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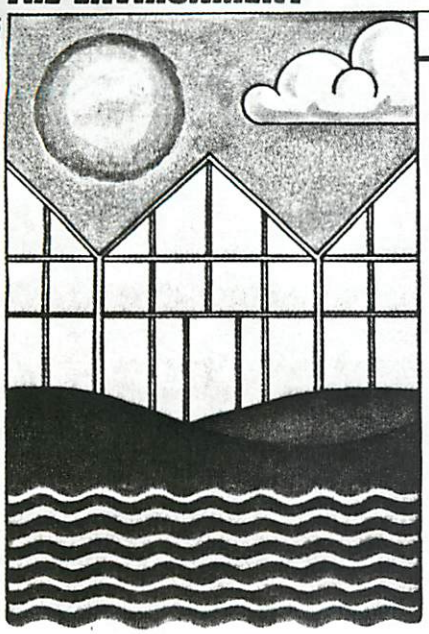
PROTECTING THE ENVIRONMENT



Transmission Of Plant Pathogens In Ebb and Flow

by V. ATMATJIDOU, R. FYNN, R. McMAHON and H. HOITINK

TO a plant pathologist, an ebb and flood system at first sight is a disaster waiting to happen. After all, when any solution is recirculated, the possibility exists that a plant pathogen could be disseminated in it.

That hasn't happened in northwestern Europe, however. Growers there have used ebb and flow for some time — without disease problems.

Diseases caused by vascular and root pathogens are much more serious in the U.S. than in northwestern Europe, regardless of the method of irrigation. Many of these pathogens, including *Fusarium* and *Pythium*, are more virulent at the higher temperatures that prevail here in the summer.

We conducted several experiments to examine the potential for transmission of *Xanthomonas campestris* and several *Pythium* species — pathogens of two diseases that we observed in a survey of ebb and flow systems in Ohio.

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Summary of Methods

For this research, we installed 24 Midwest Gro-Master ebb and flow benches with separate controls and reservoirs. The irrigation system was controlled by a Q-Com computer. Irrigation frequency varied with crop need and ranged from twice a week for newly potted rooted cuttings to twice a day on bright days for flowering plants.

We monitored the nutritional status of plants with leaf analyses and tested the pH and conductivity of the potting mix. We added nutrients of concentrations that maintained moderate fertility levels.

The following irrigation procedures were designed to reduce the potential for transmission of pathogens:

- The benches were seamless so that the surfaces could easily be sterilized between crops.
- The bench surface was divided into small areas between channels to isolate pots as much as possible and to facilitate drainage back into storage tanks.
- A filter was installed at the drain to keep plant debris out of storage tanks.
- The time period for flooding was kept short (6 minutes) to provide optimum conditions for plant growth, to reduce drainage of nutrient solution from the pots, and to prevent the

excessive moisture levels that promote root rot diseases.

Xanthomonas

Bacterial leaf spot and blight in begonias is caused by *Xanthomonas campestris* pv. *begonia*, usually transmitted by splashing water or through improper handling. While it generally affects foliage, it can also infect roots, causing a systemic infection.

We used several procedures to evaluate the potential for transmission of this bacterial blight. In one procedure, stem-inoculated plants were placed on the bench with pathogen-free plants. We wanted to determine the potential for the spread of the pathogen through the roots of inoculated plants, into the nutrient solution, to pathogen-free plants on the same bench.

In our second approach, various concentrations of the pathogen were added directly to the nutrient solution in the storage tank. This infested solution was then pumped onto the bench. We monitored survival of the pathogen in the solution and infection of plants through roots.

We inoculated the plants with a strain of *Xanthomonas* resistant to the antibiotic rifampicin to ensure that the disease observed on uninoculated plants was due to transmission instead of a naturally-occuring infection. Both experiments were repeated at least twice.

Xanthomonas was isolated from roots of stem-inoculated plants and also at a very low level from the nutrient solution in storage tanks. However, it was not recovered from control plants. There was no evidence that the pathogen was transmitted, even though it was present in the recirculating solution.

For the other experiment, low levels of *Xanthomonas* were added directly to the nutrient solution. Population levels were similar to those encountered in the first experiment and to those encountered in tanks at a grower's operation.

The pathogen was isolated from plants during postharvest incubation. After 7 weeks, 3% of the crop was infected although symptoms were observed in the foliage of only one plant. We concluded that low levels

of transmission do occur in ebb and flow systems.

We wanted to determine whether *Xanthomonas* could be transmitted from leaf to leaf through the nutrient solution containing the pathogen. Low hanging begonia leaves often are submerged in the nutrient solution on the bench during flooding. When these plants were irrigated with nutrient solution containing low levels of *Xanthomonas*, the disease did not develop, even during postharvest incubation. However, symptoms did develop when we used higher concentrations of the pathogen in the solution.

Among our other findings:

- The pathogen dies very rapidly in both clear water and nutrient solution — probably one reason it is not transmitted readily in the ebb and flow system.
- *Xanthomonas* does survive for long periods of time in dried infested leaves.

This emphasizes the importance of sanitation in ebb and flow systems. Use pathogen-free starter plants and filter the nutrient solution each time it is used. Sterilize the surface of bench tops, pumps, lines, and tanks between crops.

While *Xanthomonas* is not a significant threat to finishers of flowering begonias, it could be a problem for stock plant producers. However, if you use the solution to irrigate many benches on the same day, you could greatly increase the potential for disease transmission.

What About Nematodes?

Nematodes commonly interact with other bacterial and fungal pathogens, increasing disease severity. It is likely that they would also increase disease dissemination in ebb and flow systems.

Nematodes settle out in undisturbed water. If they entered storage reservoirs, they would probably settle on the bottom and not present a problem. Circulating nutrient solutions at low frequencies may help to avoid transmitting nematodes that increase disease problems.

However, plant to plant transmission on the bench top itself is possible — making sanitation and pathogen-free starter plants even more essential.

Pythium

Next, we examined the potential for transmission of Pythium root rot caused by both *Pythium aphanidermatum* and *Pythium ultimum*. Rooted poinsettia cuttings were potted in peat mix infested with *Pythium*, then placed on the same bench with potted rooted cuttings. Control treatments were ebb and flow benches not infested with a *Pythium* isolate and plants treated with Subdue.

P. aphanidermatum was readily transmitted from infested plants to control plants placed on the same bench. After 37 days, it had been transmitted to control plants about a yard away. *P. ultimum* was also transmitted, but much less readily.

Neither control plants grown in uninfested potting media or those treated with Subdue developed disease. This meant that the pathogen-free plants were relatively free of root rot and that the disease on plants not inoculated artificially was transmitted in the ebb and flow system.

Results of our experiments with *Pythium* confirm observations made by several growers in the U.S. and Canada using ebb and flood. *P. aphanidermatum* may be more of a problem in the U.S. than the cooler areas of northern Europe because it prefers high temperatures.

Fungicide drenches and naturally suppressive compost-amended media control Pythium root rot effectively. However, unless precautions are taken, fungus gnat and shorefly populations will increase in compost-amended media. We are exploring various ways to control this problem and provide biological control of both the diseases and the pests. **GG**

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