SCREENING CULTIVARS FOR RESISTANCE TO FUSARIUM WILT IN WEST TEXAS

Jason E. Woodward
Texas Tech University
Texas AgriLife Extension Service
Lubbock, TX
Terry A. Wheeler
Texas ArgiLife Research
Lubbock, TX

Abstract

Field trials were conducted during the 2008 and 2009 growing seasons to evaluate the performance of commercially available cotton cultivars in fields with a history of Fusarium wilt. All locations where trials were established were infested with the root-knot nematode (*Meloidogyne incognita*). The cultivars Stoneville 5458B2F, Stoneville 4288B2F, Stoneville 4498B2F, Deltapine 104B2RF, Deltapine 174RF, and Stoneville 4554B2F consistently exhibited low Fusarium wilt incidence. Conversely, disease incidence was greatest for Phytogen 375WRF, Phytogen 565WRF, Fibermax 1740B2F, Fibermax 1880B2F, and Fibermax 9063B2F. Lint yields varied by location; however, yields were higher for Deltapine 174RF, Deltapine 104B2RF, Stoneville 5458B2F, Stoneville 4288B2F, Stoneville 4498B2F. Other cultivars that ranked in the top 20% included NexGen 3410B2RF, Americot 1532B2RF, and NexGen 3348B2RF. Yields were lowest for Fibermax 1880B2F and Phytogen 375WRF in all trials. Additional parameters, such as fiber quality, loan value, and technology fees will influence a producer's decision in selecting which cultivar to plant. These results indicate that there are substantial differences in the performance of cultivars as it relates to Fusarium wilt. Additional screening is needed to better identify cultivars that are suitable for production in fields infested with *Fov*.

Introduction

Fusarium wilt, caused by the soilborne fungus *Fusarium oxysporum* f. sp. *vasinfectum* (*Fov*), is an economically important disease in portions of west Texas. Infection of cotton (*Gossypium hirsutum*) by *Fov* is more severe when fields are co-infested with the root-knot nematode (*Meloidogyne incognita*) (2). Virulent populations of *Fov*, capable of inciting disease in the absence of *M. incognita*, have been identified in the United States (5); however, disease development in west Texas appears to reflect the classical Fusarium wilt-root-knot interaction (Woodward, personal observation). Management strategies for this disease complex consist of the use of nematicides, rotation with non-host crops, soil fumigation, and planting resistant cultivars. Nematicides do not directly impact *Fov*, but can negatively impact Fusarium wilt via reducing nematode damage (3). Likewise, crop rotation affects *M. incognita* more so than *Fov*, due to the ability of the fungus to survive saprophytically (8). Fumigation is effective at reducing Fusarium wilt damage (4); however, it has yet to be widely adopted. Varying levels of resistance to *Fov* and *M. incognita* (6,7) has been identified in some cultivars. Information regarding the performance of commercially available cultivars is limited (1). The objective of this work was to identify cotton cultivars currently being marketed in west Texas which are partially resistant to Fusarium wilt.

Materials and Methods

Field trials were conducted in Dawson, Gaines, Terry, and/or Yoakum counties during the 2008 and 2009 growing seasons. These fields where known to be infested with *Fov* and have a history of Fusarium wilt. Trials consisted of 25-32 entries per location with a total of four replications. Trials were planted during the middle of May using a John Deere Maxx Emerge vacuum planter equipped with cones. The 2008 Dawson county trial, was replanted in early June due to poor stand establishment. No nematicides were used in any of the trials, and all management practices were at the discretion of the cooperating producer. Stand counts were determined approximately 28 days after planting and disease incidence was monitored throughout the season. Trials were harvested using a John Deere 484 modified with an internal basket equipped with load cells. Data were analyzed using PROC ANOVA in SAS, and means were separated using Fisher's Protected LSD ($P \leq 0.05$). The cultivars evaluated varied by trial, thus, trials were analyzed independently.

Results and Discussion

The trial location utilized in Dawson County had been used in previous years to conduct similar experiments (1). Fusarium wilt incidence ranged from 0.5 to 3.3% (Table 1), which is substantially lower than previous years (data not shown). Differences in lint yield were observed despite low levels of disease incidence. Yields ranged from 563.2 to 1164.9 lb/A for Phytogen 375WRF and Stoneville 5458B2F, respectively. Yields for Stoneville 4554B2F, Deltapine104B2RF, Deltapine 174RF, and (1090.0, 1110.5, 1156.3 lb/A, respectively) did not differ from Stoneville 5458B2F. Yields for Fibermax 9063B2F (593.2 lb/A) were similar to those of Phytogen 375WRF.

The field site in Gaines County was co-infested with *Verticillium dahliae* in addition to *Fov* and *M. incognita*. Disease incidence at this location ranged from 0 to 22.8% (Table 2), and the % mortality (due to *Fov)* was moderately correlated with yield (data not shown). Yields were lowest for the cultivars Fibermax 840B2F, Phytogen 375WRF, Fibermax 820RF, and Deltapine 167RF, 513, 549, 549, and 550 lb/A, respectively. Yields were greatest for Deltapine 174RF (1733 lb/A), followed by Stoneville 5458B2F, Stoneville 4554B2F, and NexGen 3410RF at 1423, 1136, and 1068 lb/A, respectively.

A severe Fusarium wilt epidemic was observed at the Yoakum County site in 2007. Field trials were established during the 2008 growing season; however, stands were lost due to extreme winds and blowing sand. A successful trial was conducted in 2009. Disease incidence at this location was much higher ranging from 5.7 to 83.2% with a mean of 32.9% (Table 3). Yields were negatively correlated with disease incidence (data not shown) and ranged from 99 to 1314 lb/A. Yields were lowest for Phytogen 375WRF, Phytogen 565WRF, Fibermax 1740B2F, Fibermax 1880B2F, and Fibermax 9063B2F; whereas, yields were greatest for Stoneville 5458B2F, Stoneville 4288B2F, Stoneville 4498B2F, and Deltapine 104B2RF.

Stunting, although sporadic, was observed throughout the 2009 Terry County trial; however, few plants exhibited classical Fusarium wilt symptoms (2). Despite no obvious differences in disease incidence yield results from this trial were similar to those observed in other trials. With yields being greatest for Deltapine 174RF, Stoneville 4288B2F, Stoneville 5458B2F, Stoneville 4498B2F and DP104B2RF and lowest for Phytogen 375WRF and Fibermax 1740B2F.

Fusarium wilt is a destructive disease that affects production fields on the Southern High Plains of west Texas. The interaction with *M. incognita* makes identifying resistant cultivars difficult; however, several strategies that negatively impact the nematode indirectly affect Fusarium wilt. Results from this study are of value when choosing cultivars to plant in fields infested with *Fov*. Furthermore, the rapid development and release of new cotton cultivars necessitates the need for an active screening program.

Acknowledgements

This research was funded in part through a grant from the Cotton Incorporated Texas State Support Committee. The contributions of grower collaborators Douglas Stafford, Jackie Burris, Shannon Patton and Raymond McPherson is greatly appreciated. We thank Mitchell Ratliff, Ira Yates, Brian Holliday, Evan Arnold, Justin Carthel, and Victor Mendoza for their technical assistance. We also thank all of the seed companies that provided seed.

References

Batla, M. A, J. E. Woodward, and T. A. Wheeler. 2008. Evaluation of cotton varieties for resistance to Fusarium wilt in West Texas. Proc. Beltwide Cotton Conferences. Pp. 307-312.

Colyer, P. D. 2001. Fusarium wilt. Pages 27-28 in Compendium of Cotton Diseases.T. L Kirkpatrick and C. S. Rothrock eds. American Phytopathological Society, St. Paul, MN.

Colyer, P. D., Kirkpatrick, T. L., Caldwell, W. D., and Vernon, P. R. 1997. Influence of nematicide application on severity of the root-knot nematode-Fusarium wilt disease complex in cotton. Plant Dis. 81:66-70.

Jorgenson, E. C., Hyer, A. H., Garber, R. H., and Smith, S. N. 1978. Influence of soil fumigation on the Fusarium-root-knot nematode disease complex of cotton in California. J. Nematol. 10:228-231.

Kim, Y., Hutmacher, R. B., and Davis, R. M. 2005. Characterization of California isolates of *Fusarium oxysporum* f. sp. *vasinfectum*. Plant Dis. 89:366-372.

Shepherd, R. L. 1986. Cotton resistance to the root knot-Fusarium wilt complex. II. Relation to root-knot resistance and its implications on breeding for resistance. CropSci. 26:233-237.

Shepherd, R. L., and Kappelman, A. J. 1986. Cotton resistance to the root knot-Fusarium wilt complex. I. Relation to Fusarium wilt resistance and its implications on breeding for resistance. Crop Sci. 26:227-232.

Smith, S. N., and Snyder, W. C. 1975. Persistence of *Fusarium oxysporum* f. sp. *vasinfectum* in fields in the absence of cotton. Phytopathology 65:190-196.

Table 1. Final Fusarium wilt ratings and lint yields for cotton cultivars evaluated in Gaines County, TX 2008

Cultivar[a]	Fusarium wilt (% morality)[b]	Lint yield (lb/A)[c]	
DP 174RF	0.0	1733	a[d]
ST 5458B2F	0.0	1423	b
ST 4554B2F	0.0	1136	bc
NG 3410RF	0.3	1068	cd
AT ApexB2RF	1.0	1041	cde
DP 164B2RF	0.7	930	cdef
AM 1532B2RF	1.3	924	cdef
DP 161B2RF	3.6	915	cdef
FM 9160B2F	0.0	914	cdef
AT Orbit RF	0.0	881	cdefg
DP 104B2RF	5.1	868	cdefg
AT Patriot RF	0.0	854	defg
AFD 5065B2RF	2.3	848	defgh
DP 143B2RF	1.9	833	defgh
FM 9063B2F	1.9	817	defghi
FM 9180B2F	3.3	809	defghi
AM 1622B2RF	6.5	807	defghi
PG 485WRF	3.1	788	defghij
DP 147RF	1.3	773	defghij
FM 1880B2F	0.3	764	efghij
NG 4370B2RF	9.8	762	efghij
CG 4020B2RF	2.1	737	fghij
AT Titan B2RF	5.0	717	fghij
AT Epic RF	18.7	685	fghij
AM 1550B2RF	17.9	683	fghij
CG 3035RF	9.1	614	ghij
DP 167RF	0.5	550	hij
FM 820F	1.6	549	hij
PG 375WRF	3.4	549	ij
FM840B2F	22.8	513	j

[a] Cultivar abbreviations include: DP = Deltapine, ST = Stoneville, NG = NexGen, PM = Paymaster, AT = All-Tex, AFD = Associated Farmers Delinting , AM = Americot, CG = Cropland Genetics, and PG = Phytogen. [b] Fusarium wilt was restricted to two replications of the trial, therefore, means separation was not carried out. [c] Lint yield reflect the appropriate lint % from a 1000 g sub-sample. [d] Data are the means from four replications. Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \leq 0.05$).

Table 2. Final Fusarium wilt ratings and lint yields for cotton cultivars evaluated in Dawson County, TX 2008

Cultivar[a]	Fusarium wilt (%)		Lint yield (lb/A)[b]	
DP 104B2RF	1.5	cdefg[c]	1111	ab[c]
ST 5458B2F	0.9	fg	1165	a
ST 4554B2F	1.1	defg	1090	abc
DP 174RF	2.2	cdefg	1156	a
ST 5327B2F	2.1	cdefg	1015	abcd
NG 3348B2RF	0.9	efg	927	bcde
PM 2141B2RF	0.5	g	905	cdef
AT EpicRF	4.2	a	846	defg
AFD 5064F	1.5	cdefg	844	defgh
CG 3220B2RF	1.7	cdefg	872	defg
NG 3410RF	0.5	g	894	def
AM 1532B2RF	1.2	defg	875	defg
ST 4498B2RF	0.7	g	861	defg
DP 161B2RF	1.5	cdefg	742	efgjijk
CG 3035RF	4.1	ab	795	efghi
DP 141 B2RF	1.6	cdefg	771	efghij
PG 315RF	3.0	abcd	784	efghij
AM 1550B2RF	2.7	abcdef	733	fghijk
FM 1880BRF	1.2	defg	727	fghijk
FM 9058F	2.8	abcde	720	fghijk
FM 9180B2F	0.9	fg	740	efghijk
AFD 5065B2F	1.0	defg	694	ghijk
PG 375WRF	3.3	abc	563	k
FM 9063B2F	0.7	g	593	jk
ST 5283F	3.4	abc	651	hijk

[a] Cultivar abbreviations include: DP = Deltapine, ST = Stoneville, NG = NexGen, PM = Paymaster, AT = All-Tex, AFD = Associated Farmers Delinting , AM = Americot, CG = Cropland Genetics, and PG = Phytogen. [b] Lint yield reflect the appropriate lint % from a 1000 g sub-sample. [c] Data are the means from four replications. Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \leq 0.05$).

Table 3. Final Fusarium wilt ratings and lint yields for cotton cultivars evaluated in Yoakum County, TX 2009

Cultivar[a]	Fusarium wilt (%)		Lint yield (lb/A)[b]	
ST 5458B2F	13.8	ijklm[c]	1314	a[c]
ST 4288B2F	11.8	klm	1149	ab
ST 4498B2F	10.9	klm	949	bc
DP 104B2RF	17.4	hijklm	841	bcd
PG 525WRF	14.6	ijklm	750	cde
AM 1532B2RF	21.6	ghijklm	702	cdef
ST 4554B2RF	5.7	m	678	cdefg
DP 174RF	6.2	lm	621	cdefgh
AM 1622B2RF	19.6	hijklm	613	cdefgh
NG 3348B2RF	34.8	efghi	608	cdefgh
AT Patriot	29.2	fghijk	530	defghi
DP 0935B2RF	39.9	cdefgh	528	defghi
DP 141B2RF	29.0	fghijk	523	defghi
NG 4370B2RF	36.9	cdefgh	510	defghi
DP 164B2RF	33.7	efghij	506	defghi
DP 147B2RF	33.3	efghij	484	defghi
NG 3410B2RF	32.1	fghijk	475	efghi
AT ApexB2RF	31.1	fghijk	433	efghij
ST 5288B2F	41.8	cdefg	409	efghij
DP 161B2RF	27.7	fghijkl	403	efghij
FM 9170B2F	34.6	efghi	385	fghij
DP 143B2RF	27.3	fghijklm	362	fghij
FM 9058B2F	48.8	bcdef	334	ghij
AT AridB2RF	35.0	efghi	321	ghij
DP 0949B2RF	57.3	bcd	313	hij
AT TitanB2RF	23.0	ghijklm	299	hij
DP 0924B2RF	38.7	cdefgh	274	hij
FM 9063B2F	58.9	bc	268	hij
FM 1880B2F	54.8	bcde	222	ij
FM 1740 B2F	65.3	ab	207	ij
PG 565WRF	36.6	defgh	193	ij
PG 375WRF	83.2	a	100	j

[a] Cultivar abbreviations include: DP = Deltapine, ST = Stoneville, NG = NexGen, PM = Paymaster, AT = All-Tex, AFD = Associated Farmers Delinting , AM = Americot, CG = Cropland Genetics, and PG = Phytogen. [b] Lint yield reflect the appropriate lint % from a 1000 g sub-sample. [c] Data are the means from four replications. Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \leq 0.05$).

Table 4. Lint yields for cotton cultivars evaluated in Terry County, TX 2009

Cultivar[a]	Lint yield (lb/A)[b]	
DP174	629	a
ST4288	628	a
ST5458	606	a
ST4498	595	ab
DP104	591	ab
AM1532	574	abc
PATRIOT	554	abdc
FM9180	553	abdc
PG315	541	abdc
AM2220	522	abdc
DP0902	517	abdce
FM9160	514	abdcef
FM9058	500	abdcefg
ST5288	493	abdcefg
NG3410	493	abdcefg
EPIC	485	abdcefg
ST4554	483	abdcefg
DP141	481	abdcefg
AM1550	479	abdcefg
FM9170	469	abdcefg
DP164	464	abdcefg
NG3348	435	bcdefgh
DP0912	421	cdefgh
PG565	407	cdefgh
DP0935	402	defgh
ORBIT	400	defgh
ARID	391	defgh
DP143	352	efgh
FM1740	352	efgh
EXP1	349	fgh
NG4370	334	gh
PG375	294	h

[a] Cultivar abbreviations include: DP = Deltapine, ST = Stoneville, NG = NexGen, PM = Paymaster, AT = All-Tex, AFD = Associated Farmers Delinting , AM = Americot, CG = Cropland Genetics, and PG = Phytogen. [b] Lint yield reflect the appropriate lint % from a 1000 g sub-sample. [c] Data are the means from four replications. Means within a column followed by the same letter are not significantly different according to Fisher's Protected LSD ($P \leq 0.05$).