

2013 National Cotton Fusarium Wilt Report



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2013 NATIONAL COTTON FUSARIUM WILT REPORT

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Cotton cultivars and elite breeding lines submitted by 10 cooperators were evaluated for Fusarium wilt resistance under field conditions at the E. V. Smith Research Center, Plant Breeding Unit, Tallahassee, Alabama. These entries were grown on an Independence loamy fine sand highly infested with the Fusarium wilt fungus (*Fusarium oxysporum*) Schlecht. f. *vasinfectum* [Atk.] (Snyd. & Hans.) and southern root-knot nematodes (*Meloidogyne incognita*).

In 2013, a soil analysis for nematodes revealed that southern root-knot (*Meloidogyne incognita*) was the predominant nematode species in the test plots. The South Fusarium wilt field plot contains a population of *M. incognita* that ranges from 28 to 1694 eggs and J2's per gram of root with a mean of 409. Other nematode genera present are stubby root (*Trichodorus* sp.) stunt (*Tylenchorhynchus* sp.), and spiral (*Helicotylenchus* sp.). Root-knot nematodes, however, appear to be causing the crop damage to cotton in the Fusarium Wilt Test as indicated by the high galling indices found on the roots of all cotton lines. The root-knot nematode population throughout the entire test area, i.e., even the areas with the lowest root-knot nematode populations, is more than sufficient to cause a high incidence of Fusarium wilt.

Cotton lines submitted to the Commercial Fusarium Wilt Trial were examined to determine their response to the root-knot nematode (*Meloidogyne incognita* race 3) and *Fusarium oxysporum* f. sp. *vasinfectum*. The field has a long history of the Fusarium wilt disease incidence and root-knot nematode infestation. Plots consisted of 1 row, 10 ft long, with 36 in row spacing and were planted in a randomized complete block design with four replications. All plots were maintained throughout the season using standard herbicide, insecticide, and fertility production practices as recommended by the Alabama Cooperative Extension System. Three root systems per plot were removed June 18, 2013 near 30 days after planting. The fresh root weights were recorded and nematodes were extracted from the root system by shaking in 0.6% NaOCl and collecting the eggs and J2's on a 25 µm sieve. The nematodes were counted at 40 X with the inverted Nikon TSX microscope. Data was statistically analyzed using Generalized Linear Mixed Models procedures as implemented in SAS® PROC GLIMMIX with a negative binomial distribution function for count variables. Percentage data converted to decimal fractions were treated as a pseudo-binomial, whereas seed cotton yield data in the commercial test were analyzed using a normal distribution function. Dunnett's P-values were calculated to compare entries to check cultivars. Monthly average maximum temperatures from planting in April through harvest in October were 74.7, 79.4, 87.1, 85.4, 86.5, 85.9, and 76.5°F with average minimum temperatures of 50.6, 56.1, 67.9, 68.9, 68.3, 63.1, and 52.0°F, respectively. Rainfall accumulation for each month was 3.80, 2.02, 7.10, 6.44, 5.16, 1.79, and 0.48 in with a total of 26.79 in over the entire season.

For the National Fusarium Wilt Trial, entries were planted in single 20-foot rows on 36-inch centers, separated by 6-foot alleys. Four replications of the test entries and checks were evaluated in a randomized complete block design with a split plot restriction on randomization. The set of eight test cultivars submitted by a cooperator was always evaluated as a group together with two control plots within each replicate. Both susceptible (Rowden) and resistant (M-315) cultivars were included as check subplots in the two center rows of each main plot (Fig. 1).

An industry-sponsored cotton test was planted adjacent to the National Fusarium Wilt Trial (NFWT) to compare 12 commercially available cotton cultivars to Rowden and M-315 for wilt response, root-knot nematode reaction, and yield. Trial maintenance was similar to the NFWT. Results are presented in Tables 2-5, starting on page 10 of this report.

Initial plant counts were made on June 18. Wilted plants were counted and removed on July 2, July 18, August 7, and August 22. The remaining live plants were counted and recorded on September 5. Total percent wilted plants were then determined and mean wilting for a given entry calculated.

The average % wilted plants for the susceptible check **Rowden** was 28%, with a range from 1 to 91 % on an individual plot basis (Fig. 1). Wilt development was low in block 1 (6%) but uniformly high in the three remaining blocks with equal rep averages of 75 %. The resistant check **M-315** had an average of 1% wilted plants, with a range of 0 to 5%. **Critical evaluations of breeding lines should be made relative to the Rowden check listed at the bottom of each group.**

Fig. 1. Field plot layout and % wilt for control plot of Rowden (susceptible) and M-315 (resistant). Distances (ft) from the NE corner of the trial are given in the left hand column and the bottom row.

NS		15	0		0	1		64	2	
286		Rowden	M-315		M-315	Rowden		Rowden	M-315	
260		3	18		10	0		33	4	
		M-315	Rowden		Rowden	M-315		Rowden	M-315	
234		62	0		5	14		24	0	
		Rowden	M-315		M-315	Rowden		Rowden	M-315	
208		0	41		0	9		0	20	
		M-315	Rowden		M-315	Rowden		M-315	Rowden	
182		61	0		8	0		0	13	
		Rowden	M-315		Rowden	M-315		M-315	Rowden	
156		61	5		0	6		4	0	
	8 rows	Rowden	M-315		M-315	Rowden		Rowden	M-315	
130		0	91		0	3		25	0	
		M-315	Rowden		M-315	Rowden		Rowden	M-315	
104		54	3		25	0		0	20	
		Rowden	M-315		Rowden	M-315		M-315	Rowden	
78		48	0		0	6		0	15	
		Rowden	M-315		M-315	Rowden		M-315	Rowden	
52		1	48		0	7		28	1	
		M-315	Rowden		M-315	Rowden		Rowden	M-315	
26		18	0		54	2		1	26	
		Rowden	M-315		Rowden	M-315		M-315	Rowden	
0		81	2		3	12		27	0	
		Rowden	M-315		M-315	Rowden		Rowden	M-315	
EW		24			54			84		

Table 1. Percent wilted plants for entries and check in each replicate, least squares estimate of the average, *P*-value based on Dunnett's versus the resistant check M-315, and initial average number of plants per plot.

Entry	Cultivar/Line	Percent wilted plants [†]					<i>P</i> -value	Avg. no. of plants
		Rep1	Rep2	Rep3	Rep4	Avg.		
Dawn Fraser, Monsanto Company, 741 Coker Farm Road, Hartsville, SC 29550								
101	DF-1	1	8	0	2	3	0.025	74
102	DF-2	0	5	4	2	3	0.020	75
103	DF-3	1	1	0	3	2	0.085	69
104	DF-4	3	0	4	2	2	0.036	77
105	DF-5	5	6	4	1	4	0.012	72
106	DF-6	0	0	0	5	2	0.079	74
107	DF-7	0	1	0	1	1	0.227	78
Kathryn M Glass, Auburn University, 201 Funchess Hall, Auburn, AL 36849-5415								
108	DP 1252 B2RF	19	12	8	13	13	<0.001	69
	Rowden	7	25	41	24	24	<0.001	80
	M-315	0	0	0	0	0		77
Ted Wallace, Mississippi State University, 32 Creelman Street, Miss. State University, MS 39762								
201	TW-1	9	9	10	5	7	0.002	81
202	TW-2	7	21	1	1	6	0.004	86
203	TW-3	4	20	7	5	8	0.001	72
204	TW-4	4	6	4	1	3	0.171	80
205	TW-5	0	5	4	0	2	0.505	77
Kathryn M Glass, Auburn University, 201 Funchess Hall, Auburn, AL 36849-5415								
206	DP 1048 B2RF	5	7	7	0	4	0.057	74
207	PHY 499 WRF	1	11	3	0	3	0.143	83
208	PHY 375 WRF	4	0	7	9	4	0.064	67
	Rowden	26	91	61	33	54	<0.001	79
	M-315	1	0	5	4	2		73
Joe Johnson, PhytoGen Seed Co., LLC, 118 Kennedy Flat Road, Leland, MS 38756								
301	PHY-JJ1	4	12	1	11	7	0.002	71
302	PHY-JJ2	7	3	4	4	4	0.009	79
303	PHY-JJ3	8	11	6	4	7	0.001	75
304	PHY-JJ4	5	9	3	17	8	<0.001	70
305	PHY-JJ5	4	6	1	7	4	0.007	78
306	PHY-JJ6	12	5	6	4	7	0.002	68
307	PHY-JJ7	9	5	8	15	9	<0.001	76
308	PHY-JJ8	0	0	2	1	1	0.325	68
	Rowden	28	25	6	10	17	<0.001	81
	M-315	1	0	0	0	1		77

Table 1. *continued.*

Entry	Cultivar/Line	Percent wilted plants [†]					P-value	Avg. no. of plants
		Rep1	Rep2	Rep3	Rep4	Avg.		
Fred Bourland, University of Arkansas, P.O. Box 48, Keiser, AR 72351								
401	FB-1	4	1	2	0	2	0.092	77
402	FB-2	0	1	1	0	1	0.386	73
403	FB-3	0	7	3	0	3	0.049	60
404	FB-4	0	2	1	0	1	0.362	67
405	FB-5	0	2	0	0	1	0.460	61
406	FB-6	3	1	1	0	1	0.200	76
407	FB-7	6	5	0	3	3	0.022	74
408	FB-8	0	3	3	0	2	0.156	71
	Rowden	54	20	61	62	49	<0.001	79
	M-315	2	0	0	0	1		69
Mustafa McPherson, PhytoGen Seed Co., LLC, 118 Kennedy Flat Road, Leland, MS 38756								
501	PHY- MM1	1	5	3	4	3	0.073	73
502	PHY- MM2	6	8	4	3	5	0.010	79
503	PHY- MM3	0	0	1	0	0	0.835	82
504	PHY- MM4	7	5	6	5	5	0.009	68
505	PHY- MM5	0	4	0	0	1	0.520	70
506	PHY- MM6	12	10	2	1	6	0.005	76
507	PHY- MM7	0	0	0	1	0	0.821	77
508	PHY- MM8	6	6	3	4	4	0.016	76
	Rowden	12	48	4	64	32	<0.001	80
	M-315	3	0	0	2	1		64
David Weaver, Auburn University, 201 Funchess Hall, Auburn, AL 36849-5415								
601	AU 10090	2	17	0	17	8	0.001	54
602	AU 51038	2	0	1	3	1	0.573	63
602	AU 51038	2	0	1	3	1	0.573	63
604	AU 68036	0	0	1	1	1	0.776	71
Kathryn M Glass, Auburn University, 201 Funchess Hall, Auburn, AL 36849-5415								
605	ST 6448 GLB2	0	1	0	0	1	0.882	80
606	CG 3787 B2RF	4	4	5	1	4	0.076	70
607	FM 1944 GLB2	3	0	1	2	2	0.534	71
608	DP 1321 B2RF	4	4	1	0	2	0.260	78
	Rowden	18	3	13	14	12	<0.001	76
	M-315	0	0	0	5	2		74

Table 1. *continued.*

Entry	Cultivar/Line	Percent wilted plants [†]					P-value	Avg. no. of plants
		Rep1	Rep2	Rep3	Rep4	Avg.		
Brent Styles, Bayer Crop Science, 4205 Williamson Road, Wilson, NC 27893								
701	FS-1	0	0	0	1	0	0.736	83
702	FS-2	1	0	1	0	1	0.619	84
703	FS-3	2	5	1	0	2	0.170	80
704	FS-4	0	3	2	1	1	0.303	74
705	FS-5	0	5	0	0	1	0.288	80
706	FS-6	1	2	1	0	1	0.381	82
707	FS-7	0	0	1	0	0	0.718	78
708	FS-8	9	4	1	0	3	0.020	80
	Rowden	27	54	9	15	24	<0.001	80
	M-315	0	3	0	0	1		75
Brent Styles, Bayer Crop Science, 4205 Williamson Road, Wilson, NC 27893								
801	MA-1	1	2	0	0	1	0.688	72
802	MA-2	1	0	0	0	0	0.832	82
803	MA-3	6	3	10	0	4	0.013	76
804	MA-4	2	0	0	0	1	0.752	71
805	MA-5	3	1	0	0	1	0.555	79
806	MA-6	15	7	6	0	6	0.002	67
807	FS-9	9	5	7	3	5	0.005	81
808	FS-10	2	2	0	0	1	0.504	76
	Rowden	81	15	20	18	31	<0.001	79
	M-315	2	0	0	3	1		74
Brent Styles, Bayer Crop Science, 4205 Williamson Road, Wilson, NC 27893								
901	MS-1	0	0	1	1	1	0.394	79
902	MS-2	1	0	0	0	0	0.513	74
903	MS-3	0	5	1	0	1	0.114	77
904	MS-4	7	1	7	3	3	0.009	76
905	MS-5	1	1	0	0	1	0.362	73
906	FS-11	14	4	1	0	4	0.006	70
907	FS-12	5	0	4	0	2	0.055	76
908	FS-13	0	1	0	0	0	0.477	70
	Rowden	48	6	8	1	13	<0.001	77
	M-315	1	0	0	0	0		74

[†] The number listed in the average column is the estimate of the average wilt percentage based on a generalized linear mixed model with the binomial distribution for fixed effects. This estimate will generally be close, but may or may not be identical to the arithmetic average obtained by averaging the numbers in the columns representing the 4 reps.

Commercial Cotton Wilt Trial

Table 2. Least squares estimates of the average percent wilted plants for entries and checks, confidence intervals, and *P*-values based on Dunnett's versus the susceptible check Rowden and the resistant check M-315.

Cultivar	95% Confidence Limit			Dunnett's <i>P</i> vs.	
	Avg	Lower	Upper	Rowden	M315
CG 3787 B2RF	2.5	1.1	5.7	0.004	0.186
DP 1050 B2RF	5.8	3.3	10.1	0.123	0.032
DP 1137 B2RF	3.7	1.8	7.2	0.012	0.281
DP 1252 B2RF	7.4	4.3	12.2	0.485	0.001
DP 12R242B2R2	4.3	2.3	7.8	0.013	0.010
DP 1321 B2RF	1.0	0.3	3.2	0.001	1.000
FM 1944 GLB2	0.3	0.0	2.6	0.010	0.998
PHY 339 WRF	0.3	0.0	2.3	0.007	0.891
PHY 375 WRF	1.1	0.4	3.5	0.001	0.999
PHY 499 WRF	0.9	0.2	3.0	0.001	1.000
ST 4946 GLB2	0.8	0.2	3.0	0.001	1.000
ST 6448 GLB2	0.9	0.2	3.1	0.002	1.000
M-315	0.9	0.3	2.6	<0.001	
Rowden	11.8	7.5	18.1		0.000

Table 3. Least squares estimate of root knot egg number (counts per 150 cc) for entries and checks, confidence intervals, and *P*-values based on Dunnett's versus the susceptible check Rowden and the resistant check M-315. Samples were collected at harvest.

Cultivar	95% Confidence Limit			Dunnett's <i>P</i> vs.	
	Avg	Lower	Upper	Rowden	M315
CG 3787 B2RF	3660	1564	8564	0.414	0.630
DP 1050 B2RF	2032	975	4235	0.016	0.999
DP 1137 B2RF	7544	3620	15719	1.000	0.018
DP 1252 B2RF	4501	2160	9379	0.599	0.438
DP 12R242B2R2	2265	1087	4721	0.030	0.998
DP 1321 B2RF	7912	3797	16487	1.000	0.014
FM 1944 GLB2	3449	1655	7186	0.238	0.565
PHY 339 WRF	15120	7256	31508	0.976	<0.001
PHY 375 WRF	11081	5318	23091	1.000	0.002
PHY 499 WRF	3835	1840	7991	0.360	0.556
ST 4946 GLB2	6647	3190	13850	0.994	0.036
ST 6448 GLB2	20292	9738	42284	0.645	<0.001
M-315	1480	801	2734	<0.001	
Rowden	9692	5247	17902		<0.001

Table 4. Least squares estimate of root knot egg number (counts per g of root fresh weight) for entries and checks, confidence intervals, and *P*-values based on Dunnett's versus the susceptible check Rowden and the resistant check M-315. Samples collected at the 6-8 leaves stage.

Cultivar	95% Confidence Limit			Dunnett's <i>P</i> vs.	
	Avg	Lower	Upper	Rowden	M315
CG 3787 B2RF	169	73	390	0.332	0.869
DP 1050 B2RF	141	61	325	0.176	0.982
DP 1137 B2RF	409	178	943	1.000	0.055
DP 1252 B2RF	252	109	580	0.841	0.362
DP 12R242B2R2	111	48	255	0.064	1.000
DP 1321 B2RF	409	177	942	1.000	0.055
FM 1944 GLB2	111	48	257	0.066	1.000
PHY 339 WRF	681	295	1569	1.000	0.004
PHY 375 WRF	602	261	1389	1.000	0.008
PHY 499 WRF	183	79	422	0.424	0.778
ST 4946 GLB2	264	115	609	0.891	0.308
ST 6448 GLB2	999	434	2304	0.877	<0.001
M-315	86	43	170	0.006	
Rowden	510	256	1016		0.006

Table 5. Least squares estimate of seed cotton yield (lbs per acre) for entries and checks, confidence intervals, and *P*-values based on Dunnett's versus the susceptible check Rowden and the resistant check M-315.

Cultivar	95% Confidence Limit			Dunnett's <i>P</i> vs.	
	Avg	Lower	Upper	Rowden	M315
CG 3787 B2RF	3303	1855	4751	0.748	1.000
DP 1050 B2RF	2781	1332	4229	0.987	1.000
DP 1137 B2RF	2904	1456	4352	0.963	1.000
DP 1252 B2RF	1902	454	3350	1.000	0.923
DP 12R242B2R2	3801	2352	5249	0.365	0.999
DP 1321 B2RF	2483	1035	3931	1.000	1.000
FM 1944 GLB2	5300	3852	6748	0.008	0.164
PHY 339 WRF	4712	3264	6160	0.045	0.350
PHY 375 WRF	4211	2763	5659	0.157	0.791
PHY 499 WRF	4806	3358	6254	0.034	0.511
ST 4946 GLB2	4530	3082	5978	0.072	0.481
ST 6448 GLB2	2418	969	3866	1.000	1.000
M-315	2994	1789	4198	0.873	
Rowden	1963	759	3167		0.826