CULTIVAR RESPONSE TO INOCULATION WITH XANTHOMONAS CITRI SUBSP. MALVACEARUM IN MISSISSIPPI IN 2019

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Abstract

During 2019, field evaluations trials of the cotton cultivars in the Mississippi State University Official Variety Trial program were observed for their response to the bacterial blight bacterium, *Xanthomonas citri* subsp. *malvacerrum* (*Xcm*) in inoculated and non-inoculated plots Cotton plots, consisting of two rows of each cultivar contained in the trial (n=52), 35 feet long and replicated eight times so that four replicate plots could be inoculated and four replicate plots remained non-inoculated. Inoculation was conducted with a bacterial isolate, believed to be race 18, in 15 gallons of water per acre with 1.25% (v/v) of the adjuvant SilWet using a backpack sprayer was conducted at first white flower. Observations for the presence of water-soaked lesions, a characteristic symptom of bacterial blight, were conducted two times post-inoculation. In general, the greater majority, 58%, of the cultivars were observed to be resistant to *Xcm* with 35% of the remaining cultivars exhibited a susceptible response to the bacterium. In all cases, the non-inoculated cultivars produced greater yield than the inoculated regardless of the specific response category.

Introduction

Bacterial blight of cotton, caused by *Xanthomonas citri* subsp. *malvacearum* (*Xcm*), can be a devastating foliar disease. *Xcm* can cause seedling blight, leaf spot, lesions on stems, petioles, and bolls, and a boll rot (see Figure 1A & B). In severe cases, where bacterial blight-susceptible cultivars are planted, a reduction in plant height, and subsequent yield losses on the order of 20 – 25% have previously been reported. In addition, poor fiber quality and excessive yield reductions can be the result of prolonged periods of environmentally conducive conditions.

Managing bacterial blight once the disease is observed at the field level is not possible. However, one of the best methods of reducing the likelihood of losses attributed to bacterial blight is through the planting of resistant cotton cultivars. Given the continued outbreaks of bacterial blight throughout the U.S. cotton production system over the past decade, providing farmers with unbiased information regarding the response of commercially available cultivars to *Xcm* and aiding in cultivar selection to reduce bacterial blight losses is important.

Field-level bacterial blight inoculation trials of commercially available cultivars were conducted to determine the response of cultivars to bacterial blight.

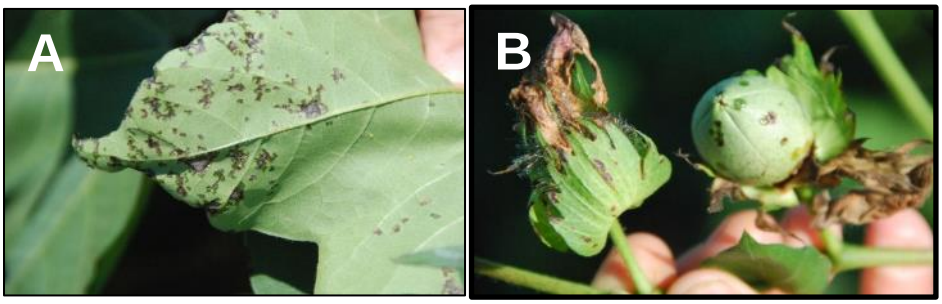

Figure 1. Typical bacterial blight lesions on cotton leaf (A) and boll (B) infected with *Xanthomonas citri* subsp. *malvacearum*.

Materials and Methods

The cultivars (n=52) contained in the Mississippi State University cotton Official Variety Trial (OVT) were planted in Stoneville, MS during 2019. Plots, consisted of two rows of each cultivar, 35' in length. Each cultivar was replicated eight times (four inoculated; 4 non-inoculated) and planted in a RCBD with a split-plot constraint (inoculation). One isolate, believed to consist of a race 18 isolate of *Xcm* collected from MS during 2011, was cultured on agar medium and incubated for 7 days. One day prior to inoculation, the bacteria was harvested from culture plates and added to

0.01 M phosphate buffered saline with a final concentration of approximately 2.8 × 10^8 cells/ml. Inoculum was prepared by mixing the PBS with water and included 1.25% of SilWet L99 (Helena, Inc.). Inoculum was applied to the adaxial side of leaves using a CO_2pressurized backpack sprayer calibrated to apply 15 GPA.

Plots were visually evaluated for disease symptoms based on the percentage of leaf surface area exhibiting water-soaked lesions (symptoms of bacterial blight; 17 and 30 days post-inoculation) as well as the total percentage of the leaves in each plot exhibiting symptoms using a 0-100% scale. Defoliation was also assessed, but data for defoliation were not considered when assessing cultivar rank. Plots were mechanically harvested at the end of the season to determine response of cultivars to inoculation.

The response to *Xcm* of each cultivar was evaluated based on the average of the last disease evaluation (30 days after inoculation). Assessments of response to the bacterium were based on the percentage of the leaf surface area within each plot exhibiting symptoms (incidence) and are reported as MR (moderately-resistant), MS (moderately-susceptible), R (resistant), and S (susceptible) based on those values.

Results

Temperature averages were not out of line with the 30-year norm for Stoneville, MS; however, the average maximum air temperature in September was 10°F warmer than the norm (96.2° vs 86°F). In addition, October was 2°F cooler than the norm. Most notably, an increase in rainfall was observed for May through August and October, when an increase of approximately 14 inches of rainfall occurred compared to the 30-year norm (35.6 inches=2019 rainfall (May-October); 21.7=30-year norm) (Figure 2).

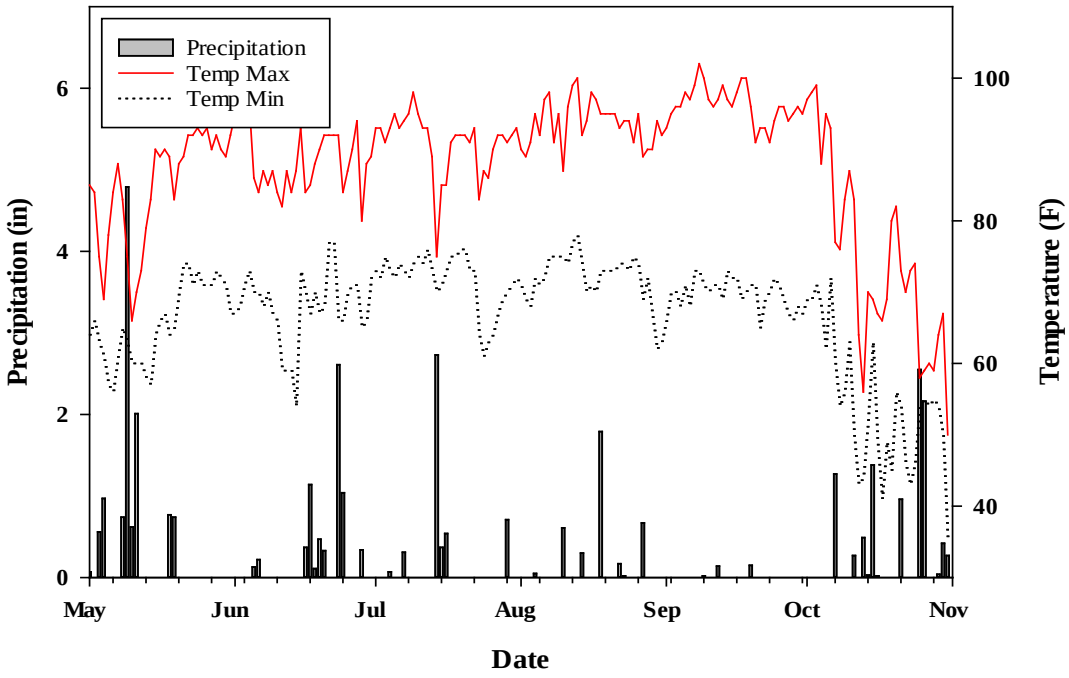

Figure 2. Environmental variables (temperature minimum, temperature maximum and precipitation) during the 2018 season between May 1 and October 31, 2019 from Stoneville, MS.

Foliar evaluations made 30 days post-inoculation suggested that 58% of the cultivars evaluated were resistant to bacterial blight with only a limited amount of symptom expression present (0.8 – 5% of the leaves in the plot exhibiting water-soaked lesions). Conversely, 35% of the entries evaluated were judged to be susceptible to bacterial blight (30 – 60% of the leaves in the plot exhibiting water-soaked lesions). The remainder of the entries, 4% and 4% were observed to be moderately susceptible and moderately resistant, respectively (Table 1).

Seed cotton yield differences were analyzed on averages of entries contained within each response group (S, R, MR, MS) (Figure 3). No significant differences were observed between the inoculated or non-inoculated entries within each response group. In all cases, the non-inoculated plots produced greater yield than the inoculated by between 31 (R cultivars) and 403 (S cultivars) lbs. of seed cotton. Entries considered to be R to bacterial blight and that were non-inoculated produced significantly more yield than S-inoculated, and the MS non- and -inoculated cultivars (Figure 3).

Table 1. Response of the cotton varieties in the 2019 Mississippi State University Official Variety Trial to inoculation with the bacterial blight bacterium at Stoneville, MS.

Variety	Response	Variety	Response
AMX 1816 B3XF	S	DP 1916 B3XF	S
AMX 1818 B3XF	R	NG 3522 B2XF	S
AMX 1828 B3XF	MR	NG 3729 B2XF	S
AMX 19A005 B3XF	S	NG 3930 B3XF	R
AMX 19A006 B3XF	R	NG 3994 B3XF	MS
CG 19XE9 B3XF	R	NG 4936 B3XF	MS
CG 9178 B3XF	S	NG 5711 B3XF	R
CG 9608 B3XF	S	PHY 340 W3FE	R
DG 3317 B3XF	S	PHY 350 W3FE	R
DG 3385 B2XF	S	PHY 480 W3FE	R
DG 3427 B3XF	S	PHY 580 W3FE	R
DG 3470 B3XF	S	PX 3B07 W3FE	R
DG 3520 B3XF	R	PX 3B09 W3FE	R
DG 3526 B2XF	S	PX 3C06 W3FE	R
DG 3555 B3XF	R	PX 3D32 W3FE	R
DG 3570 B3XF	S	PX 3D43 W3FE	R
DG 3615 B3XF	R	PX 5C05 W3FE	R
DP 1518 B2XF	R	PX 5C45 W3FE	R
DP 1646 B2XF	MR	PX 5D28 W3FE	R
DP 1725 B2XF	S	PX 5E28 W3FE	R
DP 1835 B3XF	S	PX 5E34 W3FE	R
DP 1845 B3XF	R	SSG UA 114	R
DP 1851 B3XF	R	SSG UA 222	R
DP 18R411 B3XF	R	ST 4550GLTP	S
DP 18R438 B3XF	R	ST 5471GLTP	R
DP 18R445 B3XF	S	ST 5600B2XF	S

Response is presented as a letter assessment based on the percentage of plant material exhibiting disease post-inoculation. Variety responses listed above is based on disease incidence following inoculation with the bacterial blight causal organism and based on evaluations of observable disease incidence on a 0-100% scale. Responses were assessed as S = susceptible; MS = moderately susceptible; MR = moderately resistance; and R = resistant based on the observational response of each variety in a replicated variety trial planted in Stoneville, MS. Plants were inoculated with the bacterium that causes bacterial blight and evaluated for the incidence, severity and defoliation that resulted from bacterial blight.

Yield differences were analyzed on averages of entries contained within each response group (S, R, MR, MS). No significant differences were observed between either inoculated or non-inoculated cultivars within each response group. However, significant differences were observed between some of the inoculated cultivars within specific response groups (moderately susceptible inoculated cultivars produced 8.3% greater yield than the susceptible inoculated and the moderately susceptible inoculated produced a 13.8% greater yield than the moderately resistant cultivars) suggesting that cultivar selection is important to optimize yield when choosing between the response of some cultivars to bacterial blight (Figure 3).

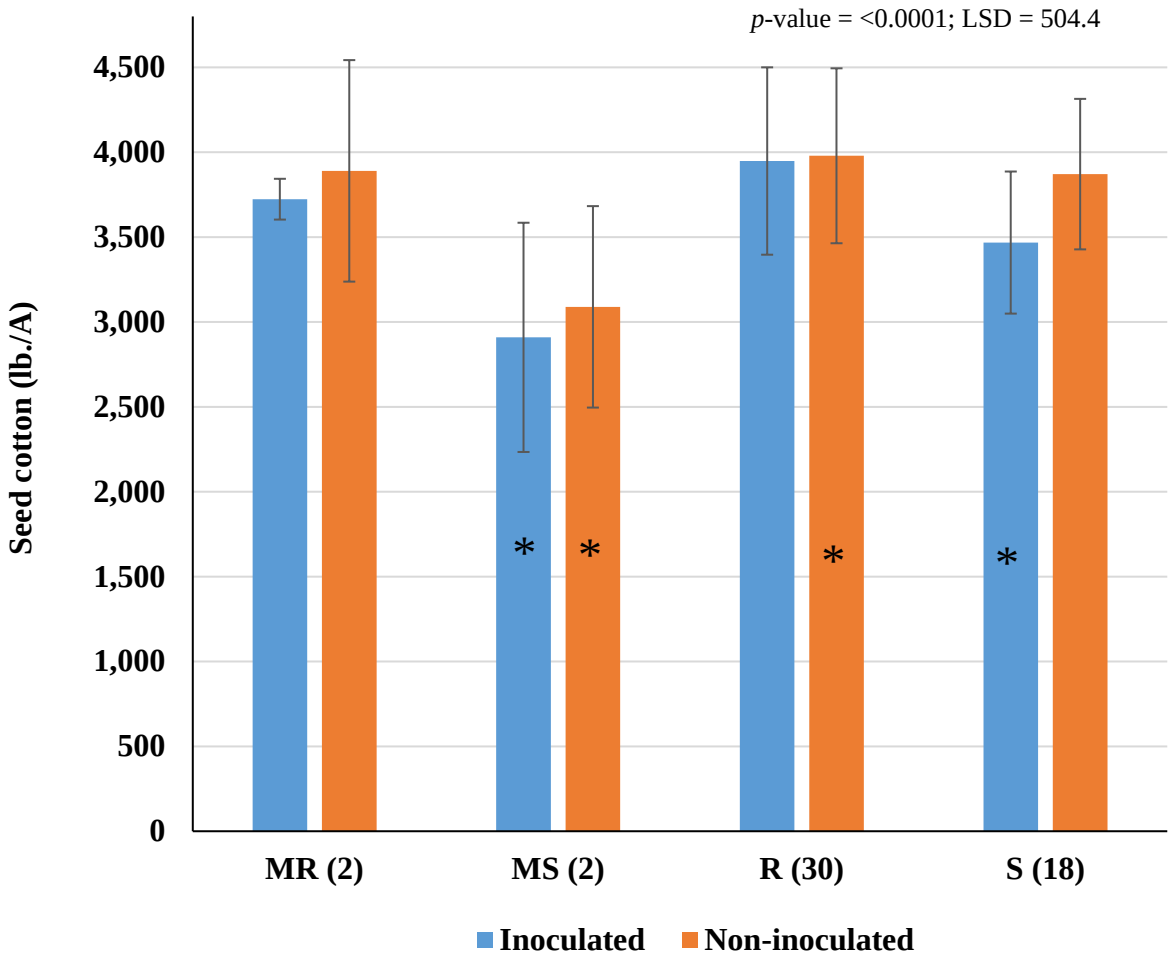

Figure 3. Yield response (seed cotton lb./A) of cultivars averaged by response to bacterial blight (either MR, MS, R, or S) inoculation. Error bars indicate the standard deviation. Asterisks indicate significant differences between yield.

Discussion

Cultivar selection is important to optimize yield when choosing between cultivar response to bacterial blight. Based on the 2019 trials, bacterial blight-resistant cultivars provide the greatest yield protection.