e-GRO Edible Alert

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Don't treat all surfaces the same

Walk into a greenhouse and notice the different materials that surround the crops (Figure 1). Ask yourself, should I sanitize all surfaces in the same way? Is the risk of pathogens the same in all surfaces?

Keep reading, but the answer to both questions is *no*.

The characteristics of materials will affect the efficacy of sanitizers and pathogen survival. In this Alert, we discuss how plant pathogens and sanitizers interact different with surfaces commonly found in greenhouses.

Figure 1. Materials observed in a typical greenhouse producing hydroponic crops in deep water culture include metal columns, polystyrene foam (Styrofoam) boards, concrete floors, plastic liner, wood production tanks, and polycarbonate or glass walls.

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The physical and chemical properties are used to select materials for specific the applications.

For example, polystyrene foam boards (Figure 2, commonly known as Styrofoam—a Dow Chemical brand) are used because of its low density (floats), thermoplasticity (solid at room temperature), moderately strong (hold plants without breaking), and limited thermal transfer (does not overheat or cool). These characteristics make the boards float, while also being steady and strong enough to hold plants without overheating.

Figure 2. Raft boards made of polystyrene used in deep water culture.

Other materials are characterized in a similar way and are then selected for a specific application. Therefore, greenhouses have a diversity of materials that are better suited to fit a specific need. However, these materials might also differ in how they harbor pathogens or interact with chemicals.

SURVIVAL OF PLANT PATHOGENS AND LETHAL DOSE

Warren Copes, research scientist at USDA, evaluated the survival of *Botrytis cinerea*—pathogen that causes grey mold— on surfaces typically used in greenhouses[1]. He observed that after 18-22 hours of the pathogen spores being in contact with the surface the mortality varied by material (Figure 3). Mortality was highest in stainless steel and exterior latex-painted pine and lowest in untreated pine.

[1]Copes, WE. 2004. Dose curves of disinfestants applied to plant production surfaces to control *Botyrtis cinerea*. Plant Dis. 88:509-515. https://apsjournals.apsnet.org/doi/pdf/10.1094/PDIS.2004.88.5.509

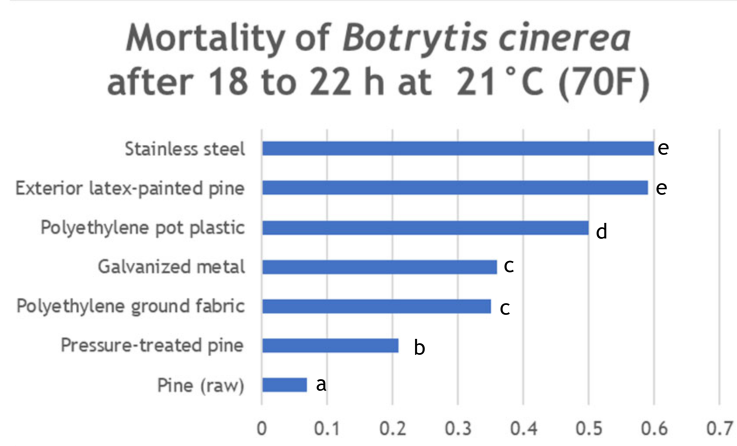

Figure 3. Mortality of Botrytis cinerea on surfaces. Image based on research from Copes, WE (2004) Dose curves of disinfestants applied to plant production surfaces to control Botyrtis cinerea. Plant Dis. 88:509–515. Values followed by the same letter are not significantly different.

Dr. Copes also evaluated mortality of *Botrytis cinerea* spores on the same surfaces when exposed to sanitizers (Table 1). Notice that some combinations work better than others. For example, you could apply lower concentrations of quaternary ammonium (QAC) or chlorine on materials such as stainless steel and galvanized metal, but higher concentrations would be needed on pressure-treated or untreated pine to achieve the same level of mortality.

Table 1. Lethal dose (grams per liter of active ingredient) to reach 90% mortality of *Botrytis cinerea* based on Copes, WE (2004) Dose curves of disinfestants applied to plant production surfaces to control *Botyrtis cinerea*. Plant Dis. 88:509–515

Material	QAC	Hydrogen Dioxide	Chlorine (NaOCl)
Stainless steel	0.75	18.56	0.87
Galvanized metal	1.05	14.35	1.07
Polyethylene pot plastic	2.98	8.58	1.41
Exterior latex-painted pine	2.78	9.39	0.87
Polyethylene ground fabric	4.04	15.08	2.09
Pressure-treated pine	5.82	12.78	5.61
Pine (raw)	8.62	19.95	3.34

The take-home message is that plant pathogens and sanitizers interact differently with materials. While we do not have information for all plant pathogens and materials, we can assume that organic surfaces with high porosity might harbor more pathogens and are more likely to interact with sanitizers—reducing its efficacy. While non-organic surfaces with smooth texture might not react as much with sanitizers and are less conducive to harbor pathogens—resulting in lower risk of pathogens and need for sanitizers.

CLEAN FIRST, SANITIZE SECOND

On a separate study[2], Copes and Hendrix measured mortality of *Thielaviopsis basicola*—causal agent of black root rot—on different surfaces and chlorine treatments (Table 2). They observed that the efficacy of 0.5% chlorine, 0.5% chlorine + detergent + scrubbing, or 1.04% chlorine was the same within a surface material (the differences in the numbers in table 1 were not statistically significant).

Table 2. Recovery of *Thielaviopsis basicola* after sanitizing treatments. Research by Copes WE, FF Hendrix (1996) Chemical disinfestation of greenhouse growing surface materials contaminated with *Thielaviopsis basicola*. Plant Dis. 80:885-886

***Thielaviopsis basicola* recovery (%)**

Treatment	Polypropylene fabric	Pressure treated-wood	Galvanized metal
Untreated	93	75	100
Sodium hypochlorite (0.52%)	5.0	7.5	0
Sodium hypochlorite (0.52%) + detergent (5g) + scrubbing	0	0	0
Sodium hypochlorite (1.04%)	0	5.0	0

Lets pivot from this research into two important points when deciding standard operating procedures in sanitizing surfaces.

First, applying high concentration of sanitizers might not always result in higher mortality, as we observed in the table above. However, high doses of sanitizers means higher risk of toxicity to the staff and the crops. Always aim for the lowest effective dose.

Second, the efficacy of chlorine and other sanitizers to control pathogens will be reduced in the presence of organic matter. While Copes and Hendrix did not see a difference when scrubbing the surface, it is well known that organic matter exerts sanitizing demand. That means that some sanitizers interact with organic matter and are "*used*" before they can kill the pathogens. For that reason, it is recommended to remove organic debris before applying any sanitizer. The other incentive to remove debris, is that organic matter might harbor pathogens too, so removing debris is an effective way to reduce inoculum.

In **summary**, implement a systems approach when deciding how to clean surfaces in the greenhouse. If possible, select materials that are easier to clean with smooth surfaces and quick-to-dry. Avoid materials composed of organic matter, such as wood, that might favor pathogen survival and can react with sanitizers.

Additional Resources:

Copes, W.E. Use of Disinfestants to Control Plant Pathogens at https://pnwhandbooks.org/plantdisease/pesticide-articles/use-disinfestants-control-plant-pathogens

Copes, W.E. Disinfestants for sanitizing production surfaces-Application of disinfestants

https://www.youtube.com/watch?v=ucqYDUX71V8

[2]Copes WE, FF Hendrix (1996) Chemical disinfestation of greenhouse growing surface materials contaminated with *Thielaviopsis basicola*. Plant Dis. 80:885-886
https://www.apsnet.org/publications/PlantDisease/BackIssues/Documents/1996Articles/PlantDisease80n08_885.PDF

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