Bacterial Spot of Tomato and Pepper
Bacterial spot xanthomonads: *Xanthomonas euvesicatoria*, *Xanthomonas vesicatoria*, *Xanthomonas perforans*, and *Xanthomonas gardneri*

Hosts: Tomato (*Solanum lycopersicum*) and pepper (*Capsicum annuum*). Alternate hosts are datura (*Datura ferox*), physalis (*Physalis minima* and *Physalis peruviana*), and potato (*Solanum tuberosum*).

Disease common name: Bacterial spot.

Pathogens: *Xanthomonas euvesicatoria*, *Xanthomonas vesicatoria*, *Xanthomonas perforans*, and *Xanthomonas gardneri*; syn.: *Xanthomonas axonopodis* pv. *vesicatoria* and *Xanthomonas campestris* pv. *vesicatoria*. The causal organism of bacterial spot of tomato and pepper has recently been divided into four species: *Xanthomonas euvesicatoria*, *Xanthomonas vesicatoria*, and *Xanthomonas gardneri* infect both tomato and pepper; whereas *Xanthomonas perforans* has been reported only on tomato. There are four races. Presently, T1 strains are classified as *Xanthomonas euvesicatoria*, T2 strains are classified as *Xanthomonas vesicatoria*, and T3 strains are classified as *Xanthomonas perforans*. The species classification was not provided by the contributors of the images shown.

Historical information: Bacterial spot was observed in the United States and South Africa in 1912 and 1914, respectively, and was identified in South Africa in 1921 by E. M. Doidge. The disease occurs worldwide and is more severe in tropical and subtropical regions where moderate or high amounts of precipitation favor disease development.

Disease Cycle

Inoculum: Inoculum occurs in infested seed, alternate hosts, soil, and undecomposed crop residues.

Transmission: Seedlings are infected when contaminated seeds germinate. Disease is spread by overhead irrigation, splashing rain, or aerosols. The pathogen is transmitted from contaminated soil to foliage by water and mechanical operations.

Survival: Bacteria survive in seed, infested debris, alternate hosts, and soil for short intervals (6 weeks or less).

Infection: Bacteria enter primarily through stomata, natural openings, and wounds caused by wind-driven sand, insect punctures, or mechanical means. Pruning, clipping of transplants, and other mechanical damage to plants create wounds that can serve as sites for bacterial infection.

Symptoms and signs: Leaves, stems, and fruits of tomato and pepper are affected. Symptoms on tomato seedlings may be severe, causing leaves to turn yellow and drop. On older leaves, symptoms first appear as water-soaked, translucent lesions that become brownish black and circular. They may enlarge to 3 mm in diameter (Fig. 1). The centers of the spots dry out. Bacterial leaf spots can be confused with those caused by fungal diseases, such as target spot and early blight. However, bacterial spots do not have concentric zones and, unlike fungal spots, they may coalesce, forming long dark streaks (Figs. 2 and 3). General yellowing is common on leaflets with many lesions. When the disease is severe, blighting occurs. This leads to severe epinasty, a downward bending of the leaves, and dead foliage remains on the plant, giving it a scorched appearance. Fruit lesions progress from minute, slightly raised blisters to scablike, slightly raised spots (Figs. 4–6). Developing lesions may have faint to prominent halos that later disappear. Symptoms on pepper leaves first appear as small, brown, water-soaked lesions that become necrotic at the center. They

may enlarge to 3 mm or more in diameter. Leaf lesions are usually sunken on the upper surface and slightly raised on the lower surface (Figs. 7 and 8). As the disease progresses, leaflets become yellow and may drop. Fruit lesions begin as round, green spots that enlarge and may reach a diameter of 2–3 mm. They become brown, cracked, and roughened with a wartlike appearance (Fig. 9). The images shown were received without reference to strains or current nomenclature.

Disease Management

An integrated approach is commonly used, incorporating such methods as producing pathogen-free seed, using seed treatments, using foliar sprays, removing plant debris, using disease-free transplants, roguing susceptible volunteers, rotating fields to avoid carryover, and using resistant cultivars (peppers). Biocontrol with bacteriophages and competitive bacteria has been reported.

References

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Figure 1. Tomato leaf with necrotic spots and shot-holes. (Courtesy J. Jones)

Figure 2. Multiple necrotic spots on lower leaves. (Courtesy J. Jones)

Figure 3. Necrotic lesions on stems and petioles. (Courtesy B. S. Kim)

Figure 4. Lesions on tomato leaves and fruits. (Courtesy J. Jones)

Figure 5. Lesions on green tomato fruit. (Courtesy S. Miller)

Figure 6. Dark brown lesions on mature fruit. (Courtesy M. Goto)

Figure 7. Water-soaked and brown necrotic lesions on pepper leaves. (Courtesy B. S. Kim)

Figure 8. Broad necrotic lesions on pepper leaves. (Courtesy J. Jones)

Figure 9. Brown, wartlike lesions on pepper fruit and leaf lesions. (Courtesy A. Alvarez)