II. UTILIZATION & BREEDING

Numerous successes in plant breeding testify to the vital importance of genetic resources in practical agriculture as well as in basic research. Even the most academic classification of plant collections or description of biochemical genetic traits potentially has some practical value in crop development programs.

Cotton germplasm development

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Few people envision California as a "cotton state." But for most recent years it has held second place (to Texas) in national production and three years ago was first.

California is the only state with a "one variety" law: cotton grown in the San Joaquin Valley, where most of the state's annual 2½ million bales are produced, must be of the Acala variety. This is a medium-long, high strength cotton. Producers in the southern desert regions of the Imperial, Coachella, and Palo Verde valleys are exempt and chiefly use the varieties of the southeastern states.

Cotton, *Gossypium hirsutum*, was introduced to the state in the early 1900s. Impetus for its establishment as a crop came from the production losses in the South to the boll weevil, and from fabric demands created by World War I. However, for most of its early years the fiber of western irrigated cotton was considered too "soft" and brought a discounted price.

Through a series of varietal improvements achieved by United States Department of Agriculture scientists at the U.S. Cotton Research Station, Shafter (founded 1921), California cotton today brings a premium price for its quality, and yields are among the highest in the nation.

The one variety law, implemented to stabilize quality by preventing varietal mixing in the field and in planting seed at the gin, placed responsibility for improvement of the Acala lines with the U.S.D.A. group. Related work in adaptability, pest control, and cultural aspects has been in collaboration with UC researchers and Cooperative Extension staff.

The original Acala germplasm came from Chiapas state in southern Mexico in 1906. It was found by federal plant explorers searching for germplasm resistant to the boll weevil. Subsequent improvements of early Acala in Texas, New Mexico, and California produced a series of varieties known for superior fiber and spinning qualities and adaptation to the irrigated Southwest. Acala cotton was first grown in California near Bakersfield in 1919. Several different Acala breeding lines were introduced into the state about this time and from these lines varietal

releases were made to the growers. Subsequently, selections were made from P12, one of the original introduced Acala lines, and these became the Acala varietal releases for several years. Selections from P12 culminated in P18C.

Verticillium wilt, since its discovery in California cotton in the mid 1920s, has become increasingly severe. In 1949, P18C was replaced by Acala 4-42, a variety with 20 percent greater fiber strength and greater Verticillium wilt tolerance. The Verticillium wilt tolerance of Acala 4-42 was improved through reselection after its release, with a highly significant improvement occurring in 1954. In 1967, workers at the Shafter station evolved Acala SJ-1, the first of the SJ series. This variety performed better on wilt-infested and non wilt-infested soils than Acala 4-42.

Breeders and geneticists at Shafter have worked to develop agronomically sound strains of Acala having all presently known desirable traits such as high quality fiber and seed traits; disease, nematode, and insect resistance; earliness; high yield potential; and good seedling vigor. New or more desirable traits obtained by crossing are transferred to Acala parents, followed by rigid reselection for Acala types.

Genes from several different sources have been gathered (introgressed) into the Shafter germplasm. Acala 4-42 was developed from selections taken from New Mexico Acala 1517, an offspring of the original Mexican introduction. These selections gave rise to several biotypes, which by reselection produced further improvements. Missdel 4, a Mississippi Delta type, was crossed to Acala P18C and the progeny to Acala 29 (New Mexico Acala), yielding A51. A51 was crossed to THEF triple hybrid material, leading to Acalas SJ-1 and SJ-2.

The THEF material had been developed in the following way. TH or triple hybrid refers to the *Gossypium aboreum* x *G. thurberi* x *G. hirsutum* interspecific hybrid. TH was crossed to EF (Early Fluff), which had been developed for high yield and earliness. A THEF progeny crossed to A51 gave rise to AxTE-1 which was later crossed to New Mexico Acala 1517D to produce Acalas SJ-1 and SJ-2.

The newer SJ-4 and SJ-5 were developed through a different route. Hopi Meoencopi, a primitive cotton cultivated by the Hopi Indians in Arizona, was crossed to a Santan Acala in Arizona. Subsequent backcrossing of this material at Shafter to Acala types gave rise to Acala-Hopi-Acala (AHA) lines. One of these, C6-5, crossed to THEF, gave rise to the C6TE line. C6TE was crossed to New Mexico Acala B3080 to draw from its high level of Verticillium wilt tolerance and excellent fiber properties. The subsequent Acala SJ-4 and Acala SJ-5 yield 20 percent more on wilt-infested soil than their predecessors.

Germplasm resources have been used to improve seed characteristics and pest resistance. *Gossypium* varieties normally have dark pigment glands containing gossypol on most plant parts and in the seed. Gossypol, a toxic substance, limits the use of the seed meal, especially for non-ruminant animals. Reselection of lines within the AHA types has produced a glandless cotton free of gossypol; the seed meal can be used as a protein source in human nutrition. The glandless trait has been transferred to Acala. The low seed gossypol of Acalas SJ-4 and SJ-5 may have been contributed by their AHA parentage.

In search for resistance to the lygus bug, which destroys cotton flower buds, 618 cottons have been screened. The most promising source appears to be the extra floral nectariless character found in *G. tomentosum*, a wild Hawaiian species. This trait has been transferred to *G. hirsutum* and is being transferred to Acala breeding lines.

Three sources of root-knot nematode resistance are: a commercial *G. hirsutum*, a wild *G. hirsutum*, and a wild *G. barbadense*. Resistance is being transferred to the Acala background.

Earliness, a highly sought trait in cotton, is being improved in Acala with genetic sources from breeding programs in Texas.

Practically all traits involved in developing an agronomically sound cotton are under quantitative control. The transfer of a new trait usually adversely affects a well-balanced cotton. Usually several years of work are involved in backcrossing and selection to the desired type, to make corrections.

Many new crosses are made each year to broaden the genetic base of the Acala germplasm developed at Shafter.

In the past the Shafter program has made use of the world collection of cotton maintained by the ARS-USDA and State Experiment Stations. Greater use of this germplasm is now being made in the California program in the search for pest resistance and other desirable characteristics.

It usually takes years to transfer a trait from a wild to an agronomic cotton. Exchange of material among cotton breeders eliminates the need for starting with a primitive cotton to obtain desired traits, and is another very important source of germplasm.

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