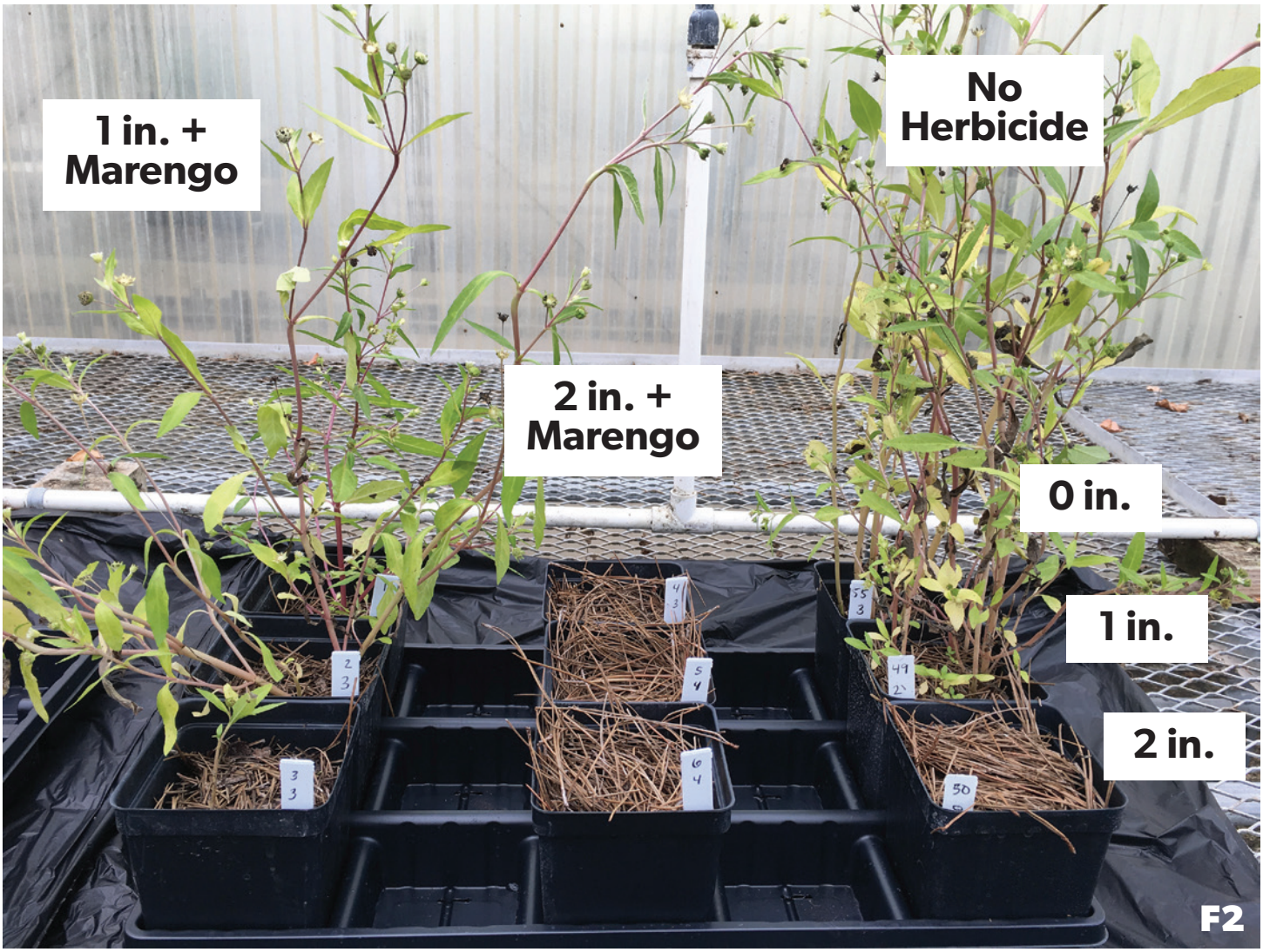
Chemical Weed Control Strategies for Nurseries and Landscapes: **Part II**

DR. DEBALINA SAHA, ASSISTANT PROFESSOR (WEED MANAGEMENT IN ORNAMENTAL CROP PRODUCTION FOR NURSERIES, LANDSCAPES, GREENHOUSES, AND CHRISTMAS TREE PRODUCTIONS), DEPARTMENT OF HORTICULTURE, MICHIGAN STATE UNIVERSITY

Debalina Saha is an Assistant Professor in weed science for ornamental crop production in nurseries, landscapes, and Christmas tree production at Michigan State University. She has earned her doctoral degree in horticultural science from the University of Florida in 2019 and her Doctoral dissertation was on "Influence of mulch chemical and physical properties on preemergence herbicide interactions and weed control". Her entire doctoral project was dedicated to the nursery growers and landscape industries as she has tried to develop an effective alternative weed control strategy by combining preemergence herbicides with different organic landscape mulch materials for a long-term weed control in ornamental production. She has her undergraduate and Master's degree in botany with a concentration in plant physiology, biochemistry, and molecular biology from University of Calcutta, India. However, she has been working as a weed scientist for almost four years and will be continuing her research in weed science for ornamental crop production. At Michigan State University, the main focus of her applied research will be improving MSU extension and helping Michigan's nursery growers, landscape industries and Christmas tree producers. She has a goal to serve the Michigan Nursery and Landscape Association, where she wants to interact and connect with the growers to know their specific weed related issues and will be providing economic, effective, and environment-friendly weed management strategies. Weeds are a major issue in ornamental crop production as hand weeding can be extremely time consuming, laborious, and expensive. A little improvement in this area can help the growers to increase their profitability and marketability of their ornamental crops. Some of Debalina's future objectives are: to develop alternative integrated weed management strategies (both chemical and non-chemical) for Michigan nurseries; to identify and manage herbicide resistant weeds in container nurseries and landscapes; algae and liverwort control in nurseries and greenhouses; and develop a weed control guide particularly for Michigan Christmas tree production. Aside from her applied research for extension, Debalina plans to teach "weed management in nurseries and landscapes for ornamentals" as both undergraduate and graduate level courses and would be mentoring undergraduate as well as graduate students in research. Debalina enjoys spending time with her husband and traveling with him throughout the world in her spare time. She also thoroughly enjoys painting plants, flowers, landscapes and portraits in oil, charcoal, and water colors and she has been pursuing her painting since her childhood.

INTRODUCTION:

Chemical weed control by application of preemergent (PRE) and postemergent (POST) herbicides is the most effective and economic method to control weeds in landscape planting beds and in container nursery production systems. If the herbicides are applied correctly, there can be little or even negative environmental impacts. Choosing the right herbicide for the target weed species, following the label instructions for the application rate, proper application timing, and following proper calibration procedures are some of the important factors of herbicide efficacy. Currently, nursery growers rely mainly on the application of PRE herbicides than POST herbicides. This is because there are less options for POST available in the market and there are more chances of phytotoxic injury to the ornamental plants (Figure 1) when the POST herbicides are applied directly over-the-top of these ornamentals. Effective and judicious use of these chemical herbicides can lead to excellent weed control in ornamental crop production without causing damage to the environment.



Preemergence Weed Control:

Many PRE herbicides can offer some control of both grass and broadleaf weeds, but most are more effective or are primarily used to control one subclass or the other. Using combination products or tank mixes of different PRE herbicides is very common in nurseries and landscapes. Tank mix of broadleaf (e.g., oxadiazon, isoxaben, dichlobenil, and dimethenamid-P) and grass (e.g. pendimethalin, prodiamine, oryzalin, and trifluralin) will generally offer a broad-spectrum weed control and can also reduce the number of herbicide applications that are generally made (Gilliam et al., 1989; Monaco and Hodges, 1974). Tank mixes can also be more cost effective than the product applied alone (Marble et al., 2015).

Yellow and purple nutsedge are often the most difficult weeds in nurseries and landscapes as they can reproduce by seeds as well as by underground tubers which can live long by remaining dormant underground. Herbicides labeled for nutsedge include dimethenamid-P (Tower®, and as a component in Freehand®), S-metolachlor (Pennant Magnum®), S-ethyl dipropylthiocarbamate or EPTC (Eptam®), and dichlobenil (Casoron®). For controlling yellow nutsedge, metolachlor is the most effective PRE herbicide.

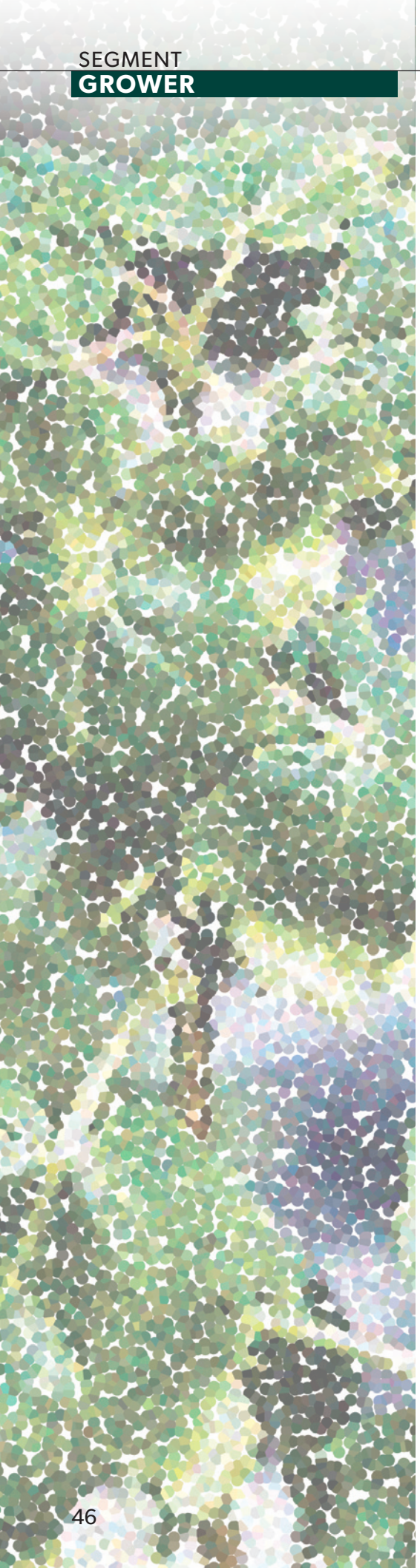
In recent years several PRE herbicides have been labeled for nursery and landscape uses for ornamental crop production. Flumioxazin (SureGuard®) is one of the popular herbicides among landscape managers for its ability to control many different annual broadleaf weed species and grasses. Dimethenamid-P (Tower® and Freehand®) is another important PRE herbicide which is labeled for controlling grasses, broadleaves, and even sedges in landscape beds. The most recent and latest PRE herbicide is indaziflam (Specticle®). This herbicide can be used for controlling many annual grasses and broadleaf weed species. However, in order to achieve an efficient long-term weed control and reduce the chances of herbicide resistance among weed species, an herbicide rotation program needs to be followed by the growers where different herbicides with different modes of action should be used in rotation. Repeated application of the same herbicide over the years can lead to the development of herbicide resistance among the weed species. Hence, to avoid such circumstances, an herbicide rotation program and using different tank mixes with different modes of action are recommended.

Preemergence Herbicide and Organic Mulch Interaction:

In many cases, PRE herbicides are applied to the already mulched landscape planting beds, which can impact the efficacy of these PRE herbicides. Organic mulch particle size

F1 Example of herbicide damage to an ornamental plant.

F2 Integrated approach (pine straw mulch in combination with preemergent herbicide, Marengo) to control *Eclipta* in container production. (From left to right) The first row contains one inch of pine straw + Marengo, the second row contains two inches of pine straw mulch + Marengo, and the third row contains only pine straw mulch at three different depths. The two inches of pine straw mulch + Marengo have shown the best control of *Eclipta* in this container trial. Photo credit: Debalina Saha, Department of Horticulture, Michigan State University.



plays an important role in herbicide efficacy. According to Saha et al. (2019), 85% of the applied PRE herbicides are retained in the mulch layer and there is more binding of herbicide molecules with the smaller particle-sized mulch materials than the coarse/larger mulch particles. Mulch depth of at least two inches is recommended in combination with the PRE herbicide for an effective, long-term weed control in nursery containers as well as in the landscape (Figure 2). The PRE herbicide bound to the fine particles of an organic mulch layer can help in controlling the newly introduced weed seeds on the top of the mulch layer. Experiments conducted by Saha et al. (2019) at Mid-Florida Research and Education Center, Apopka, Florida, have shown that pine straw is the most compatible mulch material that can be used with the three applied PRE herbicides (indaziflam, prodiamine, and dimethenamid-P + pendimethalin) in comparison to pine bark and hardwood chips.

Postemergence Weed Control:

Nursery growers and landscape managers need to be careful when applying POST herbicides and should always check the herbicide labels for the possible phytotoxic injuries to ornamental plants. If required, only directed sprays and spot applications should be done in order to avoid phytotoxic effects.

Glyphosate (RoundUp®) is one of the most popular POST herbicides which is labeled for use in landscapes. This herbicide is non-selective, and it can translocate within the weed species. However, repeated application of the same glyphosate has the potential to develop resistance among the weed species. For example, glyphosate-resistant horseweed has been reported in several locations in North Dakota.

Glufosinate (Finale®) is another nonselective herbicide that is minimally translocated (Mersey et al., 1990) and thus acts more like a contact herbicide (Marble et al., 2015). There are several gramminicides such as fluazifop-P-butyl (Fusilade®), clethodim (Envoy®), fenoxaprop-p-ethyl (Acclaim®) and sethoxydim (Segment®), which are widely used by the growers as they are safe for over-the-top application to a wide variety of broadleaf ornamentals and can also provide selective control of grass species.

Selective nutsedge control POST herbicides have been developed in the last several decades (Pereira et al., 1987). Halosulfuron (SedgeHammer®), imazaquin (Image®), bentazon (Basagran®) and sulfosulfuron (Certainty®) are selective POST herbicides that can control nutsedges and are safe to apply in and around landscape ornamentals. Imazaquin can control both yellow and purple nutsedge and can be applied over-the-top of a number of ornamentals which include common groundcovers such as Mondo grass, Asiatic jasmine, and Liriope, and also to several other perennials, shrubs, and trees. Bentazon is the only herbicide that is labeled for controlling yellow nutsedge and this herbicide can be applied as directed spray around almost all ornamental species and applied over-the-top to more than 20 species of trees, shrubs, and perennials (Marble et al., 2015).

Conclusion:

There is no one herbicide in the market that can control all weed species. However, in order to achieve the best weed control, the nursery growers and the landscape managers need to combine both chemical as well as non-chemical methods using an integrated approach. Choosing the right herbicide for the target weed species and applying at the correct rate at the right time can help to improve weed control, reduce the chances of unintended phytotoxicity, and even can reduce environmental pollution. Future research should focus on determining the best integrated approach of weed control and testing more herbicides on ornamentals for phytotoxic effect and crop tolerance. Continual training and education are also required for ornamental crop producers and herbicide applicators for a successful weed management program.

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