

**PERFORMANCE OF COMMERCIAL COTTON CULTIVARS
AGAINST BACTERIAL BLIGHT PATHOGEN IN THE TEXAS HIGH PLAINS**

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Abstract

Bacterial blight of cotton, caused by *Xanthomonas campestris* pv. *malvacearum* (Smith) Dye (XCM), is one of the most important bacterial diseases causing significant losses to cotton growers all over the world. Cotton disease resistance is the primary method of controlling bacterial blight of cotton. Studies were conducted in 2000, 2001 and 2002 to determine the resistance levels of present germplasm in west Texas. The main objective of this study was to differentiate resistant commercial cotton varieties from susceptible varieties. Plants for all experiments were inoculated with XCM (race 18) by spray application. The plots were rated for disease after the symptoms were clearly visible on both surfaces of the leaves. Differences in resistance to XCM were identified by analysis of variance ($\alpha = 0.05$) using the general linear model procedure of statistical analysis system. Mean separation between entries was performed with the Waller-Duncan k-ratio t-test at $\alpha = 0.05$. An arbitrary scale was developed for the range of ratings and used to group entries. Highly susceptible varieties were All-Tex (Atlas, Atlas RR, Atlas Plus, Excess Plus, Top-Pick), DeltaPine (2379, 458 B/RR), FiberMax (5013, 5024), Paymaster (183, 330, HS-26, 2266 RR, 2326 RR, 2326 BG/RR, 2344 BG/RR, 2379 RR, 2145 RR), Phytogen (355, GA 161, GA894, HS-12, 952, 14512), Stoneville (474, 4892 BR) and Texas 28 R. Less susceptible varieties were All-Tex Max-9, BXN 16, Paymaster 2200 RR, Stoneville 2454 R and SureGrow 501 BR. Moderately resistant varieties were All-Tex (Xpress RR, Xpress), Paymaster 2280 BG/RR, Stoneville 5599 BR, SureGrow 521 RR and Syngenta NK 2164 C. Highly resistant varieties were All-Tex Excess, FiberMax (819, 832, 958, 966, 989), Paymaster (280, 1218 BG/RR, 2167 RR), Stoneville (239, 239 BR), SureGrow (747, 215 BG/RR), Syngenta NK 2387 C and Tamcot (Sphinx, Pyramid).

Introduction

The bacterial blight pathogen has expressed significant genetic variability for virulence on cotton with the evolution of many races (Wallace and El-Zik, 1990). Due to variability in the pathogen, cultivars that were resistant to XCM either completely lost the resistance or have become less resistant (Allen and West, 1991; Brinkerhoff, 1970). There are 19 physiological races of XCM, which currently have been identified (El-Zik and Thaxton, 1992; El-Zik and Thaxton, 1994). Race 18 is the primary race distributed across the U.S. and Australia in recent years (Allen and West, 1991; Thaxton et al., 2001). It is considered the most virulent race (Kirkpatrick and Rothrock, 2001) and many U.S. varieties may be susceptible to this race. Hence, there is a need to determine levels of resistance in new and currently grown cotton cultivars.

Materials and Methods

The test site (approximately 8 hectares), located at the City Farm in Lubbock, TX, was sampled and tested for nutrient levels in the spring before planting. Nitrogen was applied pre-plant at the rate of 90 kg ha⁻¹ for 2000 and 2001 tests and 100 kg ha⁻¹ for 2002 tests. Treflan[®] (Trifluralin), a pre-emergent herbicide was incorporated into the soil @ 1.78 L ha⁻¹ using a tandem disk plow. Temik[®] (Aldicarb @ 0.5 Kg ai ha⁻¹) was applied in the furrow at planting to control insects. Seeds were treated with Vitavax-PCNB[®] (Carboxin-PCNB) at the rate of 0.73 g ai kg⁻¹ of seed and Allegiance[®] (Metalaxyl) at the rate of 0.15 g ai kg⁻¹ of seed to control common seedling pathogens. Plots were planted using a 4-row cone planter. Plots were 15.3 m long with 1-m row spacing and 2 rows wide. PM '2326 RR' was used as susceptible check during 2000, 2001 and 2002. Tamcot 'Sphinx' was used as resistant check during 2000 test where as, Tamcot 'Pyramid' was used as resistant check during 2001 and 2002 tests. All the varieties were in a randomized complete block design and replicated four times.

Three isolates of XCM (IS-3, IS-9, and IS-15), obtained from Dr. Peggy Thaxton (Texas A&M Univ., College Station) were maintained on potato carrot dextrose agar (Bird and Blank, 1951). In 2000 and 2001, inoculum was increased with an equal mixture of the isolates on Trypticase soybroth (Thomas Scientific) at 30 g L⁻¹ on shake culture for 36 hrs at room temperature. In 2002, only isolate IS-15 was used since the other two isolates were no longer sufficiently virulent. Inoculation of the pathogen was accomplished by a pressure spray (83 kPa) on the top surface of the leaves using a tractor driven sprayer. Plots were inoculated when the plants had 8-10 true leaves. The concentration of XCM used for inoculation was approximately 10⁶ bacterial cells ml⁻¹ in 2000 and 2001 and 10⁷ bacterial cells ml⁻¹ in 2002. The amount of spray fluid applied was approximately 470 L ha⁻¹. A silicon based adjuvant, Silwet L77[®] (0.25 % v/v) was mixed to the spray fluid at the time of all applications. Silwet was used to

spread the bacteria on leaf surface, which in turn helps the bacteria to gain entry into the host plant (Johnson et al., 1996). Inoculations were scheduled between the hours of 9:30 AM and 3:00 PM, so that stomata were open. One to three days after the inoculation, the plots were irrigated with a linear system to splash and spread the bacteria among the plants. The plots were inoculated three times during 2000 and 2001 tests and twice during 2002 tests. Plots were rated for disease after clear visible symptoms of disease were observed on the plants. Plots were rated 3 weeks after first inoculation in 2000 and 2001 and 2 weeks after first inoculation in 2002. A grading scale of 0 – 1 was used to assign the incidence of disease for each plot with '0' being no plant in the plot was diseased and '1' being all the plants in the plot were diseased. Each plant in a plot was evaluated, and the average rating was applied for that plot. Plots were rated based on disease incidence (DI), not severity. Differences in resistance to XCM were identified by analysis of variance ($\alpha = 0.05$) using the general linear model procedure of statistical analysis system. Mean separation between entries was performed with the Waller-Duncan k-ratio t-test at $\alpha = 0.05$. The author developed an arbitrary scale (Table 1) for the range of ratings and used it to group entries.

Results and Discussion

Highly susceptible varieties were All-Tex (Atlas, Atlas RR, Atlas Plus, Excess Plus, Top-Pick), DeltaPine (2379, 458 B/RR), FiberMax (5013, 5024), Paymaster (183, 330, HS-26, 2266 RR, 2326 RR, 2326 BG/RR, 2344 BG/RR, 2379 RR, 2145 RR), Phytogen (355, GA 161, GA894, HS-12, 952, 14512), Stoneville (474, 4892 BR) and Texas 28 R (Table. 2). Less susceptible varieties were All-Tex Max-9, BXN 16, Paymaster 2200 RR, Stoneville 2454 R and SureGrow 501 BR (Table 2). Moderately resistant varieties were All-Tex (Xpress RR, Xpress), Paymaster 2280 BG/RR, Stoneville 5599 BR, SureGrow 521 RR and Syngenta NK 2164 C (Table 2). Highly resistant varieties were All-Tex Excess, FiberMax (819, 832, 958, 966, 989), Paymaster (280, 1218 BG/RR, 2167 RR), Stoneville (239, 239 BR), SureGrow (747, 215 BG/RR), Syngenta NK 2387 C and Tamcot (Sphinx, Pyramid) (Table 2). This demonstrates that many of the seed companies, which produce U.S. varieties, have varieties with bacterial blight resistance. Producers do have some choices with respect to blight resistant material, though few of the choices are for stripper type cottons.

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Table 1. Arbitrary scale used to classify the response of different commercial cultivars against *Xanthomonas campestris* pv. *malvacearum* (race-18).

Year	Grouping*	Mean DI (%)	Disease reaction
2000	A	0.81 – 1.00	Very susceptible
	B - D	0.50 – 0.95	Less susceptible
	E - G	0.06 – 0.50	Moderately resistant
	H	0.00 – 0.06	Highly resistant or Immune
2001	A and B	0.88 – 1.00	Very susceptible
	C - E	0.48 – 0.81	Less susceptible
	F - H	0.10 – 0.34	Moderately resistant
	I - J	0.00 – 0.13	Highly resistant or Immune
2002	A	0.98 – 1.00	Very susceptible
	B and C	0.65 – 0.77	Less susceptible
	D - F	0.00 – 0.14	Highly resistant or Immune

* = Waller-Duncan k-ratio t-test grouping ($\alpha = 0.05$).

Table 2. Response of commercial cotton cultivars against *Xanthomonas campestris* pv. *malvacearum* (race 18) when screened during 2000, 2001 and 2002 at City farm, Lubbock, TX.

Variety	Mean DI (%)			Disease reaction
	2000	2001	2002	
All-Tex Atlas	1.00	1.00	-	Very susceptible
All-Tex Atlas RR	1.00	-	-	Very susceptible
All-Tex Atlas Plus	1.00	-	-	Very susceptible
All-Tex Excess Plus	1.00	-	-	Very susceptible
All-Tex Top-Pick	1.00	-	-	Very susceptible
All-Tex Max-9	0.81	-	-	Less susceptible
All-Tex Xpress RR	0.31	-	-	Moderately resistant
All-Tex Xpress	0.25	0.53	-	Moderately resistant
All-Tex Excess	0.00	-	-	Highly resistant/Immune
BXN 16	0.67	-	-	Less susceptible
DeltaPine 2379	1.00	0.98	-	Very susceptible
DeltaPine 458 B/RR	0.94	1.00	-	Very susceptible
FiberMax 5013	-	0.98	-	Very susceptible
FiberMax 5024	-	0.98	-	Very susceptible
FiberMax 819	0.00	-	-	Highly resistant/Immune
FiberMax 832	0.00	-	-	Highly resistant/Immune
FiberMax 958	0.00	0.10	-	Highly resistant/Immune
FiberMax 966	0.00	-	-	Highly resistant/Immune
FiberMax 989	0.00	-	-	Highly resistant/Immune
Paymaster 183	1.00	-	-	Very susceptible
Paymaster 330	1.00	-	-	Very susceptible
Paymaster HS-26	0.95	0.98	-	Very susceptible
Paymaster 2266 RR	-	1.00	1.00	Very susceptible
Paymaster 2326 RR	1.00	1.00	1.00	Very susceptible
Paymaster 2326 BG/RR	1.00	0.98	-	Very susceptible
Paymaster 2344 BG/RR	-	1.00	-	Very susceptible
Paymaster 2379 RR	1.00	0.98	-	Very susceptible
Paymaster 2145 RR	1.00	0.93	0.77	Very susceptible
Paymaster 2200 RR	0.67	0.95	-	Less susceptible
Paymaster 2280 BG/RR	0.41	0.34	-	Moderately resistant
Paymaster 280	0.00	-	-	Highly resistant/Immune
Paymaster 1218 BG/RR	-	0.05	0.08	Highly resistant/Immune
Paymaster 2167 RR	-	0.04	0.14	Highly resistant/Immune
Phytogen 355	1.00	1.00	-	Very susceptible
Phytogen GA 161	1.00	1.00	-	Very susceptible
Phytogen GA 894	1.00	-	-	Very susceptible
Phytogen HS-12	1.00	0.98	-	Very susceptible
Phytogen 952	1.00	-	-	Very susceptible
Phytogen 14512	1.00	-	-	Very susceptible
Stoneville 474	1.00	-	-	Very susceptible
Stoneville 2454 R	-	0.71	-	Less susceptible
Stoneville 4892 BR	-	0.88	-	Very susceptible
Stoneville 5599 BR	0.88	0.34	-	Moderately resistant
Stoneville 239	0.00	-	-	Highly resistant/Immune
Stoneville 239 BR	0.06	-	-	Highly resistant/Immune
SureGrow 501 BR	0.75	-	-	Less susceptible
SureGrow 521 RR	0.25	-	-	Moderately resistant
SureGrow 747	0.00	-	-	Highly resistant/Immune
SureGrow 215 BG/RR	-	-	0.05	Highly resistant/Immune
Syngenta NK 2165 C	0.50	0.48	-	Moderately resistant
Syngenta NK 2387 C	-	0.11	-	Highly resistant/Immune
TAMCOT Sphinx	0.00	-	-	Highly resistant/Immune
TAMCOT Pyramid	-	0.00	0.00	Highly resistant/Immune
Texas 28 R	-	-	-	Very susceptible