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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.

# Non-chemical Weed Control Strategies for Nurseries and Landscapes: Part I

## INTRODUCTION

According to the Michigan Department of Agriculture and Rural Development, Michigan has the fourth largest nursery industry in the nation. Nursery, perennial plant production, sod production, landscaping, and lawn care industries contribute \$5.715 billion to Michigan's economy. The perennial and nursery plant producers generate about \$1.2 billion in annual sales, making them the largest commodity group in Michigan.

Weed control is an important component to consider in order to improve the profitability and production of ornamentals by the growers. Weeds can compete with the new transplanted ornamental plants for nutrients, water, oxygen, space, and light. As a result, both the quality and production quantity of the ornamentals can get affected. There are very few preemergent herbicides available in the market which can be applied for ornamental production in nurseries and landscapes. Moreover, these herbicides can get leached down through the soil and can contaminate groundwater and nearby surface water causing environmental issues. So, many growers prefer to use non-chemical approaches to control weeds. Hence, in this article, some of the popular non-chemical weed control strategies for ornamental crop production in nurseries and landscapes have been discussed.

## Non-chemical Weed Control Methods

**Hand weeding and cultivation.** Hand weeding can be extremely time consuming, laborious, and expensive both in nursery container production as well as in landscape planting beds (with heavy weed infestation). Growers can spend up to \$4,000/acre (Mathers, 2003). Hand equipment and tools can be used to remove the weeds physically. In some cases, tilling or cultivating can even damage the ornamental plants in close vicinity, especially their roots and underground storage organs (Calkins et al., 1996).

**Mulching.** Using organic and inorganic mulch materials in landscape planting beds is a common practice for controlling weeds. Apart from controlling weeds, organic mulch can help to retain moisture, lower the



soil temperature, and can improve ornamental plant growth. The mechanism of weed control by the organic mulch layer includes light exclusion for weed seed germination, creation of a physical barrier for weed seed emergence, and allelopathic properties of certain mulch materials (Marble et al., 2015). Organic mulch materials such as pine straw (Figure 1), pine bark (Figure 2), and hardwood chips (Figure 3) are commonly used in the landscape setting and can be used in container production as well. Mulch depth is an important factor to consider. An



approximate depth of two inches is suggested for effective weed control. Weed seeds can germinate even in a thin layer of mulch (less than an inch). Whereas, a very thick layer of mulch (more than four inches) can cause injury to the ornamental plants. For instance, a thick pine bark layer of about four inches or more can be acidic to sensitive ornamentals. Inorganic mulches are generally pest free and do not decompose over time and can be used at much lower depths in comparison to organic mulch while providing effective weed control (Marble et al., 2015). Rocks and stones can provide effective weed control (Figure 4). However, these are heavy to transport and include labor and cost for handling. Geotextile fabrics or landscape films are some other inorganic mulching options. But in certain cases, there can be adverse effects for the ornamentals, such as restriction of root growth, reduced soil nutrients and water stress, and reduced soil oxygen (Marble et al., 2015). Hence, landscape fabrics are not recommended for weed control practices in landscape planting beds.

**Fertilizer placement.** In nursery containers, fertilizer placement can significantly reduce weed growth. Incorporation (mixing fertilizer in with the media) and topdressing (applying fertilizer on the container media surface) of fertilizer in nursery container production have shown maximum growth in eclipta (*Eclipta prostrata*) (Figure 5), spotted spurge (*Euphorbia maculata*) (Figure 6), and crabgrass (*Digitaria sanguinalis*) (Figure 7). Whereas, dibble (placing fertilizer in a small pocket beneath the root ball at a depth of three inches) and subdressing (placing fertilizer in a layer at a depth of

three inches) can reduce weed growth significantly in container production (Figures 5, 6, 7). Subdressing is more recommendable than dibble because when fertilizer is allocated in a pocket near the root ball of the ornamental it can cause phytotoxicity and injury to the ornamentals. By placing fertilizer near the ornamental root zone, there is reduction in weed growth because the ornamentals gain a competitive advantage.

**Monitoring irrigation.** Drip or micro or sub-irrigation systems have shown reduced weed growth in container plant production (Marble et al., 2015). Sub-irrigation can reduce weed growth in containers by 18% compared with overhead irrigation (Wilén et al., 1999). However, the irrigation placement (i.e. overhead vs. sub-irrigation) has shown significant reduction of weed growth in ornamentals growing in containers only (Marble et al., 2015) but not in landscape or field conditions.

**Thermal weed control.** Thermal weed control includes the use of some form of heat such as steam or flame from a propane burner. According to Ascard (1995), several different annual weed species can be suppressed by flaming, but this method is less effective on larger weed species, perennials and grasses. During dry conditions, this process can be extremely dangerous as nearby plants and other materials (such as lawn ornamentals, hoses, irrigation heads, etc.) can get damaged (Marble et al., 2015). Solarization can also be used to control different weed species such as common purslane (*Portulaca oleracea*), pigweeds (*Amaranthus* spp.), and henbit (*Lamium amplexicaule*) (Horowitz et al., 1983). Thermal weed control is suitable for very specific scenarios, as this requires special expensive equipment and involves multiple applications. Currently, there is little or minimal use of thermal weed control practice in landscape beds and it is not recommended.

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- 1** Pine straw: commonly used landscape organic mulch
  - 2** Pine bark: commonly used landscape organic mulch
  - 3** Eucalyptus hardwood chips: commonly used landscape mulch
  - 4** Rocks used as inorganic mulch for controlling weeds in a landscape planting bed.
  - 5** Effect of fertilizer placements in containers on eclipta (*Eclipta prostrata*) growth.
  - 6** Effect of fertilizer placements in containers on spotted spurge (*Euphorbia maculata*) growth.
  - 7** Effect of fertilizer placements in containers on crabgrass (*Digitaria sanguinalis*) growth.
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There are several different types of non-chemical weed control strategies that can be chosen by nursery growers and landscaping industries. However, to achieve the most economical and effective weed control, growers need to combine a variety of methods (i.e. integrated pest management (IPM)). Proper planning and application of multiple methods can lead to satisfactory weed control without using any type of herbicides. However, solely depending upon non-chemical methods can require a significant amount of time, labor, money, and constant scouting to reduce the weed seed germination and emergence.

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