

PERFORMANCE AND PLANT MAPPING OF PSC355 IN THE HOT, DRY SUMMER OF 2000

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Abstract

The superior yielding ability of PSC 355 has been demonstrated by head-to-head comparisons with 1998 and 1999 university data from Texas to North Carolina. Sustained superior performance over a range of environments is essential to the success of a new variety. The summer of 2000 in the Mid-South provided a stressful environment for the evaluation of varieties for yield stability. The average daily high from July 1 to Sept. 8 was 5.4°F higher than normal and only 0.72" of rain fell during this entire period. Six checks from Phytogen's AST were compared at four irrigated and four dryland locations in the Mid-south. DP Pearl was the highest yielding variety when averaged over both the irrigated (1253 #/acre) and the dryland (858 #/acre) locations, but PSC 355 was not statistically different from it with 1208 and 836 #/acre, respectively. DP Pearl had the highest yield at the highest yielding irrigated locations of Leland, MS and Crowleyville, LA. PSC 355 was the highest yielding check at St. Joseph, LA, Marianna, AR, and at Brownsville, TN.

Differential plant mapping reflected that DP 388 produced slightly more bolls on the bottom nodes and fewer bolls on the middle and top nodes than did PSC 355. The trend for SG 747 was similar. The differential boll distribution of ST 474 and FM 958 was opposite that of DP 388 and SG 747 with fewer bottom and slightly more middle and top bolls than PSC 355. The boll distribution for DP Pearl was similar to that for FM 958, but the magnitude of the difference from PSC 355 was greater. These differences were reflected in the analysis of map index with DP 388 having the highest and DP Pearl having the lowest map index means over locations. These mapping data suggest that ST 474 and FM 958 were slightly later than PSC 355 and that DP Pearl was significantly later maturing than PSC 355. The slight yield advantage observed for DP Pearl over PSC 355 in 2000 would probably be reversed in a more normal year in the Mid-south with fewer accumulated heat units.

Introduction

Phytogen Seed Company, LLC entered the Mid-South cottonseed market in 1999 with the early maturing varieties PSC 355 and PSC 952. PSC 355 was developed from the H10-35-05 germplasm that was licensed exclusively to Mycogen Corporation from Mississippi State University (Creech et al., 1999). The superior yielding ability of PSC 355 was demonstrated by McPherson et al. (2000) using Agrobase (Agronomix Software, Inc.) Head-to-Head comparisons with 1998 and 1999 university data from Texas to North Carolina. PSC 355 was significantly higher yielding than all other varieties except for SG 747 and PM 1218 BG/RR which were only about 2% lower yielding on average than PSC 355.

Yield is comprised of environmental, genotypic (variety), and GXE components. Over location analyses reveal that the environmental effect is the largest determinant of yield (Myers and Bordelon, 1997). The environmental effect is due to the combination and interaction of myriad variables such as soil type, fertility, water availability, temperature, insect pressure, management practices, etc. The genotypic effects on yield are due to the additive (overall mean) effect of that variety and the multiplicative interaction (GXE) of that variety with various environments. Relative performance in a wide range of environments is indicative of the yield stability of a variety.

The summer of 2000 in the Mid-South provided an ideal opportunity to evaluate varieties for stress tolerance as the weather was much hotter and dryer than normal as illustrated by the data from Stoneville, MS in Table 1. The average daily high from July 1 to Sept. 8 was 5.4°F higher than normal with the accumulated heat units at the end of the season being about two weeks ahead of normal. During this period, only 0.72" of rain fell with 9 of 10 weeks recording less than 0.10" of rainfall. The severity of this stress can be reflected by the grand mean of Phytogen's AST at Leland, MS under irrigated (1216 #/acre) and dryland (652 #/acre) conditions in close proximity within the same field. The objective of this study was to evaluate the relative performance of PSC 355 in maximum yield and stress environments and to compare the average mapped boll distribution of PSC 355 to those for other check varieties.

Materials and Methods

A 48 entry advanced strains test (AST) was planted at four irrigated and four dryland locations in the Mid-south. The test consisted of four replications of 2-row X 48' plots. At the end of the season, but before harvest, ten consecutive plants in three reps of six check varieties were mapped for the presence or absence of bolls at the first three positions of all sympodial nodes. The site-specific average number of bolls on ten plants of each variety was subtracted from that for PSC 355.

Jenkins and McCarty (1995) and McPherson et al. (1995) demonstrated that maturity was closely related to where a variety produced its yield with earlier maturing varieties having relatively more yield on lower nodes. McPherson et al. (1995) used a plant map index to transform the boll distribution graphs into a single analyzable number. This procedure was also used for the present study. Using an expected blooming interval of 3 days between nodes and 6 days between positions on the same node, a relative value was assigned to each boll site (Table 1). The number of mapped bolls at each site was converted to a fraction of the total mapped bolls which was then multiplied times the corresponding site-specific relative value. This product was then summed over all boll sites to generate the map index.

Results and Discussion

Yield

When average over the irrigated locations, DP Pearl, PSC 355, and FM 958 had the highest yields (Table 3). DP Pearl had the highest yield at the more southern irrigated locations of Leland, MS (MSL) and Crowleyville, LA (LAC), while FM 958 had, or tied for, the highest yield at the more northern irrigated locations of Hornersville, MO (MOH) and Marianna, AR (ARM). Though PSC 355 won only the ARM irrigated location, it was consistent enough to come in second to DP Pearl by only 45 #/acre over the irrigated locations.

When average over the dryland locations, DP Pearl, PSC 355, and SG 747 had the highest yields (Table 4). PSC 355 won the dryland locations of St. Joseph, LA (LAJ) and Brownsville, TN (TNB), while SG 747 won the dryland locations of Leland, MS (MSD) and Wayside, MS (MSW). DP Pearl came in second at LAJ, MSD, and MSW to beat PSC 355 overall at the dryland locations by 22 #/acre. These 2000 results indicate that PSC 355 and FM 958 were the best varieties tested in the North Delta and DP Pearl was the best variety in the South Delta with PSC 355 and SG 747 close seconds.

Plant Mapping

The mean squares from the over location analysis of map index revealed that boll distributions were affected about equally by locations and varieties (Table 5). Since the variety X loc term was not significant, the varietal differences were shown to be consistent across locations.

The differential plant maps in Figs. 1 to 5 reflect the map index differences of Table 5. DP 388 and SG 747 had the highest map index scores to confirm the very-early maturity assigned to these varieties. The differential plant maps of Fig.1 and 2 indicate that these varieties had slightly more bolls below node 10 and fewer bolls above node 9 than did PSC 355. The 33.2 map index for PSC 355 was halfway between the 36.0 for DP 388 and the 30.0 for ST 474 to “split the difference” in maturity between these two varieties. The map index for ST 474 was not different from FM 958 as reflected by the similarity between their differential plant map graphs in Figs. 3 and 4. DP Pearl had the next step lower map index with much fewer bolls below node 11 and much more bolls above node 11 than PSC 355 (Fig. 5). Using map index to assign relative maturity, DP 388 and SG 747 can be classified as very-early, PSC 355 as early, ST 474 and FM 958 as early-mid, and DP Pearl as medium maturity varieties.

Summary

PSC 355 was second only to DP Pearl in yield at the irrigated and dryland locations of Phytogen’s AST. This difference was due to significantly higher yield by DP Pearl at the more southern irrigated locations of Crowley, LA, Leland, MS, and Wayside, MS. Plant mapping revealed that DP Pearl produced significantly more of its yield on the top half of the plant as compared to PSC 355. This difference in boll distribution is normally indicative of a much later maturity that may become more apparent in a more normal year with a lower accumulation of heat units.

References

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Table 1. Formulae for calculation of map index.

Node	Relative Value			% of Total Bolls			Product				
	P1	P2	P3	P1	P2	P3	P1	P2	P3		
21	1			*	%T		=	RV%T			
20	4			*	%T		=	RV%T			
19	7	1		*	%T	%T	=	RV%T	RV%T		
18	10	4		*	%T	%T	=	RV%T	RV%T		
17	13	7	1	*	%T	%T	%T	=	RV%T	RV%T	RV%T
16	16	10	4	*	%T	%T	%T	=	RV%T	RV%T	RV%T
15	19	13	7	*	%T	%T	%T	=	RV%T	RV%T	RV%T
14	22	16	10	*	%T	%T	%T	=	RV%T	RV%T	RV%T
13	25	19	13	*	%T	%T	%T	=	RV%T	RV%T	RV%T
12	28	22	16	*	%T	%T	%T	=	RV%T	RV%T	RV%T
11	31	25	19	*	%T	%T	%T	=	RV%T	RV%T	RV%T
10	34	28	22	*	%T	%T	%T	=	RV%T	RV%T	RV%T
9	37	31	25	*	%T	%T	%T	=	RV%T	RV%T	RV%T
8	40	34	28	*	%T	%T	%T	=	RV%T	RV%T	RV%T
7	43	37	31	*	%T	%T	%T	=	RV%T	RV%T	RV%T
6	46	40	34	*	%T	%T	%T	=	RV%T	RV%T	RV%T
5	49	43	37	*	%T	%T	%T	=	RV%T	RV%T	RV%T
4	52	46	40	*	%T	%T	%T	=	RV%T	RV%T	RV%T
$\Sigma = 1.00$							Map Index = $\Sigma \Sigma (RV\%T)$				

Table 2. Weekly weather data recorded at Stoneville, MS for 2000 and 30-year average. Temperature is the weekly average daily high, DD 60’s are cumulative heat units, and rainfall is the weekly accumulation.

Week Ending	Ave. Daily High 30 Yr	DD 60’s 2000	DD 60’s 30 Yr	DD 60’s 2000	Weekly Rainfall 30 Yr	Weekly Rainfall 2000
5/5	78	79	154	172	1.29	4.57
5/12	80	84	225	287	1.24	0.59
5/19	82	84	311	375	1.15	0.46
5/26	84	87	408	507	1.05	0.64
6/2	86	92	519	651	0.94	0.72
6/9	88	85	643	748	0.84	2.47
6/16	90	93	778	907	0.85	0
6/23	90	90	921	1055	0.94	1.67
6/30	91	90	1069	1197	0.94	1.99
7/7	92	91	1220	1353	0.81	0
7/14	92	97	1375	1530	0.77	0
7/21	92	100	1528	1724	0.77	0
7/28	91	90	1679	1853	0.77	0.04
8/4	91	94	1824	2007	0.70	0.60
8/11	90	97	1967	2185	0.56	0
8/18	91	97	2109	2349	0.44	0
8/25	90	98	2249	2525	0.48	0
9/1	89	103	2389	2725	0.65	0
9/8	88	93	2502	2857	0.79	0.08

Table 3. Average lint yield of select checks in Phytogen’s AST at irrigated locations in 2000.

	Irrigated	Leland	Crowley	Marianna	Horn’ville
	Avg	MS	LA	AR	MO
Delta Pearl	1253	1489	1336	1188	998
PSC 355	1208	1229	1157	1341	1107
SG 747	1129	1297	1012	1134	1072
FM 958	1195	1304	896	1318	1264
ST 474	1151	1266	1012	1150	1177
DP 388	1040	1027	880	1174	1077
LSD	56	89	143	83	125

Bold indicates not statistically different from highest yielding check.

Table 4. Average lint yield of select checks in Phytogen AST at dryland locations in 2000.

	Dryland	Leland	Wayside	St. Joe	Brow'veille
	Avg	MS	MS	LA	TN
Delta Pearl	858	758	714	1401	559
PSC 355	836	634	546	1454	708
SG 747	830	809	764	1149	597
FM 958	742	546	640	1167	616
ST 474	655	537	488	1014	580
DP 388	694	538	657	959	620
LSD	58	71	121	146	83

Bold indicates not statistically different from highest yielding check.

Table 5. Over location analysis of variance for map index.

Source	df	MS	F	P
Locations	5	231.3	12.71	0.0002
Rep within Loc	12	18.2		
Variety	5	260.4	36.37	0.0000
Variety X Loc	25	7.2	1.52	0.0932
Residual	60	4.7		

Table 6. Average Plant Map Index for six varieties at six locations.

	Ave.	MSL	MSD	LAC	LAJ	MOH	TNB
DP 388	36.0	31.1	34.2	33.6	40.3	37.8	38.8
SG 747	35.2	28.7	35.4	35.5	37.8	34.9	38.6
PSC 355	33.2	28.8	31.0	32.5	37.8	33.8	35.5
ST 474	30.0	23.5	30.1	30.2	35.3	27.2	33.6
FM 958	29.2	22.7	28.0	29.1	32.8	29.2	33.5
DP Pearl	26.2	20.6	25.5	28.1	30.8	21.1	30.8
LSD	1.8	2.9	3.3	3.7	2.6	3.8	2.1

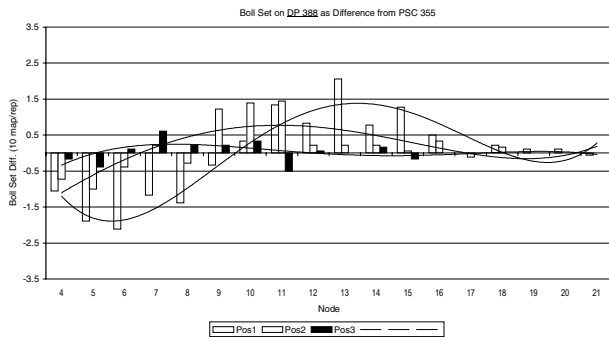


Figure 1. Differential plant mapping of DP 388 with average number of bolls on 10 plants/rep subtracted from that on PSC 355.

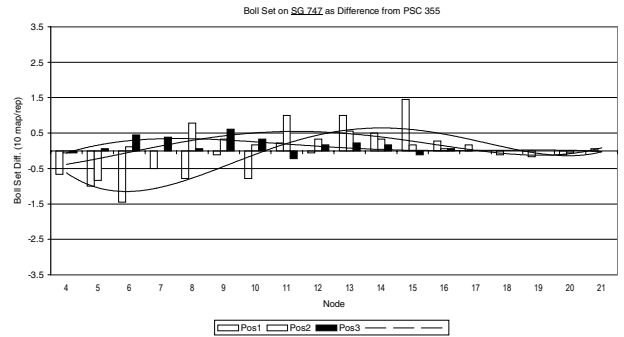


Figure 2. Differential plant mapping of SG 747 with average number of bolls on 10 plants/rep subtracted from that on PSC 355.

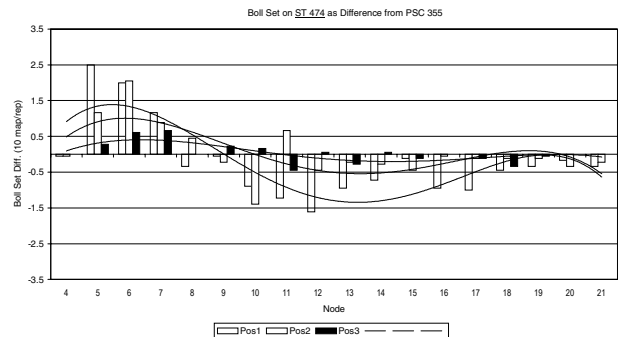


Figure 3. Differential plant mapping of ST 474 with average number of bolls on 10 plants/rep subtracted from that on PSC 355.

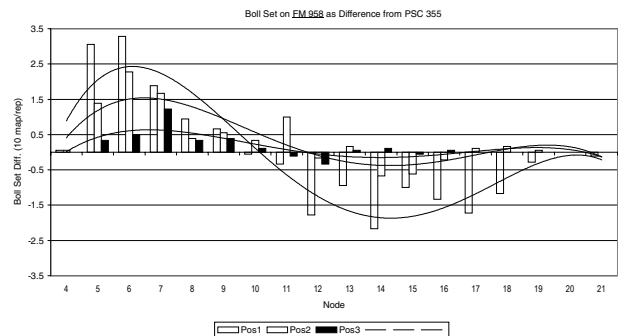


Figure 4. Differential plant mapping of FM 958 with average number of bolls on 10 plants/rep subtracted from that on PSC 355.

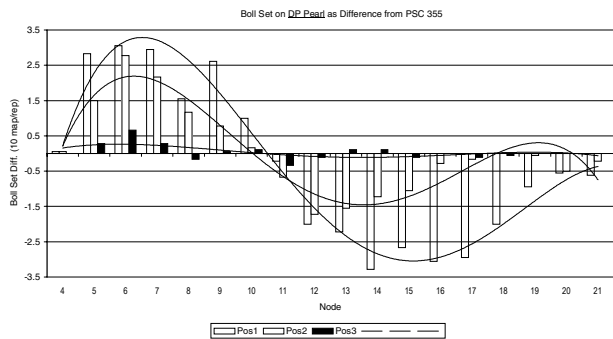


Figure 5. Differential plant mapping of DP Pearl with average number of bolls on 10 plants/rep subtracted from that on PSC 355.