CHASE NEWS

Chase Horticultural Research, Inc. Volume 8—Issue 2

DISINFESTING RECYCLED IRRIGATION WATER

In this era of recycled irrigation water, there are a number of methods recommended for disinfesting the water prior to reintroducing it into the production cycle. Systems that pass water through sand filters at various rates have been in use in Europe for many years with slow movement needed to insure removal of *Fusarium* as well as *Pythium* and *Phytophthora*. The sand filters actually harbor an array of organisms that can attack and kill propagules of the plant pathogens. Other systems include use of ultra violet light, usually at 254 nm, heat treatment, copper ionization and ozone treatment. Perhaps the most common method in the US is chlorination with various forms of chlorine including bleach and chlorine dioxide.

A number of independent trials has established 2 ppm chlorine as the minimal effective rate for water treatment and elimination of *Pythium* and *Phytophthora*. Using chlorine to kill fungi in irrigation water has been reported on occasion. Most recently, Cayanan et al. (University of Guelph in Ontario) published on efficacy of chlorine to control five common plant pathogens. Minimum contact time varied from 3 to 10 minutes with *Phytophthora* (*infestans* and *cactorum*) and *Pythium aphanidermatum* all controlled with 2 ppm of free chlorine. *Fusarium oxysporum* and *Rhizoctonia solani* required significantly higher rates up to 14 ppm of free chlorine. They followed the research with trials on safety of 2.4 ppm free chlorine in irrigation water on 17 nursery crops. The treated water was applied overhead for 11 weeks. Some crops showed visible damage but were judged salable. Since the 2ppm rate of chlorine in irrigation water is believed to be the minimum rate for reliable eradication of water borne pathogens, its safety on greenhouse crops is critical and should not be assumed. Be sure to evaluate all water treatment systems for efficacy and safety under your greenhouse conditions.

Making this method effective is not just a matter of introducing a known concentration of free chlorine. Monitoring pH is important since the activity of free chlorine is highest at a pH between 7.4 and 7.6. In addition. The ability of chlorine to act is dependent on the ORP of the water. This is the oxidation-reduction potential and it can be monitored using a hand held probe similar to a pH meter. A reading of 650-750 mV (milli-volts) is minimal for anti-microbial activity for human pathogens and until levels are established for plant production a good target.

The effectiveness of the treated water to kill spores of pathogens is diminished when the organic load—such as algae and fungi– is higher which usually happens during warmer weather in spring and summer. Sudden cold weather can create a lower chlorine demand and result in excess chlorine in the water which potentially can lead to phytotoxicity. It is important to monitor all systems in order to achieve the desired results of safe and effective water treatment.

No matter what method is used for water treatment the proof of efficacy is in the plants themselves. Testing water for pathogens can be performed as we do in our diagnostic lab, but it should be understood that thresholds for levels of plant pathogens in irrigation water are dependent on each greenhouse, the crops grown and the pathogens found. None of this data exists in the literature, leaving many questions unanswered at this time. We will be modifying our testing method and evaluating the results over the next year or so. Check the method we are suggesting for submitting water samples of page 6 of this issue of **Chase News**.

CONTENTS

WOODY ORNAMENTAL FOCUS—(Pathogens on woody plants—2008 diagnostics)	2-3
KILLING PATHOGENS ON GREENHOUSE SURFACES	4
PERENNIAL PLANTS PAGE—Watch for these perennial pathogens now	5
RESEARCH ROUND-UP	6
COLLECTING A WATER SAMPLE FOR PATHOGEN TESTING	6

Plant	Diagnosis
Arbutus	Diplodia, Xanthomonas, Phytophthora
Arctostaphylos	Pythium (2), Phytophthora, Cylindrocladium, Fusarium
Artemesia	Puccinia
Aubretia	Coniothryrium
Azalea	Pythium, Fusarium
Baccharis	Phyllosticta, Pythium
Bamboo	Pythium, Fusarium
Berberis	Pythium (3), Fusarium (3)
Blueberry	Phyllosticta, Botrytis
Bottlebrush	Cylindrocladium, Pythium
Boxwood	Phytophthora (2), Fusarium (3), Pythium (4), Cylindrocladium
Buddleia	Pythium, Fusarium
Camellia	Pythium (2), Glomerella (5), Botryosphaeria
Carpenteria	Pythium, Phyllosticta, Cercospora
Chaenomeles	Phytophthora, Pythium, Phyllosticta
Choysia	Colletotrichum
Cistus	Cylindrocladium, Pythium
Clematis	Pestalotiopsis
Clethra	Pythium
Cornus	Pythium (2), Phytophthora, Cylindrocladium, Fusarium
Cotoneaster	Phytophthora, Fusarium
Crabapple	Nectria
Cryptomeria	Monilinia, Diplodia
Cypress, Italian	Fusarium
Daphne	Xanthomonas
Dipladenia	Fusarium (2), Pythium, Cylindrocladium
Erica	Phytophthora
Eucalyptus	Sphaeropsis, Pythium, Cylindrocladium, powdery mildew
Ficus	Phyllosticta, Pythium, Rhizoctonia-like
Forsythia	Phytophthora
Fraxinus	Pythium, Cylindrocladium
Gautheria	Fusarium, Phyllosticta
Grevellia	Pythium, Fusarium
Hebe	Pythium, Phyllosticta, phytotoxicity
Hibiscus	Fusarium
Hydrangea	Xanthomonas, Fusarium (2), Pythium (2), Rhizoctonia
Ilex	Phytophthora (2), Diplodia, Colletotrichum, Nectria
Jasminum	Botrytis, Phyllosticta (2), Pythium, Phytophthora

The table on the next two pages is a summary for our lab results for many of the woody ornamental samples that we received in 2008. The pathogens were sometimes found alone and in other cases in multiples. Pathogens followed by a number indicate the number of samples with each.

Some of the most common diseases are Pythium and Fusarium root rot, usually found during the process of propagating cuttings. Dieback and anthracnose are also quite common causing leaf spots, cutting rot, dieback and blight. The organisms responsible for these diseases are *Colletotrichum*, *Glomerella*, *Phyllosticta* *(Phoma)*, *Diplodia* and a few others. Other leaf disease are more specific such as *Entomosporium* on *Raphiolepsis*, *Photinia* and ornamental pear.

One of the woody plants that we saw the most last year was Mandevilla. This crop has challenges during propagation with dieback and cutting rot caused by *Fusarium*. Anthracnose and Corynespora leaf spot also occurred occasionally (sometimes alone and sometimes in combination). The other two plants that were submitted most often were rose and rhododendron. Roses with downy mildew were common but rhododendrons had a wide range of diseases.

Plant	Diagnosis
Juniper	Phytophthora, Rhizoctonia, Cylindrocladium
Kalmia	Pythium (3), Fusarium (2), Phytophthora, Cylindrocladium
Kentia Palm	Gliocladium (2)
KnickKnick	Pythium, Phytophthora, Cylindrocladium, Fusarium
Leucodendron	Fusarium (2), Cylindrocladium (2)
Lithodora	Phytophthora, Fusarium (4), Botrytis
Loropetalum	Pythium
Magnolia	Pythium (2), Colletotrichum
Mandevilla	Pythium (5), Phytophthora (2), Fusarium (6), Colletotrichum (1), Corynespora (1), Phyllosticta (2)
Myrica	Colletotrichum
Myrtle	Phyllosticta
Nandina	Glomerella, Xanthomonas (2), Fusarium
Omphalodes	Fusarium, Rhizoctonia, Pythium (2)
Osmanthus	Colletotrichum
Palm	Pythium, Fusarium (3), Cylindrocladium, Phytophthora, Gliocladium (2)
Passiflora	Fusarium
Photinia	Pythium, Fusarium (2), Phyllosticta
Physocarpus	Powdery mildew
Picea	Pythium, Fusarium, Pestalotia
Pieris	Fusarium
Pittosporum	Diplodia (2), Cylindrocladium, Phyllosticta, Pythium (2)
Podocarpus	Fusarium, Botryosphaeria
Prunus	Xanthomonas (2), Pseudomonas, Fusarium
Pyrus	Entomosporium, Botryosphaeria, Phyllosticta, Pythium, Fusarium
Raphiolepis	Entomosporium (3), Fusarium, Pythium, Cylindrocladium, Botryosphaeria
Redwood	Phytophthora (2), Botryosphaeria (2), Pythium, Cylindrocladium
Rhamnus	Fusarium, Phyllosticta
Rhododendron	Pythium (6), Cylindrocladium, Botryosphaeria (2), Fusarium (4), Diplodia, Cercospora (2)
Ribes	Cephalosporium
Rose	Downy mildew (4), Pythium (3), Agrobacterium
Rosemary	Pythium (2), Phytophthora (2), Rhizoctonia
Star jasmine	Phyllosticta
Thuja	Pythium, Pestalotiopsis
Viburnum	Pythium, Fusarium
Vinca minor	Phyllosticta (3), Pythium (2), Fusarium
Waxflower	Phytophthora (2), Cylindrocladium (3), Powdery mildew

KILLING PATHOGENS ON GREENHOUSE SURFACES

The need to recycle materials in our industry has continued to increase rapidly over the past five years. This is the right choice for many in this green era as well as being more sustainable by decreasing material costs. We often need to reuse flats and pots. Some fungi, like that causing black root rot, can live on greenhouse benches for up to 7 months and in peat debris on or under benches.

Almost 6 years ago, Dr. Colleen Warfield (currently a University of California Farm Advisor) performed some research in the effects of some common disinfestants on flat contamination. The products included GreenShield (a quaternary ammonium), ZeroTol (peroxy acetic acid) and commercial bleach (sodium hypochlorite) on residual contamination of flats with the organism that causes black root rot—*Thielaviopsis basicola*. The research results are shown in the table to the right.

Treatment	Pre-wash	Application method	% control
None	no	—-	0
None	yes	—-	29
ZeroTol 0.5 oz/gal	no	spray	0
ZeroTol 0.5 oz/gal	yes	spray	77
ZeroTol 2.5 oz/gal	no	spray	100
ZeroTol 2.5 oz/gal	yes	spray	100
GreenShield 1 tbsp/gal	no	10 min dip	29
GreenShield 1 tbsp/gal	yes	10 min dip	98
GreenShield 1 tbsp/gal	no	20 min dip	85
GreenShield 1 tbsp/gal	yes	20 min dip	98
Bleach 10%	no	10 min dip	100
Bleach 10%	yes	10 min dip	100

Washing the flats before treatment was clearly better in most cases regardless of the disinfestant treatment that followed. The lower rate of ZeroTol was ineffective when flats were not pre-washed but the higher rate (2%) was 100% effective with or without washing. GreenShield was more effective when the dip time was doubled and flats were not pre-washed but equally effective (98%) with pre-washing at both dip times. Finally, a 10% bleach dip for 10 minutes was 100% effective with or without washing.

Dr. Warren Copes (currently, USDA/ARS, Poplarville, MS) and Floyd Hendrix also tested ability of disinfestants to kill *T.basicola* on a variety of surfaces. Quaternary ammonium provided limited control on ground fabric, pressure-treated wood and stainless steel (table below, left). In contrast, a 10% bleach solution was 100% effective on stainless steel but the concentration was raised to 20% before control was achieved on ground fabric and pressure treated wood. These results show that the concentration of the disinfestant which delivers effective control is dependent on the surface being treated.

Percent Control *Thielaviopsis basciola*			
Treatment	Plastic	Wood	Metal
Bleach (10%)	93	87	100
Bleach (20%)	100	95	100
Quaternary ammonium	6	2	2

In 2004, Copes also reported on trials he conducted to kill *Botrytis cinerea* conidia on various common greenhouse surfaces. Six disinfestants including ZeroTol, GreenShield and bleach were tested. The surfaces tested included galvanized metal, stainless steel, polyethylene ground fabric, polyethylene pot plastic, pressure-treated pine, painted pine and raw pine. As would be expected the hardest surfaces to clean were the rough textured ones such as raw pine and ground fabric. The easiest to clean were those with very slick surfaces including the painted wood and stainless steel. It was less predictable that the efficacy of ZeroTol was less affected by the surface treated than either bleach or GreenShield. While disinfestants labels do not usually list different use rates depending on the surface to be treated, the research suggests that it is an important consideration. This work was conducted using clean surfaces with additional work planned for slightly contaminated surfaces in the future.

WATCH FOR THESE PERENNIAL PATHOGENS NOW

A-*Campanula barbarata* with Pythium root rot

B-Fusarium crown rot on Dianthus

C-Botrytis mummy on Ranunculus

D-Fusarium bulb rot on Calla

E-Fusarium crown rot on Gerber daisy

F-White rust on mum

Pre-harvest fungicides for post-harvest diseases—I recently saw a research article on use of Pageant (Pristine for apples) as a preharvest spray to control post-harvest rot of apples (Xiao and Boal, Plant Disease (2009) 93:185-193). The fungicide is a combination of pyraclostrobin (strobilurin in Insignia) and boscalid (not available on ornamentals as a stand-alone fungicide). The research suggested that using fungicides during crop production or right before harvest might help control post-harvest losses from Botrytis and Penicillium. Their results indicated that a spray within 2 weeks of harvest was an effective treatment for these pathogens. This may be an important consideration for cut foliage and cut flower growers who have losses during shipping or storage due to Botrytis. It is also possible that use on perennials and woody plants going into vernalization or over-wintering might benefit from a treatment with Pageant. We are planning a test on Hydrangeas for control of Botrytis storage rot.

Pageant for Bellis rust—We are seeing more Bellis rust this winter so we did a trial of Pageant using 5 weekly sprays at 4 oz/100 gal. There was an average of 9 pustules per plant when the trial started. At the end of the trial, there was an average of 65 pustules per plant on the untreated control and only 2 pustules per plant on those treated with Pageant. Cleary this fungicide is an excellent choice for rust.

SOME PERENNIALS WITH MYROTHECIUM PROBLEMS
VERONICA
SALVIA
VIOLA
LAMIUM
SCABIOSA
MONARDA
SEDUM
CAMPANULA
LOBELIA
PENSTEMON

Controlling soft rot on calla lilies—One of the hardest diseases to control is Erwinia soft rot. This pathogen attacks many plants but is especially difficult when found on bulbs, corms or tubers. Since use of bactericides is usually not as effective as we would like, I reviewed some research on the effects of nutrition on soft rot. One study on potato found that increasing the calcium content decreased Erwinia soft rot. In callas, increasing phosphorus increased soft rot. Other suggestions for soft rot control include:

Clean calla bulb

1. Do not allow plants to wilt—stressed root are more susceptible to Erwinia.

2. Do not allow water-logging (avoid stress).

3. Avoid any bulb damage—wounds allow Erwinia to enter.

4. Soaking bulbs with Captan, bleach or streptomycin showed some efficacy. (Check labels for legal uses of all products)

5. Dips (5 min) with copper products were more effective than dips with quaternary ammonium products. Some growers report control in pot culture with a bulb spray containing copper.

6. Cure bulbs thoroughly before planting.

COLLECTING A WATER SAMPLE FOR PATHOGEN ANALYSIS

1. **Collect a total of one liter of water in small batches (100-200 ml) over a fifteen minute period.**
2. **Take a 250 ml (16 oz) sample from the larger volume making sure it is well stirred before.**
3. **Keep water samples in the dark (wrap with foil) and in a cooler to protect them from heat that could promote reproduction of any water molds (*Pythium* and *Phytophthora*) or in extreme cases destroy spores.**
4. **Try to take the sample early in the day that it is to be shipped—use overnight shipping only. If you cannot ship the same day, then keep water in a refrigerator until shipping.**

Contact Us:
www.chasehorticulturalresearch.com or
archase@chaseresearch.net.

Chase Horticultural Research, Inc.
Education for Horticulture