2003 BELTWIDE COTTON CONFERENCES, NASHVILLE, TN – JANUARY 6-10

SIMULTANEOUS IMPROVEMENT OF YIELD AND FIBER QUALITY

Ken E. Lege'
Delta and Pine Land Company
Centre, AL
Kevin D. Howard, Thomas A. Kerby, and Don L. Keim
Delta and Pine Land Company
Scott, MS
David W. Albers and Tom R. Speed
Delta and Pine Land Company
Lubbock, TX

Abstract

Over the past decade, Delta and Pine Land Company (D&PL), has been breeding to develop cotton cultivars that can potentially achieve high yields, meet the needs of the grower, and produce high fiber quality, meeting the needs of the mills. We compared three new D&PL cotton varieties, DP 555 BG/RR, DP 444 BG/RR, and DP 491 to varieties with high yield potential and/or high fiber quality grown in the U.S. The cotton varieties compared accounted for approximately 34% of the U.S. cotton acreage in 2002. Comparisons showing yield and fiber quality performance were made through direct head-to-head comparisons across the Cotton Belt using D&PL's internal trial data, as well as data from the public sector. Crop value, yield, staple length, micronaire, fiber length, % uniformity and loan value were expressed as % difference between the new varieties and the comparison varieties. DP 555 BG/RR outyielded four comparison varieties by an average of 14.5% and returned a 15.6% higher crop value per acre when averaged across the Cotton Belt. DP 444 BG/RR outyielded five comparison varieties by an average of 5.2% and returned an 8.0% higher crop value per acre when averaged across the Cotton Belt. DP 491 equaled or exceeded the lint yield of all comparisons. DP 491 exhibited excellent fiber quality traits and produced the greatest crop value per acre relative to its comparisons.

Introduction

Historically, top-yielding varieties have tended to produce higher micronaire and shorter fiber on average (Keim, 2002). Seed breeders have faced a dilemma: Produce varieties with yield that farmers want, or produce lower yielding varieties with fiber quality mills want. Farmers' emphasis on yield is partially related to the US farm program where part of the support is related to yield level.

For the past decade D&PL has been working to develop varieties that can potentially achieve high yields, meeting the needs of the grower, and have fiber quality that meets the mills needs. We will compare the yield and fiber quality among three new D&PL varieties, DP 555 BG/RR, DP 444 BG/RR, and DP 491, to existing commercial varieties that have exhibited high yield potential and/or have produced high fiber quality.

Materials and Methods

These data are a combination of D&PL trials conducted by both Research and Technical Services (ASTs), trials conducted by County Agents (CATs), and state university Official Variety Tests (OVTs). In general, D&PL Research data are from small-plot, replicated trials, while D&PL Technical Services data are primarily from large-plot trials, grown on-farm by grower-cooperators using their equipment and management practices; about one-third of these trials are replicated. County agent trials are typically large-plot, on-farm trials, while state university OVTs are generally small-plot, replicated trials conducted on university research stations. Data presented represent all available data in D&PL's Agronomic Information System database as of 2 January 2003.

We choose several varieties, which have significant market share in the U.S. and/or have been promoted as having high fiber quality (Table 1). The varieties selected account for approximately 34% of the total U.S. planted cotton acreage in 2002 (USDA, 2002). In addition, some comparisons were made to some of D&PL's leading varieties for the given maturity range and technology. The following comparisons were made:

- DP 555 BG/RR versus DP 458 B/RR, FM 989 BR, ST 4892 BR, and DP 451 B/RR individually;
- DP 444 BG/RR versus FM 989 BR, SG 215 BG/RR, PM 1218 BG/RR, ST 4892 BR, and DP 451 B/RR individually; and
- DP 491 versus FM 989, DP 565, ST 474, DeltaPEARL, and FM 832 individually.

Means presented represent all available data from all sources across the Cotton Belt, and were direct, head-to-head comparisons between each head variety and each comparison variety. Crop value, yield, staple length, micronaire, fiber length, % uniformity and loan value were expressed in % difference between the head variety and each comparison variety. The loan value was calculated based on 2002 USDA CCC loan values of $0.52/lb +/- premiums and discounts. A crop value was then calculated based on the average loan value and the average lint yield for that variety.

Results and Discussion

Performance of DP 555 BG/RR

Table 2 shows the comparison of DP 555 BG/RR to the most frequently planted mid-full Bollgard®/Roundup Ready™ cotton varieties across the U.S. Cotton Belt. In all comparisons, DP 555 BG/RR outyielded the comparison variety by an average of 14.5% and returned a 15.6% higher crop value. The staple length of DP 555 BG/RR was similar to the comparison varieties with a percent difference range of –0.9% to 0.8%. The micronaire for DP 555 BG/RR was similar to DP 451 BG/RR, 0.22 higher than FM 989 BR, and 0.15 and 0.32 lower than DP 458 B/RR and ST 4892 BR, respectively. Fiber strength for DP 555 BG/RR was always 28.0 or greater but was slightly below that for DP 458 B/RR and FM 989 BR but within 0.6 g/tex of ST 4892 BR and DP 451 B/RR. Fiber length uniformity of DP 555 BG/RR was lower than the other varieties. Loan value considers all the fiber quality parameters as a group and indicates actual price across all tests. Loan value for DP 555 BG/RR averaged 0.9 cents per pound below FM 989 BR, but 0.2, 0.3, and 2.2 cents per pound better than DP 458 B/RR, DP 451 B/RR, and ST 4892 BR, respectively. DP 555 BG/RR has exceptional yield potential with fiber quality that should avoid grower discounts as well as DP 451 BG/RR has in the past.

Performance of DP 444 BG/RR

In all comparison between DP 444 BG/RR and the most frequently planted early-mid Bollgard®/Roundup Ready™ cotton varieties across the U.S. Cotton Belt, DP 444 BG/RR, was the highest yielding variety averaging 5.2 % above the rest and with a crop value return that averaged 8.0 % more (Table 3). DP 444 BG/RR in all comparisons had an equivalent or higher staple length, lower micronaire, and in three of the five comparisons produced higher fiber strength. FM 989 BR produced 2.3% higher fiber strength than DP 444 BG/RR with ST 4892 BR being essentially the same. Uniformity for DP 444 BG/RR was very similar or higher than the comparison varieties across the Cotton Belt. Loan value for DP 444 BG/RR was within 0.1 cent per pound of FM 989 BR, and 0.7, 1.7, 1.8, and 2.2 cents per pound higher than DP 451 B/RR, SG 215 BG/RR, ST 4892 BR, and PM 1218 BG/RR, respectively.

Performance of DP 491

DP 491 yield was similar to ST 474 and DeltaPEARL, but 2,0, 12.6, and 13.0 % higher than DP 565, FM 989, and FM 832, respectively. On average DP 491 yield was higher than the average of the other four varieties by 8.8% with a return that averaged 8.5% more (Table 4). The staple length and micronaire results were favorable for DP 491 in all comparisons except versus FM 832. FM 832 had staple length of 37.2 compared to 36.4 for DP 491. FM 832 micronaire averaged 4.23 compared to 4.50 for DP 491. DP 491 and FM 989 had comparable strength and micronaire. Uniformity for DP 491 was similar to all varieties in these comparisons, with a % difference range of –1.7 to 0.4%. While the fiber quality averages for DP 491 were slightly lower compared to FM 832, DP 491 produced a higher yield by 13%, and had 10.5% higher crop value per acre than FM 832. Additionally, the average fiber quality in all comparisons shown was sufficient to be within the premium range with regard to price per pound, according to the USDA loan chart.

Summary

Delta and Pine Land Company has been breeding cotton varieties that potentially produce both higher yields and good to excellent fiber properties, thereby, potentially meeting the needs of both the grower and the mills. D&PL internal data, as well as public sector data across the belt, show that DP 555 BG/RR outyielded four varieties within its maturity range that are frequently planted by U.S. growers by an average of 14.5%, and returned 15.6% higher crop value per acre when averaged across the Cotton Belt. DP 444 BG/RR produced higher average yield versus five varieties within its maturity range by an average of 5.2%, and returned 8.0% higher crop value per acre when averaged across the Cotton Belt. DP 491 equaled or exceeded the lint yield of all comparisons and the crop value per acre for DP 491 was higher than any other variety included in the comparisons. D&PL is currently introgressing existing and upcoming transgenic traits into these new varieties, as well as other advanced, elite germplasm that has shown similar or superior performance in early-stage testing.

Acknowledgements

The authors would like to recognize the efforts and talents of the Delta and Pine Land research and technical services staff across the U.S. who collected the data and processed many samples from numerous variety trials.

References

Keim, Don L. 2002. Breaking the yield-fiber quality barrier. Proc. Beltwide Cotton Conf.

USDA. 2002. Cotton Varieties Planted, 2002 Crop. Agriculture Marketing Service – Cotton Program. Memphis, TN. September, 2002.

Table 1. The percent of total U.S. acres planted with each comparison variety†.

Cotton Variety	% Of U.S. Total Cotton Acreage
DeltaPEARL	0.50
DP 451 B/RR	6.85
DP 458 B/RR	5.97
DP 565	0.05
FM 832	2.78
FM 989	1.09
FM 989 BR	1.90
PM 1218 BG/RR	6.41
SG 215 BG/RR	2.35
ST 474	0.36
ST 4892 BR	5.70
Total	33.96

† From USDA, 2002

Table 2. Head-to-head comparisons of DP 555 BG/RR and mid-full maturity high yielding and/or high fiber quality cultivars across the U.S. Cotton Belt in D&PL ASTs, research trials, state university OVTs, and CATs, as of 2 January, 2003.

Variety Comparison	Crop Value†	Lbs. lint/ acre	% Turnout	Staple (1/32 in)	Strength (g/tex)	Micro-naire	% Uniformity	Loan Value
DP 555 BG/RR	624.25	1210	39.6	35.0	28.0	4.49	79.3	0.516
DP 458 B/RR	547.63	1066	36.6	35.1	29.0	4.64	80.8	0.514
% Difference	14.0	13.5	10.1	-0.5	-3.5	-3.2	-1.9	0.4
No. of tests:	214	214	214	214	214	214	214	214
DP 555 BG/RR	568.73	1114	39.9	34.9	28.0	4.54	78.8	0.511
FM 989 BR	492.85	948	35.6	35.0	29.1	4.32	80.7	0.520
% Difference	15.4	17.4	12.1	-0.3	-3.8	5.0	-2.3	-1.7
No. of tests:	173	173	173	173	173	173	173	173
DP 555 BG/RR	619.58	1198	40.2	35.0	28.3	4.53	79.3	0.517
ST 4892 BR	533.19	1078	37.6	34.7	28.7	4.85	82.5	0.495
% Difference	16.2	11.2	6.7	0.8	-1.4	-6.5	-3.9	4.5
No. of tests:	204	204	204	204	204	204	204	204
DP 555 BG/RR	571.21	1108	39.6	34.9	28.0	4.51	78.6	0.516
DP 451 B/RR	488.55	953	34.2	35.2	27.4	4.57	80.4	0.513
% Difference	16.9	16.2	15.6	-0.9	2.2	-1.3	-2.1	0.6
No. of tests:	159	159	159	159	159	159	159	159

† Based on 2002 USDA CCC loan value of $0.52/lb +/- premiums and discounts, expressed as $/acre gross revenue. Data are means of crop value of individual plots.

Table 3. Head-to-head comparisons of DP 444 BG/RR and early-mid maturity high yielding and/or high fiber quality cultivars across the U.S. Cotton Belt in D&PL ASTs, research trials, state university OVTs, and CATs, as of 2 January, 2003.

Variety Comparison	Crop Value†	Lbs. lint/ acre	% Turnout	Staple (1/32 in)	Strength (g/tex)	Micro-naire	% Uniformity	Loan Value
DP 444 BG/RR	520.90	998	37.2	35.3	28.5	4.02	81.3	0.522
FM 989 BR	464.95	890	34.8	35.2	29.1	4.21	80.3	0.523
% Difference	12.0	12.2	6.7	0.2	-2.3	-4.6	1.2	-0.1
No. of tests:	51	51	51	51	51	51	51	51
DP 444 BG/RR	567.72	1089	38.2	35.5	28.8	4.07	81.9	0.521
SG 215 BG/RR	542.75	1078	36.4	34.1	27.0	4.59	82.1	0.504
% Difference	4.6	1.1	4.8	4.1	6.4	-11.3	-0.2	3.5
No. of tests:	91	91	91	91	91	91	91	91
DP 444 BG/RR	578.59	1108	38.2	35.5	28.7	4.05	82.0	0.522
PM 1218 BG/RR	542.19	1085	38.1	34.2	26.9	4.82	82.7	0.500
% Difference	6.7	2.1	0.3	3.9	6.9	-16.1	-0.8	4.5
No. of tests:	86	86	86	86	86	86	86	86
DP 444BG/RR	568.99	1092	38.2	35.5	28.7	4.08	81.9	0.521
ST 4892 BR	531.04	1055	37.5	35.0	28.8	4.72	82.4	0.503
% Difference	7.1	3.5	2.0	1.5	-0.2	-13.6	-0.6	3.5
No. of tests:	92	92	92	92	92	92	92	92
DP 444BG/RR	544.41	1039	38.1	35.5	28.7	4.08	821	0.524
DP 451 B/RR	493.37	954	34.4	35.5	27.7	4.49	80.9	0.517
% Difference	10.3	8.9	10.6	0.0	3.7	-9.2	1.5	1.3
No. of tests:	103	103	103	103	103	103	103	103

† Based on 2002 USDA CCC loan value of $0.52/lb +/- premiums and discounts, expressed as $/acre gross revenue. Data are means of crop value of individual plots.

Table 4. Head-to-head comparisons of DP 491 and mid-full maturity high yielding and/or high fiber quality cultivars across the U.S. Cotton Belt in D&PL ASTs, research trials, state university OVTs, and CATs, as of 2 January, 2003.

Variety Comparison	Crop Value†	Lbs. lint/ acre	% Turnout	Staple (1/32 in)	Strength (g/tex)	Micro-naire	% Uniformity	Loan Value
DP 491	615.23	1155	40.2	37.4	30.9	4.33	82.4	0.532
FM 989	544.53	1026	38.0	36.1	31.2	4.25	82.7	0.531
% Difference	13.0	12.6	5.8	3.6	-1.3	1.9	-0.4	0.3
No. of tests:	110	110	110	110	110	110	110	110
DP 491	626.85	1177	39.5	37.5	30.8	4.35	82.2	0.533
DP 565	609.35	1153	37.1	36.3	29.8	4.52	82.5	0.528
% Difference	2.9	2.0	6.5	3.3	3.6	-3.7	-0.3	0.8
No. of tests:	190	190	190	190	190	190	190	190
DP 491	566.97	1064	38.8	37.4	30.5	4.27	81.9	0.533
ST 474	547.03	1071	38.2	35.0	28.3	4.66	82.4	0.511
% Difference	3.6	-0.7	1.6	7.0	7.7	-8.4	-0.6	4.4
No. of tests:	152	152	152	152	152	152	152	152
DP 491	593.03	1116	39.8	37.4	30.7	4.36	82.1	0.531
DeltaPEARL	587.01	1112	38.7	36.5	29.5	4.55	81.8	0.528
% Difference	1.0	0.4	2.8	2.5	4.1	-4.2	0.4	0.6
No. of tests:	194	194	194	194	194	194	194	194
DP 491	541.57	1031	38.9	36.4	30.2	4.50	81.8	0.525
FM 832	490.07	912	35.6	37.2	32.0	4.23	83.2	0.537
% Difference	10.5	13.0	9.2	-2.1	-5.7	6.4	-1.7	-2.2
No. of tests:	60	60	60	60	60	60	60	60

† Based on 2002 USDA CCC loan value of $0.52/lb +/- premiums and discounts, expressed as $/acre gross revenue. Data are means of crop value of individual plots.