

PROGRESS REPORT ON THE AVOCADO BREEDING PROGRAM AT UCLA

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Anticipated changes in the scope and nature of research on the avocado at the University of California, Los Angeles, warrant at this time a report on one aspect of these investigations, namely the avocado breeding program. The pressure of space requirements for buildings and parking on the campus has necessitated marked reduction in plantings and orchard collections and will eventually eliminate a considerable portion of such areas. In view of these actual and anticipated progressive changes in physical facilities, the program of field work associated with the avocado breeding project has been transferred gradually during the past three years to the Department of Horticulture at Riverside, where the responsibility for its continued maintenance and development has been assumed. The extensive progeny plantings, selections and breeding materials which had been developed or assembled at Los Angeles now have been relocated at the Citrus Experiment Station at Riverside or at the South Coast Field Station, Orange County. A brief report of the accomplishments of the program, the developments which have resulted from the work conducted at Los Angeles, and the present status of the materials which have been involved in this project is herewith presented.

The foundation for the avocado breeding program at Los Angeles was developed in the Department of Subtropical Horticulture at the request of the avocado industry about 1936. Professor R. W. Hodgson initiated at that time the first collections of diverse and extensive variety materials and of all available *Persea* species for the anticipated hybridizations. These varietal collections were established primarily as "canned" trees grown in large movable tubs or boxes to facilitate their placement in screened houses for cross-pollination by bees. Formal breeding work was begun in 1939 by Dr. W. E. Lammerts, whose basic original crosses are presently being observed and utilized. Some of these early crosses are now under field test. Crosses with Fuerte as one parent or with parents of diversely different parents were made with the objective of obtaining Fuerte-like progeny with the added characteristic of more dependable bearing behavior and extended season. The details of these early crosses and techniques utilized in securing the hybrids are described in several progress reports (8, 9, 10, 11, 12).

The objectives of the program were primarily to develop new and better commercial varieties to replace those now grown and to develop disease resistant rootstocks on which the commercial varieties could be grown.

The practicability of improvement through avocado breeding has been clearly indicated in the several reports which describe the progenies from the specific crosses. The potential utilization of the information acquired in the early crosses has afforded an opportunity to avoid costly mistakes in time and effort through proper selection of pollen and seed parents and through other field techniques. The project likewise has revealed some of the very unusual difficulties involved in avocado breeding in comparison with breeding programs of such fruits as peaches, pears, plums, etc. The major obstacle was demonstrated to be the comparatively small returns which could be realized from carefully controlled hand pollinations in the avocado. Whereas in peaches hand pollinated flowers may be expected to yield from 90 to 100 per cent seed, the same technique used on the avocado may provide one seed from a hundred flowers or in extreme cases only one seed from 1,000 or more flowers. Sometimes controlled hand pollination may provide a slightly higher percentage return. Regardless of these difficulties, however, it is clear that persistence and effort will ultimately produce desired progeny of the quality and quantity needed by the industry. Such progenies now have been produced and studied and selections have been made for trial and future breeding.

In addition to progeny materials, other tangible results have been forthcoming from studies associated with or involved in the actual breeding work. A considerable amount of information has been acquired concerning the floral development and behavior of the avocado, as this affects fruit-set and development (1, 2, 3, 17). Detailed studies concerning pollen production and aspects of the pollination phenomena as related to fruit-set have indicated that lack of pollination probably is not a limiting factor in fruit-set in most instances (13, 20, 24).

Cytological studies which are imperative for an intelligent approach to certain aspects of the breeding problem have revealed the basic chromosome numbers and behavior in avocado and its near relatives which should assist in planning future hybridization investigations (4). The use of colchicine and of irradiation from cobalt sources to induce mutations in the present gene populations of the avocado have been explored briefly (5, 6). The ultimate results of these trials should be of general interest.

The development of interspecific crosses (4) is not only of considerable theoretical interest but may prove highly valuable in synthesizing new varieties with potentially desirable characteristics in the future.

Upon resumption of normal travel facilities following World War II the University began a series of plant explorations into Mexico, Central and South America specifically to collect avocado materials for the breeding program. The first foreign exploration made in 1947 by the Department of Subtropical Horticulture resulted in the introduction of **Persea floccosa**, a wild form of avocado growing near Mt. Orizaba in eastern Mexico. Subsequent short visits and some extensive exploration trips to other parts of Mexico, Guatemala, El Salvador, Honduras, Costa Rica, Peru and Ecuador (16, 18, 19, 21, 22, 25, 26, 27) have been responsible for the introduction of new species, botanical relatives, and varieties which have been utilized in the breeding program or which will be available for use in the future.

Recent introductions of selected varieties from foreign sources for use directly in

California have proved highly disappointing. On the other hand, the use of imported and introduced materials for rootstocks directly or for the breeding of new rootstocks which show resistance or immunity to the **Phytophthora** organism has been much more encouraging and promising. The progress in this aspect of the project is set forth in several reports (7, 31, 32, 33, 34).

Comparable to the results of other plant breeding endeavors, many crosses of avocados have been made, extensive observations of the progenies have been recorded, but only a few from any given cross selected for further trial and observation. A goodly number of the selected hybrids produced in the Los Angeles program now have been considered of sufficient promise and value to be given additional field trials in Ventura County, East Highlands in San Bernardino County, at the Citrus Experiment Station, the South Coast Field Station, and with private growers in San Diego County and in the San Joaquin Valley. Such trials under rather favorable and in some cases unfavorable environmental conditions should provide an indication of their commercial worthiness within a few years. Twenty-three selections of crosses made at U.C.L.A. from 1943 to 1953 are now under observation in the above mentioned areas. While each selection is known at present merely by a progeny number, the parentage has been recorded under that number. If such selections prove worthy these will later be given formal variety names. Some of the parentage represented in these selections are Hass, Fuerte, Anaheim, Duke, Mexicola, Zutano and Dickinson, either self pollinated in various combinations, and in two cases as interspecific crosses with the prolific bearing **Persea floccosa** as one parent. These latter crosses should be of extreme interest to the plant breeder and may prove of considerable value as a commercial variety if the characteristic of prolificness can be maintained in the hybrid.

The variety Hass has proved itself to be highly satisfactory under a wide range of environmental conditions. It is, however, somewhat more tender to low temperature conditions than is desirable; hence an attempt has been made to incorporate the characteristic of hardiness into the clone by crossing Hass with Fuerte, **P. floccosa**, or Zutano. Selections from such crosses are now among the twenty-three being tested.

While it is not feasible to present herewith a detailed report on the characteristics of the several hybrids under study, it is sufficient to indicate that these have shown outstanding bearing behavior in limited trials and of adequate and high fruit quality as judged by competent growers and experienced investigators to warrant additional trials in other areas and in greater tree numbers.

It appears appropriate at this point to acknowledge the invaluable cooperation, encouragement, and good judgment of the late J. N. Thille of Santa Paula, on whose property the potentialities of most of the aforementioned hybrids were first ascertained. Under his expert care and supervision, the selected progeny materials were provided an optimum environment for a preliminary trial. Utilizing his excellent judgment of the characteristics of a desirable commercial variety, most of the selections were made for further trials both on his properties and in other areas. For such values as may be eventually realized from this aspect of the avocado breeding project, California will be forever indebted to our late good friend and counselor.

This brief report is presented merely to indicate the present status of the avocado

breeding program at U.C.L.A. While the field aspects of the program have been relinquished to the Riverside Experiment Station of the University, studies on certain basic aspects of fruit-set and development as related to pollination, embryo development, morphological development of the fruit and related phenomena will be continued at Los Angeles though not specifically under the breeding project. It can be stated that considerable tangible and intangible results of the breeding project have been realized irrespective of physical limitations in some instances. The future of avocado breeding appears reasonably assured of success based on the partial results which have been achieved thus far.

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