Agronomic Spotlight

Seminis grow forward

Bacterial Brown Spot in Garden Beans

- Bacterial brown spot has caused significant losses in snap bean production over the past few years.
- The development of bacterial brown spot is favored by moderate temperatures and frequent rainfall.
- Resistant varieties, the application of bactericides, and inoculum reduction are used to manage the disease.

Symptoms

Bacterial brown spot infects both leaves and pods, reducing photosynthetic area and lowering pod quality. Yield losses can range from trace to 100% when severe disease occurs in the early growth and flowering stages.[1] Small (3/25 to 8/25 inch diameter), brown, circular lesions develop on the leaves (Figure 1). The lesions may be surrounded by a narrow green-yellow zone.[2,3] The lesions can enlarge and coalesce, and the dead tissues can fall out, giving the leaves a ragged, shot-holed appearance (Figure 2). Lesions form mostly on younger leaves, rarely on older tissues.[1,2]

Figure 1. Small, circular, necrotic leaf lesions symptomatic of bacterial brown spot. Howard F. Schwartz, Colorado State University, Bugwood.org.

Lesions on the pods are circular and initially appear water-soaked (Figure 3a). With time, the lesions develop into sunken, brown, necrotic spots (Figure 3b). Infected pods can become twisted and kinked, and a white to cream colored bacterial ooze may form on the lesions.[1,3,4]

The Pathogen

Bacterial brown spot of beans is caused by the bacterium *Pseudomonas syringae* pathovar (pv.) *syringae* (*Pss*). *Pss* has a very wide host range and can grow on many different plant species. There are different strains of the bacterium, and only specialized strains cause disease on beans.[2] This bacterium is commonly an epiphyte on healthy bean leaves, meaning that it grows on the bean leaves without causing any disease.

Disease Cycle and Favorable Conditions

As mentioned, *Pss* has a wide host range, and it can be found on a number of crop and weed species that serve as sources in inoculum for beans. The bacterium can also overwinter in infested bean debris and on (and in) infected bean seed.[1,2] The bacterium is spread by splashing rain and sprinkler irrigation to neighboring plants. It also can be spread by workers, equipment, and insects moving through bean fields when plants are wet. The disease is most severe when temperatures are cool to moderate (below 80 °F) and relative humidity levels are above 95%. Severe epidemics of brown spot occur in seasons with frequent rainfall events, especially hard, driving rains.

The conventional understanding of the development of brown spot is that the bacterium spreads to a leaf or pod by splashing water, where it then enters the plant tissues through wounds or natural openings and then initiates the disease process resulting in symptoms. Recent studies have shown that in many cases, the bacterium is already present on many plants, existing as an epiphyte not causing disease. When conditions favor the growth of the bacterium, populations levels pass a certain threshold, and *Pss* switches into pathogen mode and initiates the disease process. The difference between these two concepts of how disease develops may seem subtle, but they make a difference with regards to how the disease is managed, (1) by preventing spread or (2) by preventing the growth of the bacterium to the point where it becomes a pathogen.[5,6] Brown spot is often most severe after a period of heavy, driving rain, and it has been shown that this type of rainfall stimulates the growth of *Pss* populations on bean leaves.

Figure 2. Shot-hole symptoms on brown spot infected leaves. Howard F. Schwartz, Colorado State University, Bugwood.org.

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Figure 3. (A) Initial symptoms of circular, water-soaked lesions on bean pods infected with bacterial brown spot. (B) Later pod symptoms showing necrotic, sunken lesions. Howard F. Schwartz, Colorado State University, Bugwood.org.

Management

Recommendations for managing bacterial brown spot typically include the integration of crop rotation and sanitation efforts to reduce inoculum levels, planting disease resistant varieties and pathogen-free seed, avoiding working in fields when plants are wet, and the use of copper-based bactericides to protect plants and reduce the spread of the bacterium. In areas and conditions where the bacterium is already present on plants, growing epiphytically, the focus should be on efforts that keep bacterial populations low and on minimizing conditions that favor disease development.

Sanitation efforts should include the prompt destruction of bean debris shortly after the final bean harvest. Plant material should be disked into the soil to promote rapid decomposition. Manage weed hosts and volunteer beans that can serve as sources of inoculum. Clean equipment and tools between use in infested and disease free fields, and clean harvesting machinery, seed-cleaning equipment, and storage containers at the end of the season. Rotate to non-host crops (corn, small grains, non-legume vegetables) for three to four years. Avoid the use of sprinkler irrigation if possible, or irrigate at a time (such as during dew formation) that will not increase the amount of time plants are wet. Do not reuse irrigation water.[1,2,3]

Resistance to bacterial brown spot is available in commercial bean cultivars. Studies have shown that *Pss* populations on resistant cultivars are lower than they are on susceptible cultivars grown under the same conditions. Lower populations (below the threshold that triggers the switch to pathogenicity) may be one reason why brown spot is less severe on resistant cultivars of beans.[5,6]

Disease management guides usually recommend the use of certified, pathogen-free seed, and in some cases, treatment of seed with streptomycin to eliminate any bacterial contamination on the outside of the seed. These methods reduce the likelihood that the bacterium will be introduced into a field. However, in areas where the bacterium is commonly present on crop and weed hosts, the importance of seedborne inoculum in the development of a disease epidemic is not clear because the bacterium can easily spread to bean plants as they emerge.[1,2,3]

During the season, growers should regularly inspect plants for symptoms of bacterial brown spot, especially after prolonged periods of high humidity and/or frequent rainfalls. Scout weekly from midseason to harvest. Begin treatments with bactericides at the first sign of disease.[3]

Copper-based bactericides can be used to slow the spread of the bacterium and reduce foliar populations. Example products registered for use on dry and snap beans include DuPont™ Kocide® DF Fungicide/Bactericide, Champ® Formula 2 Flowable Agricultural Fungicide/Bactericide, and Cuprofix® Ultra 40 Disperss® Dry Flowable Fungicide/Bactericide.[3,7] Apply the products according to label directions, typically at 7 to 14 day intervals, depending on weather conditions and label instructions. The bactericides are most effective if applied as protectant treatments early in the season during periods of cool to moderate temperatures and moist conditions. Bactericide applications to hail damaged plants shortly after the damage occurs can help protect wounded plants from infection.[1] However, the overall effectiveness of bactericide treatments has been inconsistent, and bactericides are less effective during periods of persistently wet weather.[3]

Sources:

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[3] Reiners, S., Wallace, J., Curtis, P., Helms, M., Landers, A., McGrath, M., Nault, B., and Seaman, A. 2018. Cornell Integrated crop and pest management guidelines for commercial vegetable production. Cornell Cooperative Extension.

[4] Babadoost, M. 2000. Bacterial diseases of beans. University of Illinois Extension. Report on Plant Disease No. 921.

[5] Hirano, S., Rouse, D., Clayton, M., and Upper, C. 1995. *Pseudomonas syringae* pv. *syringae* and bacterial brown spot of snap bean: A study of epiphytic phytopathogenic bacteria and associated diseases. Plant Disease 79:1085-1093.

[6] Hirano, S., and Upper, C. 2000. Bacteria in the leaf ecosystem with emphasis on *Pseudomonas syringae*—a pathogen, ice nucleus, and epiphyte. Microbiology and Molecular Biology Reviews 64:624–653.

[7] Egel, D., Foster, R., Maynard, E., Weller, S., Babadoost, M., Nair, A., Rivard, C., Kennelly,

For additional agronomic information, please contact your local seed representative. Developed in partnership with Technology Development & Agronomy by Monsanto.