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# Synthesis of Commercial $F_1$ Hybrids in Cotton. II. Long, Strong-fibered *G. hirsutum* L. × *G. barbadense* L. Hybrids with Superior Agronomic Properties[1]

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## ABSTRACT

**I investigated for 2 years at Las Cruces, New Mex., lint yield and fiber properties of two interspecific hybrids between *Gossypium hirsutum* L. and *G. barbadense* L. Both hybrids exhibited significant overall heterosis for yield of seedcotton. The hybrids produced 48 and 42% more seedcotton and 33 and 26% more lint cotton, respectively, than an 'Acala 1517-70' check. The hybrids in general were no taller than the commercial check. Both hybrids have fiber that is slightly longer, finer, and about equal in strength to their *G. barbadense* parents. Some evidence in this study suggests that extra fine fiber of the hybrids is due to reduced fiber diameter.**


***Additional index words:*** **Heterosis, Interspecific hybrids, Lint yield, Seed yield, Fiber properties, Plant stature, *Gossypium hirsutum* L., *Gossypium barbadense* L.**

SEVERAL investigators (Fryxell et al., 1958; Marani, 1967; Omran et al., 1974) have reported excellent heterosis in crosses of *Gossypium hirsutum* L. × *G. barbadense* L. Parents selected without regard to plant type among the cultivars of both species produce interspecific hybrids that are usually tall, luxuriant (Marani, 1964), and highly productive (Marani, 1963; Fryxell et al., 1958; Omran et al., 1974). In general, interspecific heterosis has been associated with late maturity (Marani, 1964, 1967; Fryxell et al., 1958).

Selection of early, semi-dwarf types of *G. hirsutum* as one parent has produced interspecific hybrids similar to the Acala types of *G. hirsutum* in stature and maturity (Davis, 1974). When semi-dwarf types are used as the upland parent, the resulting $F_1$ hybrids have invariably been earlier and less luxuriant, and probably well adapted for mechanized cultivation and harvest. However, none of the earlier-maturing, shorter-saturated interspecific hybrids yet reported has had lint yields significantly better than 'Acala 1517-70' *G. hirsutum*.

The main objective of this research was to test the hypothesis that significant heterosis for yield could be demonstrated on interspecific hybrid types that are no greater in stature than Acala 1517 and equal to or earlier than Acala 1517 in maturity. Hybrids must meet these criteria for yield, stature, and maturity if they are to be seriously considered for commercial use in New Mexico. I also investigated the cause of $F_1$ hybrids having finer fiber than their respective parents.

## MATERIALS AND METHODS

*G. hirsutum* 5-1 is an early maturing, short-statured cotton line developed at the New Mexico Agricultural Experiment Station. Two sibling lines, 5-1a and 5-1b, were used as female parents of the hybrids described in this paper. Selection 5-1a is the shorter-statured of the two.

The two American Pima (*G. barbadense*) types used as male parents were not closely related. 'Pima S-4' is a commercial cultivar that was widely grown in New Mexico when the experiment was initiated. Line G, an experimental, highly pubescent Pima selection, was taken from stocks developed under the designation E1097, by E. F. Young, Jr., at the Texas A&M University Agricultural Experiment Station, El Paso.

Hybrid seed of 5-1a × G and 5-1b Pima S-4 were produced by hand. $F_1$ hybrids, parents, and checks were planted in rows 102 cm wide and 10 m long, at the rate of 10 seeds/m, with a 4-row IHC planter equipped with cones. The treatment entries were seeded into the even-numbered rows, and either Acala 1517-70 (1974) or pubescent experimental *G. barbadense* (1975 and 1976) was simultaneously seeded into the odd-numbered rows to separate and provide uniform competition for the single-row plots. The experimental design was a randomized complete block with four replications.

Planting dates ranged from 29 April to 4 May. The test plot were given cultural treatment similar to surrounding farms. No treatment for insects was required. Two harvests were made, the first when 60 to 80% of the bolls on the Acala 1517-70 check had opened, and the final one at least 3 weeks after frost. The two hybrids are considered separatley since they were not grown together in the same test until 1976.

Gin turnout measurements were based on laboratory-ginned random samples from the machine-picked bulk of the first harvest. Percent lint was reported as the lint weight fraction of the machine-picked bulk sample.

Fiber properties were determined at the New Mexico Agricultural Experiment Station fiber laboratory. Length and length uniformity were determined on the digital fibrograph, micronaire values on the Sheffield FAMA-60 micronaire instrument, and strength and elongation on the 1/8-inch (3.175 mm) gauge stelometer.

## RESULTS AND DISCUSSION

Data on earliness of yield, plant height, and fiber properties of the hybrids, parents, and Acala 1517-70 are given in Table 1. In general the hybrids 5-1a × G (Exp. I) and 5-1b × Pima S-4 (Exp. III) yielded more, were as early in maturity, and no taller than Acala 1517-70. The hybrids produced 48 and 42% more seed cotton and 33 and 26% more lint cotton, respectively, than Acala 1517-70 (Exp. I and III). Therefore both hybrids meet the critical agronomic criteria, i.e., heterosis for yield in a plant type that is similar to the commercially grown Acala 1517-70. This excellent performance relative to the leading cultivars in the state for 1975-76 is an indication of commercially useful heterosis (Meredith and Bridge, 1972). Table 1, Exp. II compares the hybrid 5-1a × G with its parents. The extent of heterosis is apparent in that the hybrid falls outside the parental range in eight of the nine measured properties.

The fiber properties were typical for interspecific hybrids — very long, fine, and strong. Hybrid fiber was generally similar to Pima fiber, except for micronaire values. Micronaire readings of both hybrids were considerably lower than either of their parents and Acala 1517-70 as well. Even though the length,

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**Table 1. Agronomic and fiber performance of $F_1$ hybrids, parents, and Acala 1517-70.**

| Entry | Agronomic properties | | | | Fiber properties | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | Lint yield | First harvest | Gin turnout | Plant height | 2.5% Span length | Uniformity index | Micronaire | $T_1$ Strength | $E_1$ Elongation |
| | kg/ha | % | | cm | mm | | reading | nM/Tex | units |
| 5-1a × G ($F_1$) | 1,286 | 70.3 | 32.0 | 105 | 35.8 | 45.8 | 3.30 | 266 | 10.7 |
| Acala 1517-70 | 964 | 54.5 | 35.5 | 109 | 30.0 | 47.2 | 3.63 | 218 | 7.0 |
| L.S.D. 0.05 | 197 | ns | 1.7 | ns | 3.2 | ns | ns | 32 | 2.2 |
| Experiment II | | | | | | | | | |
| 5-1a × G ($F_1$) | 1,155 | 82.0 | 31.2 | 105 | 34.3 | 42.0 | 3.31 | 255 | 9.7 |
| Strain 5-1a | 847 | 85.7 | 34.5 | 73 | 27.4 | 48.6 | 4.24 | 232 | 8.8 |
| Strain G | 519 | 45.0 | 34.4 | 102 | 32.5 | 44.9 | 4.29 | 249 | 8.9 |
| L.S.D. 0.05 | 290 | 11.9 | ns | 16 | 1.6 | ns | ns | ns | ns |
| Experiment III | | | | | | | | | |
| 5-1b × Pima S-4 | 1,113 | 65.8 | 31.3 | 99 | 33.5 | 43.7 | 3.14 | 263 | 10.1 |
| Acala 1517-70 | 882 | 68.3 | 35.3 | 109 | 28.2 | 45.1 | 4.01 | 209 | 6.5 |
| 5-1b | 937 | 77.4 | 34.9 | 77 | 27.4 | 47.9 | 4.24 | 233 | 7.6 |
| Pima S-4 | 394 | 43.5 | 34.0 | 87 | 32.5 | 44.5 | 3.94 | 260 | 10.4 |
| L.S.D. 0.05 | 395 | 20 | 2.9 | 13 | 2.3 | ns | 0.75 | 32 | 2.3 |

**Table 2. Fiber development of hybrid 5-1b × Pima S-4 and its parents compared to an Acala 1517-70 check.**

| | Fiber diameter† | Wall thickness | Micronaire |
|---|---|---|---|
| | μm | | reading |
| Acala 1517-70 | 19.5 | 4.9 | 4.2 |
| Strain 5-1b | 19.4 | 5.2 | 4.0 |
| Pima S-4 | 18.9 | 5.1 | 4.0 |
| 5-1b × Pima S-4 ($F_1$) | 18.1 | 4.9 | 3.2 |
| L.S.D. 0.05 | 1.37 | ns | ns |

† Flat ribbon width in NaOH.

strength, and elongation compared favorably to Pima, the low micronaire of the hybrids could be a potential problem in marketing (R. T. Hoover, Jr., Cotton merchant, El Paso, Tex., personal communication). The low micronaire may be due to inherent reduction in fiber diameter, inadequate cellulose deposition of the fiber wall, or a combination of the diameter and wall thickness factors.

Analysis of the 1975 fiber measurements showed that the hybrid 5-1b × Pima S-4 had fiber smaller in diameter than either of its parents or the Acala 1517-70 check (Table 2). The difference between the hybrid and Acala 1517-70 was significant and amounted to 1.4 μ. This results in a 14% reduction in fiber cross section as compared with Acala 1517-70 which may account for part of the 24% difference in micronaire values. No significant differences were noted for fiber wall thickness. This indicates that cellulose deposition in the hybrids is normal.

The parental lines used to create both of these hybrid prototypes have been used in a backcross program to produce cytoplasmic male-sterile A lines and fertility restoring R lines (Meyer, 1973). The A × R combinations were tested beginning in 1977 to clearly determine whether or not the male-sterile *G. harknessii* Brandegee cytoplasm may have an adverse effect upon performance of the hybrid. No obvious differences were found to distinguish A × R hybrids from similar fertile × fertile hybrids. The favorable results obtained thus far indicate that these two hybrids are ready for field scale testing and this will be undertaken in the immediate future.

The fiber of these hybrids represents a distinctly different type from any of the *G. hirsutum* or *G. barbadense* types currently marketed in the United States. Its superior length, strength, and elongation with apparently normal maturity should make it highly desirable for certain uses. On the other hand, the lower micronaire values make it impossible to predict the potential market value of this fiber. Before these or similar hybrids are brought into general production, processing performance should be adequately evaluated.

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