

Greenhouse Sanitation

Proper greenhouse sanitation is one of the most important but often more overlooked aspects of a quality integrated pest management program.

The greenhouse environment with its warm, humid climate is the perfect environment for weeds, diseases and insects, which can all seriously harm production. By taking appropriate measures, such as the ones discussed below, greenhouse growers can ensure a quality crop and a reduction in pest-related problems during the growing season.

Sanitization

Sanitization is defined as the process of cleaning and disinfecting materials/facilities that may become contaminated with pests. These pests include not only pathogens, but also insects, mites, nematodes and weeds. The process might also be called sanitation, disinfestation, decontamination or sterilization.

Ultimately, the process steps for all these terms are the same:

1. assessment and pre-crop removal
2. crop removal
3. clean up
4. disinfection
5. establishment of a new crop
6. then, monitoring of that crop

Only the first four process steps will be discussed in this factsheet.

Post-crop sanitation has the effect of interrupting diseases and other pests in the midst of their life cycle.

This “breaking of the cycle” reduces the chances of pest survival, or it can eliminating the pest before it has a chance to reproduce.

There are a variety of ways pests can propagate and spread, such as wind, water or movement of contaminated tools and clothing, so it is critical that sanitization

be more than just a quick scrub of a greenhouse before a new crop. Effective cleaning is a low-cost method of dealing with problems from the previous crop. A thorough cleaning can also reduce the amount of pesticides used in production and may make other practices more effective.

As a general rule, it is always better to clean and sanitize a greenhouse at the end of the season or crop rather

than waiting until just before the start of a new crop. At season's end, it is more likely that all steps will be followed, and the rush of the mid-season will be avoided, ensuring a quality job.

Furthermore, many pests and diseases are capable of finishing their life cycles on decaying plant material, which means that even though the crop is dying, diseases and pests may continue to proliferate, making control that much more difficult when the sanitization actually occurs.

Assessment and pre-crop removal

Before sanitization, growers need to focus care and attention on problems in the previous crop. Good crop record keeping will reduce guessing afterwards and will allow the tailoring of the clean up to areas where more attention may be needed.

Greenhouse sanitation measures can improve crop quality and reduce pests.

A crop assessment should be done for the following issues:

- diseases (bacteria, fungi, viruses)
- insects (aphids, thrips, whiteflies, fungus gnats)
- mites (two-spotted, carmine)
- algae and weeds (various species)
- nematodes (root and foliar types)
- birds
- rodents

Throughout the growing season, overlapping planting or intercropping should be avoided to reduce transferring problems from one crop to another. Similarly, “green bridges” or weeds and volunteer plants that can act as hosts for problems between crops should be dealt with as quickly as possible.

Plants that develop diseases or harbour pests should be removed from the growing area as soon as they are noticed, which will not only help to limit spread but also make clean up easier.

Crop removal

After harvest or crop maturity, a broad spectrum insecticide should be applied. This application will reduce the spread of insects while the crop is being removed and is done ideally by fogging or smoking. Irrigation equipment should be turned off to dry down plant material and lower the humidity of the building.

During this drying, growers should begin planning how the crop will be removed and start setting up for the removal. Ideally, bins with lids should be brought in from off site and used to dispose of the crop.

Composting, while common, can be extremely risky if not done properly. Care should be taken to ensure that crops are not disposed of adjacent to the greenhouse and that once pests are removed, they are kept out of the greenhouse.

Clean up

After the removal of the crop, any excess soil or media should also be taken from the greenhouse, again preferably in closed bins. Debris left from the crop (leaves, blossoms, spilled media, etc.) should be swept up and removed in bins because stray organic matter can reduce the effectiveness of cleaners and disinfectants. Attention should be paid to less conspicuous areas where debris may have lodged itself, such as in wires, screens, pipes or around the legs of benches.

Since many pathogens and pests can find safe harbour in soil, bare soil should be covered with gravel or plastic/landscape fabric when possible, especially if crops are grown on the ground. Ideally, the crop is grown in raised troughs or on benches to avoid contamination, reducing contamination risks from these sources. All these steps will also make the removal of crop debris easier and more complete, eliminating further sources of contamination for future crops.

Once the crop is removed, all pots, trays and equipment should be taken to an area where they can be cleaned appropriately. Disposable pots or trays should be discarded in closed, lidded bins while re-usable receptacles should be dumped out and the media brushed out. Reusable pots or trays should be scrubbed in warm soapy water and then soaked for 20 minutes in a 1:10 bleach solution. Similarly, any regularly used tools should also be washed with soapy water and then disinfected.

Once the greenhouse structure has been cleared of debris and plants, irrigation lines, drippers and irrigation tanks should be cleaned out. Growers should ensure all electrodes and instruments are removed from tanks and lines before cleaning, and ensure that cleaning solutions are not permitted into sand filters if these are installed.

Sand filters should be disinfected with bleach while biological filters or slow sand filters should not be disinfected. Dripper spikes should be soaked in an acid solution, rinsed well and then soaked in a buffered bleach solution (2,000 ppm) for 24 hours. All tanks should be drained, washed with bleach or a similar product and rinsed well.

Irrigation lines should not be allowed to dry out before cleaning as salt buildups can be difficult to remove if allowed to dry. Ensure that the chemicals intended for use in the line cleaning are appropriate by checking with the equipment manufacturer as emitters and lines may be damaged in the process if handled incorrectly.

Before flushing with acid, pressure the lines with water or air, and then flush with nitric or phosphoric acid with a pH of 1.6 to 1.7. A solution can be prepared by adding 1 part 60 to 70 per cent concentrated acid to 50 parts of water and then pumping it through. If irrigation lines are older or narrow, it may be necessary to perform this step twice to ensure lines are clean.

After 24 hours, the lines should be well rinsed of this solution to avoid the formation of dangerous chlorine gas when bleach is used as a disinfectant. After the rinse, the irrigation lines should be filled with a disinfectant and processed according to the manufacturer’s instructions.

Before disinfection, the greenhouse structure should be power washed thoroughly using an appropriate

chemical to remove dirt, dust and any scale or buildup. Depending on the detergent or soap used, rinsing may be necessary as residues may reduce the efficacy of disinfectants.

Special care and attention should be paid to areas where pests or debris may hide such as structural members, window ledges, pipes, plastic folds or textured surfaces. Not to be forgotten are floors, benches, walkways and tables in the header house, which can also serve as refuges for pests.

The greenhouse structure should always be washed from top to bottom and back to front, with much attention focused on overhead pipes and lines.

Disinfection

The last phase of cleaning the greenhouse involves top to bottom disinfection. The effectiveness of this step depends completely on how well the preceding tasks have been carried out. Furthermore, how effective the disinfection is and how it is carried out will determine how effective the entire sanitization program has been.

Disinfectants are registered in Canada by two separate bodies under Health Canada:

- Therapeutic Products Directorate (TPD), which administers the *Food and Drugs Act*
- Pest Management Regulatory Agency (PMRA), which manages the *Pest Control Products Act*

Both these bodies oversee the registration of chemicals, and those approved by the TPD are given a Drug Identification Number (DIN) while those approved by the PMRA are given a Pest Control Product (PCP)

number. The main difference is that while disinfectants with a DIN are usually used for preventing disease in humans and animals, PCP numbered products are used for pest control.

The PMRA notes that there are three types of antimicrobial products for use in greenhouses:

- cleaning products (household or industrial)
- disinfectants (products with DIN numbers)
- sanitizers (products with PCP numbers)

To differentiate between these products, it is easiest to look at the product claims on the label. For example, if a cleaner has multiple uses and makes no claim regarding control of pests in a greenhouse, it does not need to be registered with the TPD or PMRA and, therefore, will not have a PCP or DIN number.

By contrast, a product that makes a claim regarding how well it can control an organism or what it can control will be registered and have a DIN number. Further, if a product is being applied directly to a plant or soil/medium, the assumption is that the application is to control a pest and, therefore, the product will be registered with the PMRA and be given a PCP number.

For example, ZeroTol, a hydrogen peroxide-based chemical from BioSafe Systems, is registered with the PMRA and has a PCP number. It can be used on hard surfaces, equipment, etc. as well as in irrigation water in non-food crops as a method of algae control. Alternatively, Sanidate 5.0 from BioSafe Systems has a DIN number as it is registered with the TPD for control of *E. coli*, *Staphylococcus aureus*, and *Klebsiella pneumoniae*. It is to be used strictly on hard, non-porous surfaces and is not to be applied to plants, hence registration with the TPD.

Irrigation line cleaning

Much research has been done in the area of line cleaning, and while there are commercially available disinfectants, many sources point out that buffered bleach is still one of the most effective disinfectants available.

According to the British Columbia Ministry of Agriculture, the buffered bleach solution should be targeted between pH 6.5 and 7 and used with an appropriate surfactant. Further to this detail, they recommend using the solution as a “pulse charge” of 4 times at 1 hour intervals instead of leaving the bleach in the lines for 4 hours. This solution should then be rinsed out with fresh water, and the solution disposed of according to regulation.

As with all chemicals, care and attention should be paid to the label for the correct application and exposure time. Personal protective equipment should be used at all times, and only trained, experienced staff should be permitted to perform this disinfection step.

Many factors can affect how effective a disinfectant is:

- the active ingredient used
- concentration of the chemical
- how well the facility was cleaned prior to disinfection
- drying time/contact time
- biofilms
- type of pathogens or pest present
- surface material

These factors all emphasize the need for the appropriate cleaning of equipment and greenhouse structure before disinfection as well as the need to know what materials they are made from. Most chemicals are limited in the materials to which they can be applied without causing corrosion, and more products will require rinsing to prevent this damage.

Rough, porous or soft materials can all harbour bacteria and make effective disinfection very difficult. In situations such as these, alternative methods may have to be used, such as wet or dry steam, heat, ultraviolet light or irradiation.

Following the application of the disinfectant, all safety gear, clothes and footwear should be washed and disinfected. If fabric or plastic is used on the ground, it should be changed if needed. As a last step, sticky cards should be hung to monitor insect populations after clean up, and the greenhouse should be sealed. By closing all vents and doors and letting the greenhouse sit, the excess heat and added time will kill many pests missed in the clean up process.

Integrated Pest Management (IPM) is, by its very nature, a holistic endeavour involving monitoring, crop rotation and the judicious use of pesticides. Undoubtedly, an IPM program depends on a good quality greenhouse sanitation regime and year-end clean up.

By following the steps of a pre-crop removal assessment, crop removal, clean up and disinfection, greenhouse operators can ensure that their subsequent crops are healthy, vigorous and looking their best for customers.

Sources

<http://www.agf.gov.bc.ca/cropprot/cleanup.htm>

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