Hybrid Cotton Breeding Program

limited quantity of cotton hybrids produced for scientific use but seed production on commercial scale not yet possible

John H. Turner

Numerous cotton hybrids—offspring of a cross between two individuals of dissimilar genetic constitution—have been produced in limited quantities for a plant breeding program at the Shafter Cotton Experiment Station.

In plant breeding, hybrids are made to incorporate into one plant or group of plants the desirable characteristics of each parent and the Shafter scientists are seeking a commercial cotton hybrid with superior yield and fiber quality, and maximum production efficiency at minimum cost. Together, these three criteria include some 50 characteristics. This hybrid would be the theoretical plant which the research men must fabricate by hybridization.

Hybrid Vigor

In some crop plants hybrids display more vigor than either parent. Increased yield is generally associated with this hybrid vigor. Corn is a well known example of a crop plant in which this phenomenon has been exploited, while onions and sorghum have only recently been added to the list of commercial hybrids. However, not all crosses give offspring which show hybrid vigor, and furthermore it is not possible to predict accurately which strains, when crossed, will give offspring which are more vigorous than their parents. This information can only be gained by experimentally crossing numerous strains of plants and observing which combinations give the best offspring. Finding those cotton strains which combine well with regard to the criteria of yield, quality, and production efficiency is basic to the problem of commercial hybrid cotton. Hybrid vigor has been shown to exist within the Upland species of which the Acala cottons are members, but its commercial use has been stymied due to the fact that cross-pollination can not be controlled.

In corn—for example—the male and female reproductive organs are borne separately on the plant, the male organs in the tassel and the female organs in the ear shoot. It is an easy task to control crossing by removing the tassel—male—from the plant to be used as the seed parent. In cotton the male and female reproductive organs are borne in the same flower, the male organs being not only numerous but closely encircling that of the female, which normally results in self-pollination. Thus, unless a practical means of sterilizing the male organs can be found, it will be impractical to make controlled crosses in cotton on a commercial scale.

Possible Turning Point

Scientists at the Cotton Experiment Station at Shafter are looking toward chemicals which might prove the breakthrough in solving the male sterility portion of the problem. Greenhouse tests in Texas during 1955 showed that spraying sodium alpha, betadichloroisobutyrate on cotton plants produced male sterility. This finding has been borne out under field conditions at Shafter. However, some female sterility was also produced in the tests, as evidenced by the reduction in number of seeds set per boll.

Intensive investigations are underway at Shafter and at other research centers across the cotton belt to determine the proper dosage and the time of application of several related chemicals, which may sterilize the male and leave the female organs functioning normally. If a chemical can be found and application techniques perfected which will consistently produce complete or nearly complete male sterility and at the same time leave the female organs relatively unaffected—compared to their normal functioning—the outlook for a commercial hybrid cotton is indeed promising.

Bee Pollinators

In corn, the wind carries the pollen from the organs of the male parent to those of the female parent, but in cotton pollinating insects are necessary for cross pollinating. If domestic bees cooperate—and work thus far indicates they do—at least two major difficulties are envisioned with their use in making practical large scale controlled crosses. First of all, there is the real danger of killing the bees while controlling the harmful insects by use of insecticides, and secondly, there is the need for isolating the crossing fields from other fields of cotton to such an extent that the transfer of pollen by the bees from these other fields will be practically eliminated.

California's One Variety Cotton Program, established at grower request, embodying the principle of producing a single product of uniform quality continually acceptable to the mills, is another consideration in the hybrid cotton problem.

The nonprofit California Planting Cotton Seed Distributors act as liaison between the breeding efforts of the Shafter Experiment Station and cooperating growers. Every year the Distributors receive about 50 pounds of improved hand-selfed seed from the breeding plots. The first year the seed is planted on five acres. The second year the seed yield from the original five acres is planted on 300 acres; the third year, 3,000; the fourth, 70,000; and finally in the fifth year the seed is distributed to California's cotton growers. It takes between 20 and 25 thousand tons of seed to supply them.

Under the One Variety Program, it would be necessary to multiply the seed of each strain to be used as a parent of the commercial hybrid up to the 3,000 acre step. These parent strains would then be interplanted at the final step in order to produce seed for the commercial hybrid.

Investigators at the Shafter Experiment Station are of the opinion that commercial hybrid cotton is possible, but that its realization is unlikely in the near future. Much more research is needed: *1,* to determine how and when chemical sterilants should be applied to cause male sterility with reliable results; *2,* to find strains which combine well to use as parents; and *3,* to develop techniques applicable to large scale hybrid seed cotton production.

The utilization of hybrid vigor may come about more rapidly in the form of a synthetic rather than a pure hybrid. Seed mixtures of parents—whose offspring have shown hybrid vigor—planted under field conditions where natural crossing occurred, have given a boost in yield upon several occasions. This theory as verified by experimental hybrids could well be the pay-off.

Experimental crosses, involving 15 strains of cotton, were made last season at Shafter. The hybrids from these crosses, plus two synthetic hybrids, will

Concluded on page 15

Migration habits of The Ladybird Beetle

Recent research by Kenneth S. Hagen, Assistant Entomologist in Biological Control, University of California, Berkeley, has provided additional information on the migrations of this important natural enemy of many aphid pests of agricultural crops in California.

The ladybird beetle—*Hippodamia convergens*—has the unusual habit of congregating in large masses for hibernation in mountain canyons. The times of migration from the valleys in the early summer and the return from the mountains in the following spring have an important bearing upon the effectiveness of the beetle in controlling aphid infestations. Recent research has shed much light on the several factors influencing this migration habit. After the development of one or more generations in the field during the spring, the food supply usually becomes deficient and this provides the stimulus for migration to the mountains, which may be 50 miles or more away. On arrival in the mountains in June, the beetles feed for some time on pollen, plant exudations and other noninsect food and their weight may be doubled during this period. They first assemble in small aggregations along creeks, and later consolidate in the forest litter into larger aggregations which may be as great as 500 gallons. Here they remain from October to February, usually deeply covered by snow during the winter.

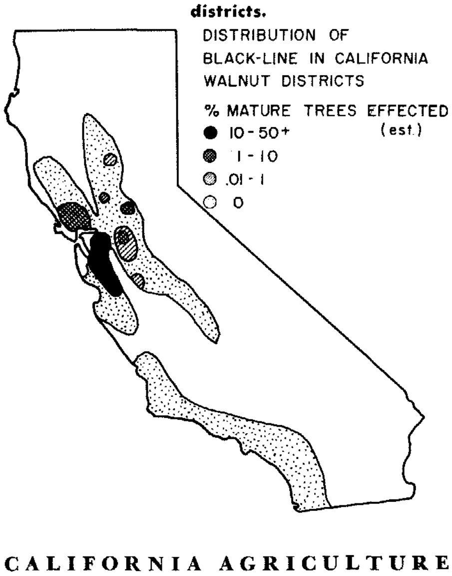
During the first warm days of February or March, when temperatures exceed 55°F, the beetles again become active. These warm periods are associated with high pressure areas over the northwestern states, creating easterly winds over the Sierra. The beetles take off vertically, ascending up to several thousand feet above the point of origin, and then ride the prevailing winds to the valleys below. A specially designed trap on an airplane was used to check the flight patterns of the beetles in both directions. Catches have been made at elevations up to 3,500′ as the beetles leave the mountains, and up to 5,000′ as they return. It is becoming apparent that the primary destination in the migrations of *H. convergens* is governed by wind direction and temperature, and that the extended flights are triggered by nutritional factors.

---

variety 74% of the new unions had blackline and 37% were completely girdled 15 years after the reworking was done. In a San Jose test orchard five old trees with blackline were regrafted below the original union in 1951. They came back into bearing in five years but one case of blackline was found in one of the new unions at the end of the sixth year. These results indicate that regrafts are likely to get blackline much more quickly than the original unions.

Surveys and tests indicate the advisability of following certain practices for walnut growing in areas where blackline is prevalent. For new walnut plantings—where no oak root fungus is present—vigorous seedlings of Persian walnut can be used as rootstocks. Where oak root fungus is present or suspected, Northern California black walnut rootstocks can be used to obtain at least partial resistance to the fungus. These trees can be topworked at 12′–14′ with 6–12 unions to delay blackline and allow for reworking of individual branches so that trees can be kept in production indefinitely.

Distribution of blackline in California walnut districts.



Where blackline is known to be present or indicated by sprout growth, all unions can be examined by making small V-shaped cuts through the bark and cambium at intervals of about 4″. Affected unions and extent of girdling can be marked. Plot maps can then be made of the orchard and a program of replanting or interplanting and salvaging decided upon and started as soon as the amount of blackline in the orchard warrants. For replanting or interplanting, vigorous Paradox hybrids can be used—except in areas known to be infected with oak root fungus—where vigorous Northern California black seedlings can be planted. Where Northern California black walnuts make unsatisfactory growth because of root lesion nematode—*Pratylenchus vulnus*—or for other reasons, Paradox hybrids can be planted. Some may be killed by oak root fungus because their resistance to this fungus is variable. Seedlings in permanent tree locations can be topworked high with multiple unions to delay blackline and to allow reworking individual branches when they are eventually being girdled by blackline.

E. F. Serr is Pomologist, University of California, Davis.

The above progress report is based on Research Project No. 1385.

COTTON

Continued from page 3

be tested and evaluated in 1959. Should either of these hybrids prove superior to our standard variety, the seed of its parental strains can be increased for large-scale field testing of the synthetic hybrid and the same seed multiplications could serve as parents for use in the one-variety program. If none of the hybrid combinations show promise, new combinations will be made using parentage of wider genetic background.

John H. Turner is Director of the U.S.D.A. Cotton Experiment Station, Shafter, and Associate in the Experiment Station, University of California.

Frank M. Eaton, Research Chemist in Soils and Plant Nutrition, University of California, Riverside, conducted the greenhouse experiments in 1955 at College Station, Texas.

R. J. Miravalle, Geneticist, and V. T. Walhood, Plant Physiologist, U.S.D.A. Cotton Field Station, Shafter, and Marvin Hoover, Extension Cotton Specialist, University of California, Shafter, participate in the continuing Hybrid Cotton Breeding Program.

CHLOROSIS

Continued from page 6

and bicarbonates. Evidence is thus accumulating that organic acids and amino acids may be directly related to the causal mechanism of lime-induced chlorosis.

William A. Rhoads is Assistant Research Plant Physiologist in Nuclear Medicine and Radiation Biology, University of California, Los Angeles.

Arthur Wallace is Associate Professor of Horticultural Science, University of California, Los Angeles.

Evan M. Romney is Assistant Research Soil Scientist in Nuclear Medicine and Radiation Biology, University of California, Los Angeles.

The above progress report is based on Research Project No. 851, in cooperation with the Department and Laboratories of Nuclear Medicine and Radiation Biology, School of Medicine, University of California, Los Angeles.

Research on chlorosis in Germany and Venezuela was conducted by W. S. Iljin.