BREEDING PLANTS FOR BOLL-WEEVIL-INFESTED REGIONS.

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OBJECTS IN VIEW.

The earlier any variety of cotton is the less it is injured by the boll weevil. The early varieties already existing have very small bolls and short coarse lint. They also drop their seed cotton easily and are thus very unsatisfactory for general culture in Texas, where big-bolled storm-proof types with fine staples of good length are still the favorite types, in spite of the fact that they mature more or less late.

The Plant Breeding Laboratory of the Department of Agriculture is striving to overcome the defects of the present varieties by breeding new types which combine in a greater or less degree the qualities of earliness and yielding power with the production of large bolls and good length of staple, as well as types which may for causes other than earliness be less susceptible to injury from the weevil.

SELECTIONS FROM EARLY VARIETIES.

We have selected King and other early varieties for longer staple and larger bolls, and at the same time increasing earliness and productiveness. Selections of early plants of King made in 1903, in 1904 gave progeny, which as a whole, had open bolls five weeks earlier than the select plants of the preceding year. Making allowances for difference in time of planting and character of seasons, this showed a marked gain in earliness. In 1903 the select plants were about a week earlier than ordinary plants in the same ground. In 1904 the progeny, as a whole, was fully two weeks earlier than ordinary plants and contained many individuals still earlier.

These early plants were also selected for productiveness. In 1903 the 65 selected plants averaged 94 grams of seed cotton to a plant. In 1904 the 83 very best selected plants averaged 196.9 grams to a plant. A part of this increased production was due to better season, better cultivation, and greater distance between plants. The weevil conditions were the same during both seasons.

We have also tried to increase the size of the boll. In 1903, 42 plants averaged 4.53 grams seed cotton to a boll. In 1904, 82 plants saved from the progeny of the 1903 selections averaged 4.84 grams. This gain might have been much larger if we had worked for size of boll alone, but we endeavored to retain earliness as well. These two qualifications are to a certain extent antagonistic. The 7 largest-bolled plants in this series averaged nearly 6 grams to a boll.

The great fault of King is its short staple. In 1903 only a few plants among many thousands were found having a $1\frac{1}{2}$ -inch staple. In 1904 among the progeny of some of these a number of plants were

found with a $1\frac{1}{8}$ -inch staple and a few with nearly or quite a $1\frac{1}{4}$ -inch staple.

• EARLY BIG-BOLL SELECTIONS.

We have also been making selections from the native large-boll storm-proof types to secure new storm-proof types with fairly large bolls and good staple which will also be early. In other words, we are introducing the quality of earliness into the favorite Texas cotton, possibly with some decrease in size of boll.

In 1903 I selected from a field of mixed cotton 47 large-bolled plants that seemed unusually early. The average yield was 121 grams of seed cotton to the plant, and 7.26 grams to the boll.

In 1904 about half of these plants reproduced in their offspring the characters of large bolls combined with earliness. From these offspring I selected 205 plants whose average yield was 250.5 grams of seed cotton to the plant and 7.52 grams to the boll. Among these plants are three different types which give every evidence of being most valuable for Texas conditions.

One of the 1903 plants yielded 135 grams of seed cotton and averaged 7.8 grams to boll. From this in 1904, 227 plants were grown. These began to open bolls in the same week with King planted in the same field only a few days later. The 25 plants saved as individuals from these averaged 250 grams of seed cotton to the plant and 7.1 grams to the boll. This was in spite of the ravages of the boll weevil. Furthermore the staple averages $1\frac{1}{8}$ inch in length.

RESULTS FROM HYBRIDIZATION.

Some of the most promising results have been obtained by hybridizing certain standard upland varieties. The progeny of one hybrid of the early King crossed with the long staple Allen was fully as early as King grown in the same field and also had fine staple $1\frac{3}{8}$ inch in length. Another series of hybrids of King and the large-bolled Russell produced plants nearly as early as King with fine large bolls and very productive. Several hybrid families of the long-staple Allen with the smooth-seeded Mattis are exceedingly productive and have long fine lint. Other combinations give more or less promise.

SELECTION FOR FOLIAGE CHARACTERS.

Varieties with sparse open foliage furnish less protection to the weevil and may escape injury to some extent. We have some interesting selections made with this end in view. Before the Civil War, a variety known as Okra with deeply cut narrow-lobed leaves was grown, but it has entirely disappeared from cultivation. Rarely reversions to this type appear in fields of ordinary cotton. Three such plants were found in 1903 and planted in 1904. Every plant of the progeny reproduced the foliage character of the mother plants. The

persistence of the type is quite remarkable inasmuch as it must have been continuously crossed with ordinary kinds for many years.

I also selected from the King and Shine varieties a number of plants of a peculiarly tall, slender, open habit, with few leaves and producing almost no shade. The same peculiar character was reproduced to a greater or less extent in about half the progeny the following year.

The value of these two types is as yet uncertain, but the experiments show that such varieties can be produced and are at hand for cultivation in case they are found to escape injury to any radical extent.

Some attention has also been directed to hairiness of stem and leaves owing to the difficulty which the weevil experiences in climbing over them; also to texture of boll-covering, and several other points. However, the transmission of these characters to progeny has been less successful in our experience so far.

The character of foliage and shape of plants seems to be the most readily and uniformly inheritable characters of the cotton plant. In straight selection work with ordinary plants it is generally the case that all the progeny of a plant closely resemble each other in these characters.

MOST PROMISING LINES OF WORK.

The most promising line of work in cotton-plant breeding is the crossing together of good upland varieties. It is of as much importance to select carefully individual parents for hybridizing as in straight selection work, (1) because of the improvement due to selection alone; (2) a defect in one parent otherwise very desirable can often be counterbalanced in the other, insuring more progeny combining desired characters in correct proportions.

I have also found it desirable in making any given combination to cross together bolls from a number of different plants rather than the same number confined to a few plants. I have found progeny from one pair of parents worthless, while that from another of apparently no better individuals of the same two varieties produced very valuable plants. The larger the number of individuals combined the greater the chance of securing valuable progeny from some of them.

The variations induced by crosses between upland varieties are not so excessive but that the new combinations can be fixed in three or four generations at most. Such crosses greatly increase the productiveness of the plants and are often valuable for that reason alone, aside from other results.

Ordinary selection work with cotton is almost as promising as work in hybridization. Cotton is sufficiently variable so that earlier, more productive, and otherwise valuable strains can easily be developed from any given variety. In straight selection work the embryo variety is approximately fixed at any stage and can be multiplied in sufficient quantity for distribution at almost any time.