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Bacterial Leaf Streak Disease of Corn

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Figure 1. Bacterial leaf streak symptoms on corn include interveinal streaks that may appear tan, brown, or especially yellow when backlit.

Introduction

Bacterial Leaf Streak (BLS) of corn (*Zea mays*) was first reported in Nebraska in 2016 and was the first time the disease *(Figure 1)* was confirmed in the United States. Since then it has been confirmed in nine additional states—Colorado, Illinois, Iowa, Kansas, Minnesota, Oklahoma, South Dakota, Texas, and Wisconsin. The results from a survey (funded by the Nebraska Corn Board) confirmed the bacterium in samples received from 74 Nebraska counties as of October 2018 *(Figure 2)*.

The bacterium causing BLS is *Xanthomonas vasicola* pv. *vasculorum*. This disease has also been reported on corn in South Africa, Argentina, and Brazil. BLS has been confirmed in field corn, seed corn, sweet corn, and popcorn. Disease severity varies by hybrid and can be severe in some susceptible popcorn hybrids.

The bacterium also causes the important "gumming disease" of sugarcane (*Saccharum* spp.) that occurs almost worldwide in tropical and subtropical areas where sugarcane is grown. However, it has not been confirmed in U.S. sugarcane.

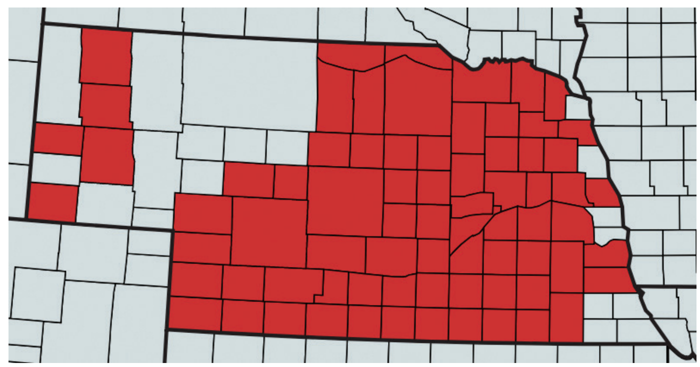

Figure 2. Confirmed distribution of bacterial leaf streak in Nebraska 2016–2018.

Grain sorghum and related species (*Sorghum* spp.) have been reported as susceptible hosts, but this has only been observed in greenhouse studies. The disease has not been confirmed in Nebraska sorghum fields at this time, although another BLS with similar symptoms caused by a closely related pathogen (*X. vasicola pv. holcicola*) has been confirmed in Nebraska and other states.

Symptoms and Signs

Symptoms of BLS include interveinal leaf streaks that are brown, tan, or yellow and range in size from small flecks to several inches long *(Figures 3a and 3b)*. Lesions are also strikingly yellow when backlit *(Figures 3a and 4)*. BLS margins are often wavy, jagged, and have a yellowish hue.

Lesions most often develop initially on the lower leaves. However, in some instances lesions can rapidly develop in the mid to upper canopy following severe storms without signs of infection in the lower canopy. In this case, lesions may be

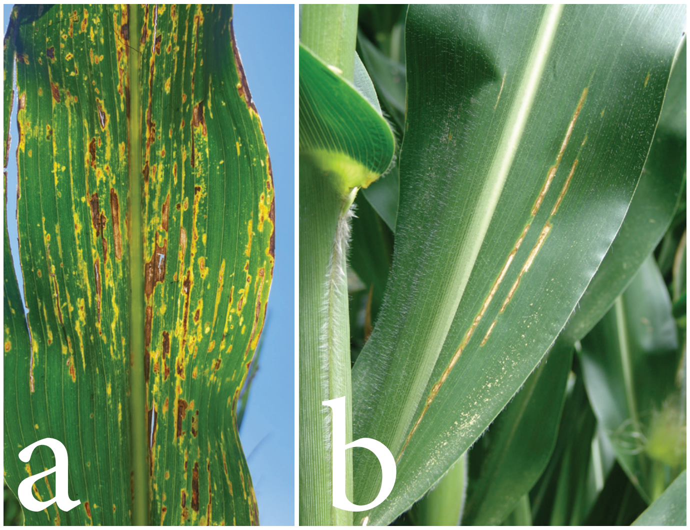

Figure 3a and 3b. Short (a) versus long (b) bacterial leaf streak lesions.

Figure 4. Lesions may appear bright yellow when backlit.

concentrated along the midrib. Lesion appearance and symptoms may differ between hybrids and inbreds, which can make initial diagnosis difficult. To date, symptoms have only been reported on plant leaves. There has been no evidence of systemic infection, wilt, or premature death of corn plants caused by this disease.

Disease can occur at any corn stage during the growing season. Lesions have been confirmed in the field as early as the V4 growth stage. But, corn seedlings inoculated with the bacteria in greenhouse tests can develop symptoms immediately upon seedling emergence under favorable conditions.

BLS can be very difficult to differentiate from some other corn diseases, especially without the greater magnification of a microscope. Symptoms can be confused with gray leaf spot, caused by the fungus *Cercospora zeae-maydis (Figure 5)*. The

Figure 5. Bacterial leaf streak symptoms can look very similar to the rectangular lesions caused by the common fungal disease gray leaf spot, pictured above.

rectangular gray leaf spot lesions tend to have smooth, linear margins *(Figure 6a)* in contrast to the often jagged, wavy margins of BLS lesions *(Figure 6b)*. Microscopic observation of bacterial streaming from inside BLS lesions is the best method to avoid misidentification. It is important to remember that fungicides used for gray leaf spot will not effectively control this bacterial pathogen. Thus, proper identification is critical for effective disease management.

The yield loss potential caused by BLS is unclear at this time because estimates are not yet available from ongoing research. However, disease severity (the magnitude of leaf area affected by disease lesions) ultimately determines its impact on yield, similar to some other leaf diseases like gray leaf spot. Yield loss caused by this disease is expected to vary widely between fields and hybrids. Low disease severity is common and may have negligible impact on yield. Yield of severely affected susceptible hybrids with as much as 50 percent or more leaf area covered is likely to be substantially impacted *(Figure 7)*.

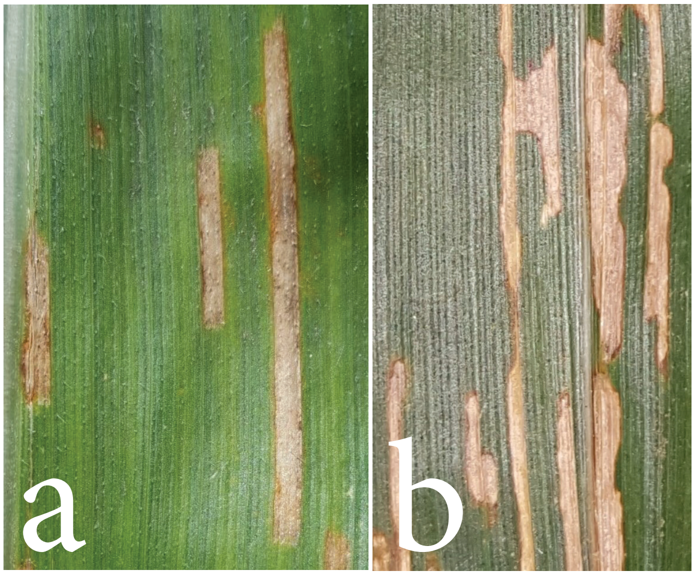

Figure 6a and 6b. The lesion margins of gray leaf spot (left) are usually smooth and linear in contrast to the often wavy, jagged margins of bacterial leaf streak lesions (right).

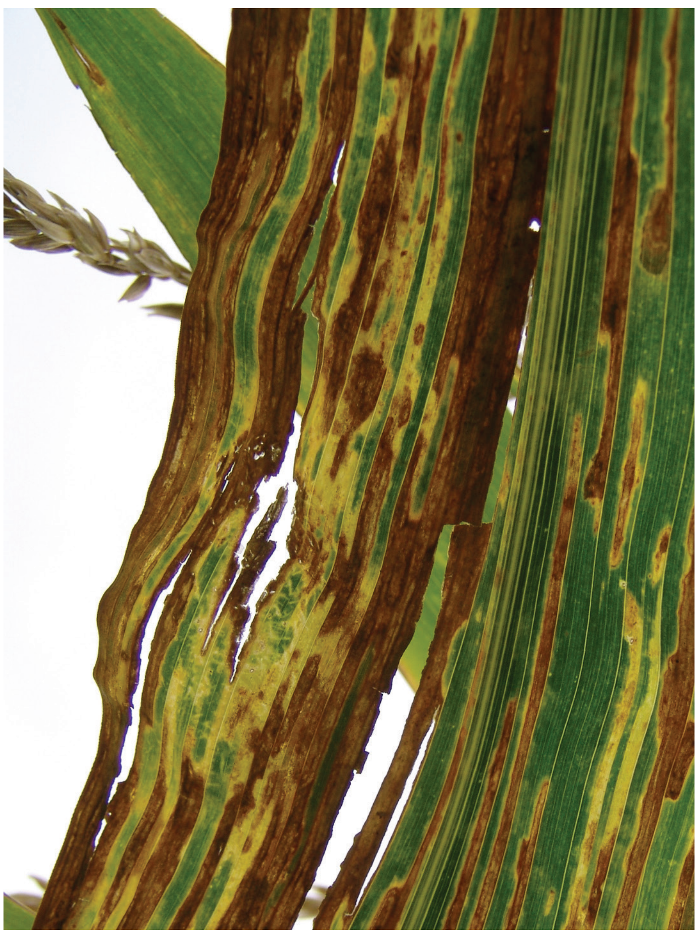

Figure 7. Bacterial leaf streak lesions can cover more than 50 percent of the leaf area when severe disease develops on susceptible hybrids, like this popcorn hybrid.

Figure 8. Bacterial leaf streak on several volunteer corn plants growing in a soybean field where the disease developed the previous year on corn.

Disease Cycle

Three things are necessary for disease development: a virulent pathogen, a susceptible host, and favorable weather conditions. These bacteria overwinter in infested crop residue acting as a source of inoculum for next year's growing season and disease outbreak. Infection can develop in the same fields during consecutive years if inoculum is available and susceptible hybrids are grown. The bacteria can infect plants through natural openings, such as stomata, not requiring wounds.

Favorable conditions for disease development include high relative humidity, leaf wetness, severe storms, growing continuous corn, and minimum tillage. Heavy rainfall and overhead irrigation may also favor infection. Infested plant residue can likely spread between fields through tillage equipment, combines, wind dispersal, and/or baling and feeding livestock. Preliminary results from experiments indicate the bacteria are at very low or undetectable levels in seed. It is unclear at this time whether this will be an important mode of pathogen movement. There are no known adverse impacts on livestock or human health from this pathogen.

Management

Crop rotation with non-host crops, such as soybean or wheat, instead of growing continuous corn may help manage this and similar diseases caused by residue-borne pathogens. However, while crop rotation can help reduce disease severity, it is also essential to manage volunteer corn during the rotation as it can harbor the bacteria from year to year. BLS has been confirmed in volunteer corn growing in soybean fields where corn with BLS was grown the previous season *(Figure 8).*

Results from greenhouse experiments have shown that several additional plant species commonly found in or near corn fields may also become infected by the bacteria *(Table 1).* These include several species of weeds, native grasses, and crops that may be planted as cover crops or in a rotation with corn. Subsequent field experiments were conducted to evaluate the potential for disease development in the plant species identified as susceptible during greenhouse testing.

Susceptible plant species from greenhouse tests were planted in a corn field with BLS and monitored for disease development. Both big bluestem (*Andropogon gerardii*) and bristly foxtail (*Setaria verticillata*) developed the disease under these natural field conditions, although at low severity and incidence. Based on these results, weed management may play a role in disease mitigation, as it prevents host weeds from harboring the bacteria when corn is not grown in the field.

Currently, the impact of native grass species on disease development and pathogen movement is unclear. Because big bluestem was demonstrated to be susceptible in the field experiments, it may be more susceptible than some other plants that were tested. Infected plants in pastures and hay meadows may be baled and potentially moving the pathogen to other locations.

At this time, the disease has not been observed on any of these alternative host species in other locations, including production fields, borders, ditches, pastures, CRP, or other areas. More research is needed to better understand if these species are infected in the natural field environment and whether or not they play a role in disease outbreaks in corn fields.

Currently, no favorable results are available on the efficacy of bactericide products to manage and/or prevent BLS. Some bactericide products, such as those containing copper, are contact products that are not absorbed by the plant and remain on the leaf surface until they are washed off by rain or overhead irrigation water. Thus, many of these products may not provide residual protection against this or other pathogens and may require reapplication and good leaf coverage to work.

Tillage may be an effective disease management strategy by reducing severity in subsequent years because it hastens degradation of infested crop debris. But, it won't completely prevent the possibility of disease development and may be undesirable or impractical for some producers, such as those using no-till cropping systems.

BLS has been observed in hybrids from most seed companies, but some vary in disease severity. Proper identification of this disease is crucial as it can easily be confused with fungal diseases, like gray leaf spot. BLS cannot be managed with a fungicide application as it is a bacterial disease.

Research on disease management with bactericides is underway, but preliminary results have not shown clear benefits, and products may require repeated applications. Repeated applications of bactericides may not be economical.

Sanitation can help slow pathogen spread from field to field. Removing infested crop debris from equipment that could be a source of inoculum between fields is a good strategy to prevent or slow pathogen spread. Harvesting severely infected fields last may also help prevent or slow pathogen spread, although wind may be responsible for moving infected residue, as well.

Currently, no commercially available hybrids have

Table 1. Plant species tested in the greenhouse for development of bacterial leaf streak. Plants were rated based on development of disease (left column) or lack of disease symptoms (right column).[a]

Disease Present	No Disease Present
CROPS	
Grain sorghum	Barley
Oat 'Jerry'	Wheat
Rice	Triticale
	Cereal Rye
	Foxtail Millet
WEEDS	
Shattercane	Large Crabgrass
Johnson Grass	Barnyardgrass
Green Foxtail	Downy Brome
Bristly Foxtail[b]	Yellow Foxtail
Yellow Nutsedge	Giant Foxtail
	Switchgrass Fall Panicum
	Sandbur
	Annual Ryegrass
	Creeping Foxtail
	Prairie Sandreed
PERENNIAL GRASSES	
Indiangrass	Meadow Brome
Orchardgrass	Pubescent Wheatgrass
Big Bluestem[b]	Sand Dropseed
Little Bluestem	Sideoats Grama
Timothy	Smooth Brome
Sand Bluestem	
TURFGRASSES	
	Bermudagrass
	Creeping Bentgrass
	Kentucky Bluegrass
	Tall Fescue

[a] Plant species were only evaluated for disease symptom development and not bacterial reproduction or colonization in the experiments reported here.

[b] Big bluestem and bristly foxtail also developed disease in subsequent experiments conducted in the field.

proven resistance to this disease. Ongoing experiments are promising and may lead to the availability of resistant hybrids in the future. In the meantime, producers should consult with their seed company agronomists about what to expect from hybrids planted in fields with a history of BLS pressure.

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Resources

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