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# Sub Okra Leaf Influence on Cotton Yield[1]

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## ABSTRACT

A study in three diverse environments in 1985 near Stoneville, MS compared the yield of eight $BC_4F_3$-derived sub okra leaf ($L^u{}_2$) and normal leaf ($l_2$) cotton plants (*Gossypium hirsutum* L.). Sub okra leaf cotton averaged significantly higher yields (3%) than normal leaf cotton. Also, a significant ($P = 0.03$) leaf type × cultivar background interaction was detected. For the cultivar backgrounds of 'Stoneville 825', 'Deltapine 26', 'Deltapine 5540', DES 2-10, and 'Tamcot CAMD-E', the average yield of sub okra and normal-derived populations was 968 and 971 kg/ha, respectively. For the backgrounds of 'DES 422', 'SC-1', and MD 65-11 the average yield was 972 and 894 kg/ha, respectively. No major differences between sub okra and normal leaf populations for earliness, yield components, or fiber properties were detected. The results from these backcross-derived populations indicate that previous evaluation studies using $F_3$ hybrid populations that were genetically similar except for one simple inherited trait, leaf type, were an acceptable method for measuring approximate yield potential of the new trait. This study indicates that for some genetic backgrounds and environments that the use of sub okra to replace normal leaf offers a potential yield increase of 3 to 5%.


*Additional index words:* Near-isogenic lines, *Gossypium hirsutum* L., Leaf canopy, Okra leaf, Super okra leaf, Canopy photosynthesis.

WITH the exception of a small hectarage in Louisiana, all cotton (*Gossypium hirsutum* L.) cultivars grown in the USA have a normal leaf type and a closed canopy. Advantages of using open-canopy cotton are numerous; Jones (2) summarized the characteristics of their earliness, pest resistance, and boll-rot resistance. Karami et al. (3) reported on potentials for drought tolerance. Landivar et al. (5), using modeling studies, surmised that under favorable moisture conditions that some leaf types other than normal might result in increased lint yields.

Meredith (6), using $F_3$ bulk hybrid populations that were genetically similar except for the more open-canopy mutants sub okra ($L^u{}_2$), super okra ($L^s{}_2$), and okra leaf ($L^o{}_2$), detected a significant increase in lint yield of 4.8% for sub okra over normal leaf cotton. For evaluating a new trait, Burton (1) suggested the evaluation method of using $F_3$ bulk hybrid populations which differ in only a few genes. The primary objective of this study was to evaluate the yield potential of genetically similar sub okra and normal leaf populations produced by the backcross method using the eight crosses from the original study (6). A secondary objective was to observe if the rarely used method of producing near-isogenic populations as suggested by Burton (1) was useful in evaluating the potential of new simply inherited traits.

## MATERIALS AND METHODS

Eight sub okra and normal leaf populations were produced from crossing HYC 79-6, a sub okra strain (8) with eight lines (Table 1) used in a previous study (6). In addition, one of the eight lines, MD 65-11, a normal leaf cotton, was crossed with La 1363L$^s$ne, a super okra strain, and La Okra 500C, an okra leaf strain, to produce genetically similar populations of normal and super okra and normal and okra leaf, respectively. HYC 79-6 was also crossed with La 1363L$^s$ne and La Okra 500C to produce super okra and sub okra and okra and sub okra leaf populations, respectively. La 1363L$^s$ne and La Okra 500C were obtained from J.E. Jones, Agronomy Dep., Louisiana Agric. Exp. Stn., Baton Rouge. The initial crosses were made at Stoneville in 1980. By use of winter increases in Mexico, four backcrosses were made so that in 1984 a large number of $BC_4F_2$ plants from 12 backcross populations were grown at Stoneville. From the eight normal × sub okra crosses two groups were formed. In one group, only normal leaf plants were retained; in the other group, only sub okra leaf type plants were retained. No selection was practiced for any characteristic other than the indicated leaf types. From the MD 65-11 crosses, $BC_4F_2$ normal and super okra and normal and okra leaf populations were produced. From the HYC 79-6 crosses with La 1363L$^s$ne and La Okra 500C, super okra and normal and okra and normal leaf $BC_4F_2$ populations, respectively, were also produced. At least 100 plants of the specified leaf type were retained for each of the 24 populations.

Table 1. Lint yield of various normal, sub okra, super okra, and okra leaf cotton.

| Strain | Lint yield | Strain | Lint yield |
|---|---|---|---|
| | kg/ha | | kg/ha |
| Stv 825 Normal | 1056 | MD 65-11 Normal | 899** |
| Stv 825 Sub | 1031 | Super | 746 |
| DES 422 Normal | 1014 | MD 65-11 Normal | 898 |
| DES 422 Sub | 1089* | Okra | 943 |
| DPL 26 Normal | 966 | La 1363L$^s$ne Super | 885 |
| DPL 26 Sub | 943 | Sub | 982** |
| DPL 5540 Normal | 966 | La 500 Okra | 937 |
| DPL 5540 Sub | 950 | Sub | 965 |
| SC-1 Normal | 792 | CV % | 10.1 |
| SC-1 Sub | 875** | | |
| DES 2-10 Normal | 951 | | |
| DES 2-10 Sub | 959 | | |
| Tamcot CAMD-E Normal | 916 | | |
| Tamcot CAMD-E Sub | 957 | | |
| MD 65-11 Normal | 875 | | |
| MD 65-11 Sub | 952* | | |
| Mean Normal | 942 | | |
| Mean Sub | 970* | | |

*,** Difference between leaf types within a cross are significant at the 5 and 1% levels of probability, respectively ($LSD_{0.05}$ = 63 kg/ha; $LSD_{0.01}$ = 83 kg/ha).

In 1985, the 24 populations were grown at three locations near Stoneville. Planting dates were 17 April, 2, and 6 May. The respective soil types were a Dundee silty clay (fine-silty, mixed, thermic Aeric Ochraqualfs), a Dubbs silt loam (fine-silty, mixed, thermic Typic Hapludalfs), and a Beulah fine sandy loam (coarse-loamy, mixed, thermic Typic Dystrochrepts). Insect populations were controlled with appropriate insecticides.

The experimental design was a split-plot with six replications. Whole plots were a specific cross and the subplots

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were the various leaf comparisons: 8 normal vs. sub okra, normal vs. super okra, normal vs. okra, super okra vs. sub okra, and okra vs. sub okra leaf. Plot size was three rows at 1.0 × 7.5 m long. Lint yield and yield components were determined from the middle row.

The yield components (i.e., lint percentage of seed cotton, boll weight of seed cotton, seed weight, lint/seed, and seed/boll) were determined from two composite samples from three replications of 30 bolls each at each location. The lint from each 90-boll composite sample was used for fiber determinations of span length, strength, elongation, and micronaire.

## RESULTS AND DISCUSSION

In the present study, sub okra's yield superiority at the three sites ranged from 15 to 40 kg/ha (mean 28 kg/ha or 3.0%; Table 1). Sub okra's yield superiority in a previous study (6) involving $F_3$ bulk populations from these same eight crosses and three sites ranged from 18 to 83 kg/ha (mean 47 kg/ha or 4.8%) superiority over environments. In both studies, the tests planted earliest and on the clay soil produced the least plant growth and showed the least difference between sub okra and normal leaf cotton. This result indicates that some of the advantages of open-canopy cottons may be lost in environments that inhibit plant growth.

The analysis of variance indicated a significant strain × leaf type interaction ($P = 0.03$). The nature of this interaction is evident in column 1 of Table 1. Difference in yield between sub okra and normal ranged from −25 to 83 kg/ha. For three cvs., DES 422, SC-1, and MD 65-11, average yields were 972 and 894 kg/ha, respectively, for sub okra and normal leaf. The average yield for the remaining five cultivars was 968 and 971 kg/ha for sub okra and normal leaf, respectively. The $F_3$ bulk hybrids, grown in 1982 from the three cultivars whose sub okra leaf backcross populations were superior to normal (6), averaged 23 kg/ha more lint. However, for the $F_3$ bulk hybrids from the other five cultivars, sub okra superiority over normal was 62 kg/ha, respectively.

Thus, while it appears that the development of near-isogenic $F_3$ populations does measure the potential of a mutant trait compared to that of the normal trait, it does not identify which specific crosses would produce the best backcross populations. Since backcross breeding results in incorporation of the new trait in the genetically reconstituted old genotype, the backcross method probably is not the best method to utilize the benefits of a new trait. For example, most backcross-developed okra leaf cottons average about 5% less yield than normal leaf recurrent parents at Stoneville (7). However, Meredith and Wells (7) developed high-yielding, commercially competitive okra leaf lines with yield superiority over their normal leaf counterparts from some populations. While high-yielding, commercially competitive sub okra strains were developed for this study, the best sub okra strains would probably come from non-backcross breeding procedures.

For comparative purposes with the previous study (6), okra leaf and super okra leaf cottons were evaluated against normal and sub okra leaf cotton (Table 1). As in the previous study, super okra cotton yielded significantly less lint than normal cotton, but there was no significant difference in yield between normal and okra leaf. In general, in the Mississippi Delta the yield of okra leaf has averaged about 5% less than the yield of normal leaf (7). La 1363L$^s$ne and La Okra 500C are super okra and okra leaf cultivars, respectively, and are grown commercially in Louisiana. The backcross-derived sub okra line yielded significantly more lint (11%) than comparable super okra population, but yields of sub okra and okra leaf La Okra 500C populations did not differ significantly. No significant differences were detected for yield components and fiber properties for normal vs. sub okra paired comparisons.

Variability associated with the backcross procedure is not significant, and parallel backcrosses produced similar populations. This was shown by comparing the yields of the three MD 65-11 normal leaf lines that were produced as checks of comparable sub okra, super okra, and okra leaf populations (875, 899, and 898 kg/ha, respectively).

These results with backcross-derived populations reinforce conclusions reached from evaluating $F_3$ bulk hybrid near-isogenic populations (6). The former study showed that the yield advantage of sub okra cotton averaged 4.8%. The present showed that the yield advantage of sub okra cotton averaged 3.0%. In the former study, no significant leaf type × genetic population interaction was detected, but in the current study there was a significant leaf type × genetic population interaction. There was no significant difference in yield between leaf types for five populations, but for three, DES 422, SC-1, and MD 65-11, sub okra leaf cotton produced significantly higher yields than normal leaf cotton. The results from integrated canopy photosynthesis studies for 1984 and 1985 by Wells et al. (9) show that sub okra averaged 7% greater photosynthesis than normal leaf. Most new mutants introgressed into cotton to replace the normal trait result in negative effects on yield (4). Our studies show that sub okra leaf cotton had a yield increase from 3 to 5% over that of normal leaf cotton in some environments and in some genetic backgrounds.

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