From Forest Nursery Notes, Summer 2009

205. Upgrade your irrigation system. Fisher, P. and Wick, R. Greenhouse Management and Production 29(3):16, 18-20. 2009.

Upgrade your irrigation system

Determine your priorities, evaluate overall sanitation, describe and monitor your existing system before choosing water treatment technologies.

By Paul Fisher and Robert Wick

When it comes to water treatment, there are many options, which can make your choice confusing. You can potentially spend a lot of money up front or over time without reaching the desired outcome.

When choosing a specific water treatment method, you should first plan out a water treatment and sanitation system, rather than focusing on an individual technology. Determine your priorities, evaluate overall sanitation, monitor your existing system, and only then choose which technologies best fit your needs.

Determine objectives, priorities

What problems do you want to address with your water treatment system? If you don't know what you want to achieve, a salesperson might make that decision for you. You should specifically answer these questions:

- Which diseases do you want to control?
- How important is algae control?
- Are regulations forcing you to eliminate or reduce runoff?
- Are there priority crops where the highest water quality is needed?

Check list to determine your need for a water treatment system. The more questions you answer with a "YES", the greater the need for water treatment.

	YES	NO
Are you are recycling or plan to recycle irrigation water (enhancing pathogen dispersal)?		
Is your water source a surface pond, river or lake (more likely to be contaminated with pathogens or algae than well or municipal water sources)?	○	○
Are your plants subirrigated (enhancing pathogen dispersal from one container to another especially if water is reused)?	○	○
Are you propagating cuttings or plugs (these are disease-sensitive crops with a high moisture level requirement)?	○	○
Is there an existing disease problem that can be spread by the irrigation system to other crops (corrective action is needed)?	○	○
Is there excess algae on greenhouse surfaces (suppression of algae is needed)?	○	○

This series is part of the Water Education Alliance for Horticulture initiative (www.watereducationalliance.org) supported by AquaHort by LHT, AquaPulse Systems, BioSafe Systems, Chem Fresh Inc., Ellegaard, Fafard, Fischer Ecoworks, Greencare Fertilizers, Griffin Greenhouse and Nursery Supplies, Hanna Instruments, Konjoian's Floriculture Education Services, National Foliage Foundation, Pindstrup, PPG Industries, Premier Horticulture, Pulse Instruments, Quality Analytical Laboratories, Regal Chlorinators, Sun Gro Horticulture, TrueLeaf/Aerotech, University of Florida, Whitmire Micro-Gen and the Young Plant Research Center partners (http://hort.ifas.ufl.edu/yprc). We thank the National Foliage Foundation and Florida Nursery, Growers & Landscape Association for supporting water research at the University of Florida.

Water treatment and sanitation

An irrigation system can distribute spores and other life stages of pathogens and algae from plant to plant. Some pathogens and algae can also grow and multiply on the surfaces of tanks and pipes or in the water they contain. However, the irrigation system is only one source of contamination. Many growers have successfully subirrigated poinsettia crops or mist-propagated cuttings without disease issues by applying water as needed and practicing integrated pest management sanitation practices.

The disease triangle

The disease triangle underlies management of disease pathogens. The pathogen must be introduced from some source, the environment must be favor-

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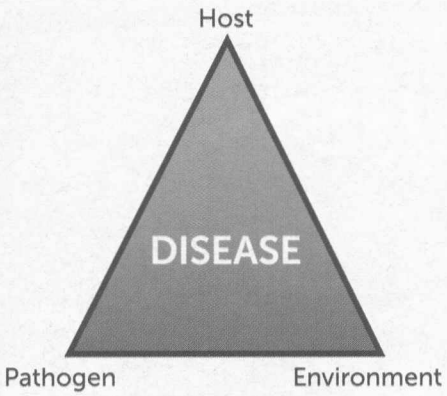
able for its development and a host crop must be present.

If an existing disease problem is present, do not jump to the conclusion that



a water treatment technology is needed. Work with a plant pathologist to identify the source of the pathogen. The source could be plant material, reused containers, contaminated surfaces, insect vectors, dripping water from overhead baskets, growing medium (especially if it is reused), or the irrigation water.

What aspects of the production environment can be improved that would address the disease triangle? For example, is a Pythium root problem in a poinsettia crop primarily caused by overwatering or should the growing medium be changed to one that has a greater porosity? If overwatering occurs and the cuttings are contaminated, then all points in the disease triangle may still be favorable for *Pythium* even if the spores in the irrigation water are killed.

Map water flow and treatment

On graph paper, make a diagram of how irrigation water flows through the greenhouse, with placement and specifics of tanks, filters and treatment systems, including acidification. Water treatment system vendors need technical information about pipe lengths, diameters and flow rates to correctly size equipment. There have been cases where copper or ozone treatment systems were undersized for the volume of water in flood floors.

The irrigation map should identify points where contamination may occur in the system, including the water source, mixing of return and fresh water, biofilm in pipes, organic material in collection tanks, on the floor and bench surfaces, and plant material.

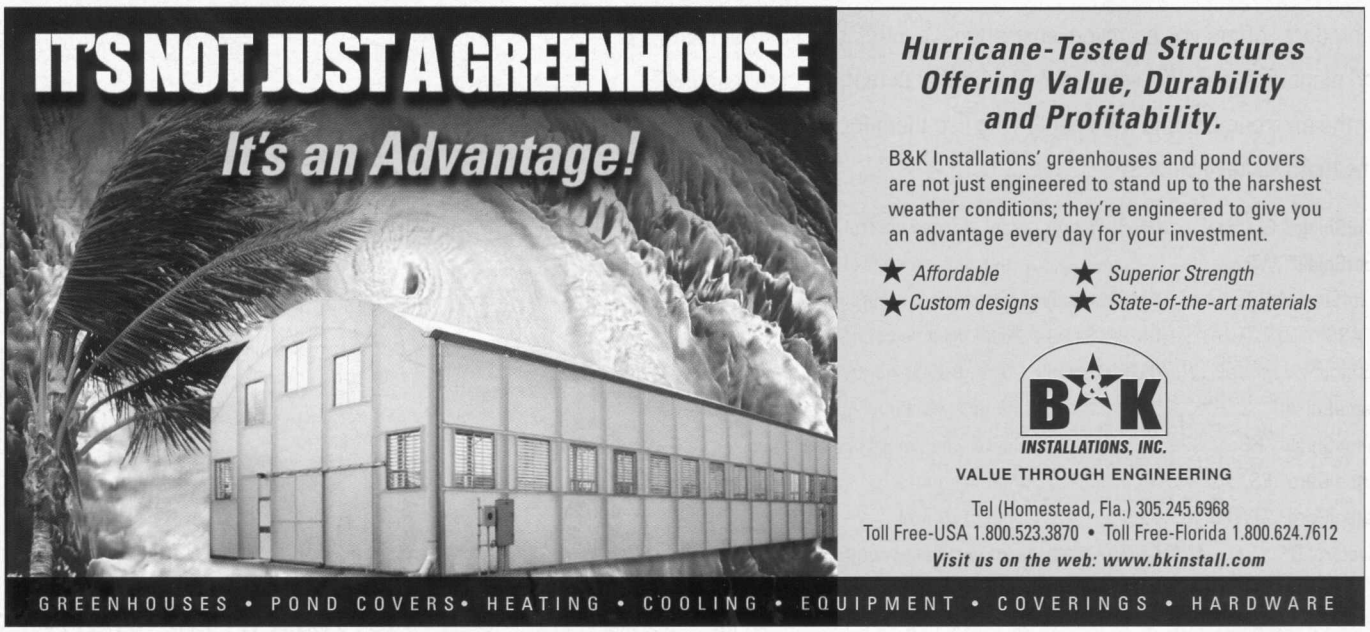
In some cases, changing the water flow can solve an existing waterborne disease issue. A tropical plant propagator was subirrigating liners from a tank that mixed fresh well water with return water from the crop. A problem with the waterborne fungal pathogen *Ceratocystis fimbriata*, which attacks syngonium plants, was addressed by adding a second tank that never received recirculated water. Only clean well water from the second tank was applied to the most disease-sensitive crops.

Sketching out a new system

If you are building a new facility, there is more flexibility available for the irrigation system. Make sure there are no dead zones in the plumbing that cannot be flushed out, which is a common problem in older flood floor systems.

If a complete system is being designed, some of the components that may be included are:

- Piping of different water qualities for low and high priority crops.
- A technology to sanitize recycled water. This typically involves filtration and a loop where portions of the return water are circulated through a residual or a point treatment such as ozone or ultraviolet light.
- A shock treatment, such as chlorine dioxide or activated peroxygen, for tanks and pipes.
- A surface treatment, such as a quaternary ammonium chloride product, for greenhouse floors and benches.



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• A monitoring and control system for chemical, physical and biological aspects of water quality to ensure application of a safe and adequate level of sanitizing agent and adequate control of pathogens. This can include inline monitoring, onsite test kits and laboratory analyses.

• A chemical treatment (i.e., copper or chlorine) with residual activity for controlling pathogens and algae as water flows through irrigation pipes.

Monitor water quality

Three aspects of water quality affect crop quality and treatment options. Monitoring each of these provides a baseline and assists in engineering a new system. Make sure to follow laboratory guidelines when collecting and sending water samples to provide representative data.

Chemical water quality. Submit a sample from each water source to a lab for analysis of pH, alkalinity, electrical conductivity, nutrients and other salts (iron, aluminum, sodium and chlorine). All water treatment technologies are affected to some extent by water chemistry. A water pH higher than 7.5 reduces efficacy of chlorine.

Physical water quality. Ask the lab to measure suspended solids and turbidity of water samples. The amount of suspended solids and organic matter in the water indicate how much additional filtration is required. It is also useful to note mesh sizes on existing filters, and how much sediment accumulates in places such as return tanks over time, and how often filters need to be cleaned. Turbidity affects light transmission, which is important for ultraviolet light treatment.

Biological water quality. Submit water samples from up to five different points in the irrigation system, including the water source(s), before and after existing water treatments, the outlet that is furthest from the water source, and the return tank or pond.

There are several biological tests that can be performed. At a minimum, request a presence/absence agar plate test of *Pythium*, *Phytophthora*, *Rhizoctonia* and *Fusarium* to the genus level (cost around $50-$150 per sample).

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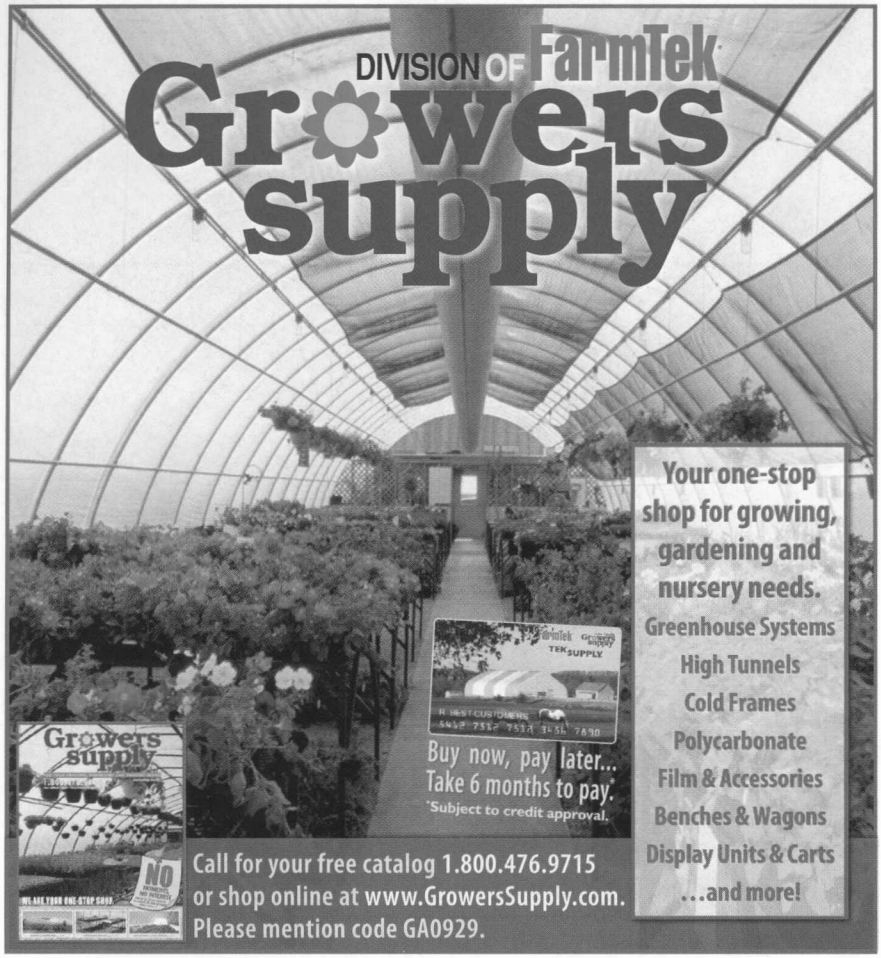

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If tests indicate positive for a potential pathogen, there are more detailed biological tests that can identify to the species level, but these are more expensive and mostly useful when a disease issue is showing up on a crop. These tests can help confirm where disease contamination is occurring in the irrigation system. One challenge with biological water tests is that they are highly variable, and sampling over time is therefore preferred.

Another test for indicating biofilm build-up is a plate count for bacteria, fungus and algae measured in colony forming units per volume of water.

Get advice

Water treatment is a specialist area, and it is worth consulting a range of technical sources. Consulting with irrigation engineers, other growers and university researchers may be helpful, in addition to communicating with vendors that represent different treatment technologies. A systems approach is required, many of the chemicals have some safety issues for workers and crops, there are regulatory restrictions, and each application needs to be individually engineered. This is rarely a case where a home-made solution is best. Visit the Water Education Alliance for Horticulture Web site (www.wateredu cationalliance.org) to learn the latest information on water treatment, including upcoming workshops.

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