CHAPTER 13

Weed & Ground Cover Management in Field Nursery Production

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Weed and Ground Cover Management

WEED & GROUND COVER

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There are three basic types of plants in a field nursery – the nursery crop, weeds, and ground covers. Weeds are defined as plants growing where they are not desired. A plant species growing in the area between the crop rows may not be considered a weed but may be considered one if growing in the row. Ideally, one would prefer a ground cover that would suppress weeds both within and between rows and require little mowing, not compete with trees or shrubs, or harbor insect pests and plant diseases. Finding such a living mulch has been difficult. Therefore, a nursery manager needs to manage vegetation both in the row and between the rows to minimize adverse effects on nursery production.

Weeds compete with nursery crops for water, nutrients, and light. Growers cannot simply overcome this competition by adding fertilizer because adding fertilizer also increases weed growth. Competition in the soil seems to be especially important for nitrogen, explaining why a nursery crop can have a pale color when growing alongside weeds. Competition for water in the root zone is especially important in dry summers. Tall weeds or vine-like weeds that grow to shade crop leaves will reduce photosynthesis of the crop plant. This loss of carbohydrate production results in reduced tree growth. Weeds that twine around crop plants are particularly damaging because they disfig-

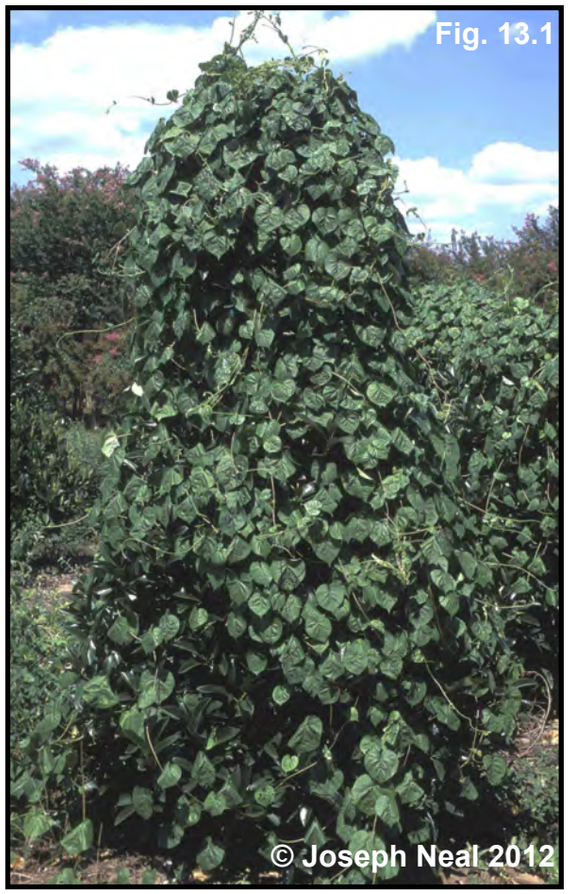

Fig. 13.1. *Holly* (Ilex sp.) *covered by morning glory*

ure stems and new growth (Figure 13.1). Weeds can also interfere with nursery practices. One example is poison ivy (*Toxicodendron radicans*), which contains a toxin to which most people are sensitive. Weeds with thorns, such as horsenettle (*Solanum carolinense*) and wild blackberry (*Rubus* spp.), are also a nuisance to individuals working in the nursery.

Weeds harbor insect pests, plant disease pathogens, and rodents that can damage nursery crops. One way to help manage disease and insect pests is through control of weed species that serve as alternative hosts. Weed growth can reduce airflow through the nursery, increasing humidity and may lead to increased disease incidence and severity. Weeds can intercept fungicide or insecticide sprays and drenches meant for the crop, reducing their effectiveness. Weeds such as white clover may attract bees to a site, which is a concern if insecticides are being applied. Weeds provide cover and a food supply for mice, voles, and other rodents.

A wide range of weed species can grow in a field nursery. Weeds can be divided into taxonomic groups or can be grouped by life cycle. Understanding taxonomic plant groups will assist in understanding selectivity of herbicide action. Understanding the life cycle of a weed species will guide the cultural and chemical control options needed for management. Growers must maintain a year-round weed management plan because both summer and winter weeds infest field production sites.

Weed Taxonomic Plant Groups

The major weed species that occur in field nurseries can be classified as **dicots***, which have two seed leaves (cotyledons) when they germinate, or **monocots**, which have one seed leaf. **Dicots** are more commonly referred to as broadleaves; an example is dandelion (*Taraxacum officinale*). Broadleaves generally have wide leaves with net venation and flower parts in twos, fours, or fives. **Monocots** tend to have narrow leaves with parallel leaf veins (parallel venation) and flower parts in threes (i.e., three sepals, three petals). **Monocots** can be divided into 1) grasses, which have round or flattened stems, such as large crabgrass (*Digitaria sanguinalis*), 2) sedges, which have triangular stems, like yellow nutsedge (*Cyperus esculentus*), and 3) other **monocots**, such as wild garlic (*Allium vineale*) and wild onion (*Allium canadense*). It is particularly important to distinguish grasses from sedges because control options differ for these two plant groups.

Weed Life Cycle

Weed species are also grouped by their life cycle into **annuals**, **biennials**, and **perennials**. **Annuals** live for only one growing season and reproduce strictly by seed. These weed species can be divided into summer **annuals** and winter **annuals**.

Winter **annuals** start to germinate in early fall (generally September) and continue to germinate in October and November depending on species and location, and there may be additional germination in late winter to early spring (February to April). Winter **annuals** will flower in spring and then die off with the onset of hot, dry weather. Summer **annuals**, which start to germinate in March, April, or May, depending on species and location, continue to germinate though the summer, flowering in summer or early fall and generally dying with the first killing frost. Summer **annuals** can be divided into broadleaves, grasses, sedges, and other **monocots**. Annual sedges are typically not a major problem in field nursery crop production.

Summer **annuals** are of greater concern to producers than winter **annuals**. Summer **annuals** are detrimental because they compete for water and nutrients with actively growing trees and shrubs during the growing season. Small winter **annuals** do not significantly compete with dormant nursery crops for resources and may be beneficial for reducing soil erosion during the winter months. However, winter annual weed species that grow tall and interfere with crop growth after budbreak, like horseweed (*Conyza canadensis*), or species that climb up trees, like vetch (*Vicia* spp.), need to be controlled.

Biennials live for two years and also reproduce strictly by seed. They form a rosette during the first year and then flower in the second year. Few biennial weeds are of

**For definitions of bold terms, see the digital version of this book at the SNIPM website* http://wiki.bugwood.org/SNIPM.

concern to nursery crop producers, all of which are broadleaves such as common mullein (*Verbascum thapsis*) and wild carrot (*Daucus carota*).

Perennials live for many years and generally are the hardest species to control. There are two types of **perennials** – simple and creeping. Simple **perennials**, like common dandelion, spread only by seed. Creeping **perennials**, such as yellow nutsedge (Figure 13.2), bermudagrass (*Cynodon* spp.), and mugwort (*Artemisia vulgaris*), can spread both by seed and vegetatively either via rhizomes, stolons, bulbs, tubers, or their **rootstocks**. It is more difficult to eradicate creeping **perennials** than simple **perennials**. Some **perennials**, such as yellow nutsedge, die back to the ground in winter and re-grow in spring from rhizomes, tubers, or other underground structures, while others, like quackgrass (*Agropyron repens*), are green throughout the year. Perennial species can also be classified as herbaceous (lacking a woody stem), such as common dandelion, or woody, like poison ivy. **Perennials** can be divided taxonomically into broadleaves, grasses, sedges, and other **monocots**. Field horsetail (*Equisetum arvense*) is a separate taxonomic group. It is a non-flowering primitive plant that spreads by spores or vegetatively by rhizomes.

Ground Covers

Ground cover within a field nursery is essential to minimize soil losses due to water and wind erosion, to maintain long-term soil productivity, and to prevent the encroachment and spread of weeds. In addition, a well-established sod makes it easier to drive through

fields when they are muddy or covered in snow or ice. A well-established sod is frequently the only economical way to support equipment such as tractors, sprayers, or mechanical harvesters when the soil is wet. Furthermore, research has demonstrated the need for a vegetative barrier around the edges of a field nursery. Grassed contour strips slow down and direct flow of water across a slope and serve as a buffer and final biological filter to remove any excess nutrients before **runoff** leaves the nursery. Kentucky bluegrass, perennial ryegrass, tall fescue, orchardgrass, and fine-leafed fescues (hard, creeping) are potential ground covers in cooler environments (zones 5 to 7). In warmer zones, tall fescue and bermudagrass are effective in providing workable sod because they are **vigorous** and provide a great deal of biomass. Bermudagrass is **invasive** however, and would be a management problem in the crop row.

If improperly managed, ground covers can compete with nursery crops for fertilizer, light, and water, thereby reducing crop growth. A common way to minimize competition while enjoying the advantages of a ground cover is to keep the rows clean or mostly weed-free with **preemergence** and/or **postemergence** herbicides, while maintaining a ground cover in the row middles (Figure 13.3).

Pre-Planting Weed Management Planning

The most important weed management tasks are performed before planting. Good site preparation includes **scouting** for perennial weeds and controlling the difficult species such as trumpetcreeper (*Campsis radicans*), multiflora rose (*Rosa multiflora*), mugwort, Florida betony (*Stachys floridana*), kudzu (*Pueraria montana* var. *lobata*), and hedge bindweed (*Calystegia sepium*) before planting. Manual or mechanical control of perennial weeds can be difficult and costly once the field is planted. In most cases, there are no **selective** herbicides for controlling perennial broadleaf weeds after planting that will not also damage or kill nursery crops.

Controlling perennial weeds requires killing the root system because most perennial weeds will regrow if only the top is destroyed. There are three options for controlling perennial weeds: cultivation, fumigation, or a **systemic postemergence** herbicide. While cultivation can be effective against certain perennial weeds, multiple cultivations over a period of several months are often required to control the root systems. Furthermore, some perennial weeds such as mugwort are spread by cultivation. Fumigation is an option of last resort to eradicate infestations of weeds that cannot be controlled after planting. **Systemic postemergence** herbicides such as glyphosate (Roundup ProMax®, Touchdown®, and many other trade names) will control many perennial weeds, but timing of the application is critical to ensure satisfactory perennial weed control. Late summer or early fall is an effective time to apply glyphosate for many perennial weeds.

Planting temporary cover crops such as sudex (*Sorghum bicolor* x *S. bicolor* var. *sudanese*), plowing in fall, and allowing the land to remain fallow can help to reduce some weed and insect problems. The intense shading, mowing, and competition created in a green manure or cover crop program will greatly reduce, if not eliminate, certain weed problems. Fall plowing exposes roots and tubers to the freeze-thaw cycles of a southeastern United States winter but will also expose the soil to erosion and is therefore not encouraged.

A permanent cover crop or sod can be planted in fall prior to planting nursery crops. The cover crop can be killed in the row using a **non-selective** herbicide such as glyphosate prior to planting trees or shrubs.

Weed Scouting

The first step in any pest management program is to identify the pest(s). **Scouting** the fields for weeds will enable the grower to determine what weeds are present and to plan appropriate management strategies. Field nurseries should be scouted at least twice a year: in late summer or early fall, and again in early summer. In late summer, most summer annual, perennial, and biennial weeds are easily identified. In early summer, winter **annuals**, **perennials**, and summer **annuals** that escaped control procedures can be identified. Weed **scouting** involves assembling an inventory of the weeds in each block. This is done by simply walking each field and recording the species encountered. Then, highlight the most important species – those that are most prevalent, perennial, new to the field, on noxious weed lists, or should have been controlled by the weed management program in place. With this information, the grower can better plan a weed management program that matches the needs of each crop and field.

In-Row Vegetation Management

Two basic strategies for in-row vegetation management are 1) residual, relying primarily on **preemergence** herbicides, and 2) non-residual, relying almost exclusively on **non-selective postemergence** herbicides. Each strategy has advantages and disadvantages. The residual approach will utilize more expensive herbicides but will require fewer trips through the fields. The non-residual approach is simple and inexpensive but will require many trips across the fields each season to control emerged weeds.

In the residual strategy, **preemergence** herbicides are applied in late winter to control summer annual weeds and late summer to control winter annual weeds. Depending upon the local conditions, weeds present, and the particular herbicides used, an additional treatment in late spring or early summer may be required. Perennial weeds are spot-treated

with appropriate **postemergence** herbicides. Most **preemergence** herbicides will not control emerged weeds, so adding a **postemergence** herbicide can control any weeds present at application.

The non-residual strategy involves frequent applications of **non-selective**, **postemergence** herbicides on an as-needed basis. Treat weeds when they are 6 to 8 inches in height; this will enable the applicator to contact weeds and avoid the crop. It is common during the growing season to treat fields every 4 to 6 weeks, but the interval between applications will vary with the weed species present, the **mode of action** of the herbicide used, and the prevailing weather conditions. Frequent field **scouting** should be conducted to identify the appropriate times for re-treatment. Herbicides commonly used in the non-residual management strategy include glyphosate (Roundup ProMax® and many other trade names), glufosinate (Finale™), diquat (Reward), and paraquat (Gramoxone®, Inteon). Each has its advantages and disadvantages. To decide upon the most appropriate one, follow the guidelines for using **postemergence** herbicides (below) and consult with your county Cooperative Extension Service and an appropriate reference. However, complete reliance on any one herbicide will lead to population shifts and herbicide resistance. This is particularly important for glyphosate-reliant vegetation management programs. Widespread adoption of glyphosate-resistant crop technology has lead to relatively rapid development and spread of glyphosate-resistant weeds such as horseweed (*Conyza canadensis*) and Palmer amaranth (*Amaranthus palmeri*). Fields should be scouted for "escaped" weeds. When resistance is suspected, remedial action should be taken immediately to prevent the reproduction and spread of resistant weed populations. Use of **non-selective** herbicides such as glyphosate or glufosinate can lead to bark damage (bark splitting, cankering, **gummosis**), especially if an excessive rate reaches the trunks of trees. Minimize the amount of these chemicals reaching the bark of desired plants through the use of shields or other techniques.

Between-Row Vegetation Management

Vegetation between rows is managed to prevent encroachment of the vegetation into the crop rows, eliminate habitat for vertebrate pests (such as deer), to provide improved access to the field, and to prevent the spread of weeds into the crop row. The vegetation between crop rows is managed by mowing, cultivation, sub-lethal rates of herbicides (referred to as chemical mowing), and/or growth regulators that can be used to slow growth of grass without killing it. The most common vegetation management practices are cultivation and mowing.

Cultivation is discouraged because it leads to erosion and may actually spread perennial, rhizomatous weeds (Figure 13.4). Mowing is generally conducted 3 to 4 times each year. The interval between mowing events can be extended by careful selection and use of plant growth regulators. For example, spraying tall fescue or orchardgrass in early spring (when there are 4 to 5 new leaves or 7 to 10 days after mowing) with 1 pint/acre of sethoxydim (Segment®), a **selective** grass herbicide, will suppress the grass for 8 to 10 weeks. Another alternative is glyphosate (Roundup ProMax®, others), which can provide 6 to 10 weeks of suppression at a cost of a few dollars per acre, much less than regular mowing. Glyphosate needs to be applied as a directed spray between the nursery stock rows. Use no more than 25 gallons of the final spray mix per broadcast acre. Chemical mowing will result in chlorotic (yellowed) grass for up to 30 days and will

Fig. 13.4. *Mugwort, rhizomatous weed that spreads via cultivation*

result in a gradual transition of the vegetation from grass to broadleaf cover. Such a transition may not be desirable as broadleaf cover generally provides less traction for vehicle tires and poorer wear tolerance compared to perennial grasses.

SECTION 2

Herbicides

HERBICIDES

1. Guidelines for Using Preemergence Herbicides
2. Guidelines for Using Postemergence Herbicides
3. Alternatives to Herbicides

Guidelines for Using Preemergence Herbicides

Preemergence herbicides will not control emerged weeds, so they should either be applied before weeds germinate or applied with a **postemergence** herbicide that will control existing weeds. In field production, **preemergence** herbicides should be applied after transplanting to weed-free soil and then irrigated for effectiveness. Most **preemergence** herbicides can be applied after the soil is settled around the transplants but before weeds germinate. This prevents weeds from emerging for several weeks to several months. Frequency of herbicide application will depend upon the residual activity of the herbicide. Residual weed control will increase with increasing herbicide application rate; control decreases with increasing amounts of rainfall or irrigation, higher temperatures, and higher soil organic matter levels. The proper herbicide for each situation will be dictated by the crop species, weed species, and future use of the field.

As with any other tool, each herbicide has unique characteristics that should be considered when planning a weed management program:

- ✶ Crop safety – First and foremost, the herbicides must be safe on your crops.
- ✶ Weed control spectrum – What weeds the herbicide will and will not control.
- ✶ Rate of application – The correct rate will vary with weed density, organic matter content of the soil, and ornamental species.
- ✶ Residual – The length of time the herbicide will provide effective weed control.
- ✶ Activation – For maximum effectiveness, each herbicide needs to be watered (about 0.5-inch irrigation or rain) into the soil surface within a specified number of days.
- ✶ Mechanism or **mode of action** – Prevent herbicide resistance by using different modes of action in combinations or rotation.
- ✶ Potential losses – Avoid leaching, **runoff**, spray drift, and volatility through proper product selection and use.

The most common practice in field nursery weed control is to combine a "grass" herbicide with a "broadleaf" herbicide in order to control a broad spectrum of weeds. Products commonly used in field nursery crop production are listed below.

Common "broadleaf" herbicides	Common "grass" herbicides
flumioxazin	napropamide
isoxaben	s-metolachlor
oxyfluorfen	oryzalin
simazine	oxadiazon
	pendimethalin
	prodiamine
	dimethenamid-p

Each herbicide differs in the weeds controlled, longevity of residual control, ornamental crop safety, and cost. For example, simazine is the least expensive broadleaf

herbicide but can injure newly-planted deciduous crops. Consequently, isoxaben is often used on those newly planted crops even though it is more expensive and does not control some broadleaf weeds as well as simazine. Where morningglory (*Ipomoea spp.*) is common in fields, flumioxazin is commonly used. Additionally, among the "grass" herbicides, only dimethenamid-p and s-metolachlor control yellow nutsedge, yet they can have a shorter residual life in the soil and are generally less effective on many common broadleaf weeds than the other herbicides listed above.

A typical residual weed control program will likely use some variation of the following scenarios:

Newly planted broadleaf trees and shrubs:
After planting, band-apply isoxaben in combination with pendimethalin, prodiamine, or oryzalin. Ten to 12 weeks later, repeat the application.

In late summer, species that are tolerant of simazine may be treated with a combination of simazine plus pendimethalin, prodiamine, or oryzalin. Species that are intolerant of simazine will receive flumioxazin or isoxaben instead of simazine.

Newly planted conifers:
Apply simazine, oxyfluorfen, or flumioxazin, plus pendimethalin, prodiamine, or napropamide.

Established plantings:
In late winter, apply simazine or flumioxazin for broadleaf weed control combined with oryzalin, pendimethalin, or prodiamine for grass control.

If morningglory is common in the field, an application of flumioxazin in early summer may be required.

In fields infested with yellow nutsedge, s-metolachlor or dimethenamid-p would be the preferred products to combine with the "broadleaf" herbicide.

In late summer, re-apply simazine or flumioxazin combined with oryzalin, pendimethalin, or prodiamine.

Escaped weeds may be controlled with spot applications of **non-selective postemergence** herbicides.

Young seedling broadleaf weeds are controlled with either oxyfluorfen or flumioxazin, so if weeds have already emerged at the time of application, it is possible to control many seedling weeds without the addition of a **non-selective postemergence** herbicide.

Before deciding which herbicides are right for each crop, consider these guidelines and consult with your county Cooperative Extension Agent and an appropriate reference.

Guidelines for using postemergence herbicides

Postemergence herbicides are applied to weeds after they have emerged. Characteristics of **postemergence** herbicides that should be considered before selection and use are:

- Crop safety – Even **non-selective** herbicides differ in their levels of **phytotoxicity** to crops.
- Weed control spectrum – What weeds the herbicide will and will not control.
- **Selective** versus **non-selective** – **Selective** herbicides will provide greater crop safety, but limited spectrum of weed control.
- **Systemic** versus **contact** – Contact herbicides are less effective on perennial weeds but are potentially less injurious to actively growing crop plants.

- Application timing (or season) for optimum control – Seedling weeds are easier to control, and season of application will influence the efficacy of glyphosate on many perennial weeds.
- Drying time – Foliar applications must get into the plant before rain or irrigation washes the herbicide off.
- Mechanism or **mode of action** – Prevent herbicide resistance by using different modes of action in combinations or rotation.
- Persistence – A few **postemergence** herbicides have soil residual that can affect subsequent crops.
- Potential losses – Avoid leaching, **runoff**, spray drift, and volatility through proper product selection and use.

Postemergence herbicides can be classified as **systemic** or contact and as **selective** or **non-selective**. **Systemic** herbicides are absorbed and move through the plant. These are useful for controlling perennial weeds. For best control, the weeds must be actively growing so the herbicides can move throughout the plant. Contact herbicides kill only the portion of the plant that is actually contacted by the herbicide. **Non-selective** herbicides have the potential to kill or injure any plant they contact, whereas **selective** herbicides kill some types of plants and not others.

The majority of **postemergence** herbicides used in field nursery crops are **non-selective**. Diquat dibromide (Reward), paraquat (Gramoxone®, Inteon), and pelargonic acid (Scythe) are **non-selective**, contact herbicides. They control small annual weeds but do not affect the underground portions of perennial weeds and may only injure the upper leaves of large annual weeds. Thorough spray coverage is especially important when applying contact herbicides. Re-application is necessary to control larger weeds. Glyphosate (Roundup ProMax® and many other trade names) and glufosinate (Finale™) are **systemic**, **non-selective** herbicides and are more effective than contact herbicides on perennial weeds or larger annual weeds. Glyphosate is better translocated in plants and is consequently more effective at controlling perennial weeds and grasses compared to glufosinate. Glufosinate is considered to be a contact herbicide by many practitioners, but limited translocation does occur within treated leaves or branches.

Grasses can be selectively controlled in many nursery crops. Clethodim (Envoy Plus®), fluazifop-P-butyl (Fusilade II®, Ornamec®), and sethoxydim (Segment®) are **selective systemic postemergence** herbicides that only kill grasses while leaving broadleaf weeds and crops unharmed. Conversely, very limited options are available for **selective postemergence** broadleaf weed control in nursery crops. Consequently, broadleaf weeds are generally controlled **preemergence** or with **non-selective** herbicides. Clopyralid (Lontrel®) can be used in certain tree and shrub species for control of weeds in the legume (Leguminosae), nightshade (Solanaceae), and aster (Asteraceae) families. Desired crops in these plant families cannot be treated with clopyralid. Major weeds controlled by clopyralid include Canada thistle (*Cirsium arvense*), groundsel (*Senecio spp.*), horseweed (*Conyza canadensis*), vetch (*Vicia spp.*), and white clover (*Trifolium repens*). Bentazon (Basagran®) can be used as a directed spray for controlling yellow nutsedge and certain broadleaf weeds.

All **postemergence** herbicides have a specified drying time for maximum effectiveness ranging from 30 minutes to six hours. This is the length of time that needs to pass after herbicide application before irrigation or rain to ensure that the herbicide has absorbed into plant tissues. Although **postemergence** herbicides labeled for field production remain in the soil for a short length of time after application, they generally have little or no soil activity; therefore, multiple applications are needed for perennial weeds. The majority of herbicides used for **postemergence** weed control in field production are used either for grass control or for **non-selective** weed control. Products that provide **non-selective** weed control should not be applied in a manner that leads to contact with the foliage or green stems of ornamental plants as severe injury or plant death may occur.

Postemergence herbicides may be applied in many different manners. Where weed populations are sparse, spot-spraying with handheld spray nozzles is common. If

weed populations are consistent, tractor-mounted (or ATV-mounted) sprayers may be used. Tractor-mounted sprayers should be adjusted and calibrated to spray a band on either side of the crop row. Do not attempt to spray the entire bandwidth from one side of the row. This will result in too much spray contact with the crop stem, possibly resulting in bark damage. Controlled droplet applicators have also been used successfully to apply **postemergence** herbicides. However, bark damage to the crop has resulted when the applicators are operated in such a manner that the concentrated spray comes into contact with crop stems. Regardless of the application method utilized, do not treat with **systemic** herbicides when **suckers**, **water sprouts**, or fresh pruning scars are present as crop injury will likely result. Remove **suckers** at least 48 hours before spraying with **systemic** herbicides such as glyphosate. Spray shields or curtains can be added to the spray rig to reduce crop exposure, but such systems do not eliminate the potential for crop exposure through spray drift or rubbing from wetted spray shields or curtains.

When using **postemergence** herbicides:

- ✶ Apply at correct rate.
- ✶ Select the most appropriate herbicide for the task.
- ✶ Remember that multiple applications are usually required to control perennial weeds.
- ✶ Use the type and amount of surfactant specified on the label.
- ✶ Apply when the air temperature is above 50° F and the comfort index (temperature in °F plus humidity) is below 140 °F.
- ✶ Treat weeds at proper growth stage.
- ✶ Allow plenty of drying time.

Alternatives to Herbicides

Herbicides cannot always be used, nor are they effective in controlling all weeds. In these situations, cultivation and hand-pulling may be the only available options.

Cultivation works well on small annual weeds; **perennials** will often re-grow from the roots even if the top is removed. Also, remember cultivation can stimulate successive flushes of germinating weeds by bringing new weed seeds to the soil surface. You will need to check for emerging weeds on a two- to three-week cycle if you are routinely cultivating. If **preemergence** herbicides have been applied and activated, they form a herbicide barrier that must be left undisturbed to be effective. Cultivation disrupts this barrier and lessens the effectiveness of the herbicide. Therefore, cultivate sparingly if you use **preemergence** herbicides.

Cultivation is not without other drawbacks. Cultivated soil is very susceptible to erosion since there is little or no vegetation to hold the soil in place. In addition, implements such as in-row weeders, which cut off weeds below the soil surface, can build up ridges, which are detrimental to growth of nursery crops. Ridged soil around the stem collar of newly transplanted **liners** tends to suffocate trees just as if they had been planted too deeply.

Cultivating near nursery stock in subsequent years causes considerable **root pruning**, delays growth, and can lead to a soil buildup around the collar of nursery stock. Many landscape contractors have had problems with trees grown with soil thrown over the surface of the roots. The surface of the **root ball** may have several inches of soil with few roots above what was the original soil line. Landscapers think they are planting at the correct height. In reality, they are planting several inches too deep. Thus, cultivation has received considerable attention in landscape magazines and has been identified as a poor practice for growing nursery stock.

It is important to develop a weed management strategy that encompasses all 12 months of the year and uses all available options. These include preventative measures, such as **preemergence** herbicides and sanitary practices that prevent the introduction and spread of weed seeds and vegetative parts, and remedial measures such as **postemergence**

herbicides, cultivation, and supplemental hand weeding. A comprehensive weed management program will incorporate the most appropriate options for each cropping situation.

Common Weed Species by Life

Summer Annuals

Summer annual grasses: barnyardgrass, large crabgrass, goosegrass, giant foxtail, yellow foxtail, fall panicum, and witchgrass

Summer annual sedges: rice flatsedge

Summer annual monocots (other than grasses or sedges): doveweed and Asiatic dayflower

Summer annual broadleaves: wild buckwheat, cocklebur, jimsonweed, ladysthumb, common lambsquarters, morningglory, pigweed, purslane, common ragweed, sicklepod, and Pennsylvania smartweed

Winter Annuals

Winter annual grasses: downy brome, annual bluegrass, cheat, and Italian (annual) ryegrass

Winter annual broadleaves: hoary alyssum, hairy bittercress, common chickweed, redstem filaree, common groundsel, henbit, horseweed, prickly lettuce, mayweed, wild mustard, pennycress, Virginia pepperweed, shepherdspurse, sowthistle, and narrowleaf vetch

Biennials

Biennial broadleaves: wild carrot, white cockle, common evening primrose, yellow goatsbeard, common mullein, wild parsnip, teasel, and plumeless thistle

Perennials

Perennial grasses:

Clump-type perennial grasses: tall fescue, orchardgrass, and dallisgrass

Creeping perennial grasses: bermudagrass, johnsongrass, wirestem muhly, and quackgrass

Perennial sedges: yellow nutsedge and purple nutsedge

Other monocots: wild garlic and wild onion

Spore producers: field horsetail

Perennial broadleaves:

Simple broadleaf perennials: chicory, broadleaf dock, curly dock, dandelion, dogfennel, broadleaf plantain, buckhorn plantain, and pokeweed

Creeping broadleaf perennials: wild blackberry, field bindweed, hedge bindweed, Virginia creeper, dewberry, hemp dogbane, goldenrod, Japanese honeysuckle, horsenettle, poison ivy, St. Johnswort, common milkweed, mugwort, red sorrel, Canada thistle, toadflax, trumpetcreeper, and yellow woodsorrel