CHANGES IN BOLL DEVELOPMENT, YIELD, AND FIBER QUALITY OF COMMERCIAL VARIETIES OVER TIME BASED ON DATE OF RELEASE

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Introduction

Historical data from the USDA Ag Statistics Service has shown that U.S. cotton yields increased nationally almost 9 to 10 lbs/acre/year over the past 50 years, with most of this yield increase credited to plant breeding programs selecting for increased lint production. Most of this increase in lint yield production has been attributed to changes in the reproductive growth and development of cotton varieties over time, with apparent increases in boll numbers and lint percentages and decreases in boll size and seed size. Moreover, yield increases since the early 1980's have coincided with improved fiber quality parameters such as fiber length and strength. Historical data from South Carolina has shown similar trends, with cotton lint yields increases over the past 150 years in the 4 to 5 lb/acre/year range. A study conducted by Wells and Meredith in the early-1980's found that more modern varieties (1970's) made an earlier transition from vegetative growth to reproductive growth and partitioned more dry matter into reproductive organs compared to older lower yielding varieties. This earlier transition from vegetative growth to reproductive growth occurred during a time when maximal leaf development was present and led to a greater harvest index and increased yields. The objective of this study was to determine what differences in vegetative/reproductive growth, fruiting characteristics, and lint quantity/quality associations have occurred over time as a result of selection for increased yield.

Materials and Methods

Fourteen cotton varieties representing various decades (1900's to 2016) of release from the Stoneville and Deltapine lineage were planted in a randomized complete block design with four replications at the Pee Dee REC located in Florence, SC and at the Sandhills REC located in Jackson Springs, NC during the 2016, 2017, and 2018 growing seasons. Plots consisted of four rows, 40 feet in length. Vegetative growth was monitored at various times during the season via leaf dry weights, stem dry weights, specific leaf weights, and leaf area indexes. Reproductive growth was also monitored by both number and dry weights of squares, flowers, and bolls. Plots were harvested with spindle type cotton pickers modified for small plot research. A seed cotton grab sample was collected from each plot, air dried, weighed and ginned. A subsample of lint was also collected for HVI fiber quality analysis.

Summary

SC location: Preliminary results showed three distinct yield environments existed at the Florence location during the 2016, 2017, and 2018 growing seasons, with average lint yields of 627, 1178, and 1260 lb/a, respectively (*Table 1*). The highest yielding varieties each year were the new transgenic varieties ST 4946GLB2 (880 lb/a in 2016, 1545 lb/a in 2017, and 1361 lb/a in 2018), DP 1252B2RF (827 lb/a in 2016, 1509 lb/a in 2017, and 1436 lb/a in 2018), and DP 1137B2RF (759 lb/a in 2016, 1250 lb/a in 2017, and 1556 lb/a in 2018). Large differences in yield were found among the varieties based on year of release, with varieties released after year 2000 having the highest yields (average yield of 780 lb/a in 2016, 1371 lb/a in 2017 and 1400 lb/a in 2018). Varieties released before 1965 had the lowest yields, averaging 470 lb/a in 2016, 947 lb/a in 2017, and 1010 lb/a in 2018. In all three years, a positive linear relationship was found between lint yield and year of release, with lint yields increasing 3.7 lb/a/year (R^2 = 0.74) in 2016, 5.0 lb/a/year (R^2 = 0.69) in 2017, and 4.7 lb/a/year (R^2 = 0.76) in 2018. Gin turnout was also affected by year of release, with newer varieties (after 2000) averaging 42% over all three years, varieties released between 1965 and 1999 averaging 39% lint, and varieties released before 1965 averaging 37% lint (Table 1). Differences among varieties were also found with fiber quality, with newer varieties (released after 2000) appearing to have longer fibers (1.08 to 1.22 range) and higher micronaire values (3.7 to 4.6) compared to varieties released before 1965 (fiber lengths of 0.98 to 1.17 range) and lower micronaire values (3.6 to 4.6) (Table 2).

NC location: The environmental conditions at the Jackson Springs, NC location appeared to be a little less variable among the three years of this study, with an average lint yield of 733 lb/a in 2016, 885 lb/a in 2017, and 1175 lb/a in 2018 (*Table 1)*. Similar to the Florence location, the highest yielding varieties each year in NC were the new transgenic varieties ST 4946GLB2 (1039 lb/a in 2016, 1048 lb/a in 2017, and 1282 lb/a in 2018), DP 1252B2RF (1069 lb/a in 2016, 939 lb/a in 2017, and 1488 lb/a in 2018), and DP 1137B2RF (888 lb/a in 2016, 994 lb/a in 2017, and 1470 lb/a in 2018). Large differences in yield were also found among the varieties based on year of release at this location, with varieties released after 2000 having the highest yields (average yield of 925 lb/a in 2016, 987 lb/a in 2017, and 1365 lb/a in 2018). Varieties released before 1965 had the lowest yields, averaging 438 lb/a in 2016, 729 lb/a in 2017, and 901 lb/a in 2018. In all three years, a positive linear relationship was also found between lint yield and year of release, with lint yields increasing 5.0 lb/a/year (R2 = 0.70) in 2016, 2.8 lb/a/year (R^2 = 0.63) in 2017, and 4.8 lb/a/year (R^2 = 0.79) in 2018. Gin turnout was also affected by year of release, with newer varieties (after 2000) averaging 44%, varieties released between 1965 and 1999 averaging 42% lint, and varieties released before 1965 averaging 38% lint (Table 1). Differences among varieties were also found with fiber quality, with newer varieties (after 2000) appearing to have longer fibers (1.10 to 1.22 range) and higher micronaire values (4.1 to 5.2) compared to varieties released before 1965 (fiber lengths of 0.95 to 1.19 range) and lower micronaire values (3.9 to 4.7) (Table 2).

Table 1. Lint Yield and Gin Turnout of Cotton Varieties Grown in Florence, SC, and Jackson Springs, NC, in 2016, 2017, and 2018.

Variety	Year of Release	Lint Yield (lb/acre)			Lint Yield (lb/acre)			Gin Turnout (%)			Gin Turnout (%)		
		Florence, SC			Jackson Springs, NC			Florence, SC			Jackson Springs, NC		
		2016	*2017*	*2018*	*2016*	*2017*	*2018*	*2016*	*2017*	*2018*	*2016*	*2017*	*2018*
ST 4946GLB2	2013	**880**	**1545**	1361	**1039**	**1048**	1282	42.7	40.5	42.8	42.8	44.9	44.4
ST 6448GLB2	2013	**830**	1239	1338	886	**950**	1316	42.4	38.4	42.2	**44.2**	44.8	43.6
DPL 1252B2RF	2012	**827**	**1509**	**1436**	**1069**	**939**	**1488**	**45.3**	**43.8**	**45.2**	**45.8**	**46.8**	**47.2**
DPL 1137B2RF	2011	**759**	1250	**1556**	888	**994**	**1470**	**44.3**	**42.4**	43.5	**45.5**	**45.9**	**46.3**
DELTAPEARL	2000	606	**1310**	1310	744	**1005**	1270	40.3	39.1	40.9	40.7	42.9	42.8
ST 474	1994		**1346**	1364		905	1192		**42.4**	41.7		44.3	44.6
DPL 5415	1990	610	1231	1375				41.2	39.6	39.9			
DPL 51	1990	561	1121	1370	780	883	1138	39.8	38.5	40.2	41.3	41.7	42.9
ST LA887	1990		1031	1139	847	814	1106		39.8	40.9	42.8	44.5	43.7
DES 119	1985					**946**	1149					42.5	42.9
DPL 90	1981	734	1120	1353	608	921	1272	39.8	35.9	39.8	41.0	41.8	44.3
DPL 16	1965				616	802	1056				41.5	42.3	42.7
ST 213	1962	591						39.4					
DPL 14	1941	459	1136	1165				38.7	37.5	40.1			
ST 2B	1938	403	1113	1068	276	764	969	37.8	36.5	38.3	36.9	39.2	40.6
DIXIE TRIUMPH	1914	409	744	789	535	655	806	35.9	34.3	35.8	33.8	38.2	39.3
LONESTAR	1905	488	795	1017	504	767	928	37.9	36.3	38.1	38.5	39.6	41.0
LSD (0.05)		140	253	166	159	114	163	1.2	3.2	1.4	2.0	1.4	1.3
C.V. (%)		16	15	9	16	9	10	2.1	5.7	2.4	3.2	2.3	2.1
Trial Mean		627	1178	1260	733	885	1175	40.4	38.9	40.7	41.2	42.8	43.3

Bold numbers are not statistically different at the 0.05 level of probability.

Table 2. Fiber Length, Strength, and Micronaire of Cotton Varieties Grown in Florence, SC, and Jackson Springs, NC, in 2016, 2017, and 2018.

Variety	Year of Release	Fiber Length (in.)			Fiber Length (in.)		Fiber Strength (g/tex)			Fiber Strength (g/tex)		Micronaire			Micronaire	
		Florence, SC			Jackson Springs, NC		Florence, SC			Jackson Springs, NC		Florence, SC			Jackson Springs, NC	
		2016	*2017*	*2018*	*2017*	*2018*	*2016*	*2017*	*2018*	*2017*	*2018*	*2016*	*2017*	*2018*	*2017*	*2018*
ST 4946GLB2	2013	1.10	**1.13**	**1.18**	**1.13**	1.20	30.0	**33.0**	**32.7**	**35.8**	**31.6**	4.1	**4.4**	**4.2**	4.9	**4.3**
ST 6448GLB2	2013	**1.16**	**1.13**	**1.22**	**1.13**	**1.24**	29.8	29.8	28.6	32.6	26.9	**4.6**	4.1	3.7	4.8	4.1
DPL 1252B2RF	2012	1.08	1.10	1.17	**1.11**	1.18	29.5	30.9	28.7	32.7	27.6	**4.5**	**4.4**	3.9	**5.2**	**4.4**
DPL 1137B2RF	2011	1.08	1.09	1.16	1.10	1.14	30.2	31.6	29.5	32.5	28.3	**4.7**	**4.4**	3.8	**5.2**	**4.3**
DELTAPEARL	2000	**1.13**	**1.14**	**1.21**	**1.13**	1.18	31.4	**32.9**	**31.5**	34.7	29.5	4.4	4.1	3.8	4.8	4.2
ST 474	1994		1.07	1.16	1.09	1.17		31.3	29.2	32.0	28.7		**4.4**	3.9	**5.2**	**4.4**
DPL 5415	1990	1.09	1.10	1.17			**33.4**	32.0	30.8			**4.6**	**4.4**	3.9		
DPL 51	1990	1.10	1.09	1.17	1.09	1.16	**31.8**	30.4	28.3	31.9	27.9	**4.7**	**4.7**	3.8	**5.0**	**4.3**
ST LA887	1990		1.09	**1.19**	1.09	1.18		**33.2**	**31.6**	**35.6**	**30.9**		**4.5**	3.9	**5.0**	**4.3**
DES 119	1985				1.10	1.17				33.2	29.1				4.8	**4.3**
DPL 90	1981	1.10	1.09	1.17	**1.11**	1.16	**33.6**	**34.3**	**31.4**	**36.1**	**31.6**	**4.5**	**4.4**	3.8	4.8	**4.4**
DPL 16	1965				**1.11**	1.15				32.9	28.4				4.9	**4.3**
ST 213	1962	**1.11**					**33.6**					**4.6**				
DPL 14	1941	**1.11**	1.10	1.15			31.1	31.1	28.7			4.3	4.0	3.8		
ST 2B	1938	1.10	**1.11**	1.17	1.06	1.12	**31.5**	31.5	28.7	29.8	27.8	4.4	4.3	3.8	4.4	4.1
DIXIE TRIUMPH	1914	0.98	0.98	1.01	0.95	1.04	29.0	29.7	27.3	30.6	26.0	4.4	4.1	3.9	4.7	4.2
LONESTAR	1905	1.10	1.09	1.14	**1.12**	1.19	**32.2**	31.5	28.2	32.5	28.3	3.6	3.7	3.6	3.9	3.9
LSD (0.05)		0.05	0.03	0.04	0.03	0.04	2.2	1.7	1.8	1.4	1.6	0.3	0.3	0.2	0.3	0.1
C.V. (%)		3.00	2.04	2.59	1.7	2.3	4.8	3.7	4.3	3.0	4.0	4.9	4.5	4.4	4.1	2.5
Trial Mean		1.10	1.09	1.16	1.09	1.16	31.3	31.6	29.6	33.0	28.7	4.4	4.3	3.8	4.8	4.2

Bold numbers are not statistically different at the 0.05 level of probability.