Integrated Pest Management Program
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Weed Management for Connecticut Nurseries and Landscapes

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Weed management is a priority for nursery managers and landscape professionals throughout the growing season. Even with consistent and routine vigilance, weeds still invade where they are not desired. Employing Integrated Pest Management (IPM) protocol correctly can reduce weed populations to acceptable or manageable levels. Long-term success in the reduction of weed populations requires that maintenance practices are consistently practiced throughout the year.

IPM is a holistic approach to pest management that controls pests through effective, economical, and ecologically sustainable methods. **Prevention, maintaining plant health, and proper pest identification are of primary importance. Multiple pest management control tactics, including mechanical, cultural, biological, and chemical controls; use of resistant varieties; and behavioral modification, are utilized in combination**. To be truly sustainable, IPM practices should include effort to reduce time and labor dedicated to weeding chores and a reduction in the use of non-renewable resource inputs. In some situations, pesticides (organic or synthetic) may be considered an acceptable mechanism of weed control, (especially when damage to desired plants needs to be immediately addressed to protect plant or human health), or when their usage can proactively eliminate seasonal weed seeds (i.e., pre-emergent herbicides). Steps should be taken to select the most appropriate pesticide.

WEED IDENTIFICATION

Correct identification of weed pests is the first essential step in weed management. An understanding of a weed's life cycle, its mode of reproduction (e.g., seed, roots, rhizomes), and how it responds to various IPM tools (e.g., mechanical, physical, or chemical controls) is key to successful management. Important life cycle characteristics to identify include whether the weed is:

- annual (winter, summer), biennial, or perennial;
- grass, broadleaf, sedge, or woody;
- cool or warm season (for grasses, sedges).

Awareness of this information allows the IPM practitioner to time application of a suitable control method, per label direction, to the correct stage of the pest lifecycle. Misidentification of the pest could lead to the use of an incorrect or ineffective method of control.

Several excellent weed identification guides are available in hard copy and online, including:

- Weeds of Container Nurseries in the United States, by North Carolina State University
- Weeds of the Northeast, by Richard H. Uva, Joseph C. Neal, and Joseph M. DiTomaso
- IPM Pocket Guide for Weed Identification in Nurseries and Landscapes, by Steven A. Gower and Robert J. Richardson
- Invasive Plant List - CT Invasive Plant Working Group (CIPWG) (cipwg.uconn.edu)
- Landscape Weed Identification; Turf Weed Identification - UConn IPM (ipm.uconn.edu)
- Weed Identification & Management - University of Wisconsin-Madison

- New Jersey Weed Gallery – Rutgers Agricultural Experiment Station
- Weed Management in Turf – Penn State Extension
- Weed Herbarium – UMass Extension

WEED CONTROL IN NURSERIES

Weed prevention helps ensure that containerized plant material thrives. Competition from weeds can suppress crop growth by monopolizing valuable resources (i.e., sunlight, water, and nutrients). Weeds may also serve as alternative hosts for pests and pathogens that threaten a plant's health and marketability. To prevent or reduce their range of spread, it is important to manage weeds before they flower and produce seed or develop vegetative structures that increase their spread (e.g., rhizomes).

SCOUTING

Develop a system to inspect crops on a consistent basis. Scout for weeds at the same time as for insect pests or disease pathogens. Use a standard reporting form such as this Greenhouse IPM Monitoring Report from UConn Extension (ipm.uconn.edu). Diligent scouting ensures that control measures are implemented at the life cycle stage during which mechanical or chemical controls are most effective. When scouting:

- Identify and record all weed species found, including their approximate height and stage of growth. Be familiar with both the juvenile and mature leaf of problem weeds.
- For each identified species, understand its life cycle to determine when it is in flower, how it reproduces, and the best time to eradicate it or reduce its growth. Observe the preferred location and growth habit of existing weeds.
  - In April and May, check for blooming winter annuals, such as bittercress, chickweed, and dandelions.
- Determine the severity of the infestation or acceptable population threshold.

FERTILIZER IMPACTS

Nutrient management is a key component of successful nursery production; it also has a great impact on weed populations in containers. Areas of the nursery that receive fertilizer generally experience increased weed growth. Fertilizer techniques like banding, incorporating, or placing fertilizer in the plug hole are ways to decrease weed growth while ensuring crops grow vigorously.

Research at Oregon State University assessed the placement of fertilizer in pots during repotting of plugs. Depending on where the fertilizer was placed in the container, differences in weed density were observed. Pots with fertilizer placed in the plug hole (dibbling) had fewer weeds when compared to fertilizer that was incorporated in the potting media or top dressed around the plug on the soil surface. (Figure 1). Dibbling is used only with controlled release fertilize, and when potting in spring or early summer, but not in fall. Test each crop with a trial of this method.

Figure 1. Weed growth in container grown lavender; fertilizers were top-dressed, incorporated, and placed in plug hole (respectively, from left to right). From Oregon State University, Container Weed Management

MANAGEMENT OPTIONS

1. Sanitation

Good sanitation practices are necessary to reduce the spread of weeds. Potting areas, where transplanting or seeding of flats occurs, should be kept weed-free to eliminate the introduction of weed seeds into the soil media or containers.

The seeds of many weeds, such as *Oxalis* spp. and bittercress (*Cardamine* spp.), are very mobile, traveling on equipment, clothing, and tools. Prevent the spread of seeds by cleaning equipment and clothes after weeding and before moving to other areas of the nursery.

Weeds removed from soil or media must be disposed of away from planting or growing areas to reduce the potential

germination of introduced weed seeds. Weeds that have not yet produced a seed head may be deposited into managed compost piles and destroyed by the appropriately heated compost. Weeds with mature seed heads should never be composted. Some weed seeds can survive composting, and then these viable propagules in the compost, when mixed with potting media, are spread into newly potted containers.

2. Barriers

Barriers may be used to prevent weed populations from establishing in production areas. Commonly used barriers on the ground include landscape fabric and organic mulches (e.g., shredded bark or wood chips). These materials are most effective in areas that are sanitized and weed-free throughout the growing season. In areas where landscape fabric may be difficult to use, such as in the shade of trees or on slight slopes, organic mulch is recommended. Mulch can also be used in containers to reduce weed pressure and to maintain moisture in the growing media. Common materials for mulch in containers include shredded bark, rice hulls, and coco fiber weed disks.

3. Mechanical

Mechanical weed management methods include hand pulling, hoeing, and flaming. Hand weeding is one of the most labor and time intensive methods. However, it is often one of the only effective ways of removing some weeds from containers. Mechanical weed management around containers is most easily achieved with string trimming, hoeing and flaming. Flaming can be effective, but it does have limitations: it is most effective on young weed seedlings; and it should not be used where landscape fabric/weed barrier or dried organic mulches may easily ignite.

4. Herbicides

Herbicide use in nurseries remains one of the most common methods of weed control, due to its success, economic affordability (in relation to cost and time savings of manpower hours), and ease of application.

Pre-emergent herbicides (Table 1) are the most effective herbicides used in nursery operations. These products may be applied to containers, often at potting time, to prevent the germination of weed seeds. Repeated applications may be made to prevent season-long germination.

Table 1. Pre-emergent Herbicides for Container Crops (Adapted from University of Arkansas' Weed Control in Container Nurseries)
[1]Herbicide classification according to chemical group. Please read and follow all manufacturer's label directions.

Trade Name	Product Rate (per 1000 sq ft)	Active Ingredient	Weeds Controlled	Site of Action (Group[1])
OH2	2.3	Oxyflourfen + pendimethalin	Grasses and Broadleaves	Cell membrane disrupter (14) + microtubule assembly inhibitor (3)
Broadstar	3.5	Flumioxazin	Grasses, Sedges, and Broadleaves	Protox inhibitor (14)
Rout	2.3	Oxyflourfen + oryzalin	Grasses and Broadleaves	Cell membrane disrupter (14) + microtubule assembly inhibitor (3)
Snapshot	2.3 - 4.6	Trifluralin + isoxaben	Grasses and Broadleaves	Microtubule assembly inhibitor (3) + cell wall synthesis inhibitor (21)
Showcase	2.3 - 4.6	Trifluralin + isoxaben + oxyfluorfen	Grasses and Broadleaves	Microtubule assembly inhibitor (3) + cell wall synthesis inhibitor (21) + cell membrane disrupter (14)
Freehand	2.3	Dimethenamid-P + pendimethalin	Grasses and Broadleaves	Cell growth inhibitor (15) + microtubule assembly inhibitor (3)
Manage 75WG	0.9	Halosulfuron	Sedges	Inhibition of acetolactate synthase (2)
Jewel	2.3	Oxadiazon + pendimethalin	Grasses and Broadleaves	Protox inhibitor (14) + microtubule assembly inhibitor (3)
Pendulum	2.3 - 4.6	Pendimethalin	Sedges and Grasses	Microtubule assembly inhibitor (3)
Harrel's Granular Herbicide 63	0.3 - 2.3	Oxyfluorfen	Broadleaves	Cell membrane disrupter (14)
Harrel's Granular Herbicide 75	2.3	Oxyfluorfen + trifluralin	Grasses and Broadleaves	Cell membrane disrupter (14) + microtubule assembly inhibitor (3)

Post-emergent herbicides control weeds after germination has occurred. These herbicides must be applied properly so that their application will not harm the desired crop, neighboring plants, or the environment. Read labels carefully: identify plants that may be sensitive to herbicide damage and ensure that the chosen herbicide is effective against the targeted weeds. Depending on the product label, the herbicide may be applied to areas between grow spaces, containers, and storage areas. Care must be taken to prevent damage to crops: spray on a clear, non-windy day and

avoid drifts caused by vents or fans.

IPM is most effective when a combination of management methods is used strategically together. The most successful programs use preventative measures of weed suppression with barriers, sanitation practices, and chemicals, and if necessary, supplement additional weed management with mechanical removal.

WEED CONTROL IN LANDSCAPES

PREVENTION

It is far easier to prevent the introduction of weeds than it is to control them after establishment. Minimize introduction of topsoil contaminants and weeds moving into landscape beds and turfgrass areas. **Important practices to reduce weed populations include:**

- **Regularly scout** for and eradicate emerging new weeds.
- **Control or eliminate weeds around buildings**, in landscape areas, and along fences and property perimeters.
- **Prevent or minimize the production of seed** or vegetative spread of annual and perennial weeds on site. Where possible, always remove weeds before they produce seed.
- **Clean mowing and landscape equipment** before transporting to other sites. If weed populations are identified and present in the lawn areas, mow the least weedy areas first, before mowing the more populated weedier areas.
- **Use weed-free compost**, mulch, seed, and other materials. When establishing or renovating lawns, purchase certified or premium quality turfgrass seed, with the highest possible purity and germination. Examine seed labels for the least amount of weed and crop seed present.
- **Remove weeds from plant material or containers** to prevent the introduction of weeds to a new landscape site and to reduce future problem populations.
- **Replenish the mulch layer in landscape beds** every 1-3 years to prevent germination of weed seeds that may contaminate the mulch surface.

CULTURAL PRACTICES

Select landscape plants or turfgrasses that thrive in the existing, specific environmental conditions in the chosen location. Unsuitable growing conditions limit plant growth, enabling weeds to establish and compete for nutrients, sunlight, water, and space. **Maintaining a landscape comprised of properly selected plant material will allow plants to mature over time and reduce open areas where weeds have the opportunity to establish.**

Select turfgrasses that are best suited for the conditions at the landscape site and maintain a dense turfgrass stand through the use of sound cultural practices (i.e., mowing, aeration, fertilization, and irrigation) **to reduce open spaces where weeds may germinate.**

Maintain a consistent height of cut, preferably mown no less than 3” to block sunlight to the soil surface and reduce annual grassy weed germination. If turfgrass areas are thin with open spaces, weed seeds will germinate. Dense, healthy lawns with few voids or divots in the turf may have reduced need for pre-emergent applications, making alternate years of application possible. **Re-establish or renovate and overseed turfgrass lawns to keep the lawn dense and healthy.** Time overseeding events so that appropriate irrigation and care can be provided, to encourage establishment of the young turfgrass plants.

Crabgrass can still germinate in high density lawns, but will do so in much reduced numbers than in thin lawns or open spaces. The denser the turfgrass canopy, the lesser the population of crabgrass. The top 1” of soil provides a huge reservoir of grassy weed seeds (especially crabgrass) just waiting for an opportunity to germinate. Recognize that any disturbance of the soil surface, including some common turfgrass maintenance practices, can be disruptive enough to create small open spaces at the soil surface, which will provide an opportunity for crabgrass seed to germinate. Therefore, it is critical that minimal disruption of the soil surface occurs in the early spring, when the potential for crabgrass germination is greatest.

Always assess the landscape to understand the existing microclimates, noting where plants receive southern vs. northern exposure and where hotter areas of the landscape exist. Crabgrass thrives in full sun and hot, dry conditions. Given that a pre-emergent herbicide treatment is the most effective method of crabgrass control, it is important to consider how soil temperatures may vary in a lawn environment. Crabgrass germination (and breakthrough of a pre-

emergent) is most likely to occur first in the sunniest and driest locations. Therefore, timing (both of the initial and second pre-emergent application) should be directed to avoiding germination or breakthrough in the more adverse locations of the lawn. While grassy weeds germinate all season long, the greatest percentage of crabgrass germination occurs in the early spring, with the balance of germination occurring in late spring and summer.

The presence of weeds in a turfgrass stand often indicates improper growing conditions or a stressed and unhealthy turfgrass. If weeds are a perpetual or extensive problem in a lawn, it may be that the turfgrass seed mixture was not appropriately selected for the site conditions. Weeds often provide clues to soil health in the turfgrass growing environment. For example, annual bluegrass thrives in excessively irrigated or poor draining wet soils; crabgrass thrives in hot, dry soils; prostrate knotweed favors compacted areas. When poor growing conditions or activity creates voids in the turfgrass stand, weeds inevitably fill those spaces. If the conditions encouraging their presence are left unchanged and the underlying problem is not corrected, weeds will always be a challenge in those thin or open areas. **Modifying cultural practices, or amending soil conditions that favor the health of the turfgrass, will reduce weed populations.**

Irrigate properly and efficiently. Water established landscape plants only when necessary, according to the needs of each plant species. Excess irrigation favors shallower rooting in both landscape plants and turfgrass, leading to unhealthy plants and a favorable environment for many weeds.

Be familiar with the soil health of the landscape properties you maintain. Soil health is important to maintain plant health and reduce weed competition in the landscape beds and turfgrass areas. Obtain a soil test (soiltest.uconn.edu) to understand the soil properties, including the pH (acidity or alkalinity), nutrient composition, and organic matter content. Follow recommendations to maintain the optimal pH for the plant or turfgrass species being grown and to add organic matter if needed. Organic materials, such as compost, liquid seaweed, and compost teas should always be considered as part of the overall nutrient management program and calibrated correctly if an application is recommended.

PHYSICAL AND MECHANICAL WEED CONTROLS

- **Mechanical removal**: Hand pulling of weeds, an important component of an IPM program, can be a viable option when only a few weeds require removal. Monitor the landscape areas and lawn for emerging weeds and quickly remove them before they become well established. Moist soil and well-designed hand tools allow for easiest removal. **String trimmers** are also a mechanical weed control tool that, with repeated application, can effectively manage some weeds.
- **Weed barriers**: Useful in playgrounds or landscape areas to prevent weed infiltration in unplanted areas. 4-6" of wood chips, bark, cardboard/newspaper, fabric, or rubber mulches are recommended. Mulch on top of a plastic barrier may also be considered.
- In landscape beds and non-priority turfgrass areas, such as along fence lines, in parking lots, at curbing interfaces or cracks in sidewalks, **handheld propane flamers or steam weeding devices** can be used to eradicate juvenile weeds.
  - **Handheld propane flamers or steam weeding devices** are best used in spring or early summer. Most effective on annuals and juvenile weeds (fewer than 4-5 leaves; less than a few centimeters tall).
  - Plants are more susceptible to heat treatments in dry conditions, but care must be taken to prevent damage to surrounding vegetation.
  - Re-seed, replant, or mulch to reduce open spaces where weeds may germinate, as soon as is practical to do so.

CHEMICAL CONTROLS

As previously mentioned, maintaining a healthy, dense lawn and landscape plantings will effectively reduce annual weed pressure. A well-timed application of a pre-emergent herbicide can proactively eliminate most grassy weed seeds, including the invasive Japanese stiltgrass, before they germinate. In CT, all professional applications of pesticide products, including organic or minimum risk products, must be performed by a licensed pesticide applicator.

- Consider soil temperatures and growing degree days (GDD) for weed control for both the appropriate application timing and product. Refer to Weather Stations for Landscape Professionals (ipm.uconn.edu) for more information.
  - **Soil temperatures in inland locations warm up earlier than coastal locations moderated by cooler water temperatures.** Soil temperatures and the germination of grassy weeds can vary depending on the location in the state. Use of growing degree days supports accurate timing of pre-emergent applications.

  - Phenological development of landscape plants can also provide clues to appropriate timing for applications.
- With this year's chillier-than-usual spring temperatures, the **effectiveness of pre-emergent products applied early in the season may be diminished**. **Two applications of a pre-emergent product are recommended to extend the effectiveness of the protective barrier at the soil surface and provide greater season-long control.** With a single early scheduled application, there is a higher likelihood that crabgrass seed germinating later in the spring breaks through the pre-emergent barrier, as the efficacy of the product fades. Heavy spring rains, such as those we had this spring, can also diminish the effectiveness of the barrier and allow an early breakthrough of crabgrass emergence at the time when growth of cool season turfgrass slows in summer. Even though the preferred time to make a pre-emergent application has past, you can still apply a pre-emergent to prevent crabgrass that has yet to germinate if the early application was missed, and you can also use a post control product, such as Acclaim, that will effectively control the 1-2 tiller stages of crabgrass seedlings. Again, timing for effective control is critical.
- **Label directions must be followed if overseeding is to be considered, as pre-emergent products vary in their ability to inhibit turfgrass seed germination.** Mesitrione (Tenacity) is one product that can be safely used at the time of seeding.
  - A spring application of pre-emergent crabgrass control timed with a fertilizer application will encourage turfgrass growth and crowd out any weeds that attempt to emerge through the turfgrass canopy.
  - Follow label recommendations for irrigation recommendations.
- **Corn gluten meal** is a popular organic land care pre-emergent herbicide. Be aware that use of the product, following label rates to provide herbicidal control of crabgrass, will inhibit turfgrass seed germination and would also release nitrogen at the time of application that exceeds appropriate agronomic recommendations.
- **Plan ahead**: Identify weed issues this spring and summer, and consider delaying weed control treatments. **Fall is an opportune time to treat problem weeds.** In intensively maintained lawns consistently plagued with annual bluegrass, a pre-emergent herbicide in September, prior to the germination of this weed, will reduce this winter annual's reoccurrence the following spring. Again, if attempting to improve turf density, select an appropriate pre-emergent product that will not be disruptive to an overseeding program.
- **In general, spot treating to eliminate problem weeds with a post-emergent herbicide is preferred** over a blanket treatment.
  - **Broadleaf weeds must be vigorously growing for post emergent products to be effective**. With our unseasonably cool spring, emergence and growth of many broadleaf weeds has been slow. As temperatures warm, growth activity will increase and allow an appropriate opportunity for treatment.
  - **Fall is also an effective time for application of a broadleaf product to eliminate challenging weeds.** A fall application also will eliminate small germinating winter annual broadleaf weeds that are a concern in the spring. The surrounding turfgrass will continue to grow and fill in the open spaces left by the dying weeds, especially if a fertilizer applied to the lawn at this time encourages growth.
  - Read product label of post emergent products and consider product sensitivity or potential damage to neighboring plants, if product can be transported as drift.

EVALUATION

Turfgrass and landscape areas should be regularly inspected throughout the growing season. Use a record keeping tool such as UConn Extension's Landscape Professionals Assessment Form. The effectiveness of the IPM program should be annually assessed based on timely evaluation of treatments, scouting records, staff observations, budget records, and client feedback.

Refer to UConn's IPM website for more information and tools: ipm.uconn.edu.

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