MDARD Horticulture Fund

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Fiscal Year 2022 Final Report

Proposal Title: Impact of Fertilizer Placements on Weed Competition with Container-grown Ornamentals

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Summary of Project: Previous research results have shown that weed competition can cause 60% reduction in ornamental growth in a restricted area. The main objective of this project is to evaluate effects of fertilizer placements on weed competition and growth of ornamental plants in container production. A greenhouse experiment was conducted at the Horticulture Teaching and Research Center, MSU, with two types of ornamental plants, Rose (*Rosa* sp) and Spirea (*Spiraea japonica*) potted in 1.5-gallon pots using standard bark-based substrate as a growth medium with four different fertilizer placements notably incorporation, dibbling, sub dressing and top dressing with the aid of controlled release fertilizer Osmocote® (17-5-11).Two pernicious weed species, large crabgrass *(Digitaria sanguinalis)* and smooth pigweed *(Amaranthus hybridus*) were germinated and grown separately till 4-5 leaves stage and then transplanted to each of the ornamental container at different densities including 0, 1, 3, 6, and 9. The results showed that sub dressing of fertilizer can provide excellent control of smooth pigweed and large crabgrass and does not affect the growth of rose plant at 60 DAT (8 weeks). Dibble fertilizer placement showed reduced growth for both ornamental plants with excellent weed control. This is because the fertilizer placed in a pocket near the root ball of the ornamentals may have caused phytotoxicity and thereby reducing the overall ornamental plant growth. Incorporation of fertilizer provided minimum weed control in all the cases. Hence, it can be concluded that sub dressing is more recommendable to growers as it can provide good weed control without affecting the growth of container-grown ornamental plants.

Background: Controlling weeds in nursery and ornamental horticulture industries is an important aspect, as they can compete with the ornamental plants for soil, nutrients, water, light, and space within the container. As a result, there is a decrease in the quality, aesthetic and market value of the ornamental plants, and sometimes ornamental crops can die due to severe competition with heavy infestation of weed species. In addition, weeds can harbor insects, pests, diseases, and pathogens resulting in further reduction of market value. Other than a select group of graminicides, which can be applied to certain ornamentals, there are virtually no POST weed control options in container nursery production other than hand weeding. Thus, weed control is typically achieved through use of preemergence herbicides in combination with supplemental hand weeding.

Fig 1. In both the pictures (left and right), weeds growing in the container is competing and reducing the quality of ornamental plants.

In a restricted growth environment, such as container plant production, weeds have been shown to reduce marketability and crop growth (Fig 1.) by up to 60%. Mostly research focuses on weed competition in agronomic crops and limited research has been conducted in the area of weed competition in container-grown ornamental plants. Previous studies have reported that single redroot pigweed or large crabgrass plant per container can reduce the growth of Japanese holly grown in 2.4-liter nursery containers by 47% and 60% respectively. Also, previous studies have shown that coffeeweed suppressed growth of pyracantha, Andorra juniper, and Japanese holly, while cocklebur suppressed pyracantha and Andorra juniper. In 1980's researchers have reported that *Potentilla fruticosa* 'Gold Drop' is very sensitive to weed interference and the grassy weed economic threshold density in these container-grown plants may be <1. These data reflect the detrimental effects of weeds in container-grown ornamental production. Limited information is available on weed suppression from troublesome weeds currently infesting container-grown ornamentals nurseries and Christmas trees. This project aims to evaluate the

interference and competitive effects of pernicious weed species in container-grown ornamental in the North Central United States and to develop non-chemical weed control strategies by altering fertilizer placements in container-production.

Specific Objectives:

Objective 1. To evaluate effect of fertilizer placements on weed competition and growth of ornamental plants in container production.
Hypothesis: By altering the fertilizer placement there will be reduction in weed competition and improvement of ornamental plant growth in container production.

Objective 2. To disseminate the research results to the green industry and scientific society.
Hypothesis: There will be adoption of new weed control strategies by altering fertilizer placement in container production by nursery growers and some of the Christmas tree producers in the North Central region of United States.

Material and Methods:

Greenhouse Trial: A greenhouse experiment was conducted at the Horticulture Teaching and Research Center, MSU to achieve objective 1. Two types of container-grown ornamental plants Rose (*Rosa* sp) and Spirea (*Spiraea japonica*) were potted in 1.5-gallon containers on August 31,2022 by using standard bark-based substrate. The substrate used was composed of 80% bark and 20% peatmoss. During potting of ornamental plants, four different controlled-release fertilizer placements were considered, incorporation, top dressing, subdressing and dibble (Fig 2.). Controlled release fertilizer included Osmocote® [17-5-11 (8 to 9 months)] were applied at its highest label rate of 35 grams per gallon. All plants received 0.5 inches of irrigation daily via overhead sprinkler and were allowed to grow till they establish well in the container.

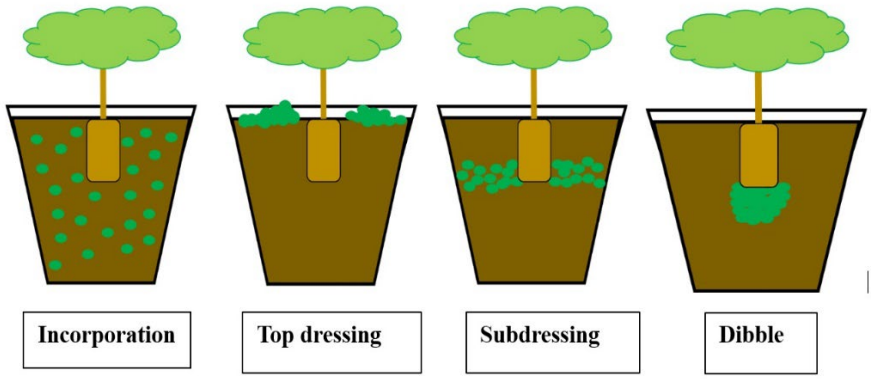

Fig 2. Four different types of controlled release fertilizer placements in the container production.

Large crabgrass (*Digitaria sanguinalis*) and smooth pigweed (*Amaranthus hybridus*) are two pernicious weed species in ornamental production. Weed seeds of large crabgrass and smooth pigweed were germinated and grown till 4-5 leaf stage separately in greenhouse before planting the ornamentals in the pots. After that weed species were transplanted carefully to each

container-grown ornamentals plants at different densities including 0, 1, 3, 6, and 9. Control set without any fertilizer and no weed species (i.e., 0 density) were also included. All containers are receiving 0.5 inches of irrigation daily via overhead sprinkler and will be allowed to grow till 12 weeks.

Fig 1. Undergraduate researcher, Shriya Kethireddy sowing weed seeds separately in rectangular pots. Photo credits: Debalina Saha, MSU Dept. of Horticulture.

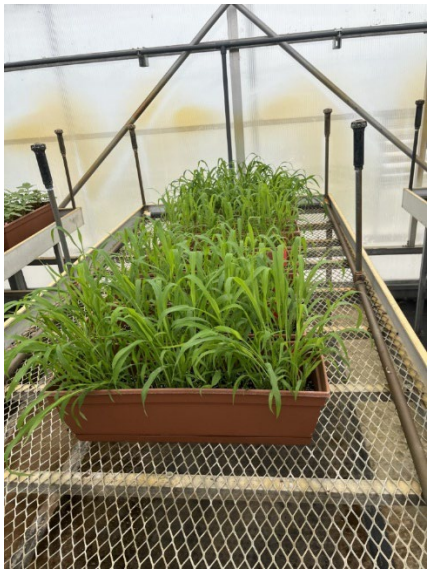

Fig 2. Large crabgrass (4-5 leaves stage) growing separately in rectangular pots, before transplantation to the ornamental containers. Debalina Saha, MSU Dept. of Horticulture.

Fig 3. Smooth pigweeds (4-5 leaves stage) growing separately in rectangular pots, before transplantation to the ornamental containers. Debalina Saha, MSU Dept. of Horticulture.

Fig 4. Greeshmanth Alluri, MS graduate student, transplanting weed species to the containers containing ornamental and taking initial growth data. Debalina Saha, MSU Dept. of Horticulture.

The experiment was a randomized complete block design (RCBD)with four replications per treatment. Data collection included initial growth indices of all ornamentals and weed species after the transplantation and at 8 weeks after transplantation (WAP). Growth indices are measured by calculating the average height and two widths of the plant by using the formula (height + width 1 + width 2)/3. At 8 WAP, total fresh weights of weeds and ornamentals were also recorded. All data were analyzed by using the R-studio.

Results:

- The results showed that dibble and sub dressing of fertilizer can provide excellent control(<50%) of smooth pigweed and large crabgrass (Fig 5).
- Incorporation showed the highest amount of large crabgrass (175 grams fresh weights) and smooth pigweed (250 grams fresh weights) at 8 WAP and hence provided minimum weed control for both the ornamentals.
- Minimum amount of large crabgrass (100 grams fresh weights) and smooth pigweed (100 grams fresh weights) were observed in case of dibble fertilizer placement (Fig 5).
- However, dibble fertilizer placement showed reduced growth for both ornamental plants with excellent weed control.
- This is because the fertilizer placed in a pocket near the root ball of the ornamentals may have caused phytotoxicity and thereby reducing the overall ornamental plant growth.
- Whereas sub dressing showed good acceptable weed control. The fresh weight of large crabgrass was about 150 grams and for smooth pigweed the fresh weight was about 125 grams (Fig 5) at 8 WAP. Which is about 50% less growth of weeds in comparison to the incorporation of fertilizer.

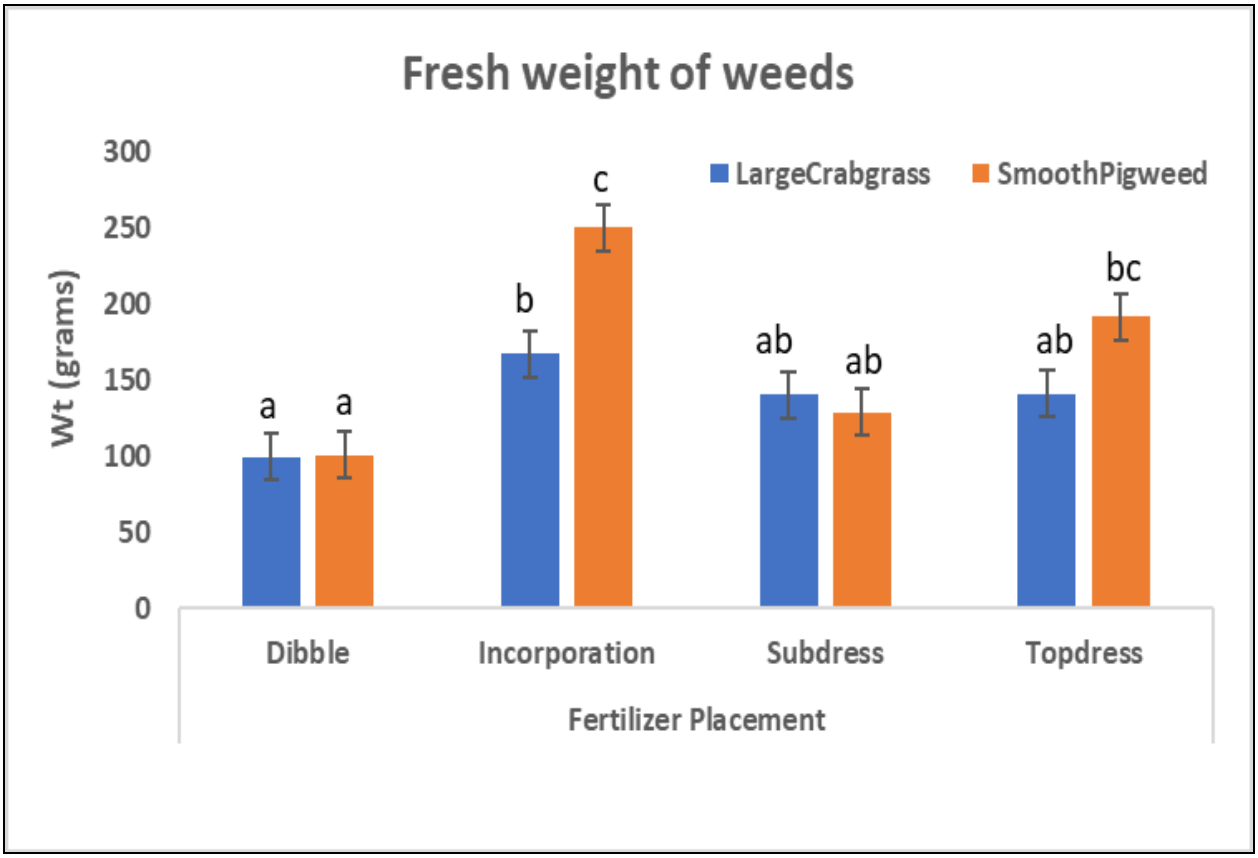

Figure 5. Graphical presentation of fresh weight of weed species at various fertilizer placements at 8 weeks after planting.

Figure 6. Pictorial representation of weed growth and ornamental growth at 8 weeks after transplanting.

Conclusion: It can be concluded that sub dressing of controlled-release fertilizer within container production is more recommendable to growers as it can provide acceptable weed control without affecting the growth of ornamental plants.

Research Dissemination: The research results were presented as a poster presentation at the national conference of American Society for Horticultural Sciences (ASHS) 2023 (in Orlando) by the graduate student, Greeshmanth Alluri. It was also presented as the 3-minute oral presentation at the ASHS 2023 annual conference. ASHS is one of the nation's biggest horticultural conferences where both scientific and industry connect. This research will also be presented at the North Central Weed Science Society annual conference (scheduled in December 2023).

Financial Summary:

Following is the financial summary of the project.

Items	Actual expenses	Expenses mentioned in the budget
Salary and wages	$9680.49	$12947
Fringe	$1243.64	$1281.08
Graduate tuition and fees	$3660.29	$3170.19
Material & supplies	$1905.30	$2574.73
Total	$16489.72	$20000