Controlling Liverwort in Greenhouse Container Production by Strategic Fertilizer Placements

Michigan Greenhouse Growers Expo (The Great Lakes Fruit, Vegetables and Farm Market Expo)

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Problem

- Major weed in greenhouses
- 6,000 to 9,000 species
- *Marchantia polymorpha* is the most common
- Become highly competitive with ornamental crops for
  - Water
  - Nutrients
  - Space
- Can prevent irrigation water and fertilizers from reaching root zone of ornamentals
- Reduce overall quality and market value of ornamentals

Previous Research

- **Among 4 types of organic mulch including rice hull (RH), cocoashell (CS), pine bark (PB) and hardwood (HW), RH and HW have provided an effective liverwort control in container production at depths of 1-2 inches.**
- **Whereas CS mulch type has provided the least liverwort control with the maximum water retention.**
- **These organic mulches have no significant phytotoxic effect on *Hosta* sp. varieties Curly fries and Pandora box.**

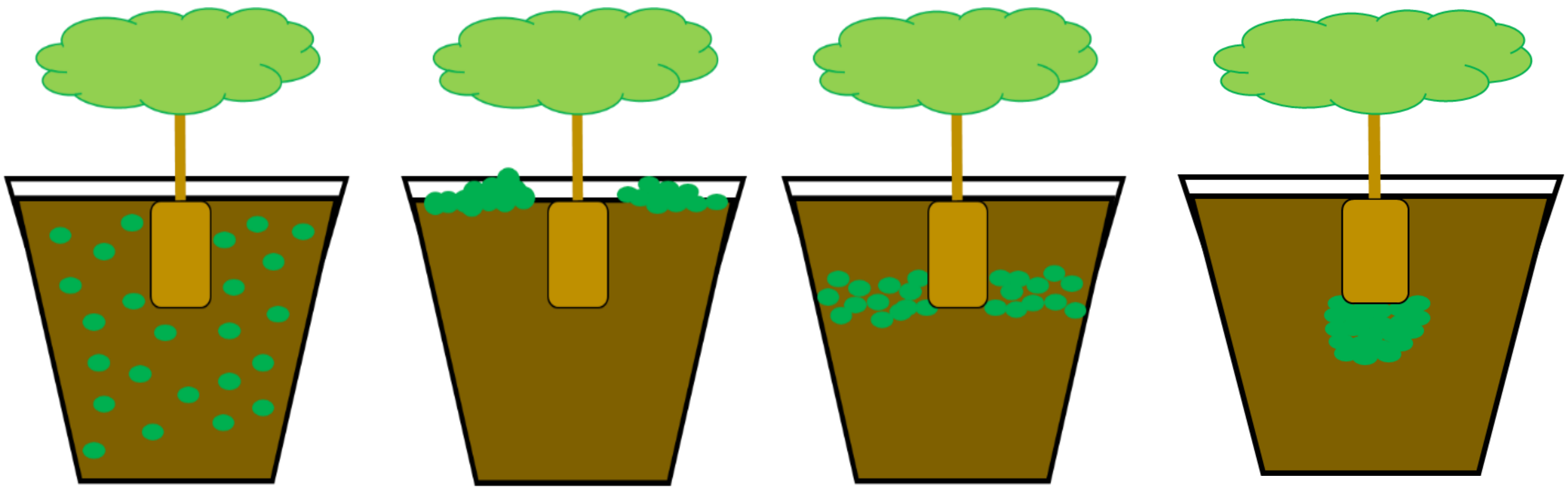
Objective

- **To evaluate the effects of four different types of controlled-release fertilizer placements on liverwort growth and reproduction.**

Materials and Methods

- **Location: Horticulture Teaching and Research Center, Michigan State University, Holt, MI**
- **Timing: Summer 2021**

Methods: Fertilizer Placements



Incorporation | Top dressing | Sub dressing | Dibble

Methods: Greenhouse experiment

Nursery pots filled with substrate

↓

Controlled-release fertilizer Osmocote® [17-5-11 (8 to 9 months)] applied to each container

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Fertilizer placements: topdress, incorporation, dibble (1,2,3 in.), subdress (1,2,3 in.)

Control set without fertilizer were included

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After 1 day, liverwort gemmae were applied to each pot

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Daily irrigation continued at 0.4 inches via overhead sprinkler

Gemmae were collected by scraping gemmae cups of vigorous liverwort stock plants

↓

Releasing into 250ml bowl of tap water to separate out the clumps

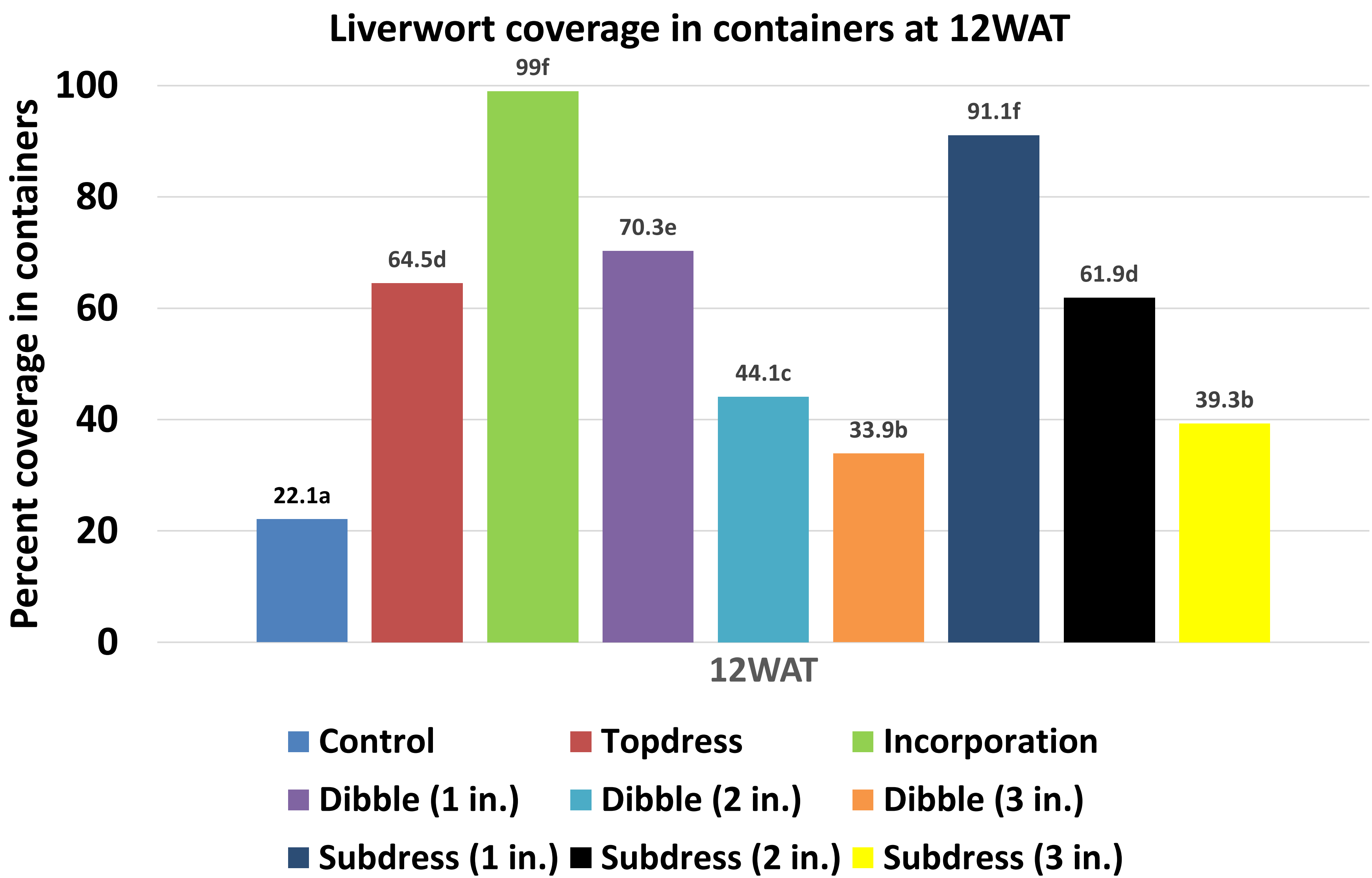
↓

Plastic spoon was used to apply 5ml water containing gemmae across the surface of each container

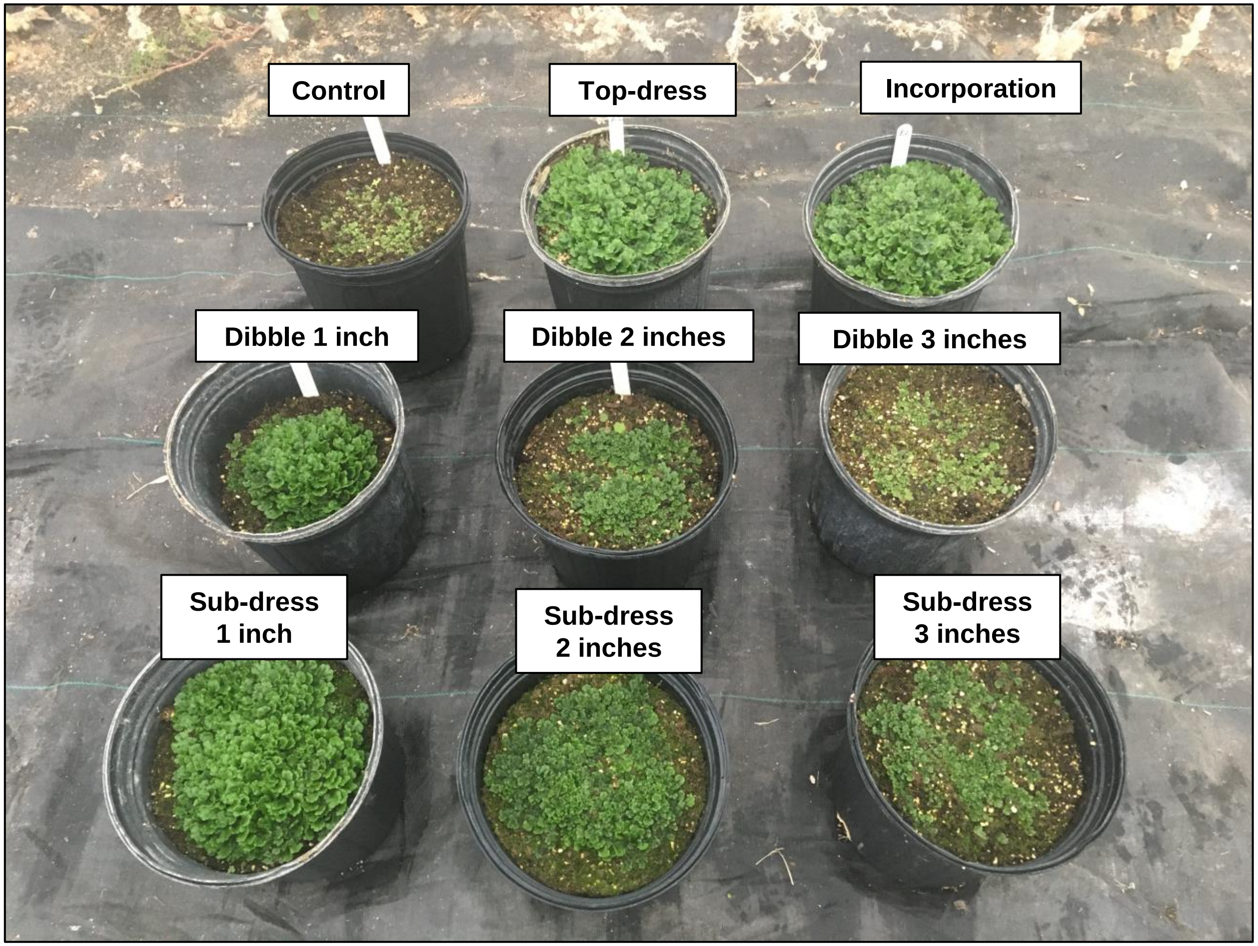
Methods: Greenhouse experiment

- **Percent of container surface covered by liverwort thalli were visually estimated at 2, 4, 6, 8, 10, and 12 weeks after treatment (WAT).**
- **At 12 weeks, number of gemma cups (asexual reproductive structures) produced on the liverwort thallus were counted and recorded from each container.**
- **Allowed to continue to grow sufficiently and were monitored at a regular basis to identify the development of sexual reproductive structures.**
- **Approximately after 28 weeks, when the sexual reproductive structures appeared, their numbers were counted separately for male and female in each container**
- **At the end, total fresh weight of liverwort thalli were also recorded.**

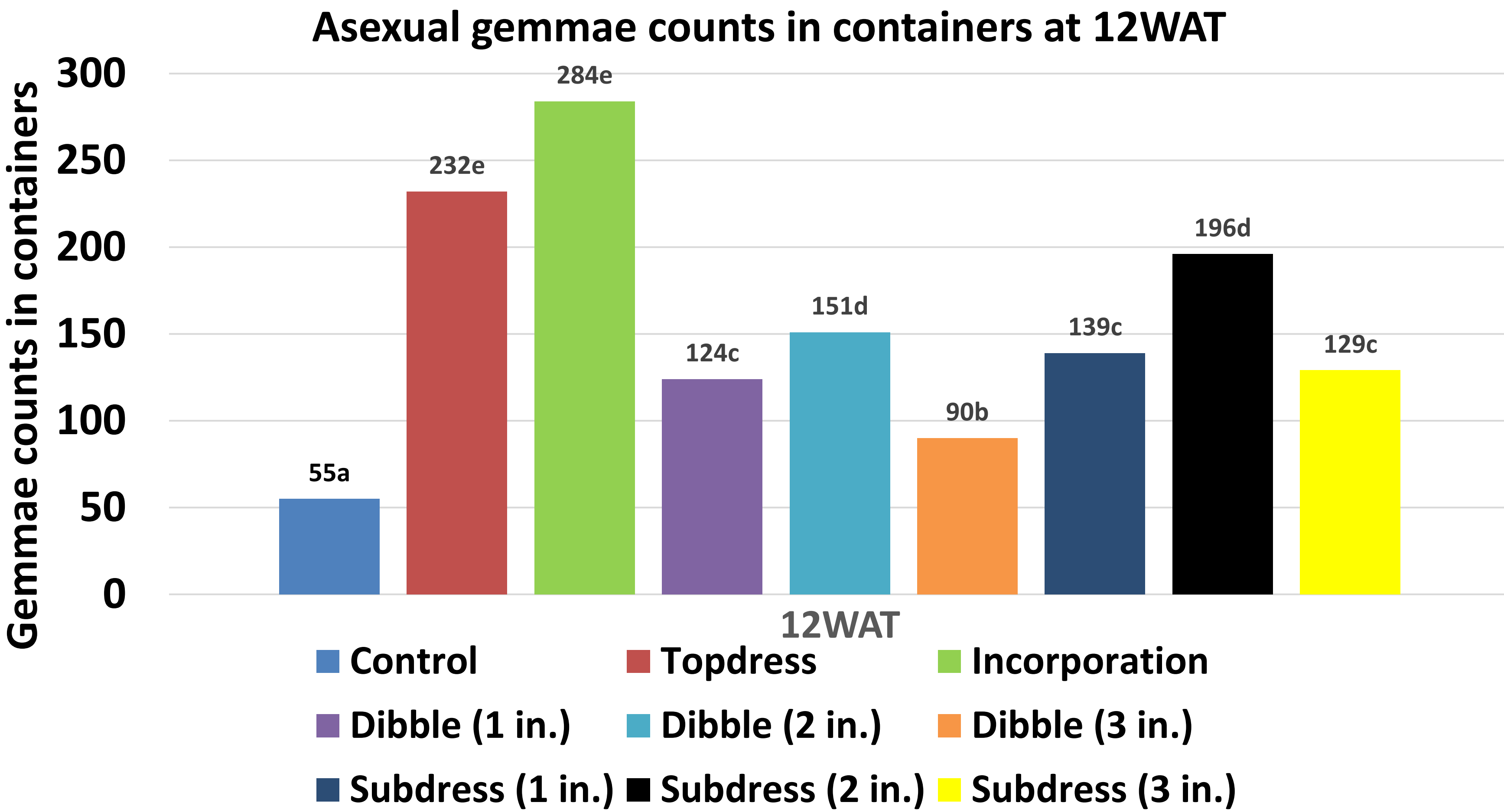
Results: Liverwort Growth at 12WAT



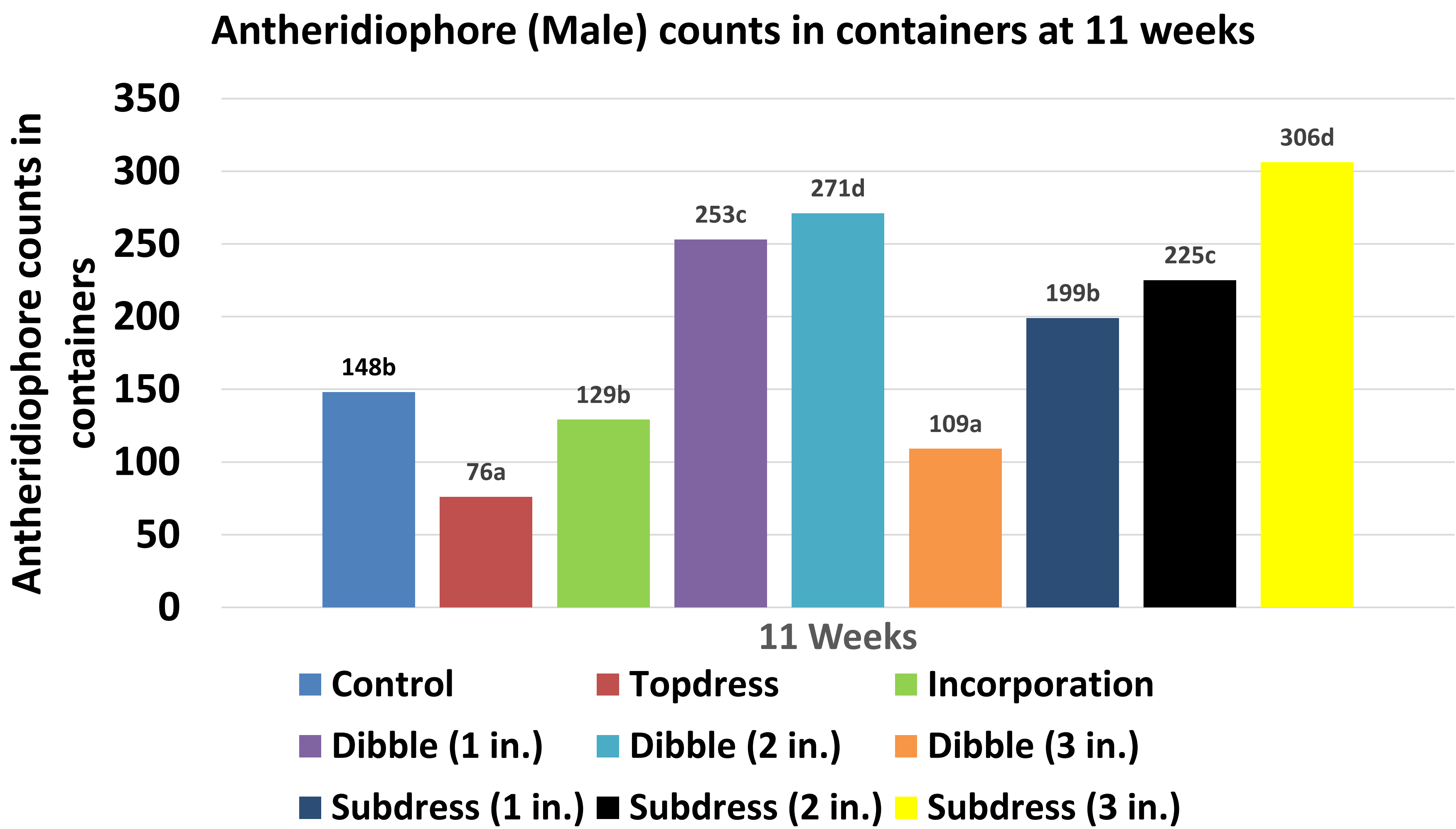
Results: Liverwort Growth at 12WAT



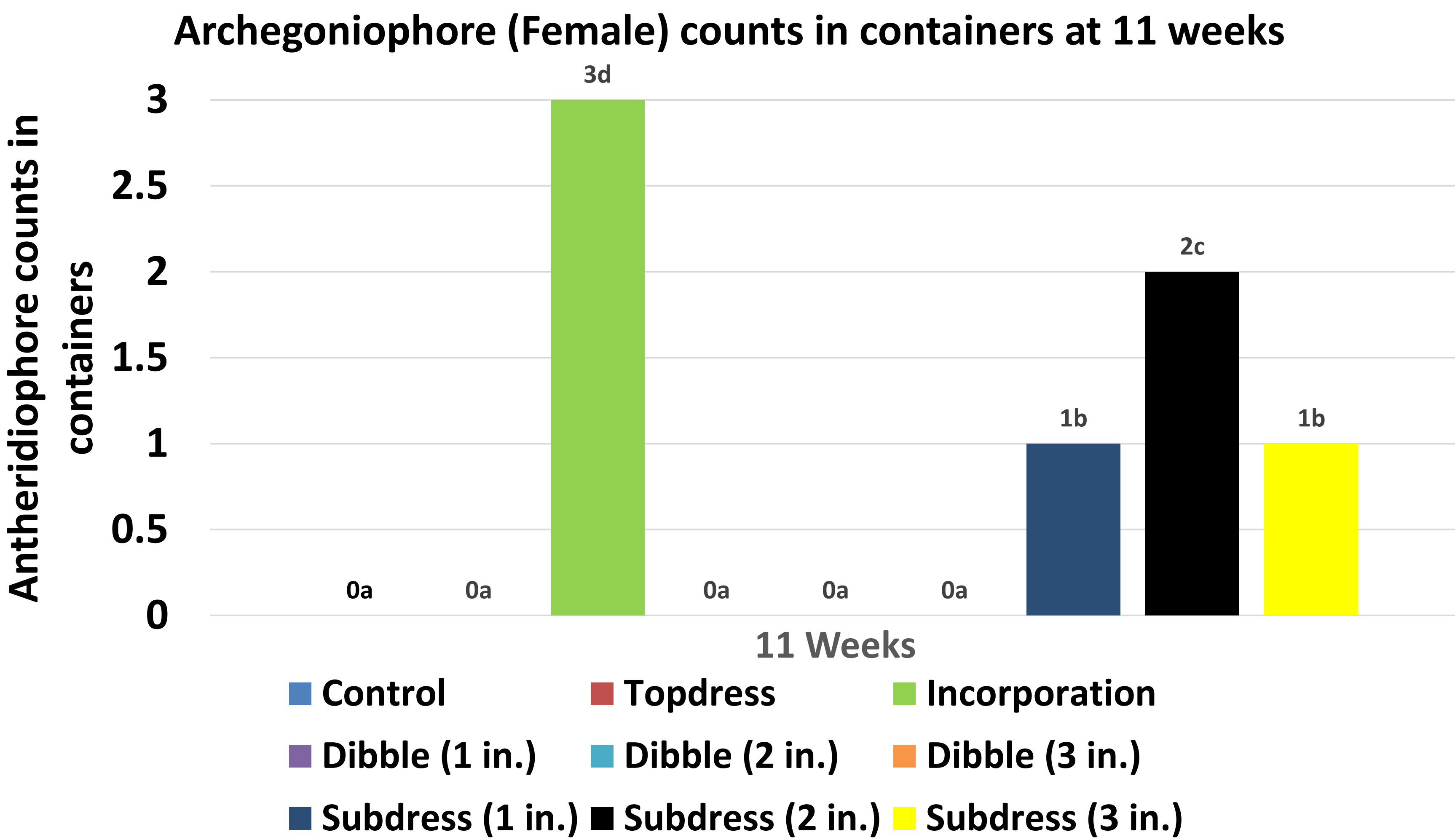
Results: Liverwort Asexual Reproduction at 12WAT



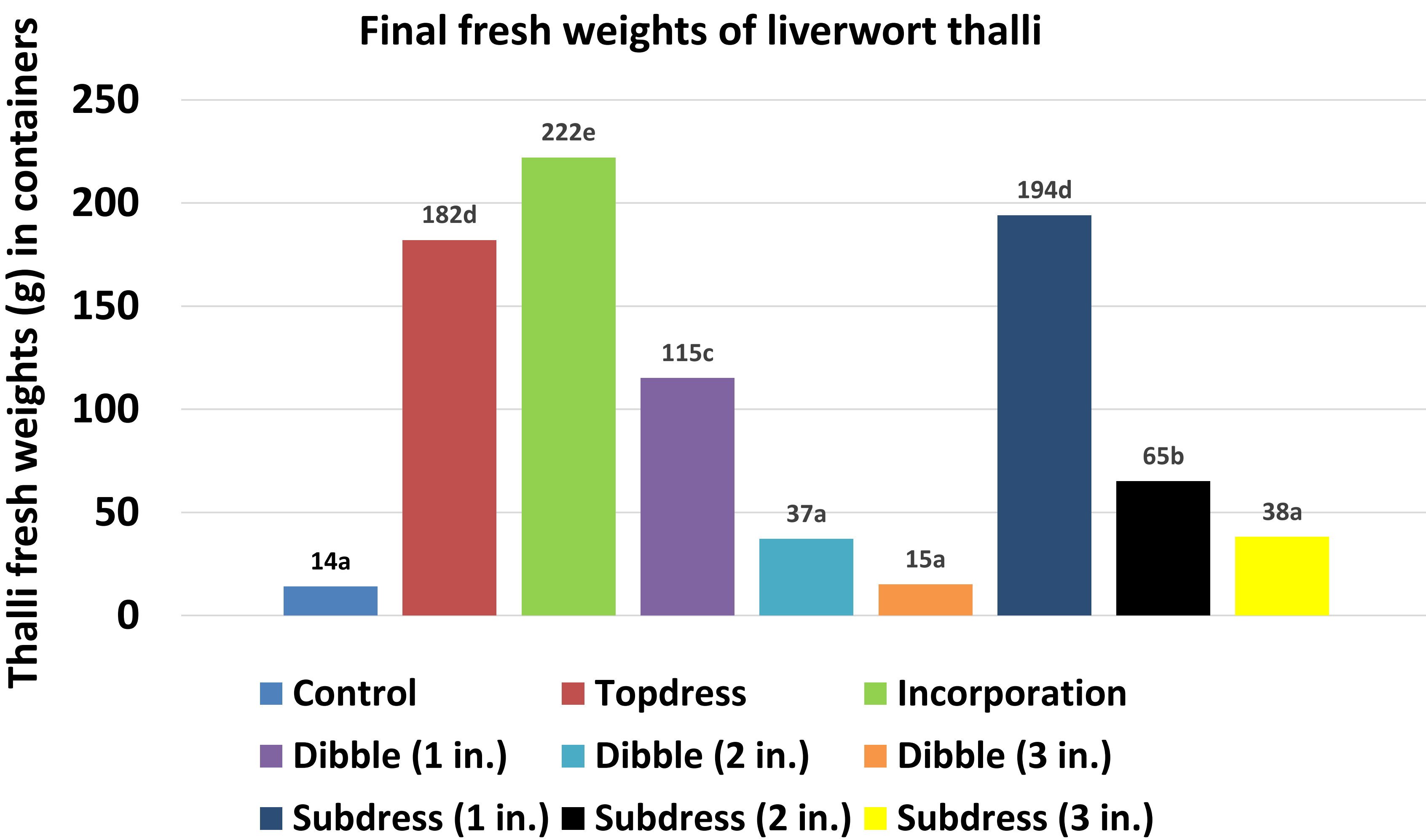
Results: Liverwort Sexual (Male) Reproduction



Results: Liverwort Sexual (Female) Reproduction



Results: Liverwort Thalli Fresh Weights



Conclusions

- **Incorporation: Maximum growth (99%), asexual gemmae counts, female structure, total fresh weight.**
- **Dibble (3 inches): Minimum growth (34%), asexual gemmae counts, female structure, total fresh weights.**
- **Subdress (3 inches): Less growth (39%), less thalli fresh weight**
- **No. of male (antheridiophores) structures were significantly higher in comparison to the female (archegoniophores) structures**
- **Age of the thallus, different light environment and nutrient availability can affect changes in sexual and asexual reproductive modes**

Take Home Message

- **Dibbling can lead to phytotoxicity of ornamental root ball as the fertilizer is placed in a small pocket and it can come in direct contact with the ornamental root ball.**
- **Subdressing of controlled-release fertilizer at a depth of 3 inches is recommended, to control the liverwort in the container production maintaining the safety of the ornamental crops.**

Acknowledgements

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- **Western Michigan Greenhouse Association**

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USDA
NIFA

Thanks

Questions ?

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Debalina Saha

Michigan State University, 2021

Introduction: Our overall goal is to develop an effective and economic non-chemical method of liverwort (*Marchantia polymorpha*) control for greenhouse container production of ornamental plants as the main limitation for liverwort control inside the greenhouse is the lack of herbicide options. Hand removal of liverwort is extremely difficult as it forms a mat like structure on top of the container medium. To remove the rhizoids, approximately an inch of the media needs to be removed from the container and the medium must be subsequently replaced. This process is very laborious, time-consuming, and costly. Currently, no commercially viable method of controlling liverwort in container production systems exist. Using organic mulch and altering the fertilizer placements are some potential cultural techniques to control weed issues. Our previous WMGA funded research on non-chemical method has shown that among 4 types of organic mulch including rice hull (RH), cocoashell (CS), pine bark (PB) and hardwood (HW), RH and HW have provided an effective liverwort control in container production at depths of 1-2 inches. Whereas CS mulch type has provided the least liverwort control with the maximum water retention. Additionally, our previous research has also shown that these organic mulches have no significant phytotoxic effect on *Hosta* sp. varieties Curly fries and Pandora box. Altering fertilizer placement is another cultural method for weed control and there is evidence that by placing fertilizers strategically within containers, broadleaf weeds can be effectively controlled. Therefore, we would like to investigate whether by altering the controlled-release fertilizer placements within the container can affect liverwort growth and reproduction.

Objective: To evaluate the effects of four different types of controlled-release fertilizer placements on liverwort growth and reproduction.

Materials and Methods: A greenhouse experiment was conducted at the Horticulture Teaching and Research Center, MSU. In this experiment nursery containers were filled with standard substrate. Controlled-release fertilizer was applied to each of the nursery containers. Fertilizer placements in the containers included four different types, top dress, sub dress, incorporation, and dibble. For sub dressing and dibble, three different depths of 1, 2, and 3 inches were considered. Control set without any fertilizer were also included. After 1 or 2 days, gemmae of liverwort (*Marchantia polymorpha*) were applied on top of the substrate in each container. Gemmae were collected by first scaping gemmae cups of vigorous liverwort stock plants and releasing the gemmae into a 250 ml bowl of tap water where they separated out from their clumps. A plastic spoon was used to apply approximately 5 ml (1 tsp) water from the bowl, which contained the gemmae, across the surface of each container. All containers received irrigation daily of approximately 0.4 inches via overhead sprinkler inside the greenhouse. There were four replications per treatment and with a completely randomize design.

Percent of container surface covered by liverwort thalli were visually estimated at 2, 4, 6, 8, 10, and 12 weeks after treatment (WAT). At 12 weeks, number of gemma cups (asexual reproductive structures) produced on the liverwort thallus were counted and recorded from each container. Liverworts were allowed to continue to grow sufficiently and were monitored at a regular basis to identify the development of sexual reproductive structures. Approximately after 28 weeks, when the sexual reproductive structures (male: antheridiophores and female: archegoniophores) appeared, their numbers were counted separately for male and female in each container to determine any differential responses. Then at the end of the experiment, the total fresh weight of liverworts was also recorded.

Results:

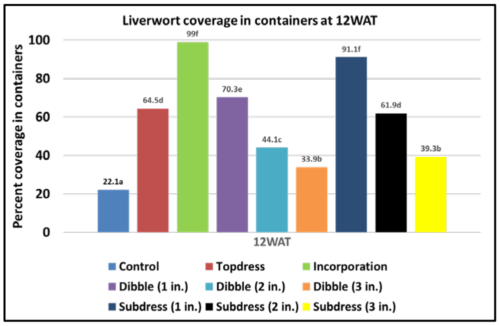

Fig1. Percent coverage of liverwort in containers at 12 weeks after treatment

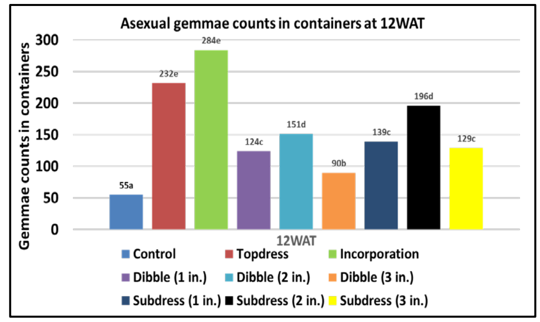

Fig2. Asexual gemmae counts in containers at 12 weeks after treatment.

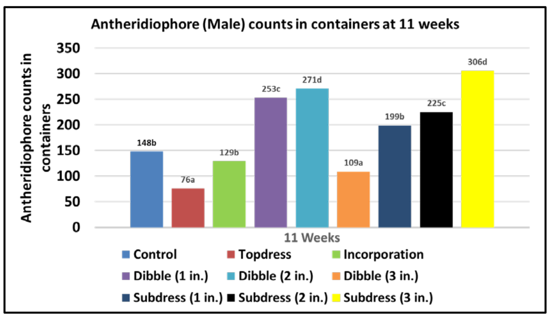

Fig3. Antheridiophore (Male reproductive Structure) counts in containers.

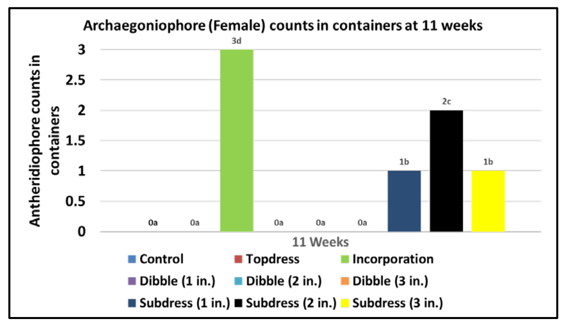

Fig4. Archegoniophore (Female reproductive structure) counts in containers.

Conclusions: From the above graphs it is evident that maximum growth (99%) of liverwort was observed in case of incorporation of controlled-release fertilizer and minimum in case of dibble (3 inches depth) (34%) followed by subdressing (3 inches depth) (39%). The asexual gemmae counts and the female sexual reproductive structure (archegoniophore) counts were also highest when fertilizer was incorporated with the substrate in the container. Dibble and subdressing at a depth of 3 inches have showed the least liverwort growth and asexual gemmae formation and even less amount of archegoniophore formation. However, dibbling can lead to phytotoxicity of ornamental root ball as the fertilizer is placed in a small pocket and it can come in direct contact with the ornamental root ball. Hence, overall take-home message from this project is that Subdressing of controlled-release fertilizer at a depth of 3 inches is more recommended, to control the liverwort in the container production maintaining the safety of the ornamental crops.

Acknowledgement: We thank Western Michigan Greenhouse Association for funding this project.