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

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Abstract

During 2018, inoculation trials with the bacterial blight cacterium, *Xanthomonas citri* subsp. *malvacerrum* (*Xcm*) were conducted to determine the susceptibility of the cotton varieties contained in the Mississippi State University official variety trial. Plots, consisting of two rows of each cultivar contained in the trial (n=67), were two rows wide, 35 feet long and replicated eight times so that four replicate plots could be inoculated and four replicate plots remained non-inoculated. Inoculations were conducted two times due to inclement weather that occurred immediately after the first inoculation event that was conducted at white flower. Observations for the presence of water-soaked lesions were conducted post-inoculation. In general, the greater majority, 54%, of the cultivars were observed to be resistant to *Xcm* with 28% of the remaining varieties exhibiting a susceptible response to the bacterium. In addition, when yield was considered based on response category (susceptible, resistant, moderately susceptible, moderately resistant) only plots containing susceptible cultivars exhibited a yield reduction in response to bacterial blight infection. Taken as a whole, bacterial blight-susceptible cultivars accounted for a 153-pound reduction in seed cotton between the non-inoculated and *Xcm*-inoculated plots.

Introduction

Bacterial blight of cotton, caused by *Xanthomonas citri* subsp. *malvacearum* (*Xcm*), can be a devastating foliar disease. In general, *Xcm* can cause seedling blight, leaf spot, lesions on stems, petioles, and bolls, and a boll rot (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% can occur. 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 recent, continued outbreaks of bacterial blight throughout the United States cotton production system, providing farmers with unbiased information regarding the response of commercially available cultivars to *Xcm* and aiding in variety 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.

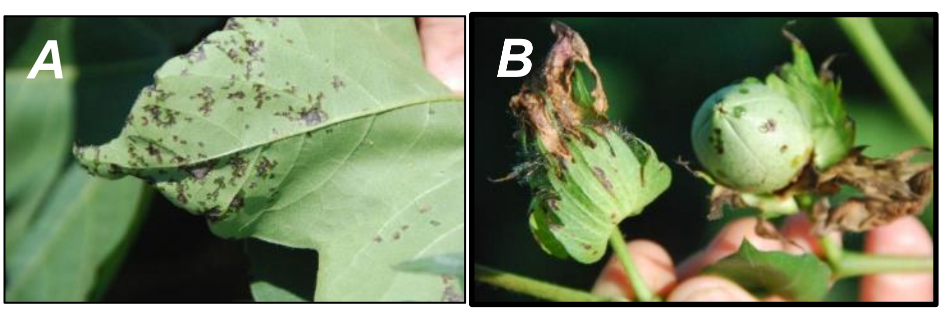

Figure 1. Typical bacterial blight lesions on cotton leaf (A) and boll (B) infected with *Xanthomonas citri* subsp. *malvacearum*.

Materials and Methods

The cultivars (n=67) contained in the Mississippi State University cotton Official Variety Trial (OVT) were planted in Stoneville, MS during 2018. Plots, consisted of two rows of each cotton cultivar by 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 multiboom mounted sprayer at 10 GPA at first white flower (July 2, 2018). However, due to rainfall occurring within one-hour post-inoculation, a second inoculation event (July 9, 2018) was conducted approximately two weeks later with a CO_2 pressurized backpack sprayer calibrated to apply 15 GPA to the adaxial leaf surface. Plots were visually evaluated for disease symptoms based on the percentage of leaf surface area exhibiting water-soaked lesions (symptoms of bacterial blight; 8 and 22 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.

Results

Environmental conditions differed during the season, but temperature averages were not out of line with the 30-year norm for Stoneville, MS. However, an increase in rainfall was observed for August and September, when an increase of approximately 10 inches of rainfall occurred compared to the 30-year norm (5.24 inches=norm; 15.64 inches observed for 2018) (Figure 2).

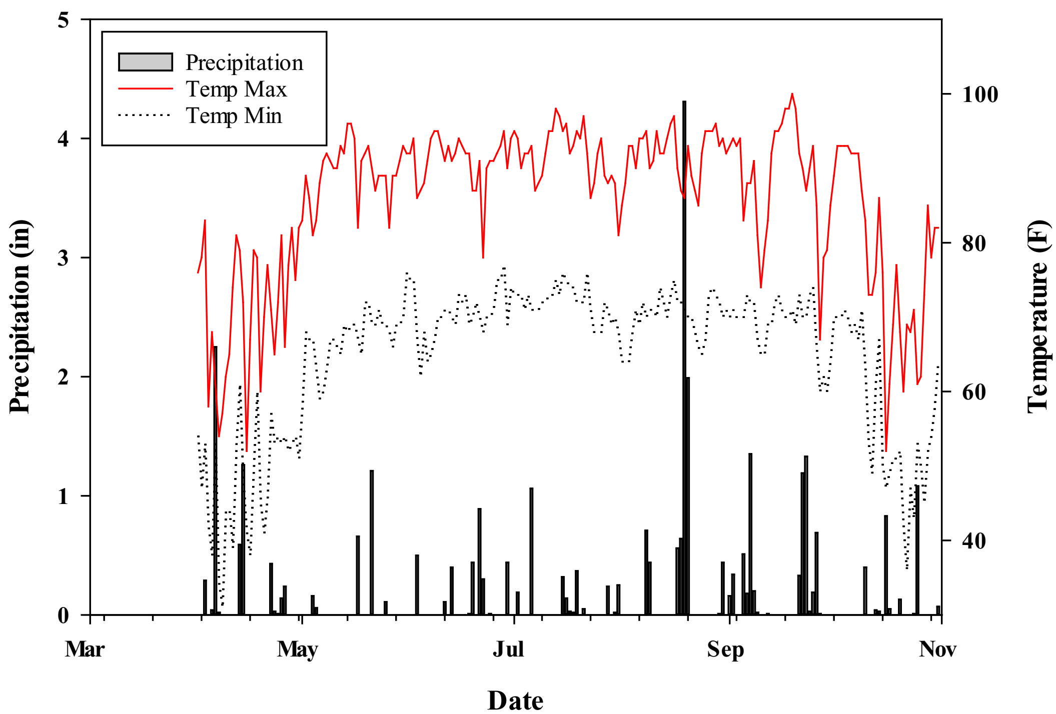

Figure 2. Environmental variables (temperature minimum, temperature maximum and precipitation) during the 2018 season between April 1 and October 31, 2018 from Stoneville, MS.

Foliar evaluations made 22 days post-inoculation suggested that 54% of the cultivars evaluated were resistant to bacterial blight with only a limited amount of symptom expression present (0.5 – 8% of the leaves in the plot exhibiting water-soaked lesions). Conversely, 28% of the cultivars evaluated were judged to be susceptible to bacterial blight (23 – 50% of the leaves in the plot exhibiting water-soaked lesions). The remainder of the cultivars, 12% and 6% were observed to be moderately susceptible and moderately resistant, respectively (Table 1).

Table 1. Response of the cultivars (n=67) contained in the Mississippi State University cotton official variety trial program to inoculation with an isolate of *Xanthomonas citri* subsp. *malvacearum*.

Cultivar	Response		Cultivar	Response
AMX 1801 B3XF	MR		NG 3699 B2XF	R
AMX 1815 B3XF	R		NG 3729 B2XF	S
AMX 1816 B3XF	S		NG 3780 B2XF	MS
AMX 1817 B3XF	S		NG 4689 B2XF	R
AMX 1818 B3XF	R		NG 4777 B2XF	R
AMX 1819 B3XF	MR		NG 5007 B2XF	S
BX 1973GLTP	S		NG 5711 B3XF	R
BX 1974GLTP	S		PHY 300 W3FE	R
BX 1975GLTP	S		PHY 312 WRF	MS
BX 1976GLTP	R		PHY 330 W3FE	R
CG 3527 B3XF	MS		PHY 340 W3FE	R
CG 9608 B3XF	S		PHY 430 W3FE	R
CPS 18501-C	R		PHY 440 W3FE	MR
CPS 18502-C	R		PHY 444 WRF	MS
CPS 18503-D	R		PHY 480 W3FE	R
CPS 18507-D	S		PX 3A82 W3FE	R
CPS 18R817	S		PX 3A99 W3FE	R
CPS 18R827	S		PX 3B07 W3FE	R
DG 1702 GLT	R		PX 3B09 W3FE	R
DG 3214 B2XF	MS		PX 3C06 W3FE	R
DG 3385 B2XF	S		PX 4A64 W3FE	R
DG 3433 B2XF	S		PX 4A69 WEFE	R
DG 3526 B2XF	S		PX 5B73 W3FE	R
DP 1518 B2XF	R		PX 5C09 W3FE	R
DP 1555 B2RF	S		PX 5D28B W3FE	R
DP 1646 B2XF	MR		SSG UA 114	R
DP 1725 B2XF	S		SSG UA 222	R
DP 17R818 B3XF	R		ST 4949GLT	S
DP 17R820 B3XF	S		ST 5020GLT	R
DP 1820 B3XF	R		ST 5122GLT	MS
DP 1823 NR B2XF	S		ST 5471GLTP	R
DP 1835 B3XF	MS		ST 5517GLTP	R
DP 1845 B3XF	R		ST 5818GLTP	MS
DP 1851 B3XF	R			

Responses to *Xcm* inoculation were defined as **S** = susceptible, **MS** = moderately susceptible, **MR** = moderately resistance, and **R** = resistant based on the observational response of each cultivar in a replicated variety trial planted in Stoneville, MS.

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).

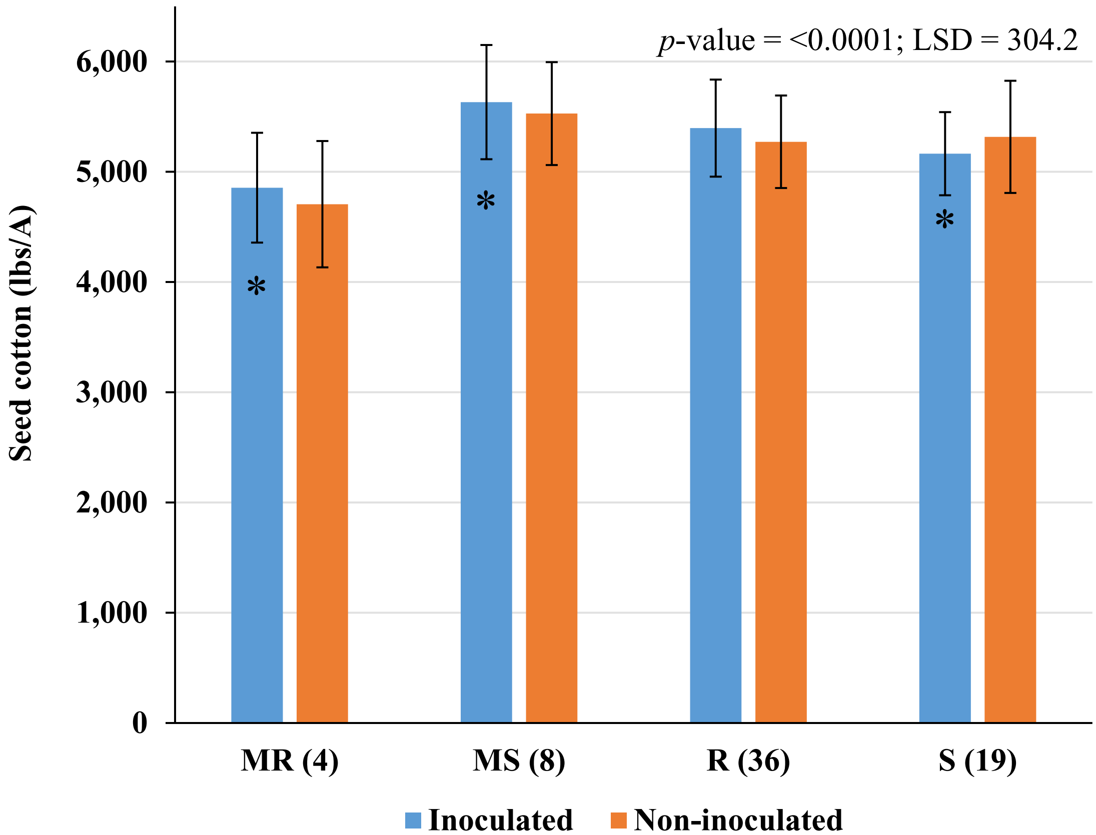

Figure 3. Yield response (seed cotton lb/A) of cultivars averaged by response to bacterial blight (either MR, MS, R, or S) inoculation. Number of entries in each classification are presented in parentheses on the x-axis. Error bars indicate the standard deviation. Asterisks indicate significant differences in yield.

Discussion

A greater number of commercially available bacterial blight-resistant cultivars offered by seed companies suggests that a shift in the breeding efforts has been made to provide farmers with resistant material. By planting bacterial blight-resistant cultivars, farmers can reduce the potential yield losses associated with a major cotton disease. The only cultivars that registered a yield reduction as a result of infection with *Xcm* were those that were observed to be susceptible based on the amount of bacterial blight present on leaves post-inoculation. Research into bacterial blight needs to continue to verify cultivar response to provide farmers with the most current information regarding the response of commercially available germplasm to an important disease.