

SANITATION THROUGH DISINFECTING STILL A FRONT-LINE DEFENSE

THE BEST DISEASE CONTROL IS AN ACTIVE AND WELL-DESIGNED SANITATION PROGRAM.

By A.R. Chase

Despite advances in plant genetics, fungicides (including biologicals), mechanization and our understanding of how diseases occur, sanitation remains critical in horticulture today. Even old diseases like crown gall, which have been minor for years, sometimes resurface, often due to a change in horticultural practices. One of the main elements of a disease outbreak is lack of adequate sanitation methods. They are easily forgotten when disease is low or undetected. Although new disinfectant products have been brought into the horticultural trade in the past 15 years our understanding of how to use them to our best advantage is sometimes limited.

Considering your Choices

Disinfectants are oxidizing agents that kill microorganisms like bacteria and fungi. The most common disinfectants used in horticultural production are alcohols, chlorine compounds (like chlorine dioxide and bleach), peroxides (like X3 and ZeroTol) and quaternary ammoniums (like GreenShield, KleenGrow and Physan 20). These disinfectants are fast-acting, broad-spectrum and

low-toxicity (to humans) biocides.

Prior to disinfecting a surface, it is critical it is free of organic matter (plant debris, potting media and especially algae and moss). It is also important to remove salt deposits that can shield microorganisms from the disinfectant. An acid-based cleaner will be necessary to remove salt deposits. Table 1 summarizes some of the important characteristics of these common disinfectants.

Efficacy

There are quite a few products being used to disinfect greenhouse surfaces like benches, floors and trays including chlorine compounds, peroxides and quaternary ammoniums. In 2005, we tested the efficacy of Strip-It cleaning agent, prior to applying a variety of disinfectants. We tested efficacy on 4 ml polyethylene film, wood and concrete block with *Fusarium oxysporum fsp. cyclamenis* (the cause of Fusarium wilt on cyclamen) under greenhouse conditions. A separate set of trials was performed with *Thielaviopsis basicola* (cause of black root rot).

Surfaces were dirty when we started with



Don't forget to use a disinfectant for cutting tools between plants.

obvious algae growth. The Strip-It was applied to each surface as a spray (1 percent) and rinsed after five minutes. This was followed by one of the disinfectants: KleenGrow (2 percent), GreenShield (1 tbs/gal), and Zeritol (1 percent). The pathogen was recovered after 24 hours.

The results are shown in Table 2 as the percent kill for the Fusarium on each type of surface. Plastic was the easiest surface to clean and wood the most difficult. Strip-It alone was very effective on concrete and somewhat effective on wood. KleenGrow was very effective on all three surfaces when the

Strip-It was used first with at least 93 percent kill. GreenShield was also very effective but was better without the Strip-It cleaning treatment. Zeritol was least effective in this test with mixed results on the different surfaces.

In a follow-up test, we evaluated the effect of treatment timing on longevity for both pathogens on wood. Wood was inoculated with *F. oxysporum* one hour before cleaning with Strip-It. This was followed an hour or a day later with KleenGrow. We then attempted recovery of the fungal pathogens using selective media one day after this treatment and again one week later. This test shows delaying the disinfecting treatment by 24 hours did result in a very low recovery of Thielaviopsis but not Fusarium. When the treatment was one hour apart no recovery of either fungus occurred. After one week, there was more Fusarium on the water treated controls than was found after a single day. Ability of the Strip-It and KleenGrow to kill these organisms was about the same after one week as it was after one day indicating that there was little re-growth over the course of the interim period.

Disinfection of cutting instruments and even water have been studied occasionally over the past 10-15 years. The spread of crown gall via contaminated tools and the efficacy of several disinfectants against *Agrobacterium tumefaciens* in walnuts were demonstrated. The cationic surfactants benzalkonium chloride (BC), cetyltrimethylammonium bromide (CTAB), and Physan 20 eliminated 100 percent of the *A. tumefaciens* population in water suspensions treated at 7, 5 and 2 ppm, respectively. Bleach (sodium hypochlorite) eliminated 100 percent of the *A. tumefaciens* population at 0.5 ppm but efficacy was reduced by 64 percent in the presence of total solids (0.7 g/ml). At similar concentrations of total solids, the efficacy of cationic surfactants decreased, on average, by only 13 percent. Further studies using treated cutting instruments showed similar results with the quaternary ammonium products more effective than bleach.

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Plant Safety

Research conducted by Copes,

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Clean greenhouses between crops. This is your best defense.

Table 1. Summary of some disinfectant characteristics.

Disinfectant	Factors that can reduce effectiveness	Corrosive	Residual activity
70% alcohol	- Organic matter - Excessive concentrations	no	low
Bleach (and to a lesser degree other Cl compounds)	- Organic matter - Sunlight - Water pH - Temperatures below 68° F	yes (metals)	low
Peroxide	- Organic matter - Sunlight	moderate (metals)	limited
Quaternary ammonium	- Soap - Hard water	no	good

Adapted from Dave Woodske and Siva Sabaratnam, Abbotsford Agriculture Centre, British Columbia Ministry. "On-Farm and Greenhouse Sanitation and Disinfection Practices to Minimize the Impact of Plant Pests."

Table 2. Efficacy of disinfectants in killing *Fusarium* spores on different greenhouse surfaces with or without pre-cleaning with Strip-It (Chase Horticultural research, 2005).

Treatment	Wood alone	Wood with Strip-It first	Concrete alone	Concrete with Strip-It first	Plastic alone	Plastic with Strip-It first
Water	0	35%	0	100%	0	0
KleenGrow	0	100%	69%	93%	100%	94%
GreenShield	75%	0	96%	80%	100%	100%
ZeroTol	0	0	81%	68%	0	100%

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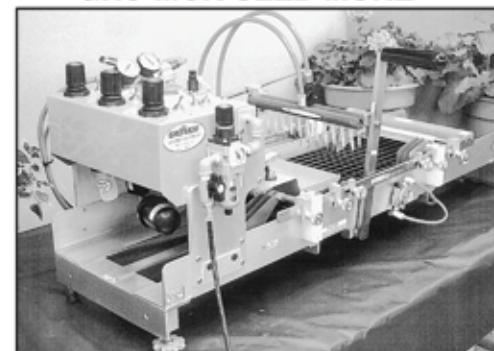
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Chastagner and Hummel tested the safety of treated irrigation water (chlorine dioxide or hydrogen dioxide). Regular and excessive rates of chlorine dioxide and hydrogen dioxide were sprayed five times at three-day intervals on eight bedding plant and nine shrub species to determine if plant damage would result. Rates of 5- and

50-ppm chlorine dioxide and 900- and 2,700-ppm hydrogen dioxide did not damage most plants tested and will likely control most common pathogen propagules (based on other work). Higher rates of chlorine dioxide (100 ppm) and hydrogen dioxide (5,400 ppm) did not damage most plants tested if sprayed less than four consec-

utive times and should control some of the more chemical-tolerant pathogens.

There has been concern expressed about spraying plants with quaternary ammoniums despite the fact that one (KleenGrow) is labeled for exactly this purpose. In this use pattern, it is acting as a fungicide/bactericide and exhibits the same safety and longevity as standard fungicide or bactericide products. Thus accidental overspray should not be a large concern when using KleenGrow to clean floors, treat water or disinfect cutting tools. One note to remember is if KleenGrow is applied routinely and allowed to build up on their surface (no exposure to overhead irrigation or rainfall), it can reach damaging levels on sensitive plants. We did see this happen in an experiment on poinsettias where it was applied for eight weeks in a row.

Conclusions

The best thing you can do is to carefully read the label of the product you are interested in using. Each product has a unique spectrum of activity as well as safety issues. We found that experimentally ZeroTol provided superior control of algae when compared to X3, while X3 was safer when sprayed directly on the crop. Do not jump to the conclusion that all peroxides or all quaternary ammoniums are created equal or that their labels are interchangeable. For instance, KleenGrow is a fourth generation quaternary ammonium that has higher longevity and more tolerance to environmental conditions than other quaternary ammonium products on the market.

As we move into the future, remember that the best disease control is an active and well designed sanitation program containing effective products such as those discussed here. There are many more articles available on the Internet and you should explore the information on these products before making a choice of which ones best meet your horticultural needs. [g]

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