UtahState University
COOPERATIVE EXTENSION

chapter 8

Weed **Control**

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INTRODUCTION

Weeds cause more garden failures than any pest. Insects and diseases damage various garden species, but weeds interfere with the growth of all desirable plants. Nothing reduces the overall production and beauty of the garden more than weeds. Weeds also are the costliest pests to control in most Utah landscapes.

There is no single definition of what makes a plant a weed. Weeds are plants out of place. A desirable plant in one location becomes a weed when it becomes aggressive and competes with more desirable plants. Other definitions define a weed as a plant with objectionable characteristics or a plant that interferes with humans, domestic animals or wildlife.

Because the definition of a weed is somewhat nebulous, the reason plants become weeds is also not hard, clear science. Weedy plants often thrive in poor soil or other hostile conditions. They might have extensive stolon or rhizome systems that allow them to quickly invade planted areas. Weeds are more of a problem where desirable plants grow poorly or on disturbed soils.

Desirable plants in some areas are weeds in other places. Bluegrass in a lawn is highly desirable, but in a flowerbed it is a difficult and persistent problem. Scotch thistle, the national flower of Scotland, is often grown as an ornamental in that country. In our dry climate, it is on the noxious weed list. Dyer's woad, another noxious weed, was introduced to Utah as a crop to produce dye, but escaped from cultivation. The weed has spread over hundreds of thousands of acres and is destroying the native vegetation in many areas.

Another weed characteristic is copious seed production or quick reproduction. Each plant might produce more than 100,000 seeds in a single season. They often have efficient dispersal methods. For example, dandelion seeds spread with parachute-like structures that fly in the wind; cockleburs attach themselves to animals; puncture vines stick into tires while other seeds are eaten by birds or grazing animals and are dispersed with their droppings. Other weed seeds spread with irrigation water or soil movement.

Weed seed longevity contributes to weed spread and persistence. Depending on the species, some weed seeds live dormant in the soil for many years until they receive the right temperature, light and moisture conditions.

Weeds become problems because they compete with desirable garden plants for water, nutrients, light and space. They also harbor pests including insects and diseases. Barbed seeds collected in clothing when hiking in the hills are a nuisance, but those same seeds become hazardous if they get inside a dog's ear or a horse's mouth.

Many weeds cause serious problems for people. Poison ivy and other weeds cause severe skin reactions when touched. Poison hemlock and other plants cause serious injury or death if ingested. Puncture vines injure people, pets and bike tires. Weeds cause hay fever and other allergies and can also create fire hazards.

Classifying Weeds

Classifying weeds is a challenge that has been resolved using several different classification methods. Weeds are most often classed by plant structure or life cycle.

Plant Structure

Broadleaved plants are dicots. They have veins that radiate from a larger vein. They typically have coarse root systems and many have tap roots.

Figure 1. Broadleaf or Dicot.

Grasses are monocots. They have long, narrow leaves with parallel veins and fibrous root systems. Grasses are physiologically different so it is possible to use selective herbicides for control.

Figure 2. Monocot or Grass.

Weed Life Cycles

Weeds are classified according to their life cycles as annuals, biennials or perennials. These classifications are important groupings to determine control measures.

Summer annuals grow from seeds that sprout in the spring, mature and reproduce before dying with the fall frost. Common summer annuals are barnyard grass, puncture vine, Russian thistle and pigweed.

Figure 3. Summer Annual, Red Root Pigweed.

Winter annuals germinate in the fall or winter and in the spring they flower, produce seed and die before the heat of summer. Common winter annuals are downy brome, chickweed, some mustards, wild oats and annual bluegrass.

Figure 4. Winter Annual, Downy Brome or Cheat Grass.

Biennials require two years to complete their life cycles. These plants grow vegetatively (without flowering) the first year. After going through the winter, the plants flower, produce seed and die. Many thistles, mullein and hound tongue are biennial plants.

Figure 5. Biennial, Bull Thistle.

Perennials live three years or longer. These plants flower and set seed without dying. Most die back in the winter but resume growth in the spring. Common examples are quack grass, field bindweed, dandelion and plantain. Simple perennials have a root system that does not spread while creeping perennials spread by stolons, rhizomes or tubers. For example, bentgrass spreads by above-ground stolons, quackgrass spreads by underground rhizomes, while Bermudagrass spreads by both methods. Yellow nutsedge produces small tubers and other weeds produce bulbs or other vegetative propagules.

Figure 6. Simple Perennial, Dandelion.

Figure 7. Creeping Perennial, Quackgrass.

Classification by Control Methods

Another way of classifying weeds is to divide them into one of five convenient groups for determining the control method. These groups are annual grasses, perennial grasses, annual broadleaf plants and perennial broadleaf plants including plants with woody stems.

Woody plants include shrubs and trees. Shrubs usually have multiple stems and are less than 15 feet tall, while trees usually have a single trunk and are more than ten feet tall. Knowing the plant type and species is important in formulating a control program.

Noxious Weeds

The Utah Department of Agriculture and Food declares weeds that pose a serious threat to agricultural or other operations as noxious weeds. As of now, the state of Utah has listed 27 plants on the Utah Noxious Weed List.

In addition, individual counties have the authority to declare specific weeds as noxious within the boundaries of their county. By law, property owners must control noxious weeds on their property, or the county will do it and attach a financial lien to the property to force the owner to pay for the control.

Other parts of the Utah Noxious Weed Act cover the transportation or sale of plant materials, seeds, animal feeds, soils, manures and similar products that contain noxious weeds or their seeds.

For online pictures and more information on these weeds go to www.utahweed.org/weeds.htm

Weed Control

Economic losses from weeds are estimated at more than $20 billion annually in the United States. Preventing weed problems is important to all Master Gardeners. Never import invasive plants into the state. Many serious weed problems in Utah began as imported crop plants, ornamental plants or as contaminants in crop seeds. Learn to identify and control weeds before they become serious problems.

Successful weed control requires more than spraying landscapes and other garden areas. Weed management means using all available methods to control them. These techniques include weed prevention, cultural controls, mechanical controls and as a last resort, chemical controls.

Correct identification of a weed and its life cycle is essential before attempting control measures. Determine the correct name, instead of a local favorite, because control measures from Utah State University or other sources use approved common names.

One example is the identification of field bindweed, a very difficult-to-control creeping perennial. Because it is often erroneously called morning glory, controls based on that name are usually ineffective. Morning glory is an official name on herbicide labels and in other control recommendations but it refers to the relatively easy–to-control annual weed with a simple root system. If the plant is not correctly identified as field bindweed, gardeners do not apply the correct control measures.

For help in identifying weeds, consult the publication *Weeds of the West* published by The Western Society of Weed Science in cooperation with the Western United States Land Grant Universities Cooperative Extension Services (2009) copies may be available through your local county extension service or order from the Cooperative Extension Service in Laramie, Wyoming at (307) 766-2115.

After identifying the plant, determine what makes the plant a pest. This helps determine the most effective control measures and the timing of those measures.

Prevention

Any successful weed control program starts with prevention. Support laws preventing the spread of unwanted plants. Never import plants from other areas or other countries that might become invasive.

Keep undesirable plants out by checking anything brought into the garden. Buy high quality seed and plants that do not contain weeds. Check sod carefully before laying it to avoid introducing unwanted weeds. Avoid manure or other organic matter that has not been hot composted. Avoid shared plants with weed rhizomes or seeds.

Watch for the appearance of unwanted plants introduced by birds or other animals, wind and those that creep in from surrounding landscapes. Secondary irrigation water is also a source of weed seeds. Weeds can also be spread by mechanical equipment. Clean tillers, mowers and aerators before using them on lawns or in gardens to prevent spreading weeds to uninfested soil.

Mechanical Control

The oldest and most common weed control method, mechanical control, is still effective in controlling annual weeds and simple perennials.

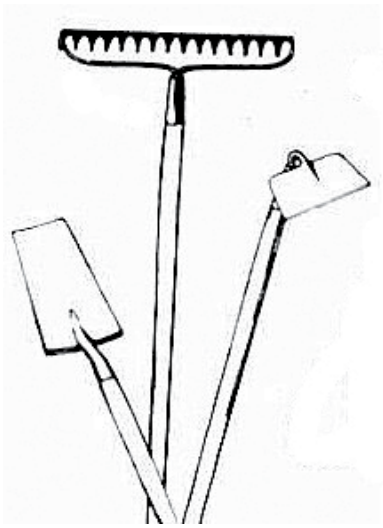

Figure 8. Mechanical Control Methods. Shovel, rake and hoe are typical weed control implements.

This method includes tilling, hand pulling, hoeing or digging. It is highly selective because a gardener targets specific weeds. However, mechanical control is labor intensive and time consuming.

Every cubic foot of topsoil contains thousands of weed seeds. They do not geminate until air, light, moisture and temperature become favorable. This is why enormous numbers of weed seedlings cover any newly prepared planting area.

Cultivate moist, but not wet soil. Working wet soil damages soil structure, especially in heavy soils. Weeds are hard to pull from dry soil and hoeing is also difficult.

There are many tools to till the soil including plows, tillers, cultivators and many kinds of hoes. Common garden hoes were originally designed to chop cotton, not remove weeds. Sharp, gliding hoes are easier to use and allow gardeners to work closer to the plants. Dandelion diggers and other specialty tools facilitate digging of tap-rooted weeds. Hand pulling small weeds is easiest when the soil is moist.

Purslane and some other plants root back in even after they are severed from their roots. Discard these to prevent their regrowth. Remove any weeds that have gone to seed. Hoe or pull weeds on hot sunny days so the weeds will wilt and not reroot. Reduce weed growth around the garden by mowing or other means to help prevent the spread of weeds and their seeds to the garden area.

Rotary tillers are effective tools for larger gardens. Till when the soil is not too wet or dry and weeds are small. Turn weeds under before they flower, to add organic matter. Avoid deep cultivation or cultivating too close to desirable plants if it is likely to damage roots or stems of the crop. Excessive tilling also breaks down soil structure.

Cultural Controls

Cultural controls help control unwanted plants. Competition from desirable plants and cover crops, mowing, mulching and even irrigation techniques can help control weeds.
Competitive Crops: Bare ground never remains bare for long. If soil is not covered with desirable plants, weeds grow. Plant vegetables and flowers close enough to cover the soil. Crop competition helps prevent weed growth.

In nature, it is always survival of the fittest. Well-established flowers, vegetables, turfgrass and woody plants compete with weeds for light, growing space, water and nutrients. Healthy turfgrass is highly effective in thwarting weed infestations.

Mowing: Cutting weeds helps prevent many plants from going to seed. Schedule mowing times to remove weed seeds before they become viable. Lawn mowers and string trimmers help control taller annual weeds but low-growing, prostrate weeds are unaffected by mowing. Mowing does not control most perennial weeds.

Mulching: Mulching helps control annual weeds. Mulches cover the soil to prevent light and moisture from reaching weed seeds. Mulches are organic – meaning they come from plants – or inorganic – meaning they come from nonliving sources.

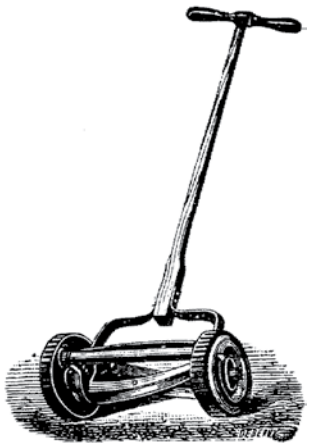

Figure 9. Mowing.

Organic materials include grass clippings, sawdust, straw, wood shavings, bark chips or newspapers. Thick layers of organic mulch will prevent most annual weeds and any that grow are usually easy to pull.

For walkways or paths, try newspaper, old carpeting, sawdust or bark. While mulches help control weeds, make certain the mulch does not interfere with crop growth.
Do not use organic mulches in cool, spring weather. Soils warm up slowly and crop development is delayed. After the soil warms,

add two inches of organic mulch to control weeds. In the fall, turn organic mulches to improve the soil.

Inorganic mulches include plastic sheeting, landscape fabric, gravel or rocks, shredded tires or other materials. Clear plastic mulches warm the soil and encourage weed growth initially but as temperatures rise, annual weeds burn off.

Remove annual weeds in perennial grasses by covering infested areas of the lawn with clear plastic on hot sunny days. The sunlight heats the area under the plastic killing the above-ground plant tissue. The perennial grass will send out new growth after the annual weeds die. This method does not control perennial weeds, so apply the plastic before annual weeds go to seed.

Black Plastic: Black plastic excludes light and is often a good way to control weeds in vegetable beds or in fallowed areas. It warms soil early in the season and greatly reduces weeds. Cut holes through the plastic after stretching it over the bed to allow seeding or transplanting. Water with drip irrigation beneath the plastic, or use furrow irrigation or sprinklers. Cut slits in the plastic for watering if needed.

Newspaper and other kinds of paper can be used as mulches. Place several layers of newspaper over the soil and secure it with soil or compost. Like organic mulches, paper reduces soil temperature, so apply it after crops are growing and the soil warms up. Thin layers of paper mulch do not delay cool-season, spring-planted crops such as lettuce, broccoli and cabbage. Apply paper over moist soil. Paper deteriorates and can be tilled in at the end of the season.

Cover Crops: Planting vigorous, well-adapted crops that do not produce seeds is an effective way to prevent many weeds. Summer cover crops include buckwheat, vetch, winter wheat, oats or barley. Winter cover crops include cereal rye, spring wheat or winter peas.

Irrigation Systems: Irrigation water can introduce weeds into the garden and can encourage or inhibit weed growth. Sprinklers soak everything including weeds. Drip irrigation reduces weed infestations by placing water only on desirable plant roots.

Biological Control

Insects, diseases or grazing animals can control weeds. These methods have excellent applications for specific weeds in specific ecosystems, but their use in home garden situations is limited. Ongoing research shows promise for reducing bindweed and puncture vine infestations.

Chemical Control

Chemical weed controls use herbicides which are plant killers. Herbicides are useful but they are not suitable for all situations or against all weeds. Consider other options first and use herbicides if other methods are ineffective.

Chemicals are not substitutes for good management. Herbicides are expensive and ineffective if applied to the wrong plants or at the wrong time. Drift may damage desirable plants, and treatment with herbicides for some weed species may promote colonization by other weeds that are more tolerant of the chemical. Drift from preemergent herbicides does not damage growing plants but could affect desirable seed germination. Herbicides must be stored and handled correctly for safe use.

Classifying Herbicides

There are many different kinds of herbicides and they work in different ways. They are classified by use, timing, application site or by chemical properties. Herbicides might fit more than one category. For example, glyphosate (Roundup®) is a nonselective, postemergent, systemic herbicide applied to the foliage while triflurilan (Preen®) is a nonselective, preemergent, nonsystemic, soil-applied herbicide.

Selective herbicides kill specific weeds without damaging the crop or desirable plants. Very few herbicides are totally selective. Most can damage or kill desirable plants as well as the weeds if misused, so it is critical to follow all label instructions.

Selective vs. Nonselective

Herbicides are divided into nonselective or selective products depending on the types of plants they control. Nonselective herbicides that affect all treated plants are contact, translocated or soil-applied products. Use these for complete vegetation control along roadways or paths or in lawn or garden areas before planting.

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Preemergent vs. Postemergent

Herbicides applied before weeds emerge are preemergent products, while those applied after they emerge are postemergent products. Preemergent products kill seeds as they germinate. Preemergent herbicides form a barrier near the soil surface where germinating seedlings absorb the chemical and die. Established crops and weeds survive because they have already grown through the chemical barrier. Postemergent herbicides are selective and are applied after plants start growing.

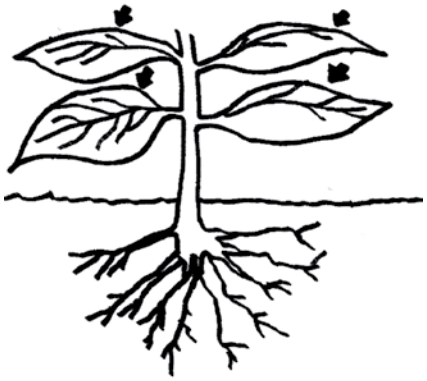

Figure 10. Contact Herbicides.

Contact vs. Systemic

Herbicides that are translocated to a different plant part than where the application was made are systemic herbicides. Those that do not move in the plant are nonsystemic or contact herbicides. Systemic herbicides are more effective in controlling perennial weeds because they move into the root system and kill the plant. Systemic properties are important when trying to control unwanted trees because spraying large plants with herbicides is prohibitively expensive and risky to other plants.

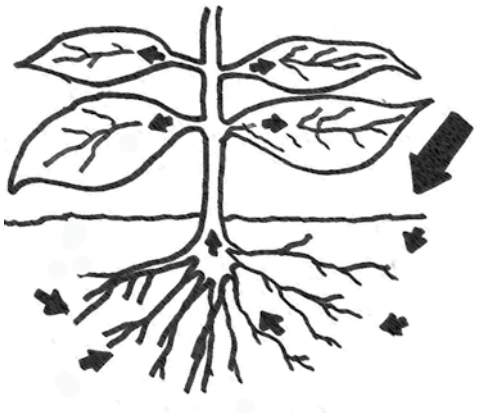

Figure 11. Systemic Herbicides.

Foliage vs. Soil-Applied

Herbicides are classified according to where they are used. Some products are applied directly to above-ground parts of the plant. Other products are applied to the soil before or after a crop is planted or before or after weeds emerge.

Figure 12. Herbicide Container. Herbicides come in many different formulations, concentrations and container sizes. Choose the products and concentrations that are going to be most effective for specific application situations.

Herbicide Classification by Chemical Group

Classifying herbicides chemically is difficult because many kinds of chemicals control plants. Classifying herbicides by chemical group requires more than two dozen categories because of the variety of modes of action. Only a few types are commonly used by home gardeners.

Inorganic herbicides do not contain carbon. They include salt, copper sulfate, sulfuric acid, sodium chlorate and other common materials. They are very persistent and cause serious soil residue problems, so home gardeners should avoid these products.

Other compounds are called organic herbicides because they contain carbon include oils and synthetic organic herbicides. Petroleum oils, refined from crude oil, are used as contact herbicides. Synthetic organic herbicides are made of carbon, hydrogen and other elements. Common synthetic organic herbicides include 2, 4-D and glyphosate.

Before using any herbicide, read the label completely to prevent injury to people, pets, wildlife and desirable plants. Check the label for the crop or the site. Many products are labeled for ornamental use but not for edible crops. Finding the same active ingredient in another product does not provide license to use it for an off-label use. Reduce the chances for weeds to develop resistance by rotating and combining weed control practices, and do not rely on any one herbicide or technique.

Even though herbicide chemistry is very complex, home gardeners only use a small group of products with a few types of formulations. These are summarized as follows:

The most widely used nonselective, systemic herbicide is glyphosate. It is sold as Roundup® and under many other generic names. It inhibits plants from producing three essential amino acids. It moves from the leaves to the perennial roots when it is applied to dust-free, actively growing foliage. Because it is nonselective, apply it carefully to avoid damaging desirable plants. It is highly effective on grasses, broad-leaved annuals and woody plants. It has no residual soil activity.

Nonselective contact-type herbicides include glufosinate (Finale®), diquat, herbicidal soaps (Safer Brand®) and pelargonic or cacodylic acid products. These disrupt cell membranes so they lose moisture and dry out rapidly. These are effective against newly germinated, annual, broadleaf and grass weeds. Most perennials grow back after treatment because the roots survive. These products are sometimes added to glyphosate to give a quick burn back of weeds or they are mixed with preemergent products to kill existing plants while other products kill newly germinating plants.

Selective broadleaf weed killers contain 2, 4-D, dicamba, carfentrazone, triclopyr and other products that control broadleaf plants but do not kill grasses when used as directed. These products are often mixed together to control a broader spectrum of weeds. Most have temperature restrictions. Do not use them when temperatures are too high because they volatilize in high temperatures. These chemicals can drift to damage desirable plants. Tree and shrub roots in treated areas can absorb these products – especially dicamba – and be severely damaged.

Preemergent herbicides are primarily used to kill crabgrass and other annual weed as they germinate. Apply these products before the weed seeds germinate and avoid disturbing soil after application. Never use these products when planning to seed within the time restrictions listed on the product label. Common crabgrass preventers include Gallery® and pendemethalin.

Preemergent herbicides labeled for flower and landscape beds and for certain vegetables usually contain trifluralin or oryzalin. Always make certain that the crop or site is listed on the label.

Selective grass killer kills grasses but not broadleaf weeds. These are useful because they can help take weedy grasses out of flower beds and groundcovers. These postemergence grass herbicides include Fusilade® (fluazifop) or Poast® (sethoxydim) and control some annual grasses and suppress or control certain perennial grasses. Fine fescues and annual bluegrass are resistant to these products. Read the label because surfactants are usually needed to increase the herbicide uptake by the weed.

Herbicides approved as "Certified Organic" products are less common and are limited in effectiveness. Petroleum distillates and citrus, thyme, clove and other oils are used, as are various combinations of acetic acid (vinegar) or citric acid mixed with other inert ingredients. Most require multiple applications and are not highly effective against anything but easily controlled annual weeds.

Corn gluten is an organic herbicide that inhibits root development in seedlings under dry conditions. Rain or irrigation, however, can cause dramatic increases in weed seedling root growth when using corn gluten meal as an herbicide. Herbicides that are of particular concern to homeowners are the nonselective persistent herbicides often called soil sterilants. These control all plants for extended periods in driveways or along fences or under asphalt. These products severely damage desirable plants when their roots grow into the treated area or if treated soil is moved into other landscaped areas. These

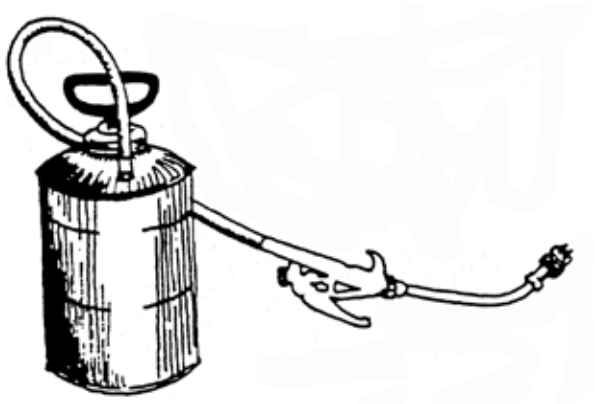

Figure 13. Weed Sprayer.

herbicides can damage plants for many years after they are applied and are never recommended for use in residential areas.

Herbicides Classified by Application Methods

Sprays: These products are applied using water or oil as a carrier to dilute and spread the herbicide. They are applied to a measured area or mixed to a specific concentration and then applied to the weeds as a uniform broadcast application.

Spot applications: Use these applications to control pests when weed infestations are concentrated in specific areas. Sprays or granular herbicide applications are suitable for spot treatments.

Concentrate treatments: Apply undiluted herbicide on newly cut stumps or frills cut with an ax at the base of the trunk. Apply enough material to fill the cut or coat the outer edge of the cut stump. The herbicide is absorbed into the trunk and translocated throughout the plant. If done correctly, the chemical kills the plant. This prevents regrowth and prevents numerous sprouts from infesting the garden.

Dry herbicide treatments: These treatments include granular formulations and weed-and-feed products where herbicides are mixed with fertilizers and may include clay or ground corncobs as carriers or herbicide pellets to control woody plants. Follow label directions because excessive application will damage desirable plants.

After making any herbicide application, evaluate the results. When using an unfamiliar product, leave a small area untreated to determine control effectiveness.

Herbicide Application Equipment

There are several types of herbicide application equipment. They range from inexpensive spray bottles included with ready to use (RTU) products to sophisticated power sprayers. Using the right equipment improves weed control and makes the application safer. Choose the one that is the right size for the situation and that accurately disperses the herbicide.

Do not use the same sprayer for insecticides and herbicides. Herbicides containing 2, 4-D and similar products are difficult to remove from sprayers and plants can be damaged by residues. If the same sprayer must be used, fill it with a solution of one part household ammonia and nine parts water. Pressurize the sprayer so the ammonia solution fills the hoses and valves. Let it stand for 12 to 24 hours, then rinse it out several times with clean water.

Improving Weed Control

The following tips help improve the effectiveness of any weed control program. Pay attention to

the weed growth stages. Grasses and broadleaf weeds go through four stages of growth: seedling, vegetative, bud and flowering and maturity. Always try to attack a weed when it is the most vulnerable. This saves time and money and treatments are more effective with less environmental impact.

The seedling growth stage is vulnerable in annual, biennial and perennial weeds. All start from seed and small, tender seedlings require less effort for control regardless of the control method. Cultivation is highly effective and herbicides with foliar and/or soil activity are effective during this stage.

Weeds then go through a vegetative growth stage. During this stage, the plant energy goes into stems, leaves and roots. Control is harder than during the seedling stage. Cultivation, mowing and post-emergence herbicides are effective controls.

Annual weeds then form buds and flowers and the energy goes into seed production. As annuals mature, they are harder to control by mechanical or chemical means. Once they flower and set seed, they complete their life cycle. Chemical control is ineffective once the seeds mature. Remove the weeds and discard them.

Many biennials grow vegetatively the first year and form a tap-rooted rosette. Mechanical and chemical controls are effective in the fall. Dig out the plant root or use herbicide to kill the taproot. Once they get to the second year, control is more difficult.

Perennials in the vegetative state use stored energy from underground roots and stems. As plants grow, energy comes from the leaves. Cultivation and herbicides are not as effective because these methods do not control the underground parts of the plant. For many perennials, waiting until these plants reach the flowering stage is more effective because flowering diverts the energy into the flowers and seeds. Food reserves are lower and some plants begin storing carbohydrates in the roots. Chemical control is effective on some weeds at this time.

With perennial weeds, the above-ground portions die each year. The underground roots remain alive and send up new growth the next spring. Chemical control is ineffective at this stage.

Woody plants go through the same four growth stages as other perennial plants. They do not die to the ground during the winter, but deciduous forms lose their foliage. Herbicide applications are effective at any stage, but are easier to apply to smaller plants. Fall treatments are easiest because the herbicide translocates to the roots.

The waxy cuticle layer affects the herbicide absorption by the weed. It must penetrate the leaf surface so leaves with a thin cuticle layer allow the spray to be absorbed. On leaves with thick waxy surfaces, the spray forms droplets and runs off. The cuticle is thinner on young weeds so herbicide applications on tender plants are more effective. Hairs on the leaf surface also keep the spray solution from being absorbed by the plant. The droplets stand up on the hair and do not contact the leaf surface. Weed seedlings usually have fewer and shorter hairs. This is another reason for early control.

Leaf shape affects herbicide absorption. Plants with narrow, vertical leaves absorb less spray while broadleaf plants hold the spray. If recommended on the label, add an adjuvant to increase spray retention.

Environmental growth factors also affect herbicide effectiveness. Soil-applied herbicides need moisture to be absorbed by the plants so irrigation or incorporation activates the product. Temperature determines the plant growth rate. At low temperatures, slower growth means plants do not take up the herbicides or the herbicide works very slowly. At high temperatures, the herbicide may evaporate (volatilize).

Foliar-applied herbicides are absorbed faster and easier with high humidity because the leaf has a thinner cuticle layer. Low humidity, wind and high temperatures cause the openings on the leaves to close and cause the cuticle to become harder and thicker.

Rain or irrigation soon after a foliar-applied herbicide treatment can decrease effectiveness. Rain increases soil moisture so soil-applied herbicides are more readily absorbed by the weeds. Too much rain moves the herbicide too deep, past the root zone. Excessive moisture can move surface-applied herbicides off the target area especially if the soil surface is packed or sloped.

Reducing Herbicide Problems

Herbicide damage to non-target areas is a frequent, serious problem. More than one-third of the plant samples submitted to USU diagnostic clinics are from herbicide misuse. Controlling what, where, how and when herbicides are used is critical.

Always read and follow all label directions. Herbicides drift to nontarget areas as droplets or particles and they drift as gases when they vaporize.

Spray droplets move from the application site in the wind. The distance particles drift is determined by wind speed, droplet size and the distance from the spray nozzle to the plant or soil. Smaller droplets come from higher pressures and cause the greatest risk of injury. Vapor drift is from the evaporation of an herbicide during or after application. It is not as common as particle drift, but it can move much farther.

Follow these precautions to reduce problems:

- Apply herbicides using low pressures.
- Avoid pumping the sprayer too much and keep the spray tip near the ground.
- Spray when wind is not blowing and when it is cool.
- Avoid spraying near sensitive plants and use herbicides before planting sensitive plants or when they are more mature in the fall.
- Use low volatility formulations if possible.

Herbicides can cause phytotoxicity. Phytotoxic symptoms include leaf drop, stunting, overgrowth, discolored and twisted foliage and stem distortion. In addition to the drift and temperature precautions, using excessive amounts of pesticides, too little water as a carrier, uneven spraying, mixtures of different herbicide formulations or adding fertilizers create more problems.

Do not confuse phytotoxicity caused by herbicide misuse with damage from insects or diseases, insufficient moisture, improper fertilization or other adverse environmental conditions. Herbicide phytotoxicity is not specific to only one plant species.

In conclusion, remember, there are many methods for controlling weeds, but none work unless the gardener does! The words of this rhyme are appropriate:

> "A man of words and not of deeds
> is like a garden full of weeds."

Start early and be aggressive. The war against weeds may never be won, but the battle against them in the garden can be won.

Review Questions:chapter 8

1. What makes a plant a weed?

2. What are the two broad classes of weeds botanically?

3. Name the four weed categories according to their life cycles.

4. What are the three nonchemical options for controlling weeds?

5. Define herbicide.

6. What is a soil sterilant and when should it be applied in a vegetable garden?

7. What is a noxious weed?

8. What is the correct common name for the weed that is commonly called morning glory in Utah?