are seldom consumed. Still, poison hemlock leaves are easy to confuse with those of parsley, seeds resemble those of anise, and roots look similar to parsnip roots. Animals may be induced to eat this disagreeable plant because it is often one of few plants remaining green in winter and among the first to resume growth in the spring. Cattle can usually tolerate poison hemlock if consumed in amounts less than 4% of their body weight. Toxicity changes little if plants are fermented with silage or dried in hay.

Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Postemergence Herbicides
Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

Related Information:

- ✓ The poisonous juice of this plant was used in ancient Greece as a means of executing criminals and other state prisoners including Socrates.

- ✓ This weed hosts many common diseases of alfalfa, celery, and carrot.

Poison Ivy *Toxicodendron radicans*

Family: Cashew Family (Anacardiaceae)

Other Names: *Rhus radicans*, markweed, mercury, picry, poison creeper, poison vine, three-leaved ivy.

Origin and Distribution: Poison-ivy is an American native that has a range extending from Canada to South America. Poison-ivy grows in many habitats including disturbed sites, woodlands, and wetlands. Because birds and animals often disperse the seeds, it is common to find poison-ivy growing in fence rows, on roadsides, at the base of trees, or along the edges of woods. Also, it has been observed in no tillage fields. Although poison-ivy grows in many soil types, it prefers soils with high calcium content.

Plant Description: This is a deciduous woody perennial distinguished by its leaves that have three leaflets. The stalk attached to the middle leaflet is considerably longer than that attached to either of the two outer leaflets. It grows in a variety of forms including trailing, shrubby, or as a vine. Reproduction is primarily by seeds that are dispersed by birds and animals. Also, it may spread by rhizomes (horizontal underground stems). Stems are capable of forming roots and sending out new shoots when in contact with soil.

Root system - Poison-ivy produces aerial roots that attach to plants and other things when it grows as a vine. These aerial roots give stems of older plants a hairy appearance.

Seedlings & Shoots - First to emerge from a seed are 2 leaves (cotyledons) that are narrow and oblong. The characteristic 3-parted leaves appear next.

Stems - Woody stems have gray bark and grow either horizontally along the soil surface with upright leafy stalks or as a climbing vine.

Leaves - Leaves are alternate (1 leaf per node) and compound consisting of 3 leaflets. Leaflets are 2 to 4 inches long, glossy, and have a pointed tip. Their shape varies from elliptic to egg-shaped. Their edges also vary from smooth, to toothed or lobed. They appear droopy and reddish green in spring, become level and change to dark green when mature, and turn yellow, orange, or bright red before falling off in the fall.

Flowers - The small, greenish flowers have 5 petals and form in cluster that are 1 to 3 inches long and often hidden in the leaf axils. Male and female flowers occur on separate plants.

Fruits & Seeds - The small white berries are round, hard, and about 1/8 inch in diameter. Their surface has ridges that resemble segments of a peeled orange. Each berry contains a single seed.

Similar Species: Seedlings of box-elder (*Acer negundo*) have the same alternate, 3-parted leaves that distinguish poison-ivy, but its leaflets are less shiny. Poison oak (*Toxicodendron toxicarium*) grows more erect than poison-ivy and its leaves have blunt tips with hairs on the upper and lower surfaces. In the U.S., poison oak is usually found growing from New Jersey southward. Leaves of poison-ivy are pointed and smooth on the upper surface, although they may be hairy on the underside. Virginia creeper (*Parthenocissus quinquefolia*) is similar in appearance to poison-ivy but its leaves have 5 leaflets and it climbs by way of tendrils. Also, its fruit is a blue berry. Hog-peanut (*Amphicarpa bracteata*) has 3-parted leaves similar to poison-ivy, but it is a twining vine lacking woody stems and its purplish, pea-like flowers are larger than those of poison-ivy. Also, its leaflets have 3 strong veins apparent on either side while poison-ivy leaflets have only one centrally located midrib.

Biology: Flowers appear from May to July. Seeds usually form after September and may remain on the plant throughout winter. Over 50 species of birds are known to eat poison-ivy seeds. Seeds are often dispersed far from the parent plant by animals and birds. Poison-ivy generally establishes on sites that have been repeatedly disturbed but not recently cultivated. It grows low to the ground and spreading,

upright and bushy as a shrub, or vine-like and spreading. Slow vegetative spread by rhizomes can result in formation of large patches. The weed is easy to control by repeatedly cultivating, cutting, or mowing. Its shallow rhizomes are easy to dig up and remove. However, care should be taken to wear heavy protective clothing and repeatedly wash clothing and tools after use. Several herbicides are available that selectively control poison-ivy if applied to growing plants such that all foliage is completely covered.

Toxicity: All parts of poison-ivy release an oil upon bruising that causes severe dermatitis with swelling and blistering. Sensitivity to the toxin varies among individuals, plants, and circumstances under which the person was exposed. If contacted, affected areas should be washed immediately with soap and water as well as any clothing or objects that may have come in contact with the oil. This activity will not decrease the severity of the reaction, but it will lessen the chance of spread. Unless removed by washing, the oil, which is similar to lacquer, can remain on plant parts, skin, clothing, and tools for an indefinite period of time without losing potency. Fluid contained in blisters is not allergenic. Objects and animals can pick up the oil and transfer it to humans. Smoke of burning poison-ivy plants can cause allergic reactions inside the lungs of susceptible people. If affected, consult a pharmacist for ointment to treat the affected area and a doctor if the case is severe.

Related Information:

- ✓ 'Toxicodendron' is Greek meaning 'poison tree'.
- ✓ 'Leaflets three, let it be -- berries white, poisonous site.'
- ✓ Each year, reactions to poison-ivy are one of the most often cited causes of workers' compensation claims.
- ✓ Application of crushed leaves of jewelweed (*Impatiens capensis*) relieved the effects of recent exposure to poison-ivy in 108 out of 114 people tested.
- ✓ Contrary to a widely-held belief, eating a poison-ivy leaf will not result in immunity to its toxin.
- ✓ Botanists have contracted dermatitis from handling 100-year-old dried plants.
- ✓ Poison-ivy has been cultivated in gardens and sold as an ornamental in Europe and Australia.
- ✓ In the Netherlands, where its attractive fall foliage is prized, it is planted along dikes.

Pokeweed, Common *Phytolacca americana*

Family: Pokeweed Family (Phytolaccaceae)

Other Names: *Phytolacca decandra*, American cancer, American nightshade, American spinach, bear's grape, cancer-root, coakum, garget, inkberry, inkweed, pigeonberry, poke, pokeberry, pokeroot, pokeweed, red-ink plant, skoke berry, Virginia poke.

Origin and Distribution: Common pokeweed is native to the eastern half of the U.S. Common pokeweed prefers low, rich, somewhat disturbed, gravelly soils, and can be found in pastures, roadsides, fencerows, open woods and wood borders.

Plant Description: Common pokeweed is a large, bushy, herbaceous perennial that sometimes resembles a small tree, growing up to 10 feet in height. It is characterized by an enormous taproot, smooth succulent red-purple stems, large lance-shaped leaves and grape-like clusters of dark purple berries in the fall. This species reproduces from seeds.

Root system - Common pokeweed produces a large, fleshy, white taproot (4 to 6 inches in diameter).

Seedlings & Shoots - Cotyledons are egg- to lance-shaped, pointed and often tinged with red on the underside and on the leaf stalk. The first true leaves are egg-shaped to oval. Stems and leaves of young shoots are smooth, fleshy and reddish (on leaf, underside only).

Stems - Stems can grow 3 to 7 feet tall (sometimes up to 10 feet), and several may emerge from one taproot. The smooth, fleshy, thick stems are typically reddish to deep red-purple, and are branched in the upper portion. Stems can attain a diameter of 4 inches and are usually hollow.

Leaves - The large, alternately arranged leaves are smooth, fleshy and shiny. Leaves are elliptical to egg-shaped, tapering to a point at one end and into a long leaf stalk (1/3 to 2 inches long) at the other. Leaves range from 5 to 20 inches long, and are usually 1/3 as wide as they are long. The upper leaf surface is dark green, while the lower surface is pinkish-green with conspicuous pink veins. Leaves become smaller toward the top of the plant.

Flowers - Whitish-green flowers are produced in long, narrow, unbranched, erect to nodding clusters (4 to 8 inches long) at the ends of stems and upper branches. Each flower in the cluster is borne on an individual flower stalk. Flowers are 1/4 inch wide and composed of 5 petal-like, rounded sepals (floral leaves; flowers lack true petals). The flower cluster often occurs opposite a leaf.

Fruits & Seeds - Each flower develops into an 8- to 10-chambered, shiny, juicy berry (1/4 inch wide), with 1 seed per chamber. Berries are flattened, round in outline, and initially green, becoming black-purple at maturity. As the fruit ripens, the clusters become heavy and drooping, resembling a grape bunch, and the stems holding the berries turn a bright red-purple. Ripe berries are filled with crimson juice. Seeds are 1/8 inch wide, lens-shaped, black and shiny.

Biology: Common pokeweed seedlings emerge from mid-spring to early summer, and shoots emerge from previously established roots in the spring. Flowers are produced from July to September. Pokeweed seeds can remain viable in the soil for up to 40 years. Birds commonly eat pokeweed berries without adverse reactions and are probably an important means for distributing this species. This poisonous weed is often found in pastures, fencerows and barnyards, in unfortunately close proximity to livestock, and is becoming an increasing problem in no-tillage crops. To control a few scattered plants, cutting below the root crown is effective (digging up the large taproot is very difficult). For larger infestations, growing a cultivated crop for 1 to 2 years will help reduce common pokeweed populations.

Toxicity: All parts of common pokeweed are toxic to humans, pets and livestock. Roots are the most poisonous, leaves and stems are intermediate in toxicity (toxicity increases with maturity), and berries

are the least toxic. Since common pokeweed is not very palatable, most animals avoid eating it unless little else is available, or if it is in contaminated hay. Horses, sheep and cattle have been poisoned by eating fresh leaves or green fodder, and pigs have been poisoned by eating the roots. Children are most frequently poisoned by eating raw berries. Infants are especially sensitive and have died from eating only a few raw berries. Although boiled young shoots have been eaten as greens and berries cooked in pie, ingestion of any part of the plant cannot be recommended. Adults have been poisoned, sometimes fatally, by eating improperly prepared leaves and shoots, especially if part of the root is harvested with the shoot, and by mistaking the root for an edible tuber. Research with humans has also shown that common pokeweed can cause mutations (possibly leading to cancer) and birth defects. Since the juice of pokeweed can be absorbed through the skin, contact of plant parts with bare skin should be avoided. Symptoms of poisoning from common pokeweed include a burning sensation in the mouth, salivation, gastrointestinal cramps, vomiting and bloody diarrhea. Most people and animals recover within 1 to 2 days if only small quantities are eaten. If large quantities are consumed, more severe symptoms can occur, such as anemia, altered heart rate and respiration, convulsions and death from respiratory failure. The primary toxic compounds are thought to be oxalic acid, saponins (phytolaccotoxin and phytolaccigenin) and an alkaloid (phytolaccin).

Related Information:

- ✓ The common name 'pokeweed' originates from the Native American word for 'blood', referring to the red dye that can be made from the fruit (however, the color is difficult to fix). Some of the other common names, such as 'inkberry' and 'inkweed', refer to this use.

- ✓ Juice from pokeweed berries was once used to 'improve' the color of cheap red wine.

- ✓ Supporters of President James Polk wore pokeweed twigs instead of campaign buttons during the 1845 campaign.

- ✓ Medical researchers have isolated a protein (pokeweed antiviral protein or PAP) from pokeweed that is being used to try to inhibit the replication of the HIV virus in human cells.

- ✓ Roots, leaves and berries of common pokeweed were used medicinally by Native Americans and early settlers to treat a variety of conditions from hemorrhoids to headaches.

- ✓ The young shoots and leaves of pokeweed have been eaten as greens ('poke sallet'), boiled with the water changed several times prior to consumption. The taste is described as similar to that of asparagus or spinach. Berries have been used to make pie. However, ingestion of any part of common pokeweed cannot be recommended.

Policeman's Helmet *Impatiens glandulifera*

USDA Symbol: IMGL

Other common names: Ornamental jewelhead, jewelhead, and Himalayan balsam.

Description: Policeman's helmet is an herbaceous annual that is succulent, smooth stemmed and hairless. The plants can reach the height of 10 feet tall, although can be smaller. The upright, hollow stems are easily broken and have a purple tinge. The leaf arrangement can be opposite or whorled with three leaves per node. Leaf shape varies from oblong to egg-shaped, with serrated edges. The flowers of this plant is solitary, irregular, ranges from white to all shades of pink in color, with 5 petals (2 fused) and 3 sepals (2 fused) and five fused stamens. The overall flower shape resembles and English policeman's helmet. The fruit is a 5-chambered capsule. This seed capsules are elongated and when touched the mature capsule explodes ejecting up to 800 seeds.

Impacts: Policeman's helmet forms dense stands along river systems and moist lowlands, excluding native forbs.

Introduction: Native to India and western Himalaya. It is established in areas of western Washington and in the lower Fraser Valley of British Columbia.

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Prostrate knotweed *Polygonum aviculare*

Description: Prostrate knotweed is an annual, common along sidewalks in turf or wherever turf is stressed and less vigorous. It thrives in dry, compacted soils or wherever there is excessive foot traffic. The plant forms a tough, wiry mat of stems and leaves. To differentiate from spurge, a broken stem does not produce a milky sap. Flowers are small, white, and inconspicuous. They are found where the leaf meets the stem. This weed produces many seeds. Annual core aeration in spring and/or fall will reduce knotweed infestation.

Control: Pre-emergent herbicides can be effective if applied in late fall/winter (knotweed can germinate in Feb or March). Post-emergent herbicides are mostly ineffective after plants become larger. 2,4-D and 2,4-D combinations will give fair control when applied to younger plants.

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Postemergence Herbicides
Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

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.

Prostrate spurge *Euphorbia prostrata*
Spotted spurge *Euphorbia maculata*

Control: Pre-emergent herbicides (DCPA, dithiopyr, isoxaben, pendimethalin) applied correctly in spring will reduce or eliminate spurge. Post-emergent herbicides are not very effective unless plants are young. 2,4-D combination herbicides are more effective than 2,4-D alone. Increasing the density of your turfgrass with proper lawn watering, fertilization, and mowing (no shorter than 2.5 inches) and other cultural practices will help in the control of spurge.

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Puncture Vine *Tribulus terrestris*

Puncture vine *Tribulus terrestris*

Puncture vine is a prostrate, mat-forming summer annual. It has small leaflets and small yellow flowers with 5 petals. Fruits containing seeds are a sharp, spiny burr that can easily puncture a bicycle inner tube (or gardener's skin!). This weed is found only in thin, less vigorous turf given insufficient water. It will pull easily out of moist soils. Be sure to wear gloves to protect your hands from the burrs. You can discourage the growth of puncture vine by increasing the turf density.

Control: A 2,4-D combination herbicide will work best on younger plants. Pre-emergent herbicides such as trifluralin + benefin or dithiopyr applied in spring can provide some control.

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Purslane *Portulaca oleracea*

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Description: Purslane is a summer annual, found only in newly seeded or thinning, non-vigorous lawns and sidewalk cracks. It has thick, succulent, rubbery leaves and small yellow flowers. The plant is sprawling and prostrate. It is easily pulled when the soil is moist. Water, fertilize and mow to increase your turf density and make it more competitive with weeds.

Control: Post-emergent herbicide use is more effective when plants are young as purslane is difficult to kill with an herbicide when larger. Always read the label before applying any pesticide.

Quackgrass *Elytrigia repens*

Quackgrass *Elytrigia repens*

Quackgrass, a creeping perennial, is a very aggressive grass and is considered a noxious weed in most states. It spreads by seeds and invasive rhizomes (underground stems). Its rhizomes are yellow-white, with brown sections, and the ends are sharply pointed.

Control A few quackgrass plants can be spot-sprayed with glyphosate, or individual blades can be painted with glyphosate. Note that glyphosate will kill any bluegrass it contacts. Repeat applications to quackgrass will likely be needed.

Renovate severely infested lawn areas. Spray with glyphosate; repeat applications will likely be needed. When the quackgrass has been killed, the areas may be re-sodded or re-seeded. Always read the label before applying any pesticide.

Queen Anne's Lace Wild carrot *Daucus carota*

Range: throughout the United States; found in fields, meadows, waste places, roadsides, fence rows, and disturbed habitats

Origin: native to Europe

Botanical description: Queen Anne's lace has feathery, finely divided leaves and a stem that rise 2-4 feet tall. The showy white flower is shaped like an umbrella and is made up of many small flowers in a lace-like pattern. At the center is a purplish-black floret. The root of Queen Anne's lace is thick and resembles a carrot. When in bloom, Queen Anne's lace looks like no other flower; without the showy white umbrella of florets, the leaves of the plant look like those of the domestic carrot and a pair of deadly relatives, poison hemlock and fool's parsley.

What's in a name: The word carrot is Celtic and means red of color; the species name, Daucus, comes from the Greek word dais, which means to burn, signifying Queen Anne's lace's pungent and stimulating qualities.

All in the family: Queen Anne's lace is a member of the Apiaceae, or parsley, family. It is the ancestor of the domestic carrot, and is related to parsley, and the aforementioned poison hemlock and fool's parsley.

Cultural uses: Traditionally, tea made from the root of Queen Anne's lace has been used as diuretic to prevent and eliminate kidney stones, and to rid individuals of worms. Its seeds have been used for centuries as a contraceptive; they were prescribed by physicians as an abortifacient, a sort of "morning after" pill. The seeds have also been used as a remedy for hangovers, and the leaves and seeds are both used to settle the gastrointestinal system. It is still used by some women today as a contraceptive; a teaspoon of seeds are thoroughly chewed, swallowed and washed down with water or juice starting just before ovulation, during ovulation, and for one week thereafter. Grated wild carrot can be used for healing external wounds and internal ulcers. The thick sap is used as a remedy for cough and congestion. The root of Queen Anne's lace can be eaten as a vegetable or in soup.

Active compounds: Queen Anne's Lace contains flavonoids, essential oils, vitamins B and C, pectin, lecithin, glutamine, phosphatide and cartotin, a vitamin A precursor.

Research: Chinese research has confirmed the function of Queen Anne 's lace seeds as an abortifacient; other research has shown the plant to be a bactericidal, a diuretic, a hypotensive, and an effective treatment for parasites.

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Ragweed *Ambrosia arteminiifolia*

USDA Symbol: AMAR2

Description: Annual; blooms late summer. Grows to 4 foot tall. Stems and leaves blue-green and covered with fine hairs. Leaves divided and bottom sides covered in fine hairs, giving a gray appearance. Flowers inconspicuous and found on terminal branches.

Impacts: This plant is common throughout the West and causes hay fever in many people. It is commonly found along ditches and waste areas. It is not highly competitive in crops or rangeland.

Red Clover *Trifolium pratense*

Range: throughout the United States; found in lawns, on roadsides, in fields and in other disturbed habitats.

Origin: native to the Eastern Mediterranean and Asia; naturalized to the United States Botanical description: Red clover grows up to 16 inches, with a hairy upright stem. The leaves are made up of three (and sometimes, the lucky four!) oval leaflets with a prominent white “V” mark in the center, called a chevron. The flowers are purple to pink and are egg-shaped. Red clover are found in fields and grassy areas and are readily identified by the three part leaves, the white V in the center of each leaf, and the distinctive purple-pink flower. Without the flower, the key to differentiating red from white clover is the V mark on the leaves, present in the red clover but absent in the white. Also, leaves of white clover are all on stems that originate from the base of a central stem; red clover leaves spring from both the base of the central stem and above.

What’s in a name: The genus name Trifolium means “three leaves”, which is characteristic not only of red but also of white clovers.

All in the family: Red clover is a member of the Leguminosae, or pea family. Other members of the family include not only peas, but beans and peanuts. These are a group of plants that are able to take nitrogen from the atmosphere and “fix” it, or make it biologically available to other plants. Nitrogen fixation is of critical importance in protein production in plants and makes the legumes a critical player in agricultural planning.

Cultural uses: Historically, tea made of the red clover flower has been used as an antispasmodic, expectorant, a mild sedative, and a blood purifier; additionally, the tea has been used for asthma, bronchitis and respiratory spasms. A wash made from the flowers is used as a topical remedy for cancer; the belief was that a concentrated decoction applied to the site of the tumor would draw it out and clear it from the body. Red clover was also used for athlete's foot, sores, burns and skin ulcers. The flowers were also smoked in "anti-asthma" cigarettes. Today, red clover flowers are made into a wine as well as the previously described tea; they are also used to treat coughs and respiratory spasms. Estrogens in red clover may be useful in treating menstrual problems. Native Americans have been known to eat red clover in salads, and dried flowers can be dried and turned into flour that can be used in breads, muffins or pancakes. Use of red clover as an anti-AIDS and anti-diabetic medicine has been suggested.

Active compounds: flavonoids, phenolic acids (including salicylic acid), volatile oils such as methyl salicylate and benzyl alcohol, sitosterol, fatty acids, tannin and starch

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Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Postemergence Herbicides
Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

NOTE: When herbicides 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.

Redroot Pigweed *Amaranthus retroflexus L.*

Amaranthaceae (Pigweed family)
Location: gardens, waterways, roadsides, waste areas, orchards, and cropland.

Occurrence: Redroot pigweed grows best in warm temperatures. Seed germination and seedling emergence begin in late spring and continue throughout the season, unless daytime temperatures exceed 95ºF. Plants flower and produce seed from mid-summer until frost.

Description: An upright summer annual, generally growing between 1 and 6 feet in height. The common name “redroot” refers to the pinkish-red color at the base of the stem (sometimes the whole stem) and the taproot. Vertical white veins are often visible down the length of the stem. The stem is often branched above, and the primary stem and branches are somewhat hairy, especially at the upper ends. Leaves are oval with a tapering point, have conspicuous veins and generally measure 1/3 inch- 3 inches long. Borne on stalks commonly as long as the leaves themselves, leaves are arranged alternately along the stem.

Weedy Characteristics: Pigweed reproduces by seed. Each plant can produce tens of thousands of seeds, which are small enough to be distributed by wind. Seeds can also be dispersed by machinery, through water, and by the movement of animals that consume them. Most seeds are able to germinate immediately at maturity, allowing the plant to produce several generations per season. Those seeds that do not germinate at once can remain viable in the soil up to 10 years or more. Pigweed will use any water available, but is drought tolerant and even thrives in hot temperatures. It colonizes and grows vigorously in bare, disturbed soil. There is also some evidence to suggest that the plant secretes chemicals that interfere with the growth of other nearby plants.

Control: Redroot pigweed seed germination is favored by warm temperatures and high light conditions, and the plant grows best when in full sun. However, soil seed populations can be reduced with soil solarization. Maintaining a vigorous, desirable plant population that can shade the soil and weed seedlings will discourage pigweed colonization. Mulching the soil will also provide necessary shade. Frequent mowing can prevent seed production, and frequent hand-pulling, hoeing, tilling, and digging can help control seedlings. For current chemical or biological methods, consult your local state or county weed specialist. When found in the lawn, pigweed can be spot-treated with herbicides containing MCPP, MCPA, and dicamba. In gardens, glyphosate (Round-up, Kleen-up) can be used, taking care not to get any of the chemical on desired plants. Pre-emergents containing oryzalin, pendimethalin, or trifluralin can be effective. When using a herbicide, be sure to read the label carefully and follow directions closely.

General Facts: Native people have used redroot pigweed to treat a variety of medical conditions, and have commonly eaten the boiled young leaves as greens, and used the ground seeds in flour. Several types of wild birds also use redroot pigweed as a food source. However, pigweed accumulates toxic nitrates in its tissues, which are at their highest levels just before flowering family (especially when drought-stressed). Pigweed also contains toxins that can cause kidney failure in livestock, when consumed in large amounts. Pigweed often hosts insect pests and plant viruses that cause damage and disease in crops, such as alfalfa and some vegetables. Because of its aggressive competition, redroot pigweed presence in crops can greatly reduce crop production.

Other Common Names: careless weed, common amaranth, pigweed amaranth, redroot amaranth, rough pigweed, wild beet.

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Redstem Filaree *Erodium cicatarium*

Redstem Filaree *Erodium cicutarium*

Redstem Filaree is a prostrate broadleaf winter annual or biennial weed. A member of the geranium family, it has fern-like, or feathery appearing foliage in a rosette. The stems are reddish and there is a large, white taproot.

Control Appearing more frequently in newly seeded lawns or thin, stressed lawns, this minor turf weed can be eliminated by increasing the density of the lawn. Newly seeded lawns will develop more density with time and will then crowd out this weed. It is often seen in buffalograss lawns. The entire plant can be easily pulled out of moist ground. Post emergent herbicides such as 2,4-D or 2.4-D combinations are only marginally effective in controlling Redstem Filaree.

Rush Skeletonweed *Chondrilla juncea*

USDA Symbol: CHJU

Description: Perennial; blooms July to September. Grows 1 to 4 feet tall. Yellow flower 3/4 inch in diameter with 7 to 15 petals. Coarse downbent hairs on the lower 4 to 6 inches of stem; almost no leaves. Spreads primarily by seed, but roots scattered by cultivation can aid in spread.

Impacts: Rush skeletonweed is an aggressive plant in both rangeland and cropland, particularly in light textured soil and has been the target of large control projects for decades. Cereal grain and potato production areas are at risk from skeletonweed invasion. Impacts include reduced yield due to competition and harvest difficulties with combine harvesters from latex sap that is exuded from the plant. Extensive efforts have been made to eradicate or contain outbreaks, but new sites are being found each year in the eastern part of Oregon.

Introduction: Native to Eurasia, this noxious weed now infests several million acres in the Pacific Northwest and California including Idaho.

Rush, Slender *Juncus tenuis*

Family: Rush Family (Juncaceae)

Other Names: field rush, path grass, path rush, poverty rush, slender yard rush, wire grass, yard rush.

Origin and Distribution: Slender rush is a native of North America and is widespread across the U.S. and Canada. It thrives in both dry and wet soils of pastures, meadows, roadsides and waste places. Some of its common names stem from the fact that it also grows abundantly in compacted soils along paths.

Plant Description: Slender rush is a clump-forming, grass- or sedge-like perennial, characterized by its wiry dark green stems and terminal clusters of greenish-brown flowers. This species reproduces by seeds.

Root system - The roots are fibrous. Plants sometime produce short rhizomes (horizontal underground stems).

Stems - Slender rush has erect, wiry, rounded, hollow, dark green stems that grow 4 to 24 inches tall.

Leaves - Narrow, grass-like leaves are produced along the lower portion of the stem. The leaf blade (free part of the leaf) is half as long as to longer than the stem, and can be flat or have inwardly rolled edges. The leaf sheaths (part of the leaf surrounding the stem) have whitish, membranous margins, and cover the lower half of the stem. The sheath margins extend upward beyond the top of the sheath to form a pair of whitish, membranous, rounded, flap-like appendages (auricles) (1/25 to 1/6 inch long).

Flowers - Small, greenish-brown flowers are clustered near the tips of branches in a flat-topped, branched flower head. Branches can be 1/3 to 3 inches long. Each flower has 3 scale-like petals and 3 sepals (modified leaves directly below the petals). A pair of narrow, curly, modified leaves (bracts) (1/3 to 4 inches long) usually extends above the flower head.

Fruits & Seeds - Seed pods are egg-shaped, brown and divided into 3 sections, each section containing several seeds. Six scale-like, pointed bracts (modified leaves) surround each seed pod. Seeds are very small (about 1/8 inch long), translucent, orangish-brown, and sometimes winged along one side.

Similar Species: Slender rush may be confused with both grasses and sedges, but it can be distinguished by its round stem, flowers that consist of petals and sepals, and its many-seeded seed pod which is surrounded by 6 pointed bracts.

Biology: Flowering occurs between June and August. Control of slender rush populations may be aided by plowing the infested area, then seeding with a cultivated crop. If the area cannot be cultivated, it could be fertilized, harrowed, and seeded with a mixture containing white clover.

Toxicity: None known.

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Russian Knapweed *Acroptilon repens See Knapweed for more info*

Russian Knapweed *Acroptilon repens*

Russian knapweed (*Acroptilon repens*) is a creeping, herbaceous perennial of foreign origin that reproduces from seed and vegetative root buds. Shoots or stems, are erect, 18 to 36 inches tall, with many branches. Lower leaves are 2 to 4 inches long and deeply lobed. Upper leaves are smaller, generally with smooth margins, but can be slightly lobed.

Shoots and leaves are covered with dense gray hairs. The solitary, urn-shaped flower heads occur on shoot tips and generally are 1/4 to 1/2 inch in diameter with smooth papery bracts.

Flowers can be pink, lavender or white. Russian knapweed has vertical and horizontal roots that have a brown to black, scaly appearance, especially apparent near the crown.

Russian knapweed emerges in early spring, bolts in May to June, and flowers through the summer into fall. Russian knapweed is toxic to horses. The key to Russian knapweed control is to stress the weed and cause it to expend nutrient stores in its root system. The best management plan includes cultural controls combined with mechanical and/or chemical control techniques.

Russian Thistle *Salsola tragus L. (Salsola iberica*

(Sennen & Pau) Botch. ex Czerepanov,
Salsola kali ssp. ruthenica (Iljin) Soo, Salsola kali ssp. tenuifolia Moq.,
Salsola pestifer A. Nels.) ***See thistle for more information***

Russian Thistle *Salsola iberica*

Chenopodiaceae (Goosefoot family)
Origin: Eurasia
Location: open, abandoned gardens, waste areas, roadsides, fence rows, rangeland, cropland, and waterways
Occurrence: Seeds germinate from mid-spring through summer, generally within a temperature range of 52º-90 º F.
Flowering takes place from early to late summer. Flowers produce seeds which are mature by late fall. When frost kills the plant, the brittle upper portion breaks off at the base and tumbles in the wind.

Description: An upright summer annual that grows between 4 inches and 3 feet tall, and usually not as wide. The plant is highly branched from the base upward and forms a rounded to pyramidal shape. Most branches arch upward. Stems are round and rigid with vertical, reddish-purple stripes, turning grayish-brown at death. Young leaves are succulent, linear and 1 inch long. Mature leaves are arranged alternately on the stem, are stiff, short and wider at the base, with a spiny tip. Inconspicuous pink to greenish-white flowers are borne singly in leaf axils, sitting in a cavity created by the leaf and two small, spiny bracts. Flowers measure 3/16 - 1/2 inch in diameter. As they mature, the flower parts dry to produce papery wings surrounding a conical fruit. The fruit houses one brown, coiled seed.

Weedy Characteristics: A large Russian thistle plant can produce over 200,000 seeds, which are widely dispersed in the wind by the tumbling process, but also by transport on animal fur and on soil clinging to shoes and wheels. Its tap root can grow 3 feet deep, with many vigorous lateral roots, and its seed is known to germinate within a few hours after a small amount of rain.

These traits allow it to thrive in drought conditions. Russian thistle will grow in poor, salty soils (hence the scientific name, Salsola, which means “salty”), which are inhospitable to most plants. It is also suspected to produce substances that interfere with the growth of other nearby plants.

Control: Russian thistle seeds need loose soil to germinate, and seedlings do best in an open, dry environment. Desirable plants that become established early in the season will create shade that Russian thistle seedlings cannot tolerate. Maintaining a vigorous garden, with little to no bare soil will greatly discourage Russian thistle colonization. As an annual, Russian thistle reproduces solely by seed. Seeds generally do not remain viable past one year. Repeated hoeing, tilling, or mowing of young plants will prevent seed production. Hand-pulling (with gloves) can also be effective for small infestations. Mowing or tilling mature plants will likely help spread seeds. For current chemical or biological methods, consult your local state or county weed specialist.

Control Control of Russian thistle is difficult. There have been numerous attempts through the years to import biological control agents, but none have been successful.

Pre-emergent herbicides are applied to the soil before the weed seed germinates and are usually incorporated into the soil with irrigation or rainfall. The most effective pre-emergent herbicides are Aatrex (atrazine), Velpar (hexazinone), Devrinol (napropamide), Telar (chlorsulfuron), Oust (sulfometuron), Princep (simazine) and Hyvar (bromacil). Other pre-emergent herbicides that are registered but only moderately effective in controlling Russian thistle are Surflan (oryzalin), Treflan (trifluralin), Prowl (pendimethalin), Endurance (prodiamine), Lasso (alachlor), Predict (norflurazon), and Kerb (pronamide).

Herbicide-resistant biotypes of Russian thistle have evolved in only a couple of years following treatment with Telar (chlorsulfuron) or Oust (sulfometuron). Avoid repeated use of a single herbicide or of herbicides that have the same mode of action to prevent the evolution of herbicide-resistant populations.

Post-emergent herbicides are applied to plants, but timing is critical. For best results, these herbicides must be applied while the weed is in its early growth stages, preferably the early seedling stage, before it becomes hardened and starts producing its spiney branches. Do not use post-emergent herbicides to try to control the mature seed (either on the plant or on the ground) as they are not effective for this purpose. Also, the later spiney stage of Russian thistle is not readily controlled by any post-emergent herbicide. If rain or irrigation occurs after a post-emergent application, additional seedlings may emerge and require future treatments. Post-emergent herbicides that are effective when properly applied include Banvel or Vanquish (dicamba), Roundup (glyphosate), 2,4-D and Gramoxone (paraquat).

General Facts: Native people have been known to eat the young plants and the roasted seeds of Russian thistle, and to use the plant for several different medicinal purposes. Small animals and birds rely on Russian thistle for protective cover, and grazing animals often eat its early growth. It is, in fact, quite high in protein, but in some circumstances it can also accumulate levels of toxic substances that can be harmful to some livestock. Some people are allergic to Russian thistle pollen, and sensitive skin can be irritated when handling the plant. When dry, Russian thistle spines can damage animal mouths, as well. Russian thistle often serves as a host to insect pests that cause viral disease in vegetable crops. Dry tumbleweeds can be an extreme fire hazard, especially when they collect along fence lines, or other such areas. Travelling tumbleweeds also compromise road safety, and interfere with crop harvesting operations. Russian thistle is sometimes confused with--and will hybridize with--a closely related plant, barbwire Russian thistle (S. paulsenii), which is rounder, stiffer, and more spiny. Russian thistle is noxious in four U.S. states and five Canadian provinces, and it is considered invasive in 10 other U.S. states.

Other Common Names: prickly Russian thistle, prickly saltwort, Russian cactus, tartor thistle, tumbleweed, windwitch.

Salsify, Western *Tragopogon dubius*

Family: Daisy Family (Compositae)
Other Names: *Tragopogon major*, buck's beard, go-to-bed-at-noon, goat's-beard, Joseph's flower, noonflower, noontide, star of Jerusalem, western goat's beard, yellow goat's-beard, yellow salsify.
Origin and Distribution: Western salsify, which originated in Eurasia and Northern Africa, was introduced into the U.S. at the beginning of the 1900's as a garden plant. It escaped cultivation and became naturalized throughout an area extending south from New York into Virginia, west to California, and north to Illinois. Western salsify grows in meadows, fields, and roadsides. It is especially troublesome in perennial horticultural crops. The species prefers dry, open sites.

Plant Description: Western salsify is a biennial (rarely a short-lived perennial) that produces foliage with a grass-like appearance. However, all parts of the plant contain a milky juice, which is not a typical trait of grasses but is a common feature among species in the Asteraceae Family. During the first year of growth, western salsify forms a rosette of long narrow leaves that look like blades of grass. The following year, 2-inch-wide yellow flower heads form at the ends of leafy stems. Flowers generally open in the morning and close by mid-day. Flowers mature into fluffy white seed heads that could easily be mistaken for those of dandelions except they are about twice as large. The plant reproduces by seeds.

Root system - A long taproot is produced that is thick, fleshy, branched, and exudes a milky juice when cut or broken.

Seedlings & Shoots - The first two seed leaves (cotyledons) are linear and grass-like. Subsequent leaves are long, narrow, and somewhat downy-hairy. During the first year of growth, plants produce grass-like leaves in a basal rosette. All parts of young plants exude a milky juice when cut or broken.

Stems - After growing as a rosette for a year, plants produce erect, leafy stems that are smooth, round, fleshy, and can grow to 3 feet tall. Each stem terminates in a solitary flower head. Stems exude a milky juice if cut or broken.

Leaves - Leaves are alternate (1 leaf per node), 1 foot long, narrow, light green, fleshy, and have smooth edges. Leaf bases broaden where they clasp the stem and narrow to a sharp tip. Leaves look similar to grass blades, but unlike grass, they exude a milky juice if broken.

Flowers - A single flower head forms at the end of a long, hollow stem. Each flower head is 1 to 2 1/2 inches wide and composed of many yellow ray flowers. Beneath each flower head are 10 or more green, slender, pointed, leaf-like bracts (phyllaries) that are longer than the flowers. Flowers generally open in the morning and close at mid-day.

Fruits & Seeds - Mature seed heads are 3 to 4 inches wide, white, fluffy, round, and similar to but larger than those of dandelions. The single-seeded fruits are rough, ridged, and more than half of their length is a slender beak with a white, parachute-like circle of feathery bristles (pappus) attached to the tip. Length of fruit including beak is about 1 1/4 inches.

Similar Species: Western salsify and meadow salsify (*Tragopogon pratensis*) appear similar except western salsify has hollow stems that are inflated below the flower head while meadow salsify has solid stems that are not inflated below the flower but rather uniformly tapered. Meadow salsify leaf tips are usually curled or curved and the edges of its phyllaries are purplish.

Biology: The probability that flowering will be initiated increases with increasing rosette size. Rosette leaves from the previous year can usually be detected as dried remnants at the base of a flowering plant. Flowering begins in May and continues until September. Flowers open and face the sun each morning, twist slightly as they follow the sun until midday, and generally close in the afternoon. The hairy pappus attached to seeds aids in their dispersal by wind, which can scatter seeds a great distance. All plant parts exude a milky juice when cut or broken that is sticky and bitter and makes the plant unpalatable to grazing animals. To control, western salsify should be mown as soon as flowers appear and again later. Badly infested fields should be plowed and cultivated for a year. There are herbicides available that successfully control this weed in grasslands.

Toxicity: None known.

Related Information:

- ✓ '*Tragopogon*' is from the Greek 'tragos' meaning goat and "pogon" meaning beard.
- ✓ The common name 'Joseph's Flower' refers to Joseph, husband of the Virgin Mary, who commonly is depicted as bearded.

Scotch Thistle *Onopordum acanthium*
For more information see Thistle

Scotch thistle *Onopordum acanthium*

Scotch thistle is a branched, robust biennial (or sometimes annual) that often grows 8 feet or more in height and 6 feet in width. Main stems may be up to 4 inches wide at the base. Stems have vertical rows of prominent, spiny, ribbon-like leaf material or "wings" that extend to the base of the flower heads. Leaves, which are armed with sharp, yellow spines, are up to 2 feet long and 1 foot wide. Upper and lower leaf surfaces are covered with a thick mat of cotton-like or woolly hairs, which give the foliage a gray-green appearance.

Plants flower in mid-summer. The globe-shaped flower heads are borne in groups of 2 or 3 on branch tips. Flower heads are up to 2 inches in diameter, with long, stiff, needle-like bracts at the base. Flowers range from dark pink to lavender. Seeds are smooth, slender, and plumed.

Shepherd's Purse *Capsella bursa-pastoris*

Shepherd's Purse *Capsella bursa-pastoris*

Shepherd's Purse Another member of the mustard family, Shepherd's purse can produce over 33,000 seeds per plant. The lower leaves are petioled and deeply lobed, quite similar to that of a dandelion. The upper leaves are irregularly toothed and clasping. White flowers appear in clusters at the top of a flower stalk that can reach 6 to 18 inches in height. The flowers are only about 2mm across. Seeds are contained in silicles that are notched triangles and resemble the purses once carried by shepherds.

Control Shepherd's purse has a slender taproot and can be easily hand-pulled or hoed from moist soil in flower and vegetable gardens while plants are young. In lawns, post-emergent herbicides provide easier control of Shepherd's purse than pre-emergents. Spot treat by spraying individual plants, rather than applying a weed and feed over the entire lawn. If you would rather not spray, the herbicide can be brushed on instead. Apply the herbicide in mid-spring and again in mid-autumn if a new crop of shepherd's purse emerges. These herbicides are most effective when temperatures are between 60-80°F. Do not spray if temperatures are projected to exceed 85°F within the next 48 hours.

Choose a time when no rain is forecast for at least 24, and preferably, 48 hours. To avoid herbicide drift, spray only when the air is still. Drift can harm or kill desirable broadleaf plants such as flowers, vegetables, trees and shrubs. Post-emergent herbicides should be labeled for use in turfgrass and contain a combination of 2,4-D and MCPP or 2,4-D, MCPP and dicamba. Do not apply any product containing dicamba underneath the canopy of young trees, near shrubs or close to gardens, as it can be absorbed by their roots.

Shrubby Lespedeza or Bicolor or Bushclover *Lespedeza bicolor*
Chinese Lespedeza or Sericea Lespedeza (Lespedeza cuneata)

Nature: Although still planted for quail food plots, these plants often invade surrounding forests, replacing native plants. Shrubby lespedeza is a shade-tolerant, 3-leaflet, shrubby legume up to 10 ft. tall with small purple-pink pea-type flowers. Chinese lespedeza is not really a shrub, but a semi-woody plant to 3 ft. tall with many small 3-leaflet leaves feathered along erect, whitish stems having tiny cream-colored flowers in leaf axils during summer. Both will form dense stands that prevent forest regeneration and land access.
Origin: Both from Japan.
Uses: Wildlife food for birds and soil stabilization.

Herbicide Control: Apply Garlon 4 as a 2% solution in water (8 ounces in a 3-gal. sprayer) with a surfactant or Escort at 2 ounces per acre in water (0.6 dry ounces in 3-gal. sprayer) to thoroughly wet all leaves in July to September. Apply Transline as a 0.2% solution (1 ounce in a 3-gal. sprayer), a glyphosate herbicide as a 2% solution (8 ounces in a 3-gal. sprayer), or Velpar L as a 2% solution (8 ounces in a 3-gal sprayer) in water with a surfactant to thoroughly wet all leaves and stems in July to September. Mowing 1-3 months before herbicide applications can assist control.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
- Elimination of weed debris
- Control of annual weeds
- Suppression of perennial weeds
- Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

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.

Silverleaf Nightshade *Solanum elaeagnifolium*

Silverleaf Nightshade *Solanum elaeagnifolium*

Silverleaf Nightshade is a member of the Nightshade (or Potato) Family. It grows to 3 feet in height and has silvery, lance shaped leaves with wavy edges which grow to 4 inches in length. The plant typically grows in open areas, such as roadsides and fields, at elevations between 1000-5500 feet. The Silverleaf Nightshade is poisonous; however, Native Americans have used the crushed berries of the plant to curdle milk since they contain a protein-digesting enzyme. Silverleaf Nightshade typically blooms between May - October and produces a bluish purple, star shaped flower with yellow anthers in the middle to 1.5 inches in width. The flower is followed by a 1/2 inch diameter yellow berry.

Control Cobra ® may be used in combination with MSMA, Bladex® and Karmex® to aid in control of certain weeds. Consult specific product labels for recommendations and precautions.

Skeletonleaf Bursage *Ambrosia tomentosa*

USDA Symbol: AMTO

Other common names: Bur ragweed, silverleaf, povertyweed

Description: Perennial; flowers June to August. Grows 4 to 18 inches tall with extensive creeping rootstocks. Leaves lanceolate, coarsely toothed and deeply lobed. Flowers inconspicuous and yellow. Fruit a light brown bur with spines.

Impacts: Skeletonleaf bursage grows in cultivated fields, pastures and waste areas in several western states and survives under varied soil moisture conditions.

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 herbicides 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.

Small Broomrape *Orobanche minor*

USDA Symbol: ORMI

Description: Annual; blooms within a week of plant emergence. Grows 6 to 20 inches tall. Lacks chlorophyll; has yellowish-brown unbranched stem with purplish tint. Leaves look like small triangular scales. Flowers pinkish, yellow or white in color and arranged in an elongated terminal cluster.

Impacts: Small broomrape is a parasitic plant. Upon germination, the first root attaches to and penetrates the root of the host plant, usually clover and other legumes, disrupting nutrients and water transport in the host root system. It has the ability to produce up to 500,000 seeds per plant that are dispersed by wind, tillage equipment, harvesters, commodity movement and animals. An uprooted flowering plant will continue to produce seed. Heavy infestations can cause severe crop damage that may result in nearly total crop failure. It is especially problematic in clover crops where the seeds are hard to detect or remove during inspections of harvested clover seed.

Introduction: A European native, small broomrape was first documented in California in 1838. Small broomrape introduction routes are largely unknown, but likely involve contaminated crop seed and equipment.

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Postemergence Herbicides
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Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

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Smartweed, Swamp *Polygonum coccineum*

Family: Buckwheat Family (Polygonaceae)
Other Names: swamp knotweed, tanweed, devil's shoestring, tansy mustard.
Origin and Distribution: A native of North America, swamp smartweed is a highly variable perennial. It exhibits two forms, terrestrial and aquatic. For this reason, the plant will invade shores, wet prairies, swamps, ponds, ditches, and quiet streams. However, it is quite common for plants to grow in drier soil. Today, the species can be found throughout much of North America.

Plant Description: Swamp smartweed reproduces using rhizomes (rootstocks) and seeds. Plants normally grow from 2' to 3' tall. The stems are usually unbranched and thicken to form nodes at the leaf joints. This trait is partially responsible for the common name of knotweed. Swamp smartweed may also exhibit a red-striped stem. The leaves of the plants are alternate, oblong, and tapering at both ends. They are usually pointed at the tip and exhibit smooth margins. The leaves of land plants grow up to 8 long, while those of aquatic plants are somewhat smaller (up to 6). The leaves of the land plants are generally more oval than those of aquatic plants, which exhibit floating, arrow-shaped leaves. The leaf stalks of both plant forms encircle the stem to form nodes. The plants display extensive root systems. They are known to grow roots at the nodes of the stem. Swamp smartweeds exhibit tall, slender, and erect flower clusters. The flowers may be red, pink, or white (very rarely) in color. The species produces seed like fruit, which may be dark brown or black in color.

Similar Species: Swamp smartweed is frequently confused with *Polygonum amphibium* (or water smartweed). However, swamp smartweed may be distinguished by its flower clusters, which are taller and more slender than those of water smartweed. In addition, water smartweed bears leaf-like fringes at the top of the nodes of the stem. Swamp smartweed lacks this trait.

Biology: Swamp smartweed blooms from July to September. The spreading root system allows for competition with other plants while making it difficult to kill the plants. For this reason, cultivation, hoeing, and harrowing may be used to control the plants. In addition, frequent mowing of fields and pastures can be used in conjunction with improving soil drainage.

Toxicity: None.

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Related Information:

- ✓ Swamp smartweed has several close relatives one of which is Polygonum hydropiper, or water-pepper smartweed. In the past, extracts of water-pepper smartweed were applied to ulcers and hemorrhoids. The uses gave rise to two of its more earthy folk names, arse-smart and smartass.

Snakeroot, White *Eupatorium rugosum*

Family: Daisy Family (Compositae)
Other Names: *Ageratina altissima*, *Eupatorium ageratoides*, *E. urticaefolium*, deerweed, deerwort, deerwort-boneset, fall poison, hemp-agrimony, Indian sanicle, milk-sickness plant, richweed, snakeroot, squaw-weed, stevia, white sanicle, white top.

Origin and Distribution: White snakeroot is a native of North America. The plant is currently naturalized throughout southern Canada and all over the eastern half of the U.S. excluding areas in the extreme south. White snakeroot is a tall plant with rather showy clusters of small bright-white flowers so it is easy to spot in fields, meadows, thickets, woods, waste places, roadsides, lake edges, stream banks, and other shady areas in which it thrives. White snakeroot prefers moist forested areas and rich soils, but plants survive in dry places and may even persist in disturbed areas. The species grows best in basic soils.

Plant Description: White snakeroot is a 3-foot-tall perennial herb. Distinctive features include opposite leaves, which are coarsely-toothed, rounded at the base, sharply-pointed at the tip, and attached to a long slender leaf stalk (petiole), and flat-topped clusters of small bright-white flowers. Ingesting leaves and stems of the plant produces a deadly condition known as "trembles" in animals, and humans can develop "milk sickness" by consuming milk from affected animals. White snakeroot reproduces by seeds and short rhizomes (horizontal underground stems).

Root system - The root system includes fibrous, branched roots and tough, knotty rhizomes (horizontal underground stems).

Seedlings & Shoots - Young leaves are thin, pale green, and have short hairs on the upper surface, edges, and veins. Leaf veins, consisting of the midrib and a simple vein on either side (3-nerved), are easy to discern on both the upper and lower surfaces. Stems and leaf stalks (petioles) of young plants are often purple-stained.

Stems - Stems are erect, leafy, 2 to 3 feet tall, and much branched near the top. Stems may be solitary or several may emerge in a cluster from the same root system.

Leaves - Leaves are opposite (2 leaves per node), thin, 2 1/2 to 7 inches long, broadly oval to lance-shaped, and 3-nerved. Larger leaves have a rounded base, sharp teeth around the edge, and taper to a point at the tip. Leaves attach to the stem by way of a slender petiole that is at least 1/4 as long as the leaf.

Flowers - Numerous flower heads are grouped into loosely-branched, flat-topped clusters arising from the axils of upper leaves. Each flower head is about 1/4 inch wide and contains 8 to 30 bright-white disk flowers.

Fruits & Seeds - The single-seeded fruits are brown or black, about 1/16 inch long, cigar-shaped, and tipped with a tuft of white hairs (pappus).

Similar Species: White snakeroot can be separated from other Eupatorium species such as bonesets, Joe-Pye weeds, other snakeroots, and thoroughworts by its distinctive leaves that are opposite, sharply-toothed, 3-nerved, and attached to long petioles.

Biology: White snakeroot generally begins to flower in July and continues until September. The weed does not persist in cultivated areas. Plants should be pulled as soon as they appear or mowed close to the ground several times during the season before seeds form. Improving drainage may aid in control of this poisonous plant.

Toxicity: Leaves and stems of white snakeroot plants contain tremetol, which is extremely poisonous. The plant is unpalatable to animals, but they will consume it if other forage is scarce. If sufficient amounts of white snakeroot are consumed, animals develop a condition known as "trembles" that may cause death. Lactating animals excrete the toxin in their milk, which can then pass to humans drinking the milk. The condition produced, known as "milk sickness", was common in early colonial times. A great milk sickness epidemic occurred in local areas of the eastern U.S. in the early nineteenth century resulting in many deaths. Abraham Lincoln's mother, Nancy Hanks Lincoln, was among those who died. Eventually, the toxin in white snakeroot was identified as the cause. The condition is rare today because it is common to pool milk from different areas and herds for commercial production thereby diluting any tremetol present. Meat of animals that eat white snakeroot can also contain tremetol at levels toxic to humans consuming it. Dried plants in hay are toxic but not as poisonous as fresh plants.

Related Information:

- ✓ Native Americans used the plant as a treatment for snakebites as well as for various diseases.

Sorrel, Red *Rumex acetosella*

Family: Buckwheat family Polygonaceae
Other Names: sheep's sorrel, field sorrel, surette, horse sorrel, sour-weed, sour-grass, cow sorrel, red-weed, mountain sorrel, cuckoo-bread, gentleman's sorrel, green-sauce, ranty-tanty, sour dock, toad's sorrel.

Origin and Distribution: Red sorrel was introduced from Europe and has become naturalized throughout the U.S. Red sorrel tolerates sites with low fertility or poor drainage but will thrive in nutrient rich soils where there is little competition from other plants. It is seldom a problem in cropland, but can be troublesome in pastures, meadows, strawberries, and grass lawns. It is common in waste areas and roadsides, especially on sandy or gravelly soils where it is difficult to eradicate.

Plant Description: Red sorrel is an herbaceous perennial that reproduces by seeds and extensive shallow horizontal roots. It is distinguished by its arrow-shaped leaves, low height, slender wiry stem with sheathed nodes, and red to rust-brown color. The creeping horizontal roots give rise to above-ground shoots that often form dense patches.

Root system - Red sorrel seedlings have a fibrous root system, but eventually produce shallow horizontal roots with whitish buds from which new shoots arise. Except for fine terminal roots, the whole root system is capable of producing buds. A root fragment as small as 1/2-inch can regenerate a new shoot.

Seedlings & Shoots - Cotyledons are oblong and dull green. Seedlings resemble a rosette, made up of many leaves whose shape changes with age from egg- to spade-, to arrow-shaped. The base of leaf petioles is often red or brown.
Stems - Flowering stems are slender and erect, reaching heights from 6 to 18 inches. A single crown produces several tough and wiry stems that are branched at the top. At each node of the stem, a thin, greenish-yellow or silvery membranous sheath (ochrea) is attached just below the leaf stalk. The sheath surrounds the stem like a collar until it turns brown and shatters with age.
Leaves - Leaves grow alternately along the stem, one leaf per node. Lower leaves are long and spade-shaped with no lobes. Middle leaves are short and almost always have a lateral lobe near the base of the leaf on each side. Upper leaves are small with no lobes or stalks.
Flowers - Flowers are small and clustered along terminal and axillary branches at the tops of stems. Red sorrel is usually dioecious, meaning that female and male flowers occur on separate plants; however, male, female, and bisexual flowers can appear on the same plant. Female flowers are greenish, while male flowers are yellow to red. Flowering begins in May and can continue throughout the growing season.
Fruits & Seeds - Seeds are less than 1/16th inch long, triangular or 3-sided, smooth, shiny, and reddish-brown or golden-brown. The rough, rust-brown hull often adheres to the seed.

Similar Species: Red sorrel is difficult to confuse with other species due to its unique arrow-shaped, sour-tasting leaves.

Biology: Red sorrel is a highly variable plant in leaf shape, color, and response to both temperature and day-length. It probably has two germination periods, one in spring and one in early autumn. Germination is increased by light, alternating temperature, and nitrate. Some populations flower and set seeds in a single year whereas others produce adventitious roots in response to short days and then flower in subsequent years. An individual crown lasts about 18 months, during which time secondary crowns develop along creeping rootstocks. The ability to form clones allows vegetative reproduction for unlimited duration; thus a clone may be decades old. Freshly mature seeds can germinate in 3 to 4 weeks, whereas buried seeds can remain viable 10 to 20 years. The small seeds used to be common contaminants of alfalfa and clover seeds, which aided its spread wherever these crops were planted. Red sorrel has a high tolerance for acid soils, but communities have been found on calcareous substrates and there are reports it germinates best in alkaline soils. Red sorrel does not tolerate shade and is not very competitive except when growing on acid and nutrient deficient soils which it tolerates better than many other species. Fertilizer, liming, and improved drainage allow other species to be more competitive and to crowd out red sorrel.

Toxicity: Red sorrel is not considered poisonous to humans, and is often eaten as a pot-herb or green. Very rarely contact with leaves may produce a dermatitis in susceptible individuals. It produces large quantities of light pollen that is easily dispersed by wind, and is a cause of hayfever. Red sorrel contains oxalic acid, which can poison livestock if consumed in sufficient quantity; the seeds are said to be poisonous to horses and sheep.

Related Information:

- ✓ Medicinal uses for fresh red sorrel include use of juice to treat urinary and kidney diseases.
- ✓ Red sorrel is considered an indicator of acidic soil conditions; however, it also thrives in neutral or slightly alkaline soils, especially those low in nitrates. The genus name, Acetosella, means slightly acid. The word 'sorrel' derives from the French, 'sur' meaning sour.
- ✓ To some, the leaves have a lemon taste. When steeped in hot water and drained, the sugared liquid is said to resemble lemonade.
- ✓ Red sorrel has been used medicinally to treat boils and skin disorders as well as sore throats. Native Americans used it as an antidote for poison.

South American Waterweed *Egeria densa* (Elodea)

USDA Symbol: EGDE

Other common names: Brazilian elodea, Brazilian waterweed, leafy elodea, dense waterweed

Description: Perennial aquatic herb that grows under water. Leaves one to three cm long, up to 5 mm broad, and in whorls of four to eight. Leaves linear and short internodes give it a very leafy appearance. Leaves and stems generally bright green. Stems erect, simple or branched and grow until they reach water's surface where they form dense mats. Flowers small, white, have three petals, and float on or rise above the water's surface on thread-like appendages. This plant reproduces by spread of plant fragments and has double nodes on the stem.

Impacts: South American waterweed aggressively invades new aquatic environments, displacing native vegetation by forming dense stands or large subsurface mats and altering the dynamics of the aquatic ecosystem. It also impedes flows in waterways, increases flooding, clogs pumps and boat propellers, and limits use of waterways for recreation.

Introduction: This plant is originally from South American and was introduced to North American for aquarium use. The first documented United States introduction was in 1893.

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Sowthistle, Annual *Sonchus oleraceus L.*

Location: gardens, roadsides, cropland, waste areas, waterways, and native plant communities

Occurrence: Annual sowthistle seeds germinate from spring to autumn, but mostly in late spring. As early as 6 weeks after germination, seedlings form a rosette. In spring, flower stalks follow soon after rosette formation, and by 9 weeks after germination flowering can take place. Flower heads can bloom between mid-summer and mid-fall. Flowers open for 2 consecutive days, and seeds are produced 1 week after flowering.

Description: An erect summer annual that grows from 1-4 feet, usually with a single, hollow, sometimes purplish stem, branching near the top. Leaves are dark green to bluish green, with toothed, slightly prickly margins, and are alternately arranged along the stem. Lower leaves have one to three pointed lobes on either side of the mid vein and clasp the stem with a pair of pointed lobes. Upper leaves are smaller and also clasp the stem, but are not as deeply lobed as lower leaves. Leaves are 1 1/2 - 8 inches long, and 1/4- 4 inches wide. Yellow, flat-topped flower heads occur in clusters at branch tips. Each flower head is 1/4 - 3/4 inch in diameter and is held in a 1/2 inch-tall cup of green bracts. Each fruit is 1/8 inch long and golden brown with white feathery hairs at the tip. Seed heads collectively form a dandelion-like globe.

Weedy Characteristics: Annual sowthistle reproduces solely by seed, generating several thousand seeds per plant. Seeds are largely dispersed by wind, but are also carried by water, animals, and birds. Given enough moisture, seeds germinate rapidly, and the plant can quickly establish a colony.

The plant can progress through its lifecycle within 100 days, and will occasionally produce more than one generation per year. Annual sowthistle is adaptable to a variety of soil types, including saturated and saline soils.

Control: Annual sowthistle seeds need light to germinate, and do not generally germinate from deeper than within 1 inch of the soil surface. Soil solarization can help reduce sowthistle seed population in the soil, and thick mulch can help prevent seed germination. Where possible, maintenance of vigorous perennial plant populations will make it more difficult for sowthistle to establish itself. Frequent tilling, hoeing, or hand-pulling throughout the spring and again from late summer until frost will destroy seedlings. In other situations, mowing closely can prevent seed set and regrowth of plants. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Annual sowthistle stems and leaf veins exude a milky latex when damaged, and although its leaves and stems are edible both raw and cooked the latex gives them a bitter flavor. The plant has been known to be used as a medicinal remedy for such things as varied as bowel trouble and teething pain. All the same, it can be a source of contamination in grass seed and can serve as a host of serious plant disease-causing viruses, fungi, and insect pests. Annual sowthistle is noxious in six Canadian provinces, and is considered invasive in several U.S. states. Spiny sowthistle (Sonchus asper) and perennial sowthistle (Sonchus arvensis) are very closely related to annual sowthistle, and the plants are often confused with each other. However, perennial sowthistle has larger flower heads and a creeping root system, and as its common name implies, spiny sow thistle leaves are stiffly spiny, while annual thistle leaf margins are only slightly prickly. Spiny sowthistle leaves are also less deeply lobed, and the basal lobes clasping the stem are rounded.

Other Common Names: common sowthistle, hare’s lettuce, spiny milk thistle

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Sowthistle, Perennial *Sonchus arvensis*

Family: Daisy Family (Compositae)
Other Names: corn sow thistle, creeping sow thistle, dindle, field milk thistle, field sow thistle, gutweed, hare's colewort, hare's lettuce, hare's palace, milk thistle, swine thistle, swinies, tree sow thistle.
Origin and Distribution: Perennial sowthistle originated in Europe and western Asia. After immigrating to North America, presumably as a contaminant of crop seed, the species spread throughout southern Canada and northern U.S. but remained scarce in most southern and central states. Perennial sowthistle inhabits disturbed areas such as pastures, roadsides, waste places, lakeshores, gardens, lawns, and no-tillage agronomic fields. The plant is adapted to many soil types but grows most abundantly on rich loams. It prefers moist rather than dry conditions.

Plant Description: Perennial sowthistle can be difficult to distinguish from several other closely-related weeds based on above-ground growth. Most of the species have hollow stems, lobed leaves with irregular teeth ending in weak prickles, and yellow flowers that appear similar to dandelion flowers but smaller. Also, all of these plants exude a sticky white juice when cut or bruised. Roots of perennial sowthistle are unique, however, in that they spread horizontally and are much more extensive than the simple taproot formed by other similar species. Perennial sowthistle reproduces by seeds and large colonies can become established from stems arising from buds on creeping roots.
Root system - The root system is extensive and composed of downward- and horizontally-growing roots, which are fleshy, brittle, cord-like, and have buds that give rise to new stems.
Seedlings & Shoots - Seedlings have club-shaped leaves with irregularly-toothed edges and a dull bloom on the lower surface. Leaves of shoots arising from roots are deeply-lobed and have wavy edges with irregular, spiny teeth. Leaf stalks (petioles) are winged with bases that encircle the stem. All leaves including the first two seed leaves (cotyledons) contain milky juice.
Stems - Stems are smooth, hollow, stout, ridged, over 4 feet tall, and contain milky juice. Stems are hairless on the lower part but upper parts, branches, and flower stalks may have hairs that appear dark due to tiny glands located at the tip.
Leaves - Leaves are alternate (1 leaf per node), 4 to 8 inches long, dull, blue-green, and crowded on the lower half of the stem. On either side of the midrib are 2 to 5 (rarely 7) deep lobes. Leaf edges are irregularly-toothed and each tooth ends with a weak prickle. Lower leaves attach to the stem by way of winged petioles. Leaves located in the middle and upper portions of the stem have shorter petioles and lobed bases that encircle the stem. Uppermost leaves are small, often unlobed, and usually scarce. Contained in leaves is a milky juice.
Flowers - Flower heads are 1 1/2 inches wide and composed of many yellow ray flowers. Flowers have an appearance similar to that of dandelion flowers but smaller and, instead of being solitary, many flower heads are clustered at the ends of branched stems.
Fruits & Seeds - Single-seeded fruits are about 1/8 inch long, brown, oval, with 5 to 7 longitudinal wrinkled ribs. At the top is a soft white tuft of hair (pappus).

Similar Species: Perennial sowthistle has an extensive root system distinguishing it from annual sowthistles (*Sonchus species*) that produce only taproots. Prickly lettuce (*Lactuca canadensis*) leaves are also lobed with prickly edges but the midribs have a row of stiff sharp prickles on the underside.

Biology: There is currently disagreement over how to delineate this species; some perennial sowthistles have glandular hairs while other do not and some authorities assign the hairless taxa to a separate variety named *Sonchus arvensis* var. *glabrescens* or a different species called *Sonchus uliginosus*. Perennial sowthistle flowers from June to October. A single plant can produce up to 9,750 seeds. New shoots arise from root segments 1 inch long or longer, so tillage can fragment and disperse roots thus enlarging the population by giving rise to new plants. Herbicides are available that, if applied in the late rosette to bud stage, provide good control. However, perennial sowthistle is relatively resistant to many common herbicides. The most effective system for control is a combination of cultural and chemical methods.

Spanish Heath *Erica lusitanica*

USDA Symbol: ERLU

Other common names: Portuguese heath, Spanish heather

Description: Spanish heath is a woody, upright, perennial evergreen shrub, (tree heather) growing up to 10 feet tall (3 m). Leaves are light green, needle like, 3-7 mm long and arranged around the stem in groups (whorls) of three to four. Blooms are a showy mass of small, white to pink, bell (tubular) shaped flowers, with three bracts, four sepals, and a corolla. Plants begin flowering in December and continue until April. Fruit are smooth capsules about 3 mm in diameter containing many, very fine pepper sized seeds. Large plants produce millions of easily transported seeds. These seeds may be wind, water, animal or human transported. Spread could be expected to be rapid.

Impacts: Spanish heath is a weedy ornamental species of Erica known from only a few sites in Curry and Coos counties in Oregon. First established in Oregon in the 1970's, at a rare plant nursery near Langlois, it slowly spread for decades until recently, with its population now increasing exponentially (Stansell, McKenzie 2008 pers. comm). Growing up to 10' tall, this species produces up to 9 million seeds per plant (Weeds of Australia, 2007) and is capable of forming dense stands in forest lands, wild areas, pastureland and on right-of-ways and will be a troublesome weed to control, should it be allowed to spread in western Oregon. Spanish heath has infested large areas in Northern California (Humboldt, Del Norte Counties) and is demonstrating a capacity to infest similar habitat in Oregon and Washington. It is well adapted to moist, acidic soils and could infest a wide range of shrub and forest habitats. In California, it is commonly found growing in close association with gorse, Scotch, French broom, and blackberry, especially along utility right of ways, riparian areas, and roadsides (Wood, 2008).In parts of Australia and New Zealand, Spanish heath is a major environmental weed (State of Victoria, 2001). Impacts to parks, wildland and wildlife refuges result from the aggressive growth and competition provided by the plant.

In California, Spanish heath is a weed of wild land and forest where it forms dense stands, especially in disturbed areas. Erica provides limited forage for grazing animals and few insects so it grows rapidly with limited herbivore pressure. Other impacts can include reductions in native plant diversity, invasion of riparian areas, competition with conifer and broadleaf tree species and overall degradation of the land base. Currently, Spanish heath infestations in Oregon are rare and impacts are minimal. Because of the experience of land managers in Australia and New Zealand under similar conditions, significant impacts to Oregon's wild lands, forestlands, pasture and right-of-way could occur. Competition from Erica could significantly impact forest regeneration and productivity, especially in Coos and Curry Counties. Pasture productivity would suffer as edible forage becomes out-competed by this less desirable shrub. Right-of-way maintenance costs would increase in infested areas. Mowing has no long-term impact on the species, and the high seed output would quickly establish dense stands blocking access roads for power lines, reducing line-of-sight on public highways, and increasing the opportunity for roadside fires in areas where herbicide use is restricted. In the cranberry growing region of southwestern Oregon, Erica favors the open ground, dikes, and access roads near cranberry bogs. Increased herbicide use would be required to maintain existing open ground and infrastructure. In all susceptible areas, control costs to contain or eradicate populations would be significant.

Introduction: Historically the plant was believed to possess medicinal properties. The name Erica derives from the Greek word ereiko meaning to break. This terminology may originate from the theory that the plant could dissolve gallstones; alternatively, it may refer to the fact that the stems are easily broken. (The Heather Society, 2007) The only positive economic benefit is associated with its harvest by the floral industry for use in arrangements mainly around Valentine's Day. No other economic use has been noted. This plants native range is from southwest France, north and western Spain and Portugal. It does not occur naturally on the American continent, or the vast majority of Asia, but has naturalized in parts of Australia and New Zealand where it is now viewed as a major environmental weed (The Heather Society, 2007).

Spikeweed *Hemizonia pungens*

USDA Symbol: HEPU5

Other common names: common tarweed and maritime spikeweed

Description: Spikeweed is annual that blooms July to September. This plant grows 1 1/2 to 3 feet tall and has basal leaves that are pale, straw colored, stiff and several inches long with narrow lobes. Stem leaves 1/2 inch long or less and sharp pointed, bearing dwarf stems in their axils. Flower heads yellow, 1/3 inch broad and borne at the tips of short leafy branches.

Impacts: Occurs on roadsides, waste areas and in low alkaline sites of grain fields and rangelands. Spikeweed is a tough, spiny plant which is avoided by livestock. It is a heavy seed producer and forms dense stands on areas favorable to its growth.

Introduction: Spikeweed is native to California.

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.

Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Postemergence Herbicides
Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

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.

Spiny Cocklebur *Xanthium spinosum*

USDA Symbol: XASP2

Description: Annual; blooms in summer. Grows 4-5 feet tall. Leaves covered with short white hairs, white-veined above, 1 to 3 inches and have 2 short lobes and a 3-forked spine at the junction with the stem. Male flowers uppermost and clustered. Female flowers below male flowers and form a bur which bears a beak with hooked bristles.

Impacts: Spiny cocklebur is most frequently found in highly disturbed waste areas and barnyards. It surrounds many small reservoirs in Oregon. The burs of spiny cocklebur can become tangled in the hide or wool of livestock adding to the cost of the woolen product. It is moderately competitive and is a nuisance in hand-harvested crops. The seeds and seedlings of spiny cocklebur are poisonous. The symptoms are anorexia, depression, nausea, and prostration. Death may occur in a few hours to three days after the symptoms are first noted.

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Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

NOTE: When herbicides 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.

Spiney (or Purple) Pigweed *Amaranthus Spinosus*

Description: Spiney, or purple pigweed is a summer annual broadleaf weed that is very similar in appearance to other pigweeds but has spines along the stems. Spines are paired, occurring at the base of most of the leaf petioles. Commonly found in waste areas and disturbed soils, it grows erect from 1-5 feet in height. The lower stems are green in color. Flowers are small and green, in bristly terminal and axillary clusters. Prolific seed producers, pigweeds will produce up to 100,000 seeds per plant. Seedlings are easily pulled or hoed from the garden. Older plants are more difficult to pull out and may scatter seeds in the process. Mulch will prevent seeds already in the soil from germinating.

Control: When found in the lawn, pigweed can be spot-treated with herbicides containing MCPP, MCPA, and dicamba. In gardens, glyphosate (Round-up, Kleen-up) can be used, taking care not to get any of the chemical on desired plants. Pre-emergents containing oryzalin, pendimethalin, or trifluralin can be effective. Read labels on herbicides carefully and follow directions closely.

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Spurge Laurel *Daphne laureola*

Other common names: daphne, daphne-spurge, daphne-laurel

Description: Spurge laurel is an attractive ornamental plant known for its spiraling evergreen leaves and greenish-yellow, bitter-fragrant flowers. Larger patches of this species emit a strong unpleasant odor. Flowering occurs in late winter-early spring, producing clusters of blue berries during the spring. The one-seeded drupes are eaten and dispersed widely by birds and small mammals. Shrubs reach a height of 0.5-1.5 meters. They can be either upright or arch over to a more sprawling form. This weed tolerates low light levels from partial to deep shade. It prefers better-drained clay loams and forest loams with neutral to acidic soils. Escaped populations form dense stands mostly under tree canopies. High plant densities produce an abundance of short-lived seeds most of which germinate within 2 years. Young plants will flower and reproduce in the second year under good conditions. Birds are the primary dispersal mechanism.

Impacts: Escaped populations from ornamental plantings continue to expand into forested areas especially adjacent to urban areas. As birds further disperse seeds, more habitats will be invaded and native plant communities altered. Oak woodland forests are the greatest at-risk forests because of this and other aggressive weed species in addition to land clearing activities. It is no longer a plant of any commercial value. Most plant parts are toxic to humans and contain toxic compounds tigliane diterpenes and coumaris glycosides. Contact with the sap can cause skin irritation and ingestion of the seeds can create poisoning especially in small children.

Introduction: The Daphne family consists of 500 species mostly small shrubs or occasional herbs. Most members of the group produce stem fibers and a few are used for papermaking in Asia. Spurge laurel was planted throughout the Pacific Northwest for decades. It is a native to much of Western Europe and the southern countries of Eastern Europe.

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Spurge, Leafy *Euphorbia esula*

Other common names: Wolf's milk, Faitour's grass, Hungarian spurge
Description: Leafy spurge is an aggressive perennial herb that grows upright, branching, and reaches two-three feet tall with tough woody stems that exclude milky white latex sap when broken. It has alternate narrow leaves, somewhat frosted and slightly wavy along the margins. The flower of this weed are very small and are borne in greenish-yellow structures surrounded by yellow distinctive heart-shaped bracts. Leafy spurge has an extensive root system that can extend up to 20 feet below the surface. Rhizomes are woody, brown, have numerous pink buds and are capable of producing above ground shoots. Seeds are ovid to cylindrical and gray to brown in color. Seed capsules have 3 compartments each with 1 seed. Plants are capable of producing copious amounts of seed which is dispersed by an explosive rupturing that can propel seeds up to 10 feet from the plant. All parts of this plant contain a poisonous latex sap.

Impacts: Leafy spurge is one of the West's most invasive and difficult to control weed species. It is capable of invading disturbed sites, including prairies, savannas, pastures, abandoned fields and roadside areas. Like all spurges it is considered toxic to cattle but sheep and goats may readily feed on it following an acclimation period. This plant has the ability to reduce cattle carrying capacity of infested rangelands by 50 to 75%. Leafy spurge is very capable of dominating the plant community and habitat and significantly decreasing the diversity of native species. Leafy spurge also shows allelopathic tendencies.

Once established, control of even modest-sized infestations is difficult, and annual treatments are required to contain populations. A grazing prescription which includes sheep grazing prior to other livestock has been successful in increasing agricultural productivity in rangelands infested with leafy spurge in parts of the West. This weed tolerates moist to dry soil conditions but is most common under dry conditions with coarse-textured soils where competition from native plants is reduced. A milky latex exists in all parts of the plant that can cause skin irritations in humans, cattle, and horses and may cause permanent blindness if rubbed into the eye.

Introduction: The scientific name of leafy spurge (Euphorbia esula) can be literally translated from the Greek to mean "good pasture for eating." Sources indicate that name was given to the plant by the King of Mauritania, naming it after his physician Euphorbos for his use of the plant. Native to Europe and Asia, brought to the U. S. from Eurasia about 1897 and it now occurs across much of the northern states.

Spurge, Myrtle *Euphorbia myrsinites*

Other common names: Creeping spurge and donkey tail spurge

Description: Perennial; blooms in early spring . Grows 4 to 6 inches tall. Leaves alternately arranged in close spirals around the fleshy, trailing, blue-green stems. Flowers inconspicuous and surrounded by a showy yellow green bract. This plant prefers well-drained dry to moist soils with partial shade to full sun. Myrtle spurge is an escaped ornamental that inhabits disrupted areas and waste places. It grows well in zones 5-9 and is known to like dry rocky areas as well.

Impacts: Originally planted as a rock garden ornamental, the species has escaped and is spreading on to open lands in dryer parts of the state. Seeds can be ejected when plants are disturbed, sticking to wildlife hair and enabling transport far from the parent plants. Aside from displacing desirable native species, the plant invades playgrounds and parks in some states. The sap of myrtle spurge is caustic and creates rashes, swelling and blistering of the skin and is a human health concern.

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St. Johnswort *Hypericum perforatum*

Other common names: Klamath weed, goat weed, common St. Johnswort

Description: Perennial; blooms June to July. Grows 1 to 3 ft. tall. Stems erect, numerous branched, somewhat 2 ridged, rust-colored and woody at their base. Leaves opposite, oblong, not over 1 in long and covered in transparent dots. Flowers 3/4 inch in diameter, bright yellow, numerous in flat-topped cymes with five petals with occasional small black dots around the edges. Stamens numerous, arranged in three groups.

Impacts: This difficult to control pest is found throughout most of the western U.S. It invades pasture and rangeland and is poisonous to livestock. Livestock seldom eat the plant unless pasture is scarce. It can invade rangelands to open timber. Infestations spread rapidly on disturbed, well drained sites such as roadways, trails, overgrazed range, and logged areas.

Known hazards: The plant contains a toxic compound that causes photo-sensitivity; poisoning appears to be cumulative. Light pigmented animals develop blisters and scabs on the mouth eyes, ears, nose and feet, especially when exposed to sunlight. Dark colored animals are generally less susceptible.

Family: St. Johnswort Family (Hypericaceae)

Origin and Distribution: Common St. Johnswort is a European native that colonists brought with them when they immigrated to North America. It is now naturalized throughout the eastern half and the west coast of the United States. The species grows in open areas such as pastures, open woods, roadsides, parking lots, and waste areas. It also appears in such disturbed sites as tree plantations, orchards, and agronomic fields that are not regularly cultivated. Common St. Johnswort grows best in sandy soil but it is also found in heavy soils. It usually occurs in dry habitats.

Plant Description: Common St. Johnswort is a perennial weed that has the general appearance of a shrubby herb with many woody stems covered with narrow leaves. It can be distinguished from other herbaceous shrubs by clear dots on its leaves that look like pin holes if the leaf is held up to a light. To distinguish it from other closely related species, look for yellow flowers with petals that are about 1/2 inch long and have black dots along the edge. Reproduction is mainly by seeds, but vegetative spread is possible by rhizomes.
Root system - Roots are slender, branched, brown, and very tough. The root system generally consists of a long taproot with shallow roots extending several inches from the crown.
Seedlings & Shoots - Seedlings consist of a slender, purple stem with 2 leaves, which have a powdery surface appearance and are unpleasant to taste.
Stems - Stems are smooth, upright, usually reddish, woody at the base, and grow up to 3 feet tall. Each plant is usually comprised of several stems with numerous branches.
Leaves - Common St. Johnswort leaves are between 1 to 2 inches long, elliptic, and opposite (2 leaves per node). Leaves lack leaf stalks (petioles), so they attach directly to the stem. Leaves are covered with small dots, visible with a hand lens when the leaf is held up to a light, that look like tiny perforations or pin holes.
Flowers - Flowers are less than 1 inch in diameter and have 5 yellow petals with black dots along the edge. About 25 to 100 flowers can be found in a broad clusters at the top of each stem.
Fruits & Seeds - The fruit is a pod with 3 parts, each filled with numerous dark brown seeds. Seeds are 1/16 inch long, cylindrical, dark brown, shiny, and have a pitted surface.

Similar Species: Common St. Johnswort can be distinguished from the more than 15 other *Hypericum* species by its yellow petals that have black dots on their edges.

Biology: Flowers appear in June to September. A single common St. Johnswort plant produces as many as 100,000 seeds per year. Seeds are wind dispersed or, because they have a gelatinous coating that becomes sticky when wet, they may adhere to animals, machinery, and other objects that can disperse them. If buried in soil, seeds survive up to 10 years. Hand pulling, digging, mowing, and fire are generally ineffective control measures. Common St. Johnswort is tolerant of many herbicides. Regular tillage is an effective control measure but it is not suitable for use on rangelands often infested by this weed. In its native Europe, there are nearly 40 known insect predators that help control common St. Johnswort. Studies have shown that some of these insects are useful as biological agents for long term control of common St. Johnswort in North America. Common St. Johnswort was a troublesome weed of pastures on the West Coast until the implementation of such biological control measures.

Toxicity: Although people differ in their sensitivity to the toxin in this weed, contact can cause second degree burns in some individuals. Ingesting common St. Johnswort causes animals to develop sensitivity to sunlight resulting in dermatitis. Symptoms range from redness and blistering of the skin to loss of hair. Animals with light-colored skin are especially sensitive. If enough of the plant is ingested, death may result. Animals generally do not relish common St. Johnswort, but they will eat it if more palatable herbage is not available. Because common St. Johnswort grows into dense patches that crowd out other species, there could be times when this weed is the only available forage in some pastures. Common St. Johnswort retains its toxic properties when dry, so animals can be affected by eating contaminated hay.

Starthistle, Iberian *Centaurea iberica*

USDA Symbol: CEIB

Description: Annual or biennial; rosette forms in May and June, blooms midsummer through fall. Grows 1 to 6 feet tall. Plant covered in fine hairs. Leaves divided into narrow linear segments. Rosettes have spines in center. Flower heads are purple with straw-colored spine-like bracts over 1 inch in length. Seeds are plumed, the distinguishing factor between this plant and purple starthistle.

Impacts: Closely resembles purple starthistle and both species have the ability to adapt to a variety of climactic conditions. They are extremely competitive along roadsides and in low-rainfall range situations as well as in higher rainfall pastures, where they displace valuable forage species. The sharp spines deter grazing animals, access to livestock and wildlife, reduce the value of hay and can impede recreational use. This weedy plant has the potential to become widely established, having significant impact to agriculture and wildland resources.

Starthistle, Purple *Centaurea calcitrapa*

Other common names: Red starthistle

Description: Annual or biennial; rosette forms in May and June, blooms midsummer through fall. Grows 1 to 6 feet tall. Plant covered in fine hairs. Leaves divided into narrow linear segments. Rosettes have spines in center. Flower heads are purple with straw-colored spine-like bracts over 1 inch in length. Seeds are not plumed, the distinguishing factor between this plant and Iberian starthistle.

Impacts: Closely resembles Iberian starthistle and both species have the ability to adapt to a variety of climactic conditions. They are extremely competitive along roadsides and in low-rainfall range situations as well as in higher rainfall pastures where they displace valuable forage species. The sharp spines deter grazing animals, access to livestock and wildlife, reduce the value of hay and can impede recreational use. This weedy plant has the potential to become widely established, having significant impact to agriculture and wildland resources.

Sumac, Smooth *Rhus glabra*

Family: Cashew Family (Anacardiaceae)
Other Names: wild sumac.

Origin and Distribution: Smooth sumac is a native of eastern U.S. Currently, it has a range extending throughout the U.S. except for an area in North Dakota and Montana. It establishes on clearings, hillsides, and such disturbed sites as roadsides and reduced-tillage fields. With the exception of bogs, swamps, and shaded areas, smooth sumac tolerates nearly any condition and type of soil.

Plant Description: This deciduous, woody perennial grows in a colony as a shrub or it may grow alone as a small tree. Smooth sumac has compound leaves composed of many 2- to 4-inch-long leaflets. Leaflets turn bright colors before falling off in the fall. Its stems are branched and smooth. Red fruits, which are covered with minute hairs, form in dense clusters located at the tips of branches. Reproduction is by seeds and rhizomes (horizontal underground stems).
Root system - Root systems tend to be shallow and wide-spreading.

Seedlings & Shoots - Young shoots are tan to medium brown and hairless.

Stems - Plants are usually between 2 to 15 feet tall, although 25-foot-tall trees have been recorded. Stems are generally less than 2 inches wide. Branches may be square in cross-section. Bark is thin, smooth, and brownish-gray. Twigs are hairless and light brown. When cut, stems exude a milky sap. Branches display U-shaped leaf scars in winter.

Leaves - Leaves are alternate (1 leaf per node) and compound with between 9 to 31 leaflets. Leaves are 8 to 20 inches long. Leaflets are located opposite each other with a single leaflet located at the tip of each leaf. Leaflets are 2 to 4 inches long, shaped like oblong lances, and have coarsely-toothed edges. In summer, leaflets are dark green above and much paler below. In fall, they turn a range of colors from orange to scarlet to purple before falling off. Leaves attach to stems by way of hairless stalks (petioles).

Flowers - Small greenish-yellow flowers form 3- to 5-inch long, pyramid-shaped clusters located at the end of stems. Male and female flowers are located on separate trees.
Fruits & Seeds - Fruits are bright red with dense but short, minute hairs.

Similar Species: Dwarf sumac (*Rhus copallina*) is similar in appearance except its stems have raised dots and its leaflets have smooth edges. Staghorn sumac (*Rhus typhina*) is distinguished from smooth sumac by the long hairs covering its stems, petioles, and fruits. Staghorn sumac fruits are in more erect clusters than those of smooth sumac. Naturally occurring crosses between staghorn and smooth sumac result in hybrid offspring with such intermediate characteristics as medium-long hairs on twigs and fruit. Characteristics of poison sumac (*Toxicodendron vernix*), which causes dermatitis in sensitive individuals, distinguishing it from smooth sumac are white hairless fruits and smooth-edged leaves. Leaves of tree-of-heaven (*Ailanthus altissima*) are also compound but their leaflets have 1 to 2 teeth located near the base compared to smooth sumac leaflets that have numerous teeth all around the edge.

Biology: Flowering begins in June and continues through July. Because plants spread by rhizomes, an area can become populated by many related plants with overlapping crowns that give the appearance of a dense colony with an extensive rounded or flat top.

Toxicity: None known. However, the cashew family also includes poison ivy, poison oak, and poison sumac. Persons sensitive to these other plants should be cautious around staghorn sumac.

Related Information:

- ✓ Native Americans used sumac as an antiseptic and astringent and in place of tobacco.

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Syrian Bean Caper *Zygophyllum fabago*

USDA Symbol: ZYFA

Description: Perennial that may act like an annual in regions with harsh winters; flowers April to June. Grows up to 1 1/2 feet tall. Leaves somewhat succulent, opposite, compound and each having 2 oval, 1-inch leaflets. Stems smooth and thickened. Flowers borne singly or in pairs from the leaf axils, salmon to yellow or white with pinkish veins and up to 3/4 in across.

Impacts: Syrian bean-caper is well suited to dry environments. Buds and branches form on spreading roots, forming dense patches which compete for water and space. Large infestations can reduce forage potential in dryer areas of the west.

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Tansy Ragwort *Senecio jacobaea*

Other common names: Stinking willie, ragwort, tansy butterweed, stinking davies, stinking ninny, tansy ragweed

Description: Biennial or short-lived perennial; blooms midsummer to fall. Grows 1 1/2 – 6 feet tall. Leaves dark green, deeply lobed. Numerous seed heads, each with multiple, yellow, multi-rayed flowers. Reproduces by seed only but can all regenerate vegetatively if grazed or mowed and moisture conditions are right.

Impact: Prolific in pastures, clear-cuts and disturbed roadside areas. Tansy ragwort is toxic to cattle and horses, causing irreversible liver damage. Unlike cattle and horses, sheep appear to be unaffected ragwort's toxicity. They may be either grazed exclusively as a pretreatment to cattle grazing or grazed with cattle. Continuous heavy grazing will prevent flowering and, in many cases, reduce density (Bedell et al. 1981, Sharrow and Mosher 1982). Tansy ragwort's seeds can lay dormant in the soil for 15 years. Once considered Western Oregon's most serious noxious weed, biological controls have reduced the severity of outbreaks below economic threshold levels.

Introduction: Senecio jacobaea is native to Europe and western Asia and has become a serious rangeland pest in New Zealand, Tasmania, Australia, South Africa, and North and South America (Baker 1982).

Teasel, Common *Dipsacus fullonum*

Family: Teasel Family (Dipsacaceae)
Other Names: *Dipsacus sylvestris*, barber's brush, brushes and combs, card teasel, card-thistle, church broom, gypsy-combs, Venus' basin, Venus'-cup, wild teasel.

Origin and Distribution: Common teasel was imported from its native Europe into North America, possibly as an ornamental or more likely because the dried flowers were used in wool production. Its current range is limited and includes areas in the northeastern U.S., the Pacific Coast, and southern Canada. Common teasel is found in pastures, abandoned fields, roadsides, railroads, and waste areas. The species prefers damp, coarse and fertile soils.

Plant Description: Common teasel is a biennial member of a genus distinguished by the manner its leaves are fused around the flowering stem forming a cup that collects rainwater. Common teasel produces puckered leaves with scalloped edges in the form of a rosette during its first year of growth after which a 6-foot-tall prickly flower stem emerges. Flowering stems are usually branched at the top and cone-shaped flower clusters form at the ends of the branches. Below each cluster and curving upward around it are several stiff bracts. In each cluster are many short bristles interspersed with individual flowers consisting of white petals united into a tube with 4 purple lobes. Stems and flowers become woody and persist through the following winter and sometimes over several seasons. Reproduction is by seeds.

Root system - The plant has a thick taproot and fibrous secondary roots.

Seedlings & Shoots - Young leaves have toothed edges, a puckered surface, and are shape similarly to an egg. Leaves persist over winter as a basal rosette.

Stems - Flowering stems are 2 to 8 feet tall, erect, angled, furrowed, branched near the top, and prickly. The pithy stems become woody and may persist for several years.

Leaves - Shiny green rosette leaves have scalloped edges, scattered stout hairs on the upper surface, and are attached to the stem by way of a leaf stalk (petiole). Leaves on the flowering stem are similar to rosette leaves except they are smaller, opposite (2 leaves per node), and have short spines on the

underside of the midrib. Rather than attaching to the stem by way of a petiole, the bases of stem leaves are fused around the stem forming a cup in which rainwater collects.

Flowers - Flowers form in cone-shaped, spiny clusters. Individual flowers, which are 2/5 to 3/5 inch long, consist of white petals united into a tube with 4 purple lobes. Below each cluster are several long, slender, stiff, bracts that curve upward. Within the cluster, there are many short, stiff bristles. Once mature, flower clusters becomes dry, hard, and persistent.

Fruits & Seeds - Fruits are light brown, about 1/5 inch long, ridged, hairy, and 4 angled. Enclosed in each fruit is a single seed.

Similar Species: Cutleaf teasel (*Dipsacus laciniatus*) can be distinguished from common teasel by its deeply-lobed leaves. Common teasel flowers resemble those of several thistle genera, but its leaves are puckered and have spineless edges and it grows for at least a year as a basal rosette.

Biology: Common teasel blooms from July to September. The first flowers to open are located in a ring around the center of the cluster. Then, bands of flowers above and below this ring bloom simultaneously. Some plants produce flowers after growing for one year as a rosette while others take 3 or more years to flower. Researchers found that leaf size predicted the onset of flowering more consistently than plant age; once leaves exceeded 5 inches, there was an 80% chance the plant would flower during the following season. Seeds usually fall within 5 feet of the mother plant. Goldfinches and blackbirds have been observed feeding on common thistle seeds, so it is possible that some seeds are dispersed by birds. An average teasel plant produces 3300 seeds. Common thistle does not survive disturbances such as cultivation.

Toxicity: None known.

Related Information:

- ✓ '*Dipsacus*' was derived from the Greek verb meaning "to be thirsty", which is likely in reference to the water-collecting cup formed by the stem leaves.
- ✓ The weed's common name refers to the practice of using the flowers to tease wool. The common names 'card teasel' and 'card-thistle' are in reference to the wire brush or "card" used to tease wool.
- ✓ Teasel is often added as a dried plant to ornamental arrangements.

Thistle, Bull *Cirsium vulgare*

Family: Daisy Family (Compositae)
Other Names: *Carduus lanceolatus*, *C. vulgare*, *Cirsium lanceolatum*, bank thistle, bell thistle, common thistle, plume thistle, spear thistle.
Origin and Distribution: Originally from Eurasia, bull thistle is now established on every continent except Antarctica. The species was introduced to northeastern U.S. during colonial times and is now widespread throughout the U.S. and Canada. It is a problem weed in disturbed areas such as pastures, rangelands, roadsides, waste places, and abandoned fields. The weed prefers relatively rich, moist soils.

Impacts: A wasteland weed that, if not controlled, presses into farmland. It is most commonly found in pastures, rangeland, newly logged sites, and takes the place of forbs and grasses..
Introduction: Bull thistle is a native of Eurasia and widely established in North America. It has been accidentally introduced many times through seed contaminant. Documentation has been found indicating early medicinal uses as well as parts of the plant being edible.

Plant Description: Bull thistle is a typical biennial species in that, during the first year of growth, it produces leaves in the form of a low growing basal rosette. Leaves are hairy on the upper surface and irregularly indented around the edge with groups of 2 or 3 spine-tipped lobes interspersed with unlobed portions. Bull thistle rosettes remain green and continue growing throughout the winter. The rosette is 3 feet in diameter by the second spring when it gives rise to a 5-foot-tall upright flowering stem. Stems have distinctly spiny wings and bear solitary, purple, globe-shaped flower heads on the ends of branches. Reproduction is solely from seeds.

Root system - Plants usually form a large fleshy taproot with many secondary fibrous roots.

Seedlings & Shoots - The two seed leaves (cotyledons) are egg-shaped and spineless and the first true leaves are oval with notched edges that are fringed with prickles. Young leaves are crisp and easily broken. Seedlings grow into a rosette of basal leaves.

Stems - Stems are 1 to 5 feet tall, stout, leafy, wooly, and widely branched. On the middle and upper portions of stems, there are spiny leaf-like wings.

Leaves - Rosette leaves are between 3 to 6 inches long and irregularly indented around the edge with groups of 2 or 3 deep lobes interspersed with unlobed portions. At the tip of each lobe is a 2/5-inch-long spine while smaller spines are randomly distributed along the rest of the leaf edge. The upper leaf surface is dark green, covered with sharp hairs, and prickly to the touch. The lower surface is light green and covered with wooly hairs that feel soft. Stem leaves are similar in appearance to rosette leaves but smaller and alternate (1 leaf per node). Leaf bases attach to and extend down the stem giving it a winged appearance.

Flowers - Many disk flowers are contained in each flower head, which is rose to reddish-purple, globe-shaped, 1 1/2 to 2 inches wide, surrounded by narrow, overlapping, outward-pointing, green, spiny bracts, and usually solitary at the end of a branch.

Fruits & Seeds - Single-seeded fruits are approximately 1/6 inch long, straw colored, streaked with black, and similar in shape to a chili pepper. Attached to one end are many brown, feathery, 3/4-inch-long hairs (pappus).

Similar Species: Lobes of Canada thistle (*Cirsium arvense*) leaves end in small spines and the upper leaf surface is smooth while lobes of bull thistle leaves end in large spines and the upper leaf surface is rough. Also, Canada thistle has creeping roots and rhizomes that spread great distances while bull thistle forms a taproot. Bull thistle grows as a rosette during its first year while Canada thistle rarely forms only basal leaves.

Biology: Bull thistle blooms from June to October. A single plant growing in a pasture can produce approximately 7000 seeds. The pappus aids in wind dispersal of seeds. Seeds dispersed from a height of 2 1/2 feet have been observed to travel as far as 40 feet in the wind. However, the pappus is easily separated from the seed prior to dissemination, which explains why so many seeds tend to be deposited directly under the mother plant. To control mechanically, plants should be mowed just before flowering or rosettes can be cut below the crown with a hoe. Bull thistle does not persist under cultivation. Several herbicides are available that selectively control the weed.

Toxicity: None known. However, bull thistle spines can irritate the mouths of grazing livestock and significantly reduce weight gain.

Related Information:

- ✓ The Latin name '*Cirsium*' is a corruption of the Greek 'kirsos', which roughly translates to 'swollen vein' and describes the result of being pricked by this spiny plant.
- ✓ Bull thistle roots are sold commercially in Australia for rabbit bait.
- ✓ Some people find roots and young leaves tasty, providing the spines are removed.

Thistle, Canada *Cirsium arvense*

Other common names: Californian thistle, Canadian thistle, creeping thistle, field thistle, corn thistle, perennial thistle

Description: Perennial; blooms midsummer. Leaves wavy margined to lobed, up to 6 inches long and armed with yellowish spines. Small purple to white flowers in clusters. Extensive deep seated root system spreading horizontally. Large seed production but low percentage of viable seeds.

Impacts: Canada thistle can be found in cultivated fields, riparian areas, pastures, rangeland, forests, lawns, gardens, roadsides, and waste areas. A lack of control will result in a reduction in crop production of up to 25% in heavily infested ground. New infestation can be spread from seeds, but are more often caused by redistribution of roots by tillage practices.

Introduction: Canada thistle is a native of southeastern Eurasia and was introduced to the US by accident in the early 1600s.

Thistle, Italian *Carduus pycnocephalus*

Description: Annual or sometimes biennial; blooms May to June. Grows 1 to 4 ft. tall. Stems have spiny wings. Leaves deeply cut into 2 to 5 pairs of lobes, have white spots and undersurface slightly woolly. Flowers purplish to pinkish, borne in cylindrical heads either solitary or in clusters of more than 5. Bracts hairy. Fruits from outer part of flower head are gray in color and inner portion are yellowish to tan.

Impacts: Italian thistle is native to southern Europe. It infests roadsides and waste areas, and can be a major problem on hill pasture land. Once established, it spreads rapidly and forms dense stands which displace more desirable vegetation and exclude livestock.

Thistle, Milk *Silybum marianum*

Other common names: Blessed thistle, St. Mary’s thistle and lady’s thistle

Description: Biennial or winter annual; blooms from April to July. Grows two to six foot tall. Stems stout, rigid and generally branching. Leaves broad, clasp stem, have spiny margins and have white marbling along veins. Flower heads reddish-purple and have leathery spine-tipped bracts.

Impacts: Once established, it forms dense clumps which exclude livestock and crowd out more desirable forage species. It has the potential to invade extensive acres of pasture land. Individual plants are so large that forage displacement is high. It is a nitrate accumulator, lethal when livestock ingest the plant. Milk thistle seed is valued as an herbal medicine. The seed is capable of remaining dormant in the soil for many years. It infests roadsides, waste and disturbed areas, grazing lands and often occurs in association with Italian and slender-flowered thistles.

Introduction: Milk thistle is a native to the Mediterranean region of Europe. This plant has been known since ancient times; it is a biblical plant. It was mentioned by Theophrastus (4th century B.C.) with the name of Pternix and by Pliny the Elder (1st century A.D.) with the name of Sillybum. Von Haller (1744) in its "Medizinischen Lexicon" documented the specific use of the plant for liver disorders. In the 19th and 20th centuries many authors such as Rademacher, Schulz and Henry Leclerc mentioned the fruits of S. marianum for the treatment of liver diseases, disorders of the bile duct and spleen.

Thistle, Musk *Cardus nutans*

Other common names: Nodding thistle

Description: Biennial; blooms in early June. Grows three to six feet tall. Flower heads large, purple, solitary and usually nodding. Musk thistle has dark green leaves with light green midrib and wavy, spiny lobed margins. Leaves have a smooth waxy surface and appear winged at attachment to stem.

Impacts: Musk thistle is unpalatable to wildlife and livestock hence selective grazing leads to severe degradation of native meadows and grasslands as wildlife focus their foraging on native plants, giving musk thistle a competitive edge. It is thought to produce chemicals that hinder the growth of other plants. The spines can be harmful to animals and can hinder their movement through infested areas. Found in pasture, range and timberlands, it spreads by seeds, taking advantage of human disturbance. Prolific in moist condition. Commonly infests ditch banks, roadsides, and cereal fields.

Introduction: Musk thistle is native to southern Europe and western Asia. Introduced in ship's ballast in the eastern United States in the mid-1800s. First recorded in Pennsylvania in 1852.

Thistle, Plumeless *Carduus acanthoides*

USDA Symbol: CAAC

Description: Winter annual or biennial herb; flowers May to July. Grows 1 to 4 feet tall. Stems covered with spiny wings. Rosette leaves 4 to 8 inches long, stem leaves alternate and blend into the stem. Flower heads in clusters of 2 to 5 and usually purple but can be yellow or white.

Impacts: Each plant generates thousands of seeds. It is very aggressive, limiting grazing and other livestock management, threaten forage production and restrict recreational activities. Plumeless thistle invades pastures, valleys, fields, roadsides and open native habitats.

Thistle, Scotch *Onopordum acanthium*

Description: Biennial that sometimes acts like an annual; blooms May-June. Often produces a rosette the first year but when acting annual it can grow 2-4 feet the first year and is capable of heights over 10 feet in the second. Large amount of soft white hair on upper leaf surface. Towering height, depending on available moisture. Winged tissue along stem. Purple flower. Stands dense and practically impenetrable because of spiny nature and large size. Spreads by seed.

Impacts: Scotch thistle is a wasteland weed that generally inhabits moist sites or drainages in dry locations. If not controlled, it presses into farmland or forms dense canopies in any area overgrazed or not under intense cultivation.

Introduction: Scotch thistle is a native of Asia and Europe but is now found throughout North America.

Thistle, Slender Flowered *Carduus tenuiflorus*

Other common names: Shore thistle

Description: Annual or sometimes biennial; blooms May to June. Grows 1 to 4 ft. tall. Stems have spiny wings. Leaves deeply cut into 2 to 5 pairs of lobes and undersurface slightly woolly. Flowers purplish to pinkish, borne in cylindrical heads either solitary or in clusters of 2 to 5. Bracts hairy; fruits from outer part of flower head gray, inner portion are yellowish to tan. Nearly identical to Italian thistle, but has larger clusters of flower heads.

Impacts: Once established, it spreads rapidly and forms dense stands which displace more desirable vegetation and exclude livestock.

Introduction: Slender-flowered thistle is native to southern Europe.

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

Thistle, Smooth distaff *Carthamus baeticus*

USDA Symbol: CALAB2

Description: Winter annual; flowers July to August. Grows up to four feet tall. Very similar to woolly distaff thistle except that it has a smaller pappus, is less hairy, and the seedling leaves are more deeply lobed.

Impacts: Plants are highly competitive with cereal crops and desirable rangeland species. Because of their spiny nature, distaff thistles can injure the eyes and mouths of livestock forced to graze within dense populations of the weeds.

Thistle, Taurian *Onopordum tauricum*

USDA Symbol: ONTA

Other common names: Bull cottonthistle

Description: Taurian thistle is a vigorous biennial or short-lived perennial with coarse, spiny leaves and conspicuous spiny-winged stems. Taurian thistle plants are a nearly florescent lime-green in color with large, mostly singular flower heads at the terminals of the main and side stems. The bright purple flower heads are 3 to 4 inches in diameter. The heads consist of numerous spiny-tipped bracts resembling an artichoke before the bud opens. The leaves are typically covered with short, sticky-glandular hairs, 10-25 cm. long, acutely triangular, with 6 to 8 pairs of spiny-toothed lobes. Taurian thistle seedlings typically appear after the first fall rains and develop into large rosettes the next growing season. From this rosette and taproot an 8 foot tall plant develops. Dead stems can persist into the next season with spines attached. Taurian thistle reproduces only by seed. Most seeds germinate in the fall but can germinate throughout the summer. Buried seed can remain viable in the soil seed bank for at least 7 years and possibly to 20 years or more. Wind, water, animals, and vehicles can disperse seeds.

Impacts: Due to its growth habits and appearance, it is considered a sister plant to Scotch thistle Onopordum acanthium. Rangeland and openings in ponderosa pine forests are the commonly invaded habitats. Competition from this plant can reduce forage availability and quality especially in drought years. Riparian areas are especially susceptible. Dense stands can form crowding out native vegetation, making some riparian areas and pasture impenetrable for medium to large animals. Studies in Australia have concluded that Taurian thistle has reduced the economic return of infested land by at least 5%.

The tall plants can also be a contaminant in alfalfa and grass hay and a troublesome sight-distance for automobiles on right-of-ways. Taurian thistle does not normally form a closed canopy but when it forms dense thickets, grasses and other desirable species are displaced. Often after occupying a site for a few years even Taurian thistle cannot germinate again for some time, leaving bare ground for several years. California has reported several infestations of Taurian thistle from Modoc and Siskiyou counties and has classified it as an "A" rated noxious weed. These counties are just south of Klamath County, Oregon.

Introduction: Taurian thistle is native to the Middle East. From Greece, it has spread across Europe into France where there is concern that it is hybridizing with illyrian thistle Onopordum illyricum, another sister plant similar to Scotch thistle. Taurian thistle has only been reported in California and in Colorado. In California, it has infested areas in the Modoc Plateau (Siskiyou County), northern coastal ranges (Monterey County), and the Sierra Nevada foothills, (Yuba County, Nevada County, and Madera County). Colorado has reported Taurian thistle in 2 counties in the Pueblo Mountains but there appears to be confusion as to whether it is actually Taurian or Scotch thistle being reported.

Thistle, Woolly Distaff *Carthamus lanatus*

USDA Symbol: CALA20

Annual; flowers July through August. Grows, up to 3 1/2’ tall. Alternate leaves, with long, stout marginal and terminal spines on the leaves. Flowers yellow in spiny heads. Very similar to smooth distaff thistle, except it has a longer pappas, is more densely covered in hairs, and seedling leaves are less deeply lobed.

Impacts: Carthamus species are believed to be the most serious threat to range and pasture lands. Dense stands can crowd out other vegetation, livestock and recreational access. Dead plants remain standing, thorned and rigid for at least one year after dying back. Woolly distaff thistle is not grazed as it is not palatable to domestic animals or wildlife. Once established, it is difficult to eliminate because of a persistent seedbank.

Timothy *Phleum pratense*

Family: Grass Family (Gramineae)
Other Names: cat's tail, herd grass, herd's grass, meadow cat's tail.
Origin and Distribution: Timothy is native to Europe and Asia, and was probably brought to America by the colonists accidentally in contaminated hay or manure. It was discovered growing wild in 1711, and soon after, was cultivated for hay. Timothy is widely naturalized in the U.S. and southern Canada, and is still cultivated for hay and pasture. Timothy grows best in nutrient-rich soils, and is adapted to cool humid climates. It does not tolerate drought conditions.

Plant Description: Timothy is an erect, clump-forming perennial grass, characterized by its dense, cylindrical, spike-like flower heads and swollen, bulb-like stem bases. Timothy reproduces through seeds, and clumps enlarge by producing new shoots (tillers) from the bases of old stems. This species can form large clumps.
Root system - The roots of timothy are slender, and form a shallow, fibrous root system. Under unusual conditions, such as when plants are covered with soil, short rhizomes (horizontal underground stems) may form.
Stems - Stems are erect, round, whitish and generally smooth (sometimes rough directly below the flower head), and grow 1 to 3 1/2 feet high (sometimes up to 5 feet). Most stems develop a swollen, bulb-like base, or haplocorm, which is usually composed of one swollen internode (the portion of stem between two joints).
Leaves - Leaves are rolled in the bud. The leaf blade (free part of the leaf) (3 to 9 inches long, 1/6 to 2/5 inch wide) is grayish green, flat and elongated, tapering to a long point. Blades are hairless, and have rough margins. The leaf sheath (part of the leaf surrounding the stem) is smooth and rounded. The ligule (projection inside on the top of the sheath) is membranous, slightly toothed (often with a distinct notch on each side), and 1/12 to 1/8 inch long. Auricles (appendages at the top of the sheath) are absent.
Flowers - Small flowers are arranged densely in a narrow, cylindrical, spike-like flower head (2 to 4 inches long, 1/5 to 1/3 inch wide). The flower head is stiff and rough-textured, turning from a pale green to tan when mature.
Fruits & Seeds - Seeds are oval and 1/12 inch long.

Similar Species: The flower heads of timothy may resemble those of the bristly foxtails (*Setaria* spp.) and the foxtails (*Alopecurus* spp.). The bristly foxtails are annual species that have a hairy ligule and a less dense flower head, with long bristles surrounding the flowers. The foxtails are a mixture of annual and perennial species that are smaller in stature and have soft-textured flower heads. These foxtails are often sprawling, and tend to grow in damp soil. Young plants of timothy may resemble those of quackgrass (*Elytrigia repens*) and orchardgrass (*Dactylis glomerata*). Quackgrass may be distinguished by its claw-like appendages (auricles) at the top of the sheath. Orchardgrass leaves are folded in the bud.

Biology: Flowering occurs in June and early July. Seeds mature in late July or early August, and many germinate in August and September. Fall seedlings can continue to grow on warm days during the winter.
Timothy spreads primarily by seed, and clumps enlarge by tillering (formation of new shoots from the base of existing stems). However, the formation of tillers also serves another important purpose. Although this species behaves as a perennial, it is not a true perennial, since each stem and its associated root system survives for only one year. Tillering allows timothy plants to perpetuate themselves vegetatively. New shoots are produced from below the haplocorm (swollen area) at the base of mature stems. These shoots develop into new stems with new haplocorms and roots, and the old stems, haplocorms and roots die. The haplocorm is thought to aid in new shoot production. Most of the roots of timothy are found within a few inches of the soil surface. Timothy is generally grown for its use as hay. It is usually mixed with clover, alfalfa or birdsfoot trefoil.

Toxicity: None known. Pollen can cause dermatitis and hayfever.

Toadflax, Dalmatian *Linaria dalmatica*

Description: Perennial; blooms summer to fall. Grows two-three feet tall. Leaves waxy, green, heart-shaped and one-three inches long. Flowers are one inch long and similar to snapdragons. Spreads both by seeds and creeping lateral roots.

Impacts: This deep rooted perennial out-competes desirable forage plants for moisture and nutrients. Thrives in arid rangelands, pastures, and railways.

Toadflax, Yellow *Linaria vulgaris*

Other common names: Butter and eggs

Description: Perennial; blooms summer and fall. Grows 1 to 2 ft. tall. Leaves pale green, narrow and pointed at both ends. Flowers orange and yellow and snapdragon-like.

Impacts: Yellow toadflax is a potential weed problem in zero and minimum till areas because of its prolific seed production and creeping rhizome. It is an aggressive weed in rangeland where it quickly replaces grasses and herbs. It is an alternate host for tobacco mosaic virus. Some sources report that toadflax is poisonous to cattle.

Introduction: Introduced as an ornamental in the United States in the mid-1800's. This invader is still occasionally found in wildflower seed mixes. This plant can be found throughout the U.S.

Family: Snapdragon Family (Scrophulariaceae)

Origin and Distribution: Toadflax is a native of Eurasia that was introduced into North America as a garden flower despite warnings of its weedy potential. Because it was regarded as a desirable wild flower, it was allowed to escape cultivation and spread. As a result, it is now naturalized throughout the U.S. and Canada. Toadflax is commonly found in eastern North America and along the Pacific Coast. It can be found along roadsides, fence lines, waste places, pastures, rangeland, wood edges, and in cultivated fields. Reproduction is by seeds and creeping horizontal roots. The species is very adaptable and can be found growing in a wide range of conditions from sub-arctic to temperate, dry plateaus to damp rocks, mountain regions to grazed areas, and gravelly or sandy soils to fertile loams.

Plant Description: Toadflax is a perennial with erect, smooth, herbaceous stems that are less than 2 feet tall and emerge in clumps from a spreading root system. Soft, gray-green leaves, which are 1 to 1 1/2 inches long and narrow, are crowded onto each stem. Stems terminate with clusters of 15 to 20

snapdragon-like flowers that are about 1 inch long and yellow. Gently pinching the sides of a flower opens its 2 lips revealing an orange throat that acts as a guide for insects to nectar produced in the spur. The plant reproduces by seeds and creeping roots.
Root system - The root system consists of horizontal spreading roots and secondary fibrous roots.
Seedlings & Shoots - Young leaves are pale green with a powdery bloom, especially beneath. First true leaves are egg-shaped and the leaves that follow get progressively longer and more linear. Even in young plants, horizontal creeping roots form at the soil surface.
Stems - Stems are erect, leafy, 1 to 2 feet tall, and either hairless or sparsely hairy at the top. Stems may be branched, especially at the top. Multiple stems emerge from the same root system.
Leaves - Leaves are narrow, linear, soft, gray-green, and less than 1 1/2 inches long. Leaves are so densely crowded on the stem that they appear opposite (2 leaves per node) although they are alternate (1 leaf per node). Leaves taper at the base and attach directly to the stem.
Flowers - Flowers consist of 5 united petals forming a 2-lobed upper lip and a lower lip with 3 lobes that end in a long spur. Petals are yellow with an orange palate on the lower lip. Flowers look snapdragon-like and are about 1 inch long. Flowers are located at the top of stems in dense clusters of between 15 to 20.
Fruits & Seeds - Fruits are egg-shaped, 2-celled capsules filled with many blackish, disk-shaped, winged seeds. When dry, pores at the apex of each capsule open releasing seeds.

Similar Species: Dalmatian toadflax (*Linaria dalmatica*) is a related species that is more prevalent in the western portion of North America while toadflax is more common in the east. Compared with toadflax, Dalmatian toadflax is taller, more branched, and has broader leaves with rounded bases that clasp the stem. Also, its seeds are sharply angular rather than round and flat.

Biology: Toadflax flowers from June to August. Seeds are shed from July until frost. Most seeds fall near the parent plant, although seeds have broad wings making wind dispersal possible. Other agents of dispersal include water, insects, and animals. Toadflax reproduces by creeping roots, which results in clumps of individuals sharing the same root system. The plant can usually be controlled by intensive cultivation. Herbicides are also effective, especially if applied when flowering begins in summer. Populations resistant to some herbicides have been reported. Therefore, herbicides should not be used as a sole long-term agent of control. Biological control programs are currently being studied that use insect predators of flowers, fruits, and seeds.

Toxicity: None known.

Related Information:

- ✓ '*Linaria*' was derived from the Latin 'linon' or 'linum', which means flax, because the foliage looks similar to that of flax.
- ✓ 'Toadflax' refers to the resemblance of the flowers to toads and the foliage to flax.
- ✓ 'Butter-and-eggs' refers to the yellow and orange color of the flowers.
- ✓ Toadflax has been used medicinally to treat various ailments. Teas and lotions made from the foliage were used to treat such complaints as constipation, jaundice, insect bites, and throat problems.
- ✓ Toadflax was widely used to make yellow dye.
- ✓ According to Scottish superstition, walking around toadflax 3 times will unbind any spell, and the English believed that 3 toadflax seeds strung on linen thread would ward off evil.

Tropical Soda Apple *Solanum viarum*

Nature: Thorny, upright plant with oak-shaped leaves and prolific golf-ball fruit that are mottled green white turning to yellow in late summer to fall. Spreading rapidly in the southern parts of the region with transportation by cattle that have recently ingested fruits and by wildlife feeding of fruits. Viable seed in both green and yellow fruit, but non-viable in white fruit. Consolidates infestations by rootsprouts.

Origin: Native to Argentina and Brazil and introduced into Florida in the 1980's.

Uses: None.

Herbicide Control: Apply Garlon 4 (or Remedy in pastures) or Arsenal AC as 2% solutions in water (8 ounces in a 3-gal. sprayer) or a glyphosate herbicide as a 3% solution in water (12 ounces in a 3-gal. sprayer) with a surfactant to thoroughly wet all leaves and stems at times of flowering before fruit appear. Mowing can be used to stop fruit production and herbicide applications should only be made 50 to 60 days after mowing to allow for adequate regrowth.

Mechanical Methods
Since emerged weeds present at seeding or transplanting are capable of growing rapidly, it is important to kill all weeds prior to planting. Weeds that emerge after planting should be removed early before they are past 3 inches tall. Large weeds are difficult to remove without uprooting vegetable plants. Early season competition which may reduce crop growth, yield, and quality may also occur if weeds are allowed to remain past the 3-inch stage. Removal by hand or cultivation can be used to rid the garden of weeds.

With removal by hand, weeds can be hand pulled or removed using hand tools. Several small hand tools are available that are very effective on small weeds and for working near garden plants. They include the springtooth hand cultivator and the trowel. These tools limit the gardener to working solely on their knees.

There are a variety of effective tools that allow the gardener to stand while removing weeds. They include the scuffle hoe, the Warren hoe, the onion hoe, and the Garden Weasel. Scuffle hoes come in several shapes and are "push-pull" weeders that require no lifting. Perhaps, the most popular is the Dutch version, an open stirrup with a blade. Others consist of triangular plates. Most scuffle hoes are very light weighted and are effective on small weeds.

The Warren hoe has an arrowhead shape. It is effective in removing small weeds. It can be used to scratch a furrow with one end and when turned upside down the two shoulder points fill in the furrow. The onion hoe is a thin bladed hoe that is recommended when removing weeds near vegetable plants. It is easier to handle than large, heavy hoes. Onion hoes can be made by simply grinding a common hoe so the blade is thin. This will allow more precise maneuvering near vegetable plants.

The Garden Weasel has three sets of wheels with spikes that you "push-pull" to cultivate weeds. It is recommended where numerous small weeds are present. The Garden Weasel is also useful in breaking soil crust to aid vegetable crop emergence.

Trumpetcreeper *Campsis radicans*

Family: Bignonia Family (Bignoniaceae)

Other Names: *Tecoma radicans*, cow-itch, hell vine, trumpet vine.

Origin and Distribution: Trumpetcreeper is a native of the southern U.S. that once was valued for its climbing habit and large flowers but, having escaped cultivation, is now considered a widely-distributed, rampant weed. Its naturalized range includes most of the eastern U.S. Trumpetcreeper inhabits low moist areas, dry woods, thickets, old fields, and roadsides where it frequently is found climbing over trees, fences, and poles.

Plant Description: Trumpetcreeper is a deciduous perennial vine. In winter, plants can be recognized by straw-colored branches and aerial roots formed in bands below the leaf nodes on woody stems. Aerial roots are the only means of support for this climbing vine. Without additional support, vines grow about 10 feet long; if support is provided, vines can grow 40 feet long. The bell-shaped, bright-orange flowers are located in clusters at the ends of branches. Mature fruits, which are filled with winged seeds, are pods about the same size and shape of a small cigar. Trumpetcreeper reproduces by seeds, running roots, and stems that produce adventitious roots.

Root system - The vine produces vigorous running roots and aerial roots are formed in 2 rows below nodes on the stem.

Stems - Stems are woody and smooth. Aerial rootlets form below nodes on the stem. Vines grow up to 10 feet long in disturbed sites and 40 feet if supported and left undisturbed.

Leaves - Leaves are opposite (2 leaves per node), 8 to 15 inches long, and compound with 7 to 11 leaflets. Leaflets are egg-shaped and have pointed tips and coarsely toothed edges.

Flowers - Flowers are orange and trumpet-shaped with a united base and bell having 5-lobes. Flowers are 2 to 3 inches long, 2 inches wide, and located in clusters at the ends of branches.

Fruits & Seeds - Fruits are capsules that are 4 to 8 inches long, shaped like a small cigar, and filled with rows of winged seeds.

Similar Species: Leaves of many sumac species (*Sumac* spp.) appear similar to those of trumpetcreeper, but sumac stems are erect and upright while trumpetcreeper has viney stems that climb or trail.

Biology: Flowers form from June to September. Flowers attract hummingbirds, which are their primary pollinators. Leaves turn yellowish before dropping off in autumn. Woody vines persist throughout winter. In the south, the plant can be undesirably aggressive. To control, roots should be dug and foliage cut and burned before seeds mature.

Toxicity: Eating leaves or flowers may result in minor skin irritation with redness and swelling.

Related Information:

- ✓ The success of trumpetcreeper in urban areas is partly due to its ability to establish in such inhospitable places as between cracks in the sidewalks.

Velvetleaf *Abutilon theophrasti*

Description: Annual; blooms June to October. Grows from two feet to seven feet tall. Completely covered in soft hairs. Leaves alternate, heart-shaped and five or more inches in width. Flowers yellow, five petaled and solitary in leaf axils.

Impacts: Velvetleaf has been a serious weed in corn and soybeans but newer herbicides have allowed for better control. It is commonly found in cultivated fields, gardens, fencerows, and waste areas. It is an alternate host for tobacco streak and turnip mosaic viruses. The seeds retain their viability in the soil for more than 50 years, making control difficult.

Introduction: This weed is native to Asia. Introduced to North America as a potential fiber crop in the mid-1700s and now is common in many cropping systems in the U.S.

Vervain, Blue *Verbena hastate*

Family: Vervain Family (Verbenaceae)

Other Names: false vervain, hastateleaf vervain, ironweed, purvain, Simpler's-joy, wild hyssop.

Origin and Distribution: Blue vervain is native of North America. BLUE VERVAIN is common in the eastern part of the U.S. and rare west of the Mississippi. The species is found in meadows, pastures, ditches, and shores. It prefers gravelly or heavy loam soils and grows mainly on low ground and other moist places.

Plant Description: Blue vervain is an upright perennial. Among the characteristics it shares with other vervain species are small flowers consisting of 5 united petals in the form of a slender tube with a flared top. Flowers are located in dense spikes at the end of square stems. Fruits are nutlets that separate into 4, single-seeded sections and remain attached to the spike. Characteristics distinguishing blue vervain are its lance-shaped leaves, blue flowers, compact spikes, and fruits packed so tightly on the stem that they frequently overlap. It reproduces by seeds and spreads by short rhizomes (horizontal underground stems).

Root system - Roots are fibrous. Adventitious roots arise early from the base of the stem.

Seedlings & Shoots - Young leaves have hairs on the upper surface, edges, and veins on their lower surface. Leaves emit a mushroom-like odor when bruised. Young leaves and stems are often purple-tinged.

Stems - Stems are 2 to 7 feet tall, erect, square, coarsely grooved, covered with short hairs, and branched near the top. Stems often appear purplish.

Leaves - Leaves are opposite (2 leaves per node), 2 to 6 inches long, lance-shaped, serrated around the edge, and rough textured.

Flowers - Flowers are about 1/8 inch across and usually blue (rarely pink). They consist of 5 petals that are united forming a slender tube with a flared top. Stiff, pencil-like spikes of numerous small flowers form at the ends of stems and axillary branches. A few flowers bloom at a time, with the location of the open blossoms progressing steadily toward the tip of the spike.

Fruits & Seeds - Spikes are crowded with overlapping fruits that separate into 4 linear nutlets. Nutlets are reddish-brown, single-seeded, and have a ridged surface.

Biology: BLUE VERVAIN flowers in June through September.

Toxicity: None known.

Related Information:

- ✓ Vervain was very popular in European folklore. People wore necklaces of the flowers as charms to cure headaches, prevent snake bites, and bring general good luck. Priests and Druids were said to use it during rites and incantations.
- ✓ The plant was discovered on the Mount of Calvary, where it was used to dress the wounds of crucified Jesus Christ.
- ✓ When medicines were in short supply during the Revolutionary War, doctors used vervain as an emetic and expectorant with favorable results.
- ✓ Nearly 200 species in the genus Verbena are found in the New World. Many of these species have been hybridized and cultivated by New World inhabitants.

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

Vervain, White *Verbena urticifolia*

Family: Vervain Family (Verbenaceae)

Other Names: netted-leaved vervain, nettleleaf vervain.

Origin and Distribution: White vervain is native of North America. WHITE VERVAIN is common in eastern and central parts of the U.S. and rare on the west coast. White vervain establishes in old fields, pastures, roadsides, thickets, wood edges, and other disturbed places. The species prefers rich, heavy soils.

Plant Description: White vervain is an upright perennial. Among the characteristics it shares with other vervain species are small flowers consisting of 5 united petals in the form of a slender tube with a flared top. Flowers are located in dense spikes at the end of square stems. Fruits are nutlets that separate into 4, single-seeded sections and remain attached to the spike. White vervain has oblong-oval leaves, small white flowers, airy spikes, and widely-separated fruits scattered along the stem. It reproduces by seeds and spreads by short rhizomes (horizontal underground stems).

Root system - Roots are fibrous. Adventitious roots appear early at the soil surface and soon equal the taproot in length.

Seedlings & Shoots - Young leaves have hairs on the upper surface, edges, and veins on their lower surface. If crushed, leaves smell like puffballs. Young leaves and stems have dull purple staining.

Stems - Stem are 3 to 5 feet tall, slender, erect, square, grooved, slightly hairy, and have few branches. Stems often appear purplish.

Leaves - Leaves are opposite (2 leaves per node), 1 to 5 inches long, oblong-oval, and have deeply-serrated edges.

Flowers - Flowers are about 1/10 inch wide and white. They consist of 5 petals that are united forming a slender tube with a flared top. Numerous, open, long, slender spikes of small flowers form at the ends of stems and axillary branches. Flowers are scattered along the length of the stem giving spikes an airy appearance.

Fruits & Seeds - Scattered along the length of the spike are widely-dispersed fruits that separate into 4 oval nutlets. Nutlets are reddish-brown, single-seeded, and have a netted surface.

Biology: WHITE VERVAIN flowers in July through September.

Toxicity: None known.

Related Information:

- ✓ Vervain was very popular in European folklore. People wore necklaces of the flowers as charms to cure headaches, prevent snake bites, and bring general good luck. Priests and Druids were said to use it during rites and incantations.

- ✓ The plant was discovered on the Mount of Calvary, where it was used to dress the wounds of crucified Jesus Christ.

- ✓ When medicines were in short supply during the Revolutionary War, doctors used vervain as an emetic and expectorant with favorable results.

- ✓ Nearly 200 species in the genus Verbena are found in the New World. Many of these species have been hybridized and cultivated by New World inhabitants.

Virginia Creeper *Parthenocissus quinquefolia*

Family: Parthenocissus quinquefolia
Other Names: American ivy, five-fingered ivy, five-leaved ivy, woodbine.
Origin and Distribution: Virginia creeper is native of eastern North America. It is found in both natural areas such as woods, fields, and stream banks and disturbed sites including orchards, vineyards, roadsides, fencerows, and no-tillage fields. Sometimes it creeps along the ground but usually it climbs over trees, fences, utility poles, or buildings. This woody vine tolerates a wide range of soil conditions from dry and sandy to moist and rich. It is adapted to grow in full sun but is also moderately tolerant of shade.

Plant Description: Virginia creeper is characterized as a rapidly growing perennial vine with foliage that turns bright red in the fall. Traits that distinguish this creeping or climbing vine from other vines include compound leaves with 5 leaflets and oval-shaped adhesive disks that form at the tips of its branched tendrils. Plants establish by seeds and spread by rooting at stem nodes.
Root system - Roots form at the nodes whenever vines come in contact with soil.
Stems - Stems are woody and either trail along the ground or adhere to objects and other plants by way of small oval disks that form at the ends of branches.
Leaves - Leaves are alternate (1 leaf per node) and compound consisting of 5 (rarely 3 or 7) leaflets. Leaflets radiate from a central point like fingers from the palm of your hand. The oblong leaflets are 2 to 6 inches long and have toothed edges.
Flowers - Virginia creeper has inconspicuous greenish flowers that are small and form in clusters consisting of 50 to 150 flowers.
Fruits & Seeds - Fruits are small, blue-black berries about the size of peas. Many fruits aggregate in small terminal clusters. Each berry contains 3 or fewer seeds.

Similar Species: Poison ivy (*Toxicodendron radicans*) is another woody vine but its leaves have 3 (rarely 1 or 2) leaflets compared with Virginia creeper, which usually has 5 leaflets. Also, Virginia creeper tendrils end in oval-shaped adhesive disks while poison ivy adheres by way of aerial roots that give stems the appearance of a millipede. In addition, Virginia creeper has small blue-black fruits whereas the fruits of poison ivy are white berries. Thicket creeper (*Parthenocissus vitacea*) is a woody vine with compound leaves, but it is usually trailing rather than climbing. Although the tips of thicket creeper tendrils may appear enlarged, they lack adhesive disks. Boston Ivy (*Parthenocissus tricuspidata*) has tendrils that are tipped with adhering disks. However, Boston ivy leaves are 3 lobed and have smooth edges compared with Virginia creeper leaves that have 5 leaflets with teeth along their edges. Also, Boston ivy tendrils are much shorter than Virginia creeper tendrils.

Biology: Flowers appear in June to July. Fruits ripen in October. Stems grow as much as 20 feet in one year. The leaves of this deciduous woody vine turn brilliant red in the fall. Virginia creeper is sometimes grown as an ornamental that is valued for the color of its foliage in autumn. Berries are an important food for birds in winter. Controlling Virginia creeper with herbicides is problematic because the foliage must be covered thoroughly without harming other plants that may be supporting the climbing vine.

Toxicity: The berries as well as the leaves are reported to be toxic. Consumption of berries causes nausea, drowsiness, and profuse sweating and can lead to death. Touching the autumn foliage may cause dermatitis in a small percentage of individuals.

Related Information:

- ✓ Teas made from this plant have been used to treat numerous ailments including jaundice, gonorrhea, and rash caused by contact with poison sumac.
- ✓ Virginia creeper has been used as an astringent and a diuretic.
- ✓ 'Leaves of three, let it be; leaves of five, let it thrive'.
- ✓ It has been estimated that 10 pounds of force would be required to separate a Virginia creeper vine adhering to a surface by way of 5, disk-bearing branches.

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 herbicides 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.

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Western Salsify *Tragopogon dubius Scop.*

(Tragopogon major Jacq.)

Asteraceae (Sunflower family)
Origin: Europe and Western Asia

Location: gardens, roadsides, waste areas, cropland, field edges, rangeland, open woodland, and natural plant communities.

Occurrence: In the first year of growth, seedlings form a rosette which looks like a tuft of grass that dies back to the root with frost. The following spring a flowering stalk forms, which can produce blooms from mid-spring through early fall. Flower heads are open on sunny mornings and close up in the afternoon.

Description: An upright biennial. Sometimes bluish-green, the linear leaves grow between 2 and 12 inches long, and not more than 1/4 inch wide. Young rosette leaves are often somewhat woolly. The flowering stalk grows 1-3 feet tall, is hollow, and sometimes branched, with smooth leaves arranged alternately on the stem. Each stem has one flower head at the top made up of many yellow ray flowers' that is 1 - 2 1/2 inches in diameter. Stems are enlarged immediately below the flower head, and 8-13 linear bracts extend outward beyond the flowers. Each flower produces a 3/4 inch-long tan seedpod. The seed pod has a narrow, elongated tip with hairy off-white bristles that form a parachute shape. The collective seed pods form a globed-shaped seed head that can be up to 4 inches in diameter.

Weedy Characteristics: Western salsify is able to tolerate drought and nutrient-poor soils. Its seeds can be dispersed long distances by the wind. The plant has a long root and breaks easily when pulled, making it difficult to successfully remove by hand.

Control: Western salsify reproduces solely by seed, and its seeds do not remain viable in the soil longer than 2 years. Therefore, if seed production can be prevented, control can be achieved. Plants should be mown prior to flowering, or as soon as the plant flowers. If only a small number of salsify is present, digging before flowering is effective. Where possible, tilling can also be done. For current chemical or biological methods, consult your local state or county weed specialist.

General Facts: Western salsify was originally introduced as a garden plant. The common name "oysterplant" refers to the flavor of the roots when eaten raw or cooked. The leaves and stems of young plants can also be eaten. All parts of the plant produce a sticky, milky, bitter juice, which is not palatable to most grazing animals. Western salsify is listed as noxious in Ontario, Canada, and is considered invasive in several U.S. states.

Another similar salsify, Tragopogon portfolios , that is an escaped cultivated plant, is distinguished from western salsify by its purple flowerheads.

Other Common Names: common salsify, Western goat's beard, wild oysterplant, yellow goat's beard, yellow salsify

White Bryonia *Bryonia alba*

USDA Symbol: BRAL

Other common names: white bryony, wild hops, devil's turnip, and western kudzu

Description: White bryonia is a vigorous herbaceous perennial vine resembling kudzu in appearance and growth habit. Infestations will overgrow and smother small trees and shrubs forming dense mats which shade out all the vegetation it grows upon. If established in areas with no structure to climb, it will form a dense mat covering the ground. Vines emerge each spring from a large fleshy parsnip-shaped tuber and grow rapidly, sometimes to 30 feet in a season. White bryonia develops a herbaceous vine each year sporting tendrils and palm-shaped, alternate, broadly five lobed leaves which are covered on upper and lower surfaces by small white glands. Flowers are small, greenish-white, with five petals and produced in clusters.

Fruits consist of dark-blue berries that can be 5/16 inches in diameter when fully ripe. When crushed, the berries contain a viscous fluid and emit a very bad odor. While the plant leaves and vines resemble the native Marah oregana, the fruiting structure on the native cucumber is a golf-ball sized fleshy pod covered in soft pointed outgrowths, very unlike the black berries of the invasive species. The plants do not overlap in their growing environment. Reproduction occurs both sexually by seeds and asexually by apomixis. Population studies indicate multiple introduction events in the Pacific Northwest resulting in large clonal populations produced through apomictic production of propagules (Mack & Novak 2000). Some genetic variation is occurring through cross pollination between clones. For long-distant dispersal, blue-black seeds are produced which are eaten by birds and deposited after digestion.

Impacts: All parts of the plant contain byonin which is poisonous to humans. Poisoning cases have been reported from this and related species worldwide. Livestock are also poisoned by eating the leaves and fruit. Dried root powder derived from the tubers is used in herbal medicine treatments and sold on many websites. White bryonia aggressively climbs and smothers small trees and shrubs commonly found along riparian areas and springs.

Thick mats will exclude all other vegetation wherever it establishes in good soil. Many important geographic areas are at risk especially Hells Canyon and other river canyons of the Pacific Northwest where it can be expected to compete with native plants which often provide browse for game animals. Control and removal costs currently represent the largest economic cost to white bryonia invasion. Vines can present a problem in yards, fencerows on farms and in parks. Control is difficult and often takes several years.

Introduction: This plant is native to Europe and northern Iran. It has been documented in the United States in Montana, Nez Perce and Latah counties and in Idaho as well as the SE counties of Washington State. Report indicates that it is spreading rapidly in all areas.

White Clover *Trifolium repens*

White clover *Trifolium repens*

Description: White Clover is a perennial that forms creeping runners. These runners will root at nodes. Many people like clover in lawns, while others find white flowers and the bees they attract objectionable. Clover is a legume which fixes nitrogen, so it is often found in lawns having low fertility. To discourage it, increase turf density with proper watering, mowing and fertilization.

Control: Triclopyr + 2,4-D combination herbicides or other 2,4-D combination herbicides can be used. 2,4-D alone is not effective.

Whitetop, Hairy *Lepidium pubescens*

Description: Perennial, blooms April-October. Grows up to two feet tall. Leaves three inches long and one inch wide, often smaller. Hairs sparse. Petals white, mostly two to three and one half mm long. Pods strongly inflated, spherical to ovoid, and covered with short hairs. Hairy whitetop is difficult to distinguish from hoary cress in the vegetative state.

Impacts: Hairy whitetop is a common weed species on alkaline soils, but is not restricted to them. It forms dense patches that can completely dominate sites, restricting the growth of other species or degrading pastures. The species is not toxic to livestock but neither is it grazed.

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Whitetop, Lens podded *Cardaria chalapensis*

Description: Lens-podded whitetop is single-stemmed, erect perennial herbs and grows less than knee high. Flowers are generally dense, white and typically flat-topped. Leaves are shaped like a lance, up to four inches long and one inch wide and it clasp the stem and have a heart shaped bases. The infestation of this species is distinguishable by the large white patches in fields.

Impacts: This very invasive weed forms dense patches that can completely dominate meadows and fields, restricting the growth of other species or degrading pastures. The species is not toxic to livestock but neither is it grazed. It negatively affects native fauna as well and very strong competitors for nutrients and moisture. Whitetop is a common weed species on alkaline soils, but is not restricted to them. It has deep, long-lived taproots that store sugars.

Introduction: Lens-podded whitetop is native to central Europe and western Asia. It has now spread to all continents and is particularly common in many parts of North America. Common method of dispersal is through movement of root fragments in mud carried by livestock, vehicles and equipment. Seed dispersal is also commonly spread by hay and forage such as cut alfalfa and by flowing water.

Whitetop *Cardaria draba*

Other common names: Hoary cress

Description: Perennial; blooms early May. Grows up to 2 ft. tall. Deep-rooted. Lower leaves blue-green and lance shaped; upper leaves have two lobes clasping the stem. Many white flowers with four petals, giving plant a white, flat-topped appearance. Three known species, lens-podded, globe-podded, and heart-podded whitetop, identified by different shaped seed pods. Plants usually die back to roots in summer as seeds mature.

Impacts: Whitetop is a common weed species on alkaline soils, but is not restricted to them. It forms dense patches that can completely dominate sites, restricting the growth of other species or degrading pastures. The species is not toxic to livestock but neither is it grazed.

Wirestem Muhly *Muhlenbergia frondosa*

Family: Grass Family (Gramineae)
Other Names: Muhlenbergia communtata, Muhlenbergia mexicana, dropseed grass, knot-root-grass, Mexican drop-seed, satin-grass, wood-grass.
Origin and Distribution: A grass species native to North America, wirestem muhly is common in the eastern and north central U.S. Outside of agricultural fields, wirestem muhly grows on roadsides, stream banks, ditches, orchards, and other areas with rich, moist soils.

Plant Description: Wirestem muhly is a creeping, sod-forming perennial grass, characterized by a leafy, bushy appearance resulting from a freely-branching growth habit. It reproduces by seeds and rhizomes (horizontal underground stems). Plants can expand by producing new shoots (tillers) from the base of existing stems, and through stolons (horizontal stems at the surface of the ground that root at the nodes).
Root system - Wirestem muhly produces very scaly, short, thick, creeping rhizomes (horizontal underground stems) near the soil surface. Fibrous roots are produced from the joints (nodes) of the rhizomes.
Stems - The leafy stems (2 to 3 1/2 feet long) can be erect or sprawling, almost horizontal to the ground. Stems are smooth, stiff, wiry, round and many-branched, with branching branches. They are sometimes purplish in color. Reclining stems can root at the nodes.
Leaves - Leaves are rolled in the bud. The pale green leaves are produced along the stems, but are densest near the tips, giving the plant a bushy look. The leaf blade (free part of the leaf) is relatively short (1 to 4 inches long, 1/4 to 1/3 inch wide), flat and somewhat blunt-tipped. The upper and lower surfaces of the blade are hairless and usually rough. Leaf margins are rough. The leaf sheath (part of the leaf surrounding the stem) is smooth and rounded, with overlapping margins. The ligule (projection inside on the top of the sheath) is membranous, jagged and short (1/25 inch long). Auricles (appendages at the top of the sheath) are absent.
Flowers - Small flowers are densely arranged in a narrow, branched flower head (1 1/2 to 4 inches long, 1/3 inch wide). Flower heads are produced at the ends of stems and in the axils of most leaves, remaining partially protected in the leaf sheath. Flowers change from soft green to brown-purple as they mature.
Fruits & Seeds - The light brown seeds are approximately 1/16 inch long.

Similar Species: Wirestem muhly may be confused with nimblewill (Muhlenbergia schreberi) and quackgrass (Elytrigia repens). Nimblewill can be distinguished by its lack of rhizomes, delicate appearance and shorter stature. Quackgrass can be distinguished by its smooth, pointed rhizomes (versus the very scaly rhizomes of wirestem muhly), and the long, claw-like auricles at the top of the sheath.

Biology: Wirestem muhly flowers from August to October. This species reproduces primarily through its scaly rhizomes, and new plants can easily establish from small pieces of rhizome. An individual plant can produce approximately 450 rhizomes in one season. In addition, plants can enlarge by producing tillers (new shoots from the base of existing stems), as many as 200 per plant per season. Most other grasses have fewer stems per plant than wirestem muhly.

Prior to 1950, wirestem muhly was not considered a common agronomic weed. The emergence of this weed in agronomic systems coincides with the introduction of herbicides that are ineffective against wirestem muhly, and reduced tillage, which allowed it to spread from field margins. Because new plants can form from rhizome fragments, wirestem muhly is often spread from field to field by farm equipment. Repeated tillage is reported to help control this grass by breaking up the rhizomes into smaller and smaller pieces and continually bringing the pieces to the surface, where they desiccate. However, infrequent cultivation can actually increase a wirestem muhly problem because it breaks up the rhizomes, but leaves many of the rhizome fragments buried, where they can form new plants.

Toxicity: None known.

Related Information:

- ✓ The genus Muhlenbergia is named for a famous 18th century American botanist, Dr. Rev. Henry Muhlenberg, whose father was the founder of the Lutheran Church in the U.S.

Yarrow, Common *Achillea millefolium*

Family: Daisy Family (Compositae)
Other Names: bad man's plaything, bloodwort, carpenter's grass, carpenter's weed, devil's nettle, devil's plaything, dog daisy, fernweed, field hoop, herbe militaris, knight's milfoil, little feather, milfoil, nosebleed, old man's pepper, sanguinary, soldier's woundwort, squirrel tail, staunchgrass, staunchweed, thousand-leaf, thousand-seal, thousand-weed, yarroway.

Origin and Distribution: Common yarrow emigrated from Europe to North America where it formed a highly variable interbreeding complex with related native and introduced Asian species. The plant has a worldwide distribution including all of the northern and parts of the southern hemispheres. The plant establishes in a variety of places such as landscapes, pastures, prairies, rocky shores, roadsides, waste areas, and field edges. It thrives in most climates, prefers dry soil, and even tolerates drought. Common yarrow typically establishes in thin soils where conditions are unfavorable for other plants. The presence of the plant in pastures is generally regarded as a sign of deteriorating soil quality.

Plant Description: Identifiable features of this perennial weed are its creeping rhizomes, finely-divided fern-like foliage, flat-topped clusters of small whitish flowers, and sage-like aroma. Most leaves form at the base of the plant resulting in what appears like a rosette. Emerging later in the season are erect leafy stems tipped with clusters of 1/4-inch-wide flower heads, each consisting of 5 ray flowers surrounding 10 to 30 disk flowers. Plants reproduce by seeds and small patches develop from new shoots emerging from rhizomes (horizontal underground stems).
Root system - Making up the extensive root system are fibrous roots that extend deep into the soil and much-branched rhizomes (horizontal underground stems) spreading horizontally.
Seedlings & Shoots - Young leaves are divided into lacey lobes with hairs scattered over the upper surface, lower surface, and edge. Initially, plants produce leaves in a basal rosette. Young plants have aromatic foliage that smells like sage when bruised.
Stems - Stems are approximately 2 feet tall and either unbranched or forked above. Some plants produce hairy stems while those of others are smooth. Several stems often arise from the same root crown.
Leaves - Leaves are alternate (1 leaf per node), 3 to 10 inches long, lance-shaped in outline, with highly dissected segments that appear fern-like or feathery, gray-green, and covered with wooly hairs. Basal leaves are numerous and attached to the stem by way of stalks (petioles). Lacking petioles, stem leaves attach directly to the stem. Size decreases as the position of the leaf moves upward toward the tip of the stem. Leaves have a sage-like aroma.
Flowers - Each flower head is 1/4 inch wide and consists of 5 white or pinkish ray flowers (often mistaken for petals) surrounding 10 to 30 whitish disk flowers. Many flower heads aggregate into flat-topped clusters located at the ends of branches.
Fruits & Seeds - Single-seeded fruits are egg-shaped, about 1/10 inch long, flat, grayish, and have whitish edges. Unlike many other species of the Asteraceae, common yarrow seeds are not topped with a tuft of hairs (pappus).

Similar Species: Common yarrow leaves and those of wild carrot (*Daucus carota*) appear similar except leaves of common yarrow are more feathery and finely dissected. Also, common yarrow has a perennial root system including creeping rhizomes whereas wild carrot is a biennial species with a large taproot.

Biology: Plants flower from June until October. On average, plants produce 1600 seeds per year, and seeds are reported to be long-lived in the soil. Rhizomes spread 3 to 10 inches in a typical year, which would increase a 2-foot-square patch to four times its original area. Several cultivated forms are available for purchase as ornamental perennials. Common yarrow does not survive cultivation. Where frequently mowed, the plant persists in a low-growing form. Several herbicides are available that effectively control this weed.

Toxicity: The plant contains compounds known to cause such allergic reactions as rashes, dermatitis, and eczema in some individuals. Common yarrow also contains the alkaloid achilleine, which reportedly promotes perspiration.

Related Information:

- ✓ '*Achillea*' was the common name given to the plant by the Greeks in reference to Achilles, who used common yarrow to treat wounds incurred by his soldiers when they stormed Troy in 1200 B.C.; '*millefolium*', which means 'thousand-leaved' or 'many-leaved', likely referred to the finely divided leaves. The common name 'yarrow' was derived from 'garawa', an old German name for the plant. 'Squirrel tail' was given as a common name because the feathery leaves emerge early in March.

- ✓ Common yarrow was used to treat a variety of wounds and ailments. As recently as the 1940's, common yarrow leaves and flowers could be purchased for medicinal use from several American drug companies.

- ✓ Sheep eat common yarrow and can aid in its control.

- ✓ Common yarrow is an important food source for deer in autumn.

2017 Changes to EPA's Farm Worker Protection Standard

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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

Yellow Alyssum *Alyssum alyssoides*

Yellow Alyssum *Alyssum alyssoides*

Description: Yellow Alyssum is a member of the mustard family. An exotic imported from Europe, it threatens native grasses. The plants grow from 4 to 8 inches in height and branch at the base. The leaves are narrow, strap-like, and covered with star-shaped hairs. In spring, yellow flowers are borne in racemes. Seeds are formed in silicles that are round, flattened, and pointed at the top, much like a bellows. In summer, seeds drop out of the center of the pods, leaving a skeleton that resembles a pair of "spectacles."

Control: Yellow alyssum has a taproot that can be easily hand-pulled from moist soil in the garden. Post-emergent treatment with 2-4,D, or triclopyr is effective in controlling this weed in turfgrass. Yellow alyssum can be spot treated with glyphosate (Round-up, Kleen-up).

Yellow Flag Iris *Iris pseudacorus*

Other common names: Water flag, yellow flag and yellow iris

Description: Yellow flag is a very showy species growing 3-4 feet in height with the most vigorous growth attained in the wettest environments. The leaves are long, flattened and sword-like, typical of most iris. Large plant clumps are formed from the lateral growth of rhizomes sometimes attaining 20 feet in width. It has erect plant stalks with multiple flowers produced on each. Fruit capsules are large, 3-angled and up to 4 inches in length. Disk-like seeds are shed from the capsules throughout the fall and winter. Floating mats of seed can be observed in backwaters and marshes aiding dispersal. Reproduction can occur asexually through rhizome fragmentation or by seed production. Food storage in this species is unique. Fructan is the main storage compound held in the cells as opposed to starch. This allows the plants to metabolize energy under very low oxygen conditions and may provide cells with a natural anti-freeze for the winter.

Impacts: An infestation of yellow flag iris presents a dual impact on both human interests and native environments. This plant displaces native plants including sedges and rushes. This can reduce the carrying-capacity of wetlands for waterfowl and disrupt other ecological relationships. Irrigation canals and flood control ditches can be severely restricted by the physical nature of the plant clumps. Removal can be costly requiring large excavation equipment or herbicides. Control of heavily infested waterways can be cost prohibitive due to the huge volume of plant material needing to be removed. Any rhizome fragments that remain quickly reestablish a population.

Invaded marshes in some eastern states are experiencing a significant displacement of native sedges and rushes with monocultures of iris. Many over-wintering waterfowl species are dependent on sedge and rush seeds as a high-energy food source. Replacement of this food source with yellow flag iris would reduce the carrying capacity of these marshes to sustain waterfowl populations. A small volume of yellow flag still exists in the nursery trade. A variegated variety is popular with aquatic gardeners and can be found in several catalogs and web sites. The ease with which this plant can be established using rhizome fragments has led to extensive trading among gardeners and aquatic plant enthusiasts.

Introduction: Yellow flag is native to most European countries with the exception of Iceland. It is also known to occur in North Africa and the Mediterranean regions. It has significant freeze tolerance and can be found in Scandinavia to 68 degrees North. Most states in the U.S. report escaped populations. Yellow flag iris is a popular ornamental in North America that is planted in natural and artificial wet areas within urban and rural landscapes. It is particularly popular as a large and colorful flowering element in ponds and has been planted in wastewater ponds where it is used to remove heavy metals. Unfortunately, this plant commonly escapes from cultivation.

The species has naturalized extensively and is currently distributed across the United States. Once established, it is an aggressive invader in most wet habitats. Along the Pacific, Atlantic and Gulf Coasts it has invaded estuarine and wetland habitats. Inland, I. psuedacorus has invaded riparian, open water features and irrigation ditches. In these habitats it has displaced native plants, disrupted ecological relationships and interfered with water movement. It is reported weedy in New Zealand and Canada. Most states in the U.S. report escaped populations but the extent of these populations are not well documented.

Yellow Nutsedge *Cyperus esculentus*

Other common names: Chufa, chufa flatsedge, yellow nutgrass, swampgrass, coco, coco-nut, earth-almond, northern nutgrass, rush nut, tiger nut.

Description: Perennial sedge; grows 6 to 30 inches tall. Three-ranked leaves and triangular pithy stems. True leaves grow from base while long leaf-like bracts radiate out just below the umbrella-like flower cluster. Leaves and stems shiny. Spikelets yellowish-brown and borne on the ends of branches of unequal lengths. Can spread by seeds, roots, or by small underground nutlets that may lie dormant in the soil for several years. Seed production is insignificant to reproduction and spread of yellow nutsedge in cultivated fields. A single plant can produce seven to nine tubers at the end of rhizomes.

Impacts: Yellow nutsedge is adaptable to a wide range of climates and habitats and has invaded cultivated agriculture lands throughout North America. It prefers moist soils, and is most troublesome in onions, sugar beets, gardens, and ornamentals.

Introduction: Cyperus esculentus L. dates back to at least the fifth millennium BC in the Neolithic age and is thought to be the third most ancient domesticated foodstuff of ancient Egypt. The tubers were also used medicinally, taken orally, as an ointment, or as an enema, and used in fumigants to sweeten the smell of homes or clothing (Darby et al. 1977). Yellow nutsedge initially became established in North America in the southeastern United States. The U.S. patent office imported cultivated chufa tubers as a potential vegetable crop in 1854, and this may have been a source of weedy tubers as well (Bartlett1889). The weed spread northward and west to become a common pest throughout the continental United States and Hawaii, Mexico, and eastern Canada in the last 50 years and also extends northward along the Pacific coast to Alaska (Britton and Brown 1913; Holm 1991b; Mulligan and Junkins 1976;Stoller 1981).

Yellow Floating Heart *Nymphoides peltata*

USDA Symbol: NYPE

Other common names: Asaza, entire marshwort, floating heart, and fringed water lily.

Description: Aquatic perennial. Grows rooted to the bottom in water depths of 2-13 feet. Floating leaves heart-shaped to circular, 1 to 4 in long, purplish underneath with slightly wavy margins. Leaves attached to long stalks that arise from creeping underwater rhizomes. Flowers bright yellow, 5-petaled, and 1 to 1 1/4 inch in diameter. Reproduces by seed and by rooting at nodes and will regenerated from plant fragments.

Impacts: Yellow floating heart grows in dense patches, excluding light for native species and creating stagnant areas with low oxygen levels underneath the floating mats. These mats make it difficult to fish, water ski, swim or paddle. It displaces native plants and animals and decrease biological diversity. This troublesome aquatic changes how natural ecosystems work. Grows on slow-moving rivers, lakes, reservoirs, and ponds.

Introduction: Introduced to the U.S. as an ornamental water plant from the Mediterranean area.

Grass Section

Grasses are usually more difficult to identify than broadleaf weeds. It is especially useful to have a hand or pocket lens with 10x magnification power because grasses possess subtle characteristics that distinguish them from one another. Most of these identifying features are contained in the collar region. The collar region can be seen by carefully pulling the leaf blade back from the stem. When the blade is pulled back, look for the ligule. The ligule is a projection at the base of the leaf blade. If a ligule is present, it will appear as a ring of hair or it may be membranous (thin and almost transparent). It can be relatively large or small, and its tip can be jagged or smooth. Some grassy weeds will have auricles; these are small fingerlike structures that appear to clasp around the stem at the collar. Like broadleaf weeds, grasses may be hairy on either the top or bottom leaf surface, or both. Grass stems can be a key feature; most are rounded, while others are flattened. A few grassy weeds will also have hair on their stems.

Sedges can be relatively easy to distinguish from grasses and broadleaf weeds. From a distance, they appear grasslike; however, upon closer inspection, the stems are triangular in shape. The leaves on sedges usually appear very glossy or shiny in texture and the leaves are hairless and occur in sets of three.

Exotic Grass Control
Exotic grasses continue to spread and increasingly reside along highway right-of-ways and thus gain access to adjoining lands. Most exotic grasses are highly flammable, increasing fire intensities while promoting their spread after wildfire or prescribed burns, with wildland firefighters subjected to increased risks. Exotic grasses have become one of the most insidious problems in the field of wildlife management, because they can totally dominate pasture and prairie lands once established, having little wildlife value and leaving no room for native plants. Repeated applications of herbicides are required for control.

Cool Season Grasses

Kentucky Bluegrass (Poa pratensis)- This plant is readily identified by its boat-shaped leaf tip. This is the only cool season turfgrass with a boat-shaped tip. It spreads by rhizomes and tillers and forms a dense sod. New shoots (rhizomes and tillers) are produced primarily in the spring and late summer.

Creeping Bentgrass (Agrostis palustris)- This plant is a perennial cool season grass that forms a dense mat. The grass spreads by profuse creeping stolons and possesses rather vigorous, shallow roots. A defining characteristic of this plant is a long membranous ligule with auricles present.

Perennial Ryegrass (Lolium perenne)- This plant has a bunch-type growth habit with a folded vernation. There is a short membranous ligule present with short or absent auricles. One of the most recognizable characteristics of this plant is its shiny backside of the leaf blade.

Annual Ryegrass (Lolium multiflorum)- Annual ryegrass also has a bunch-type growth habit. However, this plant has a rolled vernation. The most notable characteristic of this plant is a claw-like auricle. The course leaf texture and prominent veination are also very notable characteristics.

Tall Fescue (Festuca arundinacea)- This plant has a bunch-type growth habit along with rolled vernation. The ligule is often short to long in length with short, blunt auricles. The leaf blade has a pointed tip with rough edges.

Warm Season Grasses

Buffalograss (Buchloe dactyloides)- This plant has a stoloniferous growth habit with a rolled vernation. There is a ligule present with a fringe of hairs but there are no auricles present. Most notable is pubescence on upper and lower surfaces.

Bermuda grass (Cynodon dactylon)- This plant can have rhizomes and/or stolons with a folded vernation. The ligule on this plant has a fringe of hairs as most other warm season grasses have. The best identifying characteristic of this plant is the uneven internodes on the stolons.

Zoysiagrass (Zoysia spp.)- This plant has a stonloniferous growth habit with a rolled vernation. The ligule has a fringe of hairs and there is no auricle. A helpful characteristic of this plant is the broad, continuous collar.

Bahia grass (Paspalum notatum)- The stolons on this plant are very thick along with a rolled or folded vernation. The ligule is membranous with a fringe of hairs.

Kikuyu grass (Pennisetum clandestinum) - Rhizomous and stoloniferous growth habit . This plant also has a folded vernation and a very smooth leaf blade.

St. Augustine grass (Stenotaphrum secundatum)- This plant also has a stoloniferous growth habit with a folded vernation. The ligule has a fringe of hairs and the leaf blade has a blunt tip. The ID characteristic of this plant is the 90 degree twist of the leaf blades.

Centipedegrass (Eremochloa ophiuroides)- This plant has the stoloniferous growth habit and the folded vernation. The ligule is membranous with a fringe of hairs. There is a very broad collar on this plant also.

Grasses and Reeds

Giant Reed *Arundo donax*

Nature: Large leafy reed to 20 ft. tall in clumps from dense branching rhizomes. Erect terminal flower stalks and seed heads appear in late summer, but no seed are produced. Spread is by rhizomes and movement of stem parts in soil or by road grading.
Origin: Native to western Asia, northern Africa, and southern Europe and introduced in the early 1800's. Uses: Ornamental.
Herbicide Control: Apply a glyphosate herbicide as a 2% solution (8 ounces in a 3-gal. sprayer) or Arsenal AC as a 1% solution (4 ounces in a 3-gal. sprayer), or combination of the two herbicides in water with a surfactant to thoroughly wet all foliage in September or October with multiple applications to regrowth.

Tall Fescue *Lolium arundinaceum* and formerly Festuca arundinacea and F. elatior

Nature: Cool-season grass that is dark green year-round except in summer, with whitish-eared areas where blades connect to the stem and stems having swollen nodes. Certain varieties contain toxins poisonous to livestock and wildlife.
Origin: Introduced from the Europe, and now widely distributed most everywhere in the world.
Uses: Planted for improved pasture for livestock production, wildlife openings, and soil stabilization.
Herbicide Control: For non-crop lands, apply a mixture of Plateau at 10-12 dry ounces + a glyphosate herbicide at 1 qt. in 20 gal. water per acre in late summer or spring (consult the label for additives). For forestlands, substitute Arsenal AC at 24 ounces for Plateau. Other grass control herbicides that may be useful in pasture situations include Vantage, Poast, Assure, and Select, which are usually more costly than those discussed above. A non-herbicidal control method is repeated early spring burns that inhibits fescue and encourages native warm season grasses.

Cogon grass *Imperata cylindrica*

Nature: Dense, erect perennial grass with wide yellowish-green leaves having off-center midveins and finely saw-toothed margins. Spreads by wind-blown seeds in early summer and rhizome movement in fill-dirt along highways, yielding circular infestations. Highly flammable and a severe fire hazard.
Origin: Native to Southeast Asia and introduced into FL and lower LA, AL, and GA in the early 1900's.
Uses: Improved forage initially projected but without success, and initially for soil stabilization.
Herbicide Control: Apply a glyphosate herbicide as a 2% solution (8 ounces in a 3-gal. sprayer) or Arsenal AC as a 1% solution (4 ounces in a 3-gal. sprayer), or combination of the two herbicides in water with a surfactant to thoroughly wet all foliage in September or October with multiple applications to regrowth. Apply these herbicides in spring before flowering to suppress seed production to prevent spread. Multiple treatments in successive years will be required for eradication.

Nepalese Browntop *Microstegium vimineum*

Nature: Dense, mat-forming annual grass with stems growing to 1-3 ft. long, often laying over, having alternate, lanceolate leaves to 4 inches long. Shade tolerant and occupies various habitats including creek banks, floodplains, forest roadsides and trails, damp fields, and swamps. Consolidates occupation and spreads by prolific seed production in late summer.
Origin: Native to temperate and tropical Asia and introduced near Knoxville, TN around 1919.
Uses: Ground cover.
Herbicide Control: Apply a glyphosate herbicide as a 2% solution in water (8 ounces in a 3-gal. sprayer) with a surfactant in late summer. Vantage is a more selective grass control herbicide that can be used in specific locations (see label) that can be more effective and have less impact on associated plants than glyphosate herbicides. Repeat treatments for several years to control abundant germinating seeds. Mowing or pulling just prior to seed set in September will prevent seed buildup.

Chinese Silvergrass *Miscanthus sinensis*

Nature: Tall, densely tufted, perennial grass, upright to arching, 5-10 ft. tall, long-slender leaves with whitish upper midveins. Silvery to pinkish loose plumes appear in fall, with spotty seed viability. Highly flammable and a fire hazard.
Origin: Native to eastern Asia.
Uses: Still widely sold and planted as an ornamental.
Herbicide Control: Apply Arsenal AC as a 1% solution (4 ounces in a 3-gal. sprayer) or a glyphosate herbicide as a 2% solution (8 ounces in a 3-gal. sprayer), or a combination of the two herbicides in water with a surfactant to thoroughly wet all foliage in September to October, with multiple applications to regrowth.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:
• Elimination of weed debris
• Control of annual weeds
• Suppression of perennial weeds
• Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

Exotic Bamboos
Golden Bamboo *Phyllostachys aurea*

Other Exotic Invasive Bamboos (Phyllostachys spp. and Bambusa spp.)
Nature: All bamboos that form extensive infestations besides the native switchcane (Arundinaria gigantea). All have jointed cane stems with bushy tops of long-pointed grass-like leaves on branching stems.
Origin: All native to Asia.
Uses: Ornamentals and fishing poles.
Herbicide Control: Apply a glyphosate herbicide as a 4% solution (1 pint in a 3-gal. sprayer) or Arsenal AC (or Chopper) as a 3% solution (12 ounces in a 3-gal. sprayer), or combination of the two herbicides in water with a surfactant to thoroughly wet all foliage in September or October, with multiple applications to regrowth. Apply these same herbicides or mixture at twice strength immediately to stems cut just above ground level.

Exotic Fern Control

Japanese climbing fern is presently the only exotic invasive fern in the temperate parts of the Southeastern Region.

Japanese Climbing Fern *Lygodium japonicum*

Nature: Delicate viney fern with lacy finely divided leaves and green to orange to black wiry vines that climb and twine to cover and smother shrubs and trees. One of three species of climbing fern in the Southeast with the others being American climbing fern (Lygodium palmatum) and the exotic, old world climbing fern (Lygodium microphyllum) in Florida, which have once-divided leaves. All are perennial plants, from creeping rhizomes.
Origin: Native to Asia and tropical Australia and introduced from Japan.
Uses: Ornamental and stilling being spread by unsuspecting gardeners.
Herbicide Control: Apply a glyphosate herbicide, Garlon 3A or Garlon 4 as 2% solutions (8 ounces in a 3-gal. sprayer) or Arsenal AC as a 1% solution (4 ounces in a 3-gal. sprayer) in water with a surfactant to thoroughly wet all leaves in July to October. Damage to surrounding plants may occur with these herbicides, especially Arsenal, due to soil activity.

Exotic Forb Control

Forbs are broadleaf herbaceous plants. Control treatments are usually by foliar sprays of herbicides.

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Weed Control Terms

The terms listed below are used in this course to describe herbicide applications:

Active ingredient (ai) – The chemical in a herbicide formulation primarily responsible for its phytotoxicity and which is identified as the active ingredient on the product label.

Acid equivalent (ae) – Expresses the rate or quantity as the herbicidally active parent acid. For example, 2,4-D acid is formulated with either sodium, an amine, or an ester to make the active ingredient salt sold as a formulated product. The active acid equivalent per gallon of a widely used ester formulation is 3.8 lb. ae/gal while the active ingredient is 6.0 lb. ai/gal.

Band application – Herbicide applied to a narrow strip centered over the crop row.

Broadcast application – Herbicide applied over entire area.

Directed spray application – Herbicide applied to a band along the row that includes the base of crop plants and the weeds in the row. Spray is directed across the row from nozzles positioned near ground level on each side of the row. This type of application allows use of chemicals that will injure the crop plant if more than a small part of the plant is contacted by spray. Special units that guide from the ground or mount on cultivators must be used.

Drop-nozzle application – Herbicide applied by means of nozzles mounted on extensions below the spray boom to avoid spraying upper parts of the crop plant.

Formulation – Refers to the form in which a herbicide is purchased. Common forms are liquids, granules, and wettable powders which contain added ingredients to improve storage, mixing, or application characteristics of the herbicides.

Post-emergence application – Herbicide applied to the crop and weeds after they emerge.

Pre-emergence application – Herbicide applied after a crop is planted but before it or weeds emerge.

Pre-planting application – Herbicide applied before the crop is planted.

Rate – The amount of active ingredient or acid equivalent of an herbicide applied to the area treated, that is, on a broadcast basis.

Soil incorporation – Mechanical mixing of the herbicide with the soil. Chemicals may be incorporated 2 to 4 inches with a disk or rotary tiller, 1 to 2 inches with a harrow or rotary hoe, or slightly covered with planter attachments. The desired depth of incorporation depends on characteristics of the chemical being used.

Camphor Weed ***Heterotheca latifolia***

Just break a leaf and you can easily recognize the smell of camphor.

Weed Control Section

Effective weed control usually results from a combination of cultural, mechanical, and chemical practices. The ideal combination for each field will depend on a number of considerations including: 1) the crop being grown, 2) the kinds of weeds, 3) the seriousness of the weed infestation, 4) the soil type, 5) the cropping system, and 6) the availability of time and labor.

Preventive weed control is the least expensive and the only foolproof method to stop invasions of weeds. If we don't have it now, let's not plant it. When purchasing plants or seeds make sure you know what you're buying. This is extremely important when purchasing plants or seeds by mail order or through the Internet. Be particularly wary of seed mixtures--completely read the product label and make sure you are familiar with all the species in the mix. Go native to make sure you aren't introducing current or potential noxious weeds. Reputable nurseries will be able to assist you in selecting native species of plants for your lawn, landscape, or garden. Master Gardeners are another source of information on the best species of plants to select for landscape or garden.

It is also important to prevent the accidental introduction of new invasive species. Make sure that compost, mulch, sod, fill soil, or any other amendment you use is free of weeds. Use a local source for these products.

Feed your livestock weed-free feed. Sometimes this is not possible during animal transport or for other reasons. Be certain to allow time for the animals to "clean out" the weed infested feed before putting them out on pasture or rangeland. The same is true of newly added cattle, horses, or other animals. Make sure you compost manure and bedding from the period during and just after feeding suspect feed. Check boats and off-road vehicles before leaving the area where you have used them. Weeds can be carried easily in water or mud so wash the vehicles as soon as possible following use.

Even if preventative steps are taken, infestations can still occur. Be constantly on the watch for areas where you suddenly notice a new flush of vegetation. Early detection is critical to complete eradication of the weed.

Control efforts can easily be intensified and eradication a realistic goal. Weeds can be spread by animals or birds, but new infestations are most commonly due to human activities. Look for new species of weeds in areas where human activity is most common or along waterways.

What do you do once the infestation has been identified?

- Mark the perimeter of the area to delineate the infestation and determine if the infestation is increasing or decreasing once control measures are applied.
- Limit activity to and from the area to make sure seeds, roots, and other parts aren't spread.
- Try to determine how the weed was introduced. If it appears due to logging, construction, or other activities, scout similar sites in the area.
- Check horse or recreational vehicle trails in the area to determine spread.
- Check upstream and downstream if the infestation occurs along water ways.
- Select the appropriate control measures and apply them aggressively.
- Monitor the area constantly to determine the effectiveness of the control measure. Seeds can lay dormant in the soil for 10 years or longer, continue monitoring for years after you've seen the last plant in the area.

Weed Prevention Steps

Key- Avoid weed establishment; eliminate individual survivors.

- Identify and map weed infestations; keep records over years.
- Recognize and eliminate new weeds before they multiply and establish.
- Employ sanitary procedures; prevent weed spread.
- Clean equipment between sites or infestations.
- Examine nursery plants, seed, and imported soil or media.
- Screen irrigation water where weed seed contaminates surface water transported in canals and rivers or stored in lakes or ponds.
- Control weeds and seed sources around the field or site.
- Establish county and state weed laws and noxious weed control programs.

When applying control measures, start with the most basic mechanical control. Dig out the plants if possible. Burn or compost the removed vegetation on site to prevent spreading them. Mowing can be effective, but mowing promotes low growth and low seed height which can't be prevented by mowing a second time. Also, equipment must be completely cleaned of vegetation and seed before removing from the site to prevent spreading the infestation. Mechanical control is expensive, but most effective and won't interfere with reestablishing desired vegetation on the site.

Mechanical Control

A combination of mechanical and chemical controls can be very effective on woody invaders like trees or shrubs. The woody plant can be cut with hand ax or saw and the stump wiped with 2,4-D, Roundup™, or some other herbicide. It is important to apply the herbicide to the stump immediately after cutting. A delay of even a few minutes will reduce efficacy of the herbicide.

Normally, biological control of newly invasive species is not practical and should not be considered. Identifying and developing biological controls can take years, and small infestations often can't sustain on the few plants present during the initial infestation. Thus, biological control, while effective on widespread infestation, is not a consideration in eradicating a species during the initial phases of an infestation.

Cultural Control is necessary following mechanical or chemical control. Digging and chopping cause soil disturbance and desired plants need to be reestablished before the invader can get a foothold. The same is true of chemical control, the desired vegetation must be reestablished. Moreover, you must remember that the invader was able to gain a toehold under the management regime that had been in place on that land. Consider plant species, fertilization, and other cultural aspects of weed control.

Mechanical Summary

Weed debris turned under; annual weeds controlled; perennial weeds suppressed if this practice is repeated every 10 to 14 days.

Cultural Practices

Cultural practices that are optimum for crop growth should be followed. These practices include: adequate fertility, optimum stands and row width, and proper seeding date. Tillage operations, if used, should be timed to destroy weeds. Tilling the soil immediately before planting will kill weeds that have germinated, thus giving the crop a competitive advantage and often improving weed control from chemicals that do not control weeds that have germinated.

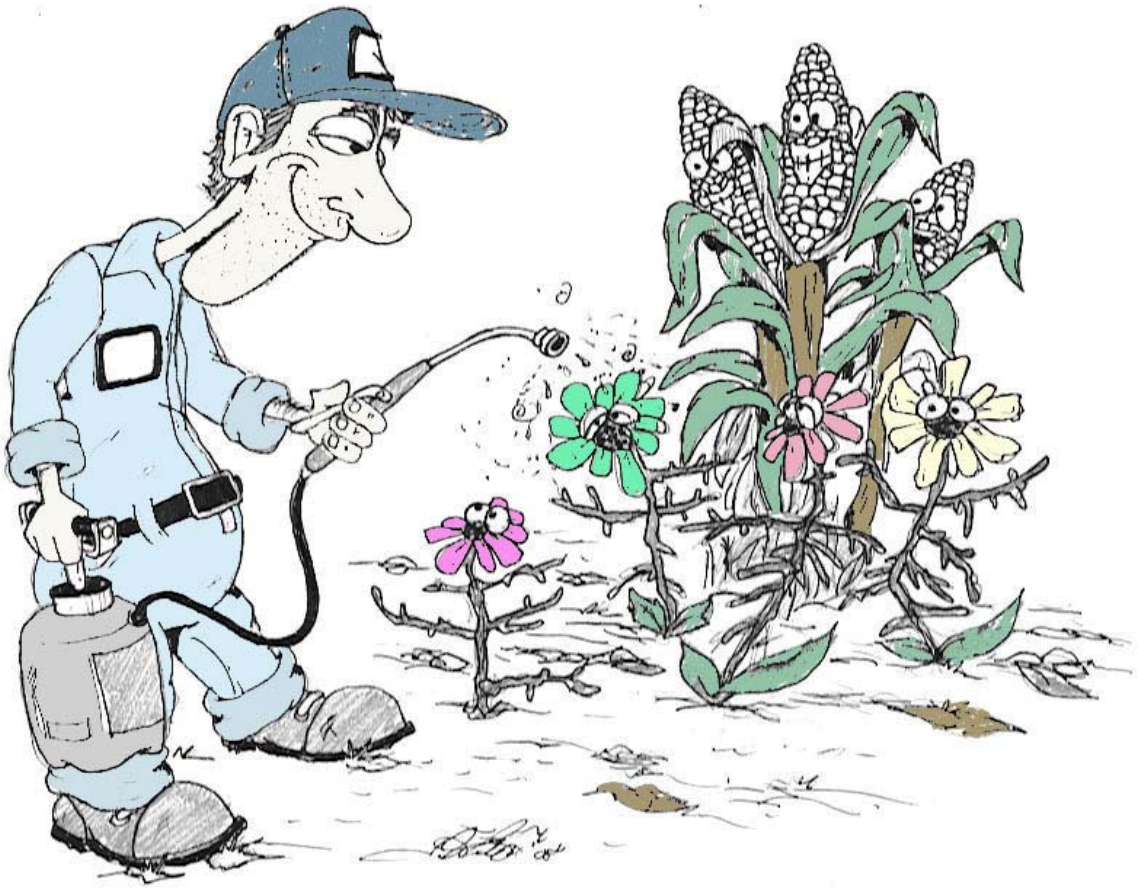
Early cultivations when weeds are small are most effective. Use a rotary hoe, harrow, or cultivator as soon as weeds begin emerging and are in the "white stage," even if herbicides have been applied. Set cultivators for shallow operation to avoid crop root pruning and to reduce the number of weed seeds brought to the surface. Throw enough soil into the row to cover small weeds. Shallow cultivation should be repeated as necessary to control newly germinated weeds.

Mowing is an effective weed control practice in perennial forage crops and non-cropland areas. To be effective, mowing must be done before seeds are formed which means you must mow by the time weeds are in the bud stage or just beginning to bloom. Earlier mowing will reduce weed competition and improve crop yield more than later cutting.

Cultural Summary *Integrate numerous components to minimize impact of weeds.*
1. Select manageable fields (identify weeds and choose crop according to feasibility of weed management strategies; e.g., avoid planting onions into perennial weeds).
2. Rotate crops (disrupt weed life cycles or suppress weeds in competitive crop followed by planting a noncompetitive crop).
3. Plant winter cover or competitive fallow crops in rotation to improve soils and crop management (specific cultivars are being evaluated).
4. Consider legumes to supplement nitrogen requirements.
5. Consider specific varieties of cereals with natural plant toxins (allelopathy); vegetation must remain uniform on soil surface; either perennial or large-seeded crops can be planted through undisturbed mulch.
6. Consider crops or cultivars that winter kill after vigorous growth during fall to avoid springtime controls.
7. Alter planting dates (plant for maximum growth or delay planting to control first weed flush).
8. Transplant slow-growing crops.
9. Band or spot fertilizer beside plant or seed (reduces availability to surface-germinating weeds).
10. Time additional side-dressings for maximum crop growth or to minimize weeds.
11. Develop crop canopy that shades weeds, suppresses weed germination.
12. Select crops or varieties that form canopy quickly.
13. Space plants in equidistant (triangular) arrangements and vary density depending on crop management constraints or harvest requirements (e.g., product quality).
14. Interplant crops in space and time (consider mechanical limitations in commercial plantings).
15. Combine broadleaf and taller, narrowleaf crops (corn or beans with pumpkins).
16. Relay plantings or harvest short-duration crops within longer maturing crops (bush beans with corn; cucumbers with peppers; tree crops with vegetables).
17. Manage appropriate living mulch (grass or legume) between perennial crop rows.

Improve pasture management by reseeding and/or fertilizing with or without control measures to reduce weed infestation (weeds often are a symptom of poor management).

Apply Mulch, Black Plastic or Geo-textiles
Organic materials: Straw (may reduce available N when decomposing; often infested with weed seed). Sawdust (avoid vertebrate pests by maintaining mulch-free circle around tree; perennial weeds become a serious problem).
Bark mulch: Newspapers (during emergence, rhizomes of some perennial weeds become disoriented when penetrating 6 to 16 layers of overlapped newspaper).
Plastic: Black excludes light, controls most annual weeds.
Clear plastic acts like greenhouse; poor weed control. New wavelength-selective plastics for pest management (research is progressing).
Geo-textiles (available at ag and garden supply stores): **Spunbonded fabrics** (nonwoven): lightweight, extruded polypropylene fibers; requires mulch cover due to moderate UV light sensitivity; weed roots and rhizomes can penetrate fabric unless removed before establishment; cheapest option.
Woven fabrics: moderate-weight polypropylene fibers woven into a mat; can be used without mulch cover due to UV light stability; weed roots and rhizomes can penetrate fabric although tightness of weave can prevent some weeds; moderate cost.
Laminates: highly porous, dense poly film bonded to capillary fibers with a pressed, nonwoven bottom layer. Surface is slick and causes rapid wetting and drying to prevent weed establishment except for perennial rhizomes which can penetrate the laminate; most expensive geo-fabric.
Solarization: Thin plastic secured tightly over loose, moist soil for 10 to 12 weeks will suppress weed infestations and other pests during hot season.



Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

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.

Broadleaf Weed Control for Home Lawns

The development and maintenance of a dense, healthy stand of grass is the best way to reduce the incidence of broadleaf weed problems developing in home lawns. To facilitate the production of healthy lawns, homeowners should incorporate recommended turfgrass selections and management practices into their establishment and maintenance programs. These recommendations include the use of adapted species and cultivars, adequate fertilization programs, proper mowing practices, adequate supplemental irrigation, and necessary insect and disease control measures. Occasionally however, even the best cared-for lawns are sometimes invaded by broadleaf weeds. To have a completely weed-free lawn, the homeowner may have to resort to the careful and selective use of broadleaf weed control herbicides.

POSTEMERGENT HERBICIDES can be used to control broadleaf weeds (i.e., non-grassy weeds) that are not prevented with the use of preemergent herbicides. It is essential that sensible cultural practices be used to encourage rapid fill-in soon after the turf has been treated with the weed control chemical, since new weeds will quickly reinfest the areas left open by the recently-killed weeds. For this reason, HERBICIDE USE SHOULD BE REGARDED AS ONLY ONE TOOL IN THE TOTAL WEED CONTROL PROGRAM.

WHICH HERBICIDE TO USE?
Before using a postemergent herbicide for broadleaf weed control, it is important to identify the weed(s) which you are attempting to control. The reason is that not all weed species are controlled via the use of one specific herbicide. The homeowner may need to use a combination of two or more herbicides to obtain the desired control. If you cannot identify the weed(s) in question, seek help from garden center personnel, or your county Extension agent.

The most readily available chemicals to homeowners for selective, postemergent control of broadleaf weeds include: 2,4- D, 2,4-DP, MCPP, and dicamba. These chemicals are available alone, and in various combinations with each other. Combination products are recommended for difficult-to-control weeds or when a variety of weed species is present in the lawn. All are available in liquid formulations (sprayable), and often in granular formulations (generally with a fertilizer) which can be applied with a drop or broadcast spreader. All of the chemicals listed above are safe for use on Kentucky bluegrass, perennial ryegrass, tall fescue, and fine fescue lawns IF THE DIRECTIONS ON THE LABEL ARE FOLLOWED. MCPP is the safest of the listed herbicides to use on bentgrass lawns.

If you decide to use an herbicide to control weeds, be sure to select the appropriate product for your situation. There are hundreds of different herbicides on the market.

Tips for selecting and using herbicides:

- Be sure to read, understand and follow all of the label directions when mixing and applying herbicides.
- Make sure the label clearly states that the product can be used in the manner you intend to use it.
- Remember, more is not better. Use the application rate on the label.
- Some herbicides are selective, and only kill certain types of plants, while others are non-selective and kill almost any type of plant.
- Some herbicides kill weeds quickly, others can take up to a week or more.
- Some herbicides persist in plants and soils for long periods of time, while others only remain in plants or soil for a short time.
- Some herbicides have active ingredients that are more likely to move through soils towards groundwater. Others are much less likely to move through soils.

WHEN TO APPLY?
Applications of herbicides intended for postemergent broadleaf weed control will only kill those weeds present at the time that the herbicide is applied. They DO NOT prevent weed seeds from germinating and

developing in the lawn at a later date. It is also important to remember weeds must be actively growing when the herbicides are applied so effective control can be achieved. This means that spring applications should be made from mid-April through early June, and fall applications should be made during the months of September and October. Herbicide applications during July and August are strongly discouraged because not only will weed control be more difficult to achieve but also an increased risk of causing damage/ discoloration to the lawn.

HOW TO APPLY?

Liquid and granular formulations of herbicides can be equally effective if they are used properly. Neither should be applied if rain is expected within 24 hours of application. For best results, the turf should NOT be mowed or watered for at least 24 hours following application of either granular or liquid products. Granular herbicides will be most effective if applied to grass that is moist (from morning dew, rainfall, or irrigation) because the granules will adhere to the wet surfaces of the weeds.

Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Weed Control	Life Cycle(1)	Recommended Chemical(2)	Time of Application	Degree of Control
Bindweed	P	2,4-D ester or dicamba(4)	early summer	good
Black medic	A	dicamba(4)	early spring	good
Chickweed, common	A	MCPP or dicamba(4)	spring or fall	good
Chickweed, mouse-ear	P	MCPP or dicamba(4)	fall or spring	good
Chickory	P	2,4-D	spring	good
Cinquefoil	P	2,4-D	fall or spring	good
Dandelion	P	2,4-D or dicamba(4)	fall or spring	good
Dock, curly	B	2,4-D or dicamba(4)	fall or spring	good
Garlic or onion	P	2,4-D ester	late fall, early spring	fair
Ground ivy	P	dicamba(4,6)	summer, fall or spring	fair-good
Heal-all	P	2,4-D	spring	good
Henbit	A	dicamba(4)	spring	good
Knotweed	A	dicamba(4,6)	spring to mid-summer	good
Mallow roundleaf	A	dicamba(4)	spring	fair
Pigweed	A	2,4-D or MCPP	summer	good
Plantain, buckhorn	P	2,4-D or MCPP	fall or spring	fair
Plantain, common	P	2,4-D or MCPP	fall or spring	good
Poison ivy	P	Amitrol-T or Roundup(5)	spring or summer	good
Purslane	A	dicamba(4)	spring or fall	good
Red sorrel	P	dicamba(4)	spring, summer or fall	good
Speedwell, creeping	P	2,4-D, MCPP or Dicamba	fall or spring	good
Speedwell, annual	A	dacthal	spring or fall	fair

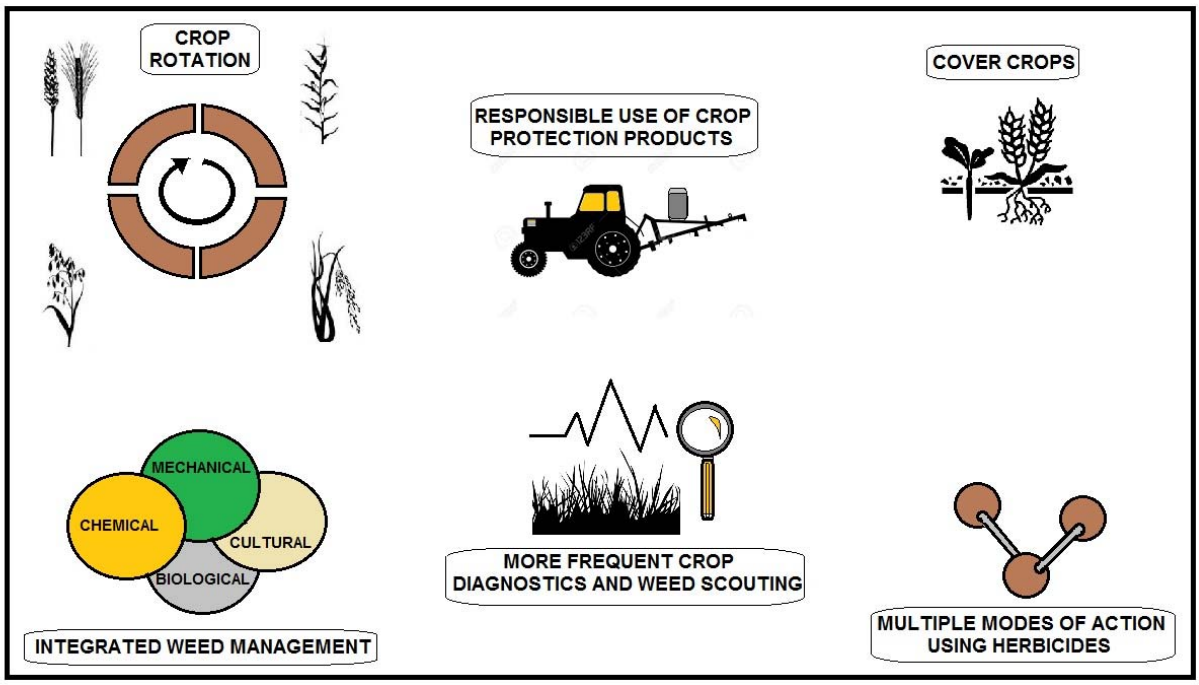
Spurge, spotted	A	dicamba(4,6) or MCPP	summer	fair-good
Sow thistle	A	2,4-D or dicamba(4)	fall	good
Thistle(3)	P	dicamba(4)	spring	fair-good
Wild violet	P	dicamba(4,6) or triclopyr	spring or fall	fair-good
White clover	P	MCPP or dicamba(4)	spring, summer or fall	good
Wild carrot	B	2,4-D or dicamba(4)	fall or spring	good
Wood sorrel (Oxalis)	A	2,4-D ester, MCPP or dicamba(4,6)	early summer	fair-good
Yarrow	P	dicamba(4)	spring	fair

(1) A = Annual, B = Biennial, P = Perennial.
(2) Do not use 2,4-D on golf course greens and use with caution on other bentgrass turf.
(3) Three or more applications may be necessary to eradicate thistle.
(4) Dicamba may accumulate in the soil with frequent or extensive use which may result in damage to trees, shrubs, or other ornamentals.
(5) Nonselective herbicides. Spot treat only.
(6) 2,4-D plus dichlorprop (Weedone formulations) 2,4-D plus triclopyr (Turflon formulations) and triclopyr plus clopyralid (Confront) are effective combinations for many broadleaf weeds, including hard-to-control species such as ground ivy, wood sorrel (oxalis), spotted spurge and wild violets.

Steps should be taken to prevent erosion when using mechanical and burning treatments. For example, burning in late winter or during spring leaf-out, minimizes the period of bare soil.

An eradication program for infestations of troublesome plants usually takes several years and surveillance for many more years to check for seed germination or new invasions. Doing this in a planned manner and being persistent is the only successful strategy. In this way, land access, productivity, and native plants can be safeguarded and wildlife can continue to have suitable habitats.

The following are herbicide prescription summaries for prevalent exotic pest plants. These prescriptions have been assembled from my published and unpublished trials, other's published research results, and reports in State and weed council's manuals, magazines, and websites (refer to list at the end). In general, very few species-specific experiments have been performed and reported that compare a full array of treatments aimed at an exotic species. But until further specific understanding is gained, we must proceed using our current knowledge and technology to combat this exotic plant invasion.



Technical Learning College

WEED RESISTANCE

Herbicide Application Section

Herbicide applications can be effective, but little information is usually known about the selectivity of a particular herbicide on newly invasive species. If the weed is a broadleaf, start with a phenoxy herbicide, such as 2,4-D, and closely monitor effectiveness. These herbicides are effective in controlling most broadleaf weeds and allow grasses to continue growing. However, before selecting a particular herbicide, determine the effect it might have on the desired vegetation. Typically, it is not possible to selectively kill the invader without killing a few desired plants. Moreover, you'll want to reestablish desired vegetation and many herbicides can persist in the soil and prevent successful reestablishment. If patches are small it might be worthwhile to use Tordon™ or other residual herbicides to completely kill the infestation and then closely monitor vegetative reestablishment.

Nonselective herbicides will kill all vegetation and require a reestablishment of desired vegetation. Glyphosate, sold as Roundup™ and other products, will kill all existing vegetation, but will not persist to cause problems with vegetative reestablishment.

Selecting Chemicals
Selection of an appropriate chemical or combination of chemicals should be based on consideration of the following factors:

- Label approval for use
- Ground and surface water pollution concerns
- Use of the crop
- Crop and variety tolerance
- Potential for soil residues that may affect following crops
- Kinds of weeds
- Soil texture
- pH of soil
- Amount of organic matter in the soil
- Formulation of the chemical
- Application equipment available
- Potential for drift problems
- Tillage practices
- Herbicide performance
- Herbicide cost
- Herbicide resistant crop

The information in this publication and on product labels will help you select and use chemicals properly according to the above factors. Proper application of chemicals is essential for obtaining satisfactory results. Follow the suggested rates on labels for specific soil and weed situations carefully. Apply herbicides at the times specified. Delayed applications usually result in poorer weed control and may injure the crop.

Weather conditions will affect herbicide performance. Weed control from soil-applied herbicides may be poor if there is insufficient rain soon after treatment, which will make timely cultivation necessary to control emerging weeds. If rainfall is very heavy, some herbicides may be moved downward in the soil, resulting in poor weed control and/or crop injury. Temperature and moisture conditions affect the weed control and crop injury resulting from herbicides applied postemergence. Observe label precautions regarding weather conditions and crop and weed size when applying herbicides.

Liquid and granular formulations of herbicides can be equally effective if they are used properly. Neither should be applied if rain is expected within 24 hours of application. For best results, the turf should NOT be mowed or watered for at least 24 hours following application of either granular or liquid products.

Granular herbicides will be most effective if applied to grass that is moist (from morning dew, rainfall, or irrigation) because the granules will adhere to the wet surfaces of the weeds.

Care should always be exercised when applying herbicides near trees, shrubs, flowerbeds, and vegetable gardens. Drift from spray applications or misdirected application of granular products can result in damage or death of these plants. It is important that dicamba NOT be applied within the dripline of trees or shrubs. Dicamba can be root absorbed by these plants, possibly resulting in damage.

Postemergence Herbicides

Postemergence herbicides are used to kill weeds after the weed plants are up and growing. To be effective, most postemergence herbicides must be absorbed through the leaves; consequently, liquid sprays generally work better than dry, granular materials. However, granular formulations may be the most practical way for homeowners to apply these materials.

Postemergence herbicides are most effectively applied when weeds are young and growing vigorously.

Selective postemergence herbicides are usually used to control annual, biennial, and perennial broad-leaved weeds because they will kill many broadleaf plants without damaging grass plants. These herbicides can severely damage or kill trees, shrubs, and flowers; thus, they should be used with great care near these plants.

Postemergence herbicides may be applied any time the weeds are actively growing, the air temperature is 60–80°F, there are no winds, and there is no rain in the forecast for 48 hours. Most effective control of perennial broadleaf weeds is obtained when applied in early fall (August 15–October 15) or in spring (May 1–June 1). For some weeds, repeated application at 20–30 day intervals may be required for control.

Nonselective postemergence herbicides kill all plants, both desirable and undesirable. These herbicides can be used to spot treat perennial grassy weeds that are not affected by selective herbicides. To spot treat an area, thoroughly wet the weed foliage with herbicide solution.

Pre-emergence or selective pre-emergence granular materials may be applied with a fertilizer spreader. The spreader must set or be calibrated to apply recommended rates. The preferred method of application is to apply one-half the recommended rate in one direction and one-half at a right angle to that direction.

Compressed air sprayers or sprayers attached to a garden hose are effective for liquid applications. Remember that the higher the pressure and the finer the mist, the more likely it is that the herbicide will drift and injure shrubs, trees, flowers, and vegetables.

Sprinkler cans can be used on small areas, but once any applicator has been used to apply herbicides, it should not be used to spray other pesticides on ornamental or garden plants. You should use a separate sprayer for killing weeds. Be sure to clean the sprayer thoroughly after each use.

Weed Control Table #1

Weed Control	Life Cycle(1)	Recommended Chemical(2)	Time of Application	Degree of Control
Bindweed	P	2,4-D ester or dicamba(4)	early summer	good
Black medic	A	dicamba(4)	early spring	good
Chickweed, common	A	MCPP or dicamba(4)	spring or fall	good
Chickweed, mouse-ear	P	MCPP or dicamba(4)	fall or spring	good
Chickory	P	2,4-D	spring	good
Cinquefoil	P	2,4-D	fall or spring	good
Dandelion	P	2,4-D or dicamba(4)	fall or spring	good
Dock, curly	B	2,4-D or dicamba(4)	fall or spring	good
Garlic or onion	P	2,4-D ester	late fall, early spring	fair
Ground ivy	P	dicamba(4,6)	summer, fall or spring	fair-good
Heal-all	P	2,4-D	spring	good
Henbit	A	dicamba(4)	spring	good
Knotweed	A	dicamba(4,6)	spring to mid-summer	good
Mallow roundleaf	A	dicamba(4)	spring	fair
Pigweed	A	2,4-D or MCPP	summer	good
Plantain, buckhorn	P	2,4-D or MCPP	fall or spring	fair
Plantain, common	P	2,4-D or MCPP	fall or spring	good
Poison ivy	P	Amitrol-T or Roundup(5)	spring or summer	good
Purslane	A	dicamba(4)	spring or fall	good
Red sorrel	P	dicamba(4)	spring, summer or fall	good
Speedwell, creeping	P	2,4-D, MCPP or Dicamba	fall or spring	good
Speedwell, annual	A	dacthal	spring or fall	fair
Spurge, spotted	A	dicamba(4,6) or MCPP	summer	fair-good
Sow thistle	A	2,4-D or dicamba(4)	fall	good
Thistle(3)	P	dicamba(4)	spring	fair-good
Wild violet	P	dicamba(4,6) or triclopyr	spring or fall	fair-good
White clover	P	MCPP or dicamba(4)	spring, summer or fall	good
Wild carrot	B	2,4-D or dicamba(4)	fall or spring	good
Wood sorrel (Oxalis)	A	2,4-D ester, MCPP or dicamba(4,6)	early summer	fair-good
Yarrow	P	dicamba(4)	spring	fair

(1) A = Annual, B = Biennial, P = Perennial.
(2) Do not use 2,4-D on golf course greens and use with caution on other bentgrass turf.
(3) Three or more applications may be necessary to eradicate thistle.

(4) Dicamba may accumulate in the soil with frequent or extensive use which may result in damage to trees, shrubs, or other ornamentals.
(5) Nonselective herbicides. Spot treat only.
(6) 2,4-D plus dichlorprop (Weedone formulations) 2,4-D plus triclopyr (Turflon formulations) and triclopyr plus clopyralid (Confront) are effective combinations for many broadleaf weeds, including hard-to-control species such as ground ivy, wood sorrel (oxalis), spotted spurge and wild violets.

Grass Weeds Table #2

Annual bluegrass (A, P) Barnyardgrass (A) Crabgrass (A) Foxtail (A) Goosegrass (A)	Use pre-emergence herbicides. Apply two to three weeks prior to expected germination of weed seeds. Some of these herbicides may injure fine fescues or bentgrasses. Most pre-emergent herbicides will harm newly seeded grasses except siduron (Tupersan).
Bromegrass (P) Quackgrass (P) Tall Fescue (P) Creeping bentgrass (P)	These weeds can be controlled only with nonselective herbicides. Spot treat only because herbicide will also kill desirable grass plants. Apply when weeds are actively growing.

A = Annual

P = Perennial

WA = Winter annual

Herbicidal Summary
Requires precision calculations, equipment, and application.

Selectivity

- Crop naturally tolerates herbicide (internal selectivity).
- Placement of herbicide prevents crop exposure.
- Timing of application to avoid susceptible stage of growth.
- Labeling requires extensive testing.
- Toxicology includes acute, subacute, and chronic toxicity; teratology (fetus); reproduction, mutagenicity (cancer); neurotoxicity (nerves); and metabolism studies along with worker exposure.
- Environmental fate includes breakdown, groundwater, ecological effects on plants and animals.
- Tolerance assessment considers normal application procedures and preharvest intervals for assessing residues within food products.

Crop Herbicide Table # 3

S. No.	Family or natural order	Descriptive features of the family	Habit and habitat of weeds	Herbicide recommendations
	(1)	(2)	(3)	(4)
1.	Acanthaceae (acanthus family)	Herbs or shrubs. Leaves, opposite, ex-stipulate. Flowers, bisexual, irregular. Calyx 4-5 partite. Corolla, two-lipped and five-lobed. Stamens, four or two, epipetalous. Fruit, a capsule.	*Justicia quinqangularis,* an annual *Kharif* season weed, occurring in crops, like rice, maize, sugarcane and cotton.	In the case of rice, MCPA or MCPB @ 5kg ha+urea 3% in 700 liters of water 3-4 weeks after direct seeding or transplanting. In the case of cotton, CMU pre-emergence @ 0.5- 1.0 kg/ha in 900 liters 0f water. In the case of maize and sugarcane, Atrazine or Simazine pre-emergence @ 1 kg/ha in 900 liters of water.
2.	Amaranthaceae (pigweed family)	Leaves, alternate; flowers, small, without petals, subtended by small bristly bracts. Fruit, one seeded, the thin pericarp releases the lens-shaped, shiny black seeds	*Amaranthus spinosus(kataili chulai)* Annual a. *viridis* Annual Reported to grow in sugarcane, maize, rice and onion A. *polygamous (Csiru kearai) Celosia argentea,* cock's comb (*sufaid murga*); Annual. *Digera arvensis(tendala)* Annual, a *kharif* season weed occurring in millets, maize, sugarcane and cotton; *Achyranthes aspera;(chirchiri)* in wasteland	In the case of rice, MCPA or MCPB @0.5 kg/ha + urea 2%. In the case of cotton, CMU pre-emergence @ 0.5-1.0 kg/ha 2-3 weeks after transplanting.(Other details given above)
3.	Asclepiadaceae (milk-weed family)	Herbs or shrubs with milky juice. Leaves, opposite ex-stipulate. Flowers,regular,bisexual and in umbellatem clusters. Calyx,5-lobed; corolla, gamopetalous. Stamens,five and filaments and united. Fruit consists of two follicles.	*Calotropis gigantea.* A large shrub. Mostly seen on waste and submarginal land.	Susceptible to 2,4-D amine 1-2 l/ha in 900 liters of water before flowering.

4.	Boraginaceae	Leaves, alternate, exstipulate; flower, regular; corolla, gamopetalous; stamens, 5, attached to the corolla tube. Fruit, a drupe, or breaks into 2-4 nutlets.	*Heliotropium eichwaldi* Annual H. *indicum* Annual Reported to occur in sugarcane, maize and cotton.	In the case of sugarcane and maize, Atrazine or Simazine @ 1 kg/ha. For other details refer to No.1.
5.	Cannabinaceae or Urti caceae (nettle family)	Plants annual. Leaves, palmately compound in *Cannabis* Flowers, greenish; male flowers, borne in long drooping panicles and female flowers borne in short axillary spikes.	*Cannabis sativa* Annual, *(bhang)* dioecious in nature. Occurs on wasteland, bunds and water channels.	Susceptible to 2,4-D ester or a mixture of 2,4-D+2,4,5-T @ 1.0-2.0/ha during flowering or earlier.
6.	Chenopo diaceae (goosefoot family)	Leaves, alternate; flowers small, without petals, no bristly bracts. Fruit, one-seeded and the pericarp is adherent to the seed.	*Chenopodium album* (lamb's-quarters) (bathua) C. *murale (khar bathua)* Annual *rabi*-season weeds, dominant in *rabi* cereals, peas, potato, linseed and carrot.	In the case of monocot crops, 2,4-D amine @0.5 kg/ha+urea 3 percent in 700 liters of water, 3-4 weeks after sowing. In the case of peas and linseed, MCPB @ 0.84 l/ha in 700 liters of water 6 weeks after sowing. In the case of potato and carrot, Linuron @ 0.5 kg/ha pre-emergence. In the case of sugar-beet, a pre-emergence soil application of Pyrazon at 2-3 kg/ha in 1,000 liters of water is very effective against *Chenopodium* spp. and other annual dicot weed.
7.	Compositae (sunflower family)	Flowers aggregated in heads comprising outerray flowers and inner tubular or disc flowers.	*Carthamus oxyacantha* Annual (wild safflower or *pohli) Sonchus oleraceus* Annual (The common sowthistle or *doodhli) Ageratum conyzoides (mahakama)* Annual *Cnicus arvensis (kantaili)* Annuala *rabi* crops such as wheat, potato, linseed and peas.	In the case of monocot crops(Refer item No. 6). In the case of potato and peas Linuron @ 0.5 kg/ha pre-emergence in 900 liters of water. In the case of linseed MCPB (Refer item No. 6). In the case of non-cropped areas, a spraying with any one of 2, 4-D, aminotriazole, Paraquate Banvel D and MSMA at 2-4 liters/ha before flowering will kill the weed and prevent its flowering and seed production. For Canada thistle; 2,4-D low volatile ester 1.5 l/ha in 900 liters of

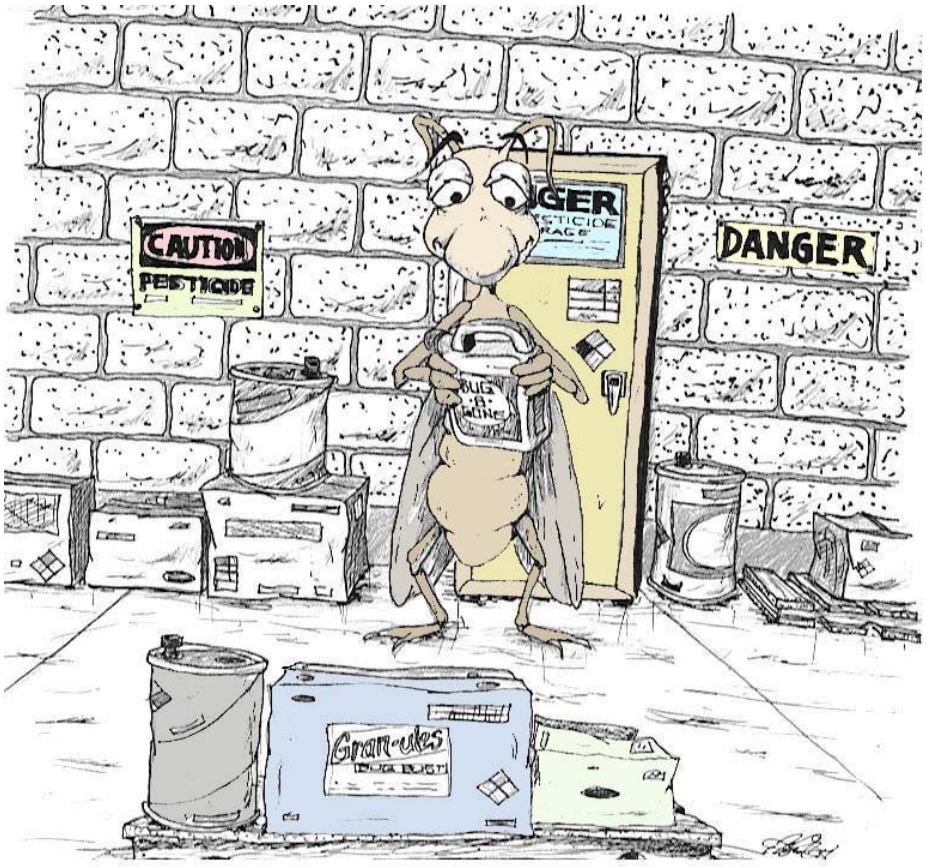
			Parthenium hysterophorus Annual *(congress ghas, safed topi, chamakta chandni)*. Prolific-seeder, extensively spread because of light seed, armed with pappus that facilitates its dispersal through natural agencies, such as wind, water, air and animals including man. *Cirsiumarvense,* Perennial (Canada thistle) *Plushea lanceolata,* Perennial *(baisuri or kadjal)*. Reproduction through underground rhizomes. Mostly found in non-cropped areas.	water at the early bloom stage or aminotriazole at 2 kg l/ha+ a wetting agent (6fl. oz.) spray at the flowering stage.
8.	Convolvulaceae (morning-glory family)	Plants, viney, trailing or twining, Leaves, alternate, entire, with a pair of basal lobes. Flowers, large, gamopetalous, with a basal tube and a spreading limb. Fruit, a 2-chambered capsule, with 2-5 seeds in each chamber.	*Convolvulus arvensis,* Perennial (field bindweed or *hirankuri) Ipomoea reptans* Aquatic weed, *Evolvulus alsinoides (Vishnu krantha)* Dodders ao *Cuscuta* spp. Flowering parasites.	For field bindweed and *ipomoea reptans*: In non-cropped land and monocot crops, 2,4-D amine 1.0 liter/ha + urea 3 percent in 900 liters of water before flowering of the weed. For dodder 2kg/ha granulated CIPC.
9.	Cruciferae (mustard family)	Leaves, alternate. Flowers cruciform (cross-like), with 4 sepals, 4 petals and 6 stamens. Fruit, a siliqua, podlike, or short and flattened, with two chambers separated by a	*Brassica sinensis* (wild mustard or *jungli sarson), Sisymbrium irio, Nasturtium indicum.*	In the case of peas and potato. Linuron (Ref. No. 7).In wheat, 2,4-D + urea (Ref. No. 6). In the case of linseed, MCPB (Ref. No. 6)

		central partition bearing two to several seeds, usually dehiscent.		
10.	Cyperaceae (sedge family)	Stems, solid and 3-angled. Leaves, similar to those of grasses, with a linear blade and basal sheath; leaf sheath forming a closed tube around the stem. Flowers, without petals, variously arranged often in spikes, enclosed by a single bract. Fruit, a flattened or 3-angled achene, with a thick hard pericarp.	*Cyperus rotundus* (Nutgrass or purple nutsedge or *motha C. esculentus* (Yellow nutsedge present in the USA) *C. iria* Perennial. Present in both cropped and non-cropped land all over the world. Reproduction through vegetative means.	An effective method of controlling nutsedge in arable land consists in giving 2-4 ploughings during May and June; immediately after each ploughing spray on the soil a mixture of 2,4-D + Dalapon 2 kg/ha of each in 900 liters of water, sowing of hybrid maize in the last week of June, using atrazine pre-emergence @ 1 kg/ha in the case of maize, and after maize, raise a wheat crop in the *rabi* season.
11.	Euphor biaceae (Spurge family)	Plants, diverse as to vegetative characters. Common species, with milky juice. Flowers, much reduced, without petals, in some species with colored bracts which resemble petals. Fruit, usually a 3-lobed, 3-chambered capsule, with one seed in each chamber.	*Euphorbia prostrata* Annual (milkweed E.*hirta(dudhi),,* E.*racunculoaies,,* Reported to occur in wheat, gram, millet and maize *Phyllanthus niru.i* Reported to occur in rice.	Except in the case of gram, 2,4-D,or MCPA or MCPB at 1 Kg/ha in 700 liters of water will kill these weeds.
12.	Grami neae (grass family)	Plants with hollow round or flat stems (culms). Leaves, arranged in two rows on the opposite sides of the stem, consisting of a blade, a sheath and a ligule. The blade is entire, linear, and parallel-veined. The flower consists of a pistil and three stamens. Each flower is enclosed by a pair	*Echinochloa crusgalli* <(barnyard grass)*(samaghas) E. colonum* An annual *kharif* season weed dominant in rice. *Cynodon dactylon* (Bermuda grass or *doob*. Perennial in almost all crops and situations. *Saccharum spontaneum*(wild sugarcane or	In case of rice, propanil 2 liters/ha in 700 liters of water 2-3 weeks after transplanting or direct seeding. For annual grasses in cotton, treat with pre-plant Treflan 2 i/ha or Diuron or Cotoran 0.5-1.0 kg/ha pre-emergence. In the case of maize and sugarcane, Atrazine pre-emergence (Ref. no. 4). For *Cynodon,* a combination of mechanical and chemical, and cropping methods (Ref.No.10). For wild oats in wheat and barley, Carbyne

		of unequal bracts, one on each side, the larger is the lemma and the smaller is the palea. The unit consisting of the flower, lemma and the palea is the floret. The florets are arranged in spikelets each of which consists of central axis, a pair of bracts (glumes) at the base, and one to several florets above. Fruit, a grain or caryopsis, 1-seeded, the fruit coat permanently adherent about the seed.	*kans*) Perennial, reported to occur in sugarcane, cotton and millets. *Sorghum halepense*(Johnson grass or *baru*) Perennial, reported to occur in sugarcane, maize and cotton. *Avena fatua* (wild oats or *Jungli jai) A. ludoviciana* Annual, reported to occur in wheat, peas, potato, gram and linseed. *Phalaris* spp. Annual Reported to occur in *rabi* crops.	(Barban) @0.5 i/ha at the 2 leaf-stage of the weed as a very low-volume spraying or preplant Avadex(trillate) at 2 l/ha. *Phalaris sp.* in wheat is controlled effectively by a pre-emergence application of Tribunil at 2 kg/ha in 900 liters of water. A single application of this chemical, in addition to killing this annual grass weed, is also lethal to all annual dicot weed.
13.	Labiatae (mint family)	Plants, with square stems and aromatic odor. Leaves, simple, exstipulate, opposite toothed or lobed. Flowers, gamopetalous, irregular, 2-lipped. The fruit, consists of usually 4, dry single-seeded nutlets.	*Leucas aspera* Annual *Ocimum canum* Annual	Susceptible to 2, 4-D amine 1 kg/ha in 900 liters of water.
14.	Leguminosae(legume family)	Leaves, alternate, compound, with three leaflets. Flowers irregular with a larger petal(standard), 2-side petals (wings), and two inner petals which are fused(keel) and enclosed the pistil and stamens. Fruits, a pod, 1-celled. Several-seeded and dehiscent, e.g. bean pod or one-seeded and	*Melilotus* (white sweet clover). Annual, in *rabi* crops. *M. indica(senji)* Annual in *rabi* crops. *Vicia sativa* (common vetch) Annual in rabi crops. *Tephrosia purpurea.* A perennial under-shrub in arid tracts. *Prosopis juliflora*(mesquite) A perennial small tree in non-cropped land. *Alhagi camelorum*	2, 4-D in cereals at 1 kg/ha kills the annual legumes. For perennials, a mixture of 2, 4-D and 2, 4, 5-T at 1-2 l/ha before flowering.

		indehiscent(sweet clover)	(Camelthorn or javasa). A thorny perennial in fallow land. *Mimosa pudica* (touch-me-not or *lajjavanti)*. A thorny perennial.	
15.	Orbanch aceae (broomrape family)	Brown or yellowish herbs, without green leaves and parasitic on the roots of other plants. Stem, simple with a few scales and ends in a spike of flowers, irregular and bisexual, calyx, 2-4-lobed; corolla, gamopetalous, stamens 4, didynamous and epipetalous, numerous seeds.	*Orobanche cernua* (broomrape) *O. indica* An annual root parasite on tobacco, mustard, etc.	Eradication with chemicals without affecting the host plants is difficult the removal of immature plants as they emerge from the soil and before they form seeds prevents its spread. Heavy infested areas can be reclaimed by growing a trap crop and spraying with 1-2 i/ha of amine 2, 4-D. 2, 4-DES at 6 kg/ha in 1,000 liters of water applied at 4-6 week intervals or in split applications at 3 kg/ha each time 2 and 6 weeks after transplanting tobacco; reduce the population of broomrape plants considerably. Sprays with amyl alcohol (0.1-0.2 per cent) are reported to be effective against broomrape in tobacco.
16.	Papaver aceae (poppy family)	Annuals, with prickly stems and leaves. Juice, yellow-orange. Sepals, 2 or 3, falling off when the flower opens. Petals, 4,stamens, many. Fruit, a capsule, many seeds, with oily endosperm	*Argemone nexicana* (prickly poppy or *bharbhand* or *satyanasi*). Annual, spread all over India, in all crops, especially wheat and mustard	In the case of monocot crops, 2, 4-D amine+urea (Ref. No. 6). In mustard, nitrofen pre-emergence 1-2 l/ha in 900 liters of water.
17.	Ponteder iaceae (water hyacinth family)	The family consists of erect or floating fresh water and marsh herbs. Flowers, bisexual more or less irregular usually in a recemose inflorescence from a spathe like bract. Perianth, tubular consisting of six	*Eichhornia crassipes* (water hyacinth). A free-floating or surface perennial, one of the worst aquatic weed, occurring all over the globe.	2, 4-Dester of low volatility @ 1-2 kg in 700 liters of water during the active growing season; Amitrole-T 2 i/ha in 00 liters of water at peak growth; repeat the application of Paraquat 2 i/ha. The addition of urea 3 percent to low doses of any of the post-emergence herbicides at lower dosage

		petal like parts in two whorls. Stamens, 6, unequal, attached, to the perianth tube.		levels(1 kg or l/ha) improves the weed killing effect.
18.	Scrophulariaceae (figwort family)	Herbs, sometimes semiparasitic, or shrubs. Leaves, exstipulate. Flowers, bisexual and usually irregular. Calyx, 4-5 lobed and 2-lipped. Stamens, usually 4, epipetalous and didynamous. Fruit, a capsule, with many seeds.	*Striga asiatica* (witch weed) *S.lutea S.euphrasioides* Annual root; parasites reported to occur in bajra, sorghum, sugarcane and rice.	In the case of monocot crops, 2,4-Damine @ l/ha in 900 liters of water soon after the germination of the parasite; fence @ 3 kg/ha in 700 liters of water as pre-planting soil incorporation, especially in the case of sugarcane.
19.	Solanaceae (potato family)	Leaves, alternate. Calyx, five-lobed; flowers, gamopetalous, regular, tubular or with tube and expanded limb. Stamens, 5, attached to the corolla tube. Fruit, a berry or a capsule with many seeds.	*Solanum Xanthocarpum(kateli)* A perennial spiny herb. *Solanum elaeagnifolium* (white horse nettle) Perennial, reported to be very prevalent in southern India.	2,4,5-T @ 1 kg/ha in 1,000 liters of water at the young stage before leaves become tough. For *Solanum elasagnifolium,* 2,4-D amine foliar spray during the period of active growth at 2 liters/ha in 900 liters of water effects remarkable reduction in the regeneration of the weed control. After this chemical treatment, if the land is cropped to sorghum, the further spread of this perennial weed control is prevented.
20.	Typhaceae	Typhas are gregarious, robust, grass-like herbs, attaining a height of even 3m and flourishing under water-logged conditions. Flowers are small in long dense cylindrical, terminal spikes.	Cattails and tules *(Typha sp.)* Aquatic emersed perennials	Dalapon @ 5kg+ wetting agent 0.5 kg to be sprayed during the active growth of Aminotriazole 1 kg+a wetting agent or 2,4-D as an ester of low volatility @ 1 kg+diesel oil in 4.5 liters in 500 liters of water.
21.	Verbenaceae (vervain family).	Herbs, shrubs or trees, exstipulate leaves; calyx 4-5 or more-lobed and sometimes colored. Corolla, tube has a 2-lipped or 4-5-lobed limb.	*Lantana camara perennial(tantani)* shrub.	A mixture of 2, 4-D+ 2, 4, 5T (Brush killer) at 1-2 kg in 1,000 liters of water at the pre-bloom stage



§ 156.208 Restricted-entry statements.

(a) Requirement. Each product with a restricted-entry interval shall bear the following statement: "Do not enter or allow worker entry into treated areas during the restricted-entry interval (REI)." This statement shall be under the heading AGRICULTURAL USE REQUIREMENTS in the labeling.

(b) Location of specific restricted-entry interval statements. (1) If a product has one specific restricted-entry interval applicable to all registered uses of the product on agricultural plants, the restricted-entry interval for the product shall appear as a continuation of the statement required in paragraph (a) of this section and shall appear as follows: "of X hours" or "of X days" or "until the acceptable exposure level of X ppm or mg/m3 is reached."

(2) If different restricted-entry intervals have been established for some crops or some uses of a product, the restricted-entry statement in paragraph (b)(1) of this section shall be associated on the labeling of the product with the directions for use for each crop each use to which it applies, immediately preceded or immediately followed by the words "Restricted-entry interval" (or the letters "REI").

(c) Restricted-entry interval based on toxicity of active ingredient--(1) Determination of toxicity category. A restricted-entry interval shall be established based on the acute toxicity of the active ingredients in the product. For the purpose of setting the restricted-entry interval, the toxicity category of each active ingredient in the product shall be determined by comparing the obtainable data on the acute dermal toxicity, eye irritation effects, and skin irritation effects of the ingredient to the criteria of § 156.10(h)(1). The most toxic of the applicable toxicity categories that are obtainable for each active ingredient shall be used to determine the restricted-entry interval for that product. If no acute dermal toxicity data are obtainable, data on acute oral toxicity also shall be considered in this comparison. If no applicable acute toxicity data are obtainable on the active ingredient, the toxicity category corresponding to the signal word of any registered manufacturing-use product that is the source of the active ingredient in the end-use product shall be used. If no acute toxicity data are obtainable on the active ingredients and no toxicity category of a registered manufacturing-use product is obtainable, the toxicity category of the end-use product (corresponding to the signal word on its labeling) shall be used.

Preventive Control

Prevention is the most essential aspect of weed management. Once a noxious weed infestation becomes established, any increase in size and density creates increasingly more expensive management efforts. Awareness of weed seed sources and plant identification is a must. Feel free to call the Weed District office or county agent for help with identification or to set up a site visit, and recognize:

- ✓ Weed seed can be spread from neighboring properties, adjacent road rights-of-way and trails. Direct sources are often livestock, manure, seed, hay, vehicles and equipment.
- ✓ Disturbed ground is most vulnerable to weed invasion; new roads, pipelines and other sites where competitive vegetation has been removed. With no restoration (see cultural control) weeds will likely appear.
- ✓ Early detection and rapid response saves time and money. Aggressive management action on small, newly established infestations can result in eradication. "An ounce of prevention is worth a pound of cure."

Cultural Control

Cultural control, the establishment of competitive and desired vegetation, prevents or slows down invasion by weedy species and is a key component of successful weed management. Weeds are typically opportunistic and readily invade disturbed sites. Impacts from road construction, intensive livestock grazing, densely populated prairie dog colonies and other disturbances that damage or remove desirable and competitive vegetation create sites for noxious weed invasion. Controlling weeds on such sites can be futile without vegetative restoration, as weeds will readily re-invade the disturbed area. Establishment of grassland or pasture can be challenging. Success often depends on proper species selection suitable for a particular soil type, moisture regime and growing season. Other factors such as soil compaction, seeding depth, time of year, and weed control during establishment can be critical to success.

Chemical Methods

Herbicides are another weed control aid that some gardeners employ. Gardeners should be aware that no single herbicide will do the entire job of controlling weeds in all vegetable crops. There is also a problem of applying relatively small amounts of the herbicide evenly to the garden surface. Miscalculation of rates or miscalibration of application equipment can cause some areas of the garden to get too much or too little of the herbicide. Under-application will result in poor weed control while over-application will result in damaged plants.

For small areas, several chemical manufacturers (e.g. Ortho, Scott, Southern States, Security, and others) sell a variety of herbicides in small quantities which are ideal for this job. These chemicals are usually formulated to make them more convenient and easier for the homeowner to apply. For larger areas, several products can be purchased can be purchased at farm chemical retail stores.

For all-purpose weed control when no crop is present (either in the fall, later winter, or early spring), use Roundup (Ortho's Kleenup). This material, applied over the top of weeds, will kill all weeds. Do not use this material when crops are present or serious injury will occur.

To control germinating weed seedlings before the crop emerges, only one major herbicide is available to choose from. This material is trifluralin (Treflan). The trade name (listed in parentheses) is the more commonly marketed forms of this herbicide. However, this herbicide may be marketed using other trade names and the buyer should read the ingredients list to be sure that the common name of the herbicide, which is listed before the trade name, appears on the label.

Weed control chemicals are available as concentrated liquids, (2 to 8 lb/gal) which need to be mixed with water before applying; as wettable powders which are from 50 to 100% active ingredient and need to be dispersed in water for uniform application, or as granules which are from 1 to 10% active ingredient and which are applied dry with granular applicators. See the label for all instructions on labeled crops and timings.

Emerged grasses can be controlled using hand removal, cultivation (see previous discussion) or sethoxydim (Poast) herbicide. It is usually effective when applied to grasses that are no larger than 4 inches tall. Consult the chart at the end of this section and the herbicide label for specifics on use, labeled crops and timings. Never exceed the recommended rate, as severe plant injury may occur.

Before selecting an herbicide, you must know the weeds you have and whether they are annual or perennial. You also need to consider their proximity to desirable plants. For broad-leaved perennial weeds, such as dandelion, plantain and perennial chickweed, products containing 2,4-D can be very effective, especially in the lawn. Take care to avoid drift if you have trees or shrubs in or adjacent to the lawns. Spot treat problem weeds rather than broadcast applications to the entire lawn.

Some broad-leaved weed killers also contain a chemical called dicamba (banvel). This product is useful in managing the tough-to-control weeds such as bindweed, thistle and oxalis. Because it can leach into the root zones of trees and shrubs, this product should be used sparingly as a spot treatment, wetting only the foliage of the weeds.

In vegetable gardens, as well as shrub borders, avoid use of broad-leaved weed killers containing 2,4-D and/or dicamba. The fumes alone can injure your plants. It is best to clean, cultivate and hand pull existing weeds, then apply a pre-emergent herbicide (weed preventer) to control any weeds that would come up from seed. Several products on the market are labeled specifically for this purpose. They usually contain dachtal or surflan. Be sure to follow all label directions to avoid injury to your vegetables.

If you have weedy areas along fences, around buildings or in gravel or other mulched areas, spot treat with glyphosate (sold as Roundup or Kleenup). Avoid applications with a fine mist-type sprayer, as even small amounts can injure non-target plants. More than one application may be needed on bindweed and thistle. Glyphosate works best when weeds are actively growing with plenty of foliage.

Do not be tempted to control weeds in your landscape with "total vegetation control chemicals" such as Triox, Pramitol and Spike. By state law, effective Jan. 1, these and similar products can only be used by certified commercial applicators. These are soil sterilants and can migrate to tree roots, shrubs and other plants with long-lasting damage. Damage can result even if you follow the label carefully. These products also can harm your neighbors' trees if their roots extend into the treated area of your property.

When using herbicides, always read the label thoroughly and follow directions carefully. The misuse of an herbicide can lead to disappointment and to long-range problems in your garden.

The best approach is to use selective applications of herbicides to target exotic plants while avoiding or minimizing application to desirable plants. Selective methods (see details in later section) are:
1. Directed foliar sprays: herbicide-water sprays aimed at plant foliage to cover all leaves to the point of run off and usually applied with a backpack sprayer (use low pressure, drift retardants, and spray shields to avoid drift).
2. Stem injection (including hack-and-squirt): herbicide concentrate or herbicide-water mixtures applied into incisions spaced around woody stems made by an ax, hatchet, machete, brush ax, or tree injector.
3. Girdle-treat: herbicide concentrate or herbicide-water mixtures applied to an encircling band of removed bark around woody stems made by a cutting tool and applied with a spray bottle, wick, or paint brush.
4. Cut-treat: herbicide concentrate or herbicide water mixture applied to freshly cut stumps (outer circumference) or stems (entire top surface) with a backpack sprayer, spray bottle, wick, or paint brush.
5. Basal sprays: herbicide-oil-penetrant mixture sprayed or daubed onto the lower portion of woody stems usually applied with a backpack sprayer or wick applicator.

6. Soil spots: application of Velpar L herbicide as metered amounts to the soil surface around target woody stems or in a grid pattern for treating many stems in an area; usually applied with a spotgun or with a backpack sprayer equipped with a straight-stream nozzle.

To treat extensive inaccessible infestations, it may be necessary to use broadcast treatments of herbicide sprays or pellets by helicopter- or tractor-mounted application systems.

To be successful with herbicide treatments:
1. The most effective herbicide for the species should be used.
2. Applied using correct methods prescribed on the label.
3. Applied during an optimum time period for maximum herbicide effectiveness.
4. Follow and adhere to all label prohibitions, precautions, and Best Management Practices during herbicide transport, storage, mixing, and application.

As far as timing, foliar applied herbicides are often most effective in late-summer to early fall and not later than a month before expected frost.
Mainly herbicides registered by the Environmental Protection Agency for forestry use and noncrop lands in the Southeast will be discussed here. Herbicides in other "land use areas" (such as right-of-ways, pastures and rangelands, etc.) may be just as effective, or even contain the same active ingredient of those mentioned.

The herbicides that will be recommended by trade name (and common name) are:
Foliar active herbicides
Foliar and soil active herbicides
Glyphosate herbicides (glyphosate)
Arsenal AC (imazapyr) such as: Accord Concentrate
Escort (metsulfuron)
Glyphosate
Pathfinder II (triclopyr)
Gly-Flo Herbicide
Pathway (2,4-D + picloram)
Garlon 3A (triclopyr)
Plateau (imazapic)
Garlon 4 (triclopyr)
Tordon 101 (2,4-D + picloram)
Tordon K (picloram)
Transline (clopyralid)
Vanquish (dicamba)
Velpar L (hexazinone)

Because exotic pest plants are usually difficult to control it is often necessary to use herbicides that have both soil and foliar activity to be most effective with the least number of applications. When applying herbicides with soil activity, it should be recognized that damage to desirable plants might occur when their roots are present within the treatment zone, or when herbicides may move downhill following heavy rainfall to untreated areas. Garlon herbicides are mainly foliar active but have some soil activity at high rates and when mixed with oils.

Garlon 4 and Vanquish have potential to volatilize at high temperatures and their residues can move by air currents to impact surrounding plants. Thus, applications should be avoided on days when temperatures exceed 80oF. If possible, forgo applications during periods of severe drought as herbicide effectiveness can be greatly reduced during these times. Also, applications should not be make when rainfall is anticipated within two days, unless soil activation is needed.

When possible, use selective herbicides that target specific species of alien plants and minimize damage to surrounding desirable plants even though they receive herbicide contact, such as Transline that controls mainly legumes (e.g., peas and beans) and composites (e.g., asters, sunflowers, goldenrods, etc.). Also, damage to desirable cohorts can be minimized by making applications when desirable plants are dormant (e.g., basal sprays in late winter). For example, evergreen or semi-evergreen exotic plants can be treated when surrounding non-evergreen native plants have entered dormancy. Unfortunately, desirable woody plants can be damaged through transfer of herbicides by root grafts and root exudates when applying stem injection, girdle-treat and cut stump treatments to adjoining exotic woody plants, or when soil-active herbicides wash off treated stems. Damage to surrounding native plants can be minimized with care and forethought during planning and enactment of application.

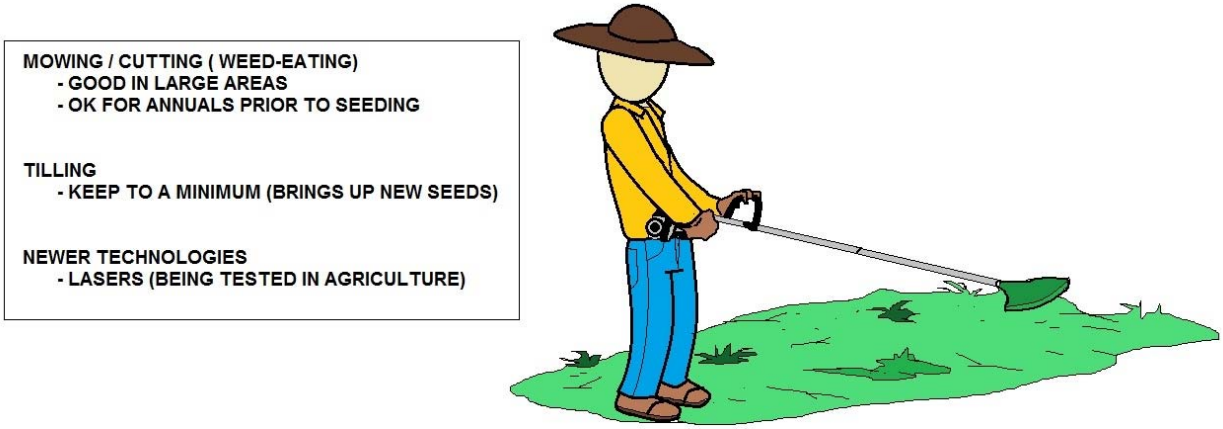
Read and thoroughly understand the herbicide label and its prohibitions before and during use. Many herbicides require the addition of a non-ionic surfactant to the spray tank to be effective. Other important points are to always use clean water when required in a herbicide mixture and mix spray solutions thoroughly before applying. Mixing should not be done in the sprayer but in a bucket with a stirring stick—stirring for a minute or more—before transferring to the sprayer. When changing from a water-based mix to an oil-based mix in a backpack sprayer, always remember to thoroughly evacuate the water from the pump and run a small amount of oil through the pumping system before filling with the oil-based mix, or a white sludge will clog the sprayer. And, always wear your personal protective equipment prescribed on the label and in supplementary materials.

Other Treatments for an Integrated Approach

Overgrazing is a way to reduce the vigor of palatable invasive plants like kudzu, but this rarely yields eradication and may spread seeds (now occurring with tropical soda apple). Mechanical treatments and prescribed burning can assist eradication measures, but are limited in effectiveness. Prescribed burning does not control root-crowns or rhizomes of perennial plants and usually only kills small aboveground shoots, providing only temporary aboveground control. In a similar way, chainsaw felling or brush mowing woody exotic plants and mowing vines and herbs, without killing roots, remove only aboveground plant parts. Mechanical root raking and disking can actually spread or aggravate a problem when dealing with plants having runners by chopping these into resprouting segments. However, the use of root raking, piling, brush mowing, or burning may be the only way to start controlling dense infestations of multiple woody exotics. Small infestations may also be handled by hand pulling, grubbing with a stout hoe, or by using the newly introduced shrub-pulling devices. Hand pulling or grubbing may be the quickest and easiest way to halt invaders when first spotted so as to stop them from gaining a foothold.

Although ineffective by themselves to achieve eradication, both mechanical and burning treatments can give added kill of herbicide-weakened plants and have a place in an integrated pest management program. The stumps and stems of exotic trees, shrubs, and bamboos that are felled can be treated with herbicides immediately after cutting to kill roots. Resprouts of trees, shrubs, and vines that are top killed by burning can be more easily treated with foliar sprays, often the most cost-effective way to use herbicides. Herbicide applications following burning or disking should be delayed to permit adequate resprouting of target plants for maximum herbicide uptake and effectiveness. Prescribed burning can also kill or stimulate seed germination of troublesome plants permitting effective herbicide control of germinants. Burning can also prepare the site for effective herbicide applications by clearing debris and revealing application hazards, such as old wells and pits. Disking and root raking, if applied correctly, can dislodge herbicide-damaged woody roots and large runners, leaving them to dry and rot.

Mechanical Weed Control



Mechanical control consists of methods that kill or suppress weeds through physical disruption. Such methods include pulling, digging, disking, plowing and mowing. Success of various mechanical control methods is dependent on the life cycle of the target weed species.

- ✓ Hand pulling and digging are effective on annual and biennial species such as kochia, musk thistle, and diffuse knapweed. It is important to remove the upper 2-3 inches of taproot to prevent re-growth. Hand pulling or digging a perennial weed such as leafy spurge can be a futile effort unless one has the time necessary to diligently dig or pull re-growth over several seasons.
- ✓ Shallow tillage with a disk or sweep is effective for controlling annual species such as cheatgrass or kochia, but can actually be counterproductive if trying to control perennial weeds such as Canada thistle, field bindweed, leafy spurge or Russian knapweed. Perennial root systems often have meristematic buds that can set roots and produce a new plant from root segments deposited on the soil surface. Shallow tillage of perennial weeds can result in a larger, denser and more uniform infestation than the initial patch.
- ✓ Moldboard plowing (complete turnover of the top 10-12 inches of soil) disrupts underground root systems and buries seed from the surface to a depth too deep to germinate. This type of tillage is seldom feasible to practice on a regular basis.
- ✓ Mowing is a suppression measure that can prevent or decrease seed head production. Mowed weeds will re-grow and set seed from a reduced height so a combined control method is necessary to be effective. Mowing causes perennial plants to weaken when forced to send up carbohydrates from underground root reserves to nourish re-growth. So mowing a perennial weed such as Canada thistle a couple of times during the summer can significantly weaken the plants, and when combined with a fall herbicide application, provides excellent control.

Several implements can be used to cultivate weeds. Push plows, also called push cultivators, are inexpensive and also very effective in killing small weeds. The large wheel versions are usually easiest to push. For large weeds, a garden tiller or small tractor is most effective. Regardless of the implement, cultivate no deeper than 2 inches deep to prevent root damage to vegetable plants. Cultivators should normally be adjusted to throw soil around the base of crop plants and over any emerged weeds that are present in the row. Row spacing can be adjusted to allow close mowing near the soil surface to control weeds. Self-propelled rotary or sicklebar mowers and/or mowers with large rear wheels are easiest to maneuver. Weedeaters fitted with plastic string can also be used to cut weeds near the soil surface.

Extreme care should be used for crop and personal safety. See manufacture's warnings prior to operating all equipment.

Mechanical Weed Control: Mechanical weed control involves the physical destruction of a weed. Techniques involve hand pulling and hand hoeing which are practical for small infestations. Mowing is often used; but by far, the most common practice of mechanical control includes tillage. Advantages of tillage include:

- Elimination of weed debris
- Control of annual weeds
- Suppression of perennial weeds
- Tillage methods include plowing, rototilling, disking, and harrowing. Weed control implements include sweeps, rolling cultivators, finger weeders, push hoes, rotary hoes, etc.

What You Can Do

In order to prevent the introduction or spread of invasive alien plants into natural areas, and to help restore our native flora and fauna, you can:

- ✓ Avoid disturbance to natural areas, including clearing of native vegetation, planting of non-native plants and dumping of yard wastes.
- ✓ Control exotic invasive plants in your landscape either by removing them entirely or by managing them to prevent their spread outside your property. This may include pruning to prevent flowering and seed dispersal or cutting, mowing or herbicide use to prevent vegetative spread.
- ✓ Discuss your concerns about invasive exotic plants with nurseries and garden shops and ask them not to sell these species. Provide them with printed material (such as this) explaining the problem to read later. Ask for non-invading alternatives instead.
- ✓ Do not purchase or use invasive exotic species in your landscaping or for land restoration or erosion control projects.
- ✓ For landscaping, use plants that are native to your local region as much as possible or those that are not known to be invasive.
- ✓ Know your plants. If you are unsure of the identification of a plant, take a sample to a university, arboretum, department of agriculture office, local nature center, or native plant society for assistance. Find out if it is known or thought to have invasive tendencies. If the exotic plant is closely related to an invasive species, it is likely to have similar tendencies. To be on the safe side, if you don't know it, don't grow it.
- ✓ Notify land managers of invasive exotic plant occurrences.
- ✓ Offer to assist in exotic plant removal projects.
- ✓ Work with your local government to encourage the use of native plants in their urban and suburban landscapes. Provide them with lists of attractive, non-invasive locally native alternatives that are naturally hardier, pest-resistant, and provide more nutritious food for wildlife than cultivated plants.

Other Cultural Methods of Weed Control

Flaming is a technique that can be useful but it requires a physical difference or separation between crops and weeds, or crop protection with a hooded row cover or protein foaming agents. Proper water management, such as the use of drip irrigation or uniform irrigation, can eliminate certain weeds. Stale seedbeds involve a delay in planting after seedbed preparation to control the first flush of weeds before seeding.

Biological Weed Control

Biological control involves the use of natural enemies, such as predators, parasitoids, competitors, or pathogens to control pest insects, weeds, or diseases to levels lower than they would otherwise be. There are three main methods of biological control: conservation, introduction, or augmentation. Human activities can greatly influence the extent to which natural enemies are able to suppress pests.

The goal of biological control is not eradication, but the use of living agents to suppress vigor and spread of weeds. Such agents can be insects, bacteria, fungi, or grazing animals such as sheep, goats, cattle or horses. Grazing produces results similar to mowing, and bacteria and fungi are seldom available for noxious weed management. Biological control is most commonly thought of as 'insect biocontrol'.

USDA-APHIS (United States Department of Agriculture-Animal and Plant Health Inspection Service), is the federal agency responsible for authorizing the screening and importation of biocontrol insects. APHIS conducts intensive multi-year screening programs assuring an insect agent's host specificity (feeds only on target weed species, not other plants) prior to approval for release.

Biological weed control through insect/plant interactions is an important component of the County's weed management program. Insect agents, proven to be effective, are utilized in cases where eradication is impractical due to the vastness or inaccessibility of an infestation, and where other methods of management are not feasible. Insect agents typically require 3-5 years for establishment and can limit the spread and density of target weed species by feeding on leaves, stems, roots and/or seed heads. One must realize that eradication of a weed cannot be attained through insect biocontrol. The most effective scenario is a weed infestation reduced to a 'tolerable level', a level where the insect agents are significantly limiting distribution and abundance of the target weed species and the weed density is no longer considered detrimental to the desired plant community.

Some biocontrol insects proven to be successful are:

- ✓ Bindweed mites - field bindweed
- ✓ Flea beetles - leafy spurge
- ✓ Mecinus janthinus - dalmatian toadflax
- ✓ Larinus minutus and Cyphocleonus achates - diffuse knapweed

Conservation Biological Control is defined as any biological control practice designed to protect and maintain populations of existing natural enemies. This approach is particularly useful in agroecosystems where management practices such as cultivation, pesticide applications, and harvest disrupt the life cycle of the beneficial organisms. Introduction or

Classical Biological Control refers to the importation of foreign natural enemies to control previously introduced, or native, pests.

Augmentation Biological Control involves control practices intended to increase the number or effectiveness of existing natural enemies. This approach is commonly used in cases where natural enemies are missing (greenhouses) or late to arrive at new plantings (some row crops), or simply too scarce to provide control.

Many of our worst weeds originated in foreign countries and biological control practices can help us to maintain them below threshold levels. These newly introduced plants, free from the natural enemies found in their homelands, gained a competitive advantage over native plants. Once they are out of control, other methods of weed management are usually not economical or physically possible. The need for a method of weed reduction that was economical, self-sustaining, and environmentally safe provides opportunities for biological control. There are several well-documented successes of biological control: St. Johnswort (Klamathweed in California), tansy ragwort in Oregon, and rush skeletonweed in the Pacific Northwest.

Biological control is a slow process, and its efficacy is highly variable. It usually takes several years for a biological control agent to become established and control a weed. Biological control agents impact weeds in two ways: directly and indirectly. Direct impact destroys vital plant tissues and functions. Indirect impact increases stress on the weeds, which may reduce their ability to compete with desirable plants.

Thus, it is very useful to integrate biological control with other weed management practices. For example, once weeds are weakened by Biological Control Agents, competitive plantings may be used to outcompete the weeds.

The goal of a biological control program is not to eradicate a pest, but to maintain it below an acceptable threshold level. When using BCAs, a residual level of the weed populations must be expected since the survival of the agents is dependent on the density of their host weeds.
After populations of the host weeds decrease, populations of BCAs will correspondingly decrease.

This is a natural cycle and should be expected. The BCAs released in the U.S. have been thoroughly tested to ensure they are host-specific. This is an expensive and time-consuming task that must be done before the agents are allowed to be introduced. An extensive assessment of BCAs prior to their release secures they will not switch to crops, native flora, and endangered plant species.

Biological control of certain weeds may not work in your area, even though an insect may be very effective in another area. Climate variations such as cold winters, and plant biotype differences may account for some of the failures that have occurred in the past.
To ensure maximum success, trained personnel must supervise biological control programs. Biological control agents are living entities and require specific conditions to survive.

As with any other weed management method, biological control has benefits and disadvantages. The benefits include: reduction of herbicide residues in the environment, host specificity on target weeds, long-term self-perpetuating control, low cost per acre, searching ability to locate hosts, synchronization of agents to life cycles of hosts, and unlikelihood that hosts will develop resistance to agents. Some of the disadvantages of biological control include: the limited availability of agents from their native homelands, the dependence of control on plant density, the slow rate at which control occurs, biotype matching, and host specificity when host populations are low.

General Principles to Reduce the Impact of Invasive Plants
1. Learn to identify invasive plants and incorporate their management into any land-use plan.

2. Prevent introduction of invasive plants to uninfested sites: This critical component is one of the most cost-effective methods of management.

3. Contain and treat new invasive plants or those not yet well established: Controlling small infestations is more effective and economical than trying to control well-established, rapidly spreading infestations.

4. Minimize transport of invasive plants from infested to uninfested areas: Cleaning vehicles and equipment is the most effective method of prevention.

5. Minimize soil disturbance: Invasive plants often prefer disturbed ground, don't disturb soil unless it is necessary.

6. Maintain desirable species: Establishing and maintaining competitive, desirable plants along roadsides and disturbed areas prevents or slows establishment of invasive plants.

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.

Reducing Weed Control Costs

There are many possibilities for reducing weed control costs while still attaining good weed control. Wise selection of weed control practices and herbicides to fit specific field situations is the key. Identify your weeds and develop an effective, low cost control program that is suitable for the crop you plan to grow. Using band applications of herbicides in row crops, supplemented with cultivation, may save you money.

Reducing herbicide rates below those recommended increases the possibility of costly weed control failure. On the other hand, applying herbicides at greater than recommended rates adds unnecessarily to your weed control costs and may result in crop injury or herbicide carryover. Applying herbicides at the proper time and rate with a carefully calibrated applicator provides the best return on your herbicide investment.

Herbicide Mixtures
Herbicide mixtures are used to overcome limitations of single chemicals. Certain mixtures may:
(1) control more kinds of weeds,
(2) give more consistent performance with variable soils and weather conditions,
(3) lessen soil residue problems,
(4) increase persistence enough to give full-season weed control, or
(5) reduce crop injury.

Only those mixtures that have been field tested under local conditions should be used. Use of some mixtures may result in poor weed control or crop injury. Growers or applicators may be responsible for chemical residues in crops, crop injury or lack of weed control resulting from use of unlabeled mixtures.

Safety Precautions
Always follow the precautions and use restrictions on the label carefully to help protect the operator, avoid crop injury, and prevent harmful residues in food and feed crops. Use herbicides only on crops specified on the label. Use only the recommended amount of herbicide; applying too much of a herbicide may damage the crop, may be unwise if the crop is to be used for food or feed, and is costly. Apply herbicides only at times specified on the label; observe the recommended intervals between treatments and pasturing or harvesting of crops. Wear goggles, rubber gloves, and other protective clothing as recommended on the label. Prevent drift onto nearby susceptible plants. Return larger quantities of unused herbicides in unopened containers to the manufacturer or store them properly until used. Dispose of empty containers in a safe manner:

- Triple rinse container thoroughly with water and use the rinse water in the sprayer.
- Bury small and decomposable containers in approved and supervised sanitary landfills.
- Send empty metal pesticide containers of 15 gallon capacity or more back to the manufacturer or to professional drum reconditioners.
- Observe special label instructions relating to disposal.

Groundwater and Surface Water Contamination
The potential for ground and surface water pollution with pesticides is a growing concern. Good land stewardship dictates that herbicide characteristics must be assessed in relation to their ground or surface water pollution potential, in addition to choosing the most effective and economical weed control. Growing public concern and increasing frequency of detections of minute levels of pesticides in groundwater will result in regulatory action if corrective measures are not taken. Atrazine is the most commonly detected herbicide in well monitoring studies. Sink-holes and shallow soil over porous, fractured limestone bedrock poses a real problem for managing certain herbicides such as atrazine in the karst area. The same situation also exists where permeable sands over shallow water tables occur.

Alternatives to atrazine should be considered in these areas to reduce pollution concerns.
Also, other herbicides have ground or surface water advisory statements on their labels. Use these compounds in sensitive areas only after assessing site specific pollution potential.

The levels of pesticides being detected in groundwater are generally in the parts per billion (ppb) range and are below current health advisory levels considered safe for drinking water. These levels often represent less than 1/1000th of the amount applied to the field, alluding to the difficulty in managing pesticide pollution. Point source concerns are often suspect if levels in a well over a few ppb are detected. Point source problems are those directly attributable to a confined area, event, or site such as mixing or manufacturing sites. Point source contamination may be responsible for a large portion of pesticide detections in wells in some areas of the state. They are relatively easy to correct. Point source problems can be reduced by the following:

- Mix chemicals in the field using a 'water only' nurse tank thereby keeping pesticides away from wells and water sources.
- If chemicals must be mixed at the well site, use hoses to maintain at least a 150 ft. buffer from the well to the spray tank, 100 ft. buffer with safeguards, or 50 ft. with safeguards and a roof present.
- Keep filling hoses out of the spray tank, use check valves, and Do Not leave tanks unattended while filling to avoid backsiphoning or overflow.
- Never dump rinsate or concentrated product in a localized area. Dispose of rinsate by applying to a labeled crop site.
- Triple rinse herbicide containers before disposal or return.
- Properly construct, grout, and case new well construction. Properly cap and seal abandoned wells.

Sphaeralcea ambigua

The desert mallow, globe mallow, "**sore eye poppy**," Sphaeralcea ambigua. The sore-eye name arose because the hairs on the plants are irritating to the eyes. They are also irritating to the skin of susceptible persons. This species is probably the most common mallow in the foothills area. However, there are many species of mallow which can be recognized by their flowers. Cotton is the most notable member of the mallow family. Okra is an edible mallow. Hibiscus and hollyhock are well known garden mallows. The sphaeralcea species are generally perennials, more or less woody at the base forming small bushes. The hairs of the leaves and stems are stellate or having radiating arms like a star. Both the shape of the leaves and the color of the flowers are variable. The flowers are most often grenadine to peach-red but may be mauve or almost white. They have five petals that are not quite symmetric. The numerous stamens and divided pistil are reddish, forming an attractive center for the blossom. The stamens are all united at their bases into a tube surrounding the pistil. This structure is characteristic of all mallows.

Common Herbicide Information Section
Diquat dibromide

Trade and Other Names: Trade names include Aquacide, Aquakill, Dextrone, Diquat, Reglone, Reglox, Reward, Tag, Torpedo, Vegetrole, and Weedtrine-D.

Regulatory Status: Diquat dibromide is a moderately toxic compound in EPA toxicity class II [1,2]. It is a General Use Pesticide (GUP). Labels for products containing diquat dibromide must bear the Signal Word **WARNING**.

Chemical Class: desiccant

Introduction: Diquat dibromide is a nonselective, quick-acting herbicide and plant growth regulator, causing injury only to the parts of the plant to which it is applied. Diquat dibromide is referred to as a desiccant because it causes a leaf or an entire plant to dry out quickly. It is used to desiccate potato vines and seed crops, to control flowering of sugarcane, and for industrial and aquatic weed control. It is not residual; that is, it does not leave any trace of herbicide on or in plants, soil, or water.

Formulation: Not Available

Toxicological Effects:

- **Acute toxicity:** Diquat dibromide is moderately toxic via ingestion, with reported oral LD50 values of 120 mg/kg in rats, 233 mg/kg in mice, 188 mg/kg in rabbits, and 187 mg/kg in guinea pigs and dogs [1,87]. Cows appear to be particularly sensitive to this herbicide, with an oral LD50 of 30 to 56 mg/kg [17]. The acute dermal LD50 for diquat dibromide is approximately 400 to 500 mg/kg in rabbits, indicating moderate toxicity by this route as well [58,87]. A single dose of diquat dibromide was not irritating to the skin of rabbits, but repeated dermal dosing did cause mild redness, thickening, and scabbing [58]. Moderate to severe eye membrane irritation occurred when diquat dibromide was administered to rabbits [88]. Ingestion of sufficient doses may cause severe irritation of the mouth, throat, esophagus, and stomach, followed by nausea, vomiting, diarrhea, severe dehydration, and alterations in body fluid balances, gastrointestinal discomfort, chest pain, diarrhea, kidney failure, and toxic liver damage [87]. Skin absorption of high doses may cause symptoms similar to those that occur following ingestion [89]. Very large doses of the herbicide can result in convulsions and tremors [88]. Test animals (rats, mice, guinea pigs, rabbits, dogs, cows, and hens) given lethal doses of diquat dibromide showed a delayed pattern of illness, with onset approximately 24 hours following dosing, subsequent lethargy, pupil dilation, respiratory distress, weight loss, weakness and finally death over the course of 2 to 14 days after dosing [58,87,89]. There have been reports of workers who have had softening and color changes in one or more fingernails after contact with concentrated diquat dibromide solutions [87]. In some instances, the nail was shed, and did not grow in again [87]. Several cases of severe eye injury in humans have occurred after accidental splashings [87]. In each case, initial irritation was mild, but after several days, serious burns and sometimes scarring of the cornea developed. Direct or excessive inhalation of diquat dibromide spray mist or dust may result in oral or nasal irritation, nosebleeds, headache, sore throat, coughing, and symptoms similar to those from ingestion of diquat [87].
- **Chronic toxicity:** Chronic effects of diquat dibromide are similar to those of paraquat [87]. Cataracts, a clouding of the eyes which interferes with light entering the eye, occurred in rats and dogs given 2.5 mg/kg/day and 5 mg/kg/day of diquat dibromide, respectively [87]. Cataracts increased in proportion to the dose given in test animals (cats and dogs) [17,88]. Chronic exposure is necessary to produce these effects [87]. Other effects on the eye (hemorrhage, retinal detachment) may occur at higher dosages [87]. Rats fed dietary doses of 2.5 mg/kg/day over 2 years did not exhibit signs of toxicity other than reduced food intake and decreased growth [17]. In another study using rats, oral doses of 4 mg/kg/day over 2 years produced no behavioral or other changes in general condition [87]. At this dose level no evidence of change in the kidneys, liver, or myocardium (heart muscle) were seen. This dosage (but not 2 mg/kg/day) caused changes in lung tissues [87]. Repeated or prolonged dermal contact may cause inflammation of the skin, and, at

high doses, systemic effects in other parts of the body. These may include damage to the kidneys [58]. Chronic exposure may damage skin, which may increase the permeability of the skin to foreign compounds [88].

- **Reproductive effects:** Diquat dibromide generally did not reduce fertility when tested in experimental animals [89]. Rats receiving 1.25 mg/kg/day decreased their food intake and showed slowed growth, but had unchanged reproduction [89]. Fertility was reduced in male mice given diquat dibromide during different stages of sperm formation [87]. Neither fertility nor reproduction was affected in a three-generation study in rats given dietary doses of 12.5 or 25 mg/kg/day of diquat dibromide, although some growth retardation was seen at the 25 mg/kg/day dose [87]. Based on this evidence it is unlikely that diquat dibromide will cause reproductive effects in humans under normal circumstances.
- **Teratogenic effects:** Offspring of pregnant rats given a fatal injected dose of 14 mg/kg of diquat dibromide showed evidence of skeletal defects of the collar bone, as well as little or no ear bone formation upon examination [58,87]. No deformities were found in the unborn offspring of pregnant rats that were injected intraperitoneally with 0.5 mg/kg/day of diquat daily during organogenesis, the stage of fetal development in which organs are formed [26]. Growth retardation was seen in test animals given extremely high doses of diquat. While no actual teratogenesis occurred in rats given single abdominal injections during days 7 to 14 of pregnancy, many rats did not have normal weight gain and bone formation in the unborn was decreased [23]. It is unlikely that diquat dibromide will cause teratogenic effects in humans under normal circumstances.
- **Mutagenic effects:** There is no evidence that diquat dibromide causes permanent changes in genetic material [87]. For example, no mutagenic effects were seen in mice given oral doses of 10 mg/kg/day for 5 days [23].
- **Carcinogenic effects:** An 80-week feeding study showed that dietary doses of 15 mg/kg/day of diquat did not cause tumors in rats [90]. Likewise, dietary levels of 36 mg/kg/day for 2 years did not induce tumors in rats [87]. Based on the evidence, it appears that diquat dibromide is not carcinogenic.
- **Organ toxicity:** In animals, diquat dibromide may affect the gastrointestinal tract, eyes, kidneys or liver, and the lungs.
- **Fate in humans and animals:** Absorption of diquat dibromide from the gut into the bloodstream is low [87]. Oral doses are mainly metabolized within the intestines, with metabolites being excreted in the feces [87,30]. Rat studies showed only a small percentage of the applied oral dose (6%) was absorbed into the bloodstream and then excreted in the urine [87]. Dermal, inhalation, or intravenous exposure results in little processing and rapid elimination in the urine [87]. Following subcutaneous injection in rats, excretion of about 90% of the dose occurred in the urine on the first day and almost all of the remainder on the next day [87]. Complete elimination of the herbicide was seen in urine and feces of rats within 4 days of administration of single oral doses of 5 to 10 mg/kg of diquat dibromide [87].

Ecological Effects:

- **Effects on birds:** Diquat dibromide ranges from slightly to moderately toxic to birds [91]. The reported acute oral LD50 in young male mallards is 564 mg/kg [8]. The oral LD50 for diquat dibromide is 200 to 400 mg/kg in hens [8]. The 5-day dietary LC50 is about 1300 ppm in Japanese quail [36].
- **Effects on aquatic organisms:** Diquat dibromide is moderately to practically nontoxic to fish and aquatic invertebrates. The 8-hour LC50 for diquat dibromide is 12.3 mg/L in rainbow trout and 28.5 mg/L in Chinook salmon [28]. The 96-hour LC50 is 16 mg/L in northern pike, 20.4 mg/L in fingerling trout, 245 mg/L in bluegill, 60 mg/L in yellow perch, and 170 mg/L in black bullhead [37,92]. Research indicates that yellow perch suffer significant respiratory stress when herbicide concentrations in the water are similar to those normally present during aquatic vegetation control programs [93]. There is little or no bioconcentration of diquat dibromide in fish [8].
- **Effects on other organisms:** Diquat dibromide is not toxic to honey bees [1]. Since diquat dibromide is a nonselective herbicide, it may present a danger to non-target plant species [91]. Cows are particularly sensitive to the toxic effects of this material [17].

Environmental Fate:

- **Breakdown in soil and groundwater:** Diquat dibromide is highly persistent, with reported field half-lives of greater than 1000 days [11]. It is very well sorbed by soil organic matter and clay [11]. Although it is water soluble [11], its capacity for strong adsorption to soil particles suggest that it will not easily leach through the soil, be taken up by plants or soil microbes, or broken down by sunlight (photochemical degradation). Field and laboratory tests show that diquat usually remains in the top inch of soil for long periods of time after it is applied [94].
- **Breakdown in water:** Studies on the erosion of diquat-treated soils near bodies of water indicate that diquat dibromide stays bound to soil particles, remaining biologically inactive in surface waters, such as lakes, rivers, and ponds [95]. When diquat dibromide is applied to open water, it disappears rapidly because it binds to suspended particles in the water [95]. Diquat dibromide's half-life is less than 48 hours in the water column, and may be on the order of 160 days in sediments due to its low bioavailability [94,95]. Microbial degradation and sunlight play roles in the breakdown of the compound [95]. At 22 days after a weed infested artificial lake was treated, only 1% of the applied diquat dibromide remained in the water and 19% was adsorbed to sediments [9].
- **Breakdown in vegetation:** Diquat dibromide is rapidly absorbed into the leaves of plants, but usually kills the plant tissues necessary for translocation too quickly to allow movement to other parts of the plant. The herbicide interferes with cell respiration, the process by which plants produce energy. Diquat dibromide is broken down on the plant surface by photochemical degradation [58]. It is rapidly absorbed by aquatic weeds from the surrounding water and concentrated in the plant tissue [8]. Thus, even low concentrations of the herbicide can control aquatic weeds [8].

Physical Properties:

- **Appearance:** Technical diquat dibromide, which is greater than 95% pure, forms white to yellow crystals [1].
- **Chemical Name:** 1,1'-ethylene-2,2'-bipyridyldiylium dibromide salt [1]
- **CAS Number:** 85-00-7
- **Molecular Weight:** 344.06
- **Water Solubility:** 700,000 mg/L @ 20 C; v.s. [1]
- **Solubility in Other Solvents:** i.s. in nonpolar solvents such as chloroform, diethyl ether, and petroleum ether [1]; s.s in alcohol and hydroxylic solvents [1]
- **Melting Point:** Decomposes above 300 C [1]
- **Vapor Pressure:** Negligible @ 20 C [1]
- **Partition Coefficient:** -4.6021 [1]
- **Adsorption Coefficient:** 1,000,000 (estimated) [11]

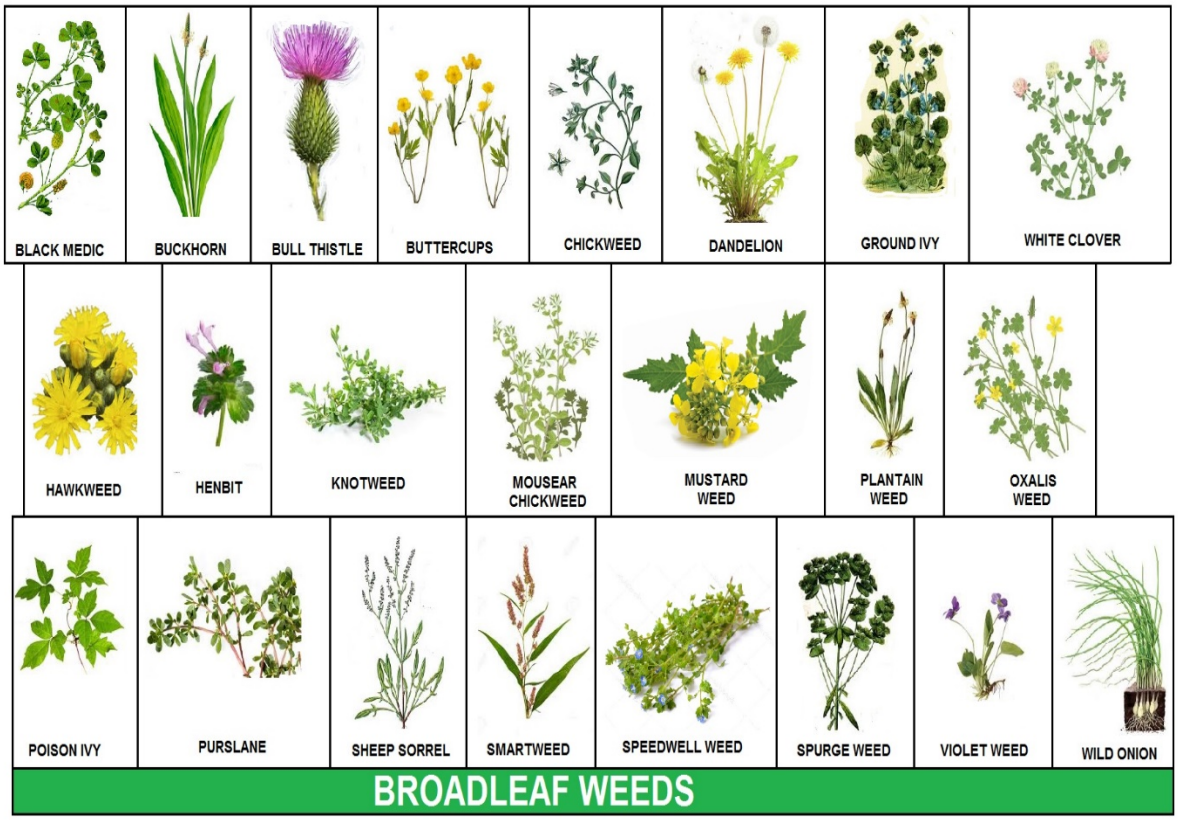
Exposure Guidelines:

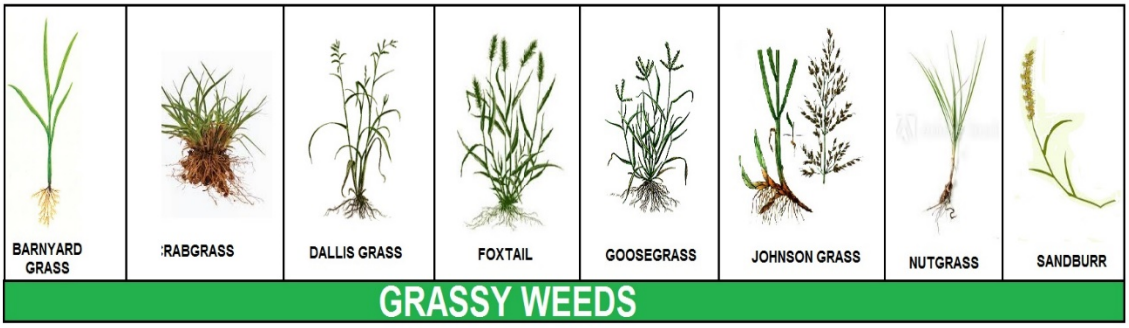
- **ADI:** 0.002 mg/kg/day [12]
- **MCL**: 0.02 mg/L [65]
- **RfD:** 0.0022 mg/kg/day [13]
- **PEL:** Not Available
- **HA**: Not Available
- **TLV**: 0.1 mg/m3 (8-hour) (respirable fraction) [17]

Basic Manufacturer:
Zeneca Ag Products
1800 Concord Pike
Wilmington, DE 19897

- **Phone:** 800-759-4500
- **Emergency:** 800-759-2500

DISCLAIMER: The information in this profile does not in any way replace or supersede the information on the pesticide product labeling or other regulatory requirements. Please refer to the pesticide product labeling.





Technical Learning College

TYPES OF WEEDS

Glyphosate

Trade and Other Names: Trade names for products containing glyphosate include Gallup, Landmaster, Pondmaster, Ranger, Roundup, Rodeo, and Touchdown. It may be used in formulations with other herbicides.

Regulatory Status: Glyphosate acid and its salts are moderately toxic compounds in EPA toxicity class II. Labels for products containing these compounds must bear the Signal Word **WARNING**. Glyphosate is a General Use Pesticide (GUP).

Chemical Class: Not Available

Introduction: Glyphosate is a broad-spectrum, nonselective systemic herbicide used for control of annual and perennial plants including grasses, sedges, broad-leaved weeds, and woody plants. It can be used on non-cropland as well as on a great variety of crops. Glyphosate itself is an acid, but it is commonly used in salt form, most commonly the isopropylamine salt. It may also be available in acidic or trimethylsulfonium salt forms. It is generally distributed as water-soluble concentrates and powders. The information presented here refers to the technical grade of the acid form of glyphosate, unless otherwise noted.

Formulation: Glyphosate itself is an acid, but it is commonly used in salt form, most commonly the isopropylamine salt. It may also be available in acidic or trimethylsulfonium salt forms. It is generally distributed as water-soluble concentrates and powders.

Toxicological Effects:

- **Acute toxicity:** Glyphosate is practically nontoxic by ingestion, with a reported acute oral LD50 of 5600 mg/kg in the rat. The toxicities of the technical acid (glyphosate) and the formulated product (Roundup) are nearly the same [58,96]. The oral LD50 for the trimethylsulfonium salt is reported to be approximately 750 mg/kg in rats, which indicates moderate toxicity [58]. Formulations may show moderate toxicity as well (LD50 values between 1000 mg/kg and 5000 mg/kg) [58]. Oral LD50 values for glyphosate are greater than 10,000 mg/kg in mice, rabbits, and goats [8,96]. It is practically nontoxic by skin exposure, with reported dermal LD50 values of greater than 5000 mg/kg for the acid and isopropylamine salt. The trimethylsulfonium salt has a reported dermal LD50 of greater than 2000 mg/kg. It is reportedly not irritating to the skin of rabbits, and does not induce skin sensitization in guinea pigs [58]. It does cause eye irritation in rabbits [58]. Some formulations may cause much more extreme irritation of the skin or eyes [58]. In a number of human volunteers, patch tests produced no visible skin changes or sensitization [58]. The reported 4-hour rat inhalation LC50 values for the technical acid and salts were 5 to 12 mg/L [58], indicating moderate toxicity via this route. Some formulations may show high acute inhalation toxicity [58]. While it does contain a phosphatyl functional group, it is not structurally similar to organophosphate pesticides which contain organophosphate esters, and it does not significantly inhibit cholinesterase activity [1,58].
- **Chronic toxicity:** Studies of glyphosate lasting up to 2 years, have been conducted with rats, dogs, mice, and rabbits, and with few exceptions no effects were observed [96]. For example, in a chronic feeding study with rats, no toxic effects were observed in rats given doses as high as 400 mg/kg/day [58]. Also, no toxic effects were observed in a chronic feeding study with dogs fed up to 500 mg/kg/day, the highest dose tested [58,97].
- **Reproductive effects:** Laboratory studies show that glyphosate produces reproductive changes in test animals very rarely and then only at very high doses (over 150 mg/kg/day) [58,96]. It is unlikely that the compound would produce reproductive effects in humans.
- **Teratogenic effects:** In a teratology study with rabbits, no developmental toxicity was observed in the fetuses at the highest dose tested (350 mg/kg/day) [97]. Rats given doses up to 175 mg/kg/day on days 6 to 19 of pregnancy had offspring with no teratogenic effects, but other toxic effects were observed in both the mothers and the fetuses. No toxic effects to the fetuses occurred at 50 mg/kg/day [97]. Glyphosate does not appear to be teratogenic.

- **Mutagenic effects:** Glyphosate mutagenicity and genotoxicity assays have been negative [58]. These included the Ames test, other bacterial assays, and the Chinese Hamster Ovary (CHO) cell culture, rat bone marrow cell culture, and mouse dominant lethal assays [58]. It appears that glyphosate is not mutagenic.
- **Carcinogenic effects:** Rats given oral doses of up to 400 mg/kg/day did not show any signs of cancer, nor did dogs given oral doses of up to 500 mg/kg/day or mice fed glyphosate at doses of up to 4500 mg/kg/day [58]. It appears that glyphosate is not carcinogenic [97].
- **Organ toxicity:** Some microscopic liver and kidney changes, but no observable differences in function or toxic effects, have been seen after lifetime administration of glyphosate to test animals [97].
- **Fate in humans and animals:** Glyphosate is poorly absorbed from the digestive tract and is largely excreted unchanged by mammals. At 10 days after treatment, there were only minute amounts in the tissues of rats fed glyphosate for 3 weeks [98]. Cows, chickens, and pigs fed small amounts of glyphosate had undetectable levels (less than 0.05 ppm) in muscle tissue and fat. Levels in milk and eggs were also undetectable (less than 0.025 ppm). Glyphosate has no significant potential to accumulate in animal tissue [99].

Ecological Effects:

- **Effects on birds:** Glyphosate is slightly toxic to wild birds. The dietary LC50 in both mallards and bobwhite quail is greater than 4500 ppm [1].
- **Effects on aquatic organisms:** Technical glyphosate acid is practically nontoxic to fish and may be slightly toxic to aquatic invertebrates. The 96-hour LC50 is 120 mg/L in bluegill sunfish, 168 mg/L in harlequin, and 86 mg/L in rainbow trout [58]. The reported 96-hour LC50 values for other aquatic species include greater than 10 mg/L in Atlantic oysters, 934 mg/L in fiddler crab, and 281 mg/L in shrimp [58]. The 48-hour LC50 for glyphosate in Daphnia (water flea), an important food source for freshwater fish, is 780 mg/L [58]. Some formulations may be more toxic to fish and aquatic species due to differences in toxicity between the salts and the parent acid or to surfactants used in the formulation [58,96]. There is a very low potential for the compound to build up in the tissues of aquatic invertebrates or other aquatic organisms [96].
- **Effects on other organisms:** Glyphosate is nontoxic to honeybees [1,58]. Its oral and dermal LD50 is greater than 0.1 mg/ bee [98]. The reported contact LC50 values for earthworms in soil are greater than 5000 ppm for both the glyphosate trimethylsulfonium salt and Roundup [58].

Environmental Fate:

- **Breakdown in soil and groundwater:** Glyphosate is moderately persistent in soil, with an estimated average half-life of 47 days [58,11]. Reported field half-lives range from 1 to 174 days [11]. It is strongly adsorbed to most soils, even those with lower organic and clay content [11,58]. Thus, even though it is highly soluble in water, field and laboratory studies show it does not leach appreciably, and has low potential for runoff (except as adsorbed to colloidal matter) [3,11]. One estimate indicated that less than 2% of the applied chemical is lost to runoff [99]. Microbes are primarily responsible for the breakdown of the product, and volatilization or photodegradation losses will be negligible [58].
- **Breakdown in water:** In water, glyphosate is strongly adsorbed to suspended organic and mineral matter and is broken down primarily by microorganisms [6]. Its half-life in pond water ranges from 12 days to 10 weeks [97].
- **Breakdown in vegetation:** Glyphosate may be translocated throughout the plant, including to the roots. It is extensively metabolized by some plants, while remaining intact in others [1].

Physical Properties:

- **Appearance:** Glyphosate is a colorless crystal at room temperature [1].
- **Chemical Name:** N-(phosphonomethyl) glycine [1]
- **CAS Number:** 1071-83-6
- **Molecular Weight:** 169.08
- **Water Solubility:** 12,000 mg/L @ 25 C [1]

- **Solubility in Other Solvents:** i.s. in common organics (e.g., acetone, ethanol, and xylene) [1]
- **Melting Point:** 200 C [1]
- **Vapor Pressure:** negligible [1]
- **Partition Coefficient:** -3.2218 - -2.7696 [58]
- **Adsorption Coefficient:** 24,000 (estimated) [11]

Exposure Guidelines:

- **ADI:** 0.3 mg/kg/day [12]
- **MCL**: Not Available
- **RfD:** 0.1 mg/kg/day [13]
- **PEL:** Not Available
- **HA**: 0.7 mg/L (lifetime) [98]
- **TLV**: Not Available

Basic Manufacturer:
Monsanto Company
800 N. Lindbergh Blvd.
St. Louis, MO 63167

- **Phone:** 314-694-6640
- **Emergency:** 314-694-4000

DISCLAIMER: The information in this profile does not in any way replace or supersede the information on the pesticide product labeling or other regulatory requirements. Please refer to the pesticide product labeling.

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Agricultural plant means any plant grown or maintained for commercial, research, or other purposes. Included in this definition are food, feed and fiber plants, trees, turf grass, flowers, shrubs, ornamentals, and seedlings (40 CFR).

Farm means any operation, other than a nursery or forest, engaged in the outdoor production of agricultural plants (40 CFR, Section 170.3).

2,4-D

Trade and Other Names: 2,4-D is used in many commercial products. Commercial names for products containing 2,4-D include Aqua-Kleen, Barrage, Lawn-Keep, Malerbane, Planotox, Plantgard, Savage, Salvo, Weedone, and Weedtrine-II.

Regulatory Status: 2,4-D is a General Use Pesticide (GUP) in the U.S. The diethylamine salt is toxicity class III- slightly toxic orally, but toxicity class I- highly toxic by eye exposure. It bears the Signal Word **DANGER - POISON** because 2,4-D has produced serious eye and skin irritation among agricultural workers.

Chemical Class: phenoxy compound

Introduction: There are many forms or derivatives of 2,4-D including esters, amines, and salts. Unless otherwise specified, this document will refer to the acid form of 2,4-D. 2,4-D, a chlorinated phenoxy compound, functions as a systemic herbicide and is used to control many types of broadleaf weeds. It is used in cultivated agriculture, in pasture and rangeland applications, forest management, home, garden, and to control aquatic vegetation. It may be found in emulsion form, in aqueous solutions (salts), and as a dry compound.

The product Agent Orange, used extensively throughout Vietnam, was about 50% 2,4-D. However, the controversies associated with the use of Agent Orange were associated with a contaminant (dioxin) in the 2,4,5-T component of the defoliant.

Formulation: It may be found in emulsion form, in aqueous solutions (salts), and as a dry compound.
Toxicological Effects:

- **Acute toxicity:** The acid form is of slight to moderate toxicity. The oral LD50 of 2,4-D ranges from 375 to 666 mg/kg in the rat, 370 mg/kg in mice, and from less than 320 to 1000 mg/kg in guinea pigs. The dermal LD50 values are 1500 mg/kg in rats and 1400 mg/kg in rabbits, respectively [1,5,7]. In humans, prolonged breathing of 2,4-D causes coughing, burning, dizziness, and temporary loss of muscle coordination [1]. Other symptoms of poisoning can be fatigue and weakness with possible nausea. On rare occasions following high levels of exposure, there can be inflammation of the nerve endings with muscular effects [25].
- **Chronic toxicity:** Rats given high amounts, 50 mg/kg/day, of 2,4-D in the diet for 2 years showed no adverse effects. Dogs fed lower amounts in their food for 2 years died, probably because dogs do not excrete organic acids efficiently. A human given a total of 16.3 g in 32 days therapeutically, lapsed into a stupor and showed signs of incoordination, weak reflexes, and loss of bladder control [1,5,7].
- **Reproductive effects:** High levels of 2,4-D (about 50 mg/kg/day) administered orally to pregnant rats did not cause any adverse effects on birth weights or litter size. Higher doses (188 mg/kg/day) resulted in fetuses with abdominal cavity bleeding and increased mortality [1,5,7]. DNA synthesis in the testes was significantly inhibited when mice were fed large amounts (200 mg/kg/day) of 2,4-D [7]. The evidence suggests that if 2,4-D causes reproductive effects in animals, this only occurs at very high doses. Thus reproductive problems associated with 2,4-D are unlikely in humans under normal circumstances.
- **Teratogenic effects:** 2,4-D may cause birth defects at high doses. Rats fed 150 mg/kg/day on days 6 to 15 of pregnancy had offspring with increased skeletal abnormalities, such as delayed bone development and wavy ribs [7]. This suggests that 2,4-D exposure is unlikely to be teratogenic in humans at expected exposure levels.
- **Mutagenic effects:** 2,4-D has been very extensively tested and was found to be non-mutagenic in most systems. 2,4-D did not damage DNA in human lung cells. However, in one study, significant effects occurred in chromosomes in cultured human cells at low exposure levels [26]. The data suggest that 2,4-D is not mutagenic or has low mutagenic potential.
- **Carcinogenic effects:** 2,4-D fed to rats for 2 years caused an increase in malignant tumors [7]. Female mice given a single injection of 2,4-D developed cancer (reticulum-cell sarcomas) [7].

Another study in rodents shows a low incidence of brain tumors at moderate exposure levels (45 mg/kg/day) over a lifetime [1,7]. However, a number of questions have been raised about the validity of this evidence and thus about the carcinogenic potential of 2,4-D. In humans, a variety of studies give conflicting results. Several studies suggest an association of 2,4-D exposure with cancer. An increased occurrence of non-Hodgkin's lymphoma was found among a Kansas and Nebraska farm population associated with the spraying of 2,4-D [25,27]. Other studies done in New Zealand, Washington, New York, Australia, and on Vietnam veterans from the U.S. were all negative. There remains considerable controversy about the methods used in the various studies and their results [28]. Thus, the carcinogenic status of 2,4-D is not clear.

- **Organ toxicity:** Most symptoms of 2,4-D exposure disappear within a few days, but there is a report of liver dysfunction from long-term exposure [1,25].
- **Fate in humans and animals:** The absorption of 2,4-D is almost complete in mammals after ingestion and nearly all of the dose is excreted in the urine. The compound is readily absorbed through the skin and lungs. Men given 5 mg/kg excreted about 82% of the dose as unchanged 2,4-D. The half-life is between 10 and 20 hours in living organisms. There is no evidence that 2,4-D accumulates to significant level in mammals or in other organisms [20]. Between 6 and 8 hours after doses of 1 mg/kg, peak concentrations of 2,4-D were found in the blood, liver, kidney, lungs, and spleen of rats. There were lower levels in muscle and brain. After 24 hours, there were no detectable tissue residues. Only traces of the compound have been found in the milk of lactating animals for 6 days following exposure. 2,4-D passes through the placenta in pigs and rats. In rats, about 20% was detected in the uterus, placenta, fetus, and amniotic fluid [27]. Chickens given moderate amounts of 2,4-D in drinking water from birth to maturity had very low levels of the compound in eggs [7].

Ecological Effects:

- **Effects on birds:** 2,4-D is slightly toxic to wildfowl and slightly to moderately toxic to birds. The LD50 is 1000 mg/kg in mallards, 272 mg/kg in pheasants, and 668 mg/kg in quail and pigeons [5-7].
- **Effects on aquatic organisms:** Some formulations of 2,4-D are highly toxic to fish while others are less so. For example, the LC50 ranges between 1.0 and 100 mg/L in cutthroat trout, depending on the formulation used. Channel catfish had less than 10% mortality when exposed to 10 mg/L for 48 hours [1,9]. Green sunfish, when exposed to 110 mg/L for 41 hours, showed no effect on swimming response. Limited studies indicate a half-life of less than 2 days in fish and oysters [24]. Concentrations of 10 mg/L for 85 days did not adversely affect the survival of adult Dungeness crabs. For immature crabs, the 96-hour LC50 is greater than 10 mg/L, indicating that 2,4-D is only slightly toxic. Brown shrimp showed a small increase in mortality at exposures of 2 mg/L for 48 hours [7,20].
- **Effects on other organisms:** Moderate doses of 2,4-D severely impaired honeybees brood production. At lower levels of exposure, exposed bees lived significantly longer than the controls. The honeybee LD50 is 0.0115 mg/bee [6,7].

Environmental Fate:

- **Breakdown in soil and groundwater:** 2,4-D has low soil persistence. The half-life in soil is less than 7 days [21]. Soil microbes are primarily responsible for its disappearance [20]. Despite its short half-life in soil and in aquatic environments, the compound has been detected in groundwater supplies in at least five States and in Canada [20]. Very low concentrations have also been detected in surface waters throughout the U.S. [23].
- **Breakdown in water:** In aquatic environments, microorganisms readily degrade 2,4-D. Rates of breakdown increase with increased nutrients, sediment load, and dissolved organic carbon. Under oxygenated conditions the half-life is 1 week to several weeks [20].
- **Breakdown in vegetation:** 2,4-D interferes with normal plant growth processes. Uptake of the compound is through leaves, stems, and roots. Breakdown in plants is by a variety of biological and chemical pathways [10]. 2,4-D is toxic to most broad leaf crops, especially cotton, tomatoes, beets, and fruit trees [7].

Physical Properties:

- **Appearance:** 2,4-D is a white powder [6].
- **Chemical Name:** (2,4-dichlorophenoxy)acetic acid [6]
- **CAS Number:** 94-75-7
- **Molecular Weight:** 221.04
- **Water Solubility:** 900 mg/L @ 25 C (acid) [5]
- **Solubility in Other Solvents:** ethanol v.s.; diethyl ether v.s.; toluene s.; xylene s. [6]
- **Melting Point:** 140.5 C [6]
- **Vapor Pressure:** 0.02 mPa @ 25 C (acid) [5]
- **Partition Coefficient:** 2.81 [20]
- **Adsorption Coefficient:** 20 (acid) [21]

Exposure Guidelines:
- **ADI:** 0.3 mg/kg/day [29]
- **MCL**: 0.07 mg/L [30]
- **RfD:** 0.01 mg/kg/day [31]
- **PEL:** 10 mg/m3 (8-hour) [32]
- **HA**: Not Available
- **TLV**: Not Available

Basic Manufacturer:
Rhone-Poulenc Ag. Co.
P.O. Box 12014
2 T.W. Alexander Dr.
Research Triangle Park, NC 27709
- **Phone:** 919-549-2000
- **Emergency:** 800-334-7577

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Triclopyr - (Trade name Renovate3®).

There are two formulations of triclopyr. It is the TEA formation of triclopyr that is registered for use in aquatic or riparian environments. Triclopyr, applied as a liquid, is a relatively fast-acting, systemic, selective herbicide used for the control of Eurasian watermilfoil and other broad-leaved species such as purple loosestrife. Triclopyr can be effective for spot treatment of Eurasian watermilfoil and is relatively selective to Eurasian watermilfoil when used at the labeled rate.

Many native aquatic species are unaffected by triclopyr. Triclopyr is very useful for purple loosestrife control since native grasses and sedges are unaffected by this herbicide. When applied directly to water, Ecology has imposed a 12-hour swimming restriction to minimize eye irritation.

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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.

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Imazapyr (Trade name Habitat®).

This systemic broad spectrum herbicide, applied as a liquid, is used to control emergent plants like spartina, reed canarygrass, and phragmites and floating-leaved plants like water lilies. Imazapyr does not work on underwater plants such as Eurasian watermilfoil. Although imazapyr is a broad spectrum, non-selective herbicide, a good applicator can somewhat selectively remove targeted plants by focusing the spray only on the plants to be removed.

Fluridone

Trade names for fluridone products include: Sonar® and Avast!®). Fluridone is a slow-acting systemic herbicide used to control Eurasian watermilfoil and other underwater plants. It may be applied as a pellet or as a liquid. Fluridone can show good control of submersed plants where there is little water movement and an extended time for the treatment. Its use is most applicable to whole-lake or isolated bay treatments where dilution can be minimized. It is not effective for spot treatments of areas less than five acres. It is slow-acting and may take six to twelve weeks before the dying plants fall to the sediment and decompose.

When used to manage Eurasian watermilfoil, fluridone is applied several times during the spring/summer to maintain a low, but consistent, concentration in the water. Although fluridone is considered to be a broad spectrum herbicide, when used at very low concentrations, it can be used to selectively remove Eurasian watermilfoil. Some native aquatic plants, especially pondweeds, are minimally affected by low concentrations of fluridone.

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Year-Round Weed Management Strategies: A Summary

Prevention
Employ sanitary practices; prevent new weed infestations. Prevent weed shifts resulting from repeated:
• Cultivation (enhances perennial weeds).
• Mowing (enhances prostrate weeds).
• Herbicides (enhance tolerant weeds, new weed biotypes, new microorganisms that render herbicide inactive).

Identify and Map
• Use reference books to help identify annual and perennial weeds.
• Map and record infestations (weed abundance).
• Keep yearly records.

Prioritize Weeds (develop thresholds)
• Highly competitive weeds (control).
• Moderately competitive weeds (suppress).
• Low growing or noncompetitive weeds (don't worry).

List Controls
• Your experience.
• Local experts.
• Published information.
• Learn strengths and weaknesses of each control method.

Design Weed Management Program
• Select fields or garden area with manageable weed species.
• Consider environmental aspects: Erosion potential, surrounding water, high-value vegetation, or urban and/or recreational areas.
• Consider costs, equipment, skills, precision timing, and other factors needed to achieve results.
• Develop year-round weed management strategies involving combinations of weed control practices.

Evaluate Results
• Evaluate weed management programs.
• Continue mapping weeds for future reference.
• Modify practices as weeds shift because of repeated practices.

Aquatic Toxicology

Aquatic toxicology is the study of the effects of environmental contaminants on aquatic organisms, such as the effect of pesticides on the health of fish or other aquatic organisms. A pesticide's capacity to harm fish and aquatic animals is largely a function of its (1) toxicity, (2) exposure time, (3) dose rate, and (4) persistence in the environment.

Toxicity of the pesticide refers to how poisonous it is. Some pesticides are extremely toxic, whereas others are relatively nontoxic. Exposure refers to the length of time the animal is in contact with the pesticide. A brief exposure to some chemicals may have little effect on fish, whereas longer exposure may cause harm.

The dose rate refers to the quantity of pesticide to which an animal is subjected (orally, dermally, or through inhalation). A small dose of a more toxic chemical may be more damaging than a large dose of a less toxic chemical. Dosages can be measured as the weight of toxicant per unit (kilogram) of body weight (expressed as mg pesticide/kg of body weight) or as the concentration of toxicant in the water or food supply (usually expressed as parts per million, ppm or parts per billion, ppb).

A lethal dose is the amount of pesticide necessary to cause death. Because not all animals of a species die at the same dose (some are more tolerant than others), a standard toxicity dose measurement, called a Lethal Concentration 50 (LC50), is used. This is the concentration of a pesticide that kills 50% of a test population of animals within a set period of time, usually 24 to 96 hours.

Hazard ratings ranging from minimal to super toxic and LC50s for commonly used insecticides, herbicides, and fungicides are presented in Tables 3, 4 and 5. For example, the 24-hour LC50 of the insecticide permethrin to rainbow trout is 12.5 ppb. This means that one-half of the trout exposed to 12.5 ppb of permethrin died within 24 hours, indicating super toxicity of this pesticide to trout.

Hazard Ratings	
Toxicity	**LC50(mg/l)**
Minimal	>100
Slight	10 - 100
Moderate	1 - 10
High	0.1 - 1.0
Extreme	0.01 - 0.1
Super	< 0,01

Exposure of fish and other aquatic animals to a pesticide depends on its biological availability (bio-availability), bio-concentration, bio-magnification, and persistence in the environment.

Bioavailability refers to the amount of pesticide in the environment available to fish and wildlife. Some pesticides rapidly break down after application. Some bind tightly to soil particles suspended in the water column or to stream bottoms, thereby reducing their availability. Some are quickly diluted in water or rapidly volatize into the air and are less available to aquatic life.

Bioconcentration is the accumulation of pesticides in animal tissue at levels greater than those in the water or soil to which they were applied. Some fish may concentrate certain pesticides in their body tissues and organs (especially fats) at levels 10 million times greater than in the water.

Bio-magnification is the accumulation of pesticides at each successive level of the food chain. Some pesticides bio-accumulate (buildup) in the food chain. For example, if a pesticide is present in small amounts in water, it can be absorbed by water plants which are, in turn, eaten by insects and minnows. These also become contaminated. At each step in the food chain the concentration of pesticide increases. When sport fish such as bass or trout repeatedly consume contaminated animals, they bio-concentrate high levels in their body fat. Fish can pass these poisons on to humans.

Persistence of Pesticides
Persistence refers to the length of time a pesticide remains in the environment. This depends on how quickly it breaks down (degrades), which is largely a function of its chemical composition and the environmental conditions. Persistence is usually expressed as the "half-life" (T1/2) of a pesticide. Half-life is the amount of time required for half of the pesticide to disappear (the other half remains). Half-life of pesticides can range from hours or days, to years for more persistent ones.

Pesticides can be degraded by sunlight (photodecomposition), high air or water temperatures (thermal degradation), moisture conditions, biological action (microbial decay), and soil conditions (pH). Persistent (long-lasting) pesticides break down slowly and may be more available to aquatic animals.

Pesticide Formulations
The active ingredient (pesticide) is combined with other inert ingredients (carriers, solvents, propellants) to comprise the formulated pesticide product. In some cases the inert ingredients may cause concern for aquatic life. Pesticides may be purchased in solid (granules, powders, dusts) or liquid (water, oil sprays) form. A major concern in using either solid or liquid forms of pesticides is their misapplication.

Sub-lethal Effects
Not all pesticide poisonings result in the immediate death of an animal. Small "sub-lethal" doses of some pesticides can lead to changes in behavior, weight loss, impaired reproduction, inability to avoid predators, and lowered tolerance to extreme temperatures.

Fish in streams flowing through croplands and orchards are likely to receive repeated low doses of pesticides if continuous pesticide applications run-off fields. Repeated exposure to certain pesticides can result in reduced fish egg production and hatching, nest and brood abandonment, lower resistance to disease, decreased body weight, hormonal changes, and reduced avoidance of predators. The overall consequences of sub-lethal doses of pesticides can be reduced adult survival and lowered population abundance.

Sub-lethal Effects include:
- Weight Loss
- Low Diseases Resistance
- Sterility
- Reduced Egg Production
- Loss of Attention
- Low Predator Avoidance

Habitat Alteration
Pesticides can reduce the availability of plants and insects that serve as habitat and food for fish and other aquatic animals. Insect-eating fish can lose a portion of their food supply when pesticides are applied. A sudden, inadequate supply of insects can force fish to range farther in search of food, where they may risk greater exposure to predation.

How Fish are Exposed
Spraying herbicides can also reduce reproductive success of fish and aquatic animals. The shallow, weedy nursery areas for many fish species provide abundant food and shelter for young fish. Spraying herbicides near weedy nurseries can reduce the amount of cover and shelter that young fish need in order to hide from predators and to feed. Most young fish depend on aquatic plants as refuge in their nursery areas.

Aquatic plants provide as much as 80% of the dissolved oxygen necessary for aquatic life in ponds and lakes. Spraying herbicides to kill all aquatic plants can result in severely low oxygen levels and the suffocation of fish. Using herbicides to completely "clean up" a pond will significantly reduce fish habitat, food supply, dissolved oxygen, and fish productivity.

The landowner who sprays a weedy fence line with herbicides may unintentionally kill the trumpet vine on which hummingbirds feed and the honeysuckle that nourish deer and quail. Similarly, the landowner who unnecessarily sprays his water plants kills the plants that feed the insects that feed the fish that feed the farmer. Casual use of herbicides for lake or farm pond "beautification" may reduce fish populations.

Fish and aquatic animals are exposed to pesticides in three primary ways (1) dermally, direct absorption through the skin by swimming in pesticide-contaminated waters, (2) breathing, by direct uptake of pesticides through the gills during respiration, and (3) orally, by drinking pesticide-contaminated water or feeding on pesticide-contaminated prey. Poisoning by consuming another animal that has been poisoned by a pesticide is termed "secondary poisoning." For example, fish feeding on dying insects poisoned by insecticides may themselves be killed if the insects they consume contain large quantities of pesticides or their toxic byproducts.

Reducing the Risk: Prior to using a pesticide, consider the following:

1. Use a Pesticide Only When Necessary
    - Is the problem bad enough to justify the use of a toxic chemical? Are there alternative ways of treating the problem? Landowners should consider the costs and consequences of pesticide treatment relative to the problem.
2. Use Less Toxic Pesticides
    - One way to reduce the effects of pesticides on aquatic systems is to use those chemicals that are least poisonous to aquatic life. The tables presented at the end of this booklet give information about the relative toxicity of many of the agricultural pesticides. Select the least toxic material.
3. Use Safe/Sensible Application Methods
    - The first rule of responsible pesticide use is to read and then reread the pesticide label and follow the directions precisely. Label instructions sometimes can be confusing. If you don't understand the instructions, contact your Extension Agent, your supplier, or the pesticide company for more information.
    - Pay particular attention to warning statements about environmental hazards on the label. Look for: "This product is toxic to fish." If you see such a warning, consider another pesticide or an alternative control method.
    - Ensure that your application equipment is in good working condition. Check for leaks, replace worn parts, and carefully calibrate your equipment.
    - When preparing the pesticides for application, be certain that you are mixing them correctly.
    - Never wash spray equipment in lakes, ponds, or rivers. If you use water from natural ponds, lakes, or streams, use an antisiphon device to prevent backflow.

- If you are applying pesticides near water, check the label to find the recommended buffer zone. Buffer strip widths between the water and the treatment areas vary. Leave a wide buffer zone to avoid contaminating fish and aquatic animals.
- Store and dispose of unused chemicals and their containers according to the label instructions.
- Avoid pesticide drift into non-target areas, or applications during wet, windy weather that might promote runoff to non-target streams, ponds, or lakes. Spray on calm days, or early in the morning or evening when it is less windy.
- Pesticide applicators are liable for downstream fish kills and pesticide contamination.

Southern Watergrass

Buttonbush

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 became 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 THE REGULATIONS - EFFECTIVE MAY 11, 1995

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.

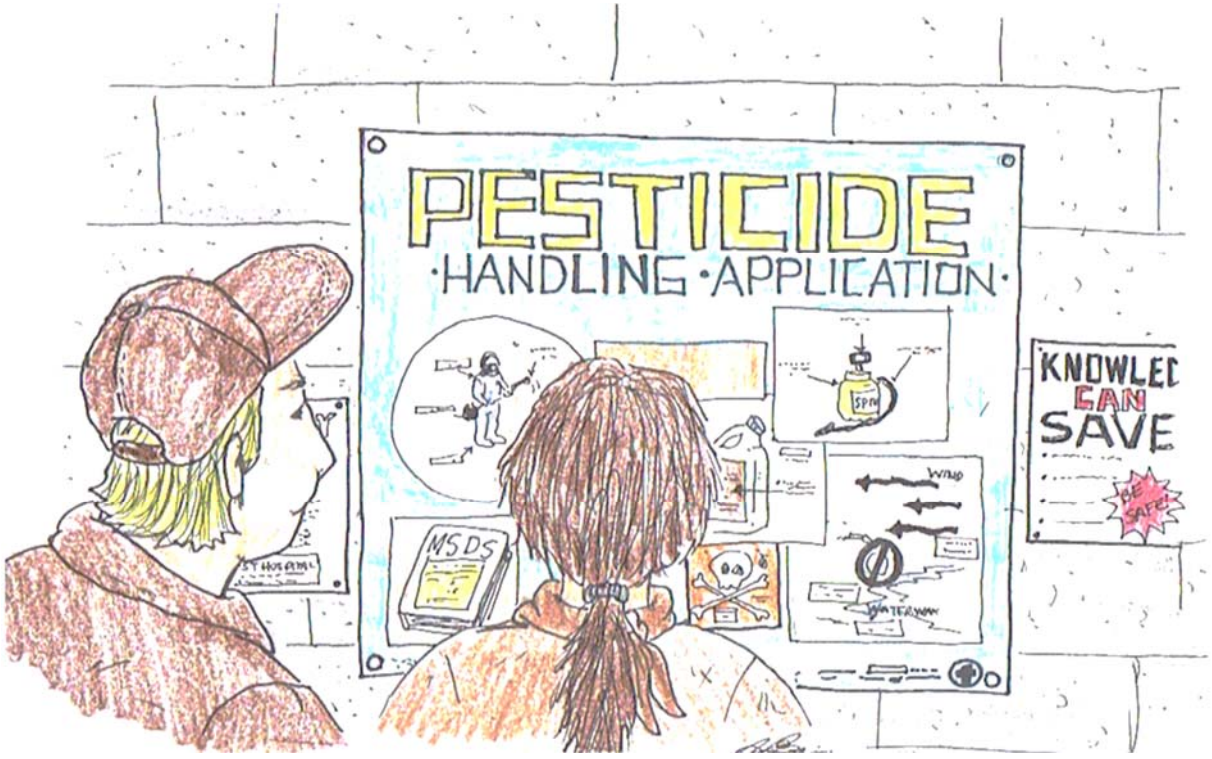
   However, whether or not the written record has been completed, the certified applicator shall provide the record information for medical treatment or first aid.

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. If it is determined by the attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, to be a medical emergency, the record information of the restricted use pesticide, relating to the medical emergency, shall be provided immediately.

6. **Change in provisions for the release of record information obtained for purposes of medical treatment.**
   (1) The attending licensed health care professional, or an individual acting under the direction of the attending licensed health care professional, may utilize and release the record or record information when 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;
   (2) the attending licensed health care professional may release the record or record information to appropriate Federal or State agencies that deal with pesticide use or any health issue related to the use of pesticides when necessary to prevent further injury or illness; and
   (3) a licensed health care professional may release the record or record information to submit pesticide poisoning incident reports to the appropriate State or Federal agencies.
7. **Clarification that the Administrator of AMS, has flexibility in assessing civil penalties.**
   The amended regulations provide the Administrator of AMS, or the Administrator's designee, with flexibility in assessing civil penalties.



Always wear PPE, respirator, rubber shoes, rubber gloves, Tyvek suit when cleaning your spray equipment.

Spanish warning statements. If the product is classified as toxicity category I or toxicity category II according to the criteria in § 156.10(h)(1), the signal word shall appear in Spanish in addition to English followed by the statement, "Si Usted no entiende la etiqueta, busque a alguien para que se la explique a Usted en detalle. (If you do not understand the label, find someone to explain it to you in detail.)" The Spanish signal word "PELIGRO" shall be used for products in toxicity category I, and the Spanish signal word "AVISO" shall be used for products in toxicity category II. These statements shall appear on the label close to the English signal word.

Insecticide Safety Precautions

The Federal Environmental Pesticide Control Act of 1972 in part prohibits the application of any pesticide in a manner inconsistent with its labeling. This means that a pesticide cannot be used unless it is registered for the specific pest. Consequently, some chemicals formerly used by homeowners and pesticide applicators can no longer be used legally.

Insecticide labels are subject to change, and changes may have occurred since this publication was printed. County Extension agents and Extension entomologists are notified as these changes occur.

The pesticide **APPLICATOR** is always responsible for the effects of pesticide residues as well as problems caused by residues that drift from the application site to other property. Always read and carefully follow instructions on the product label.

When using pesticides, always avoid prolonged chemical contact with skin. Wash exposed skin areas with generous amounts of soap and water. Launder clothing worn during application in hot water using a phosphate detergent. Do not contaminate food, dishes, utensils or food preparation areas with insecticide. Any contaminated food should be discarded, and dishes and utensils should be thoroughly washed.

Safety Notes

- **READ, UNDERSTAND** and **FOLLOW** all insecticide label directions and precautions. Some product labels may require that pilot lights should be off on stove, furnace and water heater.
- Keep insecticides in original containers with the label intact. Do not contaminate food, water, dishes or utensils.
- Keep insecticides out of reach of children and do not allow children or pets near treated surfaces until dry.

Purple Loosestrife

REQUIRED HANDLER/MIXER/APPLICATOR PPE DIAGRAM

Herbicide Hazards

Whether there is herbicide injury to crops depends upon several factors:

- the chemical nature of the herbicide,
- the sensitivity of the plant species,
- the methods of application,
- the proximity of target and non-target crops, and
- the behavior of the herbicide in the environment.

All herbicides can be classified as either selective or nonselective. Selective herbicides kill certain weeds with little or no injury to the crop. It is the difference in plant response that determines the effectiveness of the herbicide and safety to the crop.

Non-selective herbicides are those which will kill or injure virtually all kinds of vegetation. The risk of drift is great when the application is by foliar spray. When the soil is treated, a hazard may arise from the herbicide persisting in the soil longer than intended and interfering with growing a crop at some later time. The movement of a non-selective herbicide by runoff or by soil erosion to non-target areas is another possibility. Typical 2,4 D injury symptoms on grape leaves.

Drift hazards
There are two ways herbicides drift to non-target areas.

1. Mist droplets are generated by the sprayer nozzles. The size of droplet depends upon the nozzle pressure, the size of nozzle orifice and the surface tension of the spray solution.

2. Vapor may be generated depending upon the volatility of the herbicide. The amount of vapor varies with the chemical and the conditions of application.

Droplet Drift
The distance of droplet drift depends upon the size of the droplets, the velocity of the wind and the height above the ground where the herbicide is discharged. In general, larger orifices and lower pressures result in larger droplets. Conversely, the smaller the orifice and the greater the pressure, the smaller will be the size of the droplets. The smaller the droplet, the farther it will drift with wind of any particular velocity.

Vapor Drift
Volatility refers to the ability of a herbicide to vaporize and to mix freely with the air. Volatile herbicides may produce vapors that can be carried great distances from the target area to other crop sites. Such herbicide volatility can also reduce the rate of application to the target area. A row of grapevines severely injured by herbicides used to clear the nearby railroad.

Phenoxy Herbicides
The phenoxy group of herbicides has been most often involved in crop injury by off-target drift. The phenoxy group includes 2,4-D, 2,4,5-T, 2,4-DB, 2,4,5-TP (Silvex) and MCPA. These herbicides are most commonly used for the control of broad-leaved weeds in crops and for the control of undesirable woody species.

Phenoxy herbicides are more or less volatile. Vapors can arise from the herbicide while mixing, during and after application.

Phenoxy herbicides in general are formulated in two ways, as esters or amines. Esters are more effective in controlling hard-to-kill weeds but are the most hazardous in terms of volatility and consequent drift to sensitive crops.

There are two categories of esters: the regular form and the low-volatile form. The latter form is less likely to cause problems. The amine formulations are safer to use than are the esters, but they are less effective in their performance.

Susceptible Crops
Although most kinds of broad-leaved plants are susceptible to injury by phenoxy herbicides, grapes and tomatoes are the most sensitive. Cotton, soybeans, potatoes, other vegetables, legume crops and many ornamental trees, shrubs and flowers can also be severely affected.

Because grapes are one of the crops most sensitive to phenoxy herbicides, these herbicides should not be applied in an area where vineyards are established. Great distances between the site of application and the location of a vineyard, tomato field, melon patch or greenhouse may not afford protection against injury from drift.

Problems of drift are common and often result in hardship for the grower of the susceptible crop, judgments against the applicator for crop losses and a bad reputation for the herbicide. Typical leaf-curl symptoms of soybeans exposed to phenoxy herbicides.

Symptoms of Injury
Mere traces of a phenoxy herbicide may cause sensitive plants to produce abnormally large leaves, exaggerated distances between leaves and multiplied or enlarged flowering or fruiting parts.

Greater concentrations of the herbicide can cause stunting and cupping of leaves, spiraling growth of soft shoots, clearing and enlargement of major leaf veins and severe distortion of flowering or fruiting parts. After severe exposure, leaves may be fan-shaped or severely stunted and curled, with extensive development of small teeth along leaf margins.

When grapes are visibly affected, there will generally be uneven or delayed coloring of the fruit. Reduced production of sugars within the fruit can render the crop worthless. Shoots grow either excessively long or may be stunted, and the canes may lose their ability to survive normal winter temperatures. Leaves exhibit the characteristic fan shape with sawtooth margins.

Affected tomato plants exhibit cupped or elongated leaves with enlarged pale veins and toothy margins. Stem twisting, severe stunting of plants, puffy fruits or abortion of flowers commonly occur.

Soybeans usually exhibit leaf distortion at lowest levels of exposure while higher levels can result in yellowing of foliage and defoliation.

Greenhouse crops, vegetables, ornamental plants and desirable native vegetation are affected in various ways. The leaves and stems of shrubs or trees may become stunted, stretched, twisted or spindly to the extent of being unsightly or worthless.

Long-term Effects
Woody plants such as grapes, apples and peaches which show substantial stem and leaf distortion usually fail to produce a marketable crop. If the symptoms are sudden or severe, one to three years may be required for recovery. Severe cases of phenoxy herbicide injury may result in stunted growth and poor ripening for two to four years after exposure. Growers seeking monetary compensation should be aware of these long-term effects and not be too quick to settle damage claims.

Annual crops of herbaceous plants such as florist crops, field crops and vegetables do not have the same potential for long-term losses. But the value of a single season's crop can constitute a major economic loss to either the grower or the user of the herbicide.

Other Herbicides
Several herbicides other than the phenoxys can also injure sensitive crops. Some of those applied to soils to control woody plants or weeds in crops may be absorbed by the extensive roots of nearby plants such as fruit trees, nut trees and grape vines. Certain non-phenoxy herbicides used to kill woody plants by application to the foliage can cause problems when they drift to economic crops.

Preventing Crop Injury
Awareness is the key to preventing damage by phenoxy and other herbicides. Once applicators are aware of the hazards and possible consequences of misuse they can take several steps to prevent problems:

- ✓ Learn the locations of sensitive crops in the area.
- ✓ Avoid use of ester formulations of phenoxy herbicides in any area near sensitive crops.
- ✓ Use amine forms of phenoxy herbicides to reduce the risk of vapor drifting to nearby sensitive crops.
- ✓ Apply pesticides, especially herbicides, on a calm day or when a light breeze is blowing away from sensitive crops.
- ✓ Spray when temperatures will remain below 90 degrees F to prevent or reduce vaporization.
- ✓ Use sprayer nozzles with larger orifices and operate at lower pump pressures to reduce the production of fine droplets.

Resolving Problems
User responsibility. Registration and labeling of a particular pesticide clearly give individuals the right to apply the pesticide as long as they follow the directions for use and the precautions stated on the label. The use of a pesticide in any way contrary to the label is a violation of federal law. Misuse of a pesticide may make the user liable to either criminal prosecution or to civil proceedings or both.

Although there is no legal obligation for herbicide applicators to take stock of sensitive crops in the area of application and to consult and cooperate with neighbors in matters of herbicide use, it is advisable to do so.

Further information about pesticide use and hazards can be obtained from any University of Missouri Extension Center. Rights of injured parties. Those who grow specialty crops which may be injured as a result of pesticide misuse have rights protected by law. Through civil proceedings, injured parties may attempt to regain financial losses or to secure punitive judgments.

Growers of sensitive crops are not obligated to inform operators of surrounding farms and local industries of the presence and sensitivity of their crops, but it is advisable to seek the cooperation of neighbors in the use of hazardous pesticides. Reporting incidents of pesticide damage. Two governmental agencies may exercise regulatory powers in situations of herbicide misuse.

Spray Pressure
Spray pressure influences the size of droplets formed from the spray solution. The spray solution emerges from the nozzle in a sheet, and droplets form at the edge of the sheet. Increased nozzle pressure causes the sheet to be thinner, and this thinner sheet will break into smaller droplets than from a sheet produced at lower pressure. Also, larger orifice nozzles with high delivery rates produce a thicker sheet of spray solution and larger droplets than smaller nozzles.

Communication
The majority of drift complaints pertain to trees, shrubs and ornamentals. Communicating with non-agricultural rural residents may reduce complaint submissions originating from lack of knowledge of products used and injury symptoms.

Other Components
Flow control devices are necessary to make the tank, pump and nozzles work together. Depending on the application system, these devices may include pressure regulators, unloader valves and control valves. Because both the spray pattern and flow rate are determined by operating pressure, each sprayer should be equipped with a pressure gauge. The gauge should be placed where it may be easily seen. Strainers are also required for effective treatments. Strainers trap particles and debris in the spray mixture and protect the pump, control devices and nozzles from damage.

Dispersal Summary
All nozzles produce a range of droplet sizes. The small, drift-prone particles cannot be eliminated but can be reduced and kept within reasonable limits.

Here are some tips:

- Select low or nonvolatile pesticides.
- Read and follow the pesticide label. Instructions on the pesticide label are given to ensure the safe and effective use of pesticides with minimal risk to the environment. Each pesticide is registered for use on specific sites or locations. Surveys indicate approximately 65 percent of drift complaints involved application procedures in violation of the label.
- Apply a pesticide only if economic thresholds warrant an application.
- Use spray additives within label guidelines. This will increase the droplet sizes and pesticide effectiveness.
- Use larger orifice sizes. This will give larger droplets and will increase the number of tank refills, but will improve coverage and effectiveness.
- Avoid high pressure. High pressure creates finer droplets; 45 PSI should be considered maximum for conventional broadcast spraying.
- Use drift-reduction nozzles. They will produce larger droplets when operated at low pressures.
- Use wide angle nozzles, low boom heights, and keep the boom stable.
- Drift is minimal when wind velocity is less than 10 mph. Do not spray when wind is greater or blowing towards sensitive crops, gardens, dwellings, and livestock or water sources.
- Use shielded booms. When banding, use shroud covers.

Pesticide applicators and others, including landowners, play a very important role in pesticide application -- deciding whether or not to apply a pesticide and if so how best to make that application. It is their responsibility to know and understand a product's use restrictions.

They are responsible for complying with all other pesticide laws regarding pesticide applications and ensuring that their application equipment and techniques will produce a minimum of spray drift. The EPA also expects applicators to exercise a high level of professionalism in making decisions about applications.

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 section will deal with the highlights to the revision but also some areas of the current WPS that need emphasized.

The Environmental Protection Agency has revised the 1992 Agricultural Worker Protection Standard regulation to increase protection from pesticide exposure for the nation's two million agricultural workers and their families. These changes will afford farmworkers similar health protections that are already afforded to workers in other industries while taking into account the unique working environment of many agricultural jobs.

The regulation seeks to protect and reduce the risks of injury or illness resulting from ***agricultural workers'*** (those who perform hand-labor tasks in pesticide-treated crops, such as harvesting, thinning, pruning) and ***pesticide handlers'*** (those who mix, load and apply pesticides) use and contact with pesticides on farms, forests, nurseries and greenhouses. The regulation does not cover persons working with livestock.

• Annual mandatory training to inform farmworkers on the required protections. This increases the likelihood that protections will be followed.
• Expanded training includes instructions to reduce take-home exposure from pesticides on work clothing and other safety topics.
• First-time ever minimum age requirement: Children under 18 are prohibited from handling pesticides.
• Expanded mandatory posting of no-entry signs for the most hazardous pesticides. The signs prohibit entry into pesticide-treated fields until residues decline to a safe level.
• New no-entry application-exclusion zones up to 100 feet surrounding pesticide application equipment will protect workers and others from exposure to pesticide overspray.
• Requirement to provide more than one way for farmworkers and their representatives to gain access to pesticide application information and safety data sheets – centrally-posted, or by requesting records.
• Mandatory record-keeping to improve states' ability to follow up on pesticide violations and enforce compliance. Records of application-specific pesticide information, as well as farmworker training, must be kept for two years.
• Anti-retaliation provisions are comparable to Department of Labor's (DOL's).
• Changes in personal protective equipment will be consistent with the DOL's Occupational Safety & Health Administration standards for ensuring respirators are effective, including fit test, medical evaluation and training.
• Specific amounts of water to be used for routine washing, emergency eye flushing and other decontamination, including eye wash systems for handlers at pesticide mixing/loading sites.
• Continue the exemption for farm owners and their immediate family with an expanded definition of immediate family.

What Will These Changes Achieve?
There is a clear need for better protection for farmworkers. Each year, between 1,800 and 3,000 occupational incidents involving pesticide exposure are reported from the farms, forests, nurseries and greenhouses covered by the Worker Protection Standard. There is widespread underreporting.

By better protecting our agricultural workers, the agency anticipates fewer pesticide exposure incidents among farmworkers and their family members. Fewer incidents mean a healthier workforce and avoiding lost wages, medical bills, and absences from work and school. In addition, EPA is concerned about low level, repeated exposure to pesticides that may contribute to chronic illness.

What Types of Activities Are Covered?
The regulation seeks to protect and reduce the risks of injury or illness resulting from agricultural workers' (those who perform hand-labor tasks in pesticide-treated crops, such as harvesting, thinning, pruning) and

pesticide handlers' (those who mix, load and apply pesticides) use and contact with pesticides on farms, forests, nurseries and greenhouses. The regulation does not cover persons working with livestock.

Family Exemption

There is an "immediate family" exemption to the WPS that exempts family members from MOST of the WPS protections. However, family members must still use label required PPE (personal protection equipment) and still must obey the REIs (Restricted Entry Intervals) and the other label requirements.

So who falls under the Family Exemption?

The regulation revision has expanded the family exemption to now include first cousins, nephews, nieces, aunts, uncles, grandchildren, grandparents and in-laws. The original exemptions are still valid and they include children, step children, foster children, parents, step parents, foster parents, siblings and spouses and of course the owner. In spite of this exemption why not give your family the benefit of these WPS protections?

Training Changes

This is the area with the most changes. Under the revision growers subject to the WPS must now train their employees every year and they must be trained on Day 1 before they do any work in the crop areas if it has been less than 30 days since the last restricted entry interval expired. Make sure the employees sign off on their training and keep those on file. If the employee requests a copy of the sign off employers are now responsible to give them one copy.

Central Location

The big change here is the need to keep SDS sheets (Safety Data Sheets). Many of you are unfamiliar with SDS sheets but they are the old MSDS sheets in a standardized format. You will need to "display" them at the central location for 30 days following their use. Keeping them in a loose leaf notebook at the central location is acceptable. You need to keep these SDS sheets for two years after they were last used. You can get the SDS sheets from your pesticide supplier or download them off the Internet.

Of course you will still need to keep pesticide application information for 30 days at the central location and the pesticide safety information (poster). The central location must be easily accessible to your employees.

Decontamination Supplies

Pesticide handlers still need three gallons of water, soap and paper towels at the mix and load site, within a quarter mile of the application area and where PPE is taken off. If they are working with a product requiring eye protection they must have "immediate "access to at least a pint of eye wash or fresh water.

Handlers need an eye wash system at the mix and load site capable of delivering .4 gallons of water for 15 minutes or 6 gallons of water able to flow gently for 15 minutes. This does **Not** have to be a fancy system; it can be a hose attached to a faucet. A change of clothes for handlers is also required.

Although handlers and workers need to have access to the required decontamination supplies they can in emergency situations make use of natural waters that are close by in addition to the required decontamination supplies. Workers need to have access to at least a gallon of wash water, soap and paper towels within a quarter of a mile of the crop area that they are working in.

Application Exclusion Zone (AEZ)

The AEZ is an exclusion zone that surrounds the application equipment in a 360-degree radius. High drift applications such as air blast sprayers, aerial applications, fumigants, mist and fogging will need a 100 foot "bubble" where everyone is excluded except for handlers that have the proper PPE and training to work inside that bubble. Low drift applications will need a 25-foot bubble. If someone is in that AEZ the handler must suspend application in that area until they leave that area.

QUICK REFERENCE GUIDE TO THE WORKER PROTECTION STANDARD (WPS) AS REVISED IN 2015

The WPS is a federal regulation designed to protect agricultural workers (people employed in the production of agricultural plants) and pesticide handlers (people mixing, loading, or applying pesticides or doing certain tasks involving direct contact with pesticides). Each section links to the Code of Federal Regulations (40 CFR Part 170) for more information on the revised WPS. (www.ecfr.gov)

The section summarizes the maximum requirements under the revised WPS. It does not include exemptions and exceptions that may allow you to do less.

See the referenced sections below.
Exemptions (general) 170.303 (b) and170.601
Exceptions for **workers** 170.401 (b) and 170.409 (a)(2)
Exceptions for early-entry **workers** during a restricted-entry interval 170.603
Exceptions for **handlers** 170.501 (b)
Exceptions to PPE required on pesticide labels 170.607

Employer Responsibilities for Supervisors and Labor Contractors
Employers must provide sufficient information to supervisors and/or labor contractors to ensure compliance with the revised WPS.

Specify:
- ✓ The tasks supervisors / labor contractors must do, and
- ✓ The information they must provide to workers/handlers.

Employers are liable for a penalty under FIFRA if a supervisor or labor contractor acting for them fails to comply with the revised WPS requirements. 170.309 (d), 170.313 (d), 170.317 (c)

Duties of All Employees
These requirements apply to agricultural employers and commercial pesticide handler employers except the pesticide safety, application and hazard information requirements apply only to agricultural employers.

Anti-Retaliation
Employers must not retaliate against a worker or handler who attempts to comply with the WPS, files a complaint, or provides information in an investigation of alleged WPS noncompliance. 170.315

Minimum Age Requirements
1. Ensure that early-entry workers and all handlers are at least 18 years old. 170.309 (c) and 170.313 (c)

Pesticide Safety, Application and Hazard Information
An agricultural employer must display or make certain information available on the establishment. Commercial pesticide handler employers do not have to comply with information display requirements.
1. Display or make available all of the information listed in #2 together in an easily accessible (“central”) location on the agricultural establishment. 170.311 (a)(5) and 170.311 (b)(2)
2. The information includes:
- EPA WPS safety poster or equivalent information, which must include some additional information by January 2, 2018, and must be kept current. 170.311 (a)
- Application information that includes:

Product name, EPA registration number, and active ingredient
Crop or site treated, location and description of the treated area
Date, start and end times of the application, and duration of restricted-entry interval (REI). 170.311 (b)(1)
- A copy of the safety data sheet (SDS) for the formulated product for each WPS-labeled pesticide applied. 170.309 and 170.311

3. In addition, display the EPA WPS safety poster (or equivalent) where decontamination supplies are located at permanent sites and where decontamination supplies are provided for 11 or more workers. 170.311 (a)(5)
4. Allow workers and handlers unrestricted access to all of the information and keep all of the displayed information current and legible. 170.311 (a)(6)-(7) and 170.311 (b)(3)-(4)
5. Display the EPA WPS safety poster or equivalent information before an application takes place and for 30 days after the REI expires. 170.309 (h)
6. Display the SDS and application information within 24 hours of the application and before workers enter treated areas. This information must be displayed for 30 days after the REI expires and kept in records on the agricultural establishment until 2 years after the REI expires. 170.309 (h)&(l) and 170.311 (b)(5)-(6)
7. Provide the SDS and application information upon request of a worker, handler, designated representative or medical personnel, within 15 days. 170.311 (b)(7)-(9)

Pesticide Safety Training

Ensure that **workers** are trained before performing tasks in a pesticide treated area (REI in effect within the last 30 days). 170.401 (a) Ensure that **handlers** are trained before performing any handler activity. 170.501 (a) There is no grace period for worker or handler training.
1. Train workers and handlers annually. 170.401 (a) and 170.501 (a)
2. Present training using EPA-approved materials either orally from written materials or audio-visually. After January 2, 2018, the training must cover additional topics. 170.401 (c) and 170.501 (c)
3. Trainers must be certified applicators or have completed an EPA-approved train-the-trainer program or be designated by the State or Tribal pesticide enforcement agency. 170.401 (c)(4) and 170.501 (c)(4)
4. Training must be delivered in a manner the employees can understand, and the trainer must be present and respond to questions. 170.401 (c)(1) and 170.501 (c)(1)
5. Maintain training records on the establishment for two years from the training date for each worker and handler required to be trained on the agricultural establishment. 170.401 (d) and 170.501 (d)
Separate from the pesticide safety training, employers must tell workers and handlers where to find the following on the worksite: EPA WPS safety poster (or equivalent), application information, SDSs and decontamination supplies. 170.403 and 170.503 (b)

Decontamination Supplies

1. Establish accessible decontamination supplies located together within 1/4 mile of all **workers** (when required 170.411 (c)) and **handlers**. 170.411 and 170.509
- 1 gallon of water per worker and 3 gallons of water per handler at the beginning of each work period for routine and emergency decontamination,
- Plenty of soap and single-use towels, Note: hand sanitizers and wet towelettes are insufficient. 170.411 (b)(2) and 170.509 (b)(2)
- A clean coverall (or other clean change of clothes) for handlers

2. Provide water that is safe and cool enough for washing, eye-flushing, and drinking. Do not use water that is also used for mixing pesticides unless steps are taken to ensure safety. 170.411 (b)(1)
3. Provide **handlers** with decontamination supplies where personal protective equipment (PPE) is removed at the end of a task. 170.509 (a)
4. Provide **handlers** with decontamination supplies at each mixing and loading site. 170.509 (c)(1)
5. When a product requires protective eyewear for **handlers**, and/or when using a closed system under pressure, provide the following in mixing and loading areas: a system that can deliver gently running water at 0.4 gallons per minute for at least 15 minutes or 6 gallons of water in containers suitable for providing a gentle eye-flush for about 15 minutes. 170.509 (d)(1)
6. When applying a product that requires protective eyewear, provide 1 pint of water per **handler** in portable containers that are immediately available to each handler. 170.509 (d)(2)
7. Do not put **worker** decontamination supplies in areas being treated or under an REI. 170.411 (d)
8. For **handlers**, decontamination supplies must be kept outside the treated area, or any area under an REI, unless they are protected from contamination in closed containers. 170.509 (c)(1)&(3)

Employer Information Exchange

1. Before any application, commercial pesticide handler employers must make sure the owner/ operator of an agricultural establishment where a pesticide will be applied, is aware of:
- Location and description of area to be treated,
- Date of application, estimated start time and estimated end time of the application,
- Product name, EPA registration number, active ingredient(s), and REI,
- Whether the product label requires both oral warnings and treated area posting,
- All other safety requirements on labeling for workers or other people. 170.313 (i)

2. Owners/operators of agricultural establishments must make sure any commercial pesticide
- handler employer they hire is aware of: Specific location and description of any treated areas where an REI is in effect that the commercial handler may be in or walk within 1/4 mile of, and,
- Restrictions on entering those areas. 170.309 (k)
- The commercial pesticide employer must pass this information along to the handler doing the work. 170.313 (h)

Emergency Assistance

If there is reason to believe a worker or handler has been exposed to pesticides, during or within 72 hours of employment, and needs emergency medical treatment, employers must do the following:

1. Promptly make transportation available to an appropriate emergency medical facility.
2. Promptly provide to the treating medical personnel, information related to each pesticide product to which the person may have been exposed:
- Safety Data Sheet
- Product name, EPA registration number, and active ingredient(s).
- Description of how the pesticide was used on the agricultural establishment.
- Circumstances that could have resulted in exposure to the pesticide. 170.309 (f)

Additional Duties for Worker Employees

These requirements apply to agricultural employers who employ workers.

Restrictions During Applications 170.405 (a)-(b)

During pesticide applications, keep workers and everyone other than appropriately trained and equipped handlers out of the treated area (for all types of applications) and out of:
- The application exclusion zone (AEZ) for outdoor production, or
- A specified area that varies by the type of application until the ventilation criteria are met for enclosed space production.

Restricted-Entry Intervals (REIs) 170.309 (l) and 170.407

Do not direct or allow any worker to enter or remain in the treated area until the REI has expired and all posted warning signs are removed or covered. Read the exceptions in 170.603.

Notice About Applications 170.409 (a)

1. Orally warn workers **and** post treated areas if required by the pesticide labeling.
2. If not, post warning signs if the REI is **greater than**:
- 48 hours for outdoor production or
- 4 hours for enclosed space production.

3. For all other applications, **either** orally warn workers or post warning signs.

Posted Warning Signs 170.409 (b)

1. Post legible 14” x 16” WPS-design warning signs no more than 24 hours prior to an application; keep posted during REI; remove or cover before workers enter and within 3 days after the end of the REI. 170.409 (b)(1)-(3)
2. Post signs so they can be seen at all reasonably expected entrances to treated areas. 170.409 (b)(3)(ii)

3. Warning signs can be smaller than 14” x 16” under certain conditions. All warning signs must meet specific requirements. 170.409 (b)

Oral Warnings 170.409 (c)

1. Before each application, tell workers who are on the establishment (in a manner they can understand):
- Location and description of treated area,
- Date and times entry is restricted
- AEZ, REI, and not to enter during REI.

2. Workers who enter the establishment after application starts must receive the same warning at the start of their work period.

Additional Duties for Agricultural Employers Duties

Before allowing persons not directly employed by the establishment to clean, repair, or adjust pesticide application equipment, provide the following information:
- The equipment may be contaminated with pesticides.
- The potentially harmful effects of pesticide exposure.
- How to handle equipment to limit exposure to pesticides.
- How to wash themselves and/or their clothes to remove and prevent exposure to pesticide residues.

170.309 (g) and 170.313 (l)

Application Restrictions and Monitoring 170.505

1. Do not allow handlers to apply a pesticide so that it contacts, directly or through drift, anyone other than appropriately trained and equipped handlers.
2. Handlers must suspend applications when anyone other than appropriately trained and equipped handlers enter the application exclusion zone (AEZ). This goes into effect on January 2, 2018. 170.505 (b)
3. When anyone is handling a highly toxic pesticide with a skull and crossbones, maintain sight or voice contact every two hours.
4. Make sure a trained handler equipped with labeling-specific PPE maintains constant voice or visual contact with any handler in an enclosed-space production site (e.g., greenhouses, high tunnels, indoor grow houses) while applying a fumigant.

Specific Instructions for Handlers

1. Before handlers do any handling task, inform them, in a manner they can understand, of all pesticide labeling instructions for safe use. 170.503 (a)(1)
2. Ensure that the handler has access to product labeling during the entire handling task. 170.503 (a)(2)

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.

Requirement	2017 Provision	Prior 2017 Provision
Training		
Frequency of full training for workers and handlers	Annual training.	Every 5 years.
Training grace period for worker training	No grace period. Workers must be trained before they work in an area where a pesticide has been used or a restricted-entry interval has been in effect in the past 30 days.	5-day grace period with abbreviated training.
Qualifications for trainers of workers	Certified applicators, State/Tribal/Federal approved trainers, and persons who have completed an EPA- approved train-the-trainer course.	Handlers, certified applicators, State/Tribal/Federal approved trainers, and persons completing an approved train-the-trainer course.
Expand training content for workers and handlers	Keep existing and expand content. Final worker training topics expanded to 23 items, and handler training expanded to 36 items. Training on new content not required until 2 years from effective date of final rule.	11 basic training items for workers and 13 items for handlers. Minimal training on reducing take-home exposure, reporting use violations, and prohibition from employer retaliation.
Recordkeeping of training	Keep records for 2 years. Give copy of record of training to workers and handlers upon their request.	No recordkeeping of training. Voluntary verification card system.
Hazard Communication		
Content and availability of hazard communications materials	Employer must display application information and safety data sheets (SDSs) at central location within 24 hours of end of application and before workers enter that treated area. Display both for 30 days after REI expires. Keep application information and SDS for 2 years from end of REI and make available to workers, handlers, designated representatives (identified in writing) or treating medical personnel upon request.	Employer must display application-specific information at a central location before application occurs, or, if no workers or handlers are on the establishment, before next period workers/handlers are on establishment. Keep posted for 30 days after REI expires. No recordkeeping.

Requirement	2017 Provision	Prior 2017 Provision
Notification of Treated Areas		
Notification of treated areas under an REI	Post warning sign if REI is greater than 48 hours (outdoor applications) or 4 hours (enclosed space applications (e.g., greenhouses)), otherwise option for posting or oral notification unless label requires both.	Farms, forests and nurseries: Post warning sign or give oral notification for any REI, unless label requires both. Greenhouses: all applications require signs to be posted.
Warning sign	Same as current sign.	Red circle containing stern-faced man with upraised hand. At the top: “DANGER” and “PELIGRO”, “PESTICIDES”, “PESTICIDAS”. At the bottom: “KEEP OUT”, “NO ENTRE.”

Information exchange between handler employer and agricultural employer	Agricultural employer must provide application information on treated areas the handler may be in (or walk within ¼ mile of). Handler employer must notify before the application begins for certain changes and within 2 hours of end of application for most other changes, unless only change was less than 1 hour difference in application time.	Agricultural employer must provide application information on treated areas the handler may be in (or walk within ¼ mile of). Handler employer must notify of changes to application plans before application begins.

Minimum Age		
Minimum age for handlers and early-entry workers	Handlers and early-entry workers must be at least 18 years old. (Members of owner's immediate family are exempt from this and most other requirements of the WPS.)	No minimum age.
Entry Restrictions During Application for Outdoor Production		
Ag employers must prohibit entry in areas during application for outdoor production. (Restrictions for greenhouses/enclosed space production are different.)	All outdoor production: No entry into treated area or the application exclusion zone, which is an area up to 100 feet area around the application equipment during pesticide application on farms, forests and nurseries. Size of the application exclusion zone depends on type of application. Revised descriptions of application methods.	Farms and forests: No entry into treated area. Nurseries: No entry into treated area or an area up to 100 feet around the treated area, where the size of the additional area depends on type of application.
Handler Suspend Application		
Handler (applicator) must suspend application in certain circumstances	Handler must apply pesticides so as not to contact workers or other persons. Handler must suspend application if a worker or other person is in the application exclusion zone, an area up to 100 feet around the application equipment.	Handler must apply pesticides so as not to contact workers or other persons. No specific requirement to suspend applications.
Exemptions and Exceptions		
Exemption for certified crop advisors and their employees	Only certified crop advisors are exempt from labeling PPE and WPS requirements as specified in exemption. Certified crop advisor employees must use label-required PPE while working in a field during an REI, and employer must provide all required WPS protections, or rely on the PPE substitutions allowed under the crop advisors.	Certified crop advisor chooses PPE for themselves and their employees working under their direct supervision in a field during an REI. Also exempted from providing decontamination supplies and emergency assistance for themselves and employees.
Exceptions to REIs for early entry workers – notification requirements	Notify early-entry workers of application specifics, tasks to be performed, conditions of the early-entry exception, and hazard information from the pesticide label.	Inform early-entry workers of hazard information from the pesticide label.

Requirement	2017 Provision	Prior 2017 Provision
Basic Pesticide Safety Information		
Display of pesticide safety information	Display pesticide safety information at a central location and at sites where decontamination supplies are located, if the decontamination supplies are at a permanent site or at a location with 11 or more workers or handlers.	Display a safety poster at central location.
Content of pesticide safety information	Information can be displayed in any format (doesn't have to be a poster); keep the 7 concepts about preventing pesticides from entering your body; delete the point that there are federal rules to protect workers and handlers; add instructions for employees to seek medical attention as soon as possible if they have been poisoned, injured or made ill by pesticides; add name, address and telephone number of state or tribal pesticide regulatory authority; revise "emergency medical facility" to "*a nearby* operating medical care facility." New content for safety information display not required until 2 years from effective date of final rule.	The safety poster must include 7 concepts about preventing pesticides from entering your body; the point that there are federal rules to protect workers and handlers; and the name, address and phone number of the nearest emergency medical care facility.
Personal Protective Equipment		
Respirators	Employer must provide respirator and fit testing, training, and medical evaluation that conforms to OSHA standards for any handler required to wear any respirator by the labeling. Require recordkeeping of completion of fit test, training, and medical evaluation.	Employer must provide respirator listed on label and ensure it fits. No recordkeeping required.
Definition of chemical-resistant	Same as current definition.	Made of a material that allows no measurable movement of the pesticide through the material during use.
PPE exception for closed systems	Exceptions to the labeling-specified PPE allowed for handlers when using closed systems. A closed system must meet a broad performance-based standard and basic operating standards (written operating instructions and training of handlers in use of the system) must be provided.	Exceptions to the labeling-specified PPE allowed for handlers when using closed systems. No specific criteria for closed systems.
PPE exception for crop advisors and their employees	Crop advisors and their employees entering treated areas while a REI is in effect to conduct crop-advisor tasks may wear a standard set of PPE (coveralls, shoes plus socks and chemical-resistant gloves made of any waterproof material, and eye protection if the labeling of the pesticide product applied requires protective eyewear for handlers, as outlined in rule), *OR* the PPE specified on the pesticide labeling for early-entry activities instead of the PPE specified on the pesticide labeling for handling activities, provided certain conditions are met. (See exemption for certified crop advisor.)	Crop advisors and their employees entering treated areas while a REI is in effect to conduct crop-advisor tasks may wear the PPE specified on the pesticide labeling for early-entry activities instead of the PPE specified on the pesticide labeling for handling activities, provided certain conditions are met. (See exemption for certified crop advisor.)
PPE exception from eyewear for pilots in open cockpits	If product label requires eye protection, pilots in open cockpits may wear a helmet with lowered face shield instead of label-required eye protection.	If product label requires eye protection, pilots in open cockpits may wear visor instead of label-required eye protection.

Requirement	2017 Provision	Prior 2017 Provision
Personal Protective Equipment		
PPE exception from gloves for pilots in enclosed cockpits	Same as current requirement.	Gloves are optional when entering and leaving aircraft unless required by product label.
PPE exception for enclosed cabs	Maintain exception for dermal PPE as in existing rule with same conditions, but handlers in enclosed cabs must wear the labeling-specified respiratory protection except when the only labeling-specified respiratory protection is a particulate filtering facepiece respirator (NIOSH approval number prefix TC-84A), previously called a dust/mist filtering respirator.	Exceptions to the labeling-specified PPE are allowed when handling tasks are performed from inside an enclosed cab that meets the specifications defined in the rule and certain conditions are met. Exceptions to the labeling-required respiratory protection are allowed only if the cab has been certified by the manufacturer to provide respiratory protection equivalent to the respiratory protection required by the pesticide labeling for handling.
Decontamination Supplies		
Quantity of water	Provide 1 gallon for each worker and 3 gallons for each handler and each early entry worker as measured at beginning of workers' or handlers' work period.	Provide enough water for routine washing and emergency eye flushing for workers and handlers. For handlers, also provide enough to wash entire body in emergency.
Use of natural waters	Must provide water for decontamination. There is no reference to, or prohibition from, using natural waters in addition to decontamination water provided. Workers and handlers are trained to use any nearest clean water source in case of emergency.	Must provide water for decontamination. May use natural waters in addition to water provided for decontamination.
Eye wash for handlers	Provide a system capable of delivering 0.4 gallons/minute for 15 minutes, or 6 gallons of water able to flow gently for about 15 minutes at a mix/load site if handlers use products requiring eye protection or use a pressurized closed system. One pint of water in a portable container must be available to each handler applying pesticides if eye protection is required.	Provide enough water for emergency eye flushing. One pint of water in a portable container must be available to each handler if eye protection is required.
Emergency Assistance		
Emergency Assistance	Provide prompt transportation to medical facility. Promptly provide the SDS, product information (name, EPA Reg. No and active ingredient) and circumstances of exposure to treating medical personnel.	Provide prompt transportation to medical facility and provide any obtainable information about the product, antidote, first aid, and circumstances of exposure to the worker/handler or treating medical personnel.

Definitions

Weed and Plant Glossary

Abaxial – a. (L. *ab*, from; *axis*, axle) that surface of any structure which is remote or turned away from the axis, such as the lower surface of a leaf.
Absorption - The process by which a filter media traps unwanted molecules.
Acaulescent - a. (Gr. *a*, without; *kaulos*, stalk) having no stem or seemingly without a stem.
Accessory flower parts - Sepal and petal organs found on flowers. The sepals and petals are not essential for pollination, but may aid in attracting insects or other organisms.
Achene - n. (Gr. *a*, not; *chainein*, to gape) any small, dry fruit with one seed whose outer covering (pericarp) does not burst when ripe.
Acicular - a. (L. *acicula*, a small needle) slender and pointed; needle-like with a sharp point.
Acidic - Water with a pH of less than 7.
Acropetal - a. (Gr. *akros*, summit; L. *petere*, to seek) developing upward from the base toward the apex.
Acrylic - A plastic material used to construct fish tanks, filters and accessories.
Actinomorphic - a. (Gr. *aktis*, ray; *morphe*, form) descriptive of a flower or set of flower parts which can be cut through the center into equal and similar parts along two or more planes; having radial symmetry.
Aculeus - n. (L. *aculeus*, prickle) a prickle growing from bark. pl. aculei**.**
Acumen - n. (L. *acumen*, a point, a sting) the point of an acuminate leaf.
Acuminate - a. drawn out into a long point; tapering point.
Acute - a. (L. *acutus*, sharpened) sharp at the end; ending in a sharp point.
Adaxial - a. (L. *ad*, to; *axis*, axle) pertaining to the side of an organ toward the axis, such as the upper surface of a leaf.
Adipose Fin - A small fin located behind the dorsal fin and in front of the caudal fin.
Adnate - a. (L. *adnatus*, to be born, to grow to) fusion of unlike structures or parts.
Adsorption - The process by which filter media attracts unwanted molecules to its surface via a chemical charge.
Adventitious - a. (L. *adventitius*, extraneous) plant structures or tissue occurring in an abnormal position.
Adventitious plant - Able to exist either on land or in the water.
Adventitious root - Root which develops from the node of a stem or similar organ, such as a Rhizome, Stolan or runner.
Adventive - a. (L. *advenire*, to arrive) a plant that is not native to the environment.
Aerenchyma - n. (Gr. *aer*, air; *enchyma*, an infusion) parenchyma tissue with large and abundant intercellular air spaces; air-storing tissue; resembles the tissue of cork.
Aerobic - An organism that needs oxygen to survive.
Aggregate - a. (L. *ad*, to; *gregare*, to collect into a flock) crowded into a cluster; a number of separate fruits from a single flower aggregated together; an aggregate flower is formed by a cluster of carples.
Airstone - A device that attaches to the air pump to create various bubble effects.
Alimentary canal - The tube of the digestive system through which food passes; where digestion takes place.
Alkaline - Water with a pH between 7 and 14. Also known as Basic.
Allele - n. (Gr. *allelon*, one another) one of a pair or more of alternative hereditary characters; a gene which can occupy the same locus as another gene in a particular chromosome.
Allelochemicals - compounds that have an allelopathic effect.
Allelopathy - n. (Gr. *allelon*, one another; *pathos*, suffering) the influence or effect of one living plant upon another; refers to biochemical interaction between all types of plants and its effect depends on a chemical compound being added to the environment.
Alternate - a. (L. *alteratus*, one after another) said of leaves occurring one at a node; said also of members of adjacent whorls in the flower when any member of one whorl is in front of or behind the junction of two adjacent members of the succeeding whorl.
Alternation of generations - the occurrence in one life history of two or more different forms differently produced, usually an alternation of a sexual with an asexual form.

Alveola - n. (L. *alveolus*, small cavity) a pit on the surface of an organ.
Alveolate - a. (L. *alveolatus*, pitted) deeply pitted so as to resemble a honeycomb, as are the surfaces of some seeds or achenes.
Ammonia (NH3) - A dissolved gas that even in low concentrations is toxic to fish. It is produced by the breakdown of organic waste products.
Anaerobic - A term used to describe an organism that lives in an environment with little or no oxygen.
Anaerobiosis - n. (L. Gr. *an*, without; *aer*, air; *biosis*, manner of life) life in the absence of air or free oxygen; anaerobic respiration, respiration occurring in the absence of oxygen.
Anal fin - Single fin mounted vertically below the fish.
Anastomosis - n. (Gr. *ana*, up to; *stoma*, mouth) connecting by cross-veins and forming a network.
Anatomy - n. (LL. *anatomia*, dissection) the branch of morphology that deals with the structure of plants, esp. the internal structure as revealed by the microscope.
Androecium - n. (Gr. *andros*, man; *oikos*, house) male reproductive organs of a plant; a collective term applied to all structures of the stamen whorl or whorls.
Androgynal - a. (Gr. *andros*, man; *gonos*, woman) bearing staminate and pistillate flowers on the same parent stem.
Androgynous - staminate flowers above the pistillate flowers in the same inflorescence.
Androphore - n. (Gr. *aner*, man; *phoros*, carrying) a support or column, formed by fusion of filaments, on which the stamens are borne.
Anemophily - n. (Gr. *anemos*, wind; *philein*, to love) pollination by wind.
Angiospermae - n. (Gr. *anggeion*, vessel; *sperma*, seed) a major division of the plant kingdom, commonly called flowering plants (as their reproductive organs are in flowers,) having seeds which develop in a closed ovary made of carpels, a very reduced gametophyte, and endosperm develop from a triple fusion nucleus. pl. Angiosperms.
Annual - a. (L. *annualis*, yearly, from *annus*, year) a plant which completes its life history within a year.
Anoxia - n. (L. *an*, not; and oxygen) lack of oxygen or not enough oxygen.
Anther - n. (Gr. *antheros*, flowery, from *anthein*, to bloom) the top of the stamen, usually elevated by means of a filament, which contains the pollen.
Anthesis - n. (Gr. *anthesis*, bloom, from *anthein*, to bloom) stage or period during which the flower bud is fully open; flowering.
Antrorse - a. (L. *ante*, before; *vertere*, to turn) forward or upward.
Apetalous - a. (Gr. *a*, without; *petalon*, leaf) having flowers without petals; having no corolla.
Apical - a. (L. *apex*, the tip or top of a thing) at the tip or summit.
Apical bud - The principal growing point of the stem.
Apiculate - a. (LL. *apiculatus*, point) terminated abruptly by a small, distinct point, an apiculus or apicule.
Apocarpous - a. (Gr. *apo*, away; *karpos*, fruit) having separate carpels.
Apomixis - n. (Gr. *apo*, away; *mixis*, a mixing) in general, reproducing without sexual reproduction; often used to denote seed production without a sexual process having been involved.
Appressed - a., adv. (L. *ad*, to; *pressare*, to press) lying flat or close against something. Often used for hairs.
Aquatic plants - plants that must grow in water whether rooted in the mud or floating without anchorage; plants that must complete part or all of their life cycle in or near the water.
Aquatic vascular plants - aquatic plants containing the conductive vascular tissue, phloem and xylem.
Arachnoid - a. (Gr. *arachme*, spider, cobweb; *eidos*) like a cobweb; covered with or consisting of soft fibers or hairs so entangled as to give a cobwebby appearance.
Arcuate - a. (L. *arcuatus*, pp. of *arcuare*, to arch, bend like a bow, from arcus, a bow) bent or curved in the form of a bow.
Aril - n. (Fr. *arrile*, Sp. *arillo*, L. *arilli*, dried grapes, from *aridus*, dry) an additional covering that forms on some seeds after fertilization, and developing from the stalk of the ovule.
Aristate - a. (L. *arista*, awn) awned; having an awn.

Articulate - a. (L. *articulatus*, jointed, pp. of *articulare*, to join) having joints; jointed; provided with places where separation may take place.
Ascending - v. (Fr. *scandere*, to climb) rising or curving upward.
Asepalous - a. (Gr. *a*, without; L. *pelatum*, petal) without sepals.
Asexual reproduction - Any form of reproduction that does not require the union of male and female reproductive material.
Attenuate - a. (L. *attenuare*, to thin) gradually narrowed to a long point at apex or base.
Auricle - n. (L. *auricle*, small ear) any ear-like lobed appendages.
Aut- or **auto- -** comb. form. (Gr. from *autos*) a combining form meaning self.
Autogamous - adj., relating to, or reproducing by autogamy.
Autogamy - n. (*aut-* + *-gamy*, Gr. *-gamia*, fr, *gamos*, marriage) self-fertilization, pollination of a flower by its own pollen.
Auxins - growth promoting hormones that cause cell elongation, and are responsible for many developmental responses including phototropism.
Awn - n. (Icel. *ogen*, chaff) a stiff, bristlelike appendage, usually at the end of a structure.
Axil - n. (L. *axilla*, armpit) the angle found between any two organs or structures. The junction of the leaf or petiole and the stem.
Axillary - a. (L. *axilla*, armpit) in an axil, growing in an axil, as buds. Arising from the above junction.
Axillary bud - A bud, capable of developing into a lateral shoot, present in the angle between the stem and a leaf.
Ballast - A transformer which changes the voltage from your house outlet to the voltage needed to power different types of lighting.
Barbel - Whisker-like growths around the mouth, used for finding food and communication; a sensory organ.
Barbellate - a. (L. *barba*, beard) provided, usually laterally, with fine, short points or barbs.
Bark - n. (ME. *barke*; AS. *bare*, bark or rind) the outermost covering of trees and some plants. This is composed of the cuticle or epidermis, the outer bark or cortex, and the inner bark or fiber.
Bases - Compounds that make water Alkaline. If water contains more acids than bases its acidic. If it has more bases than acids it's alkaline.
Bay - n. (Fr. *baia*; LL. *baia*, bay) a part of a sea or lake indenting the shore line; the word is often applied to very large tracts of water around which the land forms a curve, as Hudson's Bay.
Bayou - n. (Fr. *boyau*, a gut, long narrow passage) a marshy inlet or outlet of a lake, river, etc.; also a backwater.
Berry - n. (AS. *berie*, berry) any fleshy simple fruit with one or more seeds and a skin, as a tomato, cranberry, banana, grape, etc.; a several-sided indehiscent fruit with a fleshy pericarp and without a stony layer surrounding the seeds.
Biennial - a. (L. *biennialis*, from *biennis*; *bis*, twice, and *annus*, year) a plant requiring two years in which to complete its life cycle, the first year growing only vegetatively, the second flowering, fruiting, then dying.
Bifid - a. (L. *bifudus*, forked; from *bis*, twice and *findere*, to cleave, divide) forked; divided by a cleft.
Bilabiate - adj., having two lips, as a bilabiate corolla of a flower.
Bilateral - a. (L. *bilateralis*; *bi*, two, and *latus*, a side) having two sides.
Bilaterally symmetrical - said of corolla or calyx (or flower) when divisible into equal halves in one plane only; zygomorphic.
Bilocular - adj., divided into two cells or compartments.
Bio-balls - A filter media used for the colonization of bacteria.
Biogenic decalcification - When there is a carbon dioxide deficiency in the water, plants can derive CO2 from the hardening constituents of the carbonate hardness. First they split the hydrogen carbonates into CO2 and carbonates. This causes the pH to rise about one step and the largely insoluble carbonates precipitate and form rough deposits on the leaves and substrate. Some plants such as Vallisneria can even destroy the carbonates and obtain CO2 from them. This raises the pH again by another step. Biogenic decalcification thus causes the water to be 10 to 100 times more alkaline than it was previously. In the dark, the process reverses and the pH drops considerably.

Biomass - n. (Gr. *bios*, life; *massein*, to squeeze) weight of all living material in a unit area at an instantaneous time. May be expressed as g/m^2, mt/ha, or other similar expressions.
Biotope - Natural environment of an organism.
Bipinnate -Leaf formed of several leaflets set on either side of the petiole.
Bisexual - a. (L. *bis*, twice; *sexus*, sex) having both female and male reproductive organs present and functional in the same flower; hermaphrodite; amphisporangiate; said of a plant having all bisexual flowers.
Black Water - Water that has a dark cola-like color caused by Humic acids, it has a very low pH and is very soft, common in the Amazon river basin.
Blade - n. (AS. *blaed*, leaf) the leaf of a plant, especially grass; the flat or expanded portion of a leaf; lamina.
Bloom - n. (ME. *blome*, a blossom) a blossom; the flower of a plant; an expanded bud; the opening of flowers in general, leaves, flowers, or fruits.
Blossom - n. (ME. *blossome*, a flower) a flower or bloom, esp. of a fruit bearing plant. A state or time of flowering, literally, and figuratively.
Bog - n. (Ir. *bogach*, a bog, from Gael. *bog*, soft moist) a quagmire covered with grass or other plants; wet, spongy ground; a small marsh; plant community on wet, very acid peat.
Bottomland - n., lowlands along streams and rivers, usually on alluvial floodplains that are periodically flooded.
Brackish - a. mixed with salt; briny.
Bract - n. (L. *bractea*, a thin metal plate) a modified leaf, growing at the base or on the stalk of a flower. It usually differs from other leaves in shape or color. Specialized scale-like leaf found at the base of a flower.
Bracteolate - adj., furnished with bracteoles.
Bracteole - n. (NL. *bracteola*, from L. a thin gold leaf) a small bract; especially one on a floral axis. pl. bracteoles.
Branch - n. (LL. *branca*, paw) a natural division of a plant stem.
Branchlet - n., a small, usually terminal, branch.
Breeding tank - An aquarium set up for the breeding of fish.
Bristle - n. (AS. *bristl*, *byrst*, a bristle) stiff, strong but slender hair or trichome.
Bud - n. (ME. *budde*; AS. *budda*, beetle) a small swelling or projection on a plant, from which a shoot, cluster of leaves, or flowers develops; a rudimentary, undeveloped shoot, leaf, or flower; gemma.
Buffer - A substance added to the water to help maintain the pH value.
Bulb - n. (Fr. *bulbe*; L. *bulbus*; Gr. *bolbos*, a bulbous root) a specialized underground bud that sends down roots and consists of a very short stem covered with leafy scales or layers which store water and nutrients, the whole enclosing next year's bud. Tightly packed fleshy leaves used as a storage organ. Onions and tulips both have bulbs.
Bullate - Blistered, bubbled or puckered in appearance.
Caducous - a. (L. *caducus*, falling, from *cadere*, to fall) said of a plant part, such as a sepal, petal, or leaf, that falls off quickly or early.
Calcium - A necessary element used by salt water corals and other organisms for their calcium carbonate skeleton or shell.
Callus - n. (L. *callus*, *callum*, hard skin) a hard protuberance or callosity; new tissue covering a wound.
Calyx - n (Gr. *kalyx*, a calyx, cup) the outer covering of a flower external to the corolla, which it encloses, consisting of a whorl of leaves, or sepals, usually of a green color and less delicate in texture than the corolla.
Calyx tube - tube formed by wholly or partially fused sepals. Not the floral tube of an epigynous or perigynous flower.
Cambium - n. (L. *cambiare*, to exchange, more at change) the layer of tissue between the bark and wood in woody plants, from which new wood and bark develops.
Campanulate - a. (Dim. of LL. *campana*, a bell) bell-shaped, usually applied to calyx and corolla.
Cancellate - a. (L. *cancellatus*, pp., of *cancellare*, to make like a lattice) latticed, or resembling a latticed construction, usually said of a surface such as that of an achene or seed.

Capillary - a. (L. *capillaris*, from *capillus*, hair, from *caput*, head) resembling hair in the manner of growth; very slender, threadlike.
Capitate - a. (L. *caput*, head) enlarged or swollen at tip, gathered into a mass at apex, as compound stigma; a knoblike stigma terminating a style.
Capitulum - n. (L. *capitulum*, small head) an inflorescence forming a head of sessile flowers or florets crowned together on a receptacle and usually surrounded by an involucre.
Capsule - n. (L. *capsula*, a little chest) a case, pod, or fruit, containing seeds, spores, or carpels; it usually bursts when ripe.
Carbonate Hardness - The part of the total hardness that is formed by the ions of carbonates(Co3) and hydrogen carbonate(HCo3). It is symbolized by dCH. It is important to know the dCH of your water, as it affects both the pH and Carbon Dioxide amounts in your water. It is also commonly called "buffering capability". A dCH of 4 to 8 is fine for most fish.
Carinate - a. (L. *carinatus*, from *carina*, a keel) shaped like the keel of a ship; having a longitudinal prominence on the back, like a keel; applied to a calyx, corolla or leaf.
Carpel - n. (Gr. *karpos*, fruit) a simple pistil, regarded as a modified leaf; also, any of the two or more carpels that unite to form a compound pistil; the unit of structure of the female portion of a flower.
Carpels - Female sex organs. They contain the Ovules which become seeds when mature.
Carpophore - n. (Gr. *karpophorus*, bearing fruit; *karpos*, fruit, and *pherein*, to bear) generally the organ that supports the carpels; specifically, a very much elongated axis to which the carpels are attached.
Caryopsis - n. (Gr. *karyon*, a nut, and *opsis*, an appearance) a small one-seeded, dry, indehiscent fruit, in which the seed adheres to the thin pericarp, so that the fruit and seed are incorporated into one body, as in wheat and other kinds of grain.
Castanea - n. (L., a chestnut, from Gr. *kastanon*) a genus of trees typified by the common chestnut.
Castaneous - a., relating to or having the color of a chestnut.
Cataphyll - n. (L. from *cata*, and *-phyll*) any rudimentary leaf, as a bud scale, preceding the true foliage leaves.
Cataphyllary leaves - rudimentary or scale-like leaves which act as a covering of buds.
Cation Exchange Capacity (CEC) - Quantifies the ability of media to provide a nutrient reserve for plant uptake. It is the sum of exchangeable cations, or positively charged ions, that media can adsorb per unit weight or volume. It is usually measured in milligram equivalents per 100 g or 100 cm^3 (meq/100 g or meq/100 cm^3, respectively). A high CEC value characterizes media with a high nutrient-holding capacity that can retain nutrients for plant uptake between applications of fertilizer. Media characterized by a high CEC retains nutrients from leaching. In addition, a high CEC provides a buffer from abrupt fluctuations in media salinity and pH. Important cations in the cation exchange complex in order of adsorption strength include calcium (Ca2+) > magnesium (Mg2+) > potassium (K+) > ammonium (NH4+), and sodium (Na+). Micronutrients which also are adsorbed to media particles include iron (Fe2+ and Fe3+), manganese (Mn2+), zinc (Zn2+), and copper (Cu2+). The cations bind loosely to negatively charged sites on media particles until they are released into the liquid phase of the media. Once they are released into the media solution, cations are absorbed by plant roots or exchanged for other cations held on the media particles. **Anion exchange capacity** Some media retains small quantities of anions, (negatively charged ions, in addition to cations). However, anion exchange capacities are usually negligible, allowing anions such as nitrate (NO3-), chloride (Cl-), sulfate (SO4-), and phosphate (H2PO4-) to leach from the media.
Catkin - n. (L. a dim. of *cat*, from its resemblance to a cat's tail) a scaly spike, the flowers of which are unisexual and petalless.
Caudal fin - Single fin at the back of a fish; the tail fin.
Caudex - n. (L. *caudex*, stem of a tree) the base of a perennial plant; the axis or stem of a woody plant, especially of a palm or tree fern.
Caulescent - a. (L. *caulis*, a stem and *-escent*) having a well-developed stem above ground level.
Cauline - a. (L. *caulis*, stalk or stem) stem.

Cellulose - n. (Fr. from L. *cellula*, dim. of *cella*, a small room) the chief substance composing the cell walls or woody part of plants; a carbohydrate of unknown molecular structure but having the composition represented by the empirical formula $(C_6H_{10}O_5)_x$.
Centrum - n. (L. from Gr. *kentron*, center) central portion.
Cespitose - a., growing in tufts or clumps; matted.
Chaff - n. (AS. *ceaf*, chaff) dry scales or bracts, as those on the receptacle subtending the flowers in the heads of certain Compositae.
Channeled - having a deep longitudinal groove.
Chartaceous - a. (L. *chartaceus*, from *charta*, a leaf of paper) having the texture of thin but stiff paper.
Chasmogamy - n. (Gr. *chasma*, an opening, chasm, and *gamos*, marriage) the opening of the perianth of a flower for the purpose of fertilization; contrast with cleistogamous.
Chelators - Synthetic organic acids that bind with various trace elements to keep them available in a form that is usable by the plants.
Chlorophyll - The pigment that makes plants green. One of the pigments necessary for photosynthesis.
Chlorophyll Absorption - Process of Photosynthesis, occurs between 420-550 nm. and at 670 nm. Values for different type bulbs.
Chlorosis - Loss of chlorophyll, often a sign of insufficient amounts of iron. n. (Gr. *chloros*, pallid) An abnormal condition characterized by absence of green pigments in plants.
Choripetalous - a. (Gr. *choris*, apart, and *petalon*, leaf) polypetalous; having unconnected or separate petals.
Ciliata - a. (L. *cilium*, eyelid) with marginal hairs that form a fringe.
Circumscissile - a. (L. *circum*, around; *scindere*, to cut) opening splitting by a transverse fissure around the circumference, leaving an upper and lower half; said of certain seed pods or capsules.
Clavata - a. (L. *clava*, a club) club-shaped; having the form of a club; growing gradually thicker toward the top, as certain parts of a plant.
Claw - n. (AS. *clawu*, a claw, hoof) the narrowed, stalk-like base of some sepals or petals.
Cleft - a. (AS. *cleofan*, to cut) divided halfway down to the midrib or further, or generally, any deep lobe or cut.
Cleistogamy - n. (Gr. *kleistos*, closed; gamos, marriage) the condition of having flowers which never open and self-pollination occurs; the flowers are often small and inconspicuous.
Clone - n. (Gr. *klon*, a twig) a group of plants, all of whose members are directly descended from a single individual.
Coagulant - A chemical compound used in water clarifiers. It causes fine particles to stick together to be more easily removed by the filter.
Coherent - a. (L. *cohaerere*, to stick together) having parts united.
Collar - n. (L. *collare*, a band or chain for the neck) region of junction between blade and leaf sheath of grasses.
Collenchyma - n. (L. from Gr. *killa*, glue, and *enchyma*, an infusion) living, supportive tissue with chloroplasts generally just beneath the surface consisting or more or less elongated cells usually thickened unevenly in a manner somewhat variable in different groups of plants.
Colonial - a. (Fr. *colonial*, from L. *colonia*, a colony) usually used to describe cloning by vegetative reproduction, the seemingly separate plants having arisen from rhizomes, stolons, or roots of a single or of neighboring "parent" plants.
Colony - n., a stand, group, or population of neighboring plants of one species, the origin having been colonial, from seeds, or both.
Colpate - adj. (Gr. *kolpos* + *E-ate*, of pollen grains) having longitudinal germinal furrows in the exine.
Coma - n. (L. *coma*; Gr. *kome*, hair) a tuft of soft hairs, as at the apices or bases of seeds; a bunch of branches; a terminal cluster of bracts on a flowering stem, as in pineapples.
Commissure - n. (L. *commissura*, a joining together) a place of joining or meeting, as where one carpel joins another in the Umbelliferae.
Communities - Different species of fish kept in the same aquarium.
Comose - a. (L. *comosus*, hairy, from *coma*, hair) having a tuft of hair.

Competition - n. (L. *competitio*, an agreement, rivalry) involves the removal or reduction of some factor from the environment by a plant or group of plants that is sharing the same habitat. Competition can be by an individual or groups of plants of the same or different species. Factors that may be reduced include water, minerals, food, and light.
Compound leaf - A leaf that is divided into several distinct leaflets.
Concretion - n. (L. *concretion*, *concretio*, to grow together) the act or process of making or becoming solid.
Connate - adj. (LL. *connatus*, past part) congenitally united.
Connivent - a. (L. *connivere*, to close the eyes) approximate but not organically united; converging; arching over so as to meet.
Contraction - The shedding of the leaves at the onset of the dormant period.
Convexity - Having the property of curving outward, like the outside of a ball.
Convolute - a. (L. *cum*, together; *volvere*, to wind) said of parts rolled or twisted together when in an undeveloped stage, as in some corollas in the bud stage.
Cordate - a. (L. *cor*, *cordis*, a heart) with a sinus and rounded lobes at the base, the overall outline usually ovate; often restricted to the base rather than to the outline of the entire organ; heart-shaped.
Coriaceous - a. (L. *coriaceus*, from *corium*, leather) leathery; tough.
Corm - n. (L. *cormus*; Gr. *kormus*, the trunk of a tree with the boughs lopped off) an enlarged solid subterranean stem, often rounded in shape but of no distinct characteristic shape or size in some species, filled with nutrients, composed of two or more internodes and covered externally by a few thin membranous scales or cataphyllary leaves.
Cormophyta - n. (Gr. *kormus*, the trunk of a tree with the boughs lopped off; *phyton*, plant) in older classifications, a division comprising all plants that have a stem and root.
Cormophyte - n., a plant of the division Cormophyta.
Corolla - n. (L. *corolla*, a little crown) the inner, usually colored or otherwise differentiated, whorl or whorls of the perianth; the petals of a flower as a whole.
Corymb - n. (Gr. *korys*, a helmet) a racemose type of inflorescence in which the lower pedicels are successively elongated, forming a more or less flat-topped inflorescence, the outer flowers opening before the inner.
Cosmopolitan - Found worldwide.
Cotyledon - n. (Gr. *kotyle*, a hollow or cavity) the first leaf or leaves of a seed plant, found in the embryo of the seed which may form the first photosynthetic leaves or may remain below ground.
Creek - n. (ME. *creke*, *crike*, from ON. *-kriki*, bend, concavity; akin to ON. *krikr*, bend, bay) a natural stream of water normally smaller than, and often tributary to, a river.
Crenate - a. (L. *crena*, a notch) having a notched, indented, or scalloped edge, as certain leaves.
Crenate - Edged with rounded teeth.
CRI: color rendering index **-** A number used for rating light bulbs on a scale up to 100, where 100 is equal to sunlight.
Crispate - With wave margins.
Crown - n. (L. *corona*, a crown, wreath) that part of a stem at or just below the surface of the ground; an inner appendage of a petal or the throat of a corolla; an appendage or extrusion standing between the corolla and stamens, or on the corolla; an outgrowth of the staminal part or circle as in milkweeds.
Crushed coral - A Calcareous substrate material with pH buffering abilities, for marine aquaria.
Culm - n. (L. *culmus*, a stalk, stem) the stalk or stem for such plants as grasses and sedges, usually jointed and hollow.
Cultivar - A man-made (cultivated) variety.
Cuneate - a (L. *cuneatus*, wedge-shaped, from *cuneus*, a wedge) narrowly triangular with the acute angle toward the base; wedge-shaped; tapering toward the point of attachment.
Cusp - n. (L. *cuspis*, a point) rigid, sharp point, especially on a leaf.
Cuspidate - a. (L. *cuspidare*, to make pointed) tipped with a short, rigid point.
Cuticle - n. (L. *cutis*, skin) a continuous layer of fatty substances covering over the outer surfaces of the epidermis of plants; it contains cutin and protects against water and gases. The thin skin of the plant. This is thicker and waxy to maintain moisture in emersed growth.

Cutin - n., a waxy substance which, together with cellulose, forms the outer layer of the skin of many plants.
Cutting - A fragment of plant material that is capable of growing to become another complete, individual plant.
Cuttings - Detached parts of stem plants: they take root after planting and become new plants.
Cyathium - n. (Gr. *kyathos*, cup) a type of inflorescence characteristic of some members of Euphorbiaceae; consisting of a cuplike involucre bearing unisexual flowers; staminate on its inner face, pistillate from the base.
Cyme - n. (Gr. *kyein*, to swell) a cluster of flowers in which each main and secondary stem bears a single flower, the bud on the main stem blooming first; determinate inflorescence in which each growing point ends in a flower.
Cymose - a., bearing a cyme or cymes.
Cystolith - n. (Gr. *kystis*, bladder; *lithos*, stone) a mass of calcium carbonate concretion, occasionally silica, formed on ingrowths of modified epidermal cell walls in some plants, esp. of the Acanthaceae family.
Day neutral plants - plants that flower regardless of day length.
Deciduous - a. (L. *deciduus*, that which falls down) falling after completion of the normal function.
Decimeter - (dm), 3.973 inches, 10 cm, or 0.1 m.
Decumbent - a. (L. *decumbere*, to lie down) trailing on the ground and rising at the tip, as some stems.
Decurrent - a. (L. *decurrere*, to run down) extending downward, applied usually to leaves in which the blade is apparently prolonged downward as two wings along the petiole or along the stem.
Decussate - Opposite pairs of shoots set at right angles to the pairs above and below.
Dehiscence - n. (L. *dehiscere*, to gape) opening and shedding contents; said of stamens and fruits.
Dehisces - vt., to burst or split open, as the seed capsules of plants.
Deltoid - a. (Gr. *delta*, and *eidos*, form) shaped like the Greek letter delta; triangular in outline.
Denitrification - Breakdown of nitrates by anaerobic bacteria into other forms.
Dentate - a. (L. *dens*, a tooth) toothed, with large saw-like teeth on the margin pointing outward, not forward.
Denticle - n. (L. *denticulus*, little tooth) a small tooth or toothlike projecting point.
Denticulate - a., having small teeth; finely dentate. Serrated, edged with small teeth.
Detritus - Organic waste matter that collects on the bottom of fish tanks.
Diadelphous - a. (from *di-*, twice, and Gr. *adelphos*, brother; *-ous*) in two sets as applied to stamens when in two, usually unequal, sets.
Dichotomous - a. (Gr. *dichotous*, a cutting in two) having or consisting of a pair or pairs; paired. Dividing into two equal branches.
Digitate - a. (L. *digitus*, finger) having fingerlike divisions, as some leaves.
Dimorphic - a. (Gr. *dimorphos*, having two forms) having two forms.
Dioecious - a. (Gr. *di*, two; *oikos*, house) said of a kind of plant having unisexual flowers, the male and female flowers on different individual plants.
Dioecious - Having male or female flowers on separate plants.
Diploid - a. (Gr. *diploos*, double; *eidos*, form) having twice the number of chromosomes normally occurring in a germ cell.
Disc flowers - the radically symmetrical flowers of the head in Compositae, as distinguished from the ligulate ray flowers.
Discoid - a. (Gr. *diskos*, a disk) having the form of a disk; discoid flower; a compound flower not radiated, but with tubular florets.
Distal - a. (L. *distare*, to stand apart) farthest away from the point of attachment or origin.
Distichous - a. (Gr. *distichos*, having two rows) two-ranked; in the case of plants with alternate leaves, the arrangement is such that 1st is directly below the 3rd.
Distichous - Leaves arranged in two rows on either side of the stem.
Divaricate - vt. (L. *divaricare*, to spread apart) to branch or spread widely apart.
Divergent - a. (L. *divergere*, to bend away) separated from one another, having tips further apart than the bases

Diverticulate - a. (L. *divertere*, to turn aside) having short offshoots approximately at right angles to axis.
Divided - a. (L. *dividere*, to divide) referring to the blade of an appendage when it is cut into distinct divisions to, or almost to, the midvein.
Division - A method of propagation in which the rhizome or vegetative cone is cut into pieces, each of which is capable of becoming a complete new plant. Division of the vegetative point of Rosette plants into two or more parts for propagation.
DKH - Abbreviation for Degrees of Carbonate Hardness.
Dolomite - A limestone gravel with a small pH buffering ability.
Dormant period - Interruption of growth in an effort to adjust to seasonal periods of stress.
Dorsal - a. (L. *dorsum*, the back) pertaining to the back; the surface turned away from the axis.
Dorsal fin - Single fin mounted on top of the fish. Some species have two, one behind the other.
Down - n. (ME. *down*, *downe*, down; probably of Scandinavian origin) fine, soft feathers; soft, fine hair.
Downy - a., covered with short, fine hairs.
Drupe - n. (Gr. *dryppa*, an overripe olive) a fleshy or pulpy fruit with the inner portion of the pericarp hard or stony and enclosing the seed; usually 1-locular and 1-seeded, sometimes more than 1-locular and more than 1-seeded.
Echinate - a. (L. *echinus*, a hedgehog) set with prickles; prickly, like a hedgehog; having sharp points.
Ecology - n. (Gr. *oikos*, house; and *-logy* Gr. *-logia*, from *legein*, to speak) branch of science concerned with the interrelationships of organisms and their environments esp. as manifested by natural cycles and rhythms, community development and structure, interaction between different kinds of organisms, geographic distributions and population alteration.
Edaphic - a., relating to, or determined by, conditions of the soil.
Elliptic - a. (Gr. *elleipsis*, a falling short, defect, ellipse) an outline that is oval, narrowed to rounded at the ends and widest at about the middle (as the outline of a football); ellipsoid, a solid with an elliptical outline.
Emarginate - vt. (L. *emarginare*, to deprive of the edge) said of leaves, sepals, or petals, and other structures that are notched at the apex.
Emerge - vt. (L. *emergere*, to rise up, rise out) to rise out of a fluid or other covering.
Emergent - n., (ME. Fr. L. *emergent-*, emergens, pres. part. of *emergere*, to emerge - more at emerge) any of various plants (as a cattail) rooted in shallow water and having most of the vegetative growth above the water.
Emersed - Grown so that the roots and bottom portion of the plant are underwater, and the rest of the plant grows above the water. adj., Standing out of or rising above a surface as an aquatic plant with flower stalk emersed.
Emersed plants - plants growing with their roots and a portion of the shoot below the water and the remainder of the shoot above the surface of the water.
Enation - n. (L. *enasci*, to spring up) an abnormal growth of an organ or of an excresence upon any part of a plant.
Endcap - A water resistant socket for fluorescent lamps.
Endemic - a. (Gr. *endemos*, native, belonging to a people) a plant that is native to a particular country or region; not introduced or naturalized. A species found only in one specific location.
Endocarp - n. (Gr. *endo*, within; *karpos*, fruit) the inter layer of the wall of a matured ovary; when its texture differs from the outer wall, it may be hard and stony, membranous, or fleshy.
Ensiform - adj. (F. *ensiforme*, Fr. L. *ensis* sword + F. *forme*, form) having sharp edges and tapering to a slender point; having a shape suggesting a sword.
Entire - a. (L. *integer*, whole, untouched, undiminished) having a margin devoid of any indentations, teeth, or lobes.
Entomophilous - a. (Gr. *entomon*, insect; *philein*, to love) pollination by insects.
Ephemeral - n. (Gr. *ephemeros*, lasting for a day) referring to an organ living a very short time, usually a day or less; lasting a very short time.
Epigynous - a. (Gr. *epi*, upon; *gyne*, woman) growing upon the top of the ovary or seeming to do so, as petals, sepals, and stamens.
Epigyny - n., the condition of being epigynous.

Epipetalous - a. (Gr. *epi*, upon; *petalon*, leaf) having stamens inserted on petals.
Epiphytic - A plant that grows on another plant but is not parasitic.
Equitant - a. (L. *equitare*, to ride) overlapping; said of leaves whose bases overlap the leaves within or above them, as in the Iris.
Erose - a. (L. *erodere*, to wear away) having small irregular notches in the margin, as if gnawed.
Essential flower parts - the stamen and pistil organs of the flower that are required for pollination.
Estuary - n. (L. *aestuarium*, part of the seacoast over which the tide ebbs and flows, from aestus, the tide) an inlet or arm of the sea; especially the wide mouth of a river, where the tide meets the current. pl. estuaries.
Etiolation - The formation of weak, spindly foliage deficient in Chlorophyll, usually occurs in light of too low intensity.
Eutrophic - a. (Gr. *ew*, well; *trophe*, nourishment) the gradual increase in nutrients in a body of water. Natural eutrophication is a gradual process, but human activities may greatly accelerate the process. Rich in dissolved nutrients, often caused by pollution.
Eutrophication - a., the process of becoming eutrophic.
Even-pinnate - said of compound leaves having an even number of leaflets, this is usually easily determined because there is a pair terminally.
Excrescence - n. (L. *excrescere*, to grow out; *ex*, out; *crescere*, to grow) a normal outgrowth; a disfiguring addition.
Excurrent - a. (L. *excurrere*, to run out, project) projecting beyond the tip, as the midrib of a leaf or bract.
Exfoliate - vt. (L. *ex*, out; *folium*, leaf) peeling off in thin layers, shreds, or plates, as the bark of some trees.
Exine - n. (L. *ex*, out of, out) the outer of two layers forming the wall of certain spores (as pollen grains) - called also exosporium.
Exocarp - n. (Gr. *exo*, without; *karpos*, fruit) the outer layer of the wall of a matured ovary.
Exsert - vt. (L. *exserere*, to stretch out) to put forth; to thrust out; to protrude.
Exserted - a., sticking out; extending beyond (some enclosing part).
Exstipulate - a. (L. *ex*, private; *stipula*, a stalk, stem) having no stem.
Falcate - a. (L. *falx*, a sickle) curved like a sickle.
Family - A term used in the classification of organisms. A family is made up of related Genera.
Farinaceous - a. (L. *farina*, meal) containing flour; starchy; mealy.
Farinose - a., full of meal; mealy; covered with a white, powdery substance.
Fascicle - n. (L. *fasciculus*, small bundle) a small bundle or tuft, as of fibers, leaves, etc.
Fastigiate - a. (L. *fastigare*, to slope up) branches erect and close to stem.
Fen - n. (ME. *fen*, *fenne*; AS. *fen*, *fenn*, a marsh, bog, fen) low land covered wholly or partially with water but producing sedge, coarse grasses, or other aquatic plants; boggy land; a moor or marsh; plant community on alkaline, neutral, or slightly acid peat.
Fenestrated - a. (L. *fenstra*, window) a type of leaf anatomy with small perforation or transparent spots. Confined to a few tropical monocotyledons which grow on the island of Madagascar.
Filament - n. (L. *filum*, thread) the stalk bearing the anther.
Filiform - a. (L. *filum*, thread; *forma*, shape) thread-like, long and very slender. Thread like.
Filtration - Method of cleaning aquarium water. There are 3 basic types: "Mechanical" removes particulate material. “Chemical" is removal of dissolved substances by passing through a type of media, like carbon. "Biological" is the process of changing from a harmful substance to a less harmful one, by bacteria.
Fimbriate - n. (L. *fimbriatus*, fringed) cut into regular segments and appearing fringed at the margins.
Fistula - n. (L. *fistula*, pipe) pathological or artificial pipe-like opening; water-conducting vessel - alt. trachea.
Fistulose - a. same as fistulous.
Fistulous - a, having the form or nature of a fistula.
Flabellate - a. (L. *flabellare*, to fan) fan-shaped.
Flaccid - a. (L. *flaccidus*, flabby) weak, limp, soft, or flabby; leaves that do not have enough water and are about to wilt or are wilting.

Floccose - a. (L. *floccus*, a lock of wool) said of pubescence which gives the impression of irregular tufts of cotton or wool.
Florescence - n. (L. *florescence*, to begin to flower) bursting into bloom, alt. anthesis.
Floret - n. (L. *flos*, flower) one of the small individual flowers of a crowded inflorescence such as capitulum; flower with lemma and palea, of grasses; alt. floscule.
Floricane - n., the stem at flowering and fruiting stage (of a bramble, Rubus).
Floscule - n. (L. *flosculus*, little flower) a small flower; a floret.
Flower - n. (ME, *flowre*, *flour*, *flur*; OFr., *flor*, *flur*, *flour*, from L. *flos*, *floris*, a flower) the part of a plant containing or consisting of the organs of reproduction, either together in a monoclinous flower or separate in male and female flowers.
Foliaceous - a. (L. *folium*, leaf) having the form or texture of a foliage leaf; thin and leaf-like; bearing leaves.
Follicle - n. (L. *folliculus*, small sac) a dry dehiscent fruit formed of one carpel, and dehiscing along one side.
Fresh weight - same as wet weight. Generally not a useful measurement for aquatic plants.
Frond - n. (L. *frons*, a leafy branch) a leaf, especially of fern or palm; a leaf-like expansion.
Frond - The "leaf" of a fern.
Fruit - n. (Fr. *fruit*, from L. *fructus*, fruit) the developed ovary of the flower containing ripe seeds, whether fleshy or dry, often used to include other associated parts such as a fleshy receptacle, then called a false fruit.
Frutescent - a. (L. *frutex*, a shrub) shrubby or becoming shrubby.
Funicle - n. (NL. *funiculus*) funiculus.
Funiculus - n. (NL. from L. *funis*, a small rope) the stalk of an ovule. pl. funiculi.
Fusiform - a. (L. *fusus*, a spindle; *forma*, form) shaped like a spindle; thick, tapering at both ends.
Gametophyte - n. (Gr. *gamete*, a wife; *phyton*, plant) the gamete-forming haploid phase in the alternation of plant generations.
Gamopetalous - a. (Gr. *gamos*, marriage; *phyllon*, a leaf) having the petals united so as to form a tubelike corolla. Same as sympetalous.
Gamosepalous - a. (Gr. *gamos*, marriage; *sepalous*) having the sepals united.
Gemma - n. (L. *gemma*, a swelling, bud, gem) a bud or outgrowth of a plant which develops into a new organism. A leaf bud rather than a flower bud.
Gemmates - a. (L. *gemmare*, to put forth buds) buds or outgrowths of a plant which develop into a new individual.
Gemmiparous - a. (L. *gemma*, a bud; *parere*, to bear) to produce gemmates.
General or Total hardness - the sum of carbonate hardness and non-carbonate hardness. Usually expressed in degrees of dH.
Geniculate - a. (L. *geniculatus*, having knee joints, joints) bent like a knee; bent abruptly at the nodes.
Genotype - n. (Gr. *genos*, race; type) the genetic constitution of an individual.
Genus - n. (L. *genus*, race) a taxonomic group consisting of closely related species, genera being grouped into families; plural - genera; a. - generic.
Geophyte - n. (Gr. *ge*, earth; *phyton*, plant) plants with an underground dormant part such as a tuber, bulb, rhizome, etc. to help the plant survive adverse conditions.
Gibberellins - n. (*Gibberella*, a fungal genus) growth hormones that accelerate shoot growth. First discovered in the fungus *Gibberella fujikuroi*, and later in other plants.
Gibbous - a. (L. *gibbus*, hump) a distended, rounded swelling on one side, as on a calyx or corolla tube or segment.
Glabrate - a. (L. *glaber*, smooth) becoming glabrous with age.
Glabrous - a., with a smooth, even surface; without hairs.
Glade - n. (prob. Scand. *golead*, a lighting, illumination, fr. *goleu*, light, clear, AS. *glaed*, bright) open space surrounded by woods or a forest; a marshy and usually low-lying area; a periodically inundated grassy marsh often running between adjacent slopes; a marshy area bounding or forming the headwaters of a stream.
Gland - n. (L. *glands*, acorn) a secreting part or appendage.
Glandular - a. (L. *glandula*, small acorn) having or bearing secreting organs, glands, or trichomes.

Glandular-pubescent - hairs or trichomes capitate and secretory.
Glaucous - a. (L. *glaucus*, sea-green) bluish green; covered with a pale green bloom.
Globose - a. (L. *globosus*, rounded as a ball) rounded; almost spherical; globular.
Glomerate - vt. (L. *glomus*, a ball of yarn) to gather or wind into a ball; growing, collected or arranged in a rounded mass, as glands, flowers, etc.; clustered.
Glomerule - n., a condensed cyme of almost sessile flowers; a compact cluster as of spores.
Glume - n. (L. *gluma*, husk) a chaffy or membranous bract, a bract at the base of a grass inflorescence or spikelet.
Glutinous - a. (L. *gluten*, glue) having a sticky, moist surface; a gluey or sticky exudation.
Guttation - n. (L. *gutta*, drop) formation of drops of water on plants from moisture in air; the process of water being exuded from hydathodes at the enlarged terminations of veins around the margins of the leaves.
Gymnospermae - n. (Gr. *gymnos*, uncovered, naked; *sperma*, seed) an important division of the plant kingdom, being woody plants with alternation of generations, having the gametophyte retained on the sporophyte and seeds produced on the surface of the sporophylls and not enclosed in an ovary.
Gynaecium - n. (Gr. *gynaikeie*, woman's part of a house) the female organs of the flower, consisting of one or more carpels forming one or several ovaries with their stigmas and styles.
Gynecandrous - a., having staminate and pistillate flowers in the same spike or spikelet, the latter above the former.
Gynoecium - n. (Gr. *gyne*, woman; *oikos*, house) the pistil or pistils of a flower, taken collectively; gynaecium.
Gynophore - n. (Gr. *gyne*, woman; *pherein*, to carry) a stalk supporting the ovary.
Gynostegium - n. (Gr. *gyne*, woman; *stege*, roof) a protective covering for a gynaecium, especially as formed by the union of stamens and style.
Habit - n. (L. *habitus*, condition, appearance, dress) the external appearance or way of growth of a plant, e.g. climbing, erect, bushy, etc.; the tendency of a plant to grow in a certain way.
Habitat - n. (L. *habitare*, to inhabit) the locality or external environment in which a plant lives.
Halophyte - n. (Gr. *hals*, salt; *phyton*, plant) any species capable of tolerating 0.5% or more NaCl.
Haplophyte - n. (Gr. *haploos*, simple; *eidos*, form) having the number of chromosomes characteristic of the gametes for the organism.
Hapteron - n. (Gr. *haptein*, to fasten) holdfast, specialized root-like projections that function to anchor a plant.
Hard water - Water with a high concentration of dissolved salts.
Hastate - a. (L. *hasta*, spear) spear shaped, more or less triangular with the two basal lobes divergent. With two out-turned lobes at the base.
Hemicryptophyte - n. (Gr. *hemi*, half; *kryptos*, hidden; *phyton*, plant) a perennial plant having its overwintering buds located at the soil surface.
Herb - n. (L. *herba*, green crop) any seed plant whose stem withers away to the ground after each season's growth; a seed plant with a green, non-woody stem.
Herbage - n. (Fr. *herbe*, an herb) herbs collectively; the green foliage and juicy stems of herbs.
Herbivore - Plant eater.
Heterophyllous - Having leaves of different shapes on the same plant. a. (Gr. *heteros*, other; *phyllon*, leaf) the presence on a single individual of two or more distinct leaf shapes. These leaves may differ markedly in shape, yet have similar gross anatomical organization.
Heterostylic - Having flowers which differ in the relative length of their styles and stamens, such that any one flower is very rarely, if ever, self-pollinated.
Heterozygote - n. (Gr. *heteros*, other; *zygon*, yoke) an organism or cell having two different alleles at corresponding loci on homologous chromosomes.
Hibernaculum - n. (L. *hibernare*, winter residence) a plant organ such as a bud, rhizome, turion, etc. which allows a plant to live through adverse conditions
Hilum - n. (L. *hilum*, a little thing, a trifle) the scar on a seed marking the place where it was attached to the seed stalk.
Hirsute - a. (L. *hirsutus*, bristly) set with bristles; hairy; shaggy.
Hispid - a. (L. *hispidus*, rough) having stiff hairs, spines, or bristles.

Hyaline - a. (Gr. *hyalos*, glass) of thin, membranous, transparent or translucent texture.
Hybrid - n. (L. *hibrida*, cross) any cross-bred plant; heterozygote. The offspring of two parents of different species or varieties.
Hydathodes - n. (Gr. *hydatos*, of water; *hodos*, way) an epidermal structure specialized for secretion, or for exudation, of water.
Hydric - a. (Gr. *hydor*, water) characterized by an abundant supply of water.
Hydrometer - A device used to measure salinity of water.
Hydrophilous pollination - The transference of pollen from the Anthers of the Stamens to the Stigmas on the surface of the water or under water.
Hydrophily - n. (Gr. *hydor*, water; *philein*, to love) water pollination.
Hydrophyte - n. (Gr. *hydor*, water; *phyton*, plant) an aquatic plant living on or in water.
Hydropote - n. (Gr. *hydropotes*, water drinker) a cell or cell group found on the lower epidermis of some species such as *Nymphaea*. These cells are thought to function in the uptake of ions from the water.
Hypanthium - n. (Gr. *hypo*, under; *anthodes*, like flowers) an expansion of the receptacle of a flower that forms a saucer-shaped, cup-shaped, or tubular structure (often simulating a calyx tube) bearing the perianth and stamens at or near its rim; it may be free from or united to the ovary.
Hypertrophy - n. (Gr. *hyper*, above; *trophe*, nourishment) excessive growth due to increase in cell size.
Hypocotyl - The part of the Stem of a seedling below the cotyledons.
Hypogynous - a. (Gr. *hypo*, under; *gyne*, female) inserted below the gynoecium, and not adherent; immediately below oogonium; the ovary thus said to be superior. n. hypogyny.
I.D.- An abbreviation for inside diameter, used when measuring tubing dimensions.
IAA - Indole-acetic acid, a natural growth hormone found in plants.
Ich - A very common parasitic disease characterized by white salt-like specks all over the fish.
Idioblasts - n. (Gr. *idios*, one's own; *blastos*, a bud, offshoot) plant cells containing oil, gum, calcium, or other products, and appearing to help provide mechanical support.
Imbricate - a. (L. *imbricare*, to tile) having parts overlapping each other like roof tiles.
Immersed - a. (L. *in*, into; *mergere*, to dip, plunge) growing under water.
Imperfect flower - a flower containing stamen and pistil organs required for pollination but lacking sepals or petals or both of these organs.
Incised - a. (L. *in*, into; *caedere*, to cut) with sharp angles between the lobes; having deeply cleft margins.
Included - a. (L. *in*, in; *claudere*, to shut, close) not projecting beyond an enclosing part.
Incrassate - vt. (L. *in*, in; *crassus*, thick) becoming thick or thicker, especially toward a tip or margin.
Indehiscent - a (L. *in*, not; *dehiscens*, gaping) fruits which do not open to release seeds, but whole fruit is shed from the plant; not opening to release spores.
Indigenous - a. (L. *in*, within; *gignere*, to bear, produce) native; originating or occurring naturally in the place specified.
Inflorence - Flower cluster.
Inflorescence - n. (L. *inflorescere*, to begin to blossom) a flower or putting forth blossoms; the mode of development and arrangement of flowers on an axis; a flowering branch.
Infructescence - n. (L. *in*, into; *fructus*, fruit) the inflorescence in a fruiting stage; collective fruits.
Inter- - (ME. *enter-*, *inter-*; OFr. *entre-*, *inter-*; L. *inter-* from *inter*, prep. between, among, during) a prefix meaning between, among - as intercellular.
Intercellular - adj. lying between cells, as intercellular space in plant tissue.
Interference - n. (L. *inter*, between; *ferire*, to strike) the overall influence of one plant or groups of plants on another, and encompasses allelopathy or competition, or both of these processes.
Internode - n. (L. *inter*, between; *nodus*, knot) the portion of a stem between nodes. The area between two nodes on a plant stem.
Interspecific competition - competition between species for nutrients, space, light, etc.
Intra- - (L., from *intra*, within, inside) a combining form meaning within, inside of, as intracellular.
Intracellular - adj., being or occurring within a body cell or within the body cells.

Intraspecific competition - a type of competition whereby an individual plant competes with one or more members of the same species for nutrients, space, light, etc.
Invertebrate - An animal with no backbone.
Involucel - n. (L. *involucrum*, covering) a secondary involucre, as the bracts subtending the secondary umbels in the Umbelliferae.
Involucre - n., a group of closely placed bracts that subtend or enclose an inflorescence.
Involute - a. (L. *involutus*, rolled up) leaves having the edges rolled inwards at each side, toward the adaxial side.
Involution - n. (L. *involutus*, rolled up) a rolling inwards of leaves.
Iron - The most important trace element for plants. Iron deficiency causes Chlorosis; a disease that makes the plant leaves Yellow.
Kelvin - A temperature reading used to rate the color of light bulbs. 5500 degrees K is equal to sunlight.
Labiate - a. (L. *labium*, lip) lipped, as in a calyx or corolla.
Lacerate - a. (L. *lacer*, mangled, lacerated) said of a margin torn irregularly.
Laciniate - a. (L. *lacinia*, a hem) cut into narrow, jagged lobes or segments.
Lacunate - a. (L. *lacuna*, cavity) with air spaces or chambers in the midst of tissue.
Lagoon - n. (It. And Sp. *laguna*, fr. L. *lacuna*, a ditch, pool, fr. lacus, lake) a shallow lake or pond, especially one connected with a larger body of water; an area of shallow salt water separated from the sea by sand dunes; the area of water surrounded by an atoll, or circular coral reef.
Lake - n. (ME. *lake*, *lak*; AS. *lacu*, a lake, pool; L. *lacus*, a hollow, a basin, tub, pool, lake) an inland body of water, usually fresh water, formed by glaciers, river drainage, etc., larger than a pool or pond.
Lamellate - a., made up of thin plates or lamina.
Lamina - n. (L. *lamina*, a thin piece of metal or wood) the expanded blade part of a foliar leaf, petal, etc.
The part of a leaf which is flattened, to a greater or lesser degree; as the Leaf Blade.
Laminae - Broad part of the leaf usually attached to the stalk by the petiole; also called the blade.
Lanate - a. (L. *lana*, wool) wooly, with long intertwined, curled hairs.
Lanceolate - a. (L. *lancea*, a lance) shaped like a lance; broadest toward the base and narrowed to the apex, several times longer than wide.
Lanceolate - Spear shaped.
Lateral line - A line of sensory scales along the sides of fish that enables them to detect vibrations and electrical impulses from other fish.
Laterite - An iron-bearing red soil found in tropical areas. Formed by centuries of heat and rain. Substance used in fresh water plant tanks to supply nutrients, either a powder placed under the gravel or chunks mixed in the gravel bed.
Leaf - n. (ME. *leef* fr. OE. *leaf*, akin to OHG. *loub*, leaf, foliage) a lateral outgrowth from a stem that constitutes part of the foliage of a plant and functions primarily in food manufacture by photosynthesis.
Leaflet - One part of a compound leaf.
Legume - n. (L. *legere*, to gather) a 1-locular fruit, usually dehiscent along two sutures, bearing seeds along the ventral suture; a leguminous plant.
Lemma - n. (Gr. *lemma*, husk) the lower (abaxial), and larger, of two membranous bracts enclosing the flower in grass.
Lenticel - n. (L. *lens*, *lentis*, lentil) corky spots on young bark, arising in relation to epidermal stomates.
Lenticular - a. (L. *lenticula*, a lentil) shaped like a double-convex lens.
Lignify - vt., to convert into wood or woody tissue; to become wood or woody by chemical and physical changes in the cell walls that convert some or all of the constituents into lignin or lignocellulose.
Lignin - n. (L. *lignum*, wood) organic substances which act as binders for the cellulose fibers in wood and certain plants, and adds strength and stiffness to the cell walls. Chemical structure of lignin is composed of a polymer of high carbon content but distinct from the carbonates. Consists of C6,C3 units.
Ligulate - a. (L. *ligula*, little tongue) having or pertaining to ligules.

Ligule - n., hyaline extension of the leaf sheath on the adaxial side of the leaf.
Limb - n. (AS. *lim*, limb) the spreading part of a synsepalous calyx or sympetalous corolla, usually referring only to the calyx or corolla lobes, sometimes to their lips.
Limnology - n., the scientific study of physical, chemical, meteorological, and biological conditions in fresh waters.
Linear - a. (L. *linea*, line) long and slender with parallel or nearly parallel sides. Long, narrow, grass-like or strap-like leaf.
Lip - n. (AS. *lippa*, *lippe*, lip) the upper or lower part of a bilabiate calyx or corolla.
Lobulate - a. (Gr. *lobos*, lobe) divided into small lobes.
Locular - a. (L. *loculus*, a cell, box) having the nature of, or consisting of cells.
Locule - n. (L. *loculus*, a cell, box) a compartment of an anther or an ovary.
Loculicidal - a. (L. *loculus*, a cell, box; *caedere*, to cut) dehiscent dorsally down middle of carpels.
Lodicule - n. (L. *lodicula*, coverlet) a scale at base of an ovary in grasses, supposed to represent part of a perianth.
Loment - n. (L. *lomentum*, bean meal) a fruit of some legumes, contracted between the seeds, the 1-seeded segments separating at fruit maturity.
Long-day plant - a plant that requires more than 12 hours of daylight before flowering will occur.
Lumens - A measurement of light intensity. (1 lumen=10.76 lux).
Lunate - a. (L. *luna*, moon; *-ate*) crescent-shaped.
Lux - The standard for measuring light.
Macronutrients - Nutrients used by plants in relatively large amounts. They are nitrogen (N), phosphorus (P), sulfur (S), calcium (Ca), magnesium (Mg) and potassium (K).
Macrophyte - n. (Gr. *makros*, large; *phyton*, plant) a member of the macroscopic plant life especially of a body of water; large aquatic plant; the term 'aquatic macrophyte' has no taxonomic significance.
Macroscopic - a. (Gr. *makros*, large; *skopein*, to view) items large enough to be observed by the naked eye.
Marcescent - a. (L. *marcescere*, to wither) withering but remaining persistent.
Marsh - n. (ME. *mersh*, meadowland) a tract of wet land principally inhabitated by emergent herbaceous vegetation.
Membranous - a. (L. *membrana*, mem- brane) having a thin, soft, pliable texture.
Mericarp - one of the two carpels that resembles achenes and forms the schizocarp of an umbelliferous plant.
Mesic - a. (Gr. *mesos*, middle) conditioned by temperate moist climate; neither xerix nor hydric; pertaining to conditions of medium moisture supply.
Micronutrients - Nutrients used by plants in small amounts. They are iron (Fe), manganese (Mn), copper (Cu), zinc (Zn), molybdenum (Mo), cobalt (Co), and boron (B).
Microphyllidious - small, leaf-shaped.
Mire - n. - synonymous with any peat-accumulating wetland.
Moniliform - a. (L. *monile*, necklace; *forma*, shape) constricted laterally and appearing beadlike.
Monoclinous - a. (Gr. *monos*, single, alone; *kline*, bed) having both stamens and pistils in the same flower.
Monocotyledons - n. (Gr. *monos*, single; *kotyledon*, cup-shaped hollow) a class of angiosperms having an embryo with only one cotyledon, part of the flower usually in threes, leaves with parallel veins, and scattered vascular bundles.
Monoculture - A large group of a single species of plant.
Monoecious - a. (Gr. *monos*, single; *oikos*, house) a plant having unisexual male and female flowers on the same individual; said of a plant having unisexual flowers.
Monotypic - a. (Gr. *monos*, only; *typos*, type) a plant of only one type.
Moor - n. (ME. *mor*, fr. OE *mor*; akin MD. *moer*, mire, swamp) chiefly British: an extensive area of open rolling infertile land consisting of sand, rock, or peat usually covered with heather, bracken, coarse grass and sphagnum moss; a boggy area of wasteland usually dominated by grasses and sedges growing in a thick layer of peat.
Morphology - n. (G. *morphologie*, fr. Gr. *morph* - (fr. *morphe*, form) + G. *-logie*, -logy, more at form) a branch of biology that deals with the form and structure of animals and plants, a study of

the forms, relationships, metamorphoses, and phylogenetic development of organs apart from their functions.
Mucro - n. (L. *mucro*, sharp point) a stiff or sharp point abruptly terminating an organ; a small awn.
Multipinnate - Leaf divided into several sub-groups of leaflets.
Muricate - a. (L. *muricatus*, having sharp points) having a rough surface texture owing to small, sharp projections.
Naturalize - vt. (Fr. *naturel*, natural) to adapt to an environment not native; of foreign origin, but established and reproducing as though native.
Nectar - n. (L. *nectar*, nectar; Gr. *nektar*, the drink of the gods, from base of necros, dead, dead body, and tar-, who overcomes; hence, death overcoming; so named because the drink was held to confer immortality) the sweetish liquid in many flowers used by bees for the making of honey.
Nectary - n. (Gr. *nektar*, nectar) a part of a flower that secretes nectar. pl. nectaries
Neomorphosis - n. (Gr. *neos*, new; *morphosis*, change) regeneration in cases where the new part is unlike anything in the body.
Neoteny - n. (Gr. *neos*, young; *teinein*, to extend, stretch) the retention of juvenile characteristics in the adult individual.
Neotropical - From the tropical areas of the new world (South or Central America).
Neutral flower - said of a sterile flower composed of a perianth without any sexual organs.
Node - n. (L. *nodus*, knob) a knob or joint of a stem from which leaves, roots, shoots, or flowers may arise. A node will contain one or more buds. The point on a plant stem from which the leaves and/or roots appear.
Nodose - a., nodular, knotty.
Nomenclature - n. (L. *nomen*, name; *calare*, to call) the making and giving distinguishing names to all groups of plants.
Nut - n. (ME. *nute*, *note*, fr. OE *hnute*; akin to OHG *nuz*, *hnuz*, nut) a hard-shelled dry fruit or seed having a more or less distinct separatable rind or shell and interior kernel or meat; a dry indehiscent one-seeded fruit with a woody pericarp developing from an inferior syncarpous ovary.
Nutlet - a small nut.
Oblanceolate - a. (L. *ob*, reversely; *lancea*, spear) shaped like a lance point reversed, that is, having the tapering point next to the leafstalk.
Oblique - a. (L. *obliquus*, slanting) slanting; unequal-sided.
Oblong - a. (L. *oblongus*, rather long) elliptical and from two to four times as long as broad.
Obovate - a. (L. *ob*, against; *ovum*, egg) inversely ovate; having the shape of the longitudinal section of an egg, with the broad end at the top, as some leaves.
Obovoid - a. (L. *ob*, against; *ovum*, egg; Gr. *eidos*, shape) inversely ovoid; roughly egg-shaped, with narrow end downwards; said of some fruits.
Obsolete - a. (L. *obsolescere*, to go out of use) rudimentary or not evident; applied to a structure that is almost suppressed; vestigial.
Obtuse - a. (L. *obtusus*, blunt) with blunt or rounded end.
Ocean - n. (ME. *ocean*; L. *oceanus*, fr. Gr. *okeanos*, the ocean) the great body of salt water that covers mores than two thirds of the surface of the earth; any of its five principal geographical divisions, the Atlantic, Pacific, Indian, Arctic, and Antarctic.
Ocrea - n. (L. *acrea*, greave or legging) - a tubelike covering around some stems, especially of plants of the Polygonaceae.
Odd-pinnate - said of compound leaves having an odd number of leaflets, this is usually easily determined because there is a single terminal leaflet.
Offset - Young plant growing along a stolon from the parent plant.
Oligotrophic - Deficient in nutrients needed for plant growth.
Opposite - a. (L. *opponere*, to oppose) said of leaves or bracts occurring two at a node on opposite sides of the stem. Said of flower parts when one part occurs in front of another.
Orbicular - a. (L. *orbis*, circle) round or shield-shaped with petiole attached to center.
Ovary - n. (L. *ovum*, an egg) the enlarged hollow part of a pistil in angiosperms in which ovules are formed.
Ovate - a. (L. *ovum*, an egg) having the shape of a longitudinal section of an egg; egg-shaped and attached by the broader end. Egg-shaped.

Oviparous - a. (L. *ovum*, an egg; *parere*, to produce) egg-laying; producing eggs which hatch after leaving the body of the female; germinating while still attached to the parent plant; for example, mangrove.
Ovoid - a. (L. *ovum*, an egg) egg-shaped.
Ovule - n. (L. *ovum*, an egg) a structure in seed plants which contains the megasporangium (nucellus), megaspore (embryo sac), a food store, and a coat, and develops into a seed after fertilization.
Palea - n. (L. *palea*, chaff) the upper, and usually shorter and thinner, of two membranous bracts enclosing the flower in grasses.
Palmate - a. (L. *palma*, palm) leaves divided into lobes arising from a common center.
Paludal - From a marshy or swampy environment.
Pandurate - a. (L. *pandura*, a bandore) shaped somewhat like a violin, as some leaves.
Panicle - n. (L. *panicula*, a tuft of plants) a branched racemose inflorescence often applied more widely to any branched inflorescence.
Paniculate - a., panicled; arranged or growing in panicles.
Papilla - n. (L. *papilla*, nipple) a glandular hair with one secreting cell above the epidermis level.
Papillose - a. (L. *papilla*, nipple) descriptive of a surface beset with short, blunt, rounded, or cylindrical projections.
Parenchyma - n. (Gr. *para*, besides; *enchyma*, infusion) plant tissue, generally soft and of thin-walled, relatively undifferentiated cells which may vary in structure and function.
Parietal - a. (L. *paries*, wall) when the placenta is attached to the wall of the ovary.
Peat - n. (ME. *pete*, fr. ML. *peta*, perh. of Celt. origin; akin to W. *peth*, thing - more at piece) a piece of turf cut for use as a fuel; a mass of partially carbonized plant tissue formed by partial decomposition in water of various plants and esp. of mosses of the genus Sphagnum, widely found in many parts of the world, varying in consistency from a turf to a slime used as a fertilizer, as stable litter, as a fuel, and for making charcoal.
Pectinate - a. (L. *pecten*, comb) comb-like.
Pedicel - n. (L. *pedicellus*, foot) the stalk of a flower in an inflorescence. The stem of an individual flower.
Peduncle - n. (LL. *pedunculus*, small foot) the stalk of a flower borne singly or the stalk of an inflorescence.
Peltate - a. (Gr. *pelta*, target) shield-shaped; leaves that are shaped like a shield and attached to the stem at the center or by some point distinctly within the margin, and having the petiole inserted into the undersurface of the lamina not far from the center.
Penicullate - a. (L. *penicillus*, a pencil or small brush) having the form of a pencil.
Perennation - n. (L. *perennis*, perennial) survival of a plant for a number of years. To live over from season to season.
Perennial - a. (L. *perennis*, through; *annus*, a year) a plant that grows for 3 or more years and usually flowers each year.
Perfect flower - a flower with both essential and accessory organs.
Perfoliate - a. (L. *per*, through; *folium*, a leaf) said of opposite or whorled leaves or bracts that are united into a collar-like structure around the stem that bears them.
Perianth - n. (Gr. *peri*, around; *anthos*, flower) the outer whorl of floral leaves of a flower, when not clearly divided into calyx and corolla; collectively, the calyx and corolla, or either one if one is absent.
Pericarp - n. (Gr. *peri*, around; *karpos*, fruit) the fruit wall which has developed from the ovary wall; sometimes used for any fruit covering.
Perigynium - n. (Gr. *peri*, around; *gyne*, female) fruit investing utricle of the sedges, Carex.
Perigynous - a. (Gr. *peri*, around; *gyne*, female) growing in a ring around the pistil, as the stamens; having stamens, etc. growing in this way, said of a flower.
Persistent - a. (L. *persistere*, to persist) remaining attached after the normal function has been completed.
Petal - n. (Gr. *petalon*, leaf) any of the component parts, or leaves, of a corolla; the unit of structure of the corolla.
Petaloid - a. (Gr. *petalon*, leaf; *eidos*, form) like a petal.
Petiolate - a. (L. *petiolus*, small foot) growing on, or provided with, a petiole.

Petiole - a. (L. *petiolus*, small foot) the slender stalk or stem of a leaf, also called a leaf stalk. The "stalk" attaching the leaf to the stem.
Phenotype - n. (Gr. *phainein*, to appear; *typos*, image) the characters of an organism due to the interaction of genotype and environment, a group of individuals exhibiting the same phenotypic characters. The detectable expression of the interaction of genotype and environment constituting the visible characters of an organism.
Phenotypic - a., a set of characters arising from reaction to environmental stimulus.
Phloem - n. (Gr. *phloios*, inner bark) the tissue involved in the transport of carbohydrates and food materials in a vascular plant, being composed of sieve elements, parenchyma cells and sometimes also of fibers and sclereids.
Photosynthesis - The conversion of light energy into chemical energy: carbohydrates, (sugar and starch), are produced from carbon dioxide and water through the action of light on the chlorophyll of green plants. Oxygen is released in the process.
Phyllode - n. (Gr. *phyllon*, leaf; *eidos*, form) a winged petiole with flattened surfaces placed laterally to the stem and functioning as a leaf.
Phyllotaxy - n. (L. *phyllo-*, and Gr. *taxis*, arrangement) the arrangement of the leaves on the stem. The three common positions are: alternate, opposite, and verticillate.
Phylogeny - n. (Gr. *phyle*, tribe; E. *genesis*) the racial history or evolutionary development of any plant or animal species.
Pileus - n. (L. *pileus*, cap) umbrella-shaped structure of mushrooms or toadstools.
Pilose - a. (L. *pilosus*, hairy) hairy; pubescence comprised of scattered long, slender, soft hairs.
Pinna - n. (L. *pinna*, feather) a leaflet or a primary division of a compound leaf. pl. pinnas or pinnae.
Pinnate - a. (L. *pinnatus*, feathered) divided in a feathery manner; with lateral processes of a compound leaf, having leaflets on each side of an axis or midrib.
Pinnate - Divided.
Pinnule (also pinule) - n. (NL. *pinnula*, fr. L., small feather, small fin) a secondary pinna, one of the ultimate divisions of a bipinnate or twice-pinnate leaf.
Pistil - n. (L. *pistillum*, pestle) the unit of female function of a flower, may be comprised of a single carpel or two or more carpels united.
Pistillate - n., said of a flower bearing a pistil or pistils but not stamens, may refer also to a plant having only pistillate flowers.
Pith - n. (AS. *pitha*, pith) the soft, spongy tissue, consisting of cellular tissue, in the center of certain plant stems.
Placenta - a. (L. *placenta*, flat cake) the part of the ovary from which the ovules arise. It generally occupies the whole or a portion of an angle of a cell.
Placentation - n., the manner in which the placenta is arranged in the ovary.
Plano-convex - flat on one side and convex on the other.
Plant - n. (L. *planta*, plant) any of a kingdom (Plantae) of living beings typically lacking locomotive movement or obvious sensory organs, generally making its own food, possessing cell walls, and unlimited growth.
Plantlet - n., a little plant. Plantlets that develop asexually from a parent plant: a rooted plantlet forming on a part of the mother plant.
Plicate - a. (L. *plicatus*, to fold) folded into plaits, usually lengthwise; arranged in pleats, as a fan.
Plumiform - Feather shaped.
Plumose - a. (L. *plumosus*, feather) with hairlike branches, feathery.
Pollen - n. (L. *pollen*, *pollis*, fine flour) the male or fertilizing element of seed plants, consisting of fine yellowish powder formed within the anther of the stamen.
Pollinium - n., a mass of coherent pollen characteristic of orchids and milkweeds.
Polygamo-dioecious - polygamous but chiefly dioecious.
Polygamo-monoecious - polygamous but chiefly monoecious.
Polygamous - a. (Gr. *polys*, much or many; *gamos*, marriage) having bisexual, pistillate, and staminate flowers on the same individual plant.
Polymorphic - a. (Gr. *polys*, many; *morphe*, shape) having, assuming, or occurring in various forms, characters, or styles.
Polymorphous - Having multiple shapes.

Polypetalous - a. (Gr. *polys*, many; *petalon*, a petal) with many separate petals.
Pond - n. (form of pound, enclosure) a body of standing water smaller than a lake, often artificially formed.
Pocosin - n. (Algonquian) a bog that has formed in a shallow, undrained depression, the surrounding land being somewhat elevated, the vegetation predominantly evergreen shrubs or small trees. Pocosins vary greatly in size.
Prickle - n. (ME. *prikle*, *prikel*, fr. OE. *prickle*, *pricel*; a kin to MD. *prikel*, prickle) a sharp pointed emergence arising from the epidermis or bark of a plant.
Primary production - the quantity of new organic matter created by photosynthesis.
Procumbent - a. (L. *pro*, forward; *cubare*, to lie down) trailing or lying flat but not rooting.
Production - n. (L. *producere*, to produce) the weight of new organic material formed over a period of time, plus any losses during that time period. Losses may be due to respiration, excretion, secretion, injury, death, or grazing.
Productivity - n., amount of production over a given period of time. Expressed as a rate such as g/m^2 per day, kg/ha per year, etc.
Proliferous - a. (L. *proles*, *prolis*, offspring; *ferre*, to bear) bearing supplementary structures such as buds or flowers, either in an abnormal manner or in a manner that is normal but from adventitious tissue.
Propagulum or **propagule -** n. (L. *propages*, layer of a plant) a runner or sucker used in the asexual propagation of plants. pl. propagula or propagules.
Prostrate - a. (L. *prostratus*, pp. of *prosternere*, to lay flat) growing on the ground, trailing.
Protogyny - n. (Gr. *proteros*, fore; *gyne*, female) development of the female organs before the appearance of the corresponding male products - thus inhibiting self-fertilization.
Pseudolamina - n. (Gr. *pseudes*, false; L. *lamina*, plate) the extended apical portion of a phyllode.
Pseudovivipary - n. (Gr. *pseudes*, false; L. *vivus*, alive; *parere*, to produce) a condition where vegetative propagules replace some or all of the normal sexual flowers in the inflorescence.
Pteridophyte - n. (Gr. *pteris*, fern; *phyton*, plant) a major division of the plant kingdom, having clear alternation of generations with a dominant vascular sporophyte initially dependent upon the gametophyte which is very reduced.
Puberulent - a. (L. *pubes*, adult) covered with fine, short, and nearly imperceptible down; minutely pubescent, the hairs soft, straight, erect, but scarcely visible to the unaided eye.
Pubescent - a. (L. *pubescere*, to become mature) a general term for hairiness; covered with soft hair or down.
Punctate - a. (L. *puntcum*, point) dotted; with depressed dots scattered over the surface.
Pustulate hair - a. (L. *pustulare*, to blister) hair with an enlarged base.
Pyriform - a. (L. *pyrum* or *pirum*, a pear) pear-shaped.
Raceme - A group of flowers similar to a spike, but with each individual flower on its own stem.
Raceme - n. (L. *racemus*, bunch) inflorescence having a common axis and stalked flowers in acropetel succession.
Racemose - a., an inflorescence whose growing points continue to add to the inflorescence and in which there are no terminal flowers, and the branching is monopodial, as racemes, or spikes.
Rachilla - n. (Gr. *rhachis*, spine) the zigzag center upon which the florets are arranged in the spikelet of grasses or in some sedges.
Rachis - n., the central prolongation of the stalk (peduncle), the axis through an inflorescence, or of a leaf stalk (petiole), the axis through a compound leaf.
Radially - a. (L. *radius*, a ray, a rod, a spoke) arranged, or having parts arranged, like rays; developing uniformly around a central axis.
Radially symmetrical - said of a flower or set of flower parts which can be cut through the center into equal and similar parts along two or more planes; actinomorphic.
Ramet - n. (L. *ramus*, branch) an individual member of a clone.
Receptacle - n. (L. *recipere*, to receive) the more or less expanded apex of a floral axis which bears the floral parts.
Remote - a. (L. *remotus*, to remove) separated from one another; separated by intervals or spaces greater than the ordinary.
Reniform - a. (L. *ren*, kidney; *forma*, shape) having the form or shape of a kidney.

Repent - a. (L. *repens*, crawling) said of a stem that is prostrate and rooting at the nodes.
Reticulate - a. (L. *reticulatus*, latticed) like network.
Retinaculum - n. (NL. fr. L. that which holds or binds, band, fr. *retinere*, to hold back, retain) the hook-like funicle of a seed of a plant of the family Acanthaceae; a band or band-like structure that holds an organ in place. pl. retinacula.
Retrorse - a. (L. *retrorsum*, backward) having hairs or other processes turned toward the base.
Retuse - a. (L. *retuses*, blunted) with a shallow, rounded notch at the apex.
Revolute - a. (L. *revolvere*, to roll back) said of margins that are rolled backward (toward the abaxial side).
Rhizomatous tuber - same as a corm.
Rhizome - n. (Gr. *rhiza*, a root) a subterranean horizontal root-like stem sending out leaves and shoots from its upper surface and roots from its lower surface.
Rhombus - n. (Gr. *rhombos*, object that can be turned) an outline like a rhomboid, a parallelogram with equal sides, having two oblique angles and two acute angles.
Root - n. (AS. *wyrt*, root) the part of a plant, usually below the ground, that holds the plant in position, draws water and nutrients from the soil, stores food, and is typically non-green.
Root pressure - pressure in the roots which, when the shoot is cut off, will cause liquid to secrete from the root stump; the mechanisms and tissues involved in this process are not clearly understood.
Root tuber - swollen food-storing roots.
Rootlet - n., a radicel; a little root or small branch of a root.
Rootstock - same as a rhizome.
Roseate - a. (L. *roseus*, rosy) rose-colored; rosy.
Rosette - A plant that rises from a distinct crown. A group of organs, such as leaves, clustered and crowned around a common point of attachment.
Rotate - a. (L. *rota*, wheel) shaped like a wheel; radially spreading in one plane.
Rugose - a. (L. *ruga*, a wrinkle) having or full of wrinkles; corrugated; ridged.
Rugulose - a., same as rugose.
Runcinate - a. (L. *runcina*, a plane) pinnatified, with the lobes convex before and straight behind, pointing backward, like the teeth of a saw, as in the dandelion leaf.
Runner - n. (AS. *rinnan*, to run) a specialized stolon consisting of a prostrate stem rooting at the node and forming a new plant which eventually becomes detached from the parent plant as in a strawberry plant.
Saccate - a. (L. *saccus*, bag) having the form of a sac; pouchlike.
Sagittate - a. (L. *sagitta*, arrow) shaped like the head of an arrow with the basal lobes pointing downward.
Salverform - a. (L. *salvus*, safe; *forma*, shape, figure, image) said of a corolla in which the tube is essentially cylindrical, the lobes abruptly spreading; a gamopetalous corolla.
Sarmentose - adj. (L. *sarmentosus*, fr. sarmentum, twig; plus, *-osus*, *-ose*) producing slender prostrate branches or runners.
Scabrid - a. (L. *scabridus*, rough) slightly roughened.
Scabrous - a. (L. *scabrosus*, rough) with small points or knobs, like a file; scaly, scabby, rough.
Scandent - adj. (L. *scandent-*, *scandens*, pres. part. of *scandere*, to climb - more at scan) climbing plant of a creeping or scandent nature.
Scape - n. (L. *scapus*, the shaft of a pillar, the stalk of a plant) a stem growing from the crown of the root, bearing the blossom without leaves.
Scapose - a. scape-bearing; scapigerous; consisting of a scape.
Scarious - a. (LL. *scariousus*, rough) tough, thin, dry, and semitransparent.
Schizocarp - n. (Gr. *schizein*, to cleave; *karpos*, fruit) a dry fruit, as in the maple, that splits at maturity into two or more one seeded carpels which remain closed.
Sclerenchyma - n. (Gr. *skleros*, hard; *enchyma*, an infusion) tissue of uniformly thick-walled, dead cells in the stem whose principal function is mechanical. The cells are usually grouped into fibers.
Scorpioid - a. (Gr. *skorpois*, scorpion; *eidon*, form) resembling a scorpion; said of a circinnately coiled determinate inflorescence in which the flowers are two-ranked and borne alternately at the right and left.

Secund - a. (L. *secundus*, following) arranged or growing on one side only, as flowers or leaves on a stem.
Seed - n. (AS. *saed*, seed) the part of a flowering plant that contains the embryo and will develop into a new plant if sown; a fertilized and mature ovule.
Sepal - n. (Fr. *sepale*; L. *separatus*, separate; *pelatum*, petal) any of the leaf divisions of the calyx. When a calyx consists of but one part, it is said to be monosepalous; when of two parts, it is said to be disepalous; when of a variable and indefinite number of parts, it is said to be polysepalous; and when the parts are more or less united, it is said to be gamosepalous.
Septate - n. (L. *septatus*, surrounded by a fence) having or divided by a septum or septa.
Septicidal - a. (L. *septum*, division; *caedere*, to cut or divide) dividing through middle of ovary septa; dehiscing or breaking open at a natural dividing line.
Septum - n. (L. *septum*, a partition) a partition separating two cavities or masses of tissue, as in fruits. pl. septa.
Serrate - a. (L. *serrare*, to saw) notched on edge like a saw; having sharp notches along the edge pointing toward the apex; as a serrate leaf. When a serrate leaf has small serratures upon the large ones, it is said to be double serrate, as in the elm. A serrate-ciliate leaf is one having fine hairs, like eyelashes, on the serratures. A serrate-dentate leaf has the serratures toothed.
Sessile - a. (L. *sedere*, to sit) sitting directly on base without support, stalk, pedicel, or peduncle; attached or stationary as opposed to free living or motile. A leaf that is directly attached to the plant stem with no petiole.
Seta - n. (L. *seta*, bristle) a bristle-like structure.
Setaceous - a. (L. *seta*, a bristle) bristly; set with bristles; consisting or having bristles.
Shaft - Flower-bearing stalk.
Sheath - n. (AS. *sceth*, shell or pod) a protective covering; lower part of leaf enveloping stem or culm.
Shoot - n. (ME. *schoten*, to shoot, dart) a young branch which shoots out from the main stock.
Short-day plant - a plant requiring less than 12 hours of daylight in order for flowering to occur.
Silique - n. (L. *siliqua*, a pod) the long, narrow pod of plants of the mustard family, Cruciferae, with valves which fall away from a frame bearing the seeds.
Sinuate - a. (L. *sinuare*, to bend) having a wavy margin, as some leaves.
Sinus - n. (L. a bent surface, a curve, a fold or hollow, bosom, a bay) the rounded depression between two consecutive lobes. as of a leaf. pl. sinuses, sinus.
Slough - n. (AS. *sloh*, a slough) a wet place of deep mud or mire; a sluggish channel; a swamp, bog, or marsh, especially one that is part of an inlet or backwater.
Spadix - n. (L. *spadix*, a palm branch) a racemose inflorescence with elongated axis, sessile flowers, and an enveloping spathe; a succulent spike; a fleshy spike of flowers, usually enclosed in a spathe.
Spathaceous - a., having a spathe, or having the nature of a spathe.
Spathe - Modified leaf surrounding the flower .
Spathe - n. (Gr. *spathe*, flat blade) a large leaflike part or pair of such enclosing a flower cluster (especially a spadix).
Spatulate - a., shaped like a spatula or spoon, gradually widening distally and with a rounded tip, as some leaves.
Species - n. (L. *species*, particular kind) a group of interbreeding individuals, not interbreeding with another such group, being a taxonomic unit including two names in binomial nomenclature, the generic name and specific epithet, similar and related species being grouped into a genus.
Spermatophyta - n. (Gr. *sperma*, seed; *phyton*, plant) a major division of the plant kingdom, characterized by reproducing by seed and subdivided into the Gymnospermae and Angiospermae.
Spicate - a. (L. *spicatus*, pp. of *spicare*, to furnish with spikes) having the form of a spike.
Spicule - n. (L. *spicula*, a small spike) a small, slender, sharp-pointed piece, usually on a surface; a small spike of flowers.
Spike - n. (L. *spica*, spike, ear of corn) a long flower cluster attached directly to the stalk. A group of flowers arranged closely at the end of a shaft, and attached directly to the shaft.
Spikelet - n., a small spike of a large one; a subdivision of a spike; as the spikelets of grasses.

Spine - n. (ME, *thorn*, spinal column, fr. L. *spinsa*, thorn, spine, spinal column) a stiff sharp-pointed plant process as a modified leaf, leaf part, petiole, or stipule.
Sporangium - The reproductive organ of primitive plants like ferns and mosses.
Spore - n. (Gr. *sporos*, seed) any of various small reproductive bodies, often consisting of a single cell, produced by mosses, ferns, etc. asexually (asexual spore) or by the union of gametes (sexual spores); they are highly resistant and are capable of giving rise to a new adult individual, either immediately or after an interval of dormancy.
Sporophyte - n. (Gr. *sporo*, a seed; *phyton*, plant) the diploid spore-producing phase in plants with alternation of generations.
Spur - n. (AS. *spura*, *spora*, a spur) a slender, tubelike structure formed by an extension of one or more petals or sepals; also refers to a very short branch with closely spaced leaves.
Stalk - n. (probably from Dan. *stilk*; Sw. *stjelk*; Icel. *stilker*, a stalk) the stem or main axis of a plant, which supports the leaves, flowers, and fruit. Any lengthened support on which an organ grows, as the petiole of a leaf or the peduncle of a flower.
Stamen - n. (L. *stare*, to stand) the male reproductive organs in flowers; it is situated immediately within the petals, and is composed, in most cases, of two parts, the filament, and the anther, which is filled with pollen.
Staminate - a., producing or consisting of stamens; flowers with stamens but not pistils.
Staminodium - n. (L. *stamen*, a thread, and Gr. *eidos*, form) a sterile stamen or an organ resembling one.
Standing crop - weight or organic material that can be sampled or harvested at any one time from a given area, but may not necessarily include the entire plant. Usually refers to normal harvesting procedures, unless specified, for the particular plant under consideration.
Stellate - a. (L. *stella*, star) starlike; said of hairs that branch in such a manner as to radiate from a central point.
Stem - n. (AS. *stemm*, tree stem) main axis of a plant typically above the soil surface, having leaves or scales, and a characteristic arrangement of the vascular tissue.
Stem tuber - swollen structures produced by stolons and runners which remain dormant during adverse conditions and later grow into new plants when the conditions become favorable for growth.
Stigma - n. (Gr. *stizein* to prick) the upper tip or part of the pistil of a flower receiving the pollen. It is generally situated at the upper extremity of the style.
Stipe - n. (L. *stipes*, stalk) the stalk-like basal part of an ovary, or of a fruit such as an achene; the stem bearing pileus in mushrooms and toadstools.
Stipel - n., a small secondary stipule at the base of a leaflet.
Stipule - n. (L. *stipula*, a stalk, a straw) one of two foliaceous or membranaceous processes developed at base of a leaf petiole, sometimes in tendril or spine form, sometimes fused.
Stolon - n. (L. *stole*, *stolonis*, a twig, shoot) a stem which grows from a stem above the ground, taking root at the tip, and ultimately developing a new plant.
Stoma - n. (NL. fr. Gr. mouth - more at stomach) one of the minute openings in the epidermis of leaves, stems, and other plant organs through which gaseous interchange between the atmosphere and the intercellular spaces within these structures occur; the opening together with its associated guard cells and accessory cells. pl. stomata.
Stramineus - a. (L. *stramen*, straw) of or like straw; straw-colored.
Striated - a. (L. *striatus*, grooved) marked by narrow lines or grooves, usually parallel.
Strigose - a. (L. *striga*, a furrow) covered with stiff hairs; ridged; marked by small furrows; surface clothed with stiff, often appressed hairs, these usually pointing in one direction.
Style - n. (Gr. *stylos*, pillar; L. *stylus*, pricker) slender upper part of pistil, supporting stigma.
Stylopodium - n. (Gr. *stylos*, pillar; *pous*, foot) the fleshy support at the base of the style in flowers of the carrot family, Umbelliferae.
Submerge - vt. (L. *submergere*, to dip or plunge under) to sink or plunge beneath the surface of water.
Submersed - Growing completely underwater.
Submersed plants - plants growing with their root, stems, and leaves completely under the surface of the water.
Suborbicular - adj. (L. *sub*, under, below; *orbis*, circle) approximately circular.

Subulate - a. (L. *subula*, an awl) awl-shaped; slender and tapering gradually to a fine point.
Succulent - n. (L. *succus*, juice) juicy; full of juice or sap.
Suffruticulose - a. (L. *sub*, under, below; *frutex*, a shrub) moderately frutescent; obscurely shrubby; usually woody only basally.
Sulcate - a. (L. *sulcus*, a furrow) furrowed, grooved; scored with deep, parallel furrows or grooves.
Suture - n. (L. *suere*, to sew) a seam formed when two parts unite; a seam or line or groove; usually applied to the line along which a fruit dehisces; any lengthwise groove that forms a junction between two parts.
Swale - n. (Sw. *sval*, cool) a hollow or depression, especially one in wet, marshy ground.
Swamp - n. (Sw. *svampig*, swampy) spongy land; low ground filled with water; a wooded area having surface water much of the time.
Sympodial - a. (Gr. *syn*, with; *pous*, foot) branching, growth of axillary shoots when apical budding has ceased.
Syncarp - n. (Gr. *syn*, together; *karpos*, fruit) a multiple or aggregate fruit derived from numerous separate ovaries of a single flower; a collective unit, as a blackberry.
Syntepalous - flowers in which the sepals are fused.
Taenia - n. (Gr. *tainia*, a ribbon or tape) formation of ribbon-like structure with little or no differentiation between the leaf blade and stem.
Tannins - n. (L. *tannum*, oak bark) complex aromatic compounds some of which are glucosides, possibly giving protection or concerned with pigment formation.
Taxon - n. (Gr. *taxis*, arrangement) a taxonomic category or unit, as a species or genus.
Taxonomy - n. (Gr. *taxis*, arrangement; *nomos*, law) a science that includes identification, nomenclature, and classification of objects, and is usually restricted to objects of biological origin; orderly classification of plants according to their presumed natural relationships forming a basic biological discipline involving during its Linnean period the firm establishment of binomial nomenclature and acceptance of the static concept of fixity of the species, during its Darwinian period the dynamic concept of speciation by natural selection, and during its modern Mendelian epoch an expansion to include study of the mechanisms underlying speciation and related processes.
Tendril - n. (O.Fr. *tendrillon*, tender sprig) a slender twining or clasping process, modified stem, leaf, or part of a leaf, by which some plants climb.
Tepal - n. (Fr. *tepale*, from petale) denoting a unit of the perianth when the sepals and petals are essentially alike and not readily differentiated.
Terete - a. (L. *teres*, round, smooth) nearly cylindrical in cross-section, as stems.
Ternate - a. (L. *terni*, three each) growing in groups of threes, as some leaves.
Testa - n. (L. *testa*, shell) the hard outer covering or integument of seed.
Thalloid - a., of or resembling a thallus.
Thallophyta - n. pl. (Gr. *thallos*, a young shoot; *phyton*, a plant) a primary division of plants including all forms consisting of one cell and cell aggregates not clearly differentiated into root, stem, and leaf, including bacteria, algae, fungi, and lichens.
Thallus - n. (Gr. *thallos*, a young shoot) a plant body that lacks differentiation into distinct forms of stems, leaves, roots, and does not grow from an apical point.
Therophytes - n. (Gr. *theros*, summer; *phyton*, a plant) an annual plant that overwinters as a seed.
Thorn - n. (ME., fr. OE.; akin to OHG. *dorn*, thorn, ON. *thorn*, Goth. *thaurnus*, thorn, Skt. *trna*, grass, blade of grass) a sharp rigid process on a plant; specif., a short, indurated, sharp-pointed, and leafless branch developed from a bud in a manner typical to a leafy branch.
Throat - n. (Gr. *drossel*, the gullet) term applied to an expanded part of a corolla tube just below the lobes.
Thyrseus - n. (Gr. *thyrsos*, wand) a panicle-like inflorescence consisting of a slender indeterminate main axis with lateral axes determinate, i.e., cymose.
Tiller - n. (OE. *telgor*, *telgra*, branch, twig, shoot) sprout, stalk, especially one from the base of a plant or from the axils of its lower leaves.

Tissue culture - The production of new plants from small amounts of plant tissue under carefully controlled laboratory conditions. The use of specialized methods to mass produce plants starting with small amounts of plant tissue.
Tomentose - a. (L. *tomentum*, down) densely covered with short, matted hair.
Tracheophyta - n. (LL. *trachia*, windpipe; and Gr. *phyton*, plant) a division of plants comprising green plants with a vascular system that contains tracheids or tracheary elements, being the Pteridophyta and Spermatophyta, commonly called vascular plants.
Trichome - n. (Gr. *trichoma*, a growth of hair) an outgrowth of the plant epidermis, either hairs or scales; a hair tuft; any hairlike outgrowth of the epidermis.
Trigonal - a. (Gr. *trigonos*, triangular) triangular in cross-section as applied to stems.
Trigonous - a., trigonal; having three prominent longitudinal angles, as a style or ovary.
Trimerous - a. (Gr. *tria*, three; *meros*, part) composed of three or multiples of three.
Triploid - n. (Gr. *triplus*, triple) having or being a chromosome number three times the monoploid number.
Triquetrous - a. (L. *triquetrus*, three-cornered) triangular; having a triangular cross section.
Tristichous - a. (Gr. *tria*, three; *stichos*, row) arranged in three vertical rows.
Truncate - a. (L. *truncatus*, cut off) terminating abruptly, as if tapering end were cut off; cut squarely across, either at the base or apex of an organ.
Trunk - n. (OFr. *trone*; fr. L. *truncus*, a trunk, stock, stem) the main stem or body of a tree, considered apart from its roots and branches.
Tuber - n. (L. *tuber*, a swelling or knob on plants) the short, thickened fleshy food-storing portion of an underground stem with many surface buds, generally shaped like a rounded protuberance. A swelling of root or underground stalk that functions as a storage organ as in a potato.
Tubercle - n. (L. *tuberculum*, a swelling) a small rounded protuberance; root swelling or nodule; bubil; a surficial nodule; a thickened, solid, spongy crown or cap, as on an achene; a small tuber or tuberlike growth.
Turbinate - a. (L. *turbinatus*, whirl, rotation) inversely conical; shaped like a cone resting on its apex.
Turion - n. (L. *turio*, shoot) young scaly shoot budded off from underground stems, detachable winter bud used for perennation in many aquatic plants.
Twig - n. (AS. *twigge*, twig) a small shoot or branch of a tree or other plant.
Umbel - n. (L. *umbella*, dim. of *umbra* shadel) an arrangement of flowers springing from a common center and forming a flat or rounded cluster.
Umbellate - a., bearing umbels; consisting of umbels; forming an umbel or umbels.
Unisexual - a. (L. *unus*, one; *sexus*, sex) of one or other sex, staminate or pistillate only, but not both.
Urceolate - a. (L. *urceolus*, a pitcher) shaped like a pitcher or urn.
Utricle - n. (L. *utriculus*, a little bag or bottle) an air bladder of aquatic plants; membranous indehiscent 1-celled fruit.
Valvate - adj. (NL. *valvatus*, fr. L., having folding doors) meeting at the edges without overlapping; opening as if by doors or valves.
Variety - n. (L. *varietas*, variety) a taxonomic group below the species used in different senses by different specialists, including a race, stock, strain, breed, subspecies, geographical race, or mutant.
Vascular bundle - a group of specialized cells consisting of xylem and phloem, sometimes separated by a strip of cambium and arranged in different patterns.
Vascular cambium - lateral meristem that forms the secondary tissue and is located between the xylem and phloem.
Vegetative cone - Growing tip of the plant. On a stem plant, it is the tip of the stem. On a rosette plant, it arises from the very center of the rosette.
Vegetative reproduction - Reproduction via means other than sexual. Unless a mutation occurs, each generation of new plants is identical to the parent plant genetically.
Velamen - n. (L. *velamen*, covering) a membrane; water-storing tissue in the outer layer of some roots.
Vernal - a. (L. *vernalis*, of the spring) belonging to the spring; appearing or occurring in spring; of the spring season.

Verrucose - a (L. *verrucosus*, full of warts, warty) warty; having little warts or wartlike growth on the surface.
Versatile - a. (L. *versatillis*, turning around) turning freely on its support, as an anther attached near the middle and capable of swinging freely on the filament.
Verticil - n. (L. *verticillus*, whorl) an arrangement of leaves, flowers, inflorescences, or other structures which surround the stem in a circle upon the same plane about the same point on the axis.
Verticillate - a. (L. *verticillus*, whorl) growing in a whorl or arranged on the same plane around an axis, as flowers, leaves, branches, etc.; arranged in verticils, whorled.
Vesicle - a. (L. *vesicula*, bladder) any small bladderlike structure, cavity, sac, or cyst; a small bladderlike sac filled with air.
Vestiture - n. (L. *vestitus*, grament) that which covers a surface, as hairs, scales, etc.
Villous - n. (L. *villosus*, hairy) pubescent; shaggy; covered with fine long hairs, but the hairs not matted.
Viscid - a. (L. *viscum*, bird lime) thick, syrupy, and sticky; viscous; covered with a viscid substance as of leaves.
Viviparous - a. (L. *vivus*, alive; *parere*, to produce) producing young alive rather than in eggs, as in most mammals; multiplying by vegetative means such as buds or bulbils in the position of flowers.
Wet weight - same as fresh weight; weight of plants after the outer surface covering of water has been removed. Wet weight is not a reliable measurement since methods to prepare plants prior to weighing vary considerably.
Wet woodland - a wooded area having surface water some of the time, for intermittent short periods.
Whorl - n. (AS. *hweorfan*, to turn) circle of flowers, parts of a flower, or leaves arising from one point; verticil.
Whorled - a., when three or more leaves are arranged at the same level on a stem, typical of such plants as hydrilla.
Woody - a. (ME. *woddy*, *wody*, fr. *wode*, wood + -y) of or containing wood or wood fibers; consisting mainly of hard lignified tissues.
Xeric - a. (Gr. *xeros*, dry) characterized by a scanty supply of moisture, tolerating, or adapted to, arid conditions.
Xylem - n. (Gr. *xylon*, wood) woody tissue that is part of the water-transporting system in plants, consisting of lignified tracheids or vessels, and which also acts as a supporting tissue.
Yield - n. (AS. *glidan*, to pay, restore, give up) standing crop expressed as a rate, i.e., g dry weight per meter square per day.
Zygomorphic - a. (Gr. *zygon*, yoke; *morphe*, shape) said of the corolla or calyx when divisible into equal halves in one plane only bilaterally symmetrical, with only one plane of symmetry.

Hemlock

Dandelion

References

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