HOW COTTON VARIETIES HAVE CHANGED OVER TIME: A COMPARISON OF VEGETATIVE/REPRODUCTIVE GROWTH, FRUITING CHARACTERISTICS, AND FIBER DEVELOPMENT OF OBSOLETE VERSUS MODERN VARIEITES

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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 (*Figure 1*), 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 (*Figure 2*). 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 and 2017 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 two different yield environments existed at the Florence location during the 2016 and 2017 growing seasons, with average lint yields of 627 and 1178 lbs/acre, respectively (*Table 1*). The highest yielding varieties each year were the new transgenic varieties ST 4946GLB2 (880 lbs/acre in 2016 and 1545 lbs/acre in 2017) and DP 1252B2RF (827 lbs/acre in 2016 and 1509 lbs/acre in 2017). Large differences in yield were found among the varieties based on year of release, with varieties released after 2000 having the highest yields (average yield of 780 lbs/a in 2016 and 1371 lbs/a in 2017). Varieties released before 1965 had the lowest yields, averaging 470 lbs/a in 2016 and 947 lbs/a in 2017. *Figure 3* shows the relationship of lint yield with the year of variety release. In both years, a positive linear relationship was found between lint yield and year of release, with lint yields increasing 3.7 lbs/acre/year ($R2 = 0.74$) in 2016 and 5.0 lbs/acre/year ($R2 = 0.69$) in 2017. Gin turnout was also affected by year of release, with newer varieties (after 2000) averaging 42% over both 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 (after 2000) appearing to have longer fibers (1.08 to 1.16 range) and higher micronaire values (4.1 to 4.6) compared to varieties released before 1965 (fiber lengths of 0.98 to 1.11 range) and lower micronaire values (3.6 to 4.6) (*Table 1*).

NC location: The environmental conditions at the Jackson Springs, NC location appeared to be a little less variable between the two years of this study, with an average lint yield of 733 lbs/acre in 2016 and 885 lbs/acre in 2017 (*Table 2)*. Similar to the Florence location, the highest yielding varieties each year in NC were the new transgenic varieties ST 4946GLB2 (1039 lbs/acre in 2016 and 1048 lbs/acre in 2017), and DP 1252B2RF (1069 lbs/acre in 2016 and 939 lbs/acre in 2017). 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 lbs/a in 2016 and 987 lbs/a in 2017). Varieties released before 1965 had the lowest yields, averaging 438 lbs/a in 2016 and 729 lbs/a in 2017. *Figure 3* shows the relationship of lint yield with the year of variety release. In both years, a positive linear relationship was also found between lint yield and year of release, with lint yields increasing 5.0 lbs/acre/year (R2 = 0.70) in 2016 and 2.8 lbs/acre/year (R2 = 0.63) in 2017. Gin turnout was also affected by year of release, with newer varieties (after 2000) averaging 44% over both years, varieties released between 1965 and 1999 averaging 42% lint, and varieties released before 1965 averaging 38% lint (Table 2). Differences among varieties were also found with fiber quality, with newer varieties (after 2000) appearing to have longer fibers (1.10 to 1.13 range) and higher micronaire values (4.8 to 5.2) compared to varieties released before 1965 (fiber lengths of 0.95 to 1.12 range) and lower micronaire values (3.9 to 4.7) (*Figure 2).*

Table 1. Lint Yield, Gin Turnout, and Fiber Quality of Cotton Varieties Grown at PDREC located in Florence, SC, in 2016 and 2017. M. Jones.

Variety	Year of Release	Lint Yield		Gin Turnout		Fiber Length		Fiber Uniformity		Fiber Strength		Elongation		Micronaire	
		lb/acre		%		in.		%		g/tex					
		2016	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*
ST 4946GLB2	2013	**880**	**1545**	42.7	40.5	1.10	**1.13**	**82.8**	**83.5**	30.0	**33.0**	7.7	6.6	4.1	**4.4**
ST 6448GLB2	2013	**830**	1239	42.4	38.4	**1.16**	**1.13**	**83.4**	**82.4**	29.8	29.8	6.2	5.4	**4.6**	4.1
DPL 1252B2RF	2012	**827**	**1509**	**45.3**	**43.8**	1.08	1.10	81.9	**82.5**	29.5	30.9	**8.5**	**8.2**	**4.5**	**4.4**
DPL 1137B2RF	2011	**759**	1250	**44.3**	**42.4**	1.08	1.09	81.0	**82.5**	30.2	31.6	**8.3**	7.0	**4.7**	**4.4**
DELTAPEARL	2000	606	**1310**	40.3	39.1	**1.13**	**1.14**	**82.9**	**82.7**	31.4	**32.9**	5.6	5.2	4.4	4.1
ST 474	1994		**1346**		**42.4**		1.07		81.4		31.3		6.2		**4.4**
DPL 5415	1990	610	1231	41.2	39.6	1.09	1.10	**82.0**	81.7	**33.4**	32.0	7.8	6.8	**4.6**	**4.4**
DPL 51	1990	561	1121	39.8	38.5	1.10	1.09	81.4	**82.4**	**31.8**	30.4	6.6	6.3	**4.7**	**4.7**
ST LA887	1990		1031		39.8		1.09		**82.7**		**33.2**		6.0		**4.5**
DPL 90	1981	734	1120	39.8	35.9	1.10	1.09	**82.8**	82.2	**33.6**	**34.3**	6.6	5.0	**4.5**	**4.4**
ST 213	1962	591		39.4		**1.11**		**83.6**		**33.6**		7.0		**4.6**	
DPL 14	1941	459	1136	38.7	37.5	**1.11**	1.10	**82.8**	**82.7**	31.1	31.1	7.4	6.0	4.3	4.0
ST 2B	1938	403	1113	37.8	36.5	1.10	**1.11**	**83.0**	82.1	**31.5**	31.5	7.0	5.6	4.4	4.3
LONESTAR	1905	488	795	37.9	36.3	1.10	1.09	**83.4**	82.2	**32.2**	31.5	**8.5**	**7.6**	3.6	3.7
DIXIE TRIUMPH	1914	409	744	35.9	34.3	0.98	0.98	77.7	78.8	29.0	29.7	**8.7**	7.3	4.4	4.1
LSD (0.05)		140	253	1.2	3.2	0.05	0.03	1.6	1.2	2.2	1.7	0.8	0.6	0.3	0.3
C.V. (%)		16	15	2.1	5.7	3.00	2.04	1.4	1.0	4.8	3.7	7.8	6.7	4.9	4.5
Trial Mean		627	1178	40.4	38.9	1.10	1.09	82.2	82.1	31.3	31.6	7.4	6.4	4.4	4.3

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

Table 2. Lint Yield, Gin Turnout, and Fiber Quality of Cotton Varieties Grown at Sandhills REC located in Jackson Springs, NC in 2016 and 2017. M. Jones.

Variety	Year of Release	Lint Yield lb/acre		Gin Turnout %		Fiber Length in.		Fiber Uniformity %		Fiber Strength g/tex		Elongation		Micronaire	
		2016	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*	*2016*	*2017*
ST 4946GLB2	2013	**1039**	**1048**	42.8	44.9		**1.13**		**83.9**		**35.8**		7.2		4.9
ST 6448GLB2	2013	886	**950**	**44.2**	44.8		**1.13**		**83.5**		32.6		4.8		4.8
DPL 1252B2RF	2012	**1069**	**939**	**45.8**	**46.8**		**1.11**		**84.2**		32.7		**8.7**		**5.2**
DPL 1137B2RF	2011	888	**994**	**45.5**	**45.9**		1.10		**83.0**		32.5		7.2		**5.2**
DELTAPEARL	2000	744	**1005**	40.7	42.9		**1.13**		**83.3**		34.7		4.6		4.8
ST 474	1994		905		44.3		1.09		82.4		32.0		5.8		**5.2**
DPL 51	1990	780	883	41.3	41.7		1.09		82.1		31.9		6.1		**5.0**
ST LA887	1990	847	814	42.8	44.5		1.09		82.7		**35.6**		5.9		**5.0**
DES 119	1985		**946**		42.5		1.10		82.9		33.2		6.5		4.8
DPL 90	1981	608	921	41.0	41.8		**1.11**		82.2		**36.1**		5.3		4.8
DPL 16	1965	616	802	41.5	42.3		**1.11**		82.5		32.9		6.9		4.9
ST 2B	1938	276	764	36.9	39.2		1.06		80.9		29.8		5.5		4.4
LONESTAR	1905	504	767	38.5	39.6		**1.12**		**83.5**		32.5		7.2		3.9
DIXIE TRIUMPH	1914	535	655	33.8	38.2		0.95		77.8		30.6		8.0		4.7
LSD (0.05)		159	114	2.0	1.4		0.03		1.4		1.4		0.6		0.3
C.V. (%)		16	9	3.2	2.3		1.7		1.2		3.0		7.1		4.1
Trial Mean		733	885	41.2	42.8		1.09		82.5		33.0		6.4		4.8

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

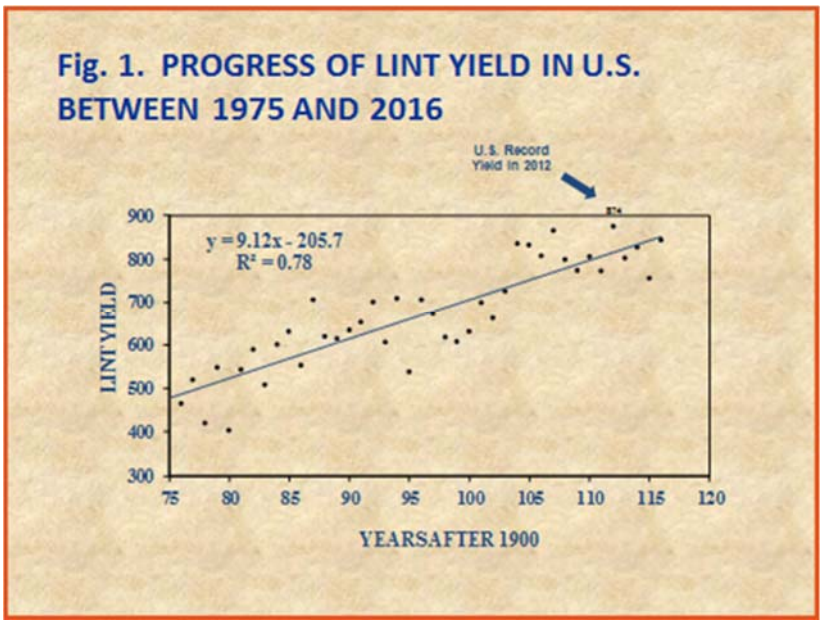

Fig. 2. SOUTH CAROLINA COTTON YIELDS (Lbs/Acre) 1866 TO 2016

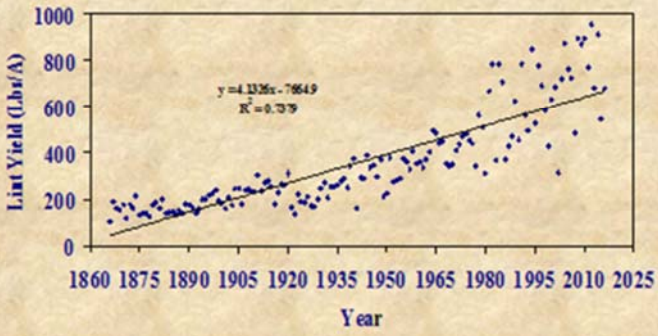

Fig. 3. LINT YIELD OF COTTON VARIETIES GROWN IN IN NC & SC VERSUS YEAR OF RELEASE