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# Weeding Out the Options

***A plant scientist emeritus discusses weed-control options for field nurseries, including manual weeding, pre-emergence herbicides and postemergence herbicides — while stressing identification of weeds and timing of applications.***

*Text and photos by*

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Historically, weeds have created great challenges for agriculture, and nurseries are no exception. With hundreds and sometimes thousands of potentially viable weed seed commonly found in every square foot of soil, as well as an estimated 100 or so potential weed species on any given farm, weed problems can always be expected. Fortunately, growers are blessed with a number of very effective herbicides to help with their weeds. But because no one herbicide controls all weeds or is safe on all ornamentals, the challenge for growers is to learn the predominant weeds on their sites and to select herbicide tools for their specific crops.

It is well-known and appreciated by growers that weeds compete with crop plants for light, nutrients, water and growing space, but how much do weeds affect plant growth in a nursery when periodic, manual weed removal is practiced? To get a handle on this question, I conducted an experiment in which I grew nursery liners for two-year spans, and at the end of the second growing season, I weighed the plants. Each year, herbicides were applied after planting or in the spring of the following year, and this sequence was followed for five plantings over 10 years on the same plots. In addition to a number of herbicide treatments, I had "weed-free" plots that were hand-weeded weekly and others that were periodically weeded or hoed at intervals of four to six weeks, three times in a season. The weed population on this site varied somewhat with the season, but consisted primarily of annual weeds, such as crabgrass, stinkgrass, oxalis, nightshade and carpetweed, and winter annuals, such as horseweed and common groundsel. Perennial weeds were not present on this site.

As shown in the table (page 48), weeds growing for a four- to six-week period in the 10th year of the experiment reduced the weights of *Tsuga canadensis* (Eastern hemlock) 60 percent, *Euonymus alatus* 'Compacta' (dwarf burning bush) 50 percent, *Thuja occidentalis* (globe arborvitae) 42 percent and *Taxus cuspidata* (Japanese yew) 33 percent, as compared with the weed-free controls. These reductions in plant growth caused by weeds are substantial.

The time required to remove weeds from the periodically weeded plots in July and August of that 10th season averaged 685 man-hours per acre. This figure varied from year to year and ranged between approximately 350 to 700 man-hours per acre. The more effective herbicide treatments, usually combinations of two herbicides, reduced weeding times by 95 to 99 percent and produced plants that almost always weighed more than the periodically weeded treatment. Exceptions occurred when an herbicide treatment injured a nursery plant and caused mortality. Obviously, even moderate populations of annual weeds can greatly reduce ornamental plant growth and be very expensive to remove.

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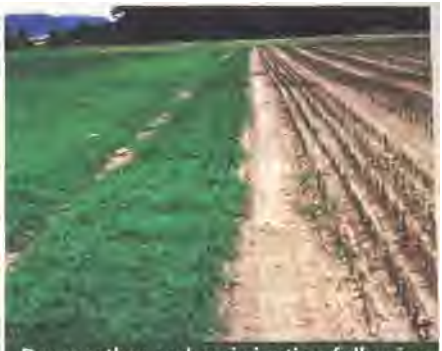

Dry weather and no irrigation following a pre-emergence application of Princep plus Surflan on the left allowed an invasion of grassy weeds. A postemergence grass herbicide, applied on the escapes, prevented hand removal.

The pre-emergence herbicides Surflan, Barricade, Pendulum, Treflan, Dimension, Devrinol and Pennant Magnum are root inhibitors, especially of grasses. Untreated crabgrass is on the left, and Surflan-treated crabgrass is on the right.

**Controlling perennial weeds.** Perennial weeds — those that live from year to year by overwintering rhizomes, rootstocks and tubers — can be even more destructive to ornamental plant growth than annual weeds. Weed-infested nursery plants often suffer high mortality, take longer to grow and may become unsalable. In addition, some states do not allow shipments of weed-infested nursery stock.

Although there are herbicides that will selectively remove some perennial weeds from nursery stock, usually it is far better to control most perennial weeds before a crop is planted. This process, called site preparation, should start at least a year before planting in many instances. The timeframe is especially true of sites infested with perennial weeds, such as quackgrass and mugwort. Glyphosate (Roundup) applied two to three times in the year before planting can be very effective in controlling most perennial weeds. Start by treating the existing weed growth when it is 6 to 8 inches tall and then re-treating when regrowth occurs, not tilling the soil between applications. Treating regrowth a third time or even a fourth, if necessary, pays dividends in the long run. Unfortunately, preplant treatment with Roundup is not adequate for some weeds, like yellow and purple nutsedges, which arise from tubers that may remain dormant in the soil for several years. For these, fumigation may be necessary, especially in high-value crops.

Choosing a nursery crop that is tolerant of a known effective herbicide is an option in situations where adequate time for preplant treatment of perennial weeds is not available. For example, clopyralid (Lontrel) controls vetches and Canada thistle safely in conifers, but not in most deciduous ornamentals. Shade trees also are a good choice for sites with perennial weeds because semidirected sprays of glyphosate can be used. Planning, therefore, is very important when dealing with perennial weeds. Mechanical and hand removal of perennial weeds after planting is an expensive, if not futile, proposition.

**Herbicide background.** Herbicides are classified for ornamentals as pre-emergence, those that kill weeds as they germinate and emerge, and postemergence, those that kill emerged weeds through foliar uptake. Pre-emergence herbicides are further divided into groups that are most effective in controlling grasses and those that are most effective in controlling broadleaf weeds. The first seven pre-emergence "grass" herbicides in the table (page 48) — Surflan, Barricade, Pendulum, Treflan, Dimension, Devrinol and Pennant Magnum — kill weeds by inhibiting roots, as illustrated for Surflan (photo, above). Of this group, only Pennant Magnum controls annual sedges and the perennial yellow nutsedge. All of these herbicides are labeled for certain herbaceous perennials or bulbs, but plant tolerances vary greatly, and label instructions should be carefully followed.

Whenever plant tolerance allows, we try to combine pre-emergence broadleaf and grass herbicides to provide broad-spectrum weed control. Examples are Princep or Gallery with Surflan, Pendulum, Barricade or Pennant Magnum and Goal plus Pennant Magnum. Whereas Princep, Sim-Trol and Gallery are safely sprayed on the foliage of many deciduous and evergreen ornamentals, sprayable formulations of oxyfluorfen (Goal, Galigan) and oxadiazon (Ronstar) are safely used primarily on conifers or where they can be directed to avoid deciduous foliage (shade trees, for example). There also are a number of granular package mixes of combinations available, such as Pre Pair, Snapshot TG, OH2, Rout and Showcase, that are labeled for a wide range of ornamental plants.

**Making pre-emergence herbicides work.** Pre-emergence herbicides do not prevent seed germination, but kill weeds in their early growth after germination. They work best when applied on weed-free soil and activated by irrigation or rainfall. Preparing a plant bed too long in advance of herbicide application allows weed seed to start germinating, often with reduced control.

The following works consistently well in new plantings: Prepare plant beds with tillage; plant as soon as possible (within a day or two), or till again; irrigate thoroughly right after planting to settle the soil; apply the herbicide the same day or the next day; then irrigate one-fourth to one-half inch to activate the herbicide. Any delays can result in more weeds. Planting and treating the same day is desirable. Waiting several days to apply the herbicide because a field is not fully planted allows many weeds to germinate and escape the herbicide treatments. For this reason, some growers utilize calibrated backpack sprayers to apply herbicides in a timely fashion and eliminate the waste inherent in applying small amounts in large sprayers.

In established plantings, applying pre-emergence herbicides as soon as possible after removing existing weeds by either chemical, hand or mechanical means can be expected to produce the best results. Whereas cultivating established ornamentals to remove weeds is an effective practice before applications of pre-emergence herbicides, it is wise to avoid cultivating after herbicide application, until weeds reappear. Cultivating dilutes the herbicide and in some cases breaks the chemical barrier, both resulting in reduced weed control. There are exceptions to this rule, of course; one is when perennial weeds need to be controlled.

**Broad-spectrum pre-emergence herbicides.** Two herbicides — one old and one new — fit this category. Dichlobenil (Casoron), an older, granular product, is useful for perennial weed control in established woody ornamentals. It is applied from November to March, preferably just before rain or snow because of its high volatility, and dissipates during the growing season. In many cases, it is the one salvation for growers who plant into sites infested with perennial weeds without site preparation.

Flumioxazin (SureGuard DG and BroadStar granules) is a relatively new addition to the herbicide arsenal. Like oxyfluorfen, flumioxazin controls some emerged annual weeds, but it is active on most weeds before emergence. Examples of established weeds controlled by flumioxazin are common chickweed, moss, liverworts, annual bluegrass and seedlings

## Nursery liner weights

Weights of nursery liners grown for two seasons and weeded either weekly or at four- to six-week intervals

| Plant | Weeded weekly* | Weeded at 4- to 6-week intervals* | Percent reduction in weight caused by weeds |
|---|---|---|---|
| *Tsuga canadensis* | 1,050 | 420 | 60 |
| *Euonymus alatus* 'Compacta' | 1,345 | 669 | 50 |
| *Thuja occidentalis* | 2,882 | 1,636 | 42 |
| *Taxus cuspidata* | 536 | 357 | 33 |

* Plant weights in grams per five plants

Shielded sprayers, such as this one built by Gardner's Nurseries Inc., Rocky Hill, CT, allow safe, effective use of glyphosate between rows.

## Postemergence herbicides for nurseries

| Trade name(s) | Active ingredient | Characteristics |
|---|---|---|
| Roundup (many formulations) | glyphosate | broad-spectrum control; nonselective; use as directed sprays only |
| Finale | glufosinate | |
| Reward | diquat | |
| Scythe | pelargonic acid | |
| Lontrel | clopyralid | controls certain broadleaf weeds; selective over many conifers |
| Fusilade | fluazifop-p-butyl | controls only grasses; selective over many ornamental species |
| Vantage | sethoxydim | |
| Envoy | clethodim | |
| Acclaim | fenoxaprop | |
| Asulam, Asulox | asulam | controls many grasses and some broadleaf weeds; selective in yew, juniper, Christmas trees |

of common ragweed. While controlling most annual broadleaf and grass weeds, including several triazine-resistant weeds, it is ineffective against most perennial weeds. An exception is the perennial mugwort, which it suppresses.

Both SureGuard DG and BroadStar are useful primarily in woody ornamentals.

## Pre-emergence herbicides

Examples of pre-emergence herbicides for nurseries

**"Grass" herbicides**

| Trade name(s) | Active ingredient |
|---|---|
| Surflan, Oryzalin | oryzalin |
| Barricade | prodiamine |
| Pendulum | pendimethalin |
| Treflan, Trilin | trifluralin |
| Dimension | dithiopyr |
| Devrinol | napropamide |
| Pennant Magnum | s-metolachlor |

**"Broadleaf" herbicides**

| Trade name(s) | Active ingredient |
|---|---|
| Princep, Sim-Trol | simazine |
| Gallery | isoxaben |
| Ronstar | oxadiazon |
| Goal, GoalTender, Galigan | oxyfluorfen |

SureGuard DG is labeled for use in dormant evergreen and deciduous stock, whereas BroadStar can be used during the growing season, as well. In deciduous plants — such as viburnum — swollen, but unopened, buds are susceptible to early growth suppression from SureGuard DG. Therefore, spring treatments have to be early, and trial use is highly recommended. Certain conifers, however, have shown tolerance to SureGuard DG sprays, even during active growth.

In a timing experiment, a colleague and I found that SureGuard DG did not injure actively growing arborvitae, juniper or yew during an eight-week period after budbreak, but caused severe injury to Eastern hemlock after budbreak. Dormant hemlocks in April or October were not affected. In large-scale treatments for containers where irrigation followed within 15 minutes of SureGuard DG applications, no injury to junipers or arborvitae was observed. However, trial use is essential whenever a new herbicide is used on plants or under conditions not prescribed on product labels.

**Postemergence herbicides.** The table (above) lists the most widely used postemergence herbicides for ornamentals. Glyphosate, glufosinate (Finale), diquat (Reward) and pelargonic acid (Scythe) are broad-spectrum herbicides that must be used as directed sprays in ornamentals to avoid plant injury.

Glyphosate is now available in more than 40 commercial products, many of which are registered for ornamentals. The newer formulations of Roundup, such as Original MAX, are more concentrated, and lower dosages are used. Glyphosate is systemic and, therefore, effective in controlling deep-rooted perennial weeds. It is commonly added to pre-emergence herbicides in deciduous trees, thereby controlling established weeds and providing residual control. Because of glyphosate's effectiveness on most weeds and its low cost, an increasing number of growers are applying it with shielded sprayers either commercially produced or built by innovative nurserymen (photo, above). MANKAR ULV sprayers are among those available commercially. Another reason for increasing use of glyphosate is that the chemical is readily inactivated in mineral soils and does not leach, making it attractive for use in aquifer zones.

Glufosinate is systemic in some weeds, but mostly is a contact herbicide, killing foliage on which it is sprayed. Diquat and pelargonic acid also kill weeds by foliar contact. None of these has residual activity in the soil.

Clopyralid primarily controls emerged weeds by systemic action in three plant families — the pea or legume family, the composite or daisy family and some members of the smartweed family. It is ineffective in controlling a number of other common broadleaf weeds, as well as all grasses and sedges. However, many of the weeds it does control can be troublesome in nursery plantings, such as Canada thistle, horseweed, fleabane, common groundsel, dock, mugwort (suppression), clovers, vetches and others. Lontrel is selective primarily over conifers and as semi-directed sprays in certain deciduous trees. It combines well with Goal and the post-

A combination of glyphosate and pre-emergence herbicides can be very effective in shade trees. Grassy row middles reduce soil erosion on many sites and reduce chemical costs.

emergence grass herbicides Fusilade and Vantage to provide tools for cleanup of a weed spectrum in the summer months.

Fluazifop-p-butyl (Fusilade), sethoxydim (Vantage), clethodim (Envoy) and fenoxaprop (Acclaim) are commonly referred to as postemergence grass herbicides or graminicides. They are all effective on specified emerged annual and some perennial grasses, especially in immature stages. Perennial grasses frequently require two applications for satisfactory control. They are ineffective on broadleaf weeds and sedges and safe when sprayed over a range of broadleaved and evergreen ornamentals. Acclaim is the only one suitable for use in certain turfgrass species, and Envoy is the only one that controls annual bluegrass. All but Vantage require the addition of a nonionic surfactant or crop oil concentrate. Because characteristics of these herbicides can vary greatly, it is important to check the herbicide labels to determine tolerant plants and susceptible grasses.

Asulam (Asulox, Asulam) can be considered a "niche" postemergence herbicide, labeled only for dormant or actively growing yew and juniper nursery plantings and several dormant Christmas tree conifers. However, it controls annual grasses and important broadleaf weeds, such as horseweed and common groundsel, and it is one of the few herbicides that suppresses field horsetail.

One of the situations where the postemergence grass herbicides have been very useful is where dry weather and lack of irrigation (poor activation) has allowed annual grasses to escape a prior application of pre-emergence herbicides (photo, above). Expensive hand removal of the established grasses can be completely eliminated with the use of one of these herbicides on many nursery plants. The grasses slowly die, and the residual pre-emergence treatments applied earlier then provide continued control. In many nursery crops, these herbicides can essentially eliminate the need for manual removal of grasses. Mixing different herbicides, especially those with any postemergence activity, should always be done with caution. Often mixing two or more herbicides that are individually safe on nursery plants can cause severe injury. Compatible mixes are often listed on the herbicide labels, but not always. Any mixes should be based on labels or prior testing. Adding surfactants to herbicides, unless mentioned on the label, also can be hazardous when sprayed over nursery plants.

In summary, successful weed management in field nurseries requires:

- identifying the problem weeds on your sites;
- selecting the herbicides for your crops and weeds;
- timing applications based on the herbicide characteristics and stages of crop and weed growth; and
- available irrigation to activate the herbicides in the absence of timely rainfall.

Having observed and researched nursery weed-control practices for almost 50 years, I can say that the most successful weed-control programs are at nurseries that have a person dedicated to pesticide management. These nurseries understand that weeds should not take a back seat to digging and shipping.

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## More on weeds

For weed identification, check out *Weeds of the Northeast* from the Cornell University Press, Ithaca, NY. Weed identification guides also are available from chemical suppliers.

For information about registered products and herbicide characteristics, check out *Weed Control Suggestions for Christmas Trees, Woody Ornamentals, and Flowers*. This excellent bulletin from the North Carolina Cooperative Extension Service, Raleigh, is under revision. Also under revision and an excellent resource is *Controlling Weeds in Nursery and Landscape Plantings* from Pennsylvania State University, University Park. Information on nursery weed control from various states also can be found by searching online and from local cooperative extension offices.

For copies of herbicide labels, go to www.cdms.net, and click "Services," or contact local suppliers.