Identification and Management of Bacterial Blight of Cotton

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Bacterial Blight, also called Angular Leaf Spot, is a disease caused by the bacterium, *Xanthomonas citri* pv. *malvacearum* ("Xcm" will be used throughout this bulletin). Bacterial Blight was first described in the United States in 1891 and continues to be a major disease of cotton throughout the world. In the U.S., commercially-planted cotton seed undergoes a process called "acid delinting," whereby the fibers that remain on the seed after ginning are removed by sulfuric acid. Before acid-delinted seed was the commercial standard, losses to Bacterial Blight in some severely affected fields were as high as 60%. Since acid delinting has been implemented, losses to Bacterial Blight have been estimated at approximately 0.1% annually. However, losses can be much greater in individual fields, with recent reports of 20% in isolated instances. Historically, losses observed in Texas and Oklahoma have been greatest; but in

Fig. 1 —Characteristic angular shapes of Bacterial Blight

recent years, Bacterial Blight has become increasingly problematic throughout the humid region of the Cotton Belt. Twenty-two races of Xcm have been described. A pathogen's race is defined by its ability to trigger susceptibility or resistance in different cotton varieties (and sometimes other plant species). Race 18 is the predominant race affecting cotton in the U.S. Should races other than 18 become more common, the effectiveness of the current, commercially-available resistant varieties may be negatively impacted.

Fig. 2 —Bottom of an infected leaf

Symptoms: Bacterial Blight starts as small, water-soaked lesions (spots) on leaves and can be observed on seedlings as well as mature plants. Lesions progress into characteristic angular shapes when the leaf veins restrict the bacterial movement **(Fig. 1)**. Unlike many other lesions on cotton leaves that are more-or-less circular, those associated with Bacterial Blight are more triangular or rectangular, although shape can be more difficult to distinguish as the leaf ages. Bacterial Blight lesions may appear on the upper leaf surface; however, the water-soaked or "greasy" appearance of the lesions is often most clearly observed on the underside of the leaf **(Fig. 2)**. When viewed on top of the leaf, lesions are sometimes encircled by a yellow ring or so-called "halo" **(Fig. 3)**. Lesions turn black as they age and increase in size. Often, the affected leaves will have a tattered appearance and premature defoliation occurs **(Fig. 4)**. Systemic infections follow the main veins

Fig. 3 —Yellow rings or halos on leaf

of the leaf and appear as black streaks that suggest the form of lightning bolts **(Fig. 5)**. Leaf lesions caused by other organisms can be difficult to differentiate from those caused by Xcm. Lesions associated with Bacterial Blight are generally darker in color than lesions caused by many of the other cotton pathogens on those associated with herbicide injury.

In advanced cases, symptoms called "black arm" develop where the infected leaf petioles and stems also exhibit dark lesions **(Fig. 6)**. Symptoms may also appear on the bracts and the bolls. Symptoms on the bolls are characteristically water-soaked, greasy in appearance, and sunken lesions that turn black as they age or harbor secondary infections from other organisms **(Figs. 7 & 8)**. Lesions associated with Bacterial Blight are often observed at the base of the boll where moisture collects beneath the leafy bracts and along the boll sutures where natural cracks and openings are easily colonized by the bacterium. Internal boll rot leading to lint discoloration and seed contamination can be associated with insect damage or infection by opportunistic fungal pathogens. Determining whether or not a boll was initially infected by Xcm or another pathogen or pest can be difficult once fungal pathogens colonize the wound and result in additional boll rot.

Fig. 4 —Tattered appearance of a Bacterial Blight infected leaf

Field Introduction, Spread, and Survival of the Pathogen:
Bacterial Blight infection of cotton fields may begin from infected crop residue from a previous season or be introduced on infected seed. The bacterium can survive in infested field debris and soil, though the duration of survival is not well understood and is likely affected by environmental conditions. Infections may be spread by wind-driven rain from an infested source or irrigation (furrow or sprinkler). Tools, tractors, and other equipment used in the field may spread Xcm.

Fig. 5 —Black streaks of Bacterial Blight

Factors Associated with Outbreaks of Bacterial Blight:
Bacterial Blight will be more severe in a field if the disease develops early in the season, especially if plants at the seedling stage become infected. The bacterium can enter the plant through openings such as stomates, lenticels and hydathodes, and wounds when plants are damaged by wind-blown sand.

Fig. 6 —Black arm symptom of Bacterial Blight on petiole

Fig. 7 —Bacterial Blight lesion on boll

Once Xcm is established in a field, rainfall, especially shortly after planting, can lead to rapid increase and spread. After the canopy develops, periods of heavy rainfall followed by warm and humid conditions when relative humidity is greater than 85% further increases the development and spread of the Bacterial Blight. Throughout the season, conditions favorable for the development and spread of Bacterial Blight occur when daytime temperatures are 90-100 F and nighttime temperatures are at least 62-68 F. Under favorable conditions, it has been reported that one seed infected with Xcm out of 6,000 is sufficient to start a Bacterial Blight epidemic in a given field.

Fig. 8 —Bacterial Blight lesions on boll

Management: The use of resistant cultivars is the most economical option to minimize yield losses from Bacterial Blight **(Table 1)**. The recent increase in the incidence of Bacterial Blight has been linked to an increase in acreage planted to susceptible varieties **(Figs. 9 & 10)**. Cotton growers can minimize their risk from Bacterial Blight by planting varieties that have some resistance to race 18. Growers should seek information on resistance to Bacterial Blight (and other diseases as well as plant parasitic nematodes) as they make seed-selection decisions. Incorporation of infected residue into the soil will help with decomposition of infected debris and result in death of the bacterium. Crop rotation will also help to reduce the amount of inoculum that survives between cotton crops. Fields with a known history of Bacterial Blight should be planted with a race 18-resistant variety. Economical chemical control options are not available.

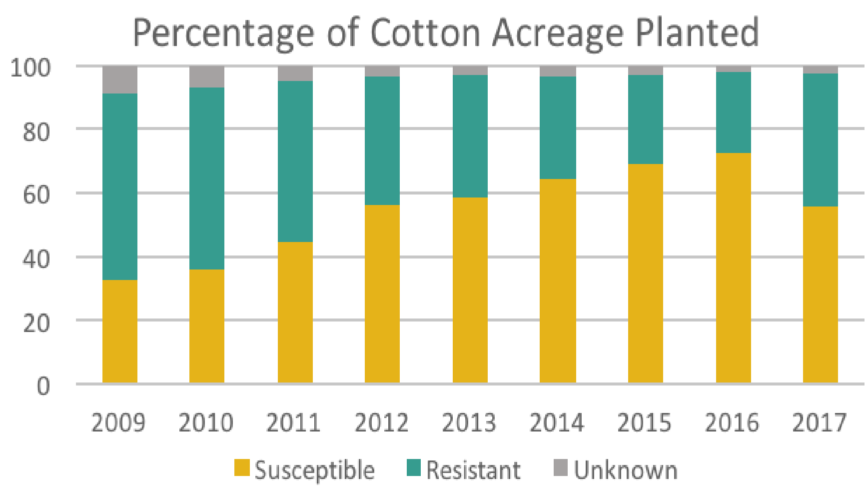

Fig. 9 —Susceptible varieties planted as a percentage of total acreage planted

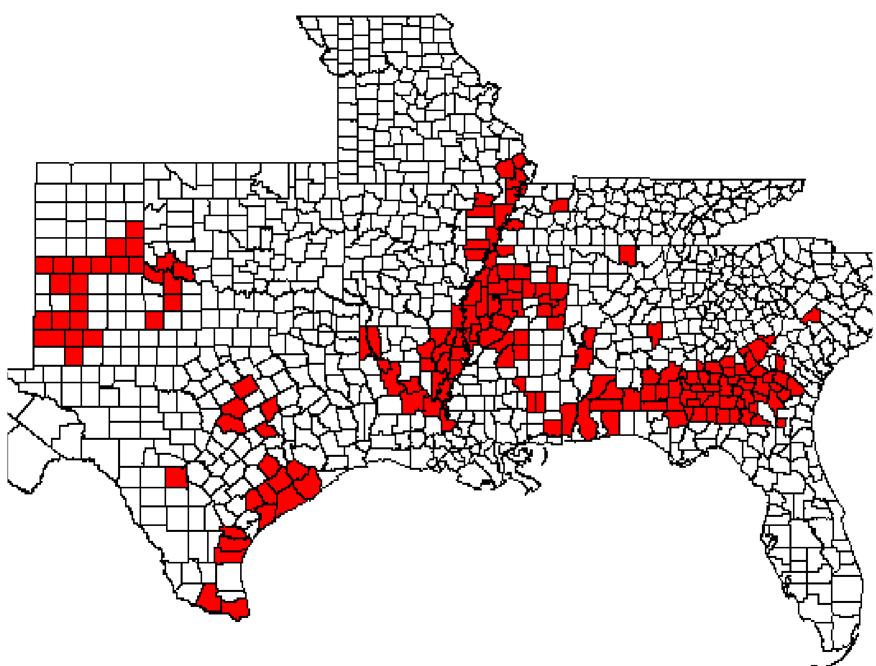

Fig. 10 —Counties with reported Bacterial Blight incidents

Table 1—Response of Cotton Varieties to Bacterial Blight (race 18)

Variety	Bacterial Blight	Variety	Bacterial Blight
All-Tex Concho B2XF	Highly Resistant	NexGen 1511 B2RF	Mostly Susceptible
All-Tex Nitro-44 B2RF	Highly Resistant	NexGen 3517 B2XF	Mostly Susceptible
Croplan Genetics 3787 B2RF	Highly Resistant	Phytogen 312 WRF	Mostly Susceptible
Deltapine 1133 B2RF	Highly Resistant	Phytogen 444 WRF	Mostly Susceptible
Deltapine 1410 B2RF	Highly Resistant		
Deltapine 1518 B2XF	Highly Resistant	All-Tex Arid B2RF	Susceptible
Deltapine 1639 B2XF	Highly Resistant	All-Tex Dinero B2RF	Susceptible
DynaGro 3445 B2XF	Highly Resistant	All-Tex Edge B2RF	Susceptible
DynaGro 3544 B2XF	Highly Resistant	All-Tex Epic RF	Susceptible
Fibermax 1740 B2F	Highly Resistant	Croplan Genetics 3226 B2XF	Susceptible
Fibermax 1830 GLT	Highly Resistant	Croplan Genetics 3527 B2XF	Susceptible
Fibermax 1888 GL	Highly Resistant	Croplan Genetics 3885 B2XF	Susceptible
Fibermax 1900 GLT	Highly Resistant	Deltapine 104 B2RF	Susceptible
Fibermax 1911 GLT	Highly Resistant	Deltapine 1050 B2RF	Susceptible
Fibermax 1953 GLTP	Highly Resistant	Deltapine 1137 B2RF	Susceptible
Fibermax 2007 GLT	Highly Resistant	Deltapine 1212 B2RF	Susceptible
Fibermax 2011 GT	Highly Resistant	Deltapine 1219 B2RF	Susceptible
Fibermax 2334 GLT	Highly Resistant	Deltapine 1252 B2RF	Susceptible
Fibermax 2484 B2F	Highly Resistant	Deltapine 1321 B2RF	Susceptible
Fibermax 9250 GL	Highly Resistant	Deltapine 1441 RF	Susceptible
NexGen 1711 B3XF	Highly Resistant	Deltapine 1454 NRB2RF	Susceptible
NexGen 3500 XF	Highly Resistant	Deltapine 1522 B2XF	Susceptible
NexGen 3640 XF	Highly Resistant	Deltapine 1538 B2XF	Susceptible
NexGen 3699 B2XF	Highly Resistant	Deltapine 1549 B2XF	Susceptible
NexGen 4012 B2RF	Highly Resistant	Deltapine 1553 B2XF	Susceptible
NexGen 4111 RF	Highly Resistant	Deltapine 1555 B2RF	Susceptible
NexGen 4545 B2XF	Highly Resistant	Deltapine 1558 NRB2RF	Susceptible
NexGen 4689 B2XF	Highly Resistant	Deltapine 1725 B2XF	Susceptible
Phytogen 300 W3FE	Highly Resistant	Deltapine 1747 NRB2XF	Susceptible
Phytogen 330 W3FE	Highly Resistant	DynaGro 3109 B2XF	Susceptible
Phytogen 339 WRF	Highly Resistant	Fibermax 1944 GLB2	Susceptible
Phytogen 340 W3FE	Highly Resistant	Fibermax 2322 GL	Susceptible
Phytogen 450 W3FE	Highly Resistant	NexGen 3306 B2RF	Susceptible
Phytogen 490 W3FE	Highly Resistant	NexGen 3405 B2XF	Susceptible
Phytogen 575 WRF	Highly Resistant	NexGen 3406 B2XF	Susceptible
Stoneville 5020 GLT	Highly Resistant	NexGen 3522 B2XF	Susceptible
Stoneville 5115 GLT	Highly Resistant	NexGen 4601 B2XF	Susceptible
Stoneville 5289 GLT	Highly Resistant	NexGen 5007 B2XF	Susceptible
Stoneville 6448 GLB2	Highly Resistant	Phytogen 222 WRF	Susceptible
Phytogen 223 WRF	Mostly Resistant	Phytogen 308 WRF	Susceptible
Deltapine 1359 B2RF	Partially Resistant	Phytogen 333 WRF	Susceptible
Deltapine 1646 B2XF	Partially Resistant	Phytogen 417 WRF	Susceptible
DynaGro 2615 B2RF	Partially Resistant	Phytogen 427 WRF	Susceptible
Phytogen 243 WRF	Partially Resistant	Phytogen 495 W3RF	Susceptible
Deltapine 1612 B2XF	Partially Susceptible	Phytogen 499 WRF	Susceptible
Fibermax 1320 GL	Partially Susceptible	Stoneville 4747 GLB2	Susceptible
NexGen 1717 B2XF	Partially Susceptible	Stoneville 4848 GLT	Susceptible
Phytogen 220 W3FE	Partially Susceptible	Stoneville 4946 GLB2	Susceptible
Croplan Genetics 3475 B2XF	Mostly Susceptible	Stoneville 4949 GLT	Susceptible
Deltapine 1044 B2RF	Mostly Susceptible	Stoneville 5032 GLT	Susceptible
Deltapine 1614 B2XF	Mostly Susceptible	Stoneville 6182 GLT	Susceptible