e-GRO Alert

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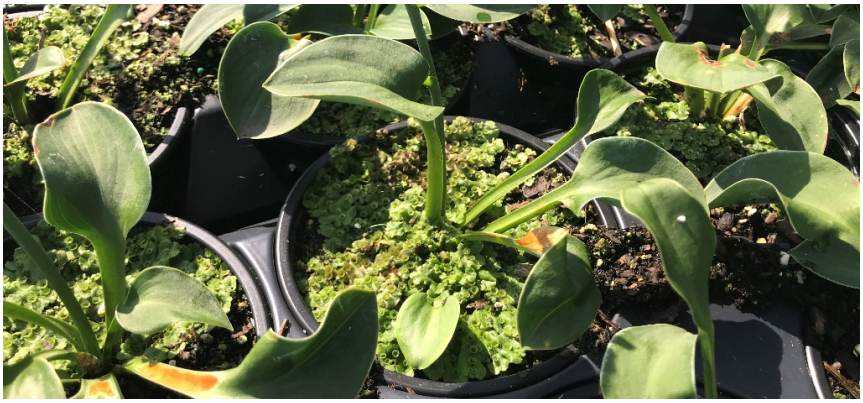
Volume 9 Number 3 January 2020

Identification and Management of Liverwort in Greenhouses

Liverwort is one of the major weeds in greenhouse and nursery production. Historically, liverwort has been reported as weed problem in cooler regions of the the United States including the Northeast and Pacific Northwest. It is primarily a problem in herbaceous perennials, woody ornamentals, or those crops with long production cycles with a dormant or vernalization period, where crops remain damp for long periods of time (Fig. 1). There are 6,000 to 9,000 species of liverwort with *Marchantia polymorpha* being the most common one prevailing in greenhouses and container nurseries.

Liverworts form dense, prostrate mats covering the container substrate surface of ornamental plants (Fig. 2). Liverwort becomes highly competitive with the ornamental crop for water, nutrients, and space. The liverwort mat can prevent the irrigation water and fertilization from reaching the root zone of the ornamental crop and can repel water when dry (Neal and Derr, 2005). As a result, the overall quality and market value of the ornamental crop decreases.



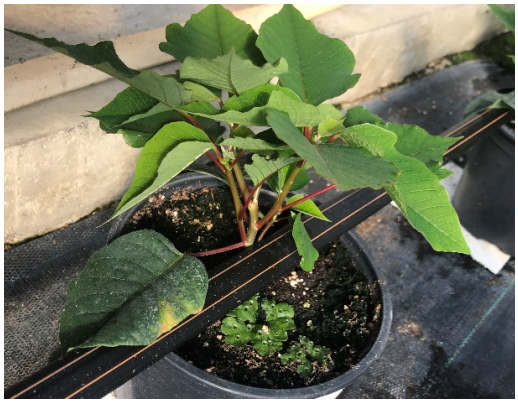


Figure 1. Liverwort is a major weed in both perennial and annual containerized crops. Photos: Heidi Lindberg

The containerized crops that are most often host to liverworts include those that are overhead irrigated, in greenhouse propagation areas, and in any other poorly drained or moist areas. Liverwort prefers cool temperatures, low UV light radiation, high fertility, and moist or damp substrate.

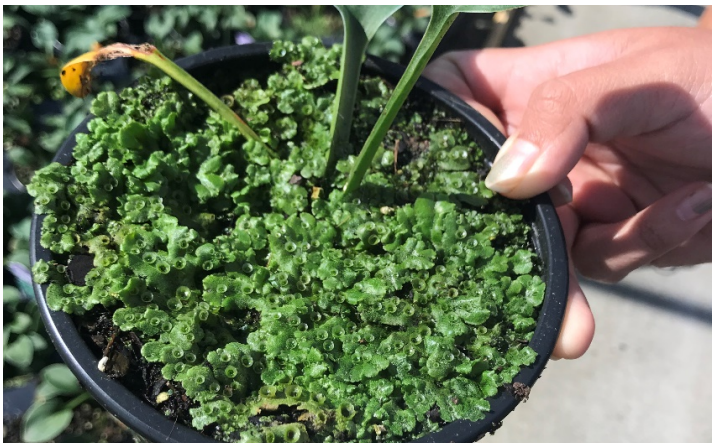


Figure 2. Liverwort creates a mat on the substrate surface and becomes highly competitive with the ornamental crop for water, nutrients, and space. Photo: Heidi Lindberg

Reproduction

The optimum temperature for vegetative growth is 64 to 72°F. Even while in the vegetative stage, liverworts can reproduce asexually. Each gemma cup can produce numerous gemmae (asexual plant buds) which can form 1-2 clonal plants after contact with moist soil/substrate (Fig. 3). Liverwort may also propagate asexually by fragmentation.

Figure 3. Liverworts can reproduce asexually; gemma cups (bowl-like structures) produce gemmae (asexual plant buds) which can form clonal plants when spread to new moist substrate. Photo: Debalina Saha.

Liverworts also reproduce sexually. When liverworts are exposed to temperatures between 50 and 59°F, they develop sexual structures or fruiting bodies (Fig. 4). Stalked, umbrella-like male and female reproductive structures are borne on separate thalli, undifferentiated plant bodies (or primitive 'leaves'). The male reproductive organs (antheridia) and female reproductive structures (archegoniophores) are both on the top of stalks. Sperm cells from the male structures travel to the eggs underneath the female reproductive structures by splashing water (rainwater or irrigation). After fertilization, spore development takes place. Once they mature, they get dispersed by wind or water and germinate on moist substrate under suitable growing conditions.

Figure 4. Liverworts also reproduce sexually by forming stalked male and female reproductive organs. Fertilized eggs create spores that are then dispersed by water or wind. Photo: Debalina Saha.

Figure 5. Sanitation is important to reduce insect, disease, and weed, including liverwort, pressure in greenhouses. Photo: Heidi Lindberg

Figure 6. Woody liner producers use a thin layer of parboiled rice hulls as a mulch to suppress liverwort. Photo: Heidi Lindberg

Physical and Cultural Control

As liverwort thrives in damp conditions, growers should improve drainage both in containers and in greenhouse or nursery facility (walkways, floors) and avoid over irrigating containers. Research has shown that drip or micro irrigation can reduce the spread of liverwort.

Growers should avoid introducing infested stock to crop area, however this is often not possible; therefore, growers are forced to use manual labor to reduce the infestation on the substrate surface by hand. Sanitation is very important in controlling liverwort in production nurseries and greenhouses (Fig. 5). Growers should sanitize greenhouse surfaces, pots, and tools with labeled disinfectants (quaternary ammonium, peroxides, etc.) prior to the season.

Mulching with organic mulch such as parboiled rice hulls (PBH), pine bark, or hazelnut shells can also decrease liverwort cover. Greenhouse and nursery growers have been using PBH in production for the last few years and research shows that a layer of 1/2 inch or 1 inch mulch of PBH was 100% percent effective at liverwort and weed control. However, this mulching depth is more applicable to larger container sizes (gallon, 3 gallon) and proves to be too deep in smaller propagation containers or liners. The 1/4 inch mulch provided some suppression but not complete control (Fig. 6). Additional research is required in this area in order to determine the best mulch type, depths, and particle size for liverwort control in the nursery and greenhouse conditions.

Growers should avoid top-dressing the containers with fertilizer as incorporating or sub-dressing fertilizer in containers reduces liverwort growth. Do not over-fertilize because liverwort reproduces rapidly when exposed to elevated levels of nitrogen and phosphorus.

Chemical control

The chemical control of liverworts in greenhouses is extremely limited. SureGuard (flumioxazin) is a preemergent herbicide which is most helpful on greenhouse floors. Sureguard is labeled for greenhouse production but it can only be applied if no plants are present in the greenhouse and growers must then wait at least 24 hours before bringing plants inside the treated greenhouse (Marble et al., 2017).

Postemergence herbicides which have shown some efficacy in liverwort control in ornamental production in nurseries and greenhouses are listed in Table 1. There are four organic products that provide control of liverwort that are labeled for use inside greenhouses; however all of them have limited practicality in greenhouse production. They may be more useful in nursery production when crops are dormant.

For example, a limited number of studies have shown that acetic acid (vinegar) products can control liverwort. However, the low pH of vinegar can cause phototoxicity and also alter the pH of the growing substrate. Other pesticides that have postemergence activity on liverwort include: ammonium nonanoate (Axxe), diquat (Reward), sodium carbonate peroxyhydrate (TerraCyte), and pelargonic acid (Scythe). **However, these herbicides have been shown to cause significant damage to the ornamental plants.** Dimethenamid-P is a potential herbicide that can suppress liverwort growth, but it works very slowly and the results may vary (Marble et al., 2017).

The Saha lab at Michigan State University will be conducting trials throughout 2020-2021 to evaluate the following mulches and mulching depths for liverwort control: rice hull, hardwood chips, cocoa hull, and pine bark will be applied on top of the substrate in nursery containers at a depth of either 0.25 or 0.5 or 1 or 2 inches. Dr. Saha and her graduate student also plans to conduct research to evaluate different organic and synthetic products such as baking soda for liverwort control in greenhouse production system.

This information is for educational purposes only. Reference to commercial products or trade names does not imply endorsement by MSU Extension or bias against those not mentioned. These recommendations are not intended to replace the specific product labels; the pesticide label is the legal document on pesticide use. Read the label carefully, as they change often and follow all instructions closely. Some products listed in this bulletin may be dropped by the manufacturer or distributor after the publication of this bulletin. The use of a pesticide in a manner not consistent with the label can lead to the injury of crops, humans, animals, and the environment. The use of a pesticide inconsistent with the label directions can also lead to civil or criminal fines and/or condemnation of the crop. Pesticides are good management tools for the control of pests on crops, but only when they are used in a safe, effective and prudent manner according to the label.

References:

Marble, C., M.S. Frank, D. Laughinghouse, S. Steed, and N. Boyd. 2017. Biology and management of liverwort (*Marchantia polymorpha*) in ornamental crop production. University of Florida, Institute of Food and Agricultural Sciences. ENH278 1:6.

Neal, J.C. and D.F. Derr. 2005. Weeds of container nurseries in the United States. North Carolina Assoc. of Nurserymen, Inc. Raleigh, NC. 16p.

Newby, A.F. 2006. Liverwort control in container-grown nursery crops. MasterThesis, Auburn University, Auburn, AL. 80p.

Svenson, S.E. 1998. Suppression of liverwort growth in containers using irrigation, mulches, fertilizers, and herbicides. HortScience 33:3 S231.

Table 1. Herbicides labeled for use in ornamental plant production that have postemergence liverwort activity[1] (Adapted from Marble et al., 2017)

Organic products					
Active ingredient	Trade name	Container production	Field production	Greenhouses	Notes
acetic acid (vinegar)	Many products available	Yes	Yes	Yes	May cause significant damage to ornamental plants. See individual product label for use sites. Must be labeled and manufactured for use as a pesticide.
ammonium nonanoate	Axxe	Yes	Yes	Yes	May cause significant damage to ornamental plants. Repeated applications may be needed.
d-limonene	AvengerAg	Yes	Yes	Yes	May cause significant damage to ornamental plants. Repeated applications may be needed.
pelargonic acid	Scythe	Yes	Yes	Yes	May cause significant damage to ornamental plants. Repeated applications may be needed.
Synthetic products					
diquat	Reward	Yes	Yes	No	Use with a surfactant; repeated applications may be needed.
flumioxazin	Broadstar	Yes	Yes	No	Greater control achieved with SureGuard.
	SureGuard	Yes	Yes	No	
oxadiazon	Ronstar 2G	Yes	Yes	No	Sprayable formulations (FLO) only labeled for over the top use on selected species. Check label for details. Granular formulation is slower and less effective to provide control.
oxyfluorfen	GoalTender	Yes	Yes	No	Applicable only in selected conifers and trees. See label for more information.
sodium carbonate peroxyhydrate	TerraCyte	Yes	No	Yes	Injury may occur if granules become trapped in/on ornamental plant foliage.

[1]Complete liverwort control with postemergence herbicide alone may not be achieved. Integration of proper cultural and sanitation practices are required for a long-term success. These herbicides have shown postemergence activity on liverwort in nursery conditions in research trials. Depending upon liverwort growth stage and environmental factors, results may vary. Except for Tower, Broadstar, and Ronstar 2G, all other products need to be applied as a directed application, avoiding ornamental crop foliage.

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