

THE 1996-1997 PRODUCTION RESEARCH PROGRAM

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The Production Research Program for 1997 just may be the most successful one in many years. In past years, progress has been achieved in most of the projects; but useful results for the California Avocado industry were expected in succeeding years. 1997 just might be the year. This report lists the projects that were selected for industry funding through the California Avocado Commission. A brief description, the principal researchers, and the funded amounts are included.

1. AVOCADO BREEDING

California has a 'Hass'—dominant, single variety near-monopoly. This project is an on—going breeding program to develop varieties that are less alternate bearing, earlier or later maturing for season extension, heavier producers of high quality fruit, and more tolerant to insect and spider mite pests. The project also includes work on light management by tree training and pruning. Seeds that will prove to have increased root rot resistance come from this project's breeding program with known tolerant selections.

Project leader: Dr. MaryLu Arpaia. Grant amount: \$55,000

2. AVOCADO CLONAL ROOTSTOCK PRODUCTION TRIAL

Previous research has found or developed rootstocks that are resistant to *Phytophthora cinnamomi* (Pc). This project assesses the horticultural attributes of many of these promising clonal rootstocks beyond their disease resistance. Productivity, fruit quality, and vegetative vigor are three such attributes.

Project leader: Dr. MaryLu Arpaia. Grant amount: \$22,000.

3. DEVELOPMENT OF A PHENOLOGY MODEL FOR CALIFORNIA AVOCADOS

The objective of this project is to collect information on a) root growth, b) root density, c) vegetative growth, d) flowering and fruit set, and e) carbohydrate partitioning for 'Hass' on four root rot resistant clonal rootstocks. The information is being correlated to individual tree yields and leaf analysis. This project may define tree conditions that cause alternate bearing.

Project leader: Dr. MaryLu Arpaia. Grant Amount: \$55,000.

4. IRRIGATION MANAGEMENT OF AVOCADOS

This project encompasses the Number One concern of California's avocado growers. Their water is expensive and often in limited supply. Using low volume sprinklers, this trial has been comparing the interaction of different irrigation amounts (90%, 110%, and 130%, etc.) and irrigation frequency (daily, twice weekly, and once weekly) on overall tree productivity. This may be the final year (fifth) for this all-important project. Very specific recommendations will be forthcoming.

Project leader: Dr. MaryLu Arpaia. Grant amount: \$60,000.

5. GENETIC MARKERS IN AVOCADO IMPROVEMENT

This project succeeds Michael T. Clegg's original avocado project which was the California avocado industry's first "basic" research into the genetic mapping of avocados. One aspect of the first project yielded the genetic markers of each of our major varieties and most promising new ones. The objectives of this second project are 1) to use genetic markers as a tool to supplement on-going research in the avocado rootstock breeding program, 2) to determine which of five varieties is a better B-type pollen source (to improve production of 'Hass' and other A-type flower varieties), 3) to investigate the influence of pollen genotype on maternally-derived fruit quality, and 4) to continue efforts to produce abundant genetic markers that are easily assayed.

Project leader: Dr. Michael Clegg. Grant amount: \$40,000.

6. SALINITY TOLERANCE IN AVOCADO

Perhaps the greatest problem of California's avocado production, and its greatest expense, is the soluble salts in the water used for irrigation. The project's objectives are to 1) evaluate scion effects on the relative salt tolerance of 'Hass', 'Bacon', and 'Lamb-Hass' when grown on moderately salt tolerant and root rot tolerant 'Duke 7', and the two most promising salt tolerant and root rot tolerant rootstocks imported from Israel, 2) evaluate the same scion-rootstock combinations for carbonate tolerance, and 3) initiate a screening program for selection of salt tolerant and carbonate tolerant rootstocks.

Project leader: Dr. David Crowley. Grant amount: \$21,000.

7. BIOLOGICAL CONTROL OF AVOCADO INSECT AND MITE PESTS

The Persea mite continues to cause tree damage and crop loss. There is now a new Scirtothrips sp. wreaking damage to avocado fruitlets. The objectives of this project are 1) to assess the multi-year impact of the predaceous mites *G. annecteus* and *G. helveolus*, including releases under different weather conditions; 2) evaluate the levels of persea mite infestation in which predatory species should be released; 3) exploration for predators and parasites for persea mite and the Scirtothrips sp., and once found evaluate their potential; and 4) work out the life history of the potential predators and parasites and their fecundity, longevity, intrinsic rate of increase, and prey consumption with respect to the hosts.

Project leaders: Drs. John Heraty and Olando Aponte. Grant amount: \$86,000.

8. AVOCADO ROOTSTOCK DEVELOPMENT BY SOMATIC HYBRIDIZATION AND GENETIC ENGINEERING

The avocado industry worldwide has strived for decades to produce true—to—type avocado rootstocks and scion varieties from tissue of the avocado selection itself. In the previous two years of this project, Dr. Richard Litz was able to produce genetically-identical avocado plants from cells of the desired selection. The objectives of this project are to 1) establish hybrids of avocados with root rot resistant avocado relatives *Persea borbonia*, *P. cinerascens*, and *P. pachypoda*; 2) genetic transformation of avocado rootstocks with anti—fungal genes, and 3) development of nuclear somatic embryogenesis as a vegetative propagation method for avocado rootstocks.

Project leader: Dr. Richard Litz. Grant amount: \$36,000.

9. COMPARISON OF DETERMINANT (TOTALLY FLORAL) VS. INDETERMINANT (FLORAL WITH TERMINAL VEGETATIVE FLUSH) SHOOTS

Of the one— to two—million flowers produced annually by an avocado tree, only 0.02% become fruit. So far, this project has confirmed that indeterminate floral shoots are less productive than determinant shoots. Determinant floral shoots have late-opening flowers which set more fruit that survive to harvest. The proportions of specific plant growth regulators are different in the two types of floral shoots. The objectives of this project this year are 1) to identify key factors regulating fruit set in the 'Hass' avocado and 2) to develop methods for improving fruit set in the field.

Project leader: Dr. Carol Lovatt. Grant amount: \$24,000.

10. INCREASING YIELD, FRUIT SIZE AND QUALITY WITH PROPERLY TIMED GA3 CANOPY SPRAYS

Related research by Dr. Lovatt has found that GAS (Gibberellic acid) can alter floral shoot phenology and morphology in different, but predictable, ways including increased yield. Objectives of this project are to continue the initial trial through two more harvests to determine the cumulative affects of the GAS treatments on yield, including fruit size and quality, and on the biennially alternating production habit of the 'Hass' avocado.

Project leader: Dr. Carol Lovatt. Grant amount: \$18,000.

11. NITROGEN FERTILIZATION STRATEGIES TO INCREASE YIELD OF THE 'HASS' AVOCADO

A previous four year study revealed the positive and negative impacts of applying extra nitrogen to 'Hass' trees during key times of the annual phenology of the tree. A double application of nitrogen in November yielded 201 pounds per tree more over the four years of the trial, and extra nitrogen in mid—April, 133 pounds more fruit per tree. Objectives of this new project are to 1) test a strategy of nitrogen fertilization to increase fruit set and yield of 'Hass' avocado without reducing fruit size or quality, and 2) to even out alternate bearing by modifying applications for on— and off—years of production.

Project leader: Dr. Carol Lovatt. Grant amount: \$24,000.

12. BIOLOGICAL CONTROL OF PHYTOPHTHORA ROOT ROT OF AVOCADO WITH MULCH AND BIOCONTROL ORGANISMS

Phytophthora root rot (PRR) now affects over 65% of California groves. Successful control of PRR has been difficult to achieve. The most reasonable approach to managing the disease is a combination of resistant rootstocks, biological control, and cultural methods. The objectives of this project are to 1) locate and collect bio-control agents for the control of PRR; 2) effectively manage PRR using mulch alone, and with biocontrol agents in conjunction with organic mulches; 3) manage PRR using continuous applications of biocontrol agents through the irrigation system; 4) understand how effective populations of biocontrol agents can be maintained in the field; and 5) characterize mechanisms of antagonism against *P. cinnamomi* provided by mulch and biocontrol agents.

Project leader: Dr. John Menge. Grant amount: \$40,000.

13. SCREENING AND EVALUATION OF NEW ROOTSTOCKS WITH RESISTANCE TO *PHYTOPHTHORA CINNAMOMI*

This is the lead project in California to finding a means of living with the *Phytophthora cinnamomi* fungus. Several good selections have been found and created. This continuing project is to find or develop the "truly" resistant rootstock. The current project is designed to collect, laboratory screen, select, breed, and develop avocado germplasm which exhibits resistance to PC. Most selections will be from the Avocado Breeding Program's cross-breeding project with selected resistant rootstocks. Increased field evaluations of past years' candidate rootstocks which will consider horticulture, soils, and productivity, as well as root rot resistance will be stressed.

Project leader: Dr. John Menge. Grant amount: \$98,000.

14. CHEMICAL CONTROL OF AVOCADO ROOT ROT

It is known that California avocado trees infected with *Phytophthora cinnamomi* root rot fungus do not respond very well to chemical applications alone. Nor do cultural practices or resistant rootstocks by themselves give the best response. Dr. Howard Ohr has two trials with integrated control methods using resistance, mulches, mounding, and chemical application (Aliette®). The primary objective in 1997 is to continue treatment and evaluation of the current trials which were designed for maximum response of the trees to treatments at the lowest cost to the grower.

Project leader: Dr. Howard Ohr. Grant amount: \$20,000.

15. AVOCADO POLLINATION IN CALIFORNIA GROWING CONDITIONS

Fruit set in avocados requires pollen to be transferred from male to female flower parts. Even among avocado researchers there is disagreement about fundamental questions. There are little good data on which to base recommendations of methods of managing insect pollinators with regard to density, timing, placement, or attraction. The project objectives for 1997 include 1) assessing environmental factors, 2) determining the different insects that visit the avocado bloom and their method of pollen transfer, and 3) relating the number of bees that provide the best tradeoff between costs and benefits.

Project leader: Dr. KirkVisscher. Grant amount: \$9,000.

16. ANALYSIS OF MONOTERPENES IN AVOCADO FRUIT

Each variety of avocado has unique flavor characteristics. Most avocado eaters feel the flavors of 'Hass' and 'Fuerte' are superior. Other varieties may have better physical characteristics but less desirable flavor. Genetic engineering of many plants is being performed. The avocado industry needs to know the chemistry that characterizes each of the avocado varieties in order to design alteration of their flavors. Terpenes are a major component of flavor. Some monoterpenes act as anti—herbivory compounds in plants to discourage feeding on fruit by insects and rodents. The objective of this project is to begin characterizing the essential oil fractions of avocado fruit mesocarp tissue for different varieties. This could be used for strategies in altering flavor, aroma, and oil content of unripe and ripe fruit. A second objective will be to determine if 1,8-cineole is found in unripe fruit; and if it is, whether it correlates with the unripe fruit being less susceptible to feeding by insects and rodents.

Project Leader: Dr. Kristin Bozak. Grant amount: \$4,000.

The California avocado industry looks forward to incorporating the results from the 1997 Production Research Program into its growers' cultural programs. Increased production of high quality fruit at reasonable grower expense is the overall goal of the program.