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# The Do's and Don't's of Using Chlorine Bleach as a Surface Disinfectant in Greenhouses

*Emphasis on sanitation in the greenhouse is a good management practice. Using sterilants improperly can cause significant damage to plants and your workers. This Alert covers the Do's and Don't's!*

I know of only a few growers whom do not find chlorine bleach useful in reducing algae build up on floors and walls. It is a common way to sterilize benches

and equipment. We use this product often at home and at work, but we rarely think about the dangers chlorine bleach can pose to our employees and to our

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Figure 1. Classic stippling, and patchy leaf cell death caused by a nearby application of full strength chlorine bleach to a greenhouse floor. Complete defoliation occurred within 48 hours. New leaves did form later, after fertilization, cleaning to remove damaged tissue, and maintaining low humidity and dry leaf surfaces to prevent infections of any remaining damaged tissue. Recovery time was 3-5 weeks from this acute exposure.

## e-GRO Alert

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greenhouse crops. Recently, I had an opportunity to evaluate an incident where a garden center employee applied a light spray application of straight bleach to a 20-foot length of cement flooring to remove algae. As you will see from the images supplied here, something went terribly wrong, causing damage to the crop of foliage plants.

Before we get into the Do's and Don'ts, let us review what it is we are spraying and why we should treat it as carefully as our applications of pesticide. Sodium Hypochlorite, or common bleach, is listed as a strong oxidizer. The gaseous material that kills algae, bac-

teria, fungi and anything crawling is chlorine gas.

When chlorine comes in contact with biological material, it reacts to form hydrochloric acid, other acids such as hypochlorous acid, chloramine (a deadly gas) and some less hazardous chlorine-salt complexes that remain after volatilization. The most deadly of these gasses is the Chloramine gas, which can be formed by bleach reacting to the ammonium in algae, accumulated detritus, and fungal tissues. Bleach also forms chloramine when in contact with the amino acids and proteins in plant leaves (via the stomata), and of course, the same



Figure 2. *Nephrolepis pinnae* showing whitening and necrosis of tissue on a recently expanded frond. Defoliation did not occur, and fronds were hand removed.

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items in your lungs. Both chloramine and chlorine gas can do significant damage to cells at seemingly low concentrations.

In the greenhouse, the most actively photosynthesizing leaves will be affected the greatest, which can yield some pretty interesting symptoms on plants. Young tissue is often the least damaged, followed by the oldest leaves. It is the middle, prime leaves that are very susceptible and easily damaged as you can see in several images here.

Human lungs react similarly. Symptoms can include

coughing, nausea, shortness of breath, watery eyes, chest pain, eye, nose and throat irritation, a bad taste in the mouth, and if exposure is severe enough, permanent cell damage and death. Bleach is actually an acutely dangerous product to humans.

Given these facts, there are some essential steps to take before sending an employee out into the greenhouse to sterilize those floors and benches.

DO's:

DO use pesticide safety equipment when in a greenhouse or enclosed



Figure 3. Characteristic bronzing of the newest fully expanded leaves where chlorine gas uptake was highest. Lesser damage did occur on unexpanded new pinnae.



Figure 4. Coffee leaves showed an almost immediate necrosis to cells within the inter-veinal regions of the leaf. Some defoliation occurred days later.



Figure 5. Newest mature leaves of Spathiphyllum showing chlorosis, and upon closer inspection, massive stippling and cell death. Necrosis followed within days.

facility. Exposure to bleach can cause skin damage and blistering in addition to the inhalation damage.

DO open vents, turn on fans and have an exit route available to the applicator before you spray!!! The damage we see in this article came about because vents were closed (it was 12 degrees), and the fans were off! Never apply bleach in an enclosed room without some form of air movement established.

DO schedule bench and floor sterilization when there are NO plants in the greenhouse. If you must treat algae on a floor when crops are in place, make sure vents and fans are on, and treat a small area, then wait 20 minutes, and apply to the next small area. The whole idea is to minimize the production of the chlorine gasses, and to disperse them rapidly before they build up. Very low gas levels will not harm plants. Patience!

**DONT's:**

DO NOT use pure bleach right out of the jug to spray the surfaces. It is



Figure 6. Begonias are by far the most sensitive. Of the 11 species present, 9 completely defoliated within 24 hours of exposure. They were also the farthest away.



Figure 7. *Aralia chinensis* showing different levels of damage based on leaf age and position on the plant. *Aralias* seem to be particularly sensitive to chlorine.

just as effective for sterilization if the bleach is cut 1 to 9 with water. Fill your sprayer 9/10ths with water first, then add the bleach. Do not use "scented" bleach as it is 3% rather than 10% bleach.

DO NOT apply bleach on hot, sunny days. Even if there are no plants in the GH, a hot GH bench will volatilize the bleach so quickly it may not be effective and it certainly is going to release the chlorine more quickly. Application in a greenhouse on a hot day is a very common situation that causes employees to be injured. Application window in early morning before 9:00 AM is best...and be sure those vent fans are running.

DO NOT mix bleach with anionic surfactant detergents, ammonium based cleaning products, acids, including vinegar, fungicides, or rust removal solutions! Each of these will cause rapid release of chlorine gas, which is deadly, and of course, will greatly reduce any sterilant effects. I know folks add dishwashing soap to bleach...I've seen and

heard dozens of growers talk about it. You may find it increases cleaning power outdoors on boats, buildings and sidewalks, but never, ever use that combination indoors! You are risking your health of your employees.

DO NOT schedule workers in the greenhouse that has just been sprayed. Wait for at least two hours if large areas have been treated. A good rule of thumb is, with fans and vents full open, to wait until surfaces are completely dry.

Accidents do happen, so what do you do if you see chlorine bleach damage? It depends on the crop and the exposure.

In general, for all short-term crops such as bedding plants and vegetable starts, the crop is likely not salvageable unless the damage occurred very early. This is due to the time it takes to replace new leaves. Remember, it is the prime photosynthesizing leaves that are most severely damaged and

hence have the greatest impact on plant growth. The plant is shocked by the loss of photosynthesis and growth stops or crawls. Weeks can be added before a marketable crop is generated.

For longer-term crops such as foliage, florist pot crops with long bench time, woodies, and succulents, there is a much greater chance of financial recovery. The protocol is simple:

1). Remove damaged leaves still attached and any leaves that have abscised from the plant onto the bench etc.

2). Check pH and EC. Push fertility. In most cases, using a 20-20-20 fertilizer at 150 to 250 ppm concentration, depending on the needs of the species, to promote rapid growth will help.

In general, expect a delay of two to five weeks, depending on the crop grown, the time it takes to re-establish leaves, and the acuteness of the chlorine exposure. As you might imagine, this

is very hard to estimate. 3). In all cases, maintain the remaining foliage as dry as you possibly can. Maintain strong air movement in the greenhouse until new leaves emerge and fully expand. Avoid temperature swings, pesticide applications and "fussing" over the plants until new leaves are established. Once established, remaining, unsightly, partially disfigured, or damaged leaves can be removed over time.

The best way to prevent Chlorine bleach damage is to have the applicator read this E-Gro alert before setting off to spray the greenhouse surfaces. Safety is worth a few minutes reading.

#### References:

1. CDC Guide to Bleach. <http://emergency.cdc.gov/agent/chlorine/basics/facts.asp>
2. WA State Guide to Bleach Mixing Dangers. <http://www.doh.wa.gov/YouandYourFamily/HealthyHome/Contaminants/BleachMixingDangers>

