GROWERTALKS

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Troubled Waters?

Ratus Fischer

Subirrigation has a track record as a relatively safe method of irrigation, but the USDA's Action Plan has muddied the water

Common sense says reusing irrigation water can be dangerous. And numerous published Ralstonia alerts have suggested avoiding subirrigation if you're growing geraniums. Yet a lot of growers *do* recirculate their irrigation water, having few, if any, problems. So what are the facts? Is subirrigation inherently prone to spreading diseases? Or does it depend on the design of the system and how it's used?

The nature of pathogen movement in water

Whenever irrigation water is collected and reused, there's the potential of pathogens getting into the water and spreading to other plants. Of most concern are fungal diseases, such as Pythium and Phytophthora, with actively swimming zoospores; Thielaviopsis; Rhizoctonia; and bacterial blights such as Xanthomonas and Ralstonia. On subirrigation systems, the same water touches many pots, which could cause cross contamination.

The emphasis is on "potential" and "could." In North America, hundreds of acres of greenhouses are using recirculating irrigation systems. Yet there are few confirmed reports of diseases spreading through recirculated water. Why does it rarely happen?

First, the pathogen has to get from the diseased plant into the water by leaching from the soil, or by diseased plant tissue falling into the water. When watering from the top with drippers, as is common in recirculating vegetable-growing operations, the leaching water travels through the growing medium. There's a good chance it will pick up fungus spores, bacteria or nematodes on its way. That's why leached water needs to be treated thoroughly before reuse. This is common practice and makes economic sense, thanks to the relatively small volumes of return water.

Capillary mats are a type of subirrigation. Because of the long watering times and low volumes of return water, they require water treatment similar to surface watering systems.

The situation is different in flood floors, flood benches and gutter systems. In these systems, the water enters the growing containers from the bottom and is wicked up by the growing medium. If the floodwater is drained quickly while that last bit of water is still moving into the soil, we have pretty much a one-way movement. The chance of pathogens getting out into the water isn't eliminated, but it's greatly reduced—provided you don't also use overhead irrigation, such as booms.

Ebb and flood systems also use high volumes of water. Usually less than 10% of the floodwater is taken up by the plants; the other 90% returns for reuse. This high volume of water moving through the system dilutes the concentration of any pathogens that may be present. Admittedly, pathologists have proven that even a single

bacterial cell can cause infection, but again, the risk of disease spread, while not eliminated, is reduced.

A third factor is how long a pathogen will survive in water. Many disease vectors, such as Xanthomonas, don't survive for a long time in water. Dr. John Biernbaum, Michigan State University, and Dr. Harry Hoitink, The Ohio State University, among others, have concluded that transmission can occur, but it rarely does. However, warm-weather Pythium (*P. aphanidermatum*) has been shown to spread very easily through water. Ralstonia also is known to be water borne, which is one of the reasons why the USDA has taken such a hard line with ebb and flood irrigation with this pathogen.

Subirrigation: A Pathologist's View

Subirrigation is an excellent means of reducing foliar diseases in the greenhouse, because it eliminates a major source of leaf wetness. However, subirrigation systems have in some cases allowed whole-crop losses in poinsettia cuttings and geraniums when the systems became contaminated with *Phytophthora drechsleri* or *Xanthomonas pelargonii*, respectively. *Pythium aphanidermatum* has been known to cause massive losses on flood -floor grown poinsettias, as well. Yes, a well-designed subirrigation system in the hands of a grower with high sanitation standards is better than a poorly designed, poorly run system, but there remains an inherent risk of spread of the agents of many root rots and highly dangerous systemic diseases.—*Margery Daughtrey, extension specialist, Long Island Horticultural Research & Extension Center, Cornell University.*

"Safer" irrigation practices

A recirculating or closed irrigation system *could* be designed and built to be extremely safe, but few growers would want to pay the high cost for it. Most are willing to use safe management practices to minimize their risks. Here are six key design elements and best practices:

* Watering times on a "safer" subirrigation systems are short—ideally less than 10 minutes.

* The concrete or bench surfaces are smooth, to make cleaning easier and more effective.

* Debris and soil particles are filtered out of the water. Increasingly, growers are investing into extra fine filtration (150 mesh). The results: fewer particles that can carry pathogens and improved water quality due to less oxygen-consuming decomposition of organic matter.

* Probably the most important preventive tool with flood irrigation is in-floor or under-bench heat. Keeping the roots at optimum temperatures and having dry surfaces free of algae and fungus gnats go a long way toward healthy crops. However, it should be noted that roots at an optimum temperature would take up the inoculum of Ralstonia or Xanthomonas readily.

* A system should be designed with options to add additional water sanitation equipment if the need arises. Ozone, UV and heat pasteurization are the favorites.

Ozone is generated on-site from oxygen in the air that's then introduced into the water. In concentrations of around 40 grams/hour/1,000 gallons, it oxidizes and kills fungi, bacteria and viruses. Ozone will be absorbed by any organic matter in the water, so good pre-filtration is essential. Ozone travels with the water and acts throughout the irrigation system. *UV light* is effective against all pathogens. Its reliability depends on good filtration that eliminates particles shielding pathogens from the light. However, unlike ozone-treated water, UV treated water doesn't retain its sanitizing qualities.

Heat pasteurization provides the most reliable disinfection. At 203F for 30 seconds, all relevant pathogens are eliminated. Most of the heat can be recovered, keeping energy use manageable.

Smart growers

Growers have learned to apply closed watering systems where they work best. Fresh cuttings (such as unrooted geraniums) rarely are rooted in subirrigation, simply because it's easier to control the amount of water in tiny soil volumes using overhead irrigation. Once the plants are put into their final containers, they may go on subirrigation.

Growers also know the danger of overwatering in subirrigation, which can cause favorable conditions for Pythium. Growers usually apply fungicides in stock chrysanthemum and poinsettia plants where Pythium is an issue, because *P. aphanidermatum* has caused major losses in subirrigated plants.

Where needed, growers add disinfecting agents such as chlorine, hydrogen peroxide or chlorine bleach to the water. ZeroTol and Agribrom have proved effective, as well as easy and safe to apply. Some growers report success against Pythium with surfactants, such as Aquagro. Drench mats on the floor at the entrance of each greenhouse section can prevent carrying pathogens on shoes and cart wheels. Best results and cost effectiveness are achieved often by combining methods. Robert Milks, production manager for Van Wingerden International, Fletcher, North Carolina, says he is confident in his ability to prevent the establishment and spread of diseases on a wide variety of crops grown on more than 30 acres of flood floors and benches.

Ralstonia: the new risk

Cornell pathologist Margery Daughtrey says we know a lot more about Ralstonia in potatoes than in the greenhouse, and that extrapolating from the few things we know is risky and uncertain. We know, for instance, that Ralstonia bacteria are likely to survive in field ditches in association with a solanaceous weed from year to year, but we can only guess what that may mean for subirrigation systems, because no research has been done. We also know that there were no known instances of recurrence after the 1999 Ralstonia outbreak, but that doesn't mean the bacteria can't survive for extended periods in subirrigation systems.

That said, your biggest unknown—and your biggest risk—is how USDA and state agriculture officials will handle subirrigation systems in cases of disease outbreaks. You read in the previous article of a grower who was forced to dump every plant in the facility because they were irrigating from a pond that gathered runoff from the greenhouse. They are still not sure if they will use the pond again for irrigation.

If you currently use subirrigation, it's never been more important to understand how to properly manage the technology. If you're considering investing in subirrigation, talk to growers who've successfully used subirrigation for many seasons, to learn how they handle the risk of diseases.

Ralstonia may teach us some new sanitation tricks, but it won't alter the fact that subirrigation is an effective and efficient means of irrigation.

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