

# GROWING KNOWLEDGE

Series content is coordinated by Dr. Lloyd Nackley, associate professor of nursery production and greenhouse management at Oregon State University in Corvallis, Oregon.



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## Tackling liverwort

Researchers evaluate two natural alternatives to fighting this pesky greenhouse invader

Fig. 1 Magnified view of liverwort (*Marchantia polymorpha*) showing its distinctive reproductive structures. The small, palm tree-like stalks are gametophores, which produce spores that enable the weed to spread rapidly in moist greenhouse environments. ADOBE STOCK PHOTO

BY LLOYD NACKLEY, RYAN HILL AND MARCELO MORETTI

**W**eed management in greenhouse propagation is more than a cosmetic concern.

Weeds, especially liverwort (*Marchantia polymorpha*), compete with crops for light and nutrients, harbor pests and diseases, and complicate irrigation and fertilization. Yet few herbicides are labeled for greenhouse use, and labor-intensive hand weeding strains budgets.

As a result, growers are increasingly interested in natural alternatives — but how well do they really work?

A recent greenhouse study from

Oregon evaluated two such options: mustard seed meal (MSM), a byproduct of mustard oil production with natural herbicidal properties, and two types of natural mulch: hazelnut shells and a biodegradable paper-based liquid mulch. The goal? To identify weed control strategies that are both effective and safe for young ornamentals during propagation.

### Why liverwort is so hard to manage

Liverwort is a persistent and increasingly common greenhouse invader. Unlike most vascular weeds, liverwort spreads through spores and vegetative fragments (gemmae), thrives in high humidity and low light, and quickly colonizes moist

container surfaces.

Its low, dense mats block irrigation and outcompete seedlings. Worse, liverwort tolerates many conventional weed control measures, making it particularly troublesome during propagation and liner production.

Liverwort infestations can be especially severe in greenhouses using overhead irrigation and organic-based substrates — exactly the conditions common in nursery production. This makes it an ideal target for sustainable control strategies like mulching and bioherbicides.

### Experimental approach

To mimic commercial propagation >>



Fig. 2 Completely randomized design with replicated mulch treatments distributed across the irrigation bench. Tender boxwood cuttings had just been transplanted, leaving exposed substrate vulnerable to liverwort. All pots were equally inoculated with liverwort spores using a blended slurry. PHOTO COURTESY OF OREGON STATE UNIVERSITY

conditions, researchers conducted a series of greenhouse trials using containerized boxwood (*Buxus sempervirens*) and gardenia (*Gardenia jasminoides*) seedlings. All plants were grown in a standard soil-less mix of bark, peat, and perlite, and were irrigated with overhead spray nozzles on a high-frequency schedule to maintain surface moisture and promote liverwort colonization.

Each experiment used a randomized complete block design with multiple replicates per treatment. Treatments included:

- MSM alone at five rates (ranging from 125 to 1,600 g/m<sup>2</sup>),
- Hazelnut shell mulch (HM) alone,
- Liquid mulch (LM) alone,
- Combinations of MSM with

either HM or LM.

MSM was applied by broadcasting dry powder evenly across the container surface using calibrated measuring spoons. Hazelnut shells were applied to a 1.25 cm depth and lightly pressed into place. Liquid mulch was diluted at a 2:1 ratio with water and poured evenly using graduated cylinders.

To simulate natural infestation, actively growing liverwort flats were placed between treatment containers and rotated weekly to ensure even spore distribution. Crop response, weed coverage, and liverwort development were monitored over 90 days. Standard slow-release fertilizer (16-16-16) was incorporated at transplanting to reflect typical greenhouse fertility practices.

### **Hazelnut mulch shows strong, consistent results**

Hazelnut shell mulch significantly reduced liverwort and broadleaf weed emergence in every trial. In some cases, liverwort coverage was reduced by more than 80%. This mulch appeared to physically block spore germination and reduce light at the surface, both of which suppress liverwort establishment.

Importantly, hazelnut mulch caused no adverse effects on either crop species. Its coarse texture also supported good airflow and did not hold excessive moisture, a critical factor in greenhouse conditions.

Given its efficacy, low cost, and availability in Oregon, hazelnut shell mulch appears to be one of the most practical natural weed control tools for greenhouse growers.

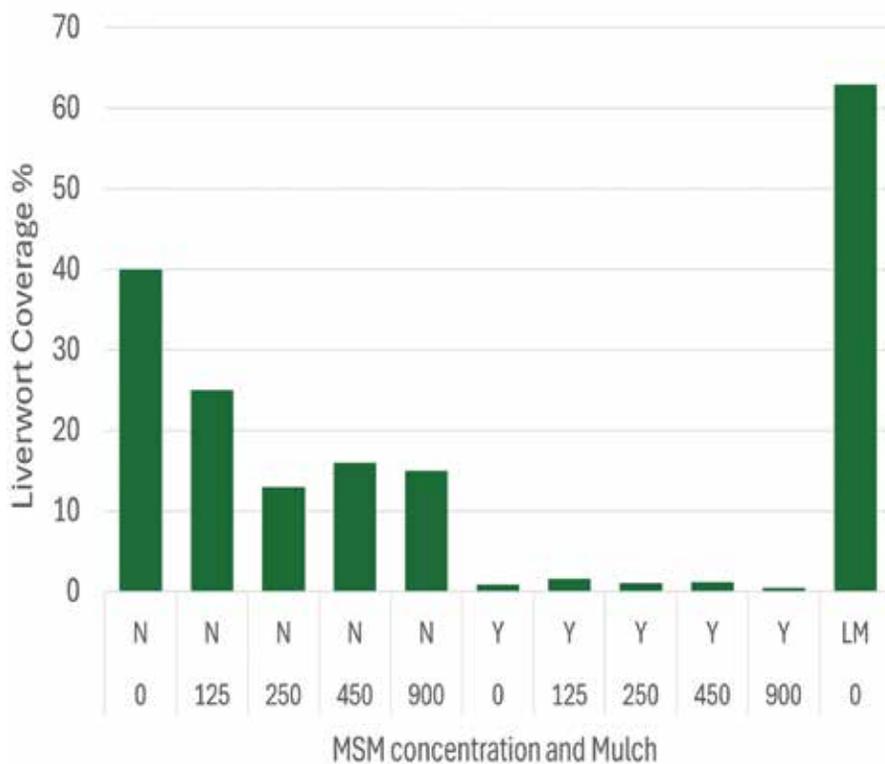


Figure 3. Percent coverage of liverwort in response to mustard seed meal (MSM) application rates (0–900 g/m<sup>2</sup>) under three mulch treatments: no hazelnut shells (N), with hazelnut shells (Y), and with liquid mulch (LM). While increasing MSM rates reduced liverwort coverage in the absence of hazelnut shells, the presence of hazelnut shells alone provided the most effective suppression across all MSM concentrations. GRAPHIC COURTESY OF OREGON STATE UNIVERSITY

### MSM suppresses weeds — but can injure crops

MSM alone reduced weed and liverwort coverage significantly — often by 50–90% — but the results came with caveats. Boxwood seedlings were highly sensitive to MSM, even at moderate application rates. At the highest rates (1,600 g/m<sup>2</sup>), MSM caused complete crop death. Interestingly, even lower MSM rates (250–500 g/m<sup>2</sup>) often suppressed weeds without improving plant growth. This suggests that the phytotoxic effects of MSM may outweigh its minor fertilizing benefits, especially for young or shallow-rooted crops.

These results align with prior field research showing MSM can release bioactive compounds — notably isothiocyanates — when exposed to moisture. In wet greenhouse environments, this release may be both rapid and intense, increasing the

risk of crop injury.

### Liquid mulch adds complexity

The biodegradable liquid mulch had mixed results. On its own, LM sometimes reduced liverwort growth, but it also appeared to trap moisture at the surface — occasionally enhancing weed growth under certain conditions.

When LM was combined with MSM, weed suppression improved — but so did phytotoxicity. The thick mulch layer may have trapped MSM’s breakdown products, extending the exposure time for sensitive roots. In several cases, combining LM and MSM increased plant injury beyond what was seen with MSM alone.

This interaction highlights the importance of understanding how mulches modify the behavior of bioherbicides — and how substrate moisture can shift a treatment from helpful to harmful.

### Why control liverwort early?

Liverwort may look harmless, but its impacts are far from superficial.

- **Once established**, liverwort mats create a water-impermeable layer that disrupts irrigation and fertilization.
- **It spreads easily** through greenhouses via tools, containers, and hands — and its rapid growth can smother young seedlings.
- **Controlling liverwort early**, especially during propagation, helps prevent longer-term losses and labor costs down the line.

### Practical recommendations

So what do these findings mean for growers looking to implement natural weed control in greenhouses?

**Hazelnut shell mulch is a good bet:** It consistently reduced liverwort and weed growth and posed no risk to young plants. It’s a simple, regionally available material that could reduce reliance on hand weeding during propagation.

**Use MSM cautiously:** While it can suppress weeds, MSM has a narrow margin of safety in greenhouses. Rates above 125 g/m<sup>2</sup> can cause injury, especially in sensitive crops like boxwood. It should be trialed in small batches before full-scale use.

**Be careful combining MSM with liquid mulch:** The LM and MSM combo may improve weed control — but it also increases the risk of crop injury due to prolonged exposure to active compounds. This combination is not recommended without crop-specific testing.

**Moisture matters:** High surface moisture levels (common with overhead irrigation) appear to increase the breakdown of MSM into its bioactive form. Adjusting irrigation practices, or switching to sub-irrigation, may make MSM use safer.

### Final thoughts

Natural weed control strategies like MSM and organic mulch have exciting ➤

## Growing Knowledge

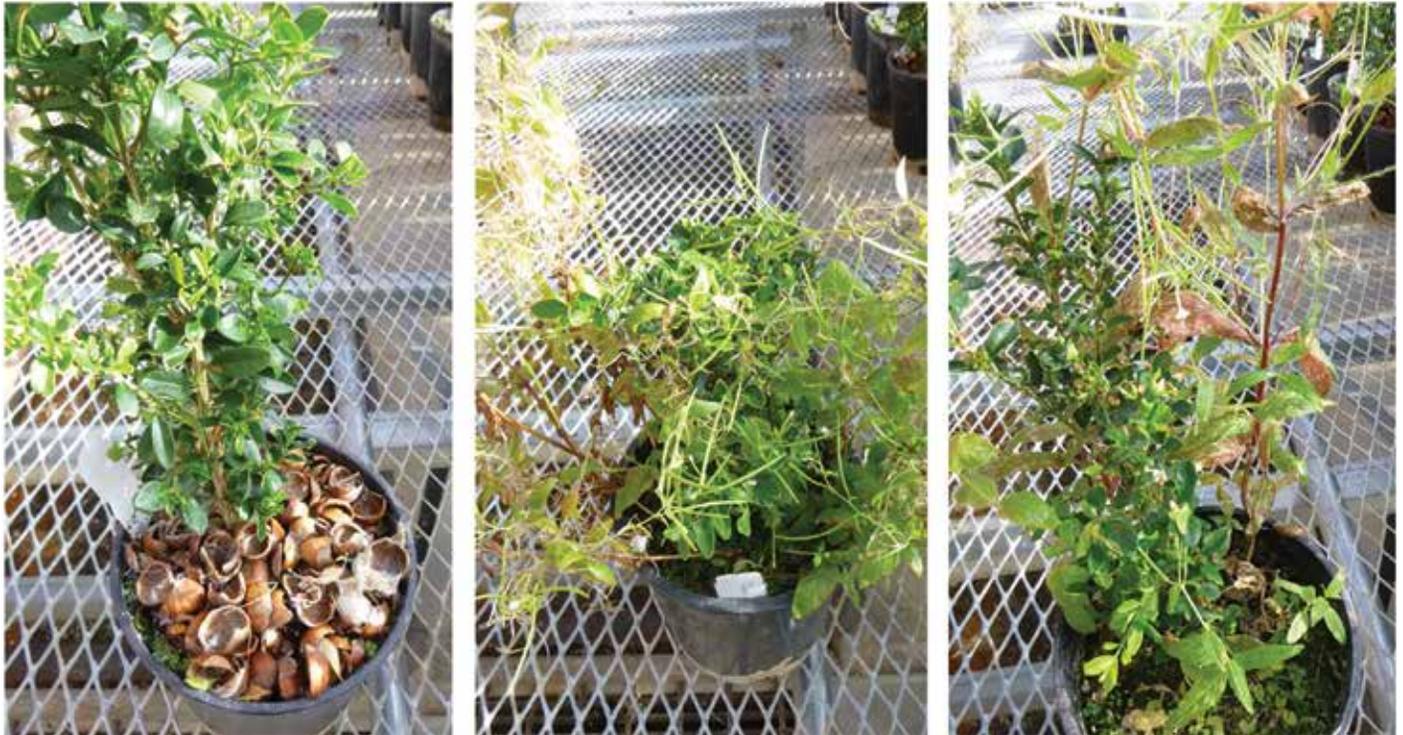


Fig. 4 Three-panel comparison of willowherb (*Epilobium* spp.) growth in treated pots. Left: hazelnut shell mulch combined with mustard seed meal (MSM) effectively suppressed seedling emergence. Center: liquid paper mulch provided moderate control. Right: untreated control pot showing dense willowherb growth. The MSM and hazelnut shell combination delivered the most consistent suppression. PHOTO COURTESY OF OREGON STATE UNIVERSITY



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potential, especially in propagation systems where synthetic herbicide options are limited. However, their effectiveness and safety depend on careful integration with existing practices.

Hazelnut mulch, in particular, stands out as a low-risk, high-reward option for liverwort control in greenhouse containers. MSM, on the other hand, requires much more nuance — and may be better suited to field or outdoor nursery applications where moisture can be more easily managed. While previous reports have shown promising weed suppression from liquid mulch in outdoor container yards, our greenhouse trials did not replicate those results — suggesting that liquid mulch performance may vary depending on environmental conditions. ☺

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### Resources

For more detail please see the free, downloadable full research featured in the Journal of Environmental Horticulture. *Journal of Environmental Horticulture* (2025) 43 (1): 41–48, go to [TinyURL.com/MSMRsearch](http://TinyURL.com/MSMRsearch).

This study marks one of the first to evaluate these materials under true greenhouse conditions with high liverwort pressure. Future work will focus on refining application rates, exploring additional mulch materials, and testing across a wider range of crops.

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