Phytophthora and Irrigation Water

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May 2018

Historically, Michigan producers grow over 75,000 acres of vegetables that are susceptible to the soilborne pathogen, *Phytophthora capsici*, including cucumber, zucchini, summer and winter squash, watermelon, cantaloupe, pumpkin, pepper, eggplant, tomato, and succulent bean. *Phytophthora* is favored by rain and warm temperatures and spreads readily via water. *Phytophthora* may be present in rivers, creeks, ponds, ditches and culverts. *Phytophthora* in surface water irrigation sources is likely to be greatest during July and August when the need to water crops is also the greatest.

Phytophthora may form many sporangia (spores) on the surface of the host plant following infection. If these sporangia come into contact with water, each sporangium will develop into 20 to 40 swimming zoospores. These zoospores may swim through saturated soil or may be carried in flowing water, including irrigation water. Swimming zoospores use electrical and chemical signals to find plant roots. Zoospores in water can survive and cause infection for days, even after they have ceased to swim. *Phytophthora* can thus be spread field-to-field via irrigation water and initiate epidemics on susceptible vegetables even in fields lacking a previous history of *Phytophthora*.

Phytophthora is not likely to be found in surface water when the water temperature is greater than 77°F or less than 57°F. Laboratory research has shown that infection of pickling cucumber fruits by *Phytophthora* zoospores in water may occur when water temperatures are 50-90°F, but is more likely when the water is warm (≥65°F). Since vegetable producers usually irrigate during the warm summer months, the temperature of irrigation water is unlikely to limit infection.

If more zoospores are present in the water, infection of susceptible crops is more

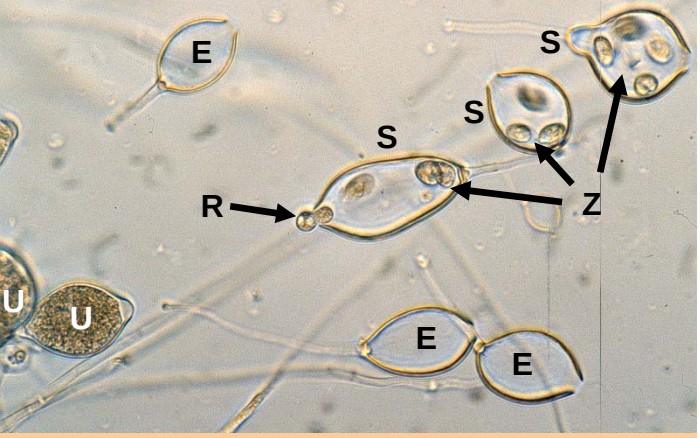
Water Management Strategies

- Avoid using surface water for irrigation
- Plant into well-drained, tiled fields
- Use raised beds and drip irrigation
- Irrigate sparingly from a well

Heavy rains caused flooding in a *Phytophthora*-infested squash field, which released swimming zoospores that infected the plants, causing death despite the use of raised beds with black plastic.

Summer squash with *Phytophthora* lesions following a heavy rain. Spores in water droplets splashed onto the fruit.

An example of a surface water source that was found to have *Phytophthora*.

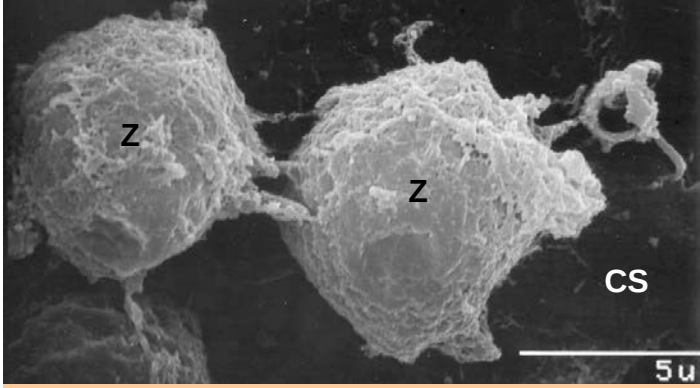


Spread of *Phytophthora capsici* in water. When immersed in water, the contents of undifferentiated sporangia (U) form swimming spores (zoospores, Z) inside the sporangia (S). The zoospores are released (R) into the water, leaving empty sporangia (E).

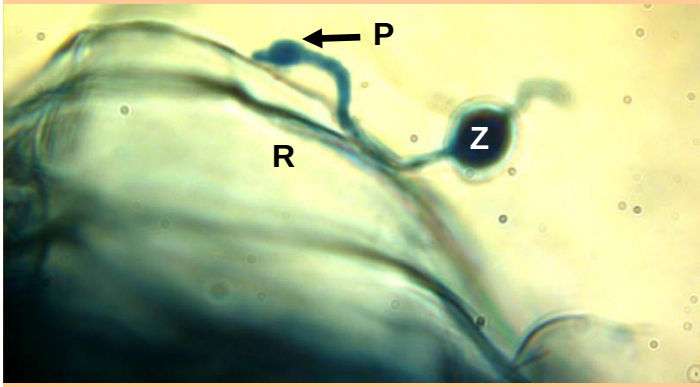
likely, even at lower water temperatures. Older zoospores could still cause infection of pickling cucumber fruits. It was discovered that the amount of infection observed once again depended on the numbers of zoospores in the water, and more fruits were infected at higher zoospore numbers. Zoospores were able to infect fruit even after being in water for 5 days, especially if high numbers of zoospores were present. Thus, zoospores can survive in water for days and still cause infection of susceptible hosts. Well water or water from well-fed ponds should be used to irrigate susceptible crops since *Phytophthora* can travel in surface runoff from infested fields into rivers, creeks, ponds, ditches and culverts.

Managing water in the field is key to managing *Phytophthora*, and drip irrigation systems are recommended to reduce splashing of infested soil onto fruit. If overhead irrigation must be used, reduced watering during fruiting may limit fruit infection.

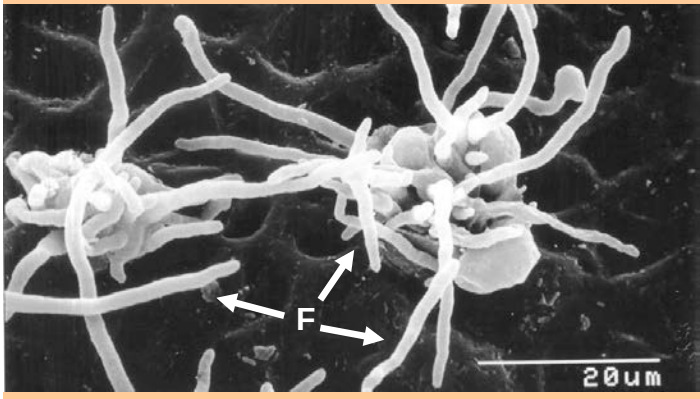
While treatment options for disinfesting surface water sources are not currently available, MSU research found that algaecides work well in the laboratory setting to kill zoospores in water. Researchers in Virginia found that chlorine effectively killed zoospores in the lab



Zoospores (Z) attach to a cucumber surface (CS) using a sticky matrix.



A zoospore (Z) that has germinated on and penetrated (P) into a pepper root (R).



Once infection is established, fungal strands (F) grow out of the host to form more sporangia.

setting. These products have the added advantage that they are already used to clear algal growth from filter intakes and irrigation lines. Future work in this area may yield options for vegetable producers to treat surface water sources so that they may be safely used for irrigation.

This material is based upon work that is supported by the National Institute of Food and Agriculture, U.S. Department of Agriculture, under award number 2015-51181-24285.