

# GREENHOUSE SANITATION AND PEST EXCLUSION

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Implementation of new Worker Safety Protection Standards, increases in pesticide costs, and concerns about liability and environmental contamination from pesticides have combined to increase both the cost and complexity of greenhouse pest management programs. These increases should encourage growers to re-examine how they control pests and to look for methods that reduce chemical usage.

Two frequently overlooked or under used concepts for pest management that deserves consideration is sanitation and pest exclusion. Both concepts, when applied aggressively, use no chemicals other than disinfectants, have no restricted entry interval, are often cost effective, are relatively easy to implement, and can reduce the need for pesticides. They operate on the basic philosophy that it is easier to prevent or exclude pest problems in the first place than to treat them once they occur.

## A management philosophy

Effective greenhouse sanitation requires a commitment by management to establish a certain "state of mind" or "awareness" in employees. This involves establishing in the minds of everyone those areas that should be treated as "clean areas" or "dirty areas." Employees should be trained from the first day to recognize pest problems, where those problems come from, how they spread, and what employee behaviors are appropriate within clean areas to prevent pest problems. Management should then monitor the areas closely to determine the effectiveness of training.

Management should identify different levels of cleanliness and assign areas in the greenhouse and product area to those levels. For example: Level 1 (most clean) is anything that comes in contact with the plants or potting media such as containers, cutting knives, work tables for processing cuttings, potting media storage, etc. Level 2 (next clean) is anything that comes in contact with the containers such as bench tops, conveyer belts or carts that transport containers, container storage, etc. Level 3 (dirty) are other areas of the production and growing. Level 4 (most dirty) is outside the production and growing area including things that are brought in from outside. Objects should always move within a cleanliness level or from a clean to dirty level but never from a dirty to clean level without disinfection. For example, if a watering wand and breaker fall from the bench top (level 2) to the floor (level 3), do not put it back on the bench top without disinfection.

## Between crop cleanup

Greenhouse cleanup between crops can serve to prevent the carry-over of pest problems to the next crop and eliminate the life-stages of insects and diseases that are difficult to control using pesticides. Though it is best to perform a cleanup between each crop, a thorough job can usually be accomplished during the summer, in

December between the poinsettia and spring bedding crops, or anytime the greenhouse is empty for a day or two. Consider the following suggestions: 1) Remove all debris from the benches and floors. Bench tops and solid floors can be swept, vacuumed or steam cleaned. Vacuuming has the advantage of picking up weed seed and spores without blowing dust into the air, which is a disadvantage of sweeping. Many growers take pride in having their employees sweep main isles. However, sweeping an isle under the greenhouse intake vent blows dust and spores into the ventilation air stream that is carried into the crop canopy. Bench tops can be treated with a greenhouse disinfectant. 2) Remove all weeds from the greenhouse floor. Herbicides registered for greenhouse use can be applied according to label directions. The following is a list of herbicides for greenhouse use:

**Roundup Pro:** Non-selective, systemic, slow control, turn off fans during application, cannot be used when desirable crops are present!

**Finale:** Non-selective, contact, turn off fans during application, can be used when desirable crops are present, cannot be used on eatable crops.

**Scythe:** Non-selective, contact, works best on young weeds and at 80°F or higher, can be used when desirable crops present, can be used for algae and moss control in cooling pads.

**Reward:** Non-selective, contact, works best on young weeds, can be used when desirable crops present, cannot be used on eatable crops.

3) Prevent wet areas on the floor by repairing leaking pipes, solenoid valves, or faucets and correcting poor drainage areas. Cover dirt floors with gravel and weed barrier. If the gravel is put down first, then covered with weed mat, it is easier to clear the floor surface of debris. 4) Disinfect fertilizer stock tanks, greenhouse trashcans, and all watering devices including watering wands and breakers and the ends of drip irrigation tubes. Scrub and disinfect propagation area floors, bench tops, pipes, and mist nozzles. Clean or replace evaporative cool-cells at the first sign of wear. 5) If possible, clean the greenhouse, wet down the interior, and close it for a few days to a week with little or no ventilation to solarize the greenhouse. Wetting the floor will encourage weed seeds and spores to germinate and high sunlight and temperature will naturally pasteurize the greenhouse interior.

## Start pests free

Start with pest-free plant material. Seeds can carry pests on the seed coat or in the embryo so purchase only the best quality seed from reputable seed producers. In many cases, the higher cost of good quality seed is worth the peace of mind. Keep records of seed sources and lot numbers, and track the crops during production so that if a problem arises, it can be traced back to the supplier. Likewise, purchase only pathogen indexed, vegetative material propagated from "elite" stock plants. Pathogen indexing is a tissue

culture procedure that eliminates systemic bacteria, viruses, and fungi from plant materials. It does cost more, but don't get burned by cheaper, non-indexed material!

Pest exclusion involves any measure that can be taken to prevent the introduction of pests into the greenhouse. Implementation of exclusion should begin with the arrival of new plant material. All incoming plants, seedlings, or cuttings (rooted or unrooted) should be examined carefully for diseases or insects by an individual trained to locate and identify these problems. Plant material shipments found to be infected should be reported to the supplier and not allowed in the greenhouse or production area.

Growers involved in certain types of production or certain crops such as geranium propagation and stock plant production should isolate incoming plant material for a period adequate to ascertain if the plants are clean. Many growers establish a free standing, "quarantine" greenhouse to isolate plants for a few days to a week. Trained employees inspect the plants daily and treat problems if they arise. These employees should attend the quarantine greenhouse at the end of the day and go home afterward without returning to the main production facility.

After potting, isolate crops known to have problems. For example, place all plants from a shipment of cutting geraniums in one greenhouse and keep shipment together. Do not place susceptible crops on the same irrigation system with other susceptible crops. This is especially important when sub-irrigation is used. Isolate

susceptible crops by plant source and shipment by 3 feet. A "buffer crop" that is not susceptible can be placed in the space between susceptible crops. Avoid hanging baskets over susceptible crops.

### During the crop

Again, be aware of dirty and clean areas. The following is a list of sanitation primers: 1) Wash any tools, containers, or equipment that may be reused on plant material or come in contact with growing medium with a greenhouse disinfectant. 2) Insist that employees wash their hands before beginning operations that involve contact with plant materials, potting mix, or containers. Provide convenient washing stations with hot water, soap, fingernail brushes, and paper towels. 3) Keep hose-ends hung up. Irrigation equipment should be considered part of the level 1 clean area. 4) Bench tops should be considered a level 2 clean area. Keep dirty equipment, feet, etc. off the benches. If standing on bench tops is necessary for overhead repairs, disinfect the benches afterward. 5) Avoid wearing brightly colored clothing, especially yellow and blue, that attracts insects that may hitch a ride into the greenhouse. 6) All weeds should be kept off the floors and pulled from growing containers. Place trashcans in each greenhouse and insist they be used and emptied daily. 7) Provide clean aprons for employees that work in propagation areas. 8) Infected, diseased, or suspicious plants should be removed with minimal disturbance from the greenhouse in plastic bags or a covered container. Remove plants showing symptoms and adjacent plants without symptoms because they may already be infected. 9) Avoid activities that result in splashing water from plant to plant where possible. Avoid activities



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that result in excessive dust in the greenhouse. 10) Scout for pests problems frequently and take corrective measures quickly. This is especially important for thrips, whiteflies, and aphids that are known vectors of systemic bacteria and viruses. 11) Do not allow customer or employee house plants to be stored in the production greenhouse.

#### Production areas

Sanitation should extend beyond the greenhouse to production and storage areas. Avoid storing media and media components outdoors where the bales can get torn or damaged and exposed to sources of insects, disease spores, or animals. A warehouse with enclosed bays or shelters will keep media dry and protected from pests. If outdoor storage is unavoidable, raise the bales off the ground on pallets and cover the stacks of bales tightly with heavy tarp or plastic. Likewise, avoid storing containers (pot, flats, or tags) outdoors.

Greenhouse media comes from the supplier reasonable sterile. It does not make sense, therefore, to put that media in used containers. This is especially true for crops that have a history of problems such as pansies or geraniums. Having said that, many growers do disinfect and reuse containers. If so, be sure a system is set up to remove all old media and debris from containers before dipping them in disinfecting solution. Lastly, keep the production area clean and organized. Periodically, sweep or vacuum and wash the floors. Never re-use potting media that has fallen on the floor. Potting equipment, benches, belts, machines, etc. should be hosed off and washed with greenhouse disinfectant at the end of the work day or

before working with a crop known to have problems. The following are properties of several commonly used greenhouse disinfectants:

**Alcohols (isopropyl):** Denatures proteins and has slow germicidal activity. Phytotoxic to some plant material, evaporates, and is flammable. Good for small jobs such as sterilizing cutting knives, pruners, and small work surfaces.

**Chlorine Bleach:** A 10% solution is highly effective as a bactericide, fungicide, and algicide (less as a sporicide). Good for dipping containers and washing benches and equipment. Corrosive to metals such as galvanized benches and has a short use life (2 hours). Should not be exposed to sunlight and is deactivated by organic materials. Releases chlorine that can irritate skin and eyes.

**Quaternary ammonium compounds (Greenshield):** A cationic detergent good for cleaning surfaces. Deactivated by household soaps that are anionic detergents. Effective as a bactericide, fungicide, and algicide (less as a sporicide). Noncorrosive, stable, inexpensive, and relative non-toxic. Phytotoxic to plant material. Greenshield can be applied with an injector. EPA approved.

**ZeroTol:** Effective as a bactericide, fungicide, algicide, and sporicide. Low toxicity, EPA approved, corrosive above 5%, but can be applied to plant material at lower concentrations. Environmentally friendly because breakdown releases water and oxygen.

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### Keeping the outside . . . out

Exclusion frequently involves physical barriers to pest entry into the greenhouse. Often, the main problem is to recognize how insects or diseases gain entry. The following are some tips: 1) Make sure the greenhouse glazing material is free of holes, tears, or leaks that could allow insect or disease entry. 2) Entry-way doors into the greenhouse should seal and automatically close. 3) Install and maintain exterior or interior louvers over fans that close when the fans are not operating. 4) Exclude pets and rodents from the greenhouse. Animals can bring in insects and diseases on their feet or their fur. 5) Consider the installation of insect screens over vents to prevent the entry of thrips, white flies, etc. This installation requires careful planning to insure that adequate ventilation is maintained. Check the insect screening weekly and keep it clean. 6) Keep areas around the greenhouse free of debris and consistently mowed before vegetation forms seed. Many growers also remove all plant material for a distance of ten to twenty feet around the greenhouse and cover this area with concrete or gravel to limit weed seed, insect, and disease entry. Weeds that emerge in the vegetation free area can be treated with Surflan (preemergent) plus Roundup Pro, Finale, Scythe or Reward. Follow label directions for applying these herbicides. Be sure to close all vents and turn off fans when applying herbicides, mowing, or using a weed eater around the greenhouse. Employees who do cleanup work outdoors should shower and change cloths before re-entering the greenhouse. If the work can be done toward the end of the workday, they can go home afterward. 7) Do not landscape with trees or shrubs next to the production greenhouse.

### Friends and neighbors

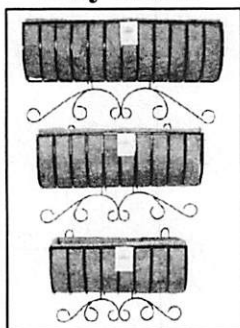
People can unknowingly pick up pests from outdoors and bring them into the greenhouse. Do not allow customers to shop in the production greenhouse. Growers who want to sell at retail should establish a retail area separate from the production facility. Wholesale buyers, sales reps, and extension personal often visit several greenhouse businesses as part of their jobs each day. Growers may not wish to exclude these individuals from the greenhouse but the potential for bringing pests into the greenhouse exists. At the very least, provide these individual an escort, limit their activities, and ask them to wash their hands before entering the greenhouse.

Implementation of judicious sanitation and pest exclusion practices in the greenhouse can control or help manage many of the problems growers face while reducing the need for chemical pesticides. All things considered, these practices may become more cost effective as the costs of pesticide application increases. However, there is one additional benefit. Most people are more productive and happier in a clean working environment. If cleanliness practices are presented to employees with a positive "can do" attitude, many people find additional ways to apply the concepts and encourage others to follow their example.

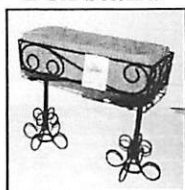
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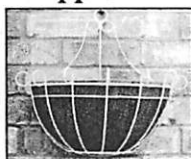
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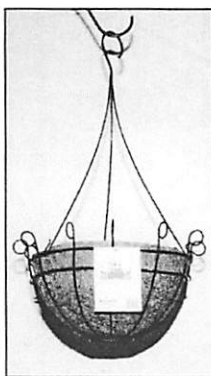
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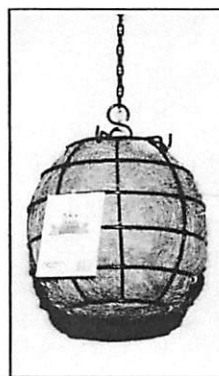
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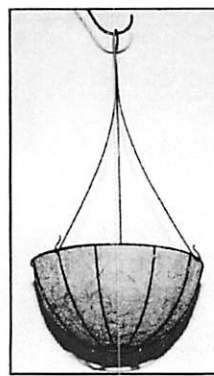
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