

# Commercial Greenhouse and Nursery Production

## Sanitation for Disease and Pest Management

*Nathan M. Kleczewski and Daniel S. Egel,*

*Purdue Botany and Plant Pathology*



Purdue Department of Horticulture  
and Landscape Architecture

[www.ag.purdue.edu/HLA](http://www.ag.purdue.edu/HLA)

Purdue Department of Botany and  
Plant Pathology

[www.ag.purdue.edu/BTNY](http://www.ag.purdue.edu/BTNY)

Purdue Floriculture

[flowers.hort.purdue.edu](http://flowers.hort.purdue.edu)

### Why Sanitize?

Greenhouse growers are often concerned about the costs of managing pests and pathogens. Proper greenhouse sanitation is a key component in reducing those costs and improving plant quality.

Investing time and money in greenhouse sanitation is much less expensive than paying for the repeated pesticide applications and crop losses associated with unsanitary conditions. Greenhouse sanitation aims to prevent disease and insect outbreaks. In that respect, it is a lot like routine car maintenance. In both cases, you may not notice the benefits immediately, but taking preventative measures saves you money and lost time in the long run.

This publication discusses general practices for maintaining a clean and profitable greenhouse.

### Think Clean

Effective greenhouse sanitation requires growers and greenhouse managers to develop a “clean” mindset. Insects and pathogens are ubiquitous and may easily enter greenhouses.

It is critical to properly train anyone using the greenhouse to recognize pest and pathogen problems, and to understand what can be done to reduce their presence in the greenhouse. It also pays to recognize the major sources of greenhouse pests, including floors and benches; weeds; tools, containers, and other equipment; trash; clothing; and new plants that have been introduced into the greenhouse.

### Floors and Benches

The greenhouse floor is a major source of pests and pathogens. Many pathogens can survive in soil and residue for extended periods (for more information, see *Preventing Seedling Diseases in the Greenhouse*, Purdue Extension publication BP-61-W). In the greenhouse, many pathogens can spread to container-grown plants through splashed water, they come in contact with plant roots or media or when watering nozzles are placed on the floor.



**Figure 1.** If benches are not an option, consider using plastic sheeting or landscape cloth to prevent soilborne pests or pathogens from moving into your pots.



## 2

When possible, make sure greenhouse floors do not contain exposed soil or plant debris: concrete or gravel floors are preferable. At a minimum, cover floors with plastic sheeting or landscape cloth and change such coverings frequently (Figure 1). Some growers utilize the soil of the greenhouse floor to grow plants to maturity. In these cases, the grower should focus on preventing pests and pathogens from entering the greenhouse; removing weeds from the greenhouse floor and area immediately outside of the greenhouse; and properly sanitizing tools, boots, and other equipment used in the greenhouse. These areas all are discussed in the following sections.

Routinely sweep and wash greenhouse floors to remove soil and debris. Conduct transplanting and seeding in a location separate from the greenhouse. Discard any plants or growing substrate that falls on the floor. There is no “three-second-rule” in the greenhouse! Hang up watering hoses so they do not contact residue, soil, or potting media on the floor or benches.

Using raised benches is an easy way to reduce contamination from the greenhouse floor. Although they are more expensive, metal benches are easier to clean than wooden benches. Wood surfaces are difficult to adequately sanitize and can harbor pathogens and problematic organisms such as algae.

See *Preventing Seedling Diseases in the Greenhouse* for more information about pathogen control in the greenhouse.



**Figure 2.** Weeds in the greenhouse are reservoirs for insects and pathogens. Immediately remove weeds in and around the greenhouse.

### Cleaning and Disinfesting Benches

Clean benches regularly to remove substrate or soil residue and potential contaminants. Water alone is not sufficient for this purpose. There are many chemicals that can be used to clean benches and other greenhouse areas (Table 1). Make sure all benches have been washed of all dirt and debris prior to using sanitation chemicals because organic matter may inactivate the compounds.

Chlorine bleach is effective for bench top sanitation (a 10 percent commercial solution allowed to sit for five minutes — since most commercial bleach contains 6 percent active ingredient, the sanitizing solution is equivalent to 0.6 percent active ingredient). More concentrated solutions are more effective at killing pathogens, but require several rinses to adequately remove residual bleach. Use chlorine bleach with caution: it is highly volatile, phytotoxic, can irritate mucus membranes and lungs, and can corrode metal.

Products that contain quaternary ammonium (Green-Shield<sup>®</sup>, Physan 20<sup>®</sup>) are less volatile and more stable than commercial bleach, and work well when used according to label directions. However, quaternary ammonium products do not penetrate wood well, so do not use them on wood benches for sanitation.

Products that contain hydrogen dioxide (ZeroTol<sup>®</sup>, OxiDate<sup>®</sup>) effectively kill bacteria, fungi, and algae on contact but do not penetrate wood well. OxiDate<sup>®</sup> is the only product listed in this publication that is approved for use in certified organic greenhouses (for more information, see the Organic Materials Review Institute website, [www.omri.org](http://www.omri.org)).

Chlorine dioxide (Selectocide<sup>®</sup>) is another product that effectively sanitizes surfaces. Chlorine dioxide is a gas, so it can penetrate and access greenhouse surfaces better than liquid products.

Always use the proper protective gear and follow product labels when applying any sanitation chemical.

### Weeds

Another source of pathogens and pests are weeds growing inside and immediately outside the greenhouse, which can harbor diseases and insects (Figure 2). Hand weeding may be sufficient to remove some weedy plants, although many weeds grow rapidly from seed, so they are difficult to control by this method alone.

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**Table 1.** Examples of chemicals used for greenhouse sanitation.

Product	Active Ingredient	Uses	Comments	Link
Numerous brands	ethanol (70%)	Effectively sanitizes cutting tools.	Extremely flammable. May not be feasible for large-scale sanitation.	
Numerous brands	chlorine bleach (approximately 1% active ingredient)	Sanitizes pots, flats, walls, and benches.	Should be prepared fresh before use. May corrode metal. Volatile and phytotoxic.	
Green Shield®	quaternary ammonium	Sanitizes all greenhouse surfaces and tools.	Little residual effect. Can also be used on evaporative cooling surfaces.	<a href="http://www.greenislanddistributors.com/productpdfs/168733Greenshield_Tech_Info.pdf">www.greenislanddistributors.com/productpdfs/168733Greenshield_Tech_Info.pdf</a>
Physan 20®	quaternary ammonium	Sanitizes all greenhouse surfaces and tools.	Also labeled for cuttings and plants.	<a href="http://www.physan.com">www.physan.com</a>
OxiDate®	hydrogen dioxide	Sanitizes all greenhouse surfaces and tools.	Approved for organic greenhouse use.	<a href="http://www.biosafesystems.com/Product-Ag-OxiDate.asp">www.biosafesystems.com/Product-Ag-OxiDate.asp</a>
ZeroTol®	hydrogen dioxide	Sanitizes all greenhouse surfaces and tools.	Can be used as a broad spectrum fungicide.	<a href="http://www.biosafesystems.com/Product-HORT-ZeroTol.asp">www.biosafesystems.com/Product-HORT-ZeroTol.asp</a>
Selectocide®	chlorine dioxide	Sanitizes all greenhouse surfaces.	Can penetrate surfaces not accessible to liquid disinfectants.	<a href="http://www.qwatro.com/selectocide.php">www.qwatro.com/selectocide.php</a>

Note: always wear personal protective equipment when applying sanitation chemicals in the greenhouse. Follow product labels for instructions and safety precautions.

Chemical applications are often the easiest and most effective means to control weeds. Products that contain glyphosate, diquat, or paraquat can be used for weed control immediately outside the greenhouse, but be certain to close the greenhouse vents and doors when applying these products in the vicinity to prevent damaging the plants inside.

For more information, visit the Purdue Weed Science website, [www.ag.purdue.edu/BTNY/weedscience](http://www.ag.purdue.edu/BTNY/weedscience).

### Tools, Containers, and Other Equipment

Regularly clean tools and equipment with soap and water, and sanitize them often. You may use many of the products listed in Table 1 for bench top cleaning to sanitize tools. In addition, ethanol (70 percent) is very effective for tool sanitation. Make sure to sanitize cutting tools after pruning or taking cuttings of plants. Many important plant pathogens such as viruses or bacteria are easily spread between plants. Sanitizing greenhouse tools effectively reduces the spread of these diseases in the greenhouse.

If possible, discard pots and flats after use. However, if it is necessary to recycle these items, take care to wash them thoroughly with soap and water, and to

disinfect them with a product labeled for that purpose (for example, OxiDate®). If you have had issues in the past with diseases such as Fusarium, Pythium, or Rhizoctonia, you should use new pots. Never store growing substrate or soil in the greenhouse.

### Trash

Trash bins can harbor pathogens and pests, so always keep them out of the greenhouse. It is particularly important to remove discarded soil and plant material from the greenhouse for this reason. At a minimum, seal trash bins with a lid and empty them daily. Thoroughly clean bins after emptying them.

### Clothing

Take care that everyone entering the greenhouse removes soil and debris from their shoes and boots. This can be another source of pathogens and insect pests. Place brushes and hoses outside the greenhouse entrance for this purpose.

You can also purchase special disinfectant mats (foot baths) that sanitize shoes and boots upon entering the greenhouse. If you work in several greenhouses during the day, work in the problem (dirty) greenhouse last to avoid infesting other houses.

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### New Plants

New plants are excellent avenues for pests and diseases to enter your greenhouse. Turn away shipments of plants that appear to have insects or are diseased.

Train all greenhouse personnel to recognize disease and injury symptoms, and to discard any suspect plants (Figure 3). Send suspicious plants or tissues to the Purdue University Plant and Pest Diagnostic Laboratory for testing (for details, visit their website, [www.ppd.l.purdue.edu](http://www.ppd.l.purdue.edu)).

Insect pests can often be managed chemically. However, you can help curtail outbreaks by preventing insects from entering the greenhouse. For example, you can use insect screens on vents to keep insects out. Sticky cards are useful tools that help assess the presence of insects in the greenhouse.

### Routine Cleaning

It is best to thoroughly clean and sanitize your greenhouse between crops. You should remove all plants, soil, and items from the greenhouse prior to sanitation. Power washers can remove dirt and algae, and sanitizing agents can clean walls, benches, tables, floors, and other surfaces.

Once clean, close all vents and doors and allow the greenhouse to sit for a day or two. Several hours of hot greenhouse temperatures (around 110°F) can effectively reduce pest populations and may adversely impact some pathogens. However, excessively hot greenhouse temperatures can ruin certain types of shade curtains and plastic coverings, voiding their warranties. Extreme temperatures may also damage lighting fixtures or structural components of the greenhouse.

These guidelines require time and attention to detail. However, the benefits of following these practices will be evident when used effectively and consistently. A clean greenhouse leads to healthy plants, and healthy plants lead to happy growers.



**Figure 3.** Minimize the spread of diseases by learning to recognize symptoms and then removing sick plants from the greenhouse. This watermelon seedling is showing symptoms of gummy stem blight. If not removed, the disease can easily spread to other watermelon transplants in the greenhouse.

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