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Performance of AHA Derivative Synthetic Varieties of Cotton[1]

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HIGH rates of natural crossing in cotton at Knoxville, Tenn., provide near ideal conditions for blending synthetic varieties. Empire Derivative synthetics blended at Knoxville were reported to be higher yielding than those produced at Greenville, Texas, where rates of natural crossing are lower (1).

Acala Hopi Acala (AHA) breeding stocks, specifically AHA 46–124, have been used extensively in breeding programs as sources of fiber quality. Derivatives from crosses of AHA 46–124 with southeastern cottons should be good component stocks for synthetic varieties, since such stocks would provide a pool of favorable genes for yield and quality. The performance of synthetic varieties produced by blending eight AHA Derivative stocks is reported in this paper.

MATERIALS AND METHODS

Equal quantities of seed of 1 breeding line from each of the following were mixed: Rowden × AHA 46–124, Paymaster × AHA 46–124, Early Fluff × AHA 46–124, Acala 29 × AHA 46–124, Triple Species Hybrid 456 × AHA 46–124, AHA 1–9 × AHA 46–124, AHA 1–9 × Station C, and Magnolia (Deltapine × Hopi Acala). Half of the mixture was planted at Knoxville, Tenn., and the remainder at Shafter, Calif., in 1955. For each of the years, 1956 through 1959, isolated plantings of seed of the preceding increase generations were made at the 2 locations. Each generation increase at each location was considered a synthetic; seed produced at Knoxville were designated K_1 to K_5 and seed at Shafter S_1 to S_5.

Yield trials of 7 of these synthetics, K_1 to K_5, S_1, and S_5, were planted at Knoxville in 1960–61. Limited quantities of seed prevented testing the other three Shafter synthetics. Check varieties used were Pope, Coker 100A, WR, Deltapine Smooth Leaf, Acala 4–42, and AHA 46–124. Plot size, replications, methods, and data taken were the same as in the Empire Derivative trials previously conducted at Knoxville (1) except for the measurement of fiber fineness by the micronaire. Earliness index, an additional characteristic, was calculated by expressing the yield at first picking as a percentage of the yield of Pope at first picking.

RESULTS AND DISCUSSION

Data for the two tests were combined and analyzed. Lint yields ranged from 643 to 475 pounds per acre, and the multiple range test indicates several groupings of these means (Table 1). The K_4, K_2, K_5, and K_3 synthetics were significantly higher yielding than the K_1, S_5, and S_1 synthetics. The four top yielding synthetics compared very favorably with the adapted southeastern check varieties Pope, Coker 100A WR, and Deltapine Smooth Leaf.

The yield advantage for AHA Derivative synthetics blended at Knoxville is in agreement with results for Empire Derivative synthetics (1). However, maximum yield was reached after only 2 years of blending for the AHA Derivative synthetics, whereas 3 years were required for the Empire Derivative synthetics (1). Different component stocks of the two synthetic groups could account for this difference.

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The Knoxville synthetics were earlier, higher in lint percentage, and smaller seeded than the Shafter synthetics (Table 1). Fiber property and yarn strength data (Table 2) show that the Knoxville synthetics were superior to the southeastern check varieties for T_1 fiber strength and yarn strength, but were inferior to the Shafter synthetics and the western check varieties for the same characteristics.

The data presented do not provide critical information on the relative importance of heterosis and natural selection as causes for the differences found in the performance of the AHA synthetics. Natural crossing at Knoxville was reported to average 46% (4) and is estimated to be approximately 5% at Shafter. Such percentages of natural crossing could result in considerable differences in the degree of blending of the AHA Derivative stocks, and it is likely that some of the yield advantage noted for the later generation Knoxville synthetics was due to heterosis. However, part of the higher yield of the Knoxville synthetics could be due to natural selection for germ plasm more adapted to the Knoxville environment. The Knoxville synthetics were earlier, higher in lint percentage, weaker in fiber and yarn strength, and smaller seeded than the Shafter synthetics. Natural selection was probably primarily responsible for these differences.

Natural selection did not seem to have any significant effect on the Empire Derivative synthetics (1). The component stocks for the Empire Derivative synthetics were adapted southeastern strains and varieties, and it is unlikely that natural selection would play an important part. However, the AHA component stocks in the present study consisted of combined western and southeastern strains and

Table 1—Two-year averages (1960–61) for lint yield and other characteristics of AHA Derivative synthetic and check varieties.

Variety	Lint yield, lb./A.	Stat. sig.*	Earliness index	Bolls per lb.	Lint percent	Lint index	Seed index
Pope	643	a	100	69	40.5	7.97	11.8
AHA Der. K_4 1958	631	ab	105	65	35.6	7.11	12.9
AHA Der. K_2 1956	622	abc	110	66	35.5	6.92	12.6
AHA Der. K_5 1959	617	abcd	109	66	35.1	6.75	12.6
Coker 100A WR	596	abcde	77	69	37.5	6.83	11.4
AHA Der. K_3 1957	577	cdef	101	64	35.2	7.05	13.0
Deltapine Sm. Lf.	563	efg	80	77	38.1	6.24	10.2
Acala 4-42	559	efgh	73	61	37.3	7.27	12.2
AHA 46-124	524	ghi	77	60	33.7	7.80	15.4
AHA Der. K_1 1955	505	ij	87	66	35.2	7.01	12.8
AHA Der. S_5 1959	489	ij	73	65	33.0	7.32	15.0
AHA Der. S_1 1955	475	j	69	66	33.7	7.35	14.5

* Any two mean lint yields not followed by the same letter are significantly different at the 5% probability level.

Table 2—Two-year averages (1960–61) for fiber properties and yarn strength of AHA Derivative synthetic and check varieties.

Variety	Fiber length U.H.M.	Fiber strength T_1	Fiber fineness Mic.	Yarn strength 22's, lb.
Pope	1.02	1.74	4.55	118
AHA Der. K_4 1958	1.08	2.04	4.90	140
AHA Der. K_2 1956	1.09	2.03	4.80	141
AHA Der. K_5 1959	1.10	1.95	4.79	136
Coker 100A WR	1.10	1.72	4.67	122
AHA Der. K_3 1957	1.10	1.95	4.80	135
Deltapine Sm. Lf.	1.11	1.82	4.68	120
Acala 4-42	1.09	2.13	3.88	149
AHA 46-124	1.15	2.29	4.98	155
AHA Der. K_1 1955	1.10	2.03	4.74	137
AHA Der. S_5 1959	1.15	2.17	4.67	152
AHA Der. S_1 1955	1.11	2.30	4.79	153

varieties, and it is very likely that natural selection in the Knoxville environment would cause a shift toward the southeastern type.

Seed production of the S_2, S_3, and S_4 synthetics (approximately 5 pounds of each) could have been insufficient for maximum blending at Shafter and may have influenced the performance of the S_5 synthetic. However, the number of plants grown in each of these synthetic generations was considered adequate to prevent any narrowing of the germ plasm base.

Observations indicate that poor quality cottonseed may result in reduced stands and weak seedlings which could significantly influence yield. Seed quality could be a factor in the results reported here, since the seed were produced in different years at different locations. However, large quantities of seed were planted, stands were good, and seemingly seed quality could not have exerted a significant influence. Heterosis and natural selection effects from blending the synthetics at Knoxville more than compensated for any advantage due to better seed quality of the synthetics produced at Shafter.

High fiber strength has been an elusive and difficult characteristic to combine with high yield in southeastern varieties (3). The data presented here show an unusual combination of good yield, earliness, high fiber strength, and high yarn strength for the four later-generation Knoxville synthetics. Evaluation of these synthetics in the southeastern cotton belt would be desirable. Lint percentage of the synthetics is lower than desired in a commercial variety, and a selection program designed to increase lint percentage has been initiated. The later-generation Knoxville synthetics should be excellent breeding stocks, since several years of blending would possibly increase the probability of obtaining desirable combinations by selection (2).

SUMMARY

Eight AHA Derivative stocks were blended for five years at Knoxville, Tenn., and Shafter, Calif., to produce synthetic varieties. The 5 Knoxville and the first and fifth Shafter generation were tested for 2 years at Knoxville. The 4 synthetics blended for 2 or more generations at Knoxville were significantly higher in yield than the Knoxville synthetic blended for 1 year and the 2 Shafter synthetics, Blending at Knoxville resulted in a shift toward a more southeastern agronomic type. It appeared likely that both heterosis and natural selection were effecting the performance of the synthetics.

The 4 Knoxville synthetics blended for 2 or more years were equal in yield to 3 southeastern varieties tested and were considerably superior in fiber and yarn strengths. The unusual combinations of yield and yarn strength in the Knoxville synthetics warrant additional testing and their use as a base breeding stock.

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