

CURRENT AVOCADO RESEARCH ON THE LOS ANGELES CAMPUS

Robert W. Hodgson

*Assistant Director of the California Agricultural Experiment Station,
University of California, Los Angeles.*

Introductory Statement

Avocado research on the Los Angeles campus dates back to the spring of 1933, the Division (now Department) of Subtropical Horticulture having been transferred from Berkeley during the fall of 1932. The first investigation begun was concerned with a study of the bearing behavior and characteristics of the Fuerte variety and of possible ways and means for overcoming its erratic and generally unsatisfactory performance.

At the present time, the departments concerned with research on the avocado are Subtropical Horticulture and Entomology. Some 15 or 20 staff members and graduate students are currently involved in the avocado research program. The long-ago requested, and now imminent, South Coast Field Station will make possible substantial expansion in avocado research and plans are now actively underway to establish research plantings there at the earliest practicable time.

SUBTROPICAL HORTICULTURE

Search for and Introduction of Avocado Species and Relatives: The exploration for and introduction of avocado species and relatives, begun many years ago, has actively continued and a number of promising materials have been received during the past year and others are expected in the near future. The primary objective of this program currently relates to rootstock materials resistant or immune to the root rot disease. Other objectives include breeding materials for the development of desired rootstocks or varieties and dwarfing rootstocks.

Countries from which materials have been obtained during recent years include Mexico, Guatemala, Honduras, Peru, Chile, Brazil, the Virgin Islands, the Canary Islands, and Israel.

Propagation: Rootstock Clones. In connection with the root rot problem, the importance of being able successfully to propagate rootstocks under old trees which have exhibited resistance is obvious. As a result of a number of years of study a successful, though tedious and expensive, method has been developed whereby it is now possible to propagate such rootstocks and thus to recombine scions and rootstocks which have proven to be either resistant to the root rot disease or unusually productive in comparison with surrounding healthy trees. This is the so-called "piece-root-graft" method.

This method has numerous disadvantages, however; as a consequence of which efforts are now being concentrated on study of ways and means for causing latent buds to develop and of inducing the development of adventitious buds on old avocado rootstocks and roots.

Nursery Problems

The old problem of the shedding of bud "eyes" during the summer months is currently under investigation. The objective is to discover the factors which contribute to the abscission and to find practical means for preventing it.

Pronounced seasonal and varietal differences in success of tip-grafting have been noted; Hass and MacArthur giving notably poor results during the summer months. Cold storage of scion wood has given better results with Fuerte than with Hass. A study of the seasonal and storage changes which occur in Hass scion wood is therefore now underway.

Rootstock-Scion Compatibility:

As rapidly as they can be propagated in adequate numbers, the rootstock-scion compatibility relations between introduced species and relatives is being determined. To date, all forms which have shown resistance or immunity to the root rot organism have proved to be incompatible as rootstocks for commercial varieties. It is suspected that the use of intermediate stem pieces may prove to be useful in this connection.

In the hope that they will contribute to a more exact understanding of the physiological nature of rootstock-scion relations and influences, studies of a bio-chemical nature have recently been undertaken to investigate the influence of rootstock upon inorganic nutrient balance, synthesis and accumulation of organic and amino acids, enzyme activity, respiration, and foliar transpiration.

Tree Physiology: Root Growth.

A study of avocado root growth, in relation to temperature, was recently undertaken. Under controlled conditions, the influence of root temperature on top growth will be made, using seedlings and cuttings of the different races and major varieties. Employing cuttings, the influence of root temperature on flowering will also be studied. The general objective of this study is to determine the cardinal temperatures for avocado root growth and temperature interactions.

Nutrition

For some years past, studies have been underway on lime-induced chlorosis and promising results have been obtained from the use of various iron chelates. Within recent months, a number of new chelating agents have been tested in the glasshouse and laboratory. These tests indicate that some of them are likely to provide satisfactory

results at field applications considerably smaller and more economical than anything yet developed.

Attention is currently being concentrated on laboratory studies on the mode of action of iron chelates in the soil and plant.

Fruit Morphology and Physiology: Anatomical Studies.

A study of the avocado fruit, with particular reference to oil cell formation and distribution as related to variety, season, and fruit size, is currently underway. A similar study on corkiness of the rind or skin, as related to developmental anatomy and environmental conditions, is also underway.

Physiological Studies

The characteristics of avocado fruit growth, both general and developmental, have been under study for sometime past. It has recently been established that the avocado fruit is subject to diurnal size fluctuation during a considerable part of the growing season. Possible relations between this fact and the occurrence of rind blemishes and corkiness are under study.

The ability of avocado fruit tissues to continue to grow *in vitro* has been established and may possibly provide a valuable tool for the study of numerous anatomical problems related to fruit development and involved in respiration and other physiological processes,

Post-Harvest Physiology

In connection with the long-established and important research program on the post-harvest physiology of avocado fruits, a significant and highly important recent development was discovery of a hitherto unknown relationship between temperature and fruit ripening (softening). It has been found that Fuerte fruits, subjected to moderately high atmospheric temperatures immediately following harvesting, fail to soften satisfactorily and develop browning and general discoloration. It is now clear that for satisfactory ripening Fuerte fruits should be held at moderate temperatures only (65 to 72 degrees Fahrenheit).

In connection with the studies in question, it has also been shown that ethylene gas accentuates the effects of high temperature. It now seems clear that ethylene, applied at lower temperatures, may be helpful in causing more rapid and uniform softening of early season fruit. A concentration of ten parts per million for 24 hours may be sufficient for maximum effect.

For some years past, controlled atmosphere storage studies of Fuerte fruits have been underway. The most recent and promising development has resulted from the use of 5 to 10 per cent carbon dioxide in combination with 5 to 10 per cent oxygen in the storage atmosphere. This combination, in nearly all cases, has extended the storage life of the fruit by 100 to 200 per cent. Additionally, the fruit lasted longer and softened

satisfactorily when removed from storage.

Basic studies of the enzyme systems in the avocado fruit have resulted in the development of a technique for such studies, which has focused attention on the avocado as a source of certain highly interesting and important enzymes. These studies have been conducted with isolated mitochondria, which are exceedingly small particles in the plant cells that are barely visible by the use of the light microscope, and have demonstrated the presence of a number of enzymes which physiologists recognize as highly important in life processes.

Pollination and Embryo Culture:

Studies are continuing on factors which affect the efficiency of pollination and the development of the pollen tube.

Primarily for the purpose of salvaging potentially valuable hybrids which otherwise may be lost because of natural fruit drop, embryo culture studies, employing immature avocado seeds, are now being conducted. In connection with these studies, efforts are being made to determine the environmental factors which control embryo development. This work is being done *in vitro*.

Breeding:

The avocado breeding program, initiated in 1938, continues to receive much time and attention. A limited number of selections from earlier crosses have been propagated for field trial. Other selections have been made for back-crossing. A large number of seedlings of known hybrid origin are currently under field trial, having been top-worked into orchard trees made available by cooperators.

Several inter-species hybrids have been produced, in efforts to combine rootstockscion compatibility and root rot resistance, none of the crosses, with immunity to the root rot disease, has been successful to date.

It is now planned to devote particular attention to the factors involved in flower bud induction, flowering, and fruit-set, for it is recognized that inadequate information concerning these subjects constitutes an important limitation to progress in the breeding program.

ENTOMOLOGY

For many years past, the Department of Entomology has successfully developed adequate control measures for the insect pests of the avocado tree and fruit. With minor exceptions only, these have been maintained under satisfactory control.

The current research program of the department is confined, largely, to two cooperative projects; one with the Department of Biological Control (Riverside), and the other with the Department of Plant Pathology (Riverside).

For several years past, in two commercial orchards in Ventura County, annual

applications have been made of a number of standard insecticides. The effects of these have been evaluated by the Department of Entomology for control of insect pests. The effects of the same treatments on the natural enemies populations have been evaluated by the Department of Biological Control. Both have been compared with untreated check plots.

To date, parathion, malathion, light medium oil, and DDT have kept the population of loopers and la tan ia scale lower than that of the checks, but DDT has seriously increased the population of brown mites. Dieldrin and wettable sulphur have greatly increased the population of all three over that of the check plots.

For the purpose of determining the possibility of incorporating fungicides with pesticides to control dothiorella fruit-rot, as well as avocado insect pests, a cooperative experiment with the Department of Plant Pathology is currently under way in San Diego County. Cuprocide has shown promise in the insecticide-fungicide combinations applied in September and October. During the past year, parathion alone resulted in a satisfactory control of the orange tortrix. The other insecticides employed (DDT and standard lead arsenate) satisfactorily controlled the other insects involved.

RESEARCH PLANNED AT THE SOUTH COAST FIELD STATION

The principal fields of research in which expansion is planned at the South Coast Field Station include the following:

1. Introduction of avocado species and relatives.

The establishment of collections of introduced species and relatives to provide materials for research use.

2. Rootstock-scion compatibility.

A study of rootstock-scion incompatibility with the Murietta Green variety. This is a variety of outstanding excellence, in which an incompatibility problem has long been recognized.

A study of the influence of scion clone and rootstock clone on yield in the Fuerte variety. Trees of known high production and known low production will be duplicated, combining the same scion rootstock clones as in the original trees. The four possible scion-rootstock combinations will be made and compared for yield, together with rooted cuttings from the high and low yielding trees.

3. Tree physiology.

A rootstock-scion-environment interaction study is planned to determine environmental effects, such as nutrition, on rootstock-scion relations. This study will involve a factorial arrangement of six rootstocks and six fertility treatments.

4. Breeding.

The availability of land for progeny testing at the South Coast Field Station will importantly increase the effectiveness of the avocado breeding program and make possible its substantial expansion.

5. Insect control.

The departments of Entomology (Los Angeles) and Biological Control (Riverside) plan to continue their cooperative studies in plantings at the South Coast Field Station.