VARIETY RESPONSE TO VERTICILLIUM WILT AND BACTERIAL BLIGHT IN THE SOUTHERN HIGH PLAINS OF TEXAS

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Abstract

Bacterial blight severity continues to decline in U.S. upland cotton acres because producers are planting more blight resistant varieties. DP 1646 B2XF, which has partial resistance to bacterial blight is the most widely planted variety for upland cotton in the U.S. In our 2020 bacterial blight testing program, all advanced lines from Phytogen were resistant to bacterial blight. However, in the case of Americot, BASF, Brownfield Seed and Delinting, and Deltapine only 25%, 44%, 43%, and 14%, respectively of entries tested were resistant to bacterial blight. That suggests that many new varieties in the next several years may be susceptible to bacterial blight. Verticillium wilt was not a big problem in 2020, due to the high temperatures in August and September. However, cultivars that appeared to have good resistance to Verticillium wilt included: DP 2022 B3XF, FM 1911GLT, FM 2202GL, FM 2334GLT, NG 4050 XF, NG 4098 B3XF, PHY 210 W3FE, PHY 394 W3FE, and ST 5600B2XF. FM 2202GL was the most consistently high yielding cultivar tested in 2020.

Introduction

Cotton is the most widely planted crop in the Southern High Plains of Texas. Rain events in this region, though sporadic can be violent with hail and strong winds in the spring and summer. This type of weather is ideal for spreading the bacterial blight pathogen (*Xanthomonas citri* pv. *malvacearum*) across fields. The dry winter climate facilitates survival of this bacteria in plant debris. Blight resistant varieties are the most effective method of reducing losses to bacterial blight of cotton. Fortunately, most cotton seed companies consider this trait important to include in their newer varieties. An inoculated blight screening program was initiated in 2000 and has been continued every year since then in Lubbock.

Verticillium wilt is another disease of cotton that can be very important to the Southern High Plains of Texas. This disease can cause significant yield losses. The fungus, *Verticillium dahliae*, is distributed widely across the region, and is particularly damaging in fields with adequate irrigation, or when weather is highly conducive (cool during August) for the disease. The most popular method for producers of limiting yield loss is to plant varieties that are partially resistant to Verticillium wilt. Small plot variety trials have been planted annually since 2005 in Verticillium wilt fields to provide cotton producers with information on this disease.

Materials and Methods

Bacterial Blight

Plots were two-rows wide, 35 feet long, and contained 37 entries, arranged in a randomized complete block design (RCBD) with four replications. The bacteria isolates (numbers 388 and 465) were put in trypticase soy broth (30 g/L) and shaken at room temperature (approximately 78°F) for 1½ days. Then 1800 ml of this solution was mixed into a 50-gallons of water that also included the product Silwet L-77 (0.2% v/v) and applied to the trial at 50 gallons/acre. The plots were treated on 27 July and rated on 11 August. Rating consisted of taking 20 paces through the plot and rating plants at each pace, and then calculating the incidence of plants expressing blight symptoms.

Verticillium Wilt

Test sites were in Floyd, Hale, and Hockley counties, in fields with a history of Verticillium wilt. Plots were 2-rows wide, 36 feet long, on 40-inch centers. Seeds were planted at a rate of 4 seed/ft row. The entries consisted of commercial varieties or advanced breeding lines from Armor (previously called Croplan), Deltapine, Fibermax, NexGen, Phytogen, and Stoneville brands. There were 36, 36, and 40 entries at the Floyd, Hale, and Hockley county sites, respectively, arranged in a randomized complete block design with four replications. Data collected included plant stand in both rows, incidence of plants with Verticillium wilt symptoms during the last week of August, and defoliation percent during late September. Plots were harvested with a 2-row John Deere cotton

stripper, and 1000 g samples were taken from harvested plots, and ginned to determine lint turnout. Lint was HVI tested at the Texas Tech Fiber and Biopolymer Center and loan values were calculated for each variety. There were additional stress at each site beside Verticillium wilt. At the Floyd county site, the pivot went down during August, resulting in substantial water stress. At the Hale county site there was an ice storm that occurred on 28 October which knocked a lot of the lint from the plants for most entries. At the Hockley county site, root-knot nematode was also present and probably caused more loss to cotton yield than Verticillium wilt.

A combined analysis was utilized to rate varieties across different trials. In each trial, the relative wilt, relative defoliation, relative yield, and relative yield x loan value was calculated. Relative values are calculated according to the formula: (plot value – minimum value in that test)/(maximum value – minimum value). A combined mixed model analysis was run on all these relative values, across the three sites. The entries were ranked best to worst, with the best = 1 and the worst = 70. An average ranking was calculated by taking the four different ranks (wilt, defoliation, yield, and yield x loan), and dividing by 4. Since yield was substantially impacted by other factors besides Verticillium wilt, another combined average ranking using only wilt and defoliation was calculated.

Results and Discussion

Bacterial Blight

Disease was good in 2020 with the more susceptible entries exhibiting 100% incidence of blight symptoms. All the new 2021 Deltapine varieties were susceptible (DP 2115 B3XF, DP 2123 B3XF, DP 2127 B3XF, DP 2141NR B3XF, and DP 2143NR B3XF, Table 1). A relatively new cultivar from Americot with blight resistance is NG 4098 B3XF. The popular NG 4936 B3XF was tested as partially susceptible. Blight resistant cultivars from BASF included FM 2202GL, FM 1621GL, FM 1730GLTP, and ST 4993B3XF. Susceptible cultivars included ST 5091B3XF and ST 5600B2XF. All the cultivars tested from Phytogen were resistant to bacterial blight. A resistant cultivar from Brownfield Seed and Delinting was BSD 9X and as was Tamcot 13SO3. LBB 16-2-507BB, which was an entry from Texas A&M AgriLife Research in Lubbock was also resistant.

Verticillium Wilt

Th test in Floyd county was planted on 18 May and harvested on 16 October. It was irrigated with a center pivot system. The field experienced water stress during the flowering and boll filling stages due to the weather conditions and the pump for the center pivot system went down. Verticillium wilt was low to moderate at this site and ranged from 3% to 26% depending on variety (Table 2). Defoliation which was moderate ranged from 22 to 65%. Lint yield ranged from 1,185 to 1,590 lbs/acre. Loan value ranged from $0.529 to $0.575/lb and lint yield x loan value ranged from $635 to $894. Yield was affected by both Verticillium wilt and by water stress. The varieties that had the combination of the best yield, yield x loan value, lowest incidence of Verticillium wilt, and least defoliation were FM 2202GL, FM 1911GLT, ST 5600B2XF, and NG 4098 B3XF. NG 4098 B3XF had the longest fiber (1.17 inches) and strongest fiber (34.6 g/tex) (Table 3).

The test in Hale county was planted on 18 May and harvested after an ice storm on 12 November. The field experienced at least one significant hail event during the growing season. Irrigation was with a center pivot system. Verticillium wilt incidence ranged from 8 to 38%, which was slightly higher than the Floydada test and defoliation ranged from 16 to 64%, which was similar to the Floydada site (Table 4). At harvest time, most of the cultivars had a substantial amount of lint that had fallen on the ground, so yield was affected strongly by storm-proofness of cultivars as well as Verticillium wilt. Yield ranged from 468 to 1,222 lbs of lint/acre. Yield x loan value ranged from $268.17 to $695.65. Loan value ranged from $0.5788 to $0.5280/lb. No cultivar was in the top rating categories of yield, yield x loan value, low wilt incidence, and low defoliation. There were many cultivars with low wilt ratings. Only DP 2022B3XF and FM 2334GLT had the lowest category of defoliation ratings. Only FM 2202GL had top yield and yield x loan values. DP 1820 B3XF had the longest fiber length (1.16 inches) and FM 2202GL had the best fiber strength (33.35 g/tex) (Table 5).

The test in Hockley county was planted on 19 May and harvested on 21 October. This field was infested with both root-knot nematode and Verticillium wilt, so some entries were included with partial or full resistance to root-knot nematode. The field was irrigated with subsurface drip. Based on the top yielding entries, it is apparent that root-knot nematode was more impactful on yield than Verticillium wilt. Verticillium wilt incidence was low and ranged from 2 to 11%, with little separation between cultivars (Table 6). Defoliation was moderate to high and ranged

from 24 to 82%. Yield ranged from 1,301 to 1,944 lbs/acre, and yield x loan value ranged from $745 to $1,114/acre. Loan value ranged from $0.547 to $0.582/lb. The varieties ST 5600B2XF and PHY 394 W3FE had the best ratings overall for yield, yield x loan value, wilt incidence, and defoliation. Both varieties are resistant to root-knot nematodes. DP 1845 B3XF had the longest fiber (1.22 inches) and DP 2055 B3XF had the best fiber strength (33.25 g/tex) (Table 7).

FM 2334GLT was planted at all three sites as the Verticillium resistant check, and in the combined analysis, it had the lowest relative combined average rank of wilt incidence and defoliation (Table 8). However, it did not yield particularly well in 2020 (relative yield was ranked 47th). The Verticillium susceptible check in all sites was DP 1909 XF, which ranked 69th out of 70 entries for relative combined values of wilt incidence and defoliation. The best five entries in terms of wilt and defoliation ratings were: FM 2334GLT, PX 2D18 W3FE, PHY 394 W3FE, FM 1911GLT, and NG 4050 XF. However, when ranking all measured attributes (wilt, defoliation, yield, and yield x loan value), then the top five entries were: PHY 394 W3FE, ST 5600B2XF, NG 4050 XF, FM 2574GLT, and FM 1911GLT.

Table 1. Bacterial blight ratings for cultivars in 2020.

Variety[1]	% Blight	Rating
Phytogen PX4B08W3FE	0 g[2]	Resistant
Phytogen PX3E33W3FE	0 g	Resistant
Phytogen PX2E05W3FE	0 g	Resistant
Phytogen PX2D18W3FE	0 g	Resistant
NexGen NG 4098 B3XF	0 g	Resistant
NexGen NG 3500 XF (check)	0 g	Resistant
Americot AMX 19A018B3XF	0 g	Resistant
FiberMax FM 1730GLTP	1.25 fg	Resistant
LBB 16-2-507BB	2.50 fg	Resistant
Bayer CropScience 19R132B3XF	5.00 efg	Resistant
BSD 9X	6.25 efg	Resistant
Stoneville ST 4993B3XF	6.25 efg	Resistant
FiberMax FM 2202GL	7.50 ef	Resistant
FiberMax FM 1621GL	7.50 ef	Resistant
Tamcot 13SO3	11.25 e	Partially Resistant
BASF BX 2194B3XF	52.50 d	Partially Susceptible
Deltapine DP 2123 B3XF	55.00 d	Partially Susceptible
LBB 15-3-1501BB	67.50 c	Partially Susceptible
NexGen NG 4936 B3XF	72.50 c	Partially Susceptible
Deltapine DP 2115 B3XF	86.25 b	Moderately Susceptible
BSD 6X	95.00 a	Susceptible
Deltapine DP 2127 B3XF	95.00 a	Susceptible
BSD Ton Buster Elite	97.50 a	Susceptible
Tamcot 73	98.75 a	Susceptible
Deltapine DP 1747NR B2XF (check)	98.75 a	Susceptible
Bayer CropScience 19R237B3XF	98.75 a	Susceptible
Stoneville ST 5600B3XF	100.00 a	Susceptible
Deltapine DP 2143NR B3XF	100.00 a	Susceptible
Deltapine DP 2141NR B3XF	100.00 a	Susceptible
BASF BX 2192B3XF	100.00 a	Susceptible
Stoneville ST 5091B3XF	100.00 a	Susceptible
BASF BX 2116GLTP	100.00 a	Susceptible
Americot AMX 19B003B3XF	100.00 a	Susceptible
Americot AMX 19B001B3XF	100.00 a	Susceptible
Americot AMX 19B016B3XF	100.00 a	Susceptible
Americot AMX 19A015B3XF	100.00 a	Susceptible
Americot AMX 19A014B3XF	100.00 a	Susceptible

[1]BSD stands for Brownfield Seed and Delinting.
[2]Means with the same letter are not significantly different at P=0.05.

Table 2. Verticillium wilt results for Floyd County in 2020.

Variety[1]	Lint Yield (lbs/a)	Turn out	Loan x Yield ($/acre)	%Wilt	%Defol-iation	Loan ($/lb)	Plants /ft row
FM 2202GL	1,590[3]	0.3523	894.20	16.0	31.3	0.5625	2.09
FM 1621GL	1,570	0.3538	866.17	14.8	49.0	0.5518	2.41
FM 2574GLT	1,535	0.3608	877.84	3.3	38.6	0.5720	2.43
DP 1822 XF	1,515	0.3474	868.10	16.1	48.6	0.5730	2.12
FM 1911GLT	1,514	0.3528	859.30	7.2	30.4	0.5675	2.60
PX 4B08W3FE	1,507	0.3206	797.20	11.9	41.4	0.5290	2.71
AMX 19A016B3XF	1,505	0.3268	798.71	19.4	36.5	0.5308	2.61
ST 5600B2XF	1,496	0.3663	828.65	7.8	30.7	0.5540	2.13
Armor 9598 B3XF	1,494	0.3490	859.62	14.1	39.6	0.5753	2.15
FM 2498GLT	1,472	0.3554	808.95	5.6	36.8	0.5495	2.58
PHY 394 W3FE	1,471	0.2996	838.60	4.2	25.6	0.5700	2.99
FM 2334GLT	1,460	0.3830	800.03	7.2	23.9	0.5478	2.59
DP 2012 B3XF	1,445	0.3514	824.95	21.8	56.6	0.5710	2.44
NG 4098 B3XF	1,444	0.3230	829.58	7.1	33.5	0.5745	2.24
Armor 9210 B3XF	1,434	0.3555	822.53	14.7	60.8	0.5735	2.11
FM 2398GLTP	1,419	0.3454	777.85	10.7	42.4	0.5480	2.51
NG 4050 XF	1,417	0.3371	799.75	7.3	35.8	0.5643	2.17
PHY 210 W3FE	1,381	0.3209	743.12	14.2	25.4	0.5383	2.46
PX 2D18W3FE	1,379	0.3216	749.49	7.8	21.6	0.5435	2.55
AMX 19A018B3XF	1,358	0.3164	777.40	12.0	48.7	0.5725	2.29
WFU T9B3XF	1,353	0.3468	761.72	7.0	50.1	0.5628	2.38
NG 3956 B3XF	1,350	0.3491	733.42	6.2	30.8	0.5433	2.79
NG 3930 B3XF	1,349	0.3280	770.40	7.0	38.8	0.5713	2.67
DP 2022 B3XF	1,312	0.3088	725.54	19.2	31.1	0.5530	2.52
AMX 19A015B3XF	1,299	0.2943	738.49	19.3	47.8	0.5683	2.69
NG 3994 B3XF	1,297	0.3401	730.58	12.8	55.1	0.5635	1.75
AMX 19B001B3XF	1,290	0.3444	730.93	10.4	61.7	0.5665	2.41
DP 2020 B3XF	1,284	0.3294	724.66	6.6	55.3	0.5645	2.38
Armor 9608 B3XF	1,273	0.3613	692.12	25.3	51.8	0.5438	1.91
DP 1909 XF	1,260	0.3255	722.88	24.8	57.9	0.5735	2.25
NG 4936 B3XF	1,240	0.3305	709.88	22.1	54.7	0.5725	2.36
Armor 9831 B3XF	1,230	0.3329	697.62	20.7	58.1	0.5673	1.98
AMX 19A014B3XF	1,199	0.3155	655.96	13.0	32.8	0.5470	2.63
ST 4480B3XF	1,196	0.3063	674.43	26.2	64.6	0.5638	2.18
NG 2982 B3XF	1,188	0.2958	635.00	12.7	45.7	0.5343	2.45
ST 4990B3XF	1,185	0.3411	676.78	11.1	48.8	0.5713	2.12
Prob>F	0.0001	0.0001	0.0001	0.001	0.001	0.0695	0.001
MSD (0.05)[2]	148	0.0329	82.38	14.0	12.0	0.0452	0.35

[1]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, NG is NexGen, PHY is Phytogen, PX are experimental lines for Phytogen, and WFU is an experimental line for Winfield United.

[2]MSD is minimal significant difference at P=0.05.

Table 3. Fiber properties for Floyd County in 2020.

Variety[1]	Mic.[3]	Length (inches)	Unif.[3] (%)	Strength (g/tex)	Elon.[3]	Rd	+b	Leaf
AMX 19A014B3XF	4.21	1.08	80.50	28.35	7.05	81.35	9.15	1.5
AMX 19A015B3XF	3.78	1.15	81.85	31.50	7.30	81.25	8.45	1.0
AMX 19A016B3XF	4.55	1.06	81.05	28.80	7.50	79.70	9.35	1.5
AMX 19A018B3XF	4.76	1.12	82.00	31.10	7.05	78.25	9.00	3.0
AMX 19B001B3XF	4.65	1.11	81.90	31.45	6.00	83.00	8.25	1.0
Armor 9210 B3XF	4.55	1.14	82.80	32.30	6.90	78.70	9.10	2.0
Armor 9598 B3XF	4.52	1.14	82.45	31.30	6.80	82.65	8.15	1.0
Armor 9608 B3XF	4.01	1.08	80.40	27.10	5.95	80.50	8.70	1.0
Armor 9831 B3XF	4.23	1.10	81.50	31.30	6.90	82.05	8.35	1.5
DP 1822 XF	4.69	1.12	81.50	32.65	5.75	80.45	8.80	1.0
DP 1909 XF	4.46	1.13	82.40	32.10	5.70	83.70	7.35	1.0
DP 2012 B3XF	4.48	1.12	81.35	29.10	6.00	82.70	8.50	1.0
DP 2020 B3XF	4.56	1.11	81.60	29.50	5.75	82.30	8.90	1.5
DP 2022 B3XF	4.18	1.09	81.30	28.85	5.50	79.10	7.95	3.0
FM 1621GL	4.89	1.09	82.20	31.15	5.60	80.55	7.95	2.5
FM 1911GLT	4.56	1.12	81.50	31.40	5.75	82.15	7.80	1.0
FM 2202GL	4.42	1.10	81.95	31.60	6.40	79.65	8.50	1.5
FM 2334GLT	5.14	1.13	82.05	30.25	5.80	81.35	8.40	1.0
FM 2398GLTP	5.15	1.10	82.05	31.10	6.10	81.60	8.15	1.0
FM 2498GLT	5.01	1.10	82.15	31.20	5.70	81.20	8.45	1.0
FM 2574GLT	4.55	1.13	82.35	30.50	5.70	81.85	8.00	1.0
NG 2982 B3XF	4.43	1.07	82.45	31.25	5.80	79.00	7.75	3.5
NG 3930 B3XF	4.77	1.12	82.80	29.60	6.10	81.55	8.95	1.0
NG 3956 B3XF	4.46	1.09	81.70	30.05	6.70	80.00	9.10	1.5
NG 3994 B3XF	4.57	1.10	81.15	28.85	6.45	80.95	9.10	2.0
NG 4050 XF	4.40	1.12	82.40	31.05	6.40	79.95	7.85	2.5
NG 4098 B3XF	3.83	1.17	81.05	34.60	6.20	79.55	8.35	2.5
NG 4936 B3XF	4.66	1.15	82.25	29.55	6.80	83.25	7.95	1.0
PHY 210 W3FE	4.85	1.08	82.05	30.65	5.40	81.20	8.10	2.0
PHY 394 W3FE	3.85	1.14	80.10	30.95	5.75	79.85	8.65	2.5
PX 2D18W3FE	4.33	1.09	80.05	29.65	5.90	79.95	8.30	1.5
PX 4B08W3FE	4.52	1.05	81.50	32.40	6.70	82.85	7.95	1.5
ST 4480B3XF	4.42	1.13	80.70	30.30	5.75	85.15	7.40	1.0
ST 4990B3XF	4.35	1.13	82.25	29.70	6.90	83.25	8.20	1.0
ST 5600B2XF	4.62	1.10	82.20	32.30	6.85	79.70	9.05	1.5
WFU T9B3XF	4.57	1.10	80.40	31.20	7.00	81.75	8.80	1.0
Prob>F	0.0001	0.0001	0.002	0.0001	0.0001	0.0001	0.0001	0.0001
MSD (0.05)	0.45	0.03	1.50	2.05	0.26	2.32	0.55	1.1

[1]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, , NG is NexGen, PHY is Phytogen, PX are experimental lines for Phytogen, and WFU is an experimental line for Winfield United.

[2]MSD is minimal significant difference at *P*=0.05.

[3]Micronaire=Mic., Uniformity=Unif., and Elongation=Elon.

Table 4. Verticillium wilt results from Hale County in 2020.

Variety[1]	Lint Yield (lbs/a)	Turn out	Loan x Yield ($/acre)	%Wilt	%Defol -iation	Loan ($/lb)	Plants /ft row
FM 2202GL	1,222	0.333	695.65	19.0	29.2	0.5695	1.90
FM 2398 GLTP	963	0.324	553.73	14.3	43.2	0.5753	2.04
Armor 9210 B3XF	953	0.365	547.64	14.5	49.6	0.5748	2.04
PHY 210 W3FE	945	0.314	534.54	14.8	30.5	0.5658	2.45
AMX 19A016B3XF	944	0.314	508.16	26.1	40.9	0.5383	2.19
ST 4550GLT	930	0.327	533.50	21.6	64.4	0.5735	2.19
WFU T9B3XF	889	0.310	510.29	33.1	41.5	0.5740	1.88
DP 1822 XF	871	0.303	503.84	11.1	34.8	0.5788	1.88
NG 3930 B3XF	831	0.296	475.05	8.9	41.3	0.5720	1.90
NG 2982 B3XF	828	0.280	437.32	25.2	52.8	0.5280	1.96
DP 1909 XF	823	0.278	471.68	38.0	51.8	0.5733	1.55
AMX 19A014B3XF	823	0.284	459.78	20.2	45.7	0.5590	2.06
AMX 19B003B3XF	823	0.275	441.52	28.1	29.0	0.5368	1.64
FM 1320GL	818	0.273	464.05	20.1	55.7	0.5673	1.44
PHY 332 W3FE	816	0.277	470.28	13.9	34.0	0.5765	2.04
FM 1621GL	812	0.311	459.05	24.1	42.1	0.5655	1.56
PX 2C14W3FE	810	0.278	452.36	8.4	32.9	0.5583	2.13
PHY 250 W3FE	807	0.298	458.48	16.5	29.6	0.5683	2.07
NG 3994 B3XF	803	0.311	461.57	14.9	43.8	0.5748	1.50
NG 3500 XF	791	0.294	435.31	11.6	26.7	0.5505	1.46
AMX 19B001B3XF	779	0.312	446.60	20.6	59.0	0.5733	2.05
AMX 19A015B3XF	765	0.278	439.82	21.3	45.9	0.5753	1.74
DP 2022 B3XF	764	0.261	429.37	19.4	16.1	0.5620	1.81
DP 1820 B3XF	753	0.295	435.55	10.6	28.1	0.5788	1.70
Armor 9598 B3XF	739	0.301	402.90	13.8	31.5	0.5450	1.72
FM 2334GLT	733	0.281	420.09	11.1	24.6	0.5735	1.91
PHY 400 W3FE	716	0.303	382.84	37.3	41.5	0.5345	1.72
FM 2322GL	716	0.290	411.63	13.6	30.9	0.5753	1.53
AMX 19A018B3XF	710	0.275	407.76	24.0	31.9	0.5745	1.69
Armor 9371 B3XF	700	0.298	399.42	20.5	55.9	0.5708	2.13
DP 2038 B3XF	695	0.304	378.77	13.7	38.6	0.5448	1.58
DP 1823NR B2XF	686	0.285	384.99	30.2	44.0	0.5610	1.51
DP 2012 B3XF	647	0.280	363.34	13.8	43.0	0.5618	2.03
DP 2020 B3XF	646	0.256	367.43	24.9	34.0	0.5690	1.85
Armor 9831 B3XF	560	0.277	321.33	22.9	36.3	0.5738	1.69
ST 4990 B3XF	468	0.264	268.17	23.5	46.1	0.5730	1.64
Prob>F	0.001	0.0001	0.0001	0.0002	0.0001	0.039	0.0001
MSD[2] (0.05)	207	0.024	115.97	15.7	10.5	0.0409	0.35

[1]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, , NG is NexGen, PHY is Phytogen, PX are experimental lines for Phytogen, and WFU is an experimental line for Winfield United.
[2]MSD is minimal significant difference at P=0.05.

Table 5. Fiber properties for Hale County in 2020.

Variety[1]	Mic.[3]	Length (inches)	Unif.[3] (%)	Strength (g/tex)	Elon.[3]	Rd	+b	Leaf
AMX 19A014B3XF	3.95	1.09	81.05	28.60	6.75	82.10	8.70	2.0
AMX 19A015B3XF	3.55	1.15	82.20	30.55	6.95	82.00	8.10	1.5
AMX 19A016B3XF	3.98	1.06	81.25	28.40	7.10	81.70	8.60	2.0
AMX 19A018B3XF	3.79	1.13	82.40	32.35	6.60	80.15	8.95	2.0
AMX 19B001B3XF	4.16	1.12	82.70	30.70	5.65	82.50	7.95	1.0
AMX 19B003B3XF	3.29	1.13	81.15	29.10	5.85	82.80	8.55	1.0
Armor 9210 B3XF	4.76	1.14	83.70	32.25	6.75	81.70	8.90	1.0
Armor 9371 B3XF	3.53	1.12	83.15	29.15	6.05	83.20	7.95	1.0
Armor 9598 B3XF	3.60	1.11	80.85	28.90	6.35	80.75	9.10	1.5
Armor 9831 B3XF	3.94	1.12	81.35	31.50	6.60	82.15	8.60	1.0
DP 1820 B3XF	4.09	1.16	82.25	32.35	5.45	83.10	8.00	1.0
DP 1822 XF	4.11	1.15	82.75	32.35	5.75	82.55	8.05	1.0
DP 1823NR B2XF	3.62	1.13	81.90	32.25	6.65	81.30	8.50	2.5
DP 1909 XF	3.74	1.15	82.15	31.35	5.60	83.45	7.15	1.0
DP 2012 B3XF	3.79	1.10	81.55	31.35	5.70	82.60	8.55	1.0
DP 2020 B3XF	3.53	1.13	81.20	27.20	5.45	82.30	8.65	1.0
DP 2022 B3XF	3.88	1.10	81.40	27.60	5.15	82.30	7.15	1.5
DP 2038 B3XF	3.63	1.08	81.25	28.90	6.00	82.85	8.90	1.0
FM 1320GL	3.88	1.11	81.55	31.20	6.50	83.30	8.10	1.0
FM 1621GL	4.07	1.11	81.55	30.55	5.45	81.35	8.20	2.5
FM 2202GL	3.68	1.11	82.95	33.35	6.10	81.05	8.25	2.0
FM 2322GL	3.87	1.12	82.05	32.65	5.25	81.55	8.20	1.0
FM 2334GLT	4.36	1.15	82.65	29.60	5.50	83.15	7.80	1.0
FM 2398GLTP	4.41	1.13	83.55	32.00	5.65	81.80	8.00	1.0
NG 2982 B3XF	3.23	1.09	82.00	33.05	5.90	80.25	7.30	3.5
NG 3500 XF	4.19	1.08	82.55	30.35	6.35	80.65	9.05	1.5
NG 3930 B3XF	3.83	1.13	82.25	29.35	6.20	81.05	8.40	2.0
NG 3994 B3XF	4.03	1.14	82.05	30.45	6.25	81.50	8.50	1.5
PHY 210 W3FE	4.27	1.10	83.00	30.35	5.35	83.50	7.60	1.5
PHY 250 W3FE	4.03	1.10	81.70	31.20	5.25	83.15	7.45	1.0
PHY 332 W3FE	3.79	1.14	82.90	31.45	6.40	80.95	8.80	1.0
PHY 400 W3FE	3.16	1.11	81.20	29.65	6.10	80.55	8.45	2.0
PX 2C14W3FE	3.61	1.09	82.00	29.25	6.65	83.65	7.95	1.0
ST 4550GLT	3.62	1.12	82.60	31.00	6.95	81.45	8.45	1.0
ST 4990B3XF	3.69	1.15	82.25	29.65	6.35	82.85	7.95	1.0
WFU T9B3XF	3.97	1.13	82.25	30.80	6.80	82.35	8.45	1.0
Prob>F	0.012	0.0001	0.0004	0.0001	0.0001	0.009	0.0001	0.0001
MSD (0.05)	0.83	0.04	1.28	2.18	0.33	2.34	0.68	0.7

[1]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, , NG is NexGen, PHY is Phytogen, PX are experimental lines for Phytogen, and WFU is an experimental line for Winfield United.

[2]MSD is minimal significant difference at P=0.05.

[3]Micronaire=Mic., Uniformity=Unif., and Elongation=Elon.

Table 6. Verticillium wilt trial in Hockley County in 2020

Variety[1]	Lint Yield (lbs/a)	Turn out	Loan x Yield ($/acre)	%Wilt	Defol-iation	Loan ($/lb)	Plants /ft row
PHY 480 W3FE	1944	0.3226	1114.03	6.9	61.3	0.5730	3.16
ST 4946GLB2	1932	0.3234	1110.11	4.7	64.4	0.5745	2.73
ST 5600B2XF	1881	0.3364	1088.84	4.7	37.1	0.5788	2.14
PHY 350 W3FE	1763	0.3193	1015.25	3.6	46.0	0.5758	2.99
Armor 9371 B3XF	1749	0.3321	1005.94	8.4	48.7	0.5753	2.61
FM 2498GLT	1734	0.3446	991.43	4.3	45.8	0.5718	2.97
PHY 394 W3FE	1733	0.2821	986.98	2.8	37.0	0.5695	2.95
NG 4777 B2XF	1712	0.3232	982.16	4.1	43.7	0.5738	2.09
PHY 443 W3FE	1709	0.3176	981.14	4.5	49.5	0.5740	2.79
NG 4792 XF	1698	0.3292	976.30	2.9	58.4	0.5750	2.15
DP 1909 XF	1680	0.3177	974.49	9.9	60.0	0.5800	2.05
NG 4050 XF	1678	0.3275	959.23	3.0	38.5	0.5715	1.73
DP 2055 B3XF	1669	0.3269	944.28	5.0	55.0	0.5658	2.75
PHY 400 W3FE	1665	0.3185	956.57	7.5	50.6	0.5745	2.61
PHY 545 W3FE	1633	0.3294	924.15	5.6	49.7	0.5660	2.72
PHY 580 W3FE	1632	0.3286	923.32	5.4	50.0	0.5658	2.60
PX 2E05W3FE	1591	0.2996	875.77	3.7	59.4	0.5503	2.90
ST 4550GLT	1554	0.3626	894.20	11.1	65.9	0.5755	2.26
PX 2C14W3FE	1551	0.2797	860.84	3.2	50.2	0.5550	2.48
DP 2020 B3XF	1551	0.3277	892.21	4.8	62.8	0.5753	2.38
NG 4098 B3XF	1541	0.2842	880.97	8.2	37.0	0.5715	2.34
DP 1845 B3XF	1537	0.3236	866.84	7.0	41.4	0.5638	2.24
ST 5610 B3XF	1537	0.3281	886.86	5.5	50.6	0.5770	2.24
PX 3E33W3FE	1523	0.3050	877.07	4.9	61.0	0.5758	2.58
NG 3956 B3XF	1520	0.2986	868.03	4.6	42.0	0.5710	2.96
ST 5707 B2XF	1517	0.2954	881.95	7.4	55.9	0.5815	2.94
DP 1840 B3XF	1513	0.3334	877.21	10.1	38.9	0.5798	1.60
DP 2038 B3XF	1510	0.3649	845.07	4.6	55.0	0.5595	1.58
FM 2334GLT	1479	0.3273	853.91	1.7	34.2	0.5775	2.24
DP 2044 B3XF	1475	0.3283	849.55	10.5	52.7	0.5760	1.65
AMX 19B003B3XF	1475	0.3198	845.70	3.6	57.8	0.5735	2.18
PX 5E34W3FE	1462	0.3004	818.92	6.9	41.8	0.5600	2.65
PHY 500 W3FE	1455	0.2819	832.85	4.3	47.7	0.5723	2.71
DP 2022 B3XF	1451	0.2819	827.98	3.0	23.6	0.5705	2.65
NG 4936 B3XF	1427	0.3219	820.62	7.8	57.5	0.5750	2.32
PX 5E28W3FE	1414	0.2790	772.88	4.4	47.6	0.5465	2.93
DP 1948 B3XF	1376	0.3034	791.80	10.2	48.4	0.5753	1.80
ST 4480 B3XF	1372	0.2890	793.97	6.2	57.7	0.5788	2.20
DP 1916 B3XF	1370	0.3512	777.35	2.9	81.6	0.5673	2.00
Armor 9608 B3XF	1301	0.3275	744.82	9.3	63.2	0.5723	1.51
Prob>F	0.0001	0.0001	0.0001	0.0003	0.0001	0.014	0.001
MSD[2] (0.05)	249	0.039	140.65	5.4	16.1	0.0206	0.24

[1]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, , NG is NexGen, PHY is Phytogen, PX are experimental lines for Phytogen, and WFU is an experimental line for Winfield United.
[2]MSD is minimal significant difference at P=0.05.

Table 7. Fiber properties for Hockley County in 2020.

Variety[1]	Mic.[3]	Length (inches)	Unif.[3] (%)	Strength (g/tex)	Elon.[3]	Rd	+b	Leaf
AMX 19B003B3XF	4.39	1.13	81.55	30.15	7.00	82.20	8.35	1.0
Armor 9371 B3XF	3.94	1.15	83.30	28.90	6.35	83.85	7.95	1.0
Armor 9608 B3XF	3.79	1.14	81.45	28.40	5.90	81.30	7.90	1.5
DP 1840 B3XF	4.05	1.20	82.25	32.25	7.10	82.55	8.25	1.0
DP 1845 B3XF	3.66	1.22	83.00	31.55	7.75	81.50	7.10	3.0
DP 1909 XF	4.10	1.19	82.60	31.90	5.95	84.40	6.90	1.5
DP 1916 B3XF	4.08	1.11	81.35	31.40	6.50	81.05	8.55	1.0
DP 1948 B3XF	3.86	1.21	82.25	31.50	8.15	82.50	7.05	3.0
DP 2020 B3XF	3.75	1.18	82.00	29.35	6.20	84.20	7.65	1.0
DP 2022 B3XF	3.71	1.14	80.80	30.00	5.55	81.35	7.35	2.5
DP 2038 B3XF	4.00	1.10	80.60	29.15	6.25	84.05	7.95	1.0
DP 2044 B3XF	3.95	1.18	81.45	29.70	7.15	83.55	7.95	1.0
DP 2055 B3XF	3.45	1.21	80.35	33.25	6.20	80.35	7.90	3.0
FM 2334GLT	4.32	1.19	82.35	31.00	5.80	83.35	7.40	1.0
FM 2498GLT	4.23	1.13	81.63	29.30	6.10	82.23	7.80	1.3
NG 3956 B3XF	4.43	1.14	82.50	30.20	6.95	81.90	8.45	1.0
NG 4050 XF	4.13	1.15	81.70	30.35	6.65	81.40	7.50	1.5
NG 4098 B3XF	3.53	1.21	81.35	33.50	6.50	78.60	7.80	3.0
NG 4777 B2XF	4.09	1.14	81.25	30.70	5.60	82.15	8.55	1.0
NG 4792 XF	4.36	1.15	81.65	31.25	6.85	82.00	8.40	1.0
NG 4936 B3XF	4.25	1.17	82.50	29.50	7.30	84.35	7.45	1.0
PHY 350 W3FE	4.15	1.16	81.90	30.20	6.90	82.70	7.80	1.5
PHY 394 W3FE	3.55	1.20	80.70	30.70	6.10	80.80	7.50	3.0
PHY 400 W3FE	3.98	1.13	80.90	31.70	6.20	81.05	7.90	2.5
PHY 443 W3FE	4.04	1.13	81.80	31.45	6.70	81.70	8.40	1.0
PHY 480 W3FE	3.89	1.15	82.10	29.80	7.70	82.05	8.30	2.0
PHY 500 W3FE	3.58	1.12	81.65	31.60	6.25	82.95	7.55	2.0
PHY 545 W3FE	4.06	1.10	81.30	29.40	7.05	81.55	8.25	2.0
PHY 580 W3FE	4.16	1.10	81.80	30.20	6.80	81.15	8.25	2.0
PX 2C14W3FE	3.68	1.10	81.00	30.75	6.90	82.90	7.65	2.0
PX 2E05W3FE	4.64	1.08	82.80	30.90	5.80	81.10	7.65	1.5
PX 3E33W3FE	4.11	1.14	81.95	30.95	6.85	81.15	8.55	1.0
PX 5E28W3FE	3.42	1.17	82.05	30.85	6.95	80.50	7.35	3.0
PX 5E34W3FE	3.34	1.17	82.00	32.30	6.85	83.80	7.65	1.0
ST 4480B3XF	3.86	1.21	82.20	32.90	5.85	84.05	6.80	1.5
ST 4550GLT	4.17	1.13	82.80	31.50	7.55	81.50	8.25	1.0
ST 4946GLB2	4.04	1.13	82.65	32.05	7.05	81.35	8.20	2.0
ST 5600B2XF	4.23	1.18	82.90	31.65	7.30	82.45	8.05	1.5
ST 5610B3XF	3.95	1.17	82.05	30.35	6.60	81.80	7.80	2.0
ST 5707B2XF	3.98	1.19	84.05	33.85	6.80	81.95	8.40	2.0
Prob>F	0.0001	0.0001	0.033	0.0001	0.0001	0.0001	0.0001	0.002
MSD[2] (0.05)	0.37	0.03	2.27	1.69	0.4	1.82	0.4	1.49

[1]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, , NG is NexGen, PHY is Phytogen, and PX are experimental lines for Phytogen.
[2]MSD is minimal significant difference at *P*=0.05.
[3]Micronaire=Mic., Uniformity=Unif., and Elongation=Elon.

Table 8. Combined analysis for the three wilt trials, using relative[1] wilt, relative defoliation, relative lint yield, relative lint yield x loan value, and the average of all four rankings (ave ranks), and average of disease rankings.

Variety[2]	Rel. wilt	Rank Wilt	Rel. Defoliation	Rank Defol-iation	Rel. yield	Rank yield	Rel. Value /a	Rank Value /a	Ave Ranks	Ave Wilt+ Defol. Ranks
FM 2334GLT	0.1021	2	0.2204	2	0.4324	47	0.4257	48	24.75	2.00
FM 1911GLT	0.1471	7	0.2506	5	0.5484	19	0.5596	15	11.5	6.00
NG 4050 XF	0.1402	6	0.2741	6	0.5794	10	0.5719	11	8.25	6.00
PX 2D18 W3FE	0.1563	10	0.234	3	0.5681	16	0.5191	21	12.5	6.50
PHY 394 W3FE	0.1525	9	0.2401	4	0.5871	9	0.5844	10	8.00	6.50
FM 2574GLT	0.0721	1	0.3731	19.5	0.5699	15	0.5919	8	10.88	10.25
NG 3956 B3XF	0.1725	12	0.3049	9	0.4068	52	0.3796	55	32.00	10.50
ST 5600B2XF	0.1891	16	0.2749	7	0.6938	5	0.6785	4	8.00	11.50
FM 2322GL	0.1737	13	0.3411	14	0.3849	58	0.4045	52	34.25	13.50
FM 2498GLT	0.1585	11	0.372	18	0.5077	26	0.4851	31	21.50	14.50
DP 1820 B3XF	0.1834	15	0.3626	16	0.4149	50	0.4386	40	30.25	15.50
NG 3500 XF	0.1994	19	0.3345	13	0.4459	43	0.4382	41	29.00	16.00
PX 2C14W3FE	0.148	8	0.4046	24	0.4602	37	0.437	43	28.00	16.00
DP 2022 B3XF	0.2357	33	0.1999	1	0.4267	49	0.4212	49	33.00	17.00
NG 3930 B3XF	0.1179	3	0.4494	37	0.5073	27	0.5261	20	21.75	20.00
NG 4777 B2XF	0.2093	24	0.3803	21	0.5752	11	0.5621	13	17.25	22.50
PHY 332 W3FE	0.2071	22	0.3901	23	0.4659	34	0.4881	30	27.25	22.50
PHY 500W3FE	0.2029	20	0.4192	26	0.3895	57	0.3766	56	39.75	23.00
Armor 9598B3XF	0.2267	31	0.3692	17	0.5059	28	0.5151	23	24.75	24.00
PX 5E28 W3FE	0.1797	14	0.442	34	0.36	62	0.3026	69	44.75	24.00
NG 4098 B3XF	0.2408	39	0.3142	10	0.5439	21	0.5504	17	21.75	24.50
PHY 250 W3FE	0.2302	32	0.3832	22	0.4586	38	0.4713	35	31.75	27.00
FM 2202GL	0.2816	47	0.2869	8	0.7108	3	0.7169	3	15.25	27.50
PHY 350 W3FE	0.2223	29	0.4219	27	0.6125	6	0.6031	7	17.25	28.00
AMX 19B03B3XF	0.2401	37	0.3731	19.5	0.4374	45	0.4199	50	37.88	28.25
PHY2 10W3FE	0.2716	46	0.3153	11	0.5699	14	0.5438	18	22.25	28.50
NG 4792 XF	0.1357	4	0.5435	53	0.5652	17	0.5549	16	22.50	28.50
DP 1822 XF	0.2073	23	0.4448	35	0.5896	8	0.6244	5	17.75	29.00
PHY 545 W3FE	0.2203	26	0.44	33	0.5177	22	0.4896	27	27.00	29.50
FM 2398GLTP	0.1984	18	0.475	42	0.5173	23	0.5122	25	27.00	30.00
DP 2038 B3XF	0.1958	17	0.4784	44	0.3988	54	0.3746	57	43.00	30.50
PHY 443 W3FE	0.2135	25	0.4708	39	0.5732	13	0.5606	14	22.75	32.00
PX 5E34 W3FE	0.2416	40	0.4068	25	0.3947	55	0.3594	61	45.25	32.50
PX 2E05 W3FE	0.2035	21	0.5029	47	0.488	29	0.4299	47	36.00	34.00
DP 1845 B3XF	0.3304	54	0.346	15	0.4492	41	0.4189	51	40.25	34.50
PX 4B08 W3FE	0.2421	41	0.4361	32	0.7014	4	0.6059	6	20.75	36.50
AMX 19A014B3XF	0.2566	43	0.4295	31	0.3459	64	0.3354	64	50.50	37.00
DP 1916 B3XF	0.1367	5	0.814	70	0.3282	67	0.3079	68	52.50	37.50
PHY 580 W3FE	0.2544	42	0.4462	36	0.517	24	0.4889	29	32.75	39.00
DP 2020 B3XF	0.2371	34	0.493	45	0.392	56	0.3958	54	47.25	39.50
DP 1840 B3XF	0.4809	67	0.3175	12	0.4312	48	0.4319	45	43.00	39.50
AMX 19A018B3XF	0.2958	50	0.4284	30	0.3425	65	0.3645	60	51.25	40.00
ST 5610B3XF	0.2617	44	0.4527	38	0.4487	42	0.4436	39	40.75	41.00
DP 2055 B3XF	0.2379	35	0.5042	48	0.544	20	0.5151	24	31.75	41.50
PX 3E33 W3FE	0.2407	38	0.4969	46	0.4387	44	0.4316	46	43.50	42.00
NG 3994 B3XF	0.2243	30	0.576	60	0.469	32	0.4805	32	38.50	45.00
ST 4946GLB2	0.2212	27.5	0.6137	63	0.7345	2	0.7206	2	23.63	45.25
AMX 19A016B3XF	0.4035	63	0.4263	28	0.5943	7	0.5382	19	29.25	45.50
FM 1621GL	0.3387	55	0.4724	40	0.5745	12	0.5627	12	29.75	47.50
DP 2012 B3XF	0.2698	45	0.5213	51	0.4831	31	0.4959	26	38.25	48.00

AMX 19B001B3XF	0.2212	27.5	0.7318	69	0.456	39	0.4701	36	42.88	48.25
DP 1948 B3XF	0.4864	68	0.4272	29	0.3325	66	0.3259	65	57.00	48.50
PHY 400 W3FE	0.3729	60	0.4725	41	0.4631	35	0.447	38	43.50	50.50
Armor 9210 B3XF	0.2382	36	0.6611	66	0.561	18	0.5849	9	32.25	51.00
ST 4990B3XF	0.2854	48	0.55	55	0.2099	70	0.2348	70	60.75	51.50
WFU T9B3XF	0.3302	53	0.5212	50	0.4531	40	0.4648	37	45.00	51.50
ST 5707B2XF	0.3532	58	0.5145	49	0.4342	46	0.4374	42	48.75	53.50
NG 2982 B3XF	0.3138	51	0.5696	58	0.3829	59	0.3394	63	57.75	54.50
DP 2044 B3XF	0.4997	69	0.4775	43	0.4037	53	0.3974	53	54.50	56.00
PHY 480 W3FE	0.3267	52	0.5775	61	0.743	1	0.7259	1	28.75	56.50
AMX 19A015B3XF	0.351	57	0.5559	56	0.4148	51	0.4324	44	52.00	56.50
Armor 9831 B3XF	0.3698	59	0.5437	54	0.2955	69	0.3111	67	62.25	56.50
Armor 9371 B3XF	0.3478	56	0.5668	57	0.4867	30	0.4894	28	42.75	56.50
FM 1320GL	0.2877	49	0.6998	67	0.4676	33	0.4792	33	45.50	58.00
DP 1823NRB3XF	0.4677	66	0.5311	52	0.3609	61	0.3665	58	59.25	59.00
NG 4936 B3XF	0.3989	61	0.5753	59	0.3562	63	0.3646	59	60.50	60.00
Armor 9608 B3XF	0.4651	65	0.5865	62	0.3681	60	0.3417	62	62.25	63.50
ST 4480B3XF	0.4011	62	0.6513	65	0.3134	68	0.3166	66	65.25	63.50
ST 4550GLT	0.4226	64	0.7284	68	0.5099	25	0.5156	22	44.75	66.00
DP 1909 XF	0.5183	70	0.6237	64	0.4627	36	0.4779	34	51.00	67.00

[1]Relative values were calculated by: (plot value – minimum value for that test site)/(maximum – minimum value).
[2]AMX are experimental lines for Americot DP is Deltapine, FM is FiberMax, NG is NexGen, PHY is Phytogen, PX are experimental lines for Phytogen, and WFU is an experimental line for Winfield United.

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