Pest Notes, Publication 7441
Revised September 2018

UC IPM

Integrated Pest Management for Home Gardeners and Landscape Professionals

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Weed Management in Landscapes

Weed management in landscaped areas is made difficult by the complexity of many plantings (Figure 1). Landscapes can include turfgrass, bedding plants, herbaceous perennials, shrubs, and trees. Usually more than one species is planted in the landscaped area, and there is often a mix of annual and perennial ornamentals. The great variety of ornamental species, soil types, irrigation systems, slopes, and use of mulches creates the need for a variety of weed management options. There is also public concern about the use of chemicals to control weeds and their effect on water quality, public health, and non-target species if the herbicide moves offsite through runoff, drift, or other means of exposure.

Figure 1. Mallow (cheeseweed) and other weeds in an unmulched landscape area. The mulched beds in the back have very few weeds.

The choice of specific weed management tactics depends on the weeds present and the types of turf or ornamentals planted in the area. Because of the many variables, weeds in landscape plantings are usually controlled by a combination of nonchemical and chemical methods.

Use this publication as a practical review and guide to weed management options suited to planting beds and areas around trees and shrubs.

Information on weed control methods that are more directed towards turfgrass can be found in *Pest Notes: Weed Management in Lawns*.

Figure 2. Concrete mowing strip separates turfgrass from ornamental beds.

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WEED MANAGEMENT BEFORE PLANTING

An integrated approach using several methods is the most economical and effective means of controlling weeds. Develop a weed management plan for landscapes before planting by following these five basic steps:

1. Site assessment.

Before soil preparation and when weeds are visible, evaluate the soil and slope of the site so problems can be corrected or future problems anticipated before planting. Site characteristics to look for include drainage, soil compaction, shading, and water infiltration rate.

Identify the weed species in the site, focusing on perennial weeds (see REFERENCES). The best time to look for winter annual weeds is mid- to late winter; perennials and summer annuals are easiest to identify in mid- to late summer.

2. Site preparation.

The most frequently overlooked aspect of a landscape maintenance program is site preparation. Control existing weeds, especially perennials, before any grading and development are started. Non-selective translocated herbicides (ones that move from the site of application to other parts of the plant) containing the active ingredient glyphosate (e.g., Roundup) or glufosinate (e.g., Leopard or Finale) can be used to kill existing annual grasses and many types of perennial weeds. Non-selective contact herbicides, including synthetic active ingredients (e.g., diquat-dibromide) or organic ingredients (e.g., acetic acid and clove oil) are effective for controlling young annual plants as long as there is good spray coverage.

Soil solarization can be used but the soil must be covered with clear plastic for 4 to 6 weeks. Solarization is most effective when done during the time of highest solar radiation—from June to August for much of California although later in some parts of the state (see REFERENCES).

The number of annual weeds can be reduced by irrigating the area after final grading, allowing the weeds to emerge. While the weeds are still small, remove them through shallow cultivation (less than 1 inch deep), scrape them off the soil, or spray with a postemergence non-selective herbicide, and then repeating this process of irrigation, emergence, and removal two or three times more. This will greatly reduce annual weed competition and population size.

3. Define the type of planting.

Appropriate choice of plant types and landscape design can make it easier to manage weeds. For example, installing mowing strips, planter beds, and borders help to reduce weed encroachment and delineate planting types (Figure 2). Woody plants, especially those that are established, are more tolerant to most preemergence herbicides and close cultivation. Consequently, there are more weed control options if the planting consists entirely of woody plants, as opposed to herbaceous annuals or perennial plants, or a mixture of all three.

Choosing drip or subsurface irrigation or microsprinklers over rotor and turf-type sprinkler heads will also help in reducing weeds, since the water is placed at or near plants. Rotor and turf-type sprinkler heads are designed to water large areas of turf such as lawns and playing fields, but in a landscaped area there are often wider spaces between plants. In addition to wasting water, this type of irrigation will only encourage weeds to grow there.

4. Don't bring in new weeds.

Weeds are sometimes introduced in the soil brought to the landscape site, either when amending the soil or in the potting mix of transplants. Specify certified amendments (US Composting Council Seal of Testing Assurance Program: compostingcouncil.org/seal-of-testing-assurance/) and check new plants for weeds, especially perennials like purple and yellow nutsedge (Figure 3) or field bindweed. Annual weeds can be removed by hand before planting but perennial weeds in a pot or tree box will create a long term weed management problem. Weed seeds can also be brought in on equipment. Washing or blowing off mowers, trimmers, and dirty shovels and hoes will help reduce the introduction of new weeds.

Figure 3. Yellow nutsedge growing through a shallow layer of mulch.

5. Encourage rapid establishment of desired plants.

Use the best management practices to get the plants established as quickly as possible so that they become competitive with weeds and more tolerant of herbicides applied to the site. Frequent weeding and keeping weeds from producing seeds in the landscape will greatly reduce overall weed populations. Using mulch will reduce the growth of annual weeds.

6. Use preemergence herbicides only if needed.

Soon after planting, once the soil has settled and if mulch is not used, preemergence herbicides can be applied. These herbicides have specific

label uses regarding types of plants on which they can safely be applied and how they should be used. The sites listed on the label determine where the herbicide can legally be used. Herbicides may damage new plantings if not used correctly. Any weed seedlings that have emerged between transplanting and the preemergence herbicide application must be removed by hand or gentle hoeing as these will usually not be controlled by preemergence herbicides.

WEED MANAGEMENT IN ESTABLISHED PLANTINGS

When developing a weed management plan for an existing planting or after an installation is in place, consider the types of landscape plants present and the weeds present and their life cycles (annual, biennial, or perennial) (Table 1).

Effective weed control options in the landscape include hand-weeding and cultivation, mowing, mulching, saturated steam treatments, and chemical control. All of these methods may be used at one time or another as part of an integrated weed management program in landscape maintenance operations (Table 2). For instance, after elimination by hand-pulling, cultivation, or a postemergence herbicide application, the subsequent growth of annual weeds can be discouraged with mulches, preemergence herbicides, or both.

Hot water, steam, and use of flamers is generally only effective for very small weeds and in specific types of sites such as sidewalk joints, along fence lines, and adjacent to edging materials. In small areas, it is usually more efficient to just hoe, mechanically trim, or hand remove weeds.

Hand-weeding and Cultivation

Cultivation (hoeing) (Figure 4) and hand-weeding are useful to selectively remove weeds from ornamental plantings. Frequent removal of weeds when they are small and have not yet set seed will rapidly reduce the number of annual weeds over time.

If weeds are scattered throughout the site, hand-weeding may be the preferred management method. Hand-weeding can be time-consuming, but should be included in all weed management programs to keep weeds from seeding. Hand-weeding must be repeated frequently until the plantings become established.

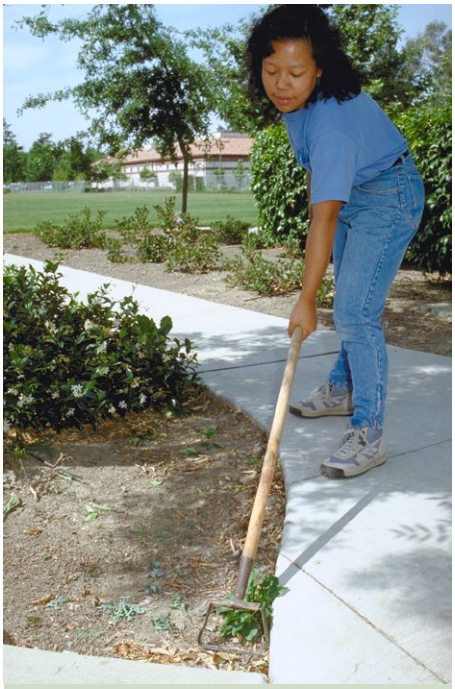

Figure 4. A sharp scuffle hoe will cut weeds near the soil surface.

Cultivation can damage ornamentals with shallow roots. When cultivating, avoid deep tilling, as this brings buried weed seeds to the soil surface where they are more likely to germinate. Perennial weeds are often spread by cultivation and should be controlled or removed by other methods.

Flaming and Heating

Young weeds in open areas also can be controlled with small flaming or infrared units (Figure 5). Propane burners are available that can be used to rapidly pass the heating element or flame over young weeds to kill them. Do not burn the weed to the ground, usually 2 to 5 seconds of exposure is enough to kill plant cells. Check the plants 1 day after the heat treatment and if the plants still look healthy, reapply heat for a slightly longer time or choose another technique.

Flaming and heating are more effective on broadleaf weeds than grasses. Be careful not to flame dried out vegetation, dry wood chips, and other

Table 1. Common Weeds in Landscape Plantings.

Annuals	Biennials	Perennials
annual bluegrass medics (black medic & burclover) common groundsel* crabgrass (large and smooth) fireweed or willowherb little mallow (cheeseweed) burning nettle pigweed (redroot & prostrate) prickly lettuce purslane sowthistle spurge (prostrate, creeping, and petty* wild barley wild oat	bristly oxtongue	asparagus fern Bermuda buttercup bermudagrass* creeping woodsorrel* dandelion field bindweed* kikuyugrass nutsedge (yellow & purple)*

*Especially troublesome

Table 2. How to Manage Weeds in Five Types of Landscape Plantings.

Type of Planting and Comments	Recommendations
Woody Trees and Shrub Beds. Dense plantings reduce weeds. Preplant weed control is not as critical as in other types of plantings. It is often necessary to combine treatments for complete weed control.	• Control perennial weeds before planting (although control may be possible after planting). • Use geotextile fabrics with a shallow layer of mulch or use a thick layer of mulch without a geotextile base. • Use a preemergence herbicide, if needed, and supplement with spot applications of postemergence herbicides and/or hand-weeding. • Remove perennial weeds by hand, spot applications of glyphosate or glufosinate, or grass-selective herbicide such as fluazifop.
Woody Ground Cover Beds. Woody mature ground covers should exclude most weeds; however, weed encroachment during establishment is likely.	• Control perennial weeds before planting, although perennial grasses may be selectively controlled after planting with fluazifop (Fusilade[1], Ornamec[1]), clethodim (Envoy[1]), sethoxydim (Grass-Getter), or other selective grass herbicides. • Control annual weeds with mulch. A preemergence herbicide can be added but rooting of stolons in new plantings may be affected; supplement with some hand-weeding. • Use geotextiles where possible but do not use them where ground covers are expected to root and spread. ***[1]For use only by professional applicators.***
Annual Flower Beds. A dense planting will help shade out many weeds. Periodic cultivations (at 3- to 4-week intervals and between display rotations) will suppress many weeds.	• Control perennial weeds before planting and carefully select flower species for weed management compatibility. • Control annual weeds with mulches, preemergence herbicides, frequent cultivation, and/or hand-weeding. • Selectively control perennial grasses with clethodim or fluazifop, or other grass-selective herbicides. • Avoid nonselective herbicides after planting.
Herbaceous Perennial Beds. Weed management options in herbaceous perennial beds are similar to those for annual flowers, except (1) it is more important to eradicate perennial weeds as there will be no opportunity to cultivate or renovate the bed for several years; and (2) fewer species are included on herbicide labels.	• Control perennial weeds before planting • Use geotextiles where possible • Use mulches, supplement with hand-weeding and preemergence herbicide after weeding if needed.
Mixed Plantings of Woody and Herbaceous Plants. Weed management is complex because of the diversity of species. Different areas of the bed could receive different treatments. Site preparation is critical because post-plant herbicide choices are few.	• Plant the woody species first • Control perennial weeds in the first two growing seasons, then introduce the herbaceous species. • Plant close together to shade the soil. • Group plants within the bed that will receive similar weed management programs.
Herbicides should not normally be needed by home gardeners. Mulching, removal by hand, and proper placement of irrigation water are sufficient in most cases.	

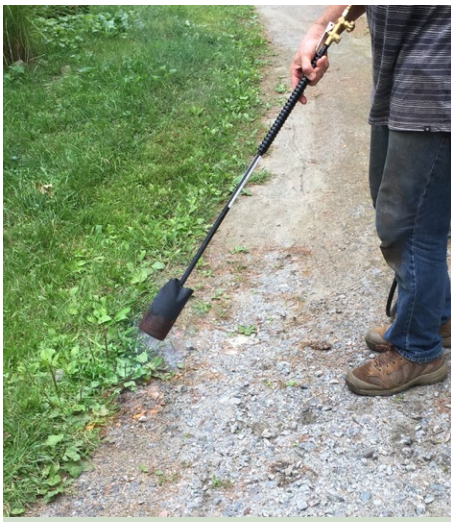

Figure 5. Flame weeders can be used in small areas such as along paths or for weeds between pavers.

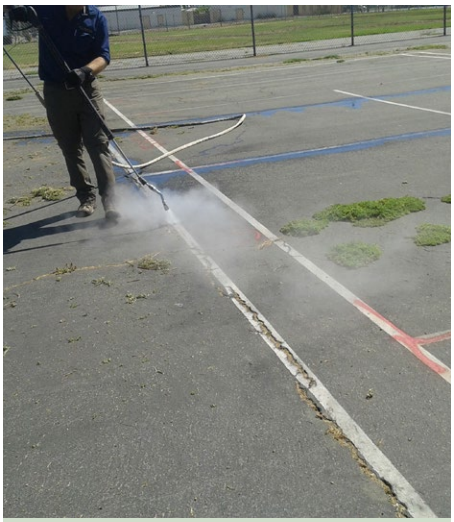

Figure 6. Pressurized steam being used to kill weeds growing in cracks in a school playground.

Figure 7. Plastic guard around young tree to protect trunk from damage by string or weed trimmer.

flammable materials, or near buildings. Don't get the flame near desired plants.

Hot Water or Steam Treatments. Hot water or steam generation can also be used in a similar fashion. The advantage is less chance of fire, but these units need considerable water and fuel. A home gardener can apply hot water (greater than 200°F) and achieve a limited amount of weed suppression. This method is often not very effective because the water temperature rapidly drops once it is removed from the heat source.

There are machines currently available that use superheated hot water or steam (Figure 6) to kill weeds. Professional-level equipment is expensive to purchase and maintain, so these machines are not appropriate for the home user. However, commercial landscapers may find them useful in certain situations where the use of herbicides is not desired, such as when line-marking playing fields, in playgrounds, around woody plants, for edging, for weeds growing in cracks in parking lots, and for weeds growing along fence lines. Because these methods employ boiling water or steam, workers must be adequately trained in the use of the machines to prevent severe burns.

These machines are most effective on very young annual weeds, especially broadleaf weeds, or perennials that have recently emerged from seeds. The effect is similar to that of a nonselective, postemergence herbicide. Hot water and steam are not very effective on perennial weeds with established storage organs, such as rhizomes and bulbs, nor do they control woody plants.

Mowing and Trimming

Mowing can be used to prevent the formation and spread of seeds from many broadleaf weeds from turf into the landscape areas by cutting off flower heads. However, weeds that flower lower than the mowing blade (such as spotted spurge or common woodsorrel) are not controlled.

Repeated mowing tends to favor the establishment of grasses and low-growing perennial weeds. Mowing of some ground covers can rejuvenate them and make them more competitive against weeds.

String and Blade Trimmers. The top growth of older weeds can be controlled by using a string or blade trimmer. Annual broadleaf weeds are more effectively controlled than annual grasses because the growing points of grasses are usually below ground. Most perennial weeds are not controlled using trimmers, but trimming will make them less noticeable in areas if you are limited in other methods for control.

Prevent repeated damage to trunks (Figure 7) of established woody perennials from the string trimmer by placing a temporary shield around the trunk. One way to create a shield is to place a segment of irrigation or drain pipe that is several inches in diameter and split lengthwise around the base of the trunk.

Mulches

A mulch is any material placed on the soil to cover and protect it. Mulches suppress annual weeds by limiting light required for weed establishment. Many types of landscape mulches are available. The most common are bark and other wood products and black plastic or landscape fabric materials. Other products that are used include paper, yard compost, hulls from nuts (such as almonds) or cereals (rice), municipal composts, and stones.

Organic Mulches. Organic mulches (Figure 8) include wood chips, sawdust, yard waste (leaves, clippings, and wood products), and hardwood or softwood bark chips or nuggets. Bark chips are moderate-sized particles (¼ to ½ inch)

Figure 8. Organic mulch composed of shredded bark.

Figure 9. Landscape fabric mulch placed round an ornamental plant. This will be followed by a layer of shredded bark mulch.

and have moderate to good ability to withstand decomposition, while bark nuggets are larger in size (½ to 1½ inches) and have excellent stability over time. All of these can be used in landscape beds planted with herbaceous or woody ornamentals. Larger mulch pieces (greater than 1½ inches) do not provide good weed control unless applied very thickly (often 6 inches or deeper) because the space between the pieces allows light to penetrate and weeds to grow through.

The thickness or depth of mulch necessary to adequately suppress weed growth depends on the mulch type, the weed pressure, and whether an herbicide or an underlayment (e.g., fabric, plastic) mulch is to be used with it. The larger the particle size of the organic mulch, the greater the depth required to exclude all light from the soil surface. Coarse-textured mulches can be applied up to 4 inches deep and provide long-term weed control. Fine-textured mulches pack more tightly and should only be applied to a depth of about 2 inches.

If the mulch is too decomposed, it becomes a means of weed propagation rather than a means of prevention. Plan to periodically replenish organic mulches, regardless of particle size, because of decomposition, movement, or settling. If seedlings germinate in mulches, a light raking, hoeing, or hand-weeding will remove the young weeds.

Bark mulches for ornamentals containing pre-applied herbicides are available for residential use. These should not be used on landscapes with food-producing plants. As with any pesticide, these products must be used with care to make sure the desired plants are not injured. Additionally, protective gloves must be worn when applying them.

Inorganic Mulches. Including both natural and synthetic products, these mulches are generally more expensive and less widely used in the landscape. Natural inorganic mulches are stable over time and include materials such as sand, gravel, or pebbles.

If using rock mulch, consider placing a landscape fabric underneath it. The fabric creates a layer between the mulch and soil, preventing rock pieces from sinking into the soil. It also prevents soil from moving above the rock layer, which would bring weed seed to the surface or create a suitable place for windborne seeds to grow.

Black plastic (solid polyethylene) can be used underneath mulches to improve weed control. It provides excellent control of annual weeds and suppresses perennial weeds, but it lacks porosity and restricts air and water movement. It also tends to tear and break apart rather quickly. For this reason, black plastic is not the preferred long-term weed control method in landscape beds.

Synthetic Mulches. Manufactured materials, called geotextiles or landscape fabrics, have been developed to replace black plastic in the landscape (Figure 9). Geotextiles are porous and allow water and air to pass through them, overcoming the major disadvantage of black plastic.

Although these materials are relatively expensive and time-consuming to install, they become cost-effective if the planting is to remain in place for 4 or more years. Geotextiles are used mainly for long-term weed control around woody ornamental tree and shrub plantings. Geotextiles should not be used where the area is to be replanted periodically, such as in annual flower beds or in areas where the fabric would inhibit the rooting and spread of ground covers.

Tree and shrub roots can penetrate the materials and if the material is removed, damage can occur to the plant's root system. This might be a concern if a fabric has been in place longer than 5 years. One geotextile fabric (BioBarrier) has an herbicide encapsulated in nodules on the fabric that reduces root penetration problems.

Placing a landscape fabric under mulch results in greater weed control than mulch used alone. There are differences in weed-controlling ability among the geotextiles: fabrics that are thin, lightweight, or have an open mesh allow for greater weed penetration than more closely woven or nonwoven (spunbonded) fabrics.

To install a landscape fabric, plant first and then install the fabric afterwards using long U-shaped staples to peg it down. After laying the cloth close to the ground, cut an "X" over the plant and pull it through the cloth). If laying down a fabric before planting, cut an

"X" through the fabric and dig a planting hole.

Avoid leaving soil from the planting hole on top of the fabric because this could put weed seeds above the material. Fold the "X" back down to keep the geotextile fabric as continuous as possible. Weeds will grow through any gap in the landscape fabric, so it is important to overlap pieces of fabric and tack them down tightly.

Apply a shallow mulch layer (about 1 inch deep) to thoroughly cover the fabric and prevent UV light from breaking it down (photodegradation). If weeds grow into or through the geotextile, remove them when they are small to prevent them from creating holes in the fabric. Maintain a weed-free mulch layer on top of the fabric by hand-weeding or by applying herbicides.

Special consideration should be given to the fact that yellow nutsedge can grow through most geotextiles. Thicker fabrics are better at suppressing yellow nutsedge than thinner types. For more information, see *Pest Notes: Nutsedge* listed in REFERENCES.

Problems with Mulches. There are several problems associated with the use of organic and inorganic mulches. Perennial weeds such as field bindweed and nutsedges often have sufficient root reserves to enable them to penetrate even thick layers of mulches. When mulches are too finely textured, applied too thickly, or begin to decompose, they stay wet between irrigations or rain events and allow annual weeds to germinate and grow directly within the mulch. For best weed control, use a coarse-textured mulch, with pieces of about ¼ to ¾ inch in size, with a low water-holding capacity. Weeds that are particular problems are those that have windborne seeds, such as common groundsel, prickly lettuce, and common sowthistle, or those with a taproot such as spotted spurge.

Applying mulches at depths of greater than 4 inches may injure plants by keeping the soil too wet and limiting oxygen to the plant's roots. Disease incidence, such as root or stem rot, may increase when such thick mulches are maintained.

Table 3. Suggestions for placement of herbicide with an organic mulch.

Herbicide	Application
Devrinol (napropamide)	Under the mulch
Dimension (dithiopyr)	Best under mulch, but provides some control when applied on top
Gallery (isoxaben)	Best under the mulch, moderate control when applied on top of mulch
OH2 (pendimethalin + oxyfluorfen)	Works well both under or over mulch
Pennant Magnum (s-metolachlor)	Under the mulch
Ronstar (oxadiazon)	Over the mulch
Rout (oryzalin + oxyfluorfen)	Works well both under or over mulch
Surflan (oryzalin)	Best under the mulch but provides some control when applied on top of mulch
Surflan + Gallery	Under the mulch but will give a fair amount of control even when applied on top of mulch
Treflan (trifluralin)	Under the mulch
XL2G (oryzalin + benefin)	Under the mulch

While the use of organic mulches may provide very effective weed control, it can be improved upon by applying a preemergence herbicide at the same time as the mulch (see Table 3). Supplemental hand-weeding or spot spraying may also be needed.

Avoid mulches with a pH less than 4 or that have an "off odor" such as an ammonia, vinegar, or rotten-egg smell. These mulches were stored incorrectly and contain chemical compounds that may injure plants, especially herbaceous plants.

If using a composted mulch, temperatures achieved during the composting process should have killed most weed seeds. However, if the compost was stored while uncovered, weed seeds may have been blown onto the mulch. Be sure the mulch is not contaminated with weed seeds or other propagules such as nutsedge tubers.

In addition to the precautions noted above about rock mulches, removal of weeds in rock mulches by hand weeding or hoeing is very difficult. White-colored rocks are very reflective, and this increased light can damage sensitive plants. Dark-colored rocks will retain heat and may also cause plant stress.

Herbicides for Landscape Plantings

Herbicides have been effectively used in many types of landscape plantings and are most often integrated with the cultural practices discussed above. Generally, home gardeners should not need to apply herbicides to existing landscapes. Hand-weeding and mulching should provide sufficient control and avoid the hazards to desirable plants associated with herbicide use.

Many of the herbicide active ingredients and trade names listed here are for use by licensed professional landscape pest managers and are not available to home gardeners. There are some home-use products that contain the same active ingredients, but the trade name is different. To determine which herbicide active ingredient(s) are in a product, read the information on the label.

Preemergence Herbicides. After annual weeds have been removed from an area or before they emerge, preemergence herbicides can be applied to prevent the germination or survival of weed seedlings. Preemergence herbicides must be applied before the weed seedlings emerge. Match herbicides with weed species present and consider using herbicide combinations. The activity of specific herbicides toward specific weed species varies. Also, the length of control varies amongst herbicide active ingredients, rates of application, and other factors.

Examples of preemergence herbicide active ingredients and trade names include: dithiopyr (Dimension), isoxaben (Gallery), napropamide (Devrinol), oryzalin (Surflan, Weed Impede), oxadiazon (Ronstar), pendimethalin (Pendulum, Pre-M), prodiamine (Barricade), trifluralin (Preen), flumioxazin (Broadstar), and indaziflam (Marengo). Most of these will control annual grasses and many annual broadleaf weeds and can be used safely around many woody and herbaceous ornamentals. Isoxaben is used for control of annual broadleaf weeds only.

Combinations of herbicides increase the spectrum of weeds controlled and provide effective control of grasses and many broadleaf weeds. Commonly used combinations include tank mixes of the materials listed above or premixed products such as isoxaben/trifluralin (Snapshot), oryzalin/benefin (XL2G), oxyfluorfen/oryzalin (Rout), and oxyfluorfen/pendimethalin (OH2), oxyfluorfen/prodiamine (Biathlon), and dimethenamid-P/pendimethalin (Freehand). Check the label to determine around which ornamental species the material can safely be used and which species of weeds may be controlled.

Timing. Timing of a preemergence herbicide application is determined by when the target weeds are expected to germinate, or by when the weed is in the stage that is most sensitive to the herbicide. In general, late summer to early fall applications of preemergence herbicides are used to control winter annuals, while late winter to early spring applications are used to control summer annuals and seedlings of perennial weeds. If the herbicide is not moved into soil due to lack of irrigation or insufficient rainfall or if a short residual (short acting) product was applied, more than one herbicide application may be needed. Generally, herbicides degrade faster under wet, warm conditions than under dry, cool conditions. Some herbicides are degraded by sunlight, so incorporation via irrigation, rain, or cultivation may be necessary. Also, some preemergence herbicides need to be applied at a higher rate if the soil is high in organic matter due to binding with the organic matter. Check the herbicide label for recommendations about what rate to use depending on your soil type.

Herbicide and Mulch Placement. The placement of a preemergence herbicide in relation to an organic mulch can affect the herbicide's performance. Additionally, the characteristics of organic mulches can affect how herbicides work.

Mulch that is made up of coarse particles will have little effect on herbicide activity. A mulch that primarily consists of fine particles can reduce the availability of some herbicides. The finer the organic material (compost or manure, compared to bark), the greater the binding of the herbicide. Many preemergence herbicides are tightly bound by organic matter, and while the binding minimizes leaching, it can also minimize an herbicide's activity.

Another important factor is the depth of the mulch. An herbicide applied on top of a thin mulch may be able to leach through to where the weed seeds are germinating, but when applied to the top of a thick layer of mulch it may not get down to the zone of weed seed germination. Suggestions for use of mulch with herbicides are given in Table 3.

Postemergence Herbicides. When weeds are not controlled by preemergence herbicides or geotextile fabrics and are difficult to control using mechanical or physical methods, postemergence herbicides may be required. Most postmergence herbicides control existing plants only and do not give residual weed control. Their primary function is to control young annual species, but some are also used to control perennial species.

Some herbicides are "systemic" or "translocated," meaning they move throughout rapidly-growing plants. Common systemic herbicides include the herbicides with the active ingredients clethodim or fluazifop which selectively control most annual and perennial grasses, 2,4-D which selectively controls many annual and perennial broadleaf plants, and glyphosate (Roundup Pro and others) which is nonselective and effective on most annual and perennial weeds.

Glufosinate (Finale or Leopard), diquat (Reward), pelargonic acid (Scythe), and herbicides containing plant oils such as clove and cinnamon (Bonide Burnout) or limonene (Avenger), or those using fatty acids (FinalSan) or acetic acid (Weed Pharm) are nonselective, contact herbicides that kill or injure any vegetation they contact. They kill small annual weeds, but only "burn off" the exposed parts of perennial weeds. They are most effective on small broadleaf weeds. When using contact herbicides, especially on larger plants, it is important to have excellent spray coverage. Weed control can often be improved by adding a surfactant to the spray mix. The herbicide's label usually provides guidance on which type of surfactant to use.

Avoid Herbicide Injury. Because of the close proximity of many different species of plants in the landscape, herbicide injury to desired plants may occur, resulting in visual plant damage. Herbicide injury symptoms vary according to plant species and the herbicide and can include the following:

- yellowing (chlorosis)
- whitening or bleaching
- root stunting
- distorted growth
- death of leaves

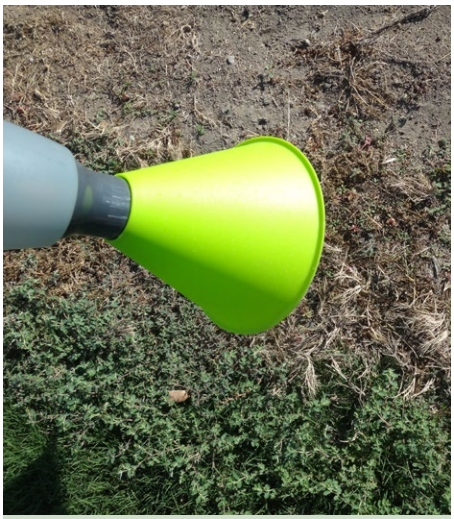

Figure 10. Shielded sprayer.

There are many other causes of similar plant injury; including nutrient deficiencies, fertilizer or salt burn, plant diseases, insect pests, and severe weather conditions.

Herbicide injury usually occurs when an herbicide is applied to a site or plant where it is not labeled or at a rate or frequency greater than written on the label. Herbicide movement from an adjacent site via air or water can occur, so applicators should avoid harming nearby plants by using some of the techniques below.

Granular formulations of preemergence herbicides are less likely to cause injury than sprayable formulations. Using a granular formulation reduces the potential for damage by foliar uptake, but granules of some herbicides can still injure plants if they collect in the base of leaves or adhere to wet leaves.

Apply nonselective liquid herbicides with low pressure and large droplets on a calm day. Use shielded sprayers (Figure 10) when making applications around ornamentals to avoid contact with nontarget plants.

Herbicide injury to established plants from soil-applied chemicals is often temporary but can cause serious growth inhibition to newly planted ornamentals. Injury may result when persistent herbicides are applied to surrounding areas for weed control in turf or complete vegetative control under pavement. Activated charcoal incorporated into the soil may adsorb the herbicide and minimize injury.

Usually it just takes time for herbicide residues to completely degrade. To speed degradation, supplement the organic content of the soil and keep it moist but not soggy during periods of warm weather.

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WARNING ON THE USE OF PESTICIDES

Pesticides are poisonous. Some pesticides are more toxic than others and present higher risks to people, nontarget organisms, and the environment. A pesticide is any material (natural, organic, or synthetic) used to control, prevent, kill, suppress, or repel pests. "Pesticide" is a broad term that includes insecticides, herbicides (weed or plant killers), fungicides, rodenticides, miticides (mite control), molluscicides (for snails and slugs), and other materials like growth regulators or antimicrobial products such as bleach and sanitary wipes that kill bacteria.

Always read and carefully follow all precautions and directions provided on the container label. The label is the law and failure to follow label instructions is an illegal use of the pesticide. 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, and animals. Never place pesticides in food or drink containers. Consult the pesticide label to determine active ingredients, correct locations for use, signal words, and personal protective equipment you should wear to protect yourself from exposure when applying the material.

Pesticides applied in your garden and landscape can move through water or with soil away from where they were applied, resulting in contamination of creeks, lakes, rivers, and the ocean. Confine pesticides to the property being treated and never allow them to get into drains or creeks. Avoid getting pesticide onto neighboring properties (called drift), especially onto gardens containing fruits or vegetables ready to be picked.

Do not place containers with pesticide in the trash or pour pesticides down the sink, toilet, or outside drains. Either use all the pesticide according to the label until the container is empty or take unwanted pesticides to your local Household Hazardous Waste Collection site. Contact your county agricultural commissioner for additional information on safe container disposal and for the location of the Hazardous Waste Collection site nearest you. Follow label directions for disposal of empty containers. Never reuse or burn the containers or dispose of them in such a manner that they may contaminate water supplies or natural waterways.

Produced by the **Statewide Integrated Pest Management Program**, University of California, 2801 Second Street, Davis, CA 95618-7774.

Technical Editor: K Windbiel-Rojas

ANR Associate Editor: AM Sutherland

Editor and Designer: B Messenger-Sikes

ILLUSTRATIONS: Figures 1, 3, 4, 7, and 8: Jack Kelly Clark; Figures 2 and 9: CA Reynolds; Figure 5: P Boise; Figures 6 and 10: CA Wilen.

This and other Pest Notes are available at ipm.ucanr.edu.

For more information, contact the University of California Cooperative Extension office in your county. See your telephone directory for addresses and phone numbers, or visit: ucanr.edu/County_Offices.

University of California scientists and other qualified professionals have anonymously peer reviewed this publication for technical accuracy. The ANR Associate Editor for Urban Pest Management managed this process.

To simplify information, trade names of products have been used. No endorsement of named products is intended, nor is criticism implied of similar products that are not mentioned.

This material is partially based upon work supported by the Extension Service, U.S. Department of Agriculture, under special project Section 3(d), Integrated Pest Management.

Suggested citation: Wilen CA. 2018. *UC IPM Pest Notes: Weed Management in Landscapes*. UC ANR Publication 7441. Oakland, CA.