

THE COTTON VARIETY IMPROVEMENT

JOHN H. TURNER

SINCE 1953-54, when a careful study was made of the cotton crop as well as grower and consumer needs, and the climate in the San Joaquin Valley, research at the USDA Cotton Research Station, Shafter, has been directed toward the following goals:

1. Development of a strain of cotton that retains more of its mid-season flowers, thus reaching the stage of maturity necessary for machine harvesting at an earlier date.

2. Improvement of fiber and seed qualities. Trends in the manufacture of textiles indicated higher-strength cotton would be required if spinners were to continue using it on their looms. Seed research should include elimination of gossypol, increased oil and ammonia content, improved germination and seedling vigor.

3. Development of disease resistance in future strains. Tolerance to Verticillium wilt is only a stop-gap measure. Resistance to seedling diseases, wilt, and other diseases should be an important part of the breeding program.

4. Development of tolerance to insects, nematodes, and adverse growing conditions, such as alkalinity, and extreme temperatures.

5. Improvement of stalk erectness, fruiting-vegetative balance, and boll, seed and fiber features to withstand mechanical harvesting, modern ginning, and processing machinery.

Phases of research

Varietal improvement in the current program involves several phases. First, screening and genetic studies are used to identify useful germ plasm and to determine the inheritance pattern for new traits. Strains and genetic stocks from

around the world have been obtained; and, in turn, locally developed lines are shared with students of research elsewhere.

The more useful lines from the screening and genetic studies are then crossed with the most advanced breeding lines—and reselected. In just a few years, it is possible to determine whether the incorporation of any new trait is feasible. Breeding techniques and hybrid potentials for cotton are under continuous study. Variety composition and means of seed increase have also received attention. Standards to evaluate fiber quality have needed constant revision as new instruments are developed.

First generation hybrids are grown at Iguala, Mexico, in a winter-time nursery, thus providing second generation lines rapidly. Thousands of plants and progenies are evaluated and harvested each year in the breeding nursery. Data are obtained in the ginning and fiber laboratories for plant selections. Spinning data are obtained for promising progenies. Only the best 5% to 10% ever move from the breeding nursery to testing and seed-increase plots.

A yield test of from 30 to 50 promising lines taken directly from the breeding nurseries is conducted on small plots each year. This first-stage testing serves as a further screening process. Based on the agronomic and quality performance data, inferior lines are eliminated. Then, sample test sites are selected throughout the San Joaquin Valley. Preliminary strain testing ranging from 10 to 25 entries, includes the best lines from the previous year's test, plus experimental composites of such lines. The next stage of Valley testing is called the advanced strains test, including the best entries

from the previous year's preliminary strains test and usually consists of four to eight entries. In all these stages of testing, the current variety is used as the check. At this advanced stage of testing, the cooperation of spinning laboratories and commercial textile mills has been valuable in determining the potential market acceptance of promising new Acala strains. Only the strains equal or superior to the Acala 4-42 check are used in further tests. The final stage of testing is a variety test, comparing introduced varieties with the current variety and the one or two advanced strains most likely to replace the current variety check.

Double check

One additional Valley test has served to double check previous decisions. The Acala 4-42 models test has been conducted since 1954, in which the two forthcoming planting seed models are

CALIFORNIA AGRICULTURE

Progress Reports of Agricultural Research, published monthly by the University of California Division of Agricultural Sciences.

William W. Paul *Manager*

Agricultural Publications

Jerry Lester *Editor*

Peggy Anne Visser *Assistant Editor*

California Agriculture

Articles published herein may be republished or reprinted provided no advertisement for a commercial product is implied or imprinted.

Please credit: University of California
Division of Agricultural Sciences.

California Agriculture will be sent free upon request addressed to: Editor, California Agriculture, 207 University Hall, 2200 University Avenue, Berkeley, California 94720.

To simplify the information in California Agriculture it is sometimes necessary to use trade names of products or equipment. No endorsement of named products is intended nor is criticism implied of similar products which are not mentioned.



PROGRAM

The U. S. Cotton Research Station at Shafter is the focal point for research on cotton variety improvement by USDA researchers with the cooperation of University scientists. This continually expanding research has already improved techniques for testing and seed multiplication, widened the genetic base of the material being used, increased yield and quality of Acala 4-42, and developed new Acala strains. Future basic research in genetics, breeding methodology, and gene transfer phases is aimed at reducing costs for producers and transforming California cotton fields into efficient, factory-like operations.

compared with current seed and the past year's model. This gives the industry a preview of what genetic differences to expect for the following two years, while pure seed of these models is being increased. The latest release may always be withdrawn if data indicate the necessity. Major commercial varieties have been evaluated in Valley tests. No introduced variety has equalled Acala 4-42 in yield, and only the New Mexico Acala strains have matched the Acala 4-42 quality.

Growers are chosen as cooperators in each zone of the Valley by the Extension Service farm advisor who is best acquainted with soil types and local conditions. In most cases, the chosen sites are used for a three-year period so that data on a strain's performance for that zone of the Valley will be more meaningful. The grower follows his normal cultural practices with the test plot. Constant visits by the research staff provide the necessary agronomic evaluations.

Testing at all these stages is conducted annually. The data obtained from these tests provide essential information for the annual choice of the best strain of Acala to release as foundation seed. After two years of increase by the seed distribution organization, the same model of planting seed (called "Green Tag") is available to all San Joaquin Valley growers.

Advance

Some of the important advances made in this variety improvement program over the past 15 years include:

1. The 1954 model of Acala 4-42 was the first wilt-tolerant strain reaching Valley growers. Test data indicated seeds from this model gave higher lint yield than previous models of Acala 4-42.

2. Tests initiated in 1954 have produced data to help the breeders choose component lines for use in the foundation seed releases. As a result, yields, gin turnout, wilt tolerance, and fiber quality have been increased. This was accomplished by elimination of certain lines and reselecting within lines to improve specific traits.

3. Results from Acala 4-42 models tests indicate that genetic gains have ranged from 18% to 30% for yield and 8% to 17% in fiber quality since 1953. State Crop Reporting Service records show yield-per-acre increases far exceed the estimated genetic gains. Actual gains in yield reflect improved grower practices plus genetic gains. Testimonials and premiums paid by textile mill operators substantiate the quality improvements.

4. Methods of testing and seed increase have been improved. Hybrid vigor in cotton has been studied, but hybrid cotton production awaits further investigation. Planting seed from multiplication blocks from different areas in the Valley has been tested. There were no performance differences regardless of where the seed was multiplied.

5. Hundreds of introduced seed stocks from around the world have been screened at Shafter, Clovis, Chowchilla, Tulare, and Firebaugh. This has provided information as to what cotton lines to use in breeding for the specified goals. These screening studies have been especially helpful in revealing sources of early maturity, stalk erectness, and disease tolerance.

6. At least two new Acala strains have shown considerable promise of replacing Acala 4-42. They retain more mid-season fruit, maintain more erect plants, and permit earlier machine harvest. Also,

these strains appear to be less sensitive to untimely or excess applications of fertilizer and water.

7. Genetic sources of tolerance to wilt, nematodes, and mites have been identified and are currently being used in breeding.

8. Two strains of glandless cotton (free of the toxic compound, gossypol) have been developed in this program, and seed is currently being increased and tested throughout the Valley.

Program plans

The current program has been expanded to make sure all zones of the San Joaquin Valley are being served with the best possible varietal releases—which will also speed up production of variety improvements needed for the future. Breeding, screening and testing will continue, along with special qualities to provide volume lint for commercial mill evaluation of spinning quality. Also, researchers are concerned with cost reduction for the producer and increasing quality to maintain consumer preference for cotton. California cotton fields must be transformed into efficient, factory-like operations. To accomplish these goals, more basic research is needed in genetics, breeding methodology, and gene transfer phases. Cooperative investigations with researchers in other disciplines continue to help speed such varietal improvements.

John H. Turner is Agronomist-in-Charge, CRD, Agricultural Research Service, USDA Cotton Research Station, Shafter. He is also a Research Associate in the Agricultural Experiment Station, Department of Agronomy, University of California, Davis.