2008 COTTON VARIETY PERFORMANCE UNDER VERTICILLIUM WILT PRESSURE

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Abstract

Verticillium wilt, caused by the soilborne fungus, *Verticillium dahliae*, is an economically important disease of cotton in Gaines County, Texas. *V. dahliae* has a broad range of hosts, including peanuts, which are rotated with cotton in Gaines County. The cotton and peanut rotation results in a yearly increase in the concentration of inoculum in the soil. The objectives of this research were to evaluate the performance of commercially available cotton varieties in fields with varying levels of *Verticillium dahliae* inoculum and compare the net returns between varieties in fields with high and low Verticillium wilt pressure. Field trials were conducted in Gaines County, TX in 2008 to evaluate eleven cotton varieties. Deltapine 174RF and 161B2RF performed consistently well in both trials; whereas, Phtyogen 375WRF performed poorly in both trials. Variety selection is one of the most important decisions a producer must make. Verticillium wilt is one factor that can significantly impact variety performance. Continued evaluations of these varieties are needed.

Introduction

Verticillium wilt, caused by the soilborne fungus, *Verticillium dahliae*, is an economically important disease of cotton in Gaines County, Texas. Symptoms of Verticillium wilt include stunting, brown flecks in the xylem tissue of the stem (Fig. 1), yellow mosaic pattern on leaves (Fig. 2), and eventually defoliation (Fig. 3) (Kirkpatrick, 2001). As a result, fiber and seed quality is reduced (Kirkpatrick, 2001). Cooler (below 90°F) wet environmental conditions favor Verticillium wilt development in host plants (Kirkpatrick, 2001). Crop rotation with a non-host is not a feasible management option since microsclerotia of *V. dahliae* persist in the soil for many years (Kirkpatrick, 2001). Additionally, *V. dahliae* has a broad range of hosts, including peanuts (Kokalis-Burelle, 1997), which are rotated with cotton in Gaines County. The cotton and peanut rotation results in a yearly increase in the concentration of inoculum in the soil. Therefore, planting cotton varieties with improved resistance or tolerance to Verticillium wilt is the most effective tool in managing this disease. The objectives of this study were to evaluate eleven commercially available cotton varieties in fields with varying levels of *V. dahliae* inoculum and to compare net returns between varieties in fields with high and low Verticillium wilt pressure.

Figure 1. Brown fleck in xylem tissue.

Figure 2. Mosaic appearance caused by necrosis of interveinal tissue and leaf margins

Figure 3. Defoliation starting at the base of the plant

Materials and Methods

Field trials were conducted in Gaines County, TX in 2008. Trial 1 had a seeding rate of 4 seed per row-foot and was planted on 5 May with 4 lb of Temik 15G placed in the furrow at planting. Trial 2 had a seeding rate of 3.5 seed per row-foot and was planted on 15 May. No Temik 15G was applied. Plots had 40 and 38 inch row spacing, respectively. Both trials were irrigated using a pivot irrigation system. Plots were 8-rows wide and extended the length of the field. Eleven varieties were evaluated in each trial. Plots were arranged in a randomized complete block design with 3 replications. Within each test, the production practices were the same for all varieties. The initial infection propagule, microsclerotia (ms) obtained from soil sampled in April, averaged 47.5 and 1.5/cm^3 soil for trials 1 and 2, respectively. Both fields were infested with the root-knot nematode (*Meloidogyne incognita*). Trial 1 and Trial 2 were harvested on 9 October and 11 November, respectively. On 24 October temperatures dropped below 30°F, resulting in slower maturation in Trial 2. All plots were weighed separately using a Lee weigh wagon. Sub-samples were taken from each plot. All sub-samples were weighed and then ginned using a sample gin with a lint cleaner, burr extractor and stick machine. Ginned lint was weighed and lint and seed turnouts were calculated. Lint and seed yield were determined by multiplying the respective turn out with field plot weights. Approximately 50 gram lint samples were randomly collected for fiber quality analysis. Fiber analysis was conducted by the Texas Tech University Fiber & Biopolymer Research Institute and Commodity Credit Corporation (CCC) lint loan values were determined for each plot. Leaf grade was set at 3 and color grade was set at 21 for all observations in Trial 1 to more closely reflect field average. Leaf grade and color grade were not set in Trial 2 since fiber analyses were similar to the field averages. Lint value was determined by multiplying the loan value with the lint yield. Seed value was determined using a value of $200/ton for seed. Ginning Cost was determined using $3.00/cwt ginning cost. Seed and technology cost was calculated using the 2008 Seed Cost Comparison Worksheet courtesy of the Plains Cotton Growers Inc. Net value was determined by adding lint value and seed value and subtracting ginning cost and seed fees and technology fees. Statistical analysis of data was conducted using SAS 9.1 for windows, using PROC GLM.

Results and Discussion

Extensive Verticillium wilt symptoms were observed by late July in Trial 1. A cool wet period occurred during the second week of September and soon after, defoliation was seen in 8 of the 11 varieties (Fig. 4). DP 174RF, DP 161B2RF, and DP 141B2F retained foliage whereas all other varieties were defoliated by late September.

Figure 4. Aerial photo of Trial 1 taken on September 23, 2008 prior to the application of harvest-aid chemicals.

Table 1. Harvest Results from Trial 1 planted in a field with an average inoculum level of 47.5 microsclerotia/cm^3 soil.

Entry[1]	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan Value[2]	Lint value	Seed Value[3]	Total value	Ginning Cost[4]	Seed/ technology cost	Net Value[5]	
	-------- % --------		------------- lb/acre -------------			$/lb	-- $/acre --						
DP 174RF	34.8	44.4	3842	1341	1706	0.5703	764.57	170.56	935.13	115.25	52.72	767.16	a
DP 161B2RF	34.0	49.6	3627	1235	1800	0.5743	709.17	180.00	889.16	108.82	61.86	718.49	a
NG 3348B2RF	34.0	47.8	3407	1154	1625	0.5582	644.28	162.47	806.75	102.22	58.25	646.28	b
FM 9180B2RF	32.5	48.9	3456	1122	1686	0.5743	644.21	168.61	812.82	103.67	63.48	645.66	b
DP 141B2RF	31.7	48.0	3684	1169	1767	0.5407	631.43	176.69	808.12	110.51	61.86	635.75	bc
FM 9063B2RF	32.9	50.0	3316	1086	1653	0.5737	622.95	165.33	788.27	99.47	63.48	625.32	bc
PHY 485WRF	31.8	48.0	3355	1064	1611	0.5568	592.53	161.14	753.67	100.66	61.16	591.85	bcd
AM 1532B2RF	31.6	47.2	3274	1034	1543	0.5633	582.48	154.27	736.75	98.23	60.29	578.23	cd
FM 1740B2RF	34.4	46.0	3179	1088	1456	0.5095	554.60	145.59	700.19	95.38	63.48	541.33	d
PHY 375WRF	33.8	44.2	2882	972	1271	0.5092	494.56	127.13	621.69	86.45	61.16	474.08	e
FM 1880B2RF	32.0	48.4	2965	948	1436	0.5082	482.42	143.58	626.00	88.94	63.48	473.57	e
Test average	33.0	47.5	3362	1110	1596	0.5490	611.20	159.58	770.78	100.87	61.02	608.89	
CV, %[6]	3.8	2.1	4.2	5.0	3.7	1.7	5.3	3.7	4.8	4.2	--	5.7	
OSL[7]	0.0282	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	--	<0.0001	
LSD[8]	2.1	1.7	240	94	100	0.0159	55.26	10.01	63.23	7.19	--	59.31	

[1]DP = Deltapine, NG = NexGen, FM = Fibermax, PHY = Phytogen, AM = Americot. [2] Value for lint based on CCC loan value from grab samples and FBRI HVI results. [3]Seed value was determined using a value of $200/ton for seed. [4]Ginning Cost were determined using $3.00/cwt ginning cost. [5]For net value/acre, means within a column with the same letter are not significantly different at the 0.05 probability level. [6]CV - coefficient of variation. [7]OSL - observed significance level, or probability of a greater F value. [8]LSD - least significant difference at the 0.05 level.

Table 2. HVI fiber property results from Trial 1 planted in a field with an average inoculum level of 47.5 microsclerotia/cm^3 soil.

Entry[1]	Micronaire units	Staple 32nds inches	Uniformity %	Strength g/tex	Elongation %	Rd reflectance	+b yellowness
AM 1532B2RF	3.6	36.3	79.9	27.2	10.1	76.8	7.9
DP 141B2RF	3.3	36.6	79.8	29.6	9.5	77.2	7.5
DP 161B2RF	3.7	38.1	81.7	30.5	9.2	79.0	7.5
DP 174RF	3.9	36.8	81.2	27.5	10.1	75.8	8.0
FM 1740B2RF	3.3	34.3	79.2	27.9	10.1	80.4	7.2
FM 1880B2RF	3.0	35.3	78.8	28.9	9.8	80.5	6.9
FM 9063B2RF	3.8	37.5	80.9	30.4	9.1	79.4	7.0
FM 9180B2RF	3.7	37.1	80.8	31.1	9.4	78.1	6.8
NG 3348B2RF	3.6	35.5	81.2	29.0	9.8	74.8	7.5
PHY 375WRF	3.2	34.2	79.9	27.3	10.0	77.0	7.5
PHY 485WRF	3.8	35.2	81.1	29.0	11.2	75.7	7.7
Test average	3.5	36.1	80.4	28.9	9.8	77.7	7.4
CV, %[2]	4.1	1.3	0.8	2.6	1.8	1.9	2.8
OSL[3]	<0.0001	<0.0001	0.0004	<0.0001	<0.0001	0.0008	<0.0001
LSD[4]	0.2	0.8	1.2	1.3	0.3	2.5	0.4

[1]DP = Deltapine, NG = NexGen, FM = Fibermax, PHY = Phytogen, AM = Americot. [2]CV - coefficient of variation. [3]OSL - observed significance level, or probability of a greater F value. [4]LSD - least significant difference at the 0.05 level.

Table 3. Harvest results from Trial 2 planted in a field with an average inoculum level of 1.5 microsclerotia/cm^3 soil.

Entry[1]	Lint turnout	Seed turnout	Bur cotton yield	Lint yield	Seed yield	Lint loan Value[2]	Lint value	Seed Value[3]	Total value	Ginning Cost[4]	Seed/ technology cost	Net Value[5]	
	-------- % --------		------------- lb/acre -------------			$/lb		------------------------------------ $/acre ------------------------------------					
DP 174RF	34.6	47.6	3870	1338	1844	0.5443	727.48	184.39	911.87	116.12	48.56	747.19	a
DP 141B2RF	33.3	52.0	3855	1284	2005	0.5575	716.06	200.54	916.60	115.66	56.98	743.96	a
FM 1740B2RF	36.2	50.1	3533	1279	1768	0.5560	711.77	176.85	888.62	105.99	58.47	724.16	ab
DP 161B2RF	32.2	51.6	3773	1214	1947	0.5698	691.20	194.68	885.87	113.19	56.98	715.71	abc
FM 9180B2RF	33.3	52.5	3495	1164	1835	0.5725	666.43	183.43	849.85	104.86	58.47	686.52	bcd
PHY 485WRF	31.9	51.8	3666	1170	1896	0.5553	649.84	189.66	839.50	109.99	56.33	673.17	bcd
FM 1880B2RF	32.7	51.0	3696	1209	1885	0.5400	653.21	188.50	841.71	110.88	58.47	672.36	cd
FM 9063B2RF	32.3	51.9	3537	1143	1835	0.5653	646.20	183.46	829.65	106.11	58.47	665.07	cde
PHY 375WRF	36.4	49.3	3367	1224	1660	0.5300	649.48	165.99	815.46	101.03	56.33	658.11	de
AM 1532B2RF	32.2	50.6	3648	1174	1844	0.5393	631.94	184.44	816.39	109.46	55.54	651.40	de
NG 3348B2RF	33.5	51.9	3427	1148	1777	0.5173	593.93	177.64	771.57	102.80	53.65	615.13	e
Test average	33.5	50.9	3625	1213	1845	0.5498	667.05	184.51	851.55	108.73	56.20	686.62	
CV, %[6]	2.1	1.8	2.7	3.7	3.0	3.2	4.4	3.0	3.8	2.7	--	4.4	
OSL[7]	<0.0001	<0.0001	<0.0001	0.0004	<0.0001	0.0241	0.0004	<0.0001	0.0004	<0.0001	--	0.0005	
LSD[8]	1.2	1.5	169	77	94	0.0304	49.43	9.39	54.52	5.06	--	51.72	

[1]DP = Deltapine, NG = NexGen, FM = Fibermax, PHY = Phytogen, AM = Americot. [2] Value for lint based on CCC loan value from grab samples and FBRI HVI results. [3]Seed value was determined using a value of $200/ton for seed. [4]Ginning Cost were determined using $3.00/cwt ginning cost. [5]For net value/acre, means within a column with the same letter are not significantly different at the 0.05 probability level. [6]CV - coefficient of variation. [7]OSL - observed significance level, or probability of a greater F value. [8]LSD - least significant difference at the 0.05 level.

Table 4. HVI fiber property results from Trial 2 planted in a field with an average inoculum level of 1.5 microsclerotia/cm^3 soil.

	Micronaire	Staple	Uniformity	Strength	Elongation	Leaf	Rd	+b	Color grade	
Entry[1]	units	32^{nds} inches	%	g/tex	%	grade	reflectance	yellowness	color 1	color 2
AM 1532B2RF	3.9	34.7	78.0	26.4	10.1	1.3	80.5	7.8	2.3	1.0
DP 141B2RF	3.6	35.7	78.4	28.8	9.5	2.7	79.9	8.0	2.7	1.0
DP 161B2RF	4.0	36.3	79.8	28.9	9.3	2.0	80.5	7.9	2.0	1.0
DP 174RF	3.7	34.6	78.5	26.2	10.3	2.3	78.2	8.8	2.3	1.0
FM 1740B2RF	4.0	34.5	80.3	27.9	9.7	1.7	79.9	8.4	2.3	1.0
FM 1880B2RF	3.5	34.5	78.3	28.8	9.3	2.0	79.9	8.0	2.3	1.0
FM 9063B2RF	3.9	35.9	78.9	29.6	9.2	2.3	81.5	7.8	2.0	1.0
FM 9180B2RF	4.2	36.3	81.2	29.9	9.2	2.3	80.7	7.7	2.3	1.0
NG 3348B2RF	3.9	33.9	79.3	27.3	9.4	3.0	75.5	9.7	3.0	1.7
PHY 375WRF	3.7	33.7	79.5	27.6	9.8	2.0	79.2	8.1	3.0	1.0
PHY 485WRF	4.1	35.1	82.1	29.5	11.3	3.3	77.7	8.3	3.0	1.0
Test average	3.9	35.0	79.5	28.3	9.7	2.3	79.4	8.2	2.5	1.1
CV, %[2]	4.4	1.9	1.3	2.5	2.4	31.0	1.0	5.2	--	--
OSL[3]	0.0010	0.0006	0.0019	<0.0001	<0.0001	0.0917	<0.0001	0.0007	--	--
LSD[4]	0.3	1.1	1.8	1.2	0.4	NS	1.3	0.7	--	--

[1]DP = Deltapine, NG = NexGen, FM = Fibermax, PHY = Phytogen, AM = Americot. [2]CV - coefficient of variation. [3]OSL - observed significance level, or probability of a greater F value. [4]LSD - least significant difference at the 0.05 level.

In Trial 1, lint yield ranged from 948 to 1341 lb/acre (average of 1110 lb lint/acre) (Table 1), while in Trial 2, lint yield ranged from 1143 to 1338 lb/acre (average of 1213 lb lint/acre) (Table 3). Verticillium wilt incidence was minimal in Trial 2 and did not impact yield (personal observation).

In Trial 1, net value ranged from $474 to $767/acre (difference of $293/acre) (Table 1), while in Trial 2, net value ranged from $615 to $747/acre (difference of $132/acre) (Table 3). Varieties that performed consistently in both trials included Deltapine 174RF and 161B2RF; whereas, Phytogen 375WRF performed poorly in both trials (Tables 1 and 3). Fibermax 1740B2RF ranked 9th of 11 varieties in Trial 1 (high pressure field), but had the 3rd highest net value in Trial 2 (low pressure field). NexGen 3348B2RF ranked 3rd in Trial 1, but had the lowest net value in Trial 2. Deltapine 141B2RF ranked 5th in Trial 1, but had the 2nd highest net value in Trial 2. Variety selection is one of the most important decisions a producer must make. Verticillium wilt is one factor that can significantly impact variety performance. Continued evaluations of these varieties are needed.

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References

Kirkpatrick, T. L. and C. S. Rothrock, ed. *Compendium of Cotton Diseases, Second Edition*. APS Press, 2001.

Kokalis-Burelle, N., D. M Porter, R. Rodriguez-Kabana, D. H. Smith, and P. Subrahmanyam, ed. *Compendium of Peanut Diseases, Second Edition*. APS Press, 1997.