Agronomic Spotlight

Seminis grow forward

Bacterial Leaf Spot of Lettuce

- Bacterial leaf spot of lettuce causes dark lesions to form on older leaves, reducing product quality and marketability.
- The bacterial pathogen can survive for short periods on infested lettuce debris.
- Lettuce varieties vary in susceptibility to the disease, and some resistant varieties are available.

The Disease and Pathogen

Bacterial leaf spot (BLS) of lettuce was first observed in 1918 in New York, where the disease caused serious damage to the crop. The disease has periodically been a problem ever since.[1] The disease caused an estimated four million dollar loss in lettuce production in Florida in 1992-1993, and substantial economic losses resulting from the disease have also occurred in California, Ohio, Quebec, and several other lettuce-growing regions around the world since the mid-1990s.[2]

BLS is caused by the bacterium *Xanthomonas campestris* pv. *vitians*. There are two biotypes of the pathogen (A and B). To date, three races of the pathogen have been identified. Currently, it is thought that biotype A corresponds to race 2, and biotype B corresponds to races 1 and 3.[3] All three races are present in the U. S., with biotype A reported from the eastern states and biotype B reported from all lettuce growing regions.[4]

Symptoms

BLS affects both head and leaf types of lettuce, with romaine (cos) and butterhead varieties being the most susceptible.[2,5] The disease reduces the marketability of the product because of the formation of darkly-colored lesions on the leaves. The lesions start out as small (0.1 to 0.2 inch dia.), watersoaked lesions, usually on the older/outer leaves (Figure 1). Lesions

Figure 1. Symptoms of bacterial leaf spot on the older, outer lettuce leaves. CT Bull and ST Koike, 2005. Used with permission.[6]

Figure 2. Lesions have an angular shape because their growth is limited by major veins in the leaf. Photograph by Steve Koike. Used with permission.

rarely develop on newer leaves. The lesions are vein-delimited, giving them an angular shape (Figure 2). With time and favorable conditions, the lesions expand and coalesce. The lesions turn dark brown to black with age and appear greasy. They may be surrounded by light-yellow borders. The affected leaf tissues become dry and papery, and infected leaves can yellow, collapse, and eventually die. Secondary infections by other pathogens, such as the fungus *Botrytis*, can develop on BLS infected lettuce in storage.[1,5]

Disease Cycle and Conditions

The development of BLS on lettuce is favored by cool and wet conditions. The bacterium spreads from plant to plant by splashing rain and sprinkler-irrigation, and the disease usually occurs only in fields where sprinkler-irrigation is used or in areas that have received regular rainfall.[1,5] The optimum temperature for infection is 73°F (23°C). However, the disease does occur at warmer temperatures on lettuce grown in greenhouses.

The bacterium initially grows as an epiphyte on lettuce, growing on the leaf surface without infecting the tissue or causing symptoms. When the number of bacterial cells on the leaf reaches a certain threshold, the bacterium switches to a pathogenic phase, enters the leaf, and starts causing symptoms.[1] The BLS bacterium also survives as an epiphyte

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on other crops, including pepper and tomato, and on several weed species, including prickly lettuce and sow thistle. However, it is not clear if these plants serve as a source of inoculum in the disease cycle on field-grown lettuce.[1,2,7]

The BLS bacterium can survive for a limited time on infested lettuce debris, depending on temperature and moisture conditions. A study on the survival of the BLS pathogen on lettuce debris in a coastal area of California found that the pathogen was able to be recovered from lettuce tissues for up to four months after harvest, and the disease developed on a fall lettuce crop that was planted in a field where BLS was present in the preceding spring lettuce crop.[5,8] The relatively cool conditions in the region allowed the pathogen to survive over the summer fallow period on infested lettuce debris. The pathogen was also detected on lettuce debris after two and four months of winter fallow, but at low levels, and the amount of disease that developed on the subsequent spring lettuce crop was not as high as it was on the fall crop.

A similar study conducted in southern Florida found that the pathogen was detected on infested lettuce debris left on the soil surface for up to one month.[7] The authors of this study concluded that infested lettuce debris was not an important source of inoculum for BLS in southern Florida unless a second crop of lettuce was planted in the same field within a month of harvesting the previous crop.

The BLS bacterium has been shown to be seedborne, both internally and externally on the seed. However, the bacterium is not commonly detected in commercial seed lots, and it has not been shown that infected seed is an important inoculum source in commercial lettuce plantings.[1,5] Other potential sources of inoculum include volunteer lettuce plants, infected transplants, and contaminated irrigation water.[1,5,8]

Management

The primary method used to manage bacterial spot of lettuce is to plant resistant or less susceptible lettuce varieties.[6] The resistance gene *Xar1* has been characterized as a single dominant gene, and it is used in some commercial cultivars, along with at least two other related resistance genes. The identified races of the BLS pathogen respond differently to these genes, in that a gene can be effective against one race but not effective against another.[1,9]

The use of pathogen-free seed and transplants are recommended.[1,3] The BLS bacterium is not detected on most commercially available lettuce seed. Seed treatments have been shown to lower pathogen levels on infested seed. Soaking seed in solutions of sodium hypochlorite has been shown to be effective in some studies but not others, depending on the concentrations of the treatment solution and soaking times used. Soaking seed in solutions of hydrogen peroxide has also been found to reduce the levels of the BLS bacterium on seed in some studies.[10,11,12]

The application of copper-based fungicides when the disease first appears can help slow the buildup of bacterial populations and lower disease levels with varying success.[1] The use of copper hydroxide has been found to provide some control, especially if it is combined with a dithiocarbamate fungicide, while the use of copper sulfate may not be as effective.[5]

Cultural strategies for managing BLS include the management of weed hosts that may serve as reservoirs of the pathogen. The prompt incorporation of crop debris after harvest will speed the decomposition of infested debris and reduce the survival time of the pathogen. In fields where an epidemic of BLS has occurred, it is recommended that growers rotate away from lettuce or that they fallow the field for at least five months. Double cropping lettuce in fields with a history of BLS epidemics is not recommended.[1,5,8]

Sources:

[1] Koike, S., Gilbertson, R., and Bull, C. 2017. Bacterial leaf spot. In Subbarao, K., Davis, R. M., Gilbertson, R., and Raid, R. (Eds.), *Compendium of lettuce diseases and pests;* Second edition (pp. 54-56). American Phytopathological Society, St. Paul.

[2] Robinson, P., Jones, J., and Pernezny, K. 2006. Bacterial leaf spot of lettuce: Relationship of temperature to infection and potential host range of *Xanthomonas campestris* pv. *vitians.* Plant Dis. 90:465-470.

[3] Bull, C., Trent, M., and Hayes, R. et al., 2016. Three races of Xanthomonas campestris pv. vitians causing bacterial leaf spot on lettuce identified. APS Annual Meeting, July 30 - August 3, 2016, Tampa, FL P-437.

[4] Fayette, J., Raid, R., Roberts, P. D., Jones, J. B., Pernezny, K., Bull, C. T., and Goss, E. M., 2016 Multilocus sequence typing of strains of bacterial spot of lettuce collected in the United States. Phytopathology 106:1262-1269.

[5] Koike, S. and Turini, T. 2017. Bacterial leaf spot. Lettuce Pest Management Guidelines. UC IPM. UC ANR Publication 3450. https://www2.ipm.ucanr.edu/agriculture/lettuce/Bacterial-leaf-spot/.

[6] Bull, C. T., and Koike, S. T. 2005. Evaluating the efficacy of commercial products for management of bacterial leaf spot on lettuce. Plant Health Progress doi:10.1094/PHP-2005-1121-01-RS.

[7] Fayette, J., Jones, J. B., Pernezny, K., Roberts, P. D., and Raid, R. 2018b. Survival of Xanthomonas campestris pv. vitians on lettuce in crop debris, irrigation water, and weeds in south Florida. European Journal of Plant Pathology 151:341-353.

[8] Barak, J. D., Koike, S. T., and Gilbertson, R. L. 2001. The role of crop debris and weeds in the epidemiology of bacterial leaf spot of lettuce in California. Plant Dis. 85:169-178.

[9] Hayes, R. J., Trent, M. A., Truco, M. J., Antonise, R., Michelmore, R. W., and Bull, C. T. 2014. The inheritance of resistance to bacterial leaf spot of lettuce caused by *Xanthomonas campestris* pv. *vitians* in three lettuce cultivars. Horticulture Research .

[10] Carisse, O., Ouimet, A., Toussaint, V., and Philion, V. 2000. Evaluation of the effect of seed treatments, bactericides, and cultivars on bacterial leaf spot of lettuce caused by Xanthomonas campestris pv. vitians. Plant Dis. 84:295-299.

[11] Pernezny, K., Nagata, R., Raid, R. N., Collins, J., and Carroll, A. 2002. Investigation of seed treatments for management of bacterial leaf spot of lettuce. Plant Disease 86:151-155.

[12] Sahin, F., and Miller, S. A. 1997. Identification of the bacterial leaf spot pathogen of lettuce, *Xanthomonas campestris* pv. *vitians*, in Ohio, and assessment of cultivar resistance and seed treatment. Plant Disease 81:1443-1446.

Websites verified 9-3-2019

For additional agronomic information, please contact your local seed representative.

Performance may vary from location to location and from year to year, as local growing, soil and weather conditions may vary. Growers should evaluate data from multiple locations and years whenever possible and should consider the impacts of these conditions on the grower's fields. The recommendations in this article are based upon information obtained from the cited sources and should be used as a quick reference for information about lettuce diseases. The content of this article should not be substituted for the professional opinion of a producer, grower, agronomist, pathologist and similar professional dealing with this specific crop.

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