Managing Weeds in Lawn, Turf, and Ornamentals

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How do you define weeds? Are they “plants out of place” or “plants whose virtues have not yet been discovered?” Would you use more serious descriptive terms in your definition, such as poisonous, injurious, harmful, hard to manage, or even pernicious? Consider this definition, which describes what weeds do best—interfere:

“A weed is any plant that interferes with the management objective(s) for a particular site or situation.”

When it comes to urban turf and ornamental situations, it usually is the homeowner who identifies the management objectives. These objectives may be based upon such things as whether the plants have spines associated with them, appearance in the lawn, or the competitive nature of the species. To one homeowner, a single dandelion in the front yard may be one too many, whereas a neighbor may feel comfortable with a lawn full of the bright, yellow flower. The level of weed management depends, in part, on the management objectives for each property.

In a newsletter article about weeds, Steve Dewey, a weed scientist at Utah State University, presented characteristics of what he considered to be one of our greatest environmental pollutants—weeds. The following is a partial list, with additional comments added:

- The pollutant often appears attractive, desirable, or harmless.
- The pollutant can be toxic, painful, or otherwise injurious to humans.
- The pollutant multiplies itself, and does so exponentially.
- The pollutant spreads naturally in water, wind, or soil.
- The pollutant also is spread by homeowners, landscape managers, and anyone who operates a mower.
- Effects of the pollutant usually are not apparent until the spread is already out of control.
- The pollutant lies dormant and undetected underground for decades, then reappears and spreads.

In the book, *The World’s Worst Weeds*, the weed spe-

Table 1. New Mexico turf and ornamentals.

Common Name	Scientific Name	Comments
1. Purple Nutsedge	*Cyperus rotundus*	Southern half
2. Bermudagrass	*Cynodon dactylon*	Statewide
3. Barnyardgrass	*Echinochloa crus-galli*	Statewide
4. Junglerice	*Echinochloa colona*	Statewide
5. Goosegrass	*Eleusine indica*	Statewide
6. Johnsongrass	*Sorghum halepense*	Not in turf
7. Cogongrass	*Imperata cylindrica*	Not known in state
8. Water Hyacinth	*Eichhornia crassipes*	Not known in state
9. Common Purslane	*Portulaca oleracea*	Statewide
10. Common Lambsquarters	*Chenopodium album*	Statewide
11. Large Crabgrass	*Digitaria sanguinalis*	Statewide
12. Field Bindweed	*Convolvulus arvensis*	Statewide
13. Wild Oats	*Avena fatua*	Not in turf
14. Smooth Pigweed	*Amaranthus hybridus*	Statewide
15. Spiny Pigweed	*Amaranthus spinosus*	Not known in state
16. Yellow Nutsedge	*Cyperus esculentus*	Statewide

cies listed in table 1 are ranked based on their impact throughout the world. It is of interest to note which ones are found in the lawns, turf, and ornamental areas in the state.

Characteristics of Weeds

Weedy plants have characteristics that make them competitive, persistent, and pernicious.

A. Number of seeds per plant. Weeds produce large numbers of seeds.

Examples:

• Prostrate knotweed	6,380 seeds
• Barnyardgrass	7,000 seeds
• Prostrate spurge	14,100 seeds
• Common purslane	52,000 seeds
• Common lambsquarters	72,000 seeds
• Redroot pigweed	117,000 seeds
• Russian thistle	200,000 seeds

B. Dormancy. Dormancy is the ability of the seeds to remain viable in the soil for a long time.

Examples:

• Johnsongrass	20 years
• Field bindweed	20+ years
• Common lambsquarters	40 years
• Redroot pigweed	40 years

C. Special adaptation or appendages. Plants have developed means to assist in their spread and distribution.

Examples:

• Hooks and spines	Sandbur and puncturevine
• Pappus (parachutes)	Dandelion and climbing milkweed
• Good looks	Dalmatian toadflax and purple loosestrife

D. Vegetative reproductive capabilities. Some asexual parts of the plant allow new plants to arise without the fertilization of the flower.

Examples:

• Roots with adventitious buds	Field bindweed
• Rhizomes	Johnsongrass and bermudagrass
• Tubers	Yellow and purple nutsedge
• Crowns	Dandelions
• Stolons	Bermudagrass

Classification and Identification of Weeds

Accurately identifying weeds is the first step in an effective weed management program. Major plant groups are designated according to the structural characteristics common to all plants in each group. Weeds of grass, turf, and ornamental situations are usually characterized into three major groups: grasses, broadleaves, and sedges (fig 1).

- **Grasses** have a single embryonic leaf (monocotyledon), a fibrous root system, and parallel veins.

- **Broadleaves** have two embryonic leaves (dicotyledons), a taproot system, and netted venation.

- **Sedges** differ from grasses in that they have triangular-shaped stems rather than round or oval ones, and the leaves extend in three directions.

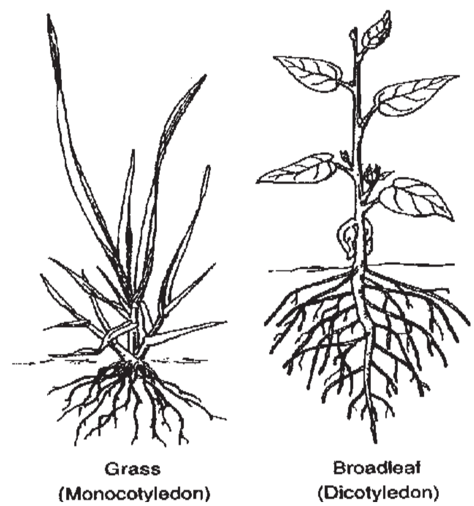


Figure 1. Difference between grass and broad-

Another type of weed classification is based on the plant life cycle. There are certain times when the plant is vulnerable to control strategies. The effectiveness of a weed management plan often depends on targeting certain plant growth stages which begins with seed germination, followed by vegetative growth, flowering, and seed maturation. Life cycle classification of weeds is broken down into, annuals, biennials, and perennials.

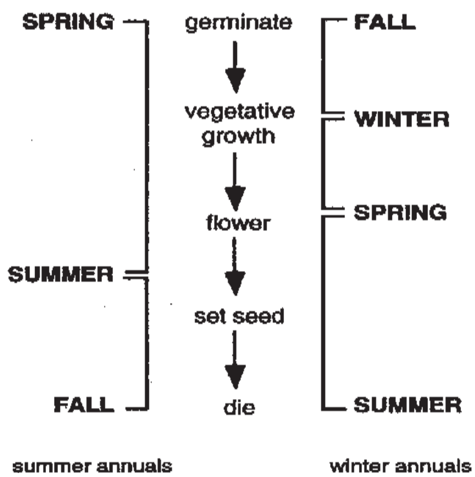


Figure 2. Life cycle comparisons.

Annual Weeds

Annual weeds complete their life cycle in less than one calendar year. Normally annuals are the easiest to manage. This group of plants have been further divided according to their time of germination (fig 2).

- **Winter annuals** germinate in the fall, then mature and set see the following spring.

Grass examples:
- Annual bluegrass
- Downy brome
- Rescuegrass
- Wall or little barley

Broadleaf examples:
- Black medic
- Henbit
- Redstem filaree
- Mustards:
  - Flixweed
  - London rocket
  - Shepherdspurse
  - Tansymustard

- **Summer annuals** germinate in the spring, mature and set seed in the same year.

Grass examples:
- Barnyardgrass
- Crabgrass—hairy and smooth
- Foxtail—green and yellow
- Goosegrass
- Sandbur
- Southwestern cupgrass
- Stinkgrass or lovegrass

Broadleaf examples:
- Climbing milkweed
- Clover
- Common chickweed
- Common lambsquarters
- Common purslane
- Kochia
- Pigweed species
- Prostrate knotweed
- Prostrate spurge
- Puncturevine
- Russian thistle
- Speedwell species
- Yellow woodsorrel

Tips for managing annual weeds:

- Annual weeds only spread and reproduce by forming and dispersing seed. This makes for a simple management principle: Don't let them set seed.

- Any management plan must deal with multiple germinations, because these weeds will germinate in the soil whenever the conditions favor the process. Once you have managed the first flush of annual weeds (through cultivation or other methods), another group of seeds will be waiting in the wings for their chance to germinate.

Biennial Weeds

Biennial weeds take two years to complete their life cycle, or they live two years. The most common biennial weed of lawn, turf, and ornamental situations is common mallow. The management principle is the same as for annual weeds because their only means of spread and reproduction is through seed.

Perennial Weeds

Perennial weeds live more than two years. Some may live almost indefinitely, resprouting from vegetative plant parts. Because of these persistent, resprouting roots, rhizomes, stolons, tubers, and plant fragments, perennials spread rapidly and are difficult to manage. Most perennials die back to the ground during winter, then resume growth from buds on the rootstock the following spring. To avoid these problem weeds, do not let perennial seedlings become established. Managing these weeds requires not only stopping their seed production, but also stopping vegetative reproduction under the soil (or above the soil in the case of the stolon). Perennial weeds have been subdivided into two groups according to root system.

- **Simple perennials** resprout from crown buds on the taproot and spread by seed. The roots usually are fleshy and there is no underground lateral branching.

Broadleaf examples:
- Dandelion
- Plantain

- **Creeping perennials** reproduce by creeping roots, creeping aboveground stems (stolons), creeping underground stems (rhizomes), or tubers.

Grass examples:
- Bermudagrass
- Johnsongrass

Sedge examples:
- Purple nutsedge
- Yellow nutsedge

Broadleaf examples:
- Creeping Woodsorrel
- Creeping chaffweed or khakiweed
- Field bindweed
- Mouse-ear chickweed
- Silverleaf nightshade

We need to remember that the first step toward developing an effective weed management plan is to correctly identify the weeds in question. Understanding the weed's biology and its growth habits will help you decide whether the weed needs to be controlled and how it can be managed. Determine why the weed successfully invaded the lawn, turf, or landscape.

Weed Management

Managing weeds involves considering all the available management options, a strategy referred to as Integrated Weed Management (IWM). The following is a working definition for IWM:

"A control strategy in which a variety of biological, chemical, and cultural management options are combined to give stable, long-term weed management at levels outlined in the management plan."

Homeowners determine the management objectives for their property. They identify how much interference they will allow the weeds to exhibit. The injury could be weed competition with desirable plants, death of desirable plants, or a less than pleasing appearance to the landscape.

The following areas of weed management will be discussed—preventive, biological, cultural, mechanical, and chemical.

Preventive weed management involves keeping the weeds out from the very beginning. It requires homeowners be actively involved in recognizing common weedy species and to want to keep weeds out of their turf situation. There are several ways this can be done, including:

- Plant certified seed. When establishing a turf area using seed rather than sod, make sure the seed is certified weed free.
- Clean along fence rows. Weeds can and do move through and under fences. It's much easier to manage the weeds outside the turf or garden area.
- Clean weeds along ditches. Weeds are not afraid of water and are good swimmers.
- Watch your topsoil. When establishing a landscape that requires adding topsoil, consider where that topsoil comes from. It may be coming from an area that is heavily infested with perennial weeds, which means those vegetative structures may be getting a free ride into your yard. Often we bring in undesirable plants in the soil surrounding trees, shrubs, and other landscape plants.

Biological weed management involves using living organisms to manage other living organisms. Within the lawn, turf, or ornamental arena there are limited biological options available. Geese have been used to eliminate grassy weeds from strawberries and there is a weevil, which was introduced into the state several years ago, to manage puncturevine.

Cultural weed management operates under the theme: Give the turf the competitive edge. Often it is pointed out that, "Weeds are not the cause of poor turf, but rather the result." Taking time to manage the other components of the lawn and turf situations allows the turf to be more competitive. The importance of allowing the turf to become part of the management process cannot be stressed too much. Management principles include:

- Irrigating correctly—timing and amount of water
- Managing the fertility properly—depending upon the turf species, use the proper blend and amount, as well, as applying it at the proper time
- Mow to the correct height—this will very depending upon the turf species
- Managing any potential diseases and insect problems

Managing the turf will go along way toward managing weed problems. Prostrate knotweed is an example of a weed that does well under stressed conditions. The presence of this weed in lawn and turf situations indicates that the overall health of the lawn or turf is in question. Sandbur prefers sandy soils, prostrate spurge does well in areas of poor fertility. These are two additional examples of weeds in turf, which can be used as turf health indicators.

Mechanical weed management is the physical removal of weeds. Any physical removal or displacement of weeds can be classified as mechanical in operation. Cultivation, mowing, hand pulling, and plowing are examples of this type of management. The success of mechanical weed management depends upon the weeds in question. Annual weeds often are effectively managed this way, while the perennial weed problem can be enhanced through the movement of the underground vegetative reproductive structure by cultivation and other mechanical activities.

Chemical weed management is the use of herbicides. When it comes to managing weeds, it is critical that the weeds be correctly identified. Then when developing an effective management plan, care needs to be taken to identify the correct plan for management. It does not take a lot of training to show someone how to correctly use a hoe or how to use a pair of gloves. How much damage can your hoe cause to desirable vegetation? Not too much. But such is not the case when using a herbicide. If the applicator is not trained properly, the herbicide may not be applied properly, the wrong application equipment may be used, or the herbicide may be applied at the wrong time or for the wrong weeds. When herbicides are not used properly, injury to desirable vegetation can occur, which can cause a long-term. Unlike you and your hoe, a herbicide, if used wrong can kill a mature tree.

Principles of Herbicide Use

When considering using a herbicide, the most critical component is the ability to read, understand, and follow the label. When looking at a herbicide label, the homeowner should be able to identify the following pieces of information:

- Company that manufacturers the herbicide.
- Trade name—the name given the product by the manufacturer.
- Common name—the actual name of the active ingredient, or the name of what will kill the weeds in question.
- Inert ingredients—those nonherbicidal compounds found in the container. These are added for the purpose of enhancing the herbicidal activity of the purchased product.
- Application statement—identifies how the herbicide is to be used. It also will identify where the herbicide can be used.
- Signal toxicity wording—based upon the toxicity of the herbicide, a signal word will be placed on the label to provide the user with an idea of the relative toxicity of the herbicide. The following words are used:

• "Danger"	EPA Category I	Highly toxic
• "Warning"	EPA Category II	Moderately toxic
• "Caution"	EPA Category III	Slightly toxic
• "Caution"	EPA Category IV	Very low toxicity

- "Keep Out of the Reach of Children"—statement found on all herbicides.

- EPA Reg. No. is the number given by the Environmental Protection Agency for the herbicide.

- EPA Est. No. is the number that identifies where the herbicide was manufactured.

- Precautionary statements—identify what precautions need to be taken when using the particular herbicide. Statements regarding personal protective equipment requirements are listed here.

- First aid statements—outline what is to be done should this product come in contact with the skin, is swallowed, gets in thee eyes, or is inhaled.

- Storage and disposal—tells the user how to store the herbicide and how to dispose of the empty container.

- Weeds controlled—identifies the weeds controlled if the herbicide is used according to the label. Just because you have weeds does not mean that the herbicide selected will offer effective results. The label identifies those weeds which the product will manage. This also points out the importance of accurate weed identification.

- Timing of application—identifies when the herbicide is to be applied. This is critical since some herbicides should be applied prior to emergence of the weeds (**preemergence**) and others after the weeds have emerged (**postemergence**).

- Turf and ornamental sensitivity—identifies whether the herbicide can be used on your turf or is safe to apply in a flower bed or other ornamental situations.

On subsequent pages of the label (fig. 4), the user will identify the other pieces of information the homeowner needs to know to correctly apply the herbicide.

Using this herbicide as an example, it is recognized that oryzalin can only be applied to warm season turf grass. Any applications to cool season turf will result

Following the sample label (fig. 3), we can identify the various parts of the label:

Trade Name: "Surflan AS"
Common Name: oryzalin
EPA Registration No.: 62719-113
EPA Establishment No.: 37429-GA-01
Application Statement: "A selective preemergence surface-applied herbicide for the control of annual grasses and many broadleaves"
Signal Toxic Word: "Caution"

Precautionary Statements are identified at the beginning of the second column (on this label). Personal protective equipment is identified along with first aid statements.

Specimen Label

DowElanco

Surflan* A.S.

Specialty Herbicide

A selective preemergence surface-applied herbicide for control of annual grasses and many broadleaf weeds in:

- Landscape Ornamentals
- Container Grown Ornamentals
- Field Grown Ornamentals
- Drainage Areas Under Greenhouses Benches
- Ornamental Bulbs
- Ground Covers
- Christmas Tree Plantations
- Noncropland
- Non-bearing Trees and Vines
- Industrial Sites
- Established Warm Season Turf (Including Bahiagrass, Bermudagrass, Buffalograss, Centipedegrass, St. Augustinegrass, Tall Fescue and Zoysiagrass)

Active Ingredient:
oryzalin: 3,5-dinitro-N^4N^4-dipropylsulfanilamide 40.4%
Inert Ingredients 59.6%
Total 100.0%
Contains 4.0 pounds of active ingredient per gallon.

EPA Registration. No. 62719-113
EPA Est. 37429-GA-01

Precautionary Statements

Hazards to Humans and Domestic Animals

CAUTION PRECAUCION:

Si usted no entiende la etiqueta, 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.)

Causes Eye Irritation - Harmful If Swallowed, Inhaled Or Absorbed Through The Skin

Avoid contact with skin, eyes or clothing. Avoid breathing spray mist. Surflan A.S. may cause skin sensitization reactions in certain individuals.

Personal Protective Equipment (PPE)

Applicators and other handlers must wear:

- Long-sleeved shirt and long pants
- Waterproof gloves
- Shoes plus socks
- Protective eyewear

Follow manufacturer's instructions for cleaning/maintaining PPE. If no such instructions for washables, use detergent and hot water. Keep and wash PPE separately from other laundry.

User Safety Recommendations

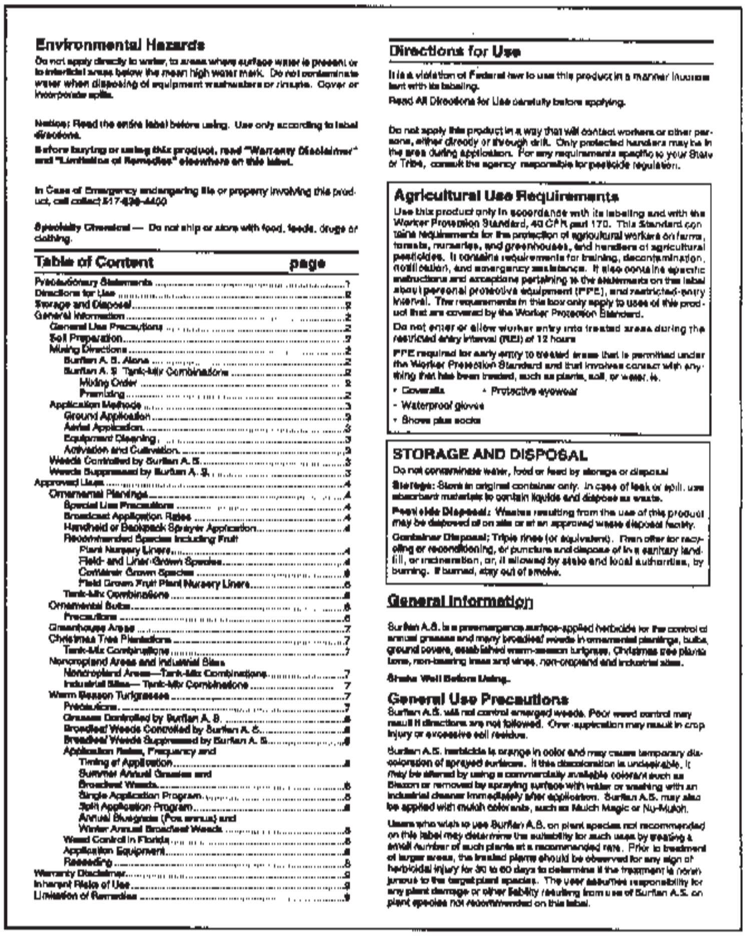
Users should:

- Wash hands before eating, drinking, chewing gum, using tobacco or using the toilet.
- Remove clothing immediately if pesticide gets inside. Then wash thoroughly and put on clean clothing.

First Aid

If in eyes: Flush with plenty of water. Get medical attention if irritation develops.
If on skin: Wash with plenty of soap and water. Get medical attention if irritation develops.
If swallowed: Do not induce vomiting. Call a physician or Poison Control Center. If available, administer activated charcoal (6-8 heaping teaspoonfuls) with a large quantity of water. Do not give anything by mouth to an unconscious person. Immediately transport to a medical care facility and see a physician.
If inhaled: Remove individual to fresh air. Get medical attention if breathing difficulty occurs. If not breathing, give artificial respiration, preferably cardiopulmonary resuscitation and get medical attention immediately.

Figure 3. Sample herbicide label.



Environmental Hazards

Do not apply directly to water, to areas where surface water is present or to intertidal areas below the mean high water mark. Do not contaminate water when disposing of equipment washwaters or rinsate. Cover or incorporate spills.

Notice: Read the entire label before using. Use only according to label directions.

Before buying or using this product, read "Warranty Disclaimer" and "Limitation of Remedies" elsewhere on this label.

In Case of Emergency endangering life or property involving this product, call collect 517-636-4400

Speciality Chemical — Do not ship or store with food, feeds, drugs or clothing.

Table of Content page

Directions for Use

It is a violation of Federal law to use this product in a manner inconsistent with its labeling.

Read All Directions for Use carefully before applying.

Do not apply this product in a way that will contact workers or other persons, either directly or through drift. Only protected handlers may be in the area during application. For any requirements specific to your State or Tribe, consult the agency responsible for pesticide regulation.

Agricultural Use Requirements

Use this product only in accordance with its labeling and with the Worker Protection Standard, 40 CFR part 170. This Standard contains requirements for the protection of agricultural workers on farms, forests, nurseries, and greenhouses, and handlers of agricultural pesticides. It contains requirements for training, decontamination, notification, and emergency assistance. It also contains specific instructions and exceptions pertaining to the statements on this label about personal protective equipment (PPE), and restricted-entry interval. The requirements in this box only apply to uses of this product that are covered by the Worker Protection Standard.

Do not enter or allow worker entry into treated areas during the restricted entry interval (REI) of 12 hours

PPE required for early entry to treated areas that is permitted under the Worker Protection Standard and that involves contact with anything that has been treated, such as plants, soil, or water, is:

- Coveralls
- Protective eyewear
- Waterproof gloves
- Shoes plus socks

STORAGE AND DISPOSAL

Do not contaminate water, food or feed by storage or disposal

Storage: Store in original container only. In case of leak or spill, use absorbent materials to contain liquids and dispose as waste.

Pesticide Disposal: Wastes resulting from the use of this product may be disposed of on site or at an approved waste disposal facility.

Container Disposal: Triple rinse (or equivalent). Then offer for recycling or reconditioning, or puncture and dispose of in a sanitary landfill, or incineration, or, if allowed by state and local authorities, by burning. If burned, stay out of smoke.

General Information

Surflan A.S. is a preemergence surface-applied herbicide for the control of annual grasses and many broadleaf weeds in ornamental plantings, bulbs, ground covers, established warm-season turfgrass, Christmas tree plantations, non-bearing trees and vines, non-cropland and industrial sites.

Shake Well Before Using.

General Use Precautions

Surflan A.S. will not control emerged weeds. Poor weed control may result if directions are not followed. Over-application may result in crop injury or excessive soil residue.

Surflan A.S. herbicide is orange in color and may cause temporary discoloration of sprayed surfaces. If this discoloration is undesirable, it may be altered by using a commercially available colorant such as Blazon or removed by spraying surface with water or washing with an industrial cleaner immediately after application. Surflan A.S. may also be applied with mulch colorants, such as Mulch Magic or Nu-Mulch.

Users who wish to use Surflan A.S. on plant species not recommended on this label may determine the suitability for such uses by treating a small number of such plants at a recommended rate. Prior to treatment of larger areas, the treated plants should be observed for any sign of herbicidal injury for 30 to 60 days to determine if the treatment is noninjurious to the target plant species. The user assumes responsibility for any plant damage or other liability resulting from use of Surflan A.S. on plant species not recommended on this label.

Figure 4. Subsequent page of a herbicide label.

in injury to the turf. Oryzalin also is labelled for use in ornamentals with the specific ornamental species being identified lon a different part of the label.

Application rates are listed as they apply to the situation, weeds to be controlled, and length of desired management.

Associated with the storage and disposal statement is the question of how to dispose of unused herbicides. This often occurs when a gallon of solution is mixed and only one quart is needed. The best way to eliminate this situation is to not let it occur in the first place. Mix up only what you will be using and use what you mix up. Questions regarding disposal of herbicides, used or unused, need to be directed to the New Mexico Department of Agriculture.

The label is a legal document and is to be followed completely. Any deviation from what the label indicates is a violation of the law. If the label says to mix two tablespoons of herbicide per gallon of water, then that is the amount to be mixed.

Herbicide Classification—Application Timing

There are several ways to classify herbicides, one of which is according to application timing—preemergence and postemergence. **Preemergence** herbicides are applied before the weeds emerge. Some preemergence herbicides are effective only on annual grasses. Others offer activity on annual grasses and broadleaves, while other will only manage annual broadleaves. Preemergence herbicides need to be incorporated into the soil to be effective (fig. 5). Sometimes this incorporation can occur through irrigation or rainfall while other times mechanical incorporation is required in order to get the herbicide in to the activation area. The length of herbicidal activity in the

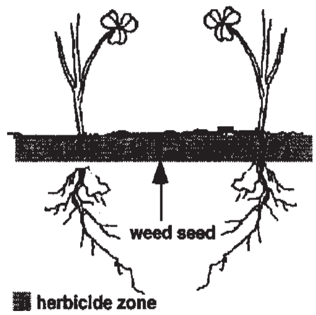


Figure 5. Preemergence herbicide placement.

soil will vary depending upon the herbicide selected, application rates, soil type, and general soil environment. Examples of preemergence herbicides include the following, listed according to their common names:

- benefin
- corn glutamate
- dithiopyr
- isoxaben
- norflurazon
- oxadiazon
- bensulide
- dichlobenil
- ethofumesate
- napropamide
- oryzalin
- pendimethalin

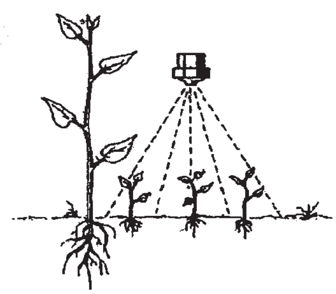


Figure 6. Postemergence application.

- prodiamine
- siduron
- S-metolachlor
- trifluralin

Postemergence herbicides are applied to emerged and actively growing weeds (fig. 6). The label will identify whether the postemergence application to the weeds will be safe, if applied postemergence to the turf or ornamental situation. Some postemergence herbicides offer extended activity in the soil, while others are rendered herbicidally inactive upon contact with the soil. Again, the label provides the necessary information for the correct use. Examples of herbicides having postemergence activity, include the following listed according to common name:

- asulam
- bromoxynil
- 2,4-D
- dicamba
- dithiopyr
- fenoxaprop-P-ethyl
- glufosinate-ammonium
- halosulfuron-methyl
- MCPA
- MSMA
- pelargonic acid
- sethoxydim
- bentazon
- clopyralid
- 2,4-DP
- diquat
- DSMA
- fluazifop-P-butyl
- glyphosate
- imazaquin
- MCPP
- oxyfluorfen
- quinclorac
- triclopy

Herbicide Classification—Physical Characteristics of the Herbicide

Aside from classifying herbicides according to their application timing, there are other ways in which they can be broken down into various groupings. Each group is independent of the other, yet together they provide a picture of activity for the homeowner. Herbicides can be broken down based upon:

- Species selectivity
- Movement within the plant
- Extended activity

Species selectivity refers to whether the herbicide will offer activity on a group of weeds, typically grasses versus broadleaves. **Selective herbicides** manage certain weeds but not others. This selectivity may be as obvious as managing only broadleaves in turf through the application of a selective broadleaf herbicide. Yet, with preemergence herbicides, the selectivity may involve herbicide placement, the growth stage of the weed, orthe specific ornamental growing. In other cases, the selectivity may not be as readily recognized. Pendimethalin, a preemergence herbicide, offers activity on many annual grasses, including crabgrass and foxtails, yet offers limited, if any, activity on sandbur. Examples of selective herbicides are listed, by common name, as follows:

- benefin
- bentazon
- clopyralid
- 2,4-D
- dicamba
- dithiopyr
- ethofumesate
- fluazifop-P-butyl
- bensulide
- bromoxynil
- corn glutamate
- 2,4-DP
- dichlobenil
- DSMA
- fenoxaprop-P-ethyl
- halosulfuron-methyl

- imazaquin
- MCPA
- MSMA
- norflurazon
- oxadiazon
- pendimethalin
- quinclorac
- siduron
- triclopyr
- isoxaben
- MCPP
- napropamide
- oryzalin
- oxyfluorfen
- prodiamine
- S-metolachlor
- sethoxydim
- trifluralin

Nonselective herbicides will effectively manage whatever vegetation they come in contact with. The common names of examples of nonselective herbicides are:

- diquat
- glufosinate-ammonium
- glyphosate
- pelargonic acid

Movement within the plant refers to what happens once the herbicide comes in contact with plant tissue. Certain herbicides move within the plant. These are referred to as **systemic herbicides.** Once absorbed through the foliage or shoots of the plant, they move throughout the plant with the water or sugar transport system. In order for them to work effectively, the weed needs to be growing actively which enhances the movement, of the herbicide, throughout the plant. Herbicides that fit into this group are listed, according to common name, as follows:

- bromoxynil
- 2,4-D
- dicamba
- fenoxaprop-P-ethyl
- glyphosate
- imazaquin
- MCPA
- norflurazon
- quinclorac
- triclopyr
- clopyralid
- 2,4-DP
- dithiopyr
- fluazifop-P-butyl
- halosulfuron-methyl
- isoxaben
- MCPP
- oxyfluorfen
- sethoxydim

Herbicides that have little movement within the plant are referred to as nonsystemic herbicides because they have little or no movement within the plant. Those postemergence herbicides which have limited movement in the plant also are referred to as “contact” herbicides because their mechanism of activity is so fast that the plant cannot translocate the herbicide within its system. Herbicides that fit into this group have the following common names:

- Benefin
- bentazon
- dichlobenil
- DSMA
- glufosinate-ammonium
- napropamide
- oxadiazon\
- pendimethalin
- S-metolachlor
- trifluralin
- bensulide
- corn glutamate
- diquat
- ethofumesate
- MSMA
- oryzalin
- pelargonic acid
- prodiamine
- siduron

A final means of classification focuses on the herbicide’s ability to offer extended activity in the soil. Herbicides vary in their soil herbicidal activity because of several factors, including:

- Amount of the herbicide applied
- The particular formulation used
- When it is applied
- Where it is applied
- The soil environment conditions, which influence rate and breakdown method

When improperly used, certain herbicides can injure desirable plants as a result of root uptake by flowers, shrubs, or trees. It is important to note the ability to persist in the soil is desirable when using a preemergence herbicide. Therefore, just because an herbicide has persistent activity (residual activity) does not mean that injury is always going to be evident. For example, oryzalin is a preemergence warm season turf herbicide which offers excellent activity on annual grasses and broadleaves. The length of residual herbicidal activity depends upon the amount applied. Depending on the amount, six to eight months of weed-free turf can be achieved with this herbicide. The label also indicates that oryzalin can be applied under trees and shrubs without any injury. But when prometon, another herbicide that offers extended annual grass and broadleaf management comes in contact with the roots of desirable vegetation, injury results.

Both oryzalin and prometon are residual herbicides, but one has the potential to injure trees and the other does not— why? They have different physiological properties, so they perform differently once they come in contact with plants, either weeds or desirable vegetation. Oryzalin is nonsystemic (it will not translocate). Its mechanism of activity is associated with cell division in germinating seeds. Prometon, on the other hand, is systemic and moves with the water transport system in the plant. Its mechanism of activity is associated with photosynthesis not cell division. As a result of these two properties, one of these residual herbicides is not registered for use around trees, unless you want to kill them, and the other one is.

Such information about the different herbicidal characteristics is taken into consideration when labels are developed. Herbicides that have no systemic activity and influence cell division of germinating seeds will not be labelled for postemergence application. Labels include any necessary precautions associated with those herbicides that have the potential to damage desirable vegetation.

Examples of residual herbicides that probably won't damage desirable plants are listed, according to common name, as follows:

- benefin
- corn glutamate
- dithiopyr
- isoxaben
- norflurazon
- oxadiazon
- prodiamine
- siduron
- bensulide
- dichlobenil
- ethofumesate
- napropamide
- oryzalin
- pendimethalin
- S-metolachlor
- trifluralin

Examples of residual herbicides that when used in the wrong place could damage desirable plants are listed, by common name, as follows:

- bromacil
- imazapyr
- diuron
- prometon

If a herbicide has no soil activity, it is referred to as a nonresidual herbicide. Factors that render the herbicide nonresidual usually involve the chemical properties of the herbicide and the soil characteristics. Herbicides that have no herbicidal activity in the soil are listed, by common name, as follows:

- bentazon
- diquat
- fenoxaprop-P-ethyl
- glufosinate-ammonium
- MSMA
- sethoxydim
- bromoxynil
- DSMA
- fluazifop-P-butyl
- glyphosate
- pelargonic acid

Table. 2 is a summary of selected herbicides used in turf and ornamental situations.

Herbicides and Environment—Plant Interactions

For a herbicide to work in the plant, a couple of requirements have to be met. First, the herbicide has to come in contact with the plant. This is not as critical with postemergence as with preemergence herbicides. Preemergence herbicides are applied with the understanding that they will be moved into the soil prior to germination of the weed species. Often the material is applied and left on top of the soil. Though the label may indicate that it will remain in its herbicidally active form for a couple of weeks, the weeds may not wait and may germinate before the active ingredient is moved into the soil where the weeds are germinating. Regarding postemergence applications, the applicator plays a critical role in making sure the herbicide comes in contact with the plant through the proper use of the herbicide sprayer. Plant characteristics also impact whether the herbicide will be absorbed through the leaf into the plant.

- **Plant age.** Young, actively growing weeds are more susceptible to control than are established, more mature plants. Also, older leaves exhibit a slower translocation rate than younger leaves, which will decreases the movement from the herbicide uptake site to the herbicidal activity site.

- **Leaf shape.** Broad leaves retain more herbicide than narrow leaves.

- **Leaf surface makeup.** Leaf surfaces have cuticular waxes on them. This waxy layer keeps water in the plant and the herbicide, in the water carrier, on

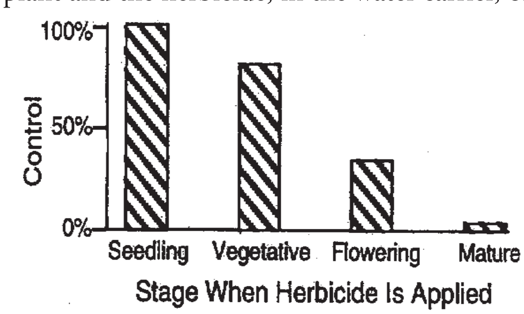


Figure 7. Percent control as it relates to growth stage.

Table 2. Selected herbicides registered for use in turf and ornamental situations.

Common Name	Trade Name(s)	Application Timing	Classification Schemes: Sel	Sys	Residual
benefin	Balan®	Pre	Yes—G&B	No	Yes—medium
benefin +oryzalin	XL®	Pre	Yes—G&B	No	Yes—medium
benefin + trifluralin	Team®	Pre	Yes—G&B	No	Yes—medium
clopyralid+ triclopyr	Confront®	Post	Yes—B	Yes	Yes—low
2,4-D	Hi-Dep®	Post	Yes—B	Yes	Yes—low
2,4-D + 2,4-DP + dicamba	Super Trimec®	Post	Yes—B	Yes	Yes—low
2,4-D + MCPP + dicamba	Trimec Classic®	Post	Yes—B	Yes	Yes—low
dicamba	Banvel®	Post	Yes—B	Yes	Yes—low
	Vanquish®	Post	Yes—B	Yes	Yes—low
dithiopyr	Dimension®	Pre/Post	Yes—B	Yes	Yes—medium
fluazifop-P-butyl	Ornamec®	Post	Yes—G	Yes	No
	Fusilade II®	Post	Yes—G	Yes	No
	Gras-B-Gon®	Post	Yes—G	Yes	No
glufosinate-ammonium	Finale®	Post	No—G&B	No	No
glyphosate	Roundup PRO®	Post	No—G&B	Yes	No
halosulfuron-methyl	Manage®	Post	Yes—G&B	Yes	No
isoxaben	Gallary®	Pre	Yes—B	No	Yes—medium
MCPA + MCPP + dicamba	Trimec Encore®	Post	Yes—B	Yes	Yes—low
Tri-Power®		Post	Yes—B	Yes	Yes—low
MCPP + 2,4-D + dicamba	Trimec Southern®	Post	Yes—B	Yes	Yes—low
MSMA	various	Post	Yes—G	No	No
MSMA + 2,4-D + MCPP +dicamba	Trimec Plus®	Post	Yes—B	Yes*	Yes—low
oryzalin	Surflan®	Pre	Yes—G&B	No	Yes—medium
oxadiazon	Chipco Ronstar®	Pre	Yes—G&B	No	Yes—medium
pelargonic acid	Scythe®	Post	No—G&B	No	No
pendimethalin	Pendulum®	Pre	Yes—G&B	No	Yes—medium
prodiamine	Barricade®	Pre	Yes—G&B	No	Yes—medium
sethoxydim	Vantage®	Post	Yes—G	Yes	No
siduron	Tupersan®	Pre	Yes—G	No	Yes—medium

Note: On the classification schemes:
Sel = Selective classification:
G = selective and controls grasses
Yes—B = selective and controls broadleaves
Yes—G&B = selective and controls grasses and broadleaves
No—G&B = not selective and controls grasses and broadleaves
Sys = Systemic classification
Residual = Is the herbicide residual and to what level
* This herbicide has active ingredients that are systemic and nonsystemic.

the outside of the leaf. Movement of the herbicide molecule through the leaf varies, depending on the thickness of the waxes. (Thick layers poses a greater barrier than thin layers).

Some plants have leaf surfaces that are covered with hairs or other surface structures. These structures often keep the herbicide spray droplet from coming into direct contact with the leaf surface. As a result, the amount of actual active ingredient that makes it into the plant is reduced.

Second, once inside the plant, the herbicide must move to its site of herbicidal activity. There are a couple of characteristics that influence the movement of the herbicide in the plant.

- **Plant age.** As previously mentioned, the older the greater the decrease in its transportation activity. A herbicide application may provide 100 percent efficacy at the seedling stage for annual weeds. But as the plant continues to grow, the percent efficacy will decrease to a point of little or no effect on the weed in the mature growth stage (fig. 7).

- **Environmental conditions.** The environmental influence is considerable. When a plant is stressed from lack of moisture, too much heat, or poor fertility, there translocation decreases. Stress also results in an increase in the cuticular wax layer on the leaf surface, reducing the potential for the herbicide to move into the plant.

Plants growing under high humidity conditions are going to respond to a herbicide application differently due to the reduction in the cuticular waxes thus allowing the herbicide to penetrate the surface more easily.

Remember, the more active the plant is growing, the easier it will be to manage with a herbicide.

Herbicides and Environment— Soil Interaction

Table 3. Soil particles, size, and surface area.

Soil Fraction	Particle Diameter	Approximate Surface Area
Coarse Sand	2-0.2mm	21 cm^2 per g
Fine Sand	0.2-0.02 mm	210 cm^2 per g
Silt	0.02-0.002 mm	2,100 cm^2 per g
Clay	< 0.002 mm	23,000 cm^2 per g

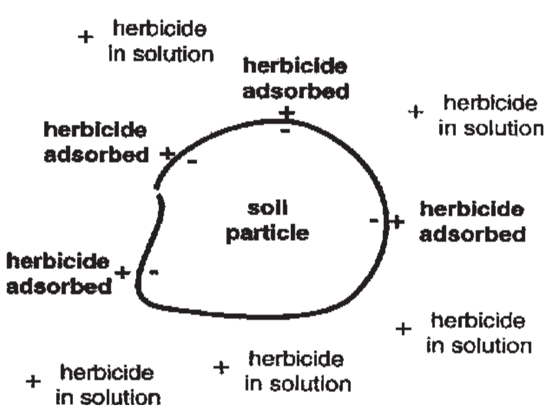


FIgure 8. Soil and herbicide binding interaction.

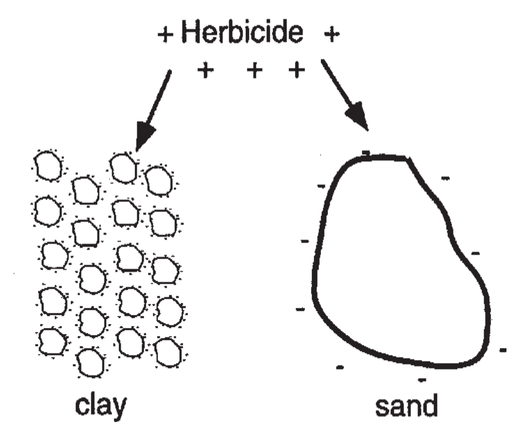


Figure 9. Herbicide and soil interaction.

The soil texture will greatly influence the behavior of the herbicide in the soil environment. Texture refers to soil particle size (table 3). Different soil types have different capacities to bind herbicides (fig. 8).

Sand is course and does not have many charge or binding sites. Silt is smaller than sand, yet larger than clay. It has more binding sites than does sand and in a given volume has a much greater surface area to which the herbicide can bind. Clay is the smallest of the classified particles and has a large surface area per given soil volume, resulting in many more available binding sites.

Soil organic matter has far more binding sites to tie up herbicides. Organic matter has been likened to a magnet and has more influence on herbicide behavior in the soil than any other factor.

Factors that influence a herbicide's behavior in the soil include solubility, adsorption, and degradation or breakdown.

- **Solubility.** The herbicide's solubility is based upon the amount of herbicide that will dissolve in water or the liquid phase of the soil. Herbicides range from practically insoluble (as is the case with trifluralin) to readily soluble in water (salt form of glyphosate, dicamba, and 2,4-D).

- **Adsorption.** The process by which herbicides are held or bound to the soil is referred to as adsorption. It affects movement and availability in soil and degradation rate. Influencing this process is the magnetic charge associated with the soil and the herbicide (fig. 9). The soil has both positive and negative binding sites, which will be available for the negative or positive charges associated with the herbicide. Herbicides that come in contact with the soil are adsorbed to some extent, which will influence their herbicidal activity. Positively charged herbicides are held strongly to the soil. Negatively charged herbicides are not readily adsorbed, because they have the same negative charges as the soil particles. However, these herbicides may be bound to organic matter in the soil and to certain positively charged soil colloids.

Herbicides adsorbed to the soil are inactive; roots and germinating seedlings can only absorb (take up) herbicide molecules that are present in soil water. Molecules tightly bound to soil particles cannot be taken up by plant roots or degraded by microorganisms. They can be displaced from these sites by ions or molecules similar or stronger in charge.

- **Degradation or breakdown.** The process whereby the active ingredient is broken down or rendered inactive is called degradation and influences the persistence of the herbicide in the soil. Several factors affect a herbicide's persistence in the soil.

  - **Photodegradation.** Sunlight can break down herbicides on the soil surface. As the herbicide is broken down it is detoxified and is no longer herbicidally active. Incorporation into the soil after application reduces the potential for any herbicide activity loss. Herbicides that are sensitive to photodegradation include a statement on the label directing the user to incorporate the particular product within a specified time frame.

  - **Microbial degradation.** Soil microorganisms, such as bacteria, fungi, and algae, degrade herbicides in the soil as they use the molecules as a food source. Some herbicides are rapidly degraded, while others take longer to break down. Soil conditions have a tremendous impact on the microbial population in the soil and influence the microbial degradation rate. Conditions that favor the microbes in the soil include high organic matter content. Warm, not hot, soil temperatures and adequate soil moisture will enhance populations in the soil as well. With low soil organic matter, hot and dry soil conditions (which is the case for much of our state), what happens to herbicide breakdown? It's slower. Herbicides persist longer under these conditions, if they rely on microbes for their degradation.

  - **Chemical degradation.** Within the soil, there are processes taking place that break down herbicides chemically. These reactions generally involve processes, such as oxidation, reduction, and hydrolysis, and they occur most readily in warm, moist soil. Soil pH (the degree of acidity or alkalinity) often influences the rate of chemical breakdown.

In turf and ornamental areas, weeds are a major management problem. They compete with desirable plants for sunlight, nutrients, water, and space. Along with the direct impact physiologically with the turf, there is the aesthetic impact that weeds have on turf and ornamentals.

Managing these species requires the homeowner correctly identify the problem, develop an integrated management plan that uses the turf, or ornamental, as a major player in the process. When considering the use of a herbicide, it is critical that the label be read at least five times:

Before purchasing the herbicide.
- Make sure it is registered for your intended use.
- Review all labelled precautions.

Before mixing and making the application.

- Understand how to mix and apply the herbicide properly.
- Review any first aid information—just in case.
- Follow the label completely.

When storing the herbicide.

- Know how to store the herbicide properly.
- Be sure storage area is posted properly.

Before disposing the herbicide.

- Understand how to properly rinse the container.
- Know who to contact (New Mexico Department of Agriculture) for information regarding the disposal of unused or surplus herbicides.

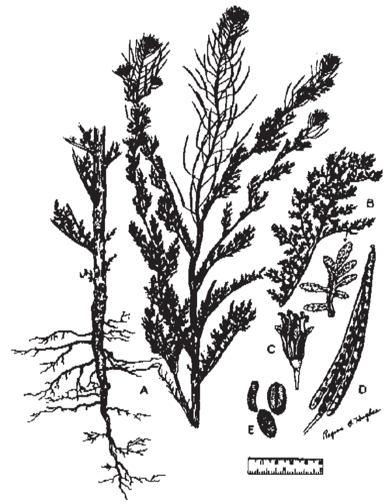
The following species of weeds are the 15 most commonly found weeds in the state. Critical characteristics for each of these species are listed. They will be grouped according to their life cycle.

- **Annual weeds.** These plants complete their life cycle within one year. They are further broken down into winter annual (those which germinate in the fall or winter months) and summer annual (spring and early summer germination).

- Mustard species:
  - Winter annual
  - Flower petals arranged in the shape of a cross
  - Several species in the state:
    - Flixweed (*Descurainia sophia*)
    - London rocket (*Sisymbrium irio*)
    - Shepherdspurse (*Capsella bursa-pastoris*)
    - Tansymustard (*Descurainia pinnata*)
- Crabgrass:
  - Summer annual grass
  - Two species:
    - Smooth crabgrass (*Digitaria ischaemum*)
      - Leaves smooth

• Large crabgrass (*Diguitaria sanguinalis*)
- Leaves hairy
- Roots at the nodes
- Fingerlike seed head

• Goosegrass (*Eleusine indica*):
- Summer annual grass
- Flattened stems

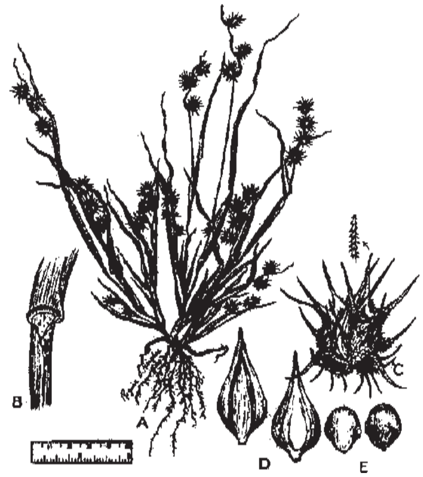


- Prostrate growth with a white center

• Sandbur
- Summer annual grass
- Prostrate and erect growth habit
- Produces a spiny fruiting structure
- Two major species in the state:
  • Field sandbur (*Cenchrus incertus*)
  • Longspine sandbur (*Cenchrus longispinus*)
- Prefers sandy soil conditions

• Kochia (*Kochia scoparia*)
- Summer annual broadleaf
- Introduced forage plant
- Early spring emergence

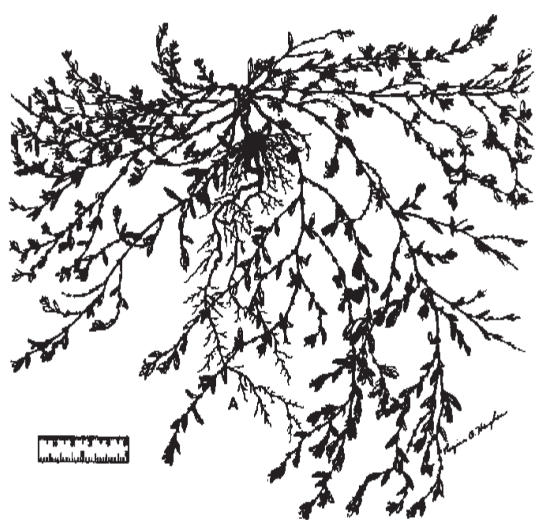
- Height ranges from 1.5 to 6 feet tall



• Prostrate knotweed (*Polygonum aviculare*)
- Summer annual broadleaf
- Prostrate growth habit
- Does well in stressed conditions
- White papery leaf sheath

• Prostrate spurge (*Euphorbia species*):

- Summer annual broadleaf
- Prostrate growth habit
- Milky latex juice in stems
- Several species, some with a red spot in the center of the leaf

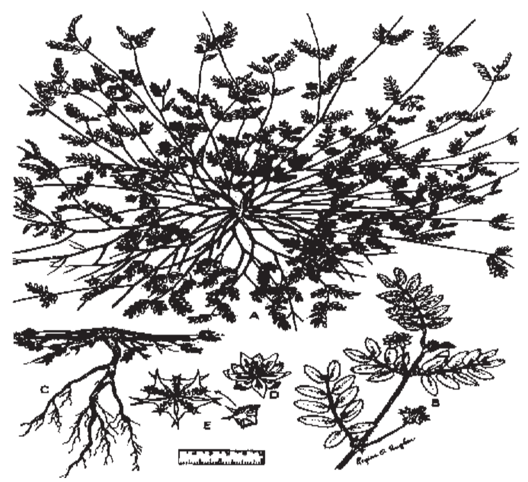


• Puncturevine (*Tribulus terrestris*):
- Summer annual broadleaf
- Prostrate growth habit
- Leaflets hairy
- Flowers yellow
- Produces spiny seed pod

- Often called "goathead"

• Purslane (*Portulaca oleracea*):
- Summer annual broadleaf
- Prostrate growth habit
- Succulent leaves and stems
- Does not have milky juice in stem

- Reroots itself when cultivated
- Edible



• Russian thistle (*Salsola iberica*):
- Summer annual broadleaf
- Round and bushy when mature
- Seedling stage succulent and edible

- Cuts itself off from the root at maturity allowing it to roll
- Flowers born in leaf axils

• Biennial weeds. These are plants that complete their life cycle within two years. There are biennial weeds of concern, but do not make the top 15 most commonly found species in the state.

• Perennial weeds. Plants classified as perennial live for an extended period of time, almost forever it seems. Due to the vegetative reproductive capabilities of these plants they will come back year after year from the same root system and don't actually need to set seed to spread and reproduce. These species are the most difficult to manage because of this property. Management requires not letting the plant set seed

and going after the root system too. Perennial weeds are divided into two groups, simple (nonbranching root system) and creeping (branching root system).

• Bermudagrass (*Cynodon dactylon*):
- Creeping perennial
- Reproduces by seed, rhizomes, and stolons
- Prostrate growth habit
- Ring of hairs at node junction
- Papery leaf sheath at node
- Fingerlike seed head
- Looks a lot like crabgrass, except it is perennial

• Dandelion (*Taraxacum officinale*):
- Simple perennial
- Reproduces by seed
- Extensive taproot

- Produces new flowering stalks from a basal crown
- Yellow showy flowers, which produce seed as a white puff-ball
- Plant is edible

• Field bindweed (*Convolvulus arvensis*):
- Creeping perennial

- Prostrate and twining growth habit
- Trumpet-shaped flowers
- Extensive underground root system
- Looks like annual morningglory, except it is perennial

- Purple nutsedge (*Cyperus rotundus*):
  - Creeping perennial
  - It's a sedge, not a grass or broadleaf

- Triangular-shaped stem
- Short subtending bracts
- Seed head has a purple color
- Produces chains of tubers, which are red, oblong, scaly, and bitter to the taste

- Yellow nutsedge (*Cyperus esculentus*):
  - Creeping perennial
  - It's a sedge
  - Triangular-shaped stem

- Long subtending bracts
- Seed head has a yellowish color
- Produces single tubers per rhizome
- Tubers are round, smooth, and bitter to the taste


A
B
C