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256. Treating irrigation water: these water treatment methods can be effective at eliminating damaging water molds in nurseries. Parke, J. and Fisher, P. Digger 56(2):41-45. 2012.

Treating irrigation water

These water treatment methods can be effective at eliminating damaging water molds in nurseries

Water storage ponds, such as this one located at Fisher Farms in Gaston, Ore., are common to the nursery industry. It's important that nurseries treat recovered water before using it again for irrigation.

By Jennifer Parke and Paul Fisher

Nursery and greenhouse growers commonly capture runoff water and reuse it for irrigation. This conserves water and prevents the escape of nutrients and pesticides into waterways.

However, reservoirs also provide a habitat for waterborne plant pathogens. The most serious of these are the water molds, which look like fungi but require water to complete their life cycles.

The most common water molds are *Pythium* species, which cause damping-off of seedlings and stem cutting rots, and *Phytophthora* species, which cause root rot, shoot dieback and foliar blight on a wide range of nursery plants.

Unless recycled water is disinfested before reuse, irrigation water may become an effective delivery system for these plant pathogens.

Water sources

Extensive sampling in nurseries indicates that surface water sources such as rivers, ponds, and reservoirs for storing runoff water are almost always contaminated with *Phytophthora* and *Pythium* species and should be disinfested before use in irrigation.

Only water from municipal sources and well water are free of these plant pathogens. You should assume that recirculated water is contaminated and disinfest it on a routine basis, or you can test your water at frequent (monthly) intervals and treat only if needed.

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A nursery technician prepares a leaf bait for an ELISA test to determine the presence of *Phytophthora* and *Pythium* pathogens in irrigation water.

Testing your water for *Pythium* and *Phytophthora*

You can test for the presence of *Pythium* and *Phytophthora* by baiting water with rhododendron leaves for seven days and then testing the leaves with field diagnostic ELISA kits. Details for baiting water samples are available here: http://www.aphis.usda.gov/plant_health/plant_pest_info/pram/downloads/rCNPv1/rncp-appendix7.pdf

ELISA kits use monoclonal or polyclonal antibodies to detect the pathogens, the same technology used in home pregnancy kits. Kits are available as dipsticks such as the ImmunoStrip® (Agdia®), or as lateral flow devices such as the Alert LF™ (Neogen Europe Ltd.).

Note that currently available ELISA tests for *Phytophthora* cross-react with several *Pythium* species, potentially leading to false positives. For this reason, the ELISA tests are best used to rule out the presence of *Phytophthora* species. If the *Phytophthora* test is positive, further testing by a university extension plant pathology lab is advised to make sure that *Phytophthora ramorum* is not present.

Water disinfestation methods

Several methods are available for effectively disinfesting irrigation water. These methods are summarized in a two-page table available for download from the Oregon Association of Nurseries website at www.bit.ly/oansystems. A summary of research on efficacy tests for different treatment technologies to control waterborne pathogens is available at www.watereducationalliance.org by selecting "grower tools" and "waterborne solutions."

Water treatment systems differ in installation costs, operating costs, mode of action, space requirements, water volume treated, worker safety, and environmental concerns. No single system is best for all nurseries. A combination of filtration with chemical or ecological treatments is often needed.

Suspended solids (such as soil and organic matter) in the water reduce the effectiveness of disinfestation treatments. Total suspended solids should ideally be less than 20 mg/L. Higher amounts of suspended solids increase the risk of plugging emitters that can interfere with water disinfestation treatments.

For example, chlorine is deactivated by organic materials in the water. Pre-filtration is usually required to remove these materials (remnants of potting media, algae and plant debris) from the water. Effective UV treatment of water to kill waterborne pathogens also requires the water to be clear. For these reasons, filtration is often the initial step in various water treatment systems.

Water chemistry also affects the effectiveness of several disinfestation treatments. For example, the sanitizing activity of chlorine is strongly dependent on pH. For water amended with either calcium hypochlorite or sodium hypochlorite, the optimal pH range is 6.0-7.5. Above pH 7.5, the chlorine would be in the form of hypochlorite, a weak sanitizer. Below pH 7.5, chlorine would be in the form of hypochlorous acid and is 20 to 30 times as effective as hypochlorite.

Copper ionization or copper sulfate is also more effective below pH 7. If electrical conductivity EC is low (<0.20 mS/cm) then it may be necessary

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Learn more

An excellent source for learning more about water treatment methods is the educational resource section of the Water Education Alliance for Horticulture website (www.watereducationalliance.org). The Alliance is a collaborative program between the University of Florida, other researchers and industry partners, that educates growers about water quality and conservation. At the website growers can find key articles and videos about water treatment technologies and monitoring, interactive grower tools and current and previous newsletters. You can also register for upcoming webinars and workshops.

to increase the electrode surface area when ionizing copper.

Runoff source and placement of the pump inlet in the reservoir

A recent study in a Virginia nursery showed that baiting of *Phytophthora* species declined with increasing distance from the source of water run-off into the reservoir. This suggests that the irrigation pump inlet should be placed as far away as possible from the source of runoff.

Bait colonization tended to be greatest when baits were at the water surface or near the bottom of the reservoir, suggesting that placement of the pump inlet at half the depth of the reservoir would result in the least uptake of *Phytophthora*.

The study can be downloaded at http://onlinelibrary.wiley.com/doi/10.1111/j.1439-0434.2011.01831.x/full.

Types of water treatment

The various water treatment systems disinfest water by different modes of action:

Oxidizing agents react with chemical groups on organic matter, changing the chemical structure of this material. Organic matter includes peat, algae, bacteria, plant debris, and pathogens. Pathogens are killed after exposure to the oxidizing agent if it is present at a certain concentration and duration. The oxidizing agent, however, can be depleted by organic matter in the water. That is why water should be pre-filtered before it is treated with oxidizing agents. Oxidizing agents also react with iron and other metals. Oxidizing agents include bromine, chlorine gas, sodium hypochlorite, calcium hypochlorite, chlorine dioxide, ozone, and activated peroxygen.

Ultraviolet (UV) radiation involves exposure of the water in tubular chambers to UV light, which kills living cells (including pathogens) by disrupting their DNA. Particulates in the water disperse the light, reducing the effectiveness of UV radiation. Pre-filtration of the water is necessary.

Copper ionization is the release of copper ions into the water resulting from an electrical charge passed between copper plates. Copper ions are toxic to most pathogens and plants, but the levels used to treat water are well below those which cause phytotoxicity. Copper is also sometimes delivered as a dissolved salt, such as copper sulfate.

Heat treatment is another method of disinfesting water, but it is energy intensive and therefore too costly for treating large volumes. A temperature of 203°F for 30 seconds is sufficient to kill most plant pathogens.

Slow sand filtration is a low technology approach for disinfesting water that has been extremely effective in eliminating *Phytophthora* from recirculating water in commercial nurseries in

Germany www.plantmanagementnetwork.org/pub/php/research/2008/recycle. A biofilm crust, or *Schmutzdecke*, develops on the surface of the sand filter. While this layer is important for the functioning of the filter, it must be maintained or the filter can become clogged. Slow sand filtration may not be rapid enough to supply the volume of water during periods of peak demand, requiring filtration and then storage of the clean water in a reservoir.

Summary

Growers can minimize their risk of exposure to plant diseases and reduce pesticide use by ensuring that their irrigation water is free of *Pythium* and *Phytophthora* species. Several different disinfestation methods, including high technology and low technology solutions, are available for use by greenhouse and nursery operations of all sizes.

Disclaimer

Chemical names and trade names are included as a convenience to the reader. Their use in this publication does not imply endorsement, nor discrimination against similar products or services not mentioned. Individuals who use chemicals are responsible for ensuring that the intended use complies with current regulations and conforms to the product label. Be sure to obtain current information about usage and examine a current product label before applying any chemical. For assistance, contact your state pesticide regulating authority.

Dr. Jennifer Parke is an associate professor (senior research) at Oregon State University in Corvallis where she conducts research on Phytophthora species in nurseries. She can be reached at Jennifer.Parke@oregonstate.edu.
Dr. Paul Fisher is an associate professor and extension specialist in the Environmental Horticulture Department at the University of Florida in Gainesville. He can be reached at pfisher@ufl.edu.