UF IFAS Extension UNIVERSITY of FLORIDA

ENH278

Biology and Management of Liverwort (Marchantia polymorpha) in Ornamental Crop Production[1]

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Liverwort is a common weed problem in production nurseries and greenhouses. This article has been written to help growers identify liverwort, understand its biology, and inform them of ways this weed can be managed in their operation.

Species Description

Order

Marchantiales

Family

Marchantiaceae

Species

Marchantia polymorpha L.

Other Common Names

Common liverwort, umbrella liverwort

Habitat

In ornamental plant production, liverworts are commonly found growing in cool, moist areas. This may include around container-grown ornamental plants (typically those that are overhead irrigated), in greenhouses, propagation and nursery ground cloth areas, and in any other poorly drained or moist areas (Figure 1). Liverworts typically favor nutrient-rich areas like potting media (Altland n.d.).

Figure 1. Liverwort growing on weed mat on the floor of a nursery. Credits: Annette Chandler, UF/IFAS

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Distribution

Occurs in temperate and tropical regions worldwide in a variety of moist, sunny-to-shady habitats. Commonly grows on damp, recently burned soils. The moist, nutrient-rich conditions found in many nurseries and greenhouses are favorable for liverwort growth.

Growth Habit

Dense, green, prostrate or low-growing mats that cover the soil or container media surface. As the liverwort mat forms, it becomes highly competitive with the crop for water and nutrients. Thick mats of liverworts may prevent irrigation and/or fertilizer applications from reaching crop roots, and, when dried, can actually repel water (Neal and Derr 2005).

Foliage

Liverworts do not have true leaves or stems, but have undifferentiated bodies, called thalli (singular thallus), which are glossy green, flattened, irregularly branched, and overlapping (Figure 2). Thalli have dorsiventral symmetry, meaning the upper and lower surfaces are different. The upper surface is photosynthetic and, on mature thalli, bears cup-shaped non-sexual reproductive structures (gemmae), as well as erect, stalked, umbrella-like sexual reproductive organs (gametophores). Thalli contain oil bodies, which may function in UV protection, cold resistance, and herbivore deterrence (He et al. 2013).

Figure 2. Thalli (the leaf-like bodies of the liverwort) are flattened, irregularly branching, and overlapping. They bear gemmae cups for asexual reproduction on their upper surfaces.
Credits: Chris Marble

Roots

Although liverworts do not have true roots (containing vascular tissues called xylem and phloem), they have unicellular hair-like structures called rhizoids, which grow from the underside of the thallus (Figure 3). Rhizoids anchor the liverwort to the surface it is growing on and help to absorb, conduct, and retain water through capillary action.

Figure 3. Hair-like rhizoids on the underside of the thallus anchor the liverwort in place.
Credits: Chris Marble

Reproductive Structures

Liverworts are able to spread rapidly because they reproduce both sexually and asexually. In sexual reproduction, stalked, umbrella-like male and female reproductive structures are borne on separate thalli. The male reproductive organs (antheridia), which produce the sperm, are located on the upper surface of a flattened disc atop a narrow stalk (antheridiophore) (Figure 4). The female reproductive structures (archeogoniophores) are also stalked, but the upper portion has narrow lobes bending downward along its margins, and the reproductive organs (archegonia), which produce the eggs, are located on the underside of those lobes (Figure 5). Sperm cells produced by the antheridia travel via water (typically from rain or irrigation splashing on the upper surface of the antheridiophore) to fertilize the eggs on the undersides of the archeogoniophore. Spores then develop and, once mature, are dispersed by wind or water and will germinate on a moist substrate under suitable growing conditions. In asexual reproduction, vegetative propagules called gemmae are produced inside circular gemmae cups (Figure 6). Gemmae are spread by irrigation or rainfall splashing into the gemmae cups (Shimamura 2015). When hand-weeding pots, it is critical that all liverwort plant tissue be removed from the pots to prevent regrowth. Even then, tiny spores or gemmae may be present on the soil surface and will result in regrowth.

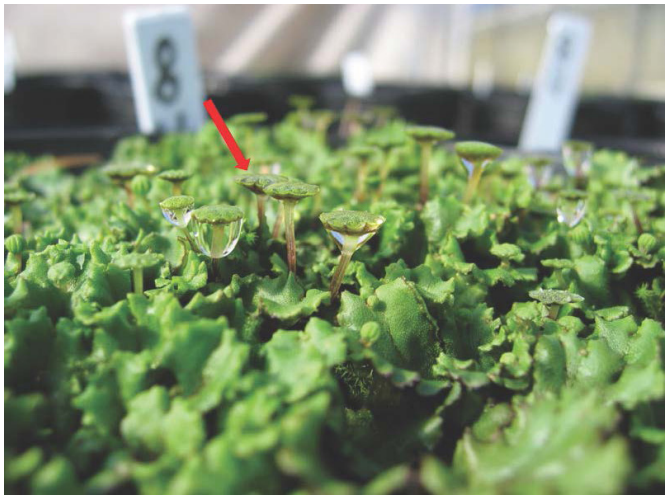

Figure 4. Antheridiophores, or male reproductive structures (shown by red arrow). The sperm-producing antheridia are located on the upper surface.
Credits: Chris Marble

Figure 5. Archeogoniphores, or female reproductive structures (shown by red arrow). The archegonia, which produce eggs, are located on the lower surface of the downward curving lobes.
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Figure 6. Gemmae cups (shown by red arrow) contain asexual propagules that splash out and spread liverwort vegetatively.
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Similar Species

There are 6,000 to 9,000 species of liverworts, with *Marchantia polymorpha* being the most common species found in nursery production. Liverworts may appear similar to some mosses and other non-vascular plants, but can be distinguished by their reproductive structures, unicellular rhizoids, and distinctive growth habit. Another liverwort species, *Lunularia cruciata*, or crescent cup liverwort, has been observed growing in nurseries in other states, but reports indicate that it is easier to manage than *Marchantia polymorpha* (Altland n.d.). As its common name suggests, *Lunularia cruciata* can be recognized by its crescent-shaped gemmae cups, while the gemmae cup of *Marchantia polymorpha* is circular in outline.

Plant Biology

Liverworts are considered the oldest lineage of terrestrial land plants. In Florida, they can grow year-round, especially in greenhouses and other climate-controlled production areas that remain relatively cool or are shaded. As indicated, they are found primarily in areas that stay moist throughout the year, are humid, and are high in nutritional content. Liverworts are not usually found in areas that remain dry for extended times because water is required for their reproduction.

Management

Cultural and Physical Control

Liverwort management requires an integrated approach and cannot be controlled effectively with herbicides alone. Avoid introducing infested stock. Sanitation in the nursery or greenhouse environment is critical. Sanitize greenhouse surfaces, pots, and tools with labeled disinfectants (quaternary ammonium, peroxides, etc.). Avoiding over-irrigation, improving drainage (both in containers and in walkways, floors, greenhouses, etc.), increasing airflow, and switching to micro or drip irrigation systems where feasible can help reduce liverwort infestations. Sub-irrigation systems may also reduce liverwort occurrence (Dumroese et al. 2006, Schmal et al. 2001, Svenson 1998). Mulching with large-particle, porous materials like pine bark or hazelnut shells can also decrease liverwort cover (Svenson 1998). Soil-incorporated rather than top-dressed fertilizer may also further decrease liverwort growth (Altland n.d.). Do not over-fertilize, because high nitrogen and phosphorous levels may increase liverwort growth.

Chemical Control

Preemergence Herbicides

Flumioxazin (Broadstar and SureGuard) are labeled for liverwort control. Broadstar is a granular formulation and can be applied over the top of many woody nursery crops. SureGuard is a water-dispersible granule (WDG) formulation that must be sprayed as a directed application, avoiding crop foliage. Thus, it is most useful in larger containers, and especially with leafless deciduous trees or on nursery floors. Neither product can be used inside a greenhouse (SureGuard can be applied if no plants are present; growers should wait 24 hours and water in SureGuard before bringing plants inside a treated greenhouse). Research trials in Oregon and Alabama (Altland n.d., Newby 2006) have demonstrated that herbicides containing oxyfluorfen (OH2, Regal O-O, Rout, etc.) or oxadiazon (Ronstar) may reduce liverwort coverage on container media when applied preemergence. All three of these herbicides (flumioxazin, oxyfluorfen, and oxadiazon) are Group 14 herbicides known as "protox" or protoporphyrinogen oxidase (PPO) inhibitors. Preemergence herbicides containing these active ingredients may provide some level of suppression depending upon nursery conditions, but further research is needed. Preemergence herbicides are less effective if cultural conditions favoring liverwort growth are not corrected. Herbicides showing some efficacy on liverwort are summarized in Table 1.

Postemergence Herbicides

Glyphosate offers little to no control. In addition to preemergence use, flumioxazin (SureGuard, Broadstar) can provide some postemergence control of liverwort. However, control is usually much greater and faster with SureGuard. Acetic acid (vinegar) products have also provided liverwort control in research trials (Altland n.d.). When considering acetic acid or other products, only those labeled for use as pesticides in nurseries should be applied. Other herbicides that have shown efficacy on liverwort include mostly non-systemic contact products including diquat (Reward), ammonium nonanoate (Axxe), sodium carbonate peroxyhydrate (TerraCyte), and pelargonic acid (Scythe). All of these herbicides can cause significant damage to ornamentals when applied to foliage or other green tissues. Therefore, be sure sprays are directed away from the plant. Dimethenamid-p (Tower) is a preemergence herbicide labeled for use over the top of many ornamental plants. However, research has shown that it may provide some postemergence control of liverwort when applied at 32 fl. oz. per acre, but Tower herbicide is slow to work and results may vary. Postemergence herbicides that provide some control of liverwort, and the areas in which they can be applied, are summarized in Table 2. Additional information on other active ingredients, crop safety, and research summaries are available in the IR-4 ornamental horticulture database available at http://ir4.rutgers.edu/Ornamental/Ornamentals.cfm.

References

Altland, J.A. n.d. *Marchantia polymorpha* liverwort page. Accessed: March 27, 2017. https://horticulture.oregonstate.edu/weed/liverwort.

Dumroese, R.K., J.R. Pinto, D.F. Jacobs, A.S. Davis, and B. Horiuchi. 2011. "Subirrigation reduces water use, nitrogen loss, and moss growth in a container nursery." *Native Plant J*. 7(3):253–261.

He, X., Y. Sun, and R.-L. Zhu. 2013. "The oil bodies in liverworts: unique and important organelles in land plants." *Critical Reviews in Plant Sciences*. 32(5):293–302.

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

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

Schmal, J.L., R.K. Dumroese, A.S. Davis, J.R. Pinto, and D.F. Jacobs. 2011. "Subirrigation for production of native plants in nurseries – concepts, current knowledge, and implementation." *Native Plants*. 12(2):81–93.

Shimamura, M. 2015. *Marchantia polymorpha*: "Taxonomy, phylogeny, and morphology of a model system." *Plant Cell Physio*. Accessed: March 21, 2017. https://academic.oup.com/pcp/article/57/2/230/2460945.

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

Table 1. This table lists registered pesticides that should be integrated with other pest management methods. Contact your local UF/IFAS Extension office for additional information (**https://ifas.ufl.edu**). Contact: Weed Specialist (**marblesc@ufl.edu**).

Table 1. Protox[1] inhibiting preemergence herbicides labeled for use in ornamental plant production.

Common Name (active ingredient)	Example trade name and formulation	WSSA Herbicide Group[2]	Container production	Field production	Greenhouse or fully-enclosed structures
flumioxazin[3]	Broadstar™ 0.25G	14	YES	YES	NO
	SureGuard® 51WDG		YES[4]	YES[4]	YES[5]
oxadiazon	Ronstar® 2G	14	YES	YES	NO
oxyfluorfen	Goal® 2XL (EC)	14	YES[4]	YES[4]	NO
oxadiazon + prodiamine	RegalStar® II	14 + 3	YES	YES	NO
oxyfluorfen + oryzalin	Rout® 3G	14 + 3	YES	YES	NO
oxyfluorfen + pendimethalin	OH2® 3G	14 + 3	YES	YES	NO
oxyfluorfen + prodiamine	Biathlon® 2.75G	14 + 3	YES	YES	NO
oxyfluorfen + oxadiazon	Regal OO, Double O™ 3G	14 + 14	YES	YES	NO

[1] Herbicides with this mode of action (Group 14) have shown some efficacy in previous preemergence liverwort research trials. Not all herbicides or combinations have been tested, and results may vary based on individual nursery conditions. It is likely that regardless of herbicide choice, liverwort will not be controlled effectively if proper cultural and sanitation practices are not followed.

[2] Herbicide groups are based according to primary sites of action and can be used to select herbicides that have differing sites of action (Weed Technology 17:605-619 [2003]) so as to minimize the potential for the development of herbicide resistant weeds.

[3] Flumioxazin (SureGuard and Broadstar) is the only herbicide that lists liverwort on the label as a controlled species.

[4] Can only be used in selected conifer and deciduous tree species. Check manufacturer's label for a complete list of species and recommended application methods.

[5] Cannot be used while a crop is inside the house. Check label for further details and precautions.

Table 2. This table lists registered pesticides that should be integrated with other pest management methods. Contact your local UF/IFAS Extension office for additional information (**https://ifas.ufl.edu**). Contact: Weed Specialist (**marblesc@ufl.edu**).
Table 2. Herbicides labeled for use in ornamental plant production that provide postemergence liverwort control[1].

Active Ingredient	Example trade name	Container production	Field production	Greenhouse or fully-enclosed structures	Notes
acetic acid (vinegar)	many products available	YES	YES	YES	Must be labeled and manufactured for use as a pesticide. See individual product label for use sites.
ammonium nonanoate	Axxe	YES	YES	YES	Repeated applications may be needed.
diquat	Reward	YES	YES	YES	Use with a surfactant; repeated applications may be needed.
d-limonene	AvengerAg	YES	YES	YES	Repeat applications may be needed.
dimethenamid-p	Tower	YES	YES	NO	Used as a preemergence herbicide; may provide control or suppression in some instances. Will work slowly.
flumioxazin	Broadstar	YES	YES	NO	Greater control generally achieved with SureGuard.
	SureGuard	YES	YES	NO	
oxadiazon	Ronstar 2G	YES	YES	NO	Granular formulation typically less effective and slower to provide control. Sprayable formulations (FLO) are only labeled for over the top use on select species. Check label for details.
	Ronstar FLO				
oxyfluorfen	GoalTender	YES	YES	NO	Can be used only in selected conifers and trees. See label for more details.
pelargonic acid	Scythe	YES	YES	YES	Repeated applications may be needed.
sodium carbonate peroxyhydrate	TerraCyte	YES	NO	YES	Do not let granules become trapped in/on ornamental plant foliage or injury may result.

[1] Herbicides that have shown postemergence activity on liverwort in nursery conditions in research trials. Results may vary depending upon liverwort growth stage and environmental factors. With the exception of Tower, Broadstar, and Ronstar 2G, apply all products as a directed application (avoiding crop foliage). Other non-selective, contact action postemergence herbicides may also be effective. It is unlikely complete liverwort control will be achieved using herbicides alone. Proper cultural and sanitation practices are needed for long-term success.