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Comparative Performance of Obsolete Varieties and Current Varieties of Upland Cotton[1]

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ABSTRACT

We evaluated 13 obsolete cotton varieties and three current commercial varieties for yield, agronomic, and fiber properties over a 2-year period, (1967 to 1968), to determine what genetic improvements the new varieties had over come of the older ones.

The current commercial varieties yielded approximately 112 kg/ha more lint than the best obsolete variety. Most obsolete varieties yielded 124-448 kg/ha less lint than the commercial check varieties. These data indicated that varieties exhibiting increased yield potential had higher lint percentages, smaller bolls, smaller seed, and higher micronaire values. Increases in lint percentage have played a major role in increasing yield. Fiber properties of varieties currently grown were better than those of some old varieties, but inferior to those of others. Advances in fiber properties have not been as rapid as advances in yield.

Additional index words: **Cotton breeding, Selection, Genetic improvement, *Gossypium hirsutum* L.**

A wide range of varietal types of American Upland cotton, *Gossypium hirsutum* L., has been developed through breeding. The evaluation of cotton varieties is a continuous process because improved varieties are released, cultural practices are altered, and needs for new types arise. Most successful varieties have an average life of about 10 years because they cannot compete with the performance of newly released varieties.

A great expansion in the numbers and names of varieties occurred in the United States between 1880 and 1930 because almost every cotton-growing community developed local varieties. As production expanded, growers noticed that there were differences in the performance of various types of cotton. This was a time when many seed producers were plantation operators first and breeders second; and they put out a profusion of variety names. When an individual spoke of a variety, he was likely to give it the name of the person from whom he secured the seed rather than the original name. This renaming of varieties added to the list of varieties, but many were only synonyms for existing populations (6).

In 1880, 58 varieties were listed, but according to Tracy (3) only six were commonly grown in 1895. In 1907, Tyler (4) listed over 600 varieties and variety names of which only 25 were in existence and only nine were grown extensively in 1925 (6). In 1936, Ware (6) stated that over 1,200 names had been listed since records of cotton varieties had been kept. Approximately 40 varieties were grown during 1965-69, but 12 varieties accounted for 90% of the acreage planted. Approximately 71% of the 1969 cotton crop was planted to cotton varieties of the 'Deltapine,' 'Stoneville,' 'Acala,' and 'Lankart' types. This reduction in the number of named varieties in recent years is attributed to: (*1*) a reduction in the number of seedsmen or seed companies engaged in breeding, development, and sales of cotton planting seed; and *2*) one-variety community programs, varietal standardization programs, and efforts to improve fiber properties.

Ware (5) reported that the spread of the boll weevil, *Anthonomus grandis* Boh., over the Cotton Belt caused a widespread change in the types of cotton grown in different regions. The advent of the boll weevil made it impossible to grow late-maturing varieties. The late-maturing long stapled, small-bolled varieties, commonly grown before the turn of the century, were replaced by early-maturing, short stapled, big-bolled varieties that allowed cotton to be grown profitably in spite of the boll weevil.

The heavy selection pressure on early maturity and yield during the early 1900's resulted in varieties with markedly shorter staple length. Certain varieties grown extensively in the 1920's had staple lengths of 13/16 inch or less.

As late as 1929, 58% of the crop was 7/8 inch or less in length (5). By 1935, the portion of the crop that was 7/8 inch or shorter was reduced to 44%. The over-all negative association between yield and staple, apparent during the early post-boll weevil period, proved capable of being broken in certain specific instances. The development of the high yielding, medium stapled (1 1/16) 'Deltapine 14' variety in the 1940's is a prime example. By 1944, 84% of the cotton crop had a staple length of 15/16 inch or longer, compared with 44% in 1928. The average length of the cotton crop in 1928 was 29.9/32 compared with 32.9/32 in 1964 (1).

The large increases in crop yields achieved through breeding have played a major role in the improvement and efficiency of farm production. The increase of more than 50% in average yield of cotton in the United States between 1947-49 and 1957-59 exceeded that of any other major crop except grain sorghum (1). The level of approximately 560 kg of lint per harvested ha (500 lb/acre) in 1963 compared with 190.4 kg (170 lb) in 1933, reflects the rate of increase (1). In the 1950's the increase in yield was nearly 5% per year. In 1965, Meredith (unpublished) estimated that there had been a yearly increase of approximately 34 kg/ha in lint yield since 1950 in the Delta of Mississippi. Although yields have increased in the Delta, it is difficult to determine precisely how much can be attributed to genetic advance and cultural change. Increased use of fertilizers, confinement of the crop to better land adapted for high yields, new cultural practices, irrigation, insect control, timely harvesting,

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combined with more extensive use of better varieties have been important factors in increasing cotton yields.

Yield continues to be the prime character of selective importance, but in recent years a great deal of breeding attention has been given to special fiber properties and disease resistance. More recently a considerable effort has been directed to breeding for plant resistance (or tolerance) to insects and plant and boll adaptation to fully mechanized cultural and harvesting practices. In respect to the fiber properties, length of staple is still the character that is being worked on the most, but such other fiber attributes as strength, fineness, maturity, shape, color, and length uniformity also are receiving considerable attention. Breeding for resistance to fusarium wilt and the wilt-nematode complex has been going on for many years and a number of tolerant to resistant cotton varieties have been developed. Resistance to verticilum wilt and bacterial blight has been the objective of several breeding programs during the past 15 or 20 years. Programs concerned with breeding for resistance to insects and for adaptation to mechanized production are relatively recent.

Thus, over the years breeding objectives have changed to meet the new and ever-changing demands of the cotton farmer and the cotton industry. As new and improved varieties come into farm use, they gradually replace the old established stocks until finally seed production of the old varieties is discontinued and the varieties become obsolete. The replacement of one variety by another is a continuing but unpredictable process. The average "life" of a commercial cotton variety is estimated to be about 10 years; however, some remain in successful production for more than twice that long while others may last only a season or two.

Since, historically, genotypes of cotton varieties have been changed to meet the needs of changing production conditions and requirements, it is possible that certain varieties that became obsolete because their genotypes were such that they could not compete successfully under the conditions then prevailing, might carry latent or unnoticed genes which would contribute to the improvement of varieties under current or prospective future conditions.

This paper reports the results of a comparative study of lint yield and seven other economic characters in a selected group of 13 obsolete varieties of Upland cotton. Three currently (or recently) grown commercial varieties were included in the study as standards of comparison.

MATERIALS AND METHODS

The question has been asked many times: What genetic improvements have the new varieties over some of the older ones? To try to partially answer this question, we evaluated 13 obsolete varieties and three relatively new varieties ('Stoneville 213,' 'Deltapine Smooth Leaf,' and 'Coker 413-68') at Stoneville, Miss. in 1967 and 1968. These varieties were chosen on the basis of their relative commercial importance at the time they were grown (Table 1). Each of the obsolete varieties was once considered to be an important commercial variety in the Mississippi Delta. Deltapine Smooth Leaf and Stoneville 213 are two varieties bred in the Delta, and they have accounted for a major portion of the cotton acreage in the Mississippi Delta since 1966. Coker 413-68 is a new variety bred in the Southeast. While it has been grown on considerable acreage in the Southeast, it has not been grown extensively in the Mississippi Delta. Coker 413-68 was chosen to represent the current attempt to develop a cotton with emphasis on its unique combination of fiber properties. Even though it is not adapted to the Delta, it was a check against fiber properties, whereas Stoneville 213 and Deltapine Smooth Leaf served as checks against breeding with major emphasis on yield.

Seed of the obsolete varieties were obtained from the Regional Collection of Upland cotton maintained at the Delta Branch Station, Stoneville, Miss. Seed of the current commercial varieties were obtained from breeders of the three varieties mentioned. Seed of all test entries were increased at Iquala, Mexico to obtain approximately the same seed quality for each variety. Seed from the Regional Collection of Upland cotton may not properly represent the obsolete varieties. A very small sample of a variety was taken when the germplasm collection was initiated and has been maintained through inbreeding by growing a short row of each entry every few years. We acknowledge this limitation; however, the samples used are the best representatives of the obsolete varieties that can be obtained. The release of these varieties for commercial production occurred from the early 1900's to 1966 (Table 1).

A randomized complete block test design with six replications was used each year. The plots consisted of two rows, 19.8 m long with 1.0 m between rows. The seeding rate was approximately 16.8 kg/ha of acid delinted seed planted in hills approximately 38 cm apart.

Data were obtained on lint yield, lint percentage, 2.5% span length, fiber strength (g per tex and yarn strength), fiber elongation, and fiber fineness (micronaire units). Fiber property evaluations were made by the U.S. Cotton Fiber Laboratory of the Crops Research Division, Agricultural Research Service, U.S. Department of Agriculture, Knoxville, Tennessee.

DISCUSSION AND RESULTS

Lint Yield

Average lint yields for the 2-year period (1967-68) are presented in Table 1. The lint yields of the two current commercial varieties, Deltapine Smooth Leaf and Stoneville 213 were 112 to 620 kg/ha greater than the other varieties tested. The yield of these two varieties, however, was not significantly different from that of Deltapine 14. Deltapine 14 was a widely used variety in the 1940's and has a yield potential that is relatively close to our presently grown varieties. Yield of 'Deltapine 11A' was not significantly different from Deltapine Smooth Leaf, but was significantly lower than the yield of Stoneville 213. Coker 413-68, which was released for commercial production in 1966, showed a yield potential equal to or greater than any old variety. Coker 413-68 yielded significantly less than the Delta-developed varieties now being grown.

Neely (2) in 1935 to 1938, placed varieties into groups on the basis of mean yields and the difference required for significance. Deltapine 11A, 'Stoneville 5A,' and 'Ambassador' were regarded as superior in yield of lint. 'Stoneville 2B,' 'Delfos 531,' and 'Washington' were intermediate, and 'Missdel 1 W.R.' was inferior to the others with respect to lint yield. Our data showed that these varieties ranked in this same general order, but yielded significantly less than the present standard check varieties.

'Deltatype Webber' and 'Coker Wilds' were developed in the 1920's. These two varieties were the result of efforts to develop long fiber in upland varieties after it was found that Egyptian varieties were unsuitable for the main Cotton Belt. These varieties matured very late and yielded 448 to 620 kg/ha less than the currently grown varieties.

Lint Percentage

A high lint percentage is a desirable characteristic since the cost of picking and ginning a pound of lint

Table 1. Comparative performance of obsolete and current varieties of upland cotton for lint yield, lint percentage, seed index, boll size, and fiber properties.

	Year variety developed†	Lint yield, kg/ha	Lint percentage	Seed index	Boll size, g/boll	2.5% span length	Strength, g/tex	Yarn strength	Elongation	Micronaire
Stoneville 213	1962	1,201 a*	38.76 abc	9.9 gh	5.24 f	1.05 e*	18.06 efg	117 hi	7.38 bc	4.46 b
Deltapine Smooth Leaf	1959	1,186 ab	39.96 ab	9.5 h	5.26 ef	1.08 de	19.06 cd	126 c	8.24 a	4.38 bc
Deltapine 14	1941	1,075 abc	39.55 a	9.3 h	5.17 f	1.05 e	18.46 de	120 ef	8.30 a	4.10 cd
Deltapine 11A	1936	1,072 bc	37.38 cd	10.3 fg	5.01 f	0.99 f	18.45 cde	117 hi	8.49 a	4.16 bc
Stoneville 5A	1938	1,014 cd	38.11 bc	9.6 gh	5.26 ef	0.95 g	15.89 i	108 k	6.38 ef	4.28 bc
Coker 413-68	1966	974 cde	36.28 de	10.7 ef	5.54 ef	1.11 cd	19.39 c	134 b	6.32 f	3.79 de
Delfos 9169	1944	916 def	34.38 fg	11.3 de	6.34 d	1.11 cd	17.43 gh	119 fg	7.91 ab	3.85 de
Rowden 41B	1930	885 defg	34.88 f	13.9 a	7.84 a	0.99 f	17.85 efg	111 j	6.96 cde	4.87 a
Ambassador	1936	871 efg	33.00 h	13.0 b	7.11 b	1.00 f	17.53 fgh	119 fg	6.38 ef	4.24 bc
Stoneville 2B	1938	861 efg	33.11 h	11.9 cd	6.50 cd	1.07 e	16.75 hi	121 e	6.54 def	3.83 de
Washington	1936	858 efg	35.48 ef	12.0 cd	6.91 bc	1.05 e	18.09 efg	118 gh	6.49 def	4.07 cd
Delfos 531C	1932	845 efg	32.91 h	10.2 fg	5.44 ef	1.14 bc	18.41 def	124 d	8.12 a	3.65 ef
Coker 100	1937	833 fg	33.16 gh	10.6 ef	5.25 f	1.08 de	17.76 efg	116 i	8.24 a	3.80 de
Missdel 1 WR	1932	780 fg	31.33 i	12.6 bc	6.34 d	1.15 b	21.35 a	142 a	7.10 cd	3.64 ef
Coker Wilds no. 9	1929	743 g	31.88 hi	12.0 cd	5.81 e	1.19 a	20.28 b	143 a	7.40 bc	3.50 ef
Deltatype Webber	1922	565 h	30.75 i	12.6 bc	6.43 cd	1.16 b	20.83 ab	142 a	7.09 cd	3.43 f

* Means followed by the same letter are not signtfieantly different at the 5% level, within a partlcular measurement. † Approximate year variety was developed.

is much less in strains with high lint percentages. Many obsolete varieties had good seed cotton yields, but due to a very low lint percentage, the amount of lint produced was very low. Our results indicate that lint percentage (Table 1) is one character in which vast improvements have been made. There appeared to be a close association between lint yield and lint percentage, which indicated that improved lint percentages may have played a major role in increasing lint yield. The five highest-yielding varieties also have the highest lint percentage (Table 1).

Neely (2), in grouping 24 strains on the basis of mean lint percentage and the difference required for significance, found that the lint percentage of Deltapine 11A was significantly higher than any other variety tested. He further showed that the lint percentage of 'Rowden,' Stoneville 5A, Washington, Ambassador, Stoneville 2B, Delfos 531, and Missdel 1 W.R. were 3 to 7% lower than Deltapine 11A. Our data showed the lint percentage of these varieties to be 2 to 6% lower than Deltapine 11A.

Deltapine 14 was released for commercial production in about 1941 and became more extensively grown in the Cotton Belt than any previous variety. With the release of Deltapine 14 there was an upward shift in lint percentage. Deltapine 14 was a different type variety. It was a variety with small bolls, small seed, and high lint percentage. Many of the old varieties such as 'Coker 100,' Stoneville 2B, 'Rowden 41-B, Delfos 531, and Coker Wilds were unable to compete with Deltapine 14.

Seed Index

These data (Table 1) showed that seed of most old varieties were significantly larger than those of the high-yielding varieties that are presently being grown. The three highest-yielding varieties (Stoneville 213, Daltapine Smooth Leaf, and Deltapine 14) had the lowest seed index. Seed index of the varieties tested ranged from 9.3 to 13.9; the seed of Rowden 41-B was significantly larger than any other variety tested. All large seeded varieties produced at least 300 kg/ha less lint than the standard check varieties.

Boll Size

The boll size of cotton varieties was once considered an economic characteristic because less labor was required to pick a bale from a large-bolled variety than from a small-boll variety. Since the advent of mechanized harvesting less emphasis has been placed on boll size.

The varieties with large seed also tended to have large bolls (Table 1). The bolls of Rowden 41-B were significantly larger than those of all other varieties. These data indicated that seed and bolls of the older varieties were significantly larger than more recently released varieties. Since the release of Deltapine 14 there has been a general change to smaller bolls, smaller seed, and higher lint percentage in successful Delta varieties.

Fiber Length

The fiber (Table 2) of Coker Wilds was significantly longer than that of any other variety tested. Three low yielding varieties, (Deltatype Webber, Missdel 1 W.R., and 'Delfos 531C') had significantly longer fiber than Stoneville 213 and Deltapine Smooth Leaf. Coker 413-68 and 'Delfos 9169' had good fiber length, but they were not significantly different from Deltapine Smooth Leaf. Two of the better yielding old varieties (Stoneville 5A and Deltapine 11A) had fiber less than an inch long. Fiber of the highest yielding variety, Stoneville 213, was significantly longer than only four other varieties tested; however, only the lower yielding varieties had significantly longer fiber length. These data indicated that the lower yielding varieties had the longest fiber. These varieties were developed when the major breeding emphasis was fiber length rather than lint yield. These low yielding, long fiber varieties could be called quality cottons today, but they could not compete economically with the high yielding varieties presently being grown. In general, very little improvement has been made in the past several years for fiber length in high yielding varieties.

Fiber and Yarn Strength

The fiber strength and yarn strength of Missdel 1 W.R., Daltatype Webber, and Coker Wilds were significantly better than those of any other variety tested (Table 2). Yarn strength tended to separate varieties into more significantly different groups than did fiber strength. There was no significant difference between Deltapine Smooth Leaf and Coker 413-68 on the basis of fiber strength; however, Coker 413-68 had significantly better yarn strength.

The lowest yielding varieties (Missdel 1 W.R., Deltatype Webber, and Coker Wilds) had superior yarn

strength. Coker 413-68, Deltapine Smooth Leaf, and Delfos 531C had intermediate yarn strength. Stoneville 5A and Rowden 41-B had very weak yarn. Stoneville 5A had the shortest and weakest fiber.

Breeders have not succeeded in bridging the gap between fiber properties and yield, but varieties like Coker 413-68 are a return to improved fiber property types and have partially closed this gap.

Fiber Elongation

Fiber elongation (Table 2) appeared to be partially associated with varietal types. The Deltapine and Delfos varieties had the highest fiber elongation values. Fiber elongation of Coker 100 and Coker Wilds is high, but Coker 413-68 had the lowest fiber elongation value of any variety tested. Fiber elongation of the currently grown varieties, (Deltapine Smooth Leaf, Stoneville 213, and Coker 413-68) were classified as high, intermediate, and low, respectively, in elongation values.

Micronaire

The relative importance of micronaire values has changed in the past few years as discounts and premiums are now made on the basis of micronaire.

The micronaire (Table 2) of Rowden 41-B was significantly higher than that of any other variety tested. The varieties having the lowest micronaire values (Missdel 1 W.R., Deltatype Webber, and Coker Wilds) were the lowest yielding varieties, but they had the longest and strongest fiber. There has been a general trend toward higher micronaire values in many of the more recently released varieties. The two proven commercial varieties (Stoneville 213 and Deltapine Smooth Leaf) had higher micronaire values than any variety except Rowden 41-B. These increased micronaire values have been partly due to the importance placed on this character at the time a particular variety was being developed. In past years emphasis was placed on high micronaire. Varieties were needed with a coarse fiber to meet manufacturer's demand for a cotton that would mix well with wool for making blankets. Another need was a coarse, long-stapled variety for spinning with asbestos to make fire-proof materials. In many cases as higher lint percentages were attained, higher micronaire values were also attained. The breeding objective at the present time is for a variety having a micronaire value between 3.8 and 4.8.

CONCLUSIONS

These data indicated that the two extensively used Delta developed varieties (Stoneville 213 and Deltapine Smooth Leaf) yielded approximately 112 kg/ha more lint than the best obsolete variety. Most old varieties yielded 224 to 448 kg/ha less lint than the commercial check varieties. Coker 413-68, a new variety with good fiber properties, yielded approximately 200 kg/ha less lint than Stoneville 213 and Deltapine Smooth leaf. However, Coker 413-68 had significantly better fiber properties than the better yielding obsolete varieties and the two currently grown Delta varieties.

These data showed that lint percentage was increased in more recently developed varieties and large increases in lint yield came about through selection of varieties for high lint percentage. Most Delta developed varieties released since Deltapine 14 have had higher lint percentages, small bolls, small seed, and higher micronaire values.

These data indicated that most of the breeding emphasis has been placed on lint yield rather than fiber quality. Stoneville 213 is a high yielding variety that has been one of the predominant varieties grown in the Mississippi Delta for the past 6 years. These data show that only four old varieties have shorter fiber and lower yarn strength than Stoneville 213. Deltapine Smooth leaf and Coker 413-68 had higher yarn strength than most old varieties, but Coker 413-68 yielded approximately 212 kg/ha of lint less than the best yielding varieties.

Coker Wilds, Missdel 1 W.R., and Deltatype Webber had the longest, strongest, and finest fiber, but lint yields were approximately 450 to 620 kg/ha less than varieties presently being grown. These varieties would be called high quality cottons today, but they could not compete economically with the high yields and more abundant fiber quality and spinning performance of the varieties currently being grown.

Modified adaptational needs have brought about a completely new series of varieties. The breeding and development of new high quality varieties have partially, but not completely, closed the gap between yield and quality. Breeders have succeeded in developing cottons to meet special situations in the past, and they will continue to develop new types as the economic need arises.

LITERATURE CITED

1. Hamby, D. S. 1965. The American cotton handbook vol. 1. John Wiley and Sons, Inc., New York. 518 p.
2. Neely, J. W. 1940. The effect of genetical factors, seasonal differences and soil variations upon certain characteristics of upland cotton in the Yazoo-Mississippi Delta. Miss. Agr. Exp. Sta. Tech. Bull. 28. 43 p.
3. Tracy, S. M. 1896. The cotton plant. USDA Bull. 33.
4. Tyler, F. J. 1910. Varieties of American upland cotton. USDA Bur. Plant Ind. Bull. 163.
5. Ware, J. O. 1937. Plant breeding and the cotton industry. p. 657-744. *In* USDA Yearbook. US Government Printing Office, Washington.
6. Ware, J. O. 1952. Origin and performance of principal cotton varieties in Arkansas. Ark. Agr. Exp. Sta. Bull. 527. 65 p.