Ornamental Weed Control

Introduction

If there were no humans there wouldn't be any weeds. There are no weeds in nature. Good or bad, we decide which plants are weeds. Opinions as to what is a weed vary widely. Divergent viewpoints on this matter have given rise to the observation that one person's weed is another's wildflower. Typically, a weed is a plant growing where someone doesn't want it.

Weed control in ornamentals may be one of the most difficult challenges in pest management. Unlike turfgrass weed control, there is rarely an opportunity to control weeds in a planting of a single species. Landscape managers are likely to encounter woody trees and shrubs along with annual and perennial herbaceous species in the same bed. Multiplying these life cycle and growth habit possibilities by the hundreds of species and varieties available yields an endless number of combinations. Other challenges include little opportunity to use traditional approaches to weed control such as mowing, selective, broad-spectrum herbicides and cultivation. Landscape weed control is almost always labor intensive due to steep slopes and other design obstacles that make it impossible to use anything but hand-held equipment.

Weed Identification

To conduct an effective weed management program, the manager should be able to identify target weeds to genus and preferably to species. (For example: *Poa annua*. *Poa* is the genus name and *annua* is the species name for annual bluegrass.) Accurate weed identification is essential to selecting the appropriate control technique.

Weed identification should begin with classifying weeds by type. The five most common weed types are grasses, broadleaves, sedges, rushes and other non-grass monocots such as weeds in the lily family.

Grasses are monocotyledonous plants, which mean they have only one seed leaf (cotyledon) present when a grass seedling emerges from the soil. Grasses have joints (nodes) and hollow, rounded stems. The true leaves (as opposed to seed or cotyledon leaves) have parallel veins and are several times longer than they are wide. Bermudagrass, crabgrass, goosegrass and annual bluegrass are typical grass weeds found in ornamentals.

Broadleaf weeds are dicotyledonous, which means they have two cotyledons (seed leaves) at emergence and have net-like veins in their true leaves. Broadleaves often have colorful flowers compared to the inconspicuous flowers found on grasses. Chickweed, spurge, groundsel, henbit, lespedeza, clover, dandelion and dock are typical broadleaf weeds.

Sedges have solid, triangular stems (in most species) which bear leaves extending in three directions (3-ranked). Sedges lack ligules and auricles, and the leaf sheath is continuous around the stem. Yellow and purple nutsedge, annual sedge, green kyllinga, rice flatsedge and globe sedge are examples.

Rushes have round, solid stems and favor a moist habitat. Path rush is an example of the rush family. Path rush is often found on golf cart routes, sports fields and other compacted areas.

The **Lily** family also contains some important species such as wild garlic, false garlic, star-of-Bethlehem and grape hyacinth. These plants have parallel veins but are not grasses, sedges or rushes.

Weed Life Cycles

The previously listed weed classifications may be further divided into annuals, biennials and perennials. **Annuals** germinate from seed, grow, mature and die in less than 12 months. Annuals may be further classified as winter and summer annuals. **Winter annuals** germinate in the fall, grow during cool periods, mature in the spring and then die during the summer. **Summer annuals** germinate in the spring, grow actively during the summer and die in the fall. Crabgrass and goosegrass are examples of summer annual grasses. Prostrate knotweed is an example of a summer annual broadleaf, while

henbit and chickweed are representative of winter annual broadleaves.

Biennials reproduce from seed and complete their life cycle in two years. Biennials form rosettes and store foods in their fleshy roots the first year and then flower the second year. Many thistle species are biennials.

Perennial weeds live more than two years. Perennials may reproduce from seed or from vegetative structures such as roots, rhizomes, stolons, tubers or bulbs. The ability to reproduce vegetatively makes perennials more difficult to control. Some perennials such as dandelion, dock and wild garlic are actively growing during cool weather, while others like dallisgrass and nutsedge grow rapidly during the summer months. Perennials are further subdivided as simple perennials and creeping perennials. **Simple perennials**, such as dock and dandelion, overwinter by means of a vegetative structure such as a perennial root with a crown, but they reproduce almost entirely by seed. **Creeping perennials** can both overwinter and produce new independent plants from vegetative reproductive structures. Vegetative reproductive structures include creeping roots, stolons (bermudagrass), rhizomes (johnsongrass), tubers (nutsedge) and bulbs (wild garlic). Most perennials can also reproduce from seed.

If you are serious, a guide to weed identification is a very useful tool because weed identification is arguably the most important part of weed control. Some recommended publications may be found in the section “Selected Weed ID References.”

Herbicides

Nomenclature

Herbicide labels contain three names: trade name, common name and chemical name. The nomenclature for Roundup would be as follows:

Trade Name: Roundup

Common Name: glyphosate

Chemical Name: N-(phosphonomethyl)glycine

The trade name is used by the chemical company to market the product and is often the most recognizable name. The common name is a generic name that is given to a specific chemical. Only one common name exists for each herbicide. It is useful to be familiar with common names when comparing products. The chemical name describes the chemistry of the herbicide. To make things confusing, the same or different chemical companies often sell the same herbicide under different trade names. For example, prodiamine is marketed by Syngenta for turf use as Barricade and for landscape use as Factor.

Herbicide Classification

Herbicides may be classified in many ways, but some of the most important groupings are selectivity, timing of application, chemistry and mode of action.

Selectivity

Selective. A selective herbicide controls or suppresses some plant species without seriously affecting the growth of another plant species. Selectivity may be due to differential absorption, translocation, morphological and/or physiological differences between ornamentals and weeds. Most ornamental herbicides are selective. Fusilade II is an example of a selective herbicide that controls many grass weeds without causing significant injury to broadleaf plants.

Non-selective. Non-selective herbicides control or suppress plants regardless of species. Glyphosate (Roundup Pro), glufosinate (Finale) and diquat (Reward) are examples of non-selective herbicides. These products are often used for trimming along sidewalks and fences and as preplant treatments when renovating or establishing ornamentals. It is important to note that the selectivity of some herbicides is based on rate. Increasing the rate of a selective herbicide such as Princep (simazine) will move it into the non-selective category.

Mode of Action

Mode of action refers to the sequence of events, which includes herbicide absorption, translocation to the site(s) of action, inhibition of a specific biochemical reaction, the degradation or breakdown of the herbicide in the plant, and the effect of the herbicide on plant growth and structure.

Herbicide Movement in Plants

Systemic (sometimes referred to as **translocated**) herbicides are extensively translocated in the vascular system of the plant. The vascular system consists of the xylem and phloem. The xylem transports water and various nutrients in solution, upward from the roots where they entered the plant, through the stems, and into leaves, flowers and fruits. The phloem conducts food materials from their principal sites of synthesis in leaves to other locations, such as fruits and developing roots and shoots, for storage and use. Systemic herbicides are slower acting than contact herbicides because they require from several days to a few weeks to move throughout the vascular system of a treated plant. Systemic herbicides may be selective or non-selective. Glyphosate (Roundup Pro) is an example of a non-selective systemic herbicide, while Vantage (sethoxydim) is an example of a selective systemic herbicide. Most of the systemic herbicides move in the xylem and phloem with the exception of the triazines (atrazine, simazine, Sencor), which are xylem mobile only.

Contact herbicides affect only the green plant tissue that comes in contact with the herbicide spray. Thus, thorough coverage of the weed foliage is needed to achieve optimum control. These herbicides are either not translocated, or only move to a limited extent, within the vascular system of plants. For this reason, underground vegetative reproductive structures such as roots, rhizomes and tubers are not affected. Multiple applications of contact herbicides are needed for long-term control because plants regrow from these unaffected plant parts. Contact herbicides are fast acting. Symptoms are often visible within a few hours of application. Basagran T/O (bentazon) is a selective contact herbicide. Reward (diquat) is a non-selective contact herbicide.

Herbicide Families

Herbicides with similar chemistry are grouped into families. In general, herbicides in the same family exhibit similar absorption, translocation and mode of action. It is convenient to combine herbicide families that have similar sites of action into groups. For ornamental weed managers, the importance of knowing which herbicides have similar sites of action lies in developing weed control strategies that minimize the potential for developing herbicide-resistant weed populations.

Herbicide Resistance

A number of weed species that were once easily managed by certain herbicides have developed resistance. These weeds are no longer controlled by applications of previously effective herbicides.

Herbicide resistance probably develops through the selection of naturally occurring biotypes of weeds exposed to a family of herbicides over several years. A biotype is a population of plants within the same species that has specific traits in common. Resistant biotypes may have slight biochemical differences from their susceptible counterparts so they are no longer sensitive to certain herbicides. Resistant plants survive, go to seed and create new generations of herbicide-resistant weeds.

Dinitroaniline-resistant goosegrass and crabgrass have been documented in ornamentals. However, these plants are susceptible to other preemergence grass herbicides such as Ronstar.

Experience has shown that the potential for developing resistance is greatest when an herbicide has a single site of action. Development of johnsongrass resistant to the grass specific herbicides has already occurred in many areas in spite of their relatively short time in the market. We now have Illoxan-resistant ryegrass in the United States and several other countries.

Regardless of the mechanism for resistance, becoming familiar with the herbicide mode of action can help turf managers design programs that prevent the development and spread of herbicide-resistant weeds. Management programs for herbicide resistance should emphasize an integrated approach that stresses prevention. Dependence on a single strategy or herbicide family for managing weeds will surely increase the likelihood of additional herbicide resistance problems.

Some Strategies for Managing Resistance

1. Rotating herbicides having different modes of action. This is a problem in landscape weed control because there are a limited number of modes of action from which to choose.
2. Using tank mixtures of herbicides having different modes of action.
3. Avoiding sequential application of the same herbicides (over several years) or herbicides having the same mode of action.
4. Controlling weedy escapes in border areas and ditch banks.
5. Practicing good sanitation to prevent the spread of resistant weeds.
6. Integrating cultural, mechanical and chemical weed control methods.

Herbicide Formulations

The two big groups of herbicide formulations are dry and liquid. The amount of active ingredient in a dry formulation is designated as a percent of the weight. Active ingredient in liquid forms is listed in pounds per gallon. Within the dry formulations there are granular or pelletized herbicides that are spread directly on the target in dry form. These products usually contain very low percentage of active ingredient (0.1% to 2.0%) and are designated by the abbreviation **G** or **GR** (granule) or **P** (pellet). Other dry formulations are mixed with water and sprayed on the target. These products are designated as **SP** (soluble powder), **W** or **WP** (wettable powder), **WSP** (water soluble packet), **DF** (dry flowable), **SG** (soluble granule) or **WG**, **DG** or **WDG** (water dispersible granule). Liquid formulation designations include **L** or **F** (liquid suspension), **E** or **EC** (emulsifiable concentrate), **SC** (suspension concentrate), **SL** (soluble liquid), **ME** (microencapsulated) and **CS** (capsule suspension).

Some herbicide formulations may be incompatible. MSMA and 2,4-D amine will sometimes form sludge when mixed. Liquid nitrogen and 2,4-D amine will always form sludge when mixed. In addition to physical incompatibility, two herbicides may mix well but may be chemically incompatible resulting in a reduction in herbicidal activity. For example, mixing 2,4-D with Fusilade, Vantage or other grass-specific herbicides will result in

Ornamental Herbicides with the Same Mode of Action

Dinitroanilines (Root Growth Inhibitors)	Lipid Inhibitors	ALS Inhibitors
Balan 2.5G (benefin) Biobarrier II (trifluralin) Biobarrier Root Control (trifluralin) Dimension 1 EC (dithiopyr) Barricade 65 WDG (prodiamine) Ornamental Weedgrass Control (pendimethalin) Pendulum 2G (pendimethalin) Pendulum 3.3 EC (pendimethalin) Pendulum WDG (pendimethalin) Pre-M 3.3 EC (pendimethalin) Pre-M 60 DG (pendimethalin) Treflan 5G (trifluralin) Surflan (oryzalin)	Acclaim Extra (fenoxaprop) Envoy (clethodim) Fusilade II (fluazifop) Ornamec 170 (fluazifop) Vantage (sethoxydim)	Image (imazaquin) Manage (halosulfuron)

decreased grass control. This is referred to as antagonism. The label will give instructions on what can and cannot be mixed with that herbicide. When tank mixing different formulations: (1) fill the tank 2/3 full of water, (2) start the agitation and keep it running and (3) add the respective formulations in this order: wettable powders > dry flowables > liquid suspensions > emulsifiable concentrates > soluble concentrates.

Herbicide Spray Additives and Their Uses

Adjuvant: Any additive used with an herbicide that enhances the performance or handling of the herbicide.

Compatibility agent: A material that allows the mixing or improves the suspension of two or more formulations when applied together as a tank mix. Compatibility agents are used most frequently when a liquid fertilizer is the carrier solution for an herbicide.

Crop oil concentrate: Oil-based material that enhances herbicide penetration through the leaf cuticle.

Defoamer: A material that eliminates or suppresses foam in the spray tank so that pumps and nozzles can operate correctly.

Drift control agent: A material used in liquid spray mixtures to reduce spray drift.

Fertilizer: Certain fertilizers added to the spray tank can enhance penetration of the herbicide into the leaf. Ammonium sulfate and 10-34-0 are commonly used as additive in some parts of the country. Ammonium sulfate is sometimes mixed with glyphosate to treat weeds under marginal conditions such as drought stress. 10-34-0 has been used as an herbicide additive for velvetleaf control in the upper Midwest.

Surfactant: A material that improves the emulsifying, dispersing, spreading, wetting or other surface-modifying properties of liquids.

Wetting agent: A material that reduces interfacial tensions between water droplets and the leaf cuticle.

Timing of Application

Herbicides are also classified by when the chemical is applied relative to turfgrass and/or weed seed germination. The majority of herbicides may be classified into one of three timing categories: preplant, preemergence or postemergence. However, several herbicides have pre and postemergence activity. Examples include imazaquin (Image), simazine (Princep) and pronamide (Kerb).

Preemergence Herbicides

Preemergence herbicides are the foundation of an ornamental weed management program. Preemergence herbicides are applied to the site before weed seed germination. After being activated by rainfall or irrigation, these herbicides form an herbicide barrier at or just below the soil surface. When the roots or shoots of germinating seeds come in contact with the herbicide barrier, their growth is inhibited. Most preemergence herbicides are cell division inhibitors affecting the emerging root and shoot, which are sites of rapid cell division. Weeds that have already emerged (visible) are not consistently controlled because their growing point has escaped contact with the herbicide. The primary target of preemergence herbicides is annual grass, but some small-seeded annual broadleaves will be controlled.

A variety of factors affect the performance of preemergence herbicides. These include timing of application in relation to weed seed germination, soil type, environmental conditions (primarily temperature and rainfall), target weed species and biotype, and cultural practices that follow application. Soil organic matter and clay content have the greatest influence on the activity of preemergence herbicides.

Ideally, preemergence herbicides should be applied just before weed seed germination begins. Applying too early may result in reduced control or no control due to leaching and/or normal herbicide degradation. Preemergence herbicides must be in place and activated before the onset of weed seed germination. Activation of preemergence herbicides requires 0.25 to 0.5 inch of rainfall or overhead irrigation. For optimum performance, rainfall or

irrigation should occur within 24 hours of application. Water moves the herbicides into the upper layer of the soil. Failure to incorporate herbicides will result in loss through processes such as breakdown by sunlight and escape into the atmosphere as a gas. The critical period between application and activation by rainfall or irrigation varies with herbicide, rate and environmental conditions. However, it is safe to assume that sooner is better and, if irrigation is available, water-in preemergence herbicides immediately after application.

In warm weather, herbicides begin to degrade soon after application, eventually reaching a level at which weed emergence and growth can occur. Preemergence herbicides will degrade to the point of ineffectiveness from one to four months after application. For this reason, repeat or sequential applications are needed for full season control.

A typical cycle of preemergence herbicide applications would include an initial application in late winter to early spring to control summer annuals followed by second application in late summer to early fall to control winter annuals. In some parts of the country such as the humid South, an application in late May or early June may be needed because the spring application will have dissipated by that time.

Postemergence Herbicides

Postemergence herbicides are intended for use on weeds that have emerged and are visible. Postemergence herbicides are applied directly to emerged weeds. In contrast to preemergence herbicides, most postemergence herbicides have little or no soil activity. It is possible to conduct a total postemergence weed control program in ornamentals provided multiple applications are used throughout the year. Disadvantages of total postemergence weed control include the need for frequent applications and the possibility of temporary ornamental injury. Most weed control professionals use a combination of preemergence and postemergence herbicides. Preemergence herbicides form the basis of most programs with postemergence herbicides used to control weeds that escape the preemergence treatments. Established perennial weeds, both grasses and broadleaves, must be controlled with postemergence herbicides.

General guidelines for best results with postemergence applications are small weeds, adequate soil moisture and air temperatures between 60º and 90ºF. Weeds that are small (two to four-leaf stages) and actively growing are much easier to control with postemergence herbicides. Control is improved at this stage because young weeds readily absorb and translocate herbicides.

Weeds that are stressed due to dry weather, heat or other environmental factors are more difficult to control with postemergence herbicides. Applying postemergence herbicides at temperatures above 90ºF increases the risk of ornamental injury.

The resistance of postemergence herbicides to wash-off by rainfall or irrigation varies among products. Typically, a rain-free period of 6 to 24 hours is sufficient to avoid a reduction in effectiveness. Even if rain falls soon after application, some degree of control will be achieved.

Rather than a single rate, a range of postemergence herbicide rates for a product usually is given. Repeat applications at moderate rates are generally more effective than a single application of the higher rate. The follow-up application is timed to be 7 to 14 days after the first or when regrowth appears.

Spot Spraying

Directed spot spraying with a hand-held, pump-up sprayer or lever-operated, backpack sprayer is one of the most commonly used methods of applying herbicides in and around landscape plantings. Lack of herbicide selectivity and the obstructions created by landscape plants often dictate the use of this approach. Spot spraying solutions are typically prepared by adding a certain amount of liquid herbicide per gallon of spray mix. These are usually given on a percent of total volume basis. For example, to make a 2% mixture of Roundup and water, add 2.66 oz of Roundup per gallon of water. This method is best for herbicides with little or no soil activity. Soil active herbicides should be carefully applied on a per unit area basis (per 1,000 sq ft or per acre).

Most pump-up sprayers do not have pressure gauges or pressure controls. The pressure in the tank will drop as the material is sprayed from the tank.

This pressure drop can be partly overcome by filling the tank only 2/3 full with spray solution, so that considerable air space is left for initial expansion, and by re-pressurizing the tank frequently. If the sprayer has a pressure gauge, re-pressurize when the pressure drops approximately 10 psi from the initial reading.

When spraying, do not overapply. The coverage should be similar to that resulting from a light rain. Just wet the foliage of the target weed and move on. Do not spray until runoff.

Use a funnel or some other shield attached just above the nozzle when applying non-selective herbicides such as Roundup, Reward or Finale. Solo sells an attachment for this purpose called a Drift Guard or you can improvise. A normal plastic funnel may be adapted, or cutting the top from a 2-liter soft drink bottle can make a cheap alternative. Attach it with duct tape or a hose clamp. Beware of dripping or tracking herbicide with your feet when moving from one location to another.

Principles of Herbicide Use

Before selecting any herbicide, determine whether or not the desirable landscape plants are tolerant of the chemical being considered. Consult the label to determine which herbicides may be safely used on the ornamentals in question. The majority of ornamental herbicide failures and mistakes are not from the weakness of the herbicide but from:

1. Choosing the wrong herbicide due to misidentification or lack of research into herbicide selection.
2. Applying at the wrong time.
3. Treating an ornamental species that is sensitive to the herbicide and will be damaged.
4. Poorly calibrated application equipment.
5. Failure to distribute the herbicide uniformly across the target area.
6. Using application equipment not suited to the job.
7. Inadequate spray tank agitation.
8. Treating the target weed at the wrong stage of growth (too large, too small).
9. Applying when environmental conditions are not conducive to good weed control (dry, hot, cold, windy, rainfall imminent).

Herbicide Selection Criteria

1. Does it control most of the weeds present?
2. Are the existing ornamentals listed on the label?
3. How close are susceptible ornamentals and other non-target species?
4. Is there potential for damage to future plantings due to residual herbicide remaining in the soil?
5. How will the herbicide be applied? Spread or sprayed?

Site Preparation

Because weed control in landscape plantings is difficult under the best conditions, it is nearly impossible to spend too much time on preplant weed control. There are always exceptions to this admonition, but many years of experience have taught me that people rarely expend excessive effort on preplant weed control in turfgrass and ornamentals. This may be all right on some sites, but if there are tough perennial weeds present, it is a mistake. Fumigation using methyl bromide, Basamid or soil solarization is an option for landscape beds. Solarization may not be practical because it must be done during the hottest part of the year and the covers must be left in place for six weeks.

Preplant Herbicide Application

One application of Roundup Pro or another labeled glyphosate product at least two weeks before planting is a cheaper but less effective alternative to soil fumigation. Complete control of some perennial weeds may require multiple applications

of Roundup. The treatments should be timed to the appearance of regrowth of the target weed. It should be noted that a full growing season of repeated Roundup treatments (usually 3 or 4) will control bermudagrass but not yellow or purple nutsedge.

Soil Fumigation

Soil fumigants are volatile liquids or gases that control a wide range of soilborne pests. Soil fumigants are also highly toxic and are expensive. Their use is often limited to high-value crops such as putting greens, propagation beds and ornamentals. A cover, usually plastic film, is placed over the treated area to trap the fumigant vapors in the soil. In addition to many weeds, fumigants also control diseases, nematodes and insects. Weed seeds that have hard, water-impermeable seedcoats such as mallow, sicklepod, white clover, redstem and morningglory are not controlled by fumigants. In addition, nutsedge control with fumigants is not dependable. Factors to consider before choosing a soil fumigant include expense, soil moisture level, soil temperature and time available before planting. There are three compounds available for soil fumigation in ornamentals: (1) methyl bromide, (2) metham or metam-sodium and (3) Basamid (dazomet).

Methyl bromide is a colorless, nearly odorless liquid or gas. At 38ºF, the liquid becomes a gas and at 68ºF is 3.2 times heavier than air. These properties require that a cover is used or methyl bromide will escape. Methyl bromide is extremely toxic (acute vapor toxicity is 200 ppm) due to inhalation hazard, and it is commonly combined with a warning agent such as chloropicrin (teargas) to warn the user of escaping gas.

Before using methyl bromide, the soil should be in a condition suitable for planting including seedbed preparation by tilling. Control will be only as deep as the soil is adequately tilled. Soil should be moist for adequate soil penetration and dispersion. Saturated soils or extremely dry soil will limit fumigant movement through the soil, thus reducing the level of weed control. Soil temperature at 4 inches should be a minimum of 66ºF. Fumigation will not be effective if soil temperature is below 50ºF. Before or during application, the site should be covered with plastic film with the edges properly sealed to prevent gas leakage. The treated area should be covered for 24 to 48 hours. The cover should then be removed and the soil aerated for 24 to 72 hours before planting.

Metham or **metam-sodium**. Metham (methyldithiocarbamate) is a member of the thiocarbamate herbicide family. Metham is water-soluble and upon contact with the moist soil breaks down to form the highly toxic and volatile chemical methyl isothiocyanate. Metham should be applied to moist soil with a temperature of at least 60ºF. It is most effective when used with a cover, but it may be used with a water and soil-seal method. With the water soil-seal method, the soil is cultivated and kept moist for a week before treatment. The material is applied, roto-tilled and watered in to the desired depth of control (usually 4 to 6 inches). Approximately seven days after treatment, the area should be cultivated to help release any residual gas. One to two weeks later (two to three weeks after initial application), the treated area may be planted. Disadvantages of metham use include the lowered effectiveness when used without a cover and the longer waiting period before planting. The oral LD_{50} of metham is 820 mg/kg while the dermal LD_{50} is 2,000 mg/kg.

Basamid (dazomet) has recently been introduced as a soil fumigant. Dazomet is a granular formulation and is not a restricted-use pesticide. Dazomet must be applied accurately and uniformly and then incorporated into the soil. Its use and effectiveness are very similar to metham. One of its main attractions is that, unlike methyl bromide, it can be handled without any special equipment. We have used Basamid in our research program on native soil with good success. While the label gives other options, use a plastic film to seal the site just as you would with methyl bromide. We consider Basamid to be about 80% as effective as methyl bromide.

Planters

When planting containers, it is a good idea to use sterile or weed-free potting soil whenever practical. Even if clean planting media is used, there will be some weed encroachment. The most practical method of weed control for a small

number of planters is the use of hand weeding and mulches. The key to successful hand weeding is frequent inspection. It is important to make regular weed removal rounds during the growing season before the number of weeds present becomes overwhelming. A single smooth pigweed may produce up to 200,000 seeds; a single annual bluegrass plant is capable of producing 2,000 seeds. The other option is the use of herbicides to control most of the weeds. Do not enter into herbicide use in planters lightly. Accurate application and careful herbicide selection is critical. There is a limited soil volume in containers, and this provides less herbicide buffering capacity compared to field plantings. As always, when using herbicides, it is a good idea to try new products and techniques on a small trial area before treating everything in the landscape. Not all ornamental herbicides are labeled for use in containers. Some are designated for field use only. Consult the label for use options. Ornamental Herbicide II and Rout herbicide are two of the most popular preemergence products for containers. Both products contain Goal (oxyfluorfen), which will cause contact burn of foliage if not washed off with irrigation water immediately after application. Ronstar (oxadiazon) also has the potential for foliar burn. Some of the other products registered for container use include Treflan, Ronstar and Devrinol.

Annual Flower Beds

In a perfect world, all annual beds would be fumigated before planting. If time and money allow, fumigation should be the first choice on high value annual beds. While under scrutiny at this time, methyl bromide is still available for soil fumigation. The other products available for this use are Vapam and Basamid. Methyl bromide remains the most effective of the three although its high level of toxicity restricts its use to professional applicators.

Short of fumigation, hand weeding, frequent cultivation, mulches, herbicides or a combination of all these methods are used for weed control in annuals. Cultivation has limitations as a weed control method in landscape beds. Cultivation may damage roots, spread perennial weeds and encourage germination of weed seeds by bringing them to the soil surface. Perennial weeds should be controlled before planting. Select annual species that are compatible with effective herbicides. Use of landscape fabrics is not practical for annual beds due to the short-term nature of the planting. Organic mulches are the most practical. Preemergence herbicides may be applied to the soil before mulching or applied to the mulch and watered in after planting. Place transplants into weed-free soil. When using a preemergence herbicide in an annual bed, irrigate to settle the soil around the plants before applying the herbicide. A granular product such as Pendulum 2G is easy to apply and labeled for use on many popular bedding plants. Planting to encourage the rapid formation of a canopy will help shade weeds. Avoid small, odd-shaped flowerbeds. They are difficult to maintain and mow around. When mowing, blow clippings away from beds to prevent the introduction of weed seeds. Prepare the soil and apply the mulch before planting annuals. It is easier to install transplants through the mulch than to attempt to mulch around them after planting. Cultivation when changing plantings will suppress some weeds but may bring additional weed seeds to the soil surface. A preplant application of a non-selective herbicide between plantings will help reduce weed competition without disturbing the soil. Do not try to use non-selective herbicides such as Roundup Pro or Finale while annuals are present. It is too easy to make a mistake. Envoy, Fusilade II or Vantage may be used postemergence to selectively control weedy grasses after planting. No wide spectrum, selective, postemergence herbicide exists for broadleaf weeds and sedges.

Herbaceous Perennial Beds

The major differences in weed management for herbaceous perennial beds (as compared to annuals) are (1) preplant perennial weed control is more important because there won't be an opportunity for cultivation or renovation for several years and (2) geotextiles may be used in many instances. Mulches may be used over landscape fabrics and supplemented with preemergence herbicides and hand weeding. Apply preemergence herbicides soon after transplanting. Perennial weeds in herbaceous perennial beds may be controlled with carefully directed applications of Roundup. Do not allow the Roundup to contact the foliage of the desirable plants. Care must be taken when using Roundup in beds due to the many possibilities for getting

Roundup on non-target plants. Dripping spray wands, accidental wiping of foliage or tracking the herbicide onto turfgrass or onto another bedding plant are common Roundup use mistakes. While close planting will produce a rapid canopy to discourage weeds, perennials should be spaced to allow 3 to 5 years of growth. Open areas will make weed control more difficult but will eliminate the hassle of removing crowded plants to change the spacing.

Woody Groundcover Beds

After they are well established, woody groundcovers will crowd out most weeds. However, during establishment, weed control will be more difficult. The need to control perennial weeds before planting becomes increasingly important because injury free spot spraying with Roundup is almost impossible in a dense groundcover bed. Plan ahead and chose groundcovers that are tolerant of the herbicides that fit the weed spectrum present. Annual weeds may be controlled with a combination of mulch, preemergence herbicides and hand weeding. Envoy, Vantage and Fusilade II are excellent for postemergence control of annual and perennial grasses. Use landscape fabrics where possible, but not where groundcovers are expected to root and spread.

Woody Tree and Shrub Beds

Beds made up exclusively of woody plants offer more weed control options due to greater herbicide tolerance. Depending on the growth habit of the species selected, the opportunity for directed applications of herbicides such as Roundup Pro or Finale is greatly enhanced. Care should be taken to avoid applying Roundup Pro to green bark or trees with fresh wounds from pruning, string trimmers, mowers, etc. Suckers and low-hanging branches should be removed well in advance of spraying to allow the wounds to heal. In situations where brownout is not objectionable, Finale may be used to prune suckers or contain low-growing creeping plants. Finale (glufosinate) does not translocate in most species. Mulches, landscape fabrics and herbicides may be readily combined to provide broad-spectrum weed control. A landscape fabric combined with a shallow layer of mulch or a deep mulch layer without landscape fabrics are two reasonable approaches. Supplement these measures with a preemergence herbicide. Escaped weeds may be controlled with directed applications of non-selective herbicides. Hand weeding may be sufficient for scattered infestations. The greater range of control options available reduces the importance of preplant weed control. In some instances, dormant season application of Casoron (dichlobenil) may be useful for perennial weed control. Design plantings to provide a dense canopy that will shade weeds.

Mixed Plantings of Woody and Herbaceous Species

Consider planting the woody species first and then spending two years controlling perennials with non-selective herbicides. After the perennial weeds are under control, then plant the herbaceous species. Space the woody plants to provide plenty of shade to suppress weeds. Given the greater herbicide tolerance of woody plants, it may be necessary to develop separate weed management programs for different areas in the same planting.

Paved Areas

Before installing paving, regardless of the material used, perennial weeds such as nutsedge and bermudagrass should be controlled. Minimizing the number of cracks in the paving will reduce weed control problems in the future. When treating cracks in paving with Roundup or another non-selective herbicide, adding a non-staining, residual herbicide such as Factor will reduce the number of applications needed per season. Do not apply industrial vegetation management herbicides such as Hyvar (bromacil), Velpar (hexazinone), Tordon (picloram), Spike (tebuthiuron), Pramitol (prometone) and Arsenal (imazapyr) to control weeds in paved areas near ornamentals. Plants whose roots extend into the treated area may be killed or injured by these products. Remember that tree roots can grow under paving and pick up herbicides that were applied before the paving was installed. Large shade trees have roots that extend well beyond the drip line. An additional hazard associated with these herbicides is runoff onto sites with desirable vegetation. Every year desirable ornamental trees and shrubs are killed by the use of this category of herbicides. Roundup

Pro can be safely used to control most annual and perennial weeds growing under trees and shrubs. Grass encroachment onto paved areas can be reduced with the use of Roundup Pro. A neater edge can be accomplished with the use of Finale when edging creeping grasses. Finale is translocated very little thus leaving a uniform line of dead grass. Primo (trinexepac-ethyl) will also reduce the amount of edging needed when trying to control the growth of grasses that produce runners.

Spray Tips for Edging Paved Areas

Standard flat fan tips deliver a tapered pattern, which means that the application rate on the outside of the pattern is less than that in the center of the pattern. This is overcome in boom spraying applications by overlapping the spray patterns. When applying an edging spray with a single nozzle, use an even flat fan tip. These tips have an E designation such as 8003E on the tip. Typical nozzles such as 80° or 95° are often too wide for edging. A 4003E flat fan works very well for this purpose. It is not a commonly available tip and will have to be ordered. The narrower pattern produced by the 4003E makes it a good tip for spot spraying.

Mulches

Mulches prevent weed emergence by blocking light needed to stimulate germination. While very effective, mulches will not provide complete weed control. Hardwood and pine barks are two of the most popular materials. One common error made with using mulches is applying them too deep. Excessive mulching creates a constantly wet environment, which prevents oxygen penetration into the soil. Coarse bark mulch should be about 4 inches deep and fine-textured bark about 2 inches deep. Coarse mulches provide less water holding capacity and are less likely to have weeds growing in the mulch. Fine mulches hold water and provide a favorable environment for weed seed germination. Fine mulch has greater potential for tying up preemergence herbicides. Thin mulch layers make preemergence herbicides more effective. Biobarrier II, a landscape fabric that contains plastic nodules impregnated with Treflan, is an alternative to mulching and then applying a preemergence herbicide. Bark and other organic mulches need periodic replenishment due to decomposition. Some perennial weeds such as nutsedge and field bindweed have sufficient root reserves to penetrate all mulches. Another problem often associated with organic mulches is weed seed germination on top of the mulch. Seeds that are readily carried by the wind such as groundsel, prickly lettuce and sow-thistle may be deposited on the mulch from remote sites. Avoid mulches that are contaminated with weed seed. Do not use foul-smelling mulches. They have gone anaerobic and may contain compounds that are toxic to plants.

Landscape Fabrics for Weed Control in Commercial and Home Landscapes

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A number of fabrics are currently available for landscape weed control. They were developed in part as replacements for black plastic (solid polyethylene). We discourage the use of black plastic in landscapes due to plastic's lack of porosity. This lack of porosity restricts water and gas penetration through solid polyethylene. Carbon dioxide can accumulate under black plastic, which poses a problem since plant roots require oxygen for development. If black plastic is placed over dry soil, subsequent rainfall may not be able to reach plant roots. If placed over wet soil, the soil may not be able to dry out properly. Black plastic is still recommended for short-term weed control in areas such as vegetable gardens.

Because these fabrics do allow for water and gas exchange, they overcome the major problem of black plastic, namely its lack of porosity. Not only have we evaluated these fabrics for weed control, we have also recorded soil moisture and temperature under landscape fabrics, and have monitored the growth of landscape trees and shrubs.

These materials, also called geotextiles or weed barriers, are made of fibers that are woven (fiber runs in two directions) or nonwoven (in which fibers run in various directions and are attached at random spots using heat or glue). The fabrics are primarily composed of polypropylene, but some are made of polyester, polyethylene or a

combination of various materials. A few other weed barriers are made of solid polyethylene, in which small holes are punched through the material to allow for water penetration. Spun-bonded fabrics tend to be more expensive than woven ones, and while most fabrics are black, some are white, gray or brown.

We have attempted to evaluate all of the major brands of landscape fabrics currently being sold. In our research, solid black plastic has provided better weed control than any landscape fabric or other weed barrier. Weed shoots and weed roots were able to penetrate through holes present in the fabrics. Perennial weeds such as yellow nutsedge can penetrate all of the fabrics we have tested. The landscape fabrics are more effective in suppressing annual weeds. Not all fabrics are equal in their ability to control weeds. Dalen's Weed-X has provided the greatest suppression of weeds, with DeWitt Weed Barrier ranked second. Weed-X was also the best fabric for retarding weed root penetration.

Another important difference we noted among fabrics was their ability to withstand breakdown by sunlight. Some fabrics, such as Duon and Typar, broke down more quickly than fabrics such as Visqueen or DeWitt, probably due to differences in UV light stabilization. This can be important if the mulch shifts due to wind or rainfall, exposing the fabric to sun.

Advantages of Landscape Fabrics

1. Fabrics reduce the need for, or replace the use of, chemicals for weed control.
2. These products allow for water and gas exchange.
3. The rougher surface tends to hold mulch better than black plastic.
4. They provide long-term weed control if kept covered by mulch.
5. They improve weed control over mulch alone.

Disadvantages of Landscape Fabrics

1. They are more expensive than black plastic.
2. Installation is more difficult.
3. These materials will not control all weeds, especially perennial ones.
4. They may stimulate surface rooting of trees and shrubs.
5. Weed roots and shoots may grow through and become intertwined in the fabric.
6. The roots of ornamentals may grow through and into the fabric.
7. Seems to create a favorable environment for rodents.

Recommendations for Using Landscape Fabrics (Geotextiles)

1. Control perennial weeds prior to fabric installation.
2. Overlap fabric pieces; use U-shaped nails to peg down the fabric. The big staples that are used to hold big roll sod together work very well for this purpose. Another source of staples for this use is cutting the ends off wire coat hangers. Each hanger yields two staples.
3. Cut an X pattern for planting.
4. Do not leave soil from planting holes on top the fabric because it will provide a medium for seed germination.
5. Maintain shallow mulch layer to prevent photodegradation but do not use excess amounts because organic mulches such as pine bark become good growing media for weeds as they decompose.
6. Control weeds that germinate in the mulch layer when small.
7. Choose a fabric with a low ratio of open to closed space (fiber arrangement), such as Weed-X.
8. Landscape fabrics provide more effective weed control if used in combination with rock or other inorganic mulches rather than organic mulches.

9. Remember that yellow nutsedge will penetrate all mulches. Pennant applied under mulch will reduce yellow nutsedge emergence.

10. Compare the advantages and disadvantages of landscape fabrics to other weed control options for specific weed problems.

Weed IPM for Ornamentals

Weed prevention is avoiding the introduction of weeds into an uninfested area. One of the keys to making integrated pest management effective in controlling ornamentals weeds is not allowing weeds to become established. Some common sense steps to weed prevention include:

1. Using weed-free mulch.

2. Using weed-free plant materials. Container nursery stock and balled and burlapped material may contain weeds. While it may not be practical to return the plants, it will be possible to get a jump on controlling these weeds.

3. Keeping border areas weed-free and preventing weeds from producing seeds.

4. Washing equipment between uses.

Landscape weed control is not herbicides alone. Approach weed control as an integrated process that combines good cultural practices that will produce dense, vigorous landscape plants with intelligent selection and use of herbicides. To conduct an effective weed control program:

1. Provide proper cultural practices.

2. Have the ability to identify specific weeds.

3. Be familiar with the growth and reproductive characteristics of weeds. Scout for weeds and pay attention to perennial species because they have the greatest potential for creating future problems. The best time to identify perennials is during late summer or early fall. Note the location of various weed infestations. This information will allow you to be ready with the correct plan of attack come treatment time.

4. Have knowledge of the control measures available and have the ability to select and use them properly.

Too often weed control measures are a reaction to an immediate problem rather than part of a well-planned and coordinated program. Weed control professionals should spend at least as much time learning the conditions that lead to weed infestation as they do studying control options after weeds have become established.

Herbicide Management

Remember that herbicides can injure non-target or desirable plants. When using any herbicide, research the characteristics of the product and manage the application carefully. Take steps to ensure that herbicides are directed to the target. Use them at the proper rate, at the right time and on a site that the label permits. Control each application so there is no off-target movement. Herbicide movement may result from drift of spray droplets, volatilization (movement as a gas) and contaminated surface runoff water or by tracking with feet or equipment. One way to avoid injury to desirable plants is to make treatments when the non-target plants are not present or not actively growing. For example, applying Roundup or preemergence herbicides in late winter before ornamentals break dormancy will reduce the chances of accidental injury. Always remember that some herbicides are mobile. Avoid applications during windy conditions. Always follow label directions, and heed label precautions. Volatile herbicide labels have restrictions to avoid vapor drift. Do not use these products during hot weather. Do not apply a volatile product during the heat of the day or in the morning of a day when very warm temperatures may occur.

Use extreme care when applying non-selective herbicides. Directed sprays are used to prevent contact with leaves or shoots of desirable plants. Droplets too small to be seen will readily move through the air and damage sensitive plants. Shielded sprays, where a cone surrounds a nozzle, can prevent the spray from hitting the foliage of a desired plant. A wiper (wick) application, where an herbicide solution is wiped on weed foliage only, is

another way to use non-selective herbicides safely around desired plants.

Be aware that some herbicides will leach vertically through the soil profile. They may injure or even kill sensitive trees and shrubs if their roots extend under the treated soil. Rainfall may move these products into the root zone, leading to injury. Atrazine and simazine are herbicides with potential for vertical and lateral movement.

When finished applying granular herbicides or fertilizers, sweep or blow them off hard surfaces such as parking lots, driveways, sidewalks and streets to prevent contamination of runoff water. Turf acts as a filter, but the materials left on impervious surfaces go directly into storm sewers or ditches and eventually into the water supply. Monitoring of rivers in the Atlanta area has shown a sharp increase in the levels of pesticides and fertilizers used in turfgrass management during the busy spring-early summer lawn care season.

Rules of Thumb for Weed Control in Ornamentals

1. When confronted with difficult-to-control perennial weeds, consider the herbicide tolerance of the ornamentals to be planted. Plant yellow nutsedge infested sites with ornamentals that tolerate Pennant or allow post-directed applications of Roundup, Manage or Basagran.

2. Make the minimum preplant weed control procedure one application of Roundup at least two weeks before planting. If possible, plan one year ahead. For tough perennials such as bermudagrass, it is best to spend an entire growing season making repeat applications to get complete control. Use a 2% solution of Roundup Pro (2 2/3 oz per gallon) or broadcast 3 quarts per acre.

3. Apply grass-specific herbicides such as Fusilade, Vantage and Envoy to seedling annual grasses (2 to 5 leaves) during good growing conditions. Mature grasses are much more difficult to control. Consult the label for the proper growth stage to treat perennial grasses. Grass specific herbicides only affect true grasses, not other monocots such as monkey grass, liriope, lilies and iris.

4. Apply and water-in preemergence herbicides with 0.25 to 0.5 inch of rainfall or irrigation as soon as possible after planting. Remember that weed seeds will often germinate within a few days of tillage or a burn-down herbicide application.

5. If possible, combine preemergence grass and broadleaf herbicides to broaden the spectrum of weed control. An example would be using a premix such as Snapshot or tank mixing Gallery and Surflan or Barricade or Pendulum.

6. Use a funnel or some other shield when applying non-selective herbicides such as Roundup or Finale. The top of a 2-liter soft drink bottle makes an acceptable funnel to attach to the end of a spray wand.

7. Do not allow weeds in landscape beds to produce seeds. The old saying, “One year’s seeding – seven year’s weeding,” is pretty accurate.

8. Do not apply granular herbicides to ornamentals when the foliage is wet.

9. Delay irrigation following application of postemergence herbicides according to the label.

10. Repeat preemergence herbicide applications on an 8- to 12-week interval or two to four times per season depending on weed pressure and environmental conditions.

11. Bear in mind that there is no really good postemergence, selective herbicide available for broadleaf weed control over the top of ornamentals.

12. Use Roundup as a wipe-on if possible.

13. When spraying over the top of ornamentals with grass herbicides such as Vantage, Fusilade II and Envoy, use a nonionic surfactant rather than crop oil concentrate.

14. Avoid applying postemergence herbicides when temperatures are over 90ºF.

15. Don't cultivate for 5-7 days before and after applying a translocated or systemic herbicide such as Roundup.

16. Do not tank mix Roundup with contact herbicides such as Reward or Finale. They destroy the plant tissue before the Roundup has a chance to translocate through the weed.

17. Nutsedge will not be eradicated by repeat applications of Roundup. It will come back. Roundup does not translocate to the nutsedge tubers. Roundup is more effective than Finale or Reward on nutsedge and other perennials.

18. Cover outdoor soil and mulch piles to prevent weed seed contamination.

19. Keep cultivation for weed control very shallow. Cultivation may bring new weed seeds to the surface, scatter root, rhizomes, tubers, etc., of perennial weeds or damage roots of ornamentals.

20. Cut woody sprouts in landscape beds with pruning shears and treat the cut end with undiluted Roundup or a 50% triclopyr + water solution to prevent resprouting.

21. Seal the soil around newly transplanted ornamentals with irrigation before applying soil-active herbicides.

22. Install edging that is wide enough for a mower wheel to ride. This will eliminate scalping and leaving an un-mowed band of grass.

23. Contact herbicides such as Finale will create a straighter line than a systemic herbicide such as Roundup when edging bermudagrass or other stoloniferous grasses. However, bermudagrass will recover faster from the Finale application. Cutting bermudagrass runners that have rooted in a bed before spraying them will prevent translocation back to the mother plant.

24. Use an even flat fan tip for edging to ensure uniform application across the spray pattern.

25. Use granular formulations of preemergence herbicides for greater crop safety.