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# Non-chemical Greenhouse Weed Management Strategies

Weed are a persistent problem in greenhouses, hoopouses, propagation houses and other enclosed structures. Hairy bittercress (*Cardamine hirsuta*), yellow woodsorrel (*Oxalis stricta*), spotted spurge (*Euphorbia maculata*), liverwort (*Marchantia polymorpha*) are some of the common weeds that are found inside greenhouses and other enclosed structures. Weeds can grow on the container media competing with the ornamental plants for space, nutrients, water, light, and oxygen and thereby reducing the overall growth and market value of the plants.



Figure 1. Heavy weed infestation under the benches inside a commercial greenhouse. Photo credits: Debalina Saha, MSU Horticulture

They can even find growing in the drain holes of the containers, under the benches (Fig 1), on the benches (Fig 2), ground-cloth floors, sides of the walkways inside the greenhouses, and even in the liners/stock plants. Not only these weeds reduce the quality of the ornamental plants, but they also harbor insects, such as whitefly and thrips, and other pests such as mites, slugs and snails. In addition to that, bittercress and woodsorrel are known to be hosts for impatiens necrotic spot virus (INSV) and tobacco spotted wilt virus (TSWV) which may be vectored to susceptible host crops by certain thrips. It is important to regularly scout for weeds.

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## Prevention and Sanitation Practices

Maintaining sanitation and adopting preventive measures are the first and foremost step in an effective weed control program. It is recommended to use clean and sterile substrate or media for growing ornamentals. The tools and equipment need to be cleaned thoroughly each time they are being used to make sure that there are no weed seeds attached to them. Greenhouse workers should maintain proper sanitation practices and are recommended to disinfect their shoes/boots and gloves thoroughly as weed seeds can get dispersed via human beings. Weeds growing outside greenhouse also need to be controlled to reduce the introduction of weed seeds and propagules by foot traffic and wind blowing.

Screen exclusions on vents may help in reducing the amount of wind-borne weed seeds from entering the greenhouse. Make sure the storage areas for bulk goods and racks are not infested with weeds. Keep weed seeds and other propagules (tubers, rhizomes, etc.) out of the greenhouse by using weed-free plant materials and stock plants (Marble and Pickens, 2022). Regularly scout for weed species inside the greenhouses and always monitor new shipments of plants and inspect them for small weeds before placing them inside the greenhouse. Weed barrier fabrics (Fig 3) and concrete floors (Fig 4) can help to reduce weed seed germination. Also, avoid storing/keeping container media under the benches and if reusing the containers, wash them thoroughly with pressurized water (Fig 5) and chemical disinfectants to remove weed seeds, pathogens, and dirt.



Figure 2. Weeds growing on the greenhouse benches inside greenhouse conditions. Photo credits: Debalina Saha, MSU Horticulture.



Figure 3. Weed barrier fabric can reduce weed seed germination to certain extent. Photo credits: Debalina Saha, MSU Horticulture.



Figure 4. Concrete floors inside greenhouse can help in weed management. Photo credits: Debalina Saha, MSU Horticulture.



Figure 5. Greenhouse interior being cleaned with pressurized water after all plants have been taken out. Photo credits: <https://pestadvisories.usu.edu/2020/01/17/greenhouse-sanitation/>



Figure 6. Rice hull applied as an organic mulch layer can help controlling weeds inside greenhouse conditions. Photo credits: Debalina Saha, MSU Horticulture.

Sanitizing a greenhouse before filling it will give growers a head start against pests and reduces the amount of effort and resources needed to maintain a weed free environment as the growing season progresses. One way to do this is by emptying the greenhouse and turning off all irrigation so that any weeds present can completely dry up. This is called solarization. Once the greenhouse has had the opportunity to heat up and dry out, going back through and removing dead weeds by hand that may have gone to seed can help reduce the amount of seed available in the seed bank.

You can also solarize the growth media itself. Soil can be solarized in bags, pots, plastic buckets, or flats. Containers of growth media should be placed on an elevated surface, such as wooden pallets, and covered with a double tent of transparent plastic. The double layer of plastic can increase soil temperatures by up to 50° F, and placing containers on pallets allows for heating from all sides. Soil temperatures should be monitored closely to assure that temperatures are high enough to control pests and weed seeds (Stapleton et al, 2015).

Another way to sanitize the greenhouse and growth media is through steam sterilization. This method is used to kill soil-borne pathogens and weed seeds. Typically steam emitter hoses are placed on the ground or over pots and covered with tarp, then steam is injected. There are also manually operated surface steam systems that are more convenient for treating smaller areas, as well as areas with obstacles that make it impractical or difficult to cover the ground or containers with a tarp. In the case of either method, it is important to closely monitor the soil temperatures. You must reach and maintain 175 F (~80C) for at least a 30 minutes (Neal, 2023). Once sterilized, steamed media should be covered and used within a week because it can be reinfested while stored.

## Cultural Control Practices

Water use can contribute to weed germination and growth within enclosed structures. Algae, moss, and liverwort all thrive in moist conditions and therefore overwatering can lead rapidly to their growth and spread of these weeds on container media, particularly on crops with long production times. Nostoc (bluegreen algae, similar to algae) is another problematic weed which causes surfaces to become very slippery, creating safety issues for greenhouse workers. Ensure that irrigation systems are uniformly applying water and take weather patterns that decrease water demand by the crop (cool, cloudy weather) into consideration to avoid overwatering. Properly maintaining greenhouse drains will also prevent water collection on the floor and surfaces. A less obvious consideration is reducing humidity levels, when possible, through ventilation and plant spacing as high humidity may increase weed germination rates (Marble and Pickens, 2022).

Strategic placement of controlled released fertilizers in containers can further help to reduce weed germination, emergence, and growth. Instead of topdressing with fertilizers, incorporation or subdressing is recommended as it reduces weed access to fertilizers in the top 0.5-1" of media where they germinate. Topdressing larger containers with 1 to 2 inches of organic mulch materials, such as pine bark or rice hulls (Fig 6), is another strategy which can create a physical barrier and help reduce weed emergence and growth.

## Manual Removal or Hand Weeding

Frequent scouting and hand-pulling of weeds inside the greenhouse can minimize the chances of the weeds to become established and generate more seeds. Some common weed species such as yellow woodsorrel and bittercress can produce thousands of seeds per plant and are known to have nearly a 100% germination rate. Therefore, it is highly recommended to hand-pull these species when young, prior to flowering. After hand-pulling weeds, remove weed materials from the greenhouse floors as these weeds are resilient and can re-root in the humid conditions (Marble and Pickens, 2022).

## Weed control outside the greenhouse

Maintaining a low weed environment outside of the greenhouse can be almost as important as maintaining a weed free environment inside. Weeds are incredibly persistent, particularly perennial weeds, and can find their way into the greenhouse through vents, windows, holes in the foundation or walls, irrigation water, and greenhouse workers' clothes and boots.

Additionally, weed control around the greenhouse may also serve to reduce populations of arthropods and other pests (Neal 2023). Many options are available for controlling these exterior weeds. One option is mowing, if done at the right time it can prevent much of the weed seed formation and distribution. Cultivation is also an option, as well as hand weeding, however those can be costly in labor. It is also recommended that a vegetation-free strip be placed adjacent to the foundation using a ground fabric covered with gravel or another inorganic mulch. This strip can act as its own type of barrier to discourage weed growth up against the structure (Neal 2023).

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