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report on
PLANT
DISEASE

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BACTERIAL CANKER, BACTERIAL SPECK, AND BACTERIAL SPOT OF TOMATOES

All three of these widespread and important diseases of tomatoes are caused by bacteria: bacterial canker by *Clavibacter michiganensis* subsp. *michiganensis*; bacterial speck by *Pseudomonas syringae* pv. *tomato*; and bacterial spot by *Xanthomonas campestris* pv. *vesicatoria*. Epidemics of these diseases can occur during warm (canker and spot) or cool (speck), moist conditions. These diseases occur in Illinois every year. All three diseases may occur in the same field.

Figure 1. Bacterial canker of tomato, caused by Clavibacter michiganensis susp. michiganensis.

SYMPTOMS

Bacterial canker. The major symptom of the bacterial canker is a systemic wilt of the plant. Early symptoms include a downward turning of lower leaves, marginal necrosis of leaflets, and wilting of leaflets. Initially, the leaf petioles remain turgid as the leaflets wilt and become distorted (Figure 1). Stems may display external discolored streaks, with stem cankers forming under some conditions . In the staked plants, canker symptoms may first obvious on the stem where the string has caused an abrasion. Initially, the vascular tissues of the infected stems exhibit light yellow to brown streaks, which later turn reddish brown and are prominent at the nodes (Figure 1). Eventually, the pith becomes discolored and "mealy." The fruit symptoms have been referred to as bird's-eye spot: lesions with raised brown centers that are surrounded by a white halo (Figures 2 & 7). When present, bird's-eye spots, 3-6 mm in diameter, are a helpful diagnostic aid.


Figure 2. Tomato fruit infected by Clavibacter michiganensis susp. michiganensis.

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Bacterial speck. All above-ground parts of plants can be infected. Lesions on leaflets are round and dark brown to black. A halo is lacking in the early stages but develops with time (Figure 3). The lesions develop throughout the entire leaf but are most prominent on the abaxial surface. Spots may coalesce, killing large areas of tissue. Stems, petioles, peduncles, pedicels, and sepals are also affected. Lesions on these plant parts are oval to elongated. On fruit, minute lesions or specks develop that are dark and rarely larger than 1 mm in diameter (Figures 4 & 7). The tissue around each speck may be more intense green than unaffected areas. The lesions are slightly raised or flat when first observed. In some instances the spots are sunken.

Figure 3. Bacterial speck lesions on tomato leaves, caused by Pseudomonas syringe pv. tomato. Photo courtesy APS.

Bacterial spot. The bacterium affects all aboveground plant parts. Brown, circular spots develop on leaves, stems, and fruit spurs (Figures 5 & 6). The spots are water-soaked during rainy periods or when dew is present. Lesions rarely develop to more than 3 mm in diameter. When conditions are optimal for disease development, spots on the leaves, petioles, and rachis coalesce to form long dark streaks. A general yellowing may occur on leaflets with many lesions (Figure 5). Blighting of the foliage occurs with the coalescing of lesions, and the plants become huddled in appearance because of severe epinasty. Often the dead foliage remains on the plant, giving it a scorched appearance. Fruit lesions begin as minute, slightly raised blisters. As a spot increases in size, it becomes brown, scab-like, and slightly raised (Figures 6 & 7). A developing lesion may have a faint to prominent halo, which eventually disappears. Bacterial canker, bacterial speck, and bacterial spot of tomato can be diagnosed from each other on the base of fruit lesions (Figure 7).

Figure 4. Tomato fruit infected by *Pseudomonas syringe pv. tomato*.

DISEASE CYCLES

Bacterial canker. Sources of inoculi for bacterial canker include overseasoning in plant debris in soil, weed hosts, volunteer plants, contaminated wooden stakes, and seed. Secondary spreads of the bacterium can occur by means of splashing water, contaminated equipment, and workers' hands. The disease is also spread by pruning plants and clipping transplants. Plants infected from seed may die, fail to set fruit, or display no symptoms at all. Secondary dissemination often results only in foliar symptoms, bird's-eye fruit spots, or both. Also, secondary dissemination by clipping in transplant fields results in systemic infection and death of the plant after transplanting.

Bacterial speck. *P. syringae* pv. *tomato* is a seed-borne pathogen. The bacterium is disseminated by splashing rain and by equipment used in the clipping of transplants. It has been reported that *P. syringae* pv. *tomato* survives in crop residue for up to 30 weeks. Weed species support population of the bacterium. Both high humidity and low temperatures 64-75°F (18-24°C) favor bacterial speck development.

Figure 5. Bacterial spot on tomato leaves, caused by Xanthomonas campestris pv. vesicatoria. Photo courtesy J.P. Jones.

Bacterial spot. The pathogen survives on tomato volunteers and infected plant debris. The bacterium may also be disseminated by seed. Disease development is favored by temperatures of 75-86°F (24-30°C) and by high precipitation. The pathogen is disseminated within fields by wind-driven rain droplets, the clipping of transplants, and aerosols. It penetrates through stomates and wounds created by wind-driven sand, insect punctures, or mechanical means.

DISEASE MANAGEMENT

Bacterial canker. Bacterial canker is one of the most difficult tomato diseases to control. First, there is the problem of detecting infected plants, due to the wide variability of symptom expression. Second, the highly infectious nature of the pathogens, the number of sources of inoculum, and the absence of effective chemicals for treatment mean that sanitation and preventive measures must be enforced.

Figure 6. Tomato fruit infected by Xanthomonas campestris pv. vesicatoria.

1. Only certified, pathogen-free seed from canker-free plants should be planted. Saving seed from a source known to have had bacterial canker should be avoided. Acetic acid extraction or fermentation process of seed eliminates seed coat contamination, but it does not completely control embryonic infection.

2. Only certified disease-free transplants that have been produced under an inspection program should be planted. It is usually not possible to distinguish between infected and healthy seedlings at the time of transplanting.

3. Greenhouse seedbeds and soils must be sterilized to destroy the bacteria. Steam sterilization is preferred.

4. Proper sanitation of transplant production greenhouses is necessary.

4. If the disease is suspected or confirmed in a greenhouse crop, every effort must be made to isolate affected areas from the rest of the crop. Hands, shoes, and tools should be disinfested.

5. Crop rotation with non-solanaceous crops for at least 3 years should be considered.
6. Weeds belonging to the Solanaceae family should be controlled.

7. Fixed copper sprays may help in protecting healthy plants. Also, application of Tanos fungicide may help suppress bacterial diseases.

8. Tillage of the field after harvest is recommended.

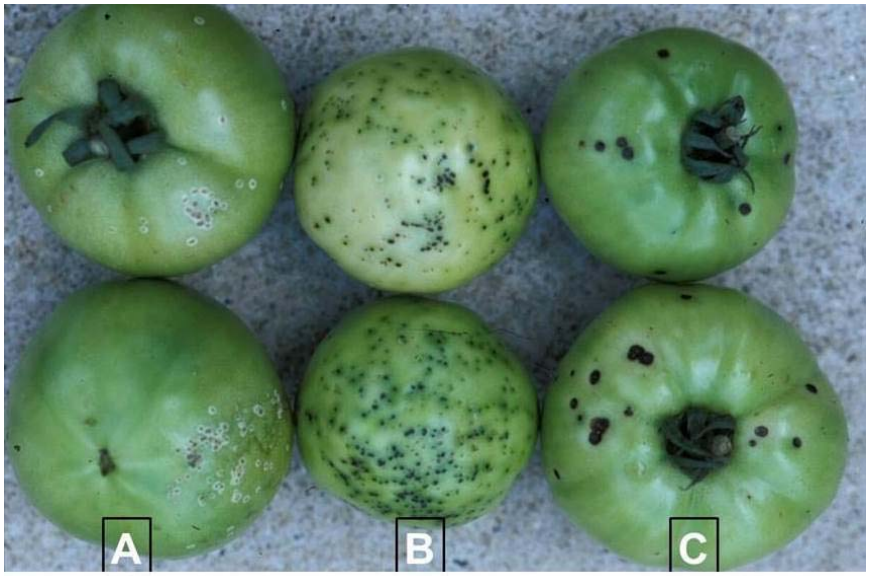

Figure 7. Tomato fruit infected by bacteria. A, bacterial canker (Clavibacter michiganensis susp. Michiganensis). B, bacterial speck (Pseudomonas syringe pv. tomato); C, bacterial spot (Xanthomonas campestris pv. vesicatoria).

Bacterial speck and bacterial spot. The same methods are used to manage these two diseases.

1. Only pathogen-free seed should be planted.

2. Only certified disease-free transplants should be planted.

3. Crop rotation with non-host plants.

4. Effective weed control should be practiced.

5. Plant resistant cultivars, if available.

6. Spray-application of copper plus mancozeb can suppress disease development and spread.

7. Actigard, Agri-mycin 17, copper, mancozeb, Serenade Max, and Tanos are labeled for management of these diseases. Strains of the bacterium that cause bacterial spot on tomato that are resistant to copper products have been reported. For the up-to-date recommendation on chemicals for control of bacterial diseases of tomato, refer to the current edition of publication number C1373, “Midwest Vegetable Production Guide for Commercial Growers” (www.btny.purdue.edu/pubs/id/id-56/). This publication is available from ITCS, University of Illinois, 1917 S. Wright St., Champaign, IL 61820; or call 1-800-345-6087.