RUTGERS
New Jersey Agricultural Experiment Station

Bacterial Canker of Tomato

The Disease

Bacterial canker, caused by *Clavibacter michiganense* subsp. *michiganense* (*Cmm*), is a serious pathogen of tomatoes wherever they are grown, and is currently increasing in occurrence and severity in the northeastern United States. Within the past five years, bacterial canker has become a major problem in tomato production throughout New Jersey. For many New Jersey tomato growers, bacterial canker is presently the most serious disease in the production system. Losses when bacterial canker is present in a tomato planting can vary from none (minimal foliar injury) to total (systemic infections), and are dependent on source of the infection, weather conditions and cultural practices.

Symptoms

Bacterial canker is often first seen as dark, necrotic lesions at the margins of older leaves. This necrosis is the result of bacteria gaining entry into the leaves via the hydathodes. As the bacteria multiply on leaf surfaces and plant growth progresses, small, raised white blisters often occur on young green fruit. This type of lesion is known as a "bird's-eye" spot, and is characteristic of bacterial canker.

Marginal necrosis on leaf

Bird's eye lesions occur on fruit that were infected just after pollination. Fruit that avoid this early exposure to the pathogen do not develop lesions even if exposed later. As affected fruit mature and become red, the blisters remain yellowish, making the fruit unmarketable. When plants are infected after some time in the field (such as after a second tying), often the symptoms are confined to foliar and fruit lesions, resulting in minimal crop loss.

Fruit lesions on green fruit (*left*) and red fruit

When plants become infected earlier (such as during transplant production) or through significant wounding, the infection may be systemic, affecting the vascular tissue. Under these circumstances, entire branches or even whole plants wilt and die. This type of infection can result in significant yield loss as plants do not reach full potential.

Plant showing cankered branches

Pathogen Survival and Spread

Horsenettle (*top*), and tomato debris

Infected seed is commonly named as the source of bacterial canker infections, and plants that are systemically infected with *Cmm* will produce seed that may contain the bacteria both on and within the seed coat. *Cmm* has, however been detected on living and dead plant material in canker infected fields, and *Cmm* cells are reported to survive on tomato debris (including seed) for up to 5 years if the debris is undecomposed. Survival is influenced by the depth to which the inoculum is buried, and the degree to which infested debris breaks down. *Cmm* will survive for relatively short periods of time in soil without solid debris.

Cmm can survive for up to a year on infested tomato stakes, and presumably on greenhouse benches and plant debris within the greenhouse. Perennial solanaceous weeds like horsenettle may serve as overwintering hosts, and *Cmm* has been isolated from roots of this weed growing in fields without tomatoes for up to 2 years. Debris from annual solanaceous

weeds like our nightshades may harbor *Cmm* through the winter as well. Additionally, solanaceous weeds serve as asymptomatic hosts on which the pathogen can multiply during the course of a growing season.

A common and serious means of dissemination is through transplant production. In this case, even low numbers of infected seed can result in widespread infections, as seedlings are in close proximity to one another and are handled frequently. Seedlings are also at risk for infection if tools, benches, etc. have not been cleaned properly, or there are potentially infected weed hosts or debris present in the greenhouse. Infected seedlings then are put into the field, where the infection becomes severe. In-field infections can originate from infected tomato plants, infected weeds, or infested debris and stakes. Once individual or groups of plants are infected, dissemination through the field is aided by cultural practices that injure the plants including tying, pruning, and harvesting as well as wind driven rain. Even injury as slight as breaking of the hairs (trichomes) on leaves and stems has been implicated disease spread. Infections are difficult to contain once they appear in a planting. The extent of the damage is largely related to the timing and method of initial of infection.

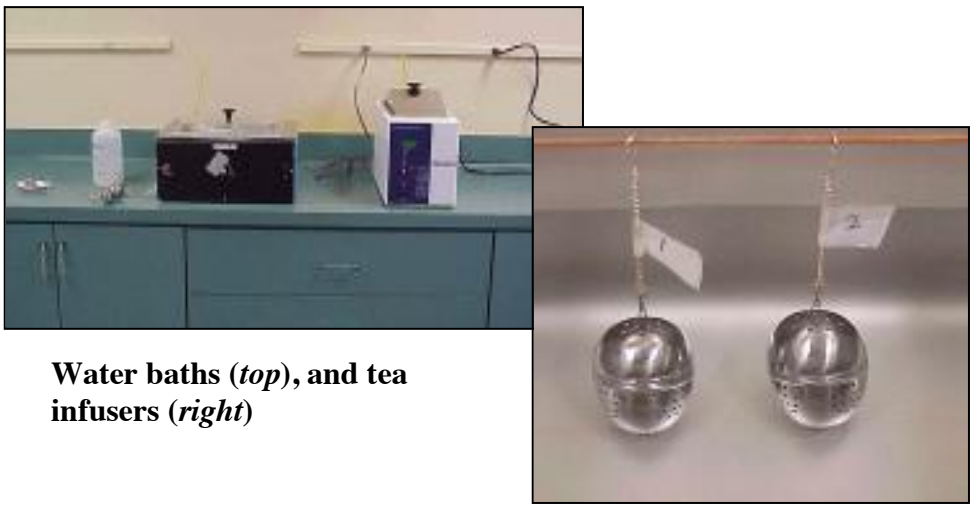
Tomato seedlings on greenhouse floor

Management Strategies

Start with pathogen free seed.

Because a field wide bacterial canker infestation can develop from a very low number of infected seeds, it is advisable to handle all seed lots as if they were infected. Avoid pelletized seed, as this is difficult to treat. **For best results, heat-treat seeds** using the following protocol provided by Dr. Sally Miller at Ohio State Univ.:

> *Place seed in a tea infuser or loose mesh cloth bag (less than one half full) and place in a 100° F water bath for 10 minutes. After 10 minutes, immediately remove the seed from the bath and place them in a second water bath set at 122° F for 25 minutes. Thermostatically controlled water baths are best for this procedure as they are more precise and eliminate the need to watch them constantly.*



Water baths (*top*), and tea infusers (*right*)

After the 25 minute heat treatment, remove the seeds and rinse thoroughly in cool tap water. Then spread the seeds in a single layer on screen to dry. Prior to planting, the seeds should be re-treated with fungicide as per the growers' preference, as the supplier applied seed treatment will have been washed off during the heat treatment. If you purchase transplants, ask the producer if the seed was heat treated.

Transplant greenhouse preparation.

Use new flats, trays and pots. If re-using these containers, treat them in a chlorine bleach soak consisting of 5 gallons of 5.25% sodium hypochlorite per 100 gallons of solution. **Treat all benches and greenhouse surfaces with a commercial sanitizer** such as Greenshield, Physan, or Prevent. Eliminate all weeds from the greenhouse, as they may serve as hosts for some pathogens.

Treat seedling flats (*left*), and greenhouse benches prior to use.

Pathogen management during transplant production.

Try to maintain enough separation among flats that splashing between varieties is minimized when watering. This will help prevent spread among varieties should bacterial pathogens be present. **Apply streptomycin** at a rate of 1.25 tsp. per gallon beginning at the first true leaf stage, and again at 4-5 day intervals until transplanting. If transplants are purchased, ask the producer about their disease management practices.

Field rotation and management.

Maintain a 3-year minimum rotation on tomato fields. After a tomato crop is finished, remove plastic mulch and stakes (if used) and completely **incorporate all plant material into the soil** as completely as possible during the current season. This may entail mold-board plowing. This practice will help insure complete decomposition of debris, making it more difficult for the pathogen to survive long periods.

Plow to incorporate crop residue from current season.

Eliminate all solanaceous weeds like nightshades and horse nettles from the field, as they are alternate hosts for *Cmm*. If they appear during the season, consider hand applications of glyphosate or paraquat to prevent prolonged survival.

Herbicide application to prevent potential weed hosts between beds.

Use new stakes, or if re-using old ones, wash them to completely remove soil and sterilize them. This is done by submerging the stakes in a solution consisting of 5 gallons of 5.25% sodium hypochlorite per 100 gallons of solution, plus a surfactant to help gain penetration into the wood surface. If heat treatment of stakes is feasible, make sure the internal temperature of bundled stakes rises above 122° F for over one hour.

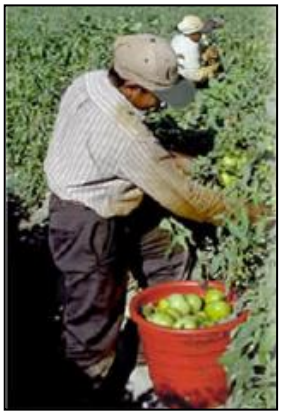
Regular fungicide applications with antibacterial agents (*left*), are important for management of *Cmm*. Buckets with bleach or other sterilizing agent at row ends should accompany activities like tying (*right*). Tying wands may be dipped periodically to limit potential pathogen spread.

In-field pathogen management.

After transplanting, **treat tomatoes with Actigard at a rate of 0.33 oz . 50WG/A or 1 lb. ai of fixed copper per acre plus mancozeb at 1.5 lb 75 WP/A.** Either treatment should be repeated at 7 day intervals throughout the season. If applying fungicides based on a forecasting system such as TomCast, be sure to maintain the regular copper or Actigard treatments.

Sterilize tying and pruning implements. When plants are to be tied, place buckets of bleach solution at the ends of the field, and have extra wands so that they may be rotated and sterilized at the end of each row. If plants are pruned, soak pruning implements frequently in a similar bleach solution to prevent spread of *Cmm* over greater distances in the field.

Avoid working in fields when foliage is wet. When it is necessary to work in more than one planting the same day, always work in the youngest planting first. This will prevent spread from older plants to younger ones, resulting in greater potential damage.



Field activities can spread infections, especially if foliage is wet.

Checklist

- ○ Heat treated your seed?
- ○ Used new or sanitized trays, flats, etc.?
- ○ Sanitized all greenhouse surfaces?
- ○ Treated seedlings with an anti-bacterial agent?

If you purchase transplants, are you:

- ○ Satisfied that the above practices have been used?

All growers should:

- ○ Maintain at least a 3-year rotation without tomatoes.
- ○ Completely incorporate all plant debris during the
- ○ Eliminate promptly, all weeds like nightshade and horsenettle.
- ○ Use new stakes or clean and sterilize old ones with heat or by submerging them in a bleach solution.
- ○ Treat field plantings with an anti-bacterial agent on a regular schedule.
- ○ Sterilize all pruning and tying equipment during those operations.

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