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Production Research Accomplishments, 1992-1997

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Good research, by its nature, is often a slow process which carefully provides useful information when the right questions are asked. Those of us who are involved in the oversight of the production research program have worked hard to see that the right questions are being asked and that the right people are seeking the answers. With some pride in the results, this article looks at some of the highlights of your research program.

• Persea Mite

Defoliating trees and sunburned fruit were frightening sights in San Diego County in 1992 and 1993. The spider mite causing this devastation was spreading — as fast as the new avocado thrips is spreading today. Dr. Jim McMurtry, a UC Riverside entomologist already being funded for biological control of avocado pests, added Persea mite to his list of concerns. Later, Bio-tactics Insectary received seed funding from the Production Research Committee to greatly improve the techniques for mass producing the predator mite that Dr. McMurtry imported from Florida. Today, Persea mite is much less a concern in San Diego County. Hopefully this condition will be repeated in Ventura, Santa Barbara and San Luis Obispo counties where growers are now experiencing what San Diego did in the early 1990's. The predator mite *Galendromus helveolus,* and later, *G. annectens,* which was found in Mexico as part of Dr. McMurtry's program, were reared and released in many groves in San Diego, Riverside, and Orange counties. At the same time, studies were conducted on the mite populations in selected groves. Although many groves were sprayed with Omite® or pesticidal oil, most growers adopted biological control programs that allowed the reared predators to thrive, along with the other native, natural predators. For as much as three years some damage was sustained but control without spraying was eventually achieved. There are still hundreds of groves that have never been sprayed with pesticides and are very healthy with a well balanced beneficial complex. Combating the Persea mite continues to be an important focus of ongoing research.

• Zinc is a Necessity

The studies conducted by Dr. David Crowley established an effective and efficient treatment for zinc deficiency. Foliar sprays were shown to be unnecessary, as well as inefficient. Even in calcareous clay soils, Dr. Crowley determined that zinc sulfate, applied through irrigation water at seven pounds per tree was the most effective and least costly treatment to correct zinc deficiency and provided trees with a continuing

source of zinc. He recommends that zinc sulfate be applied all at one time. This treatment should last from three to five years. An acid wash procedure developed by Dr. Crowley proved that most of the zinc applied foliarly was tied up in the waxy surface of the leaves. Zinc sulfate was the most effective foliar treatment when compared to zinc oxide and zinc metallosate. The acid wash procedure is now known to most laboratories conducting avocado leaf analysis — ask for it for more accurate results.

Increased Production

After the low production years of 1989,1990, and 1991, a stated goal of the production research program was, and is, to increase production.

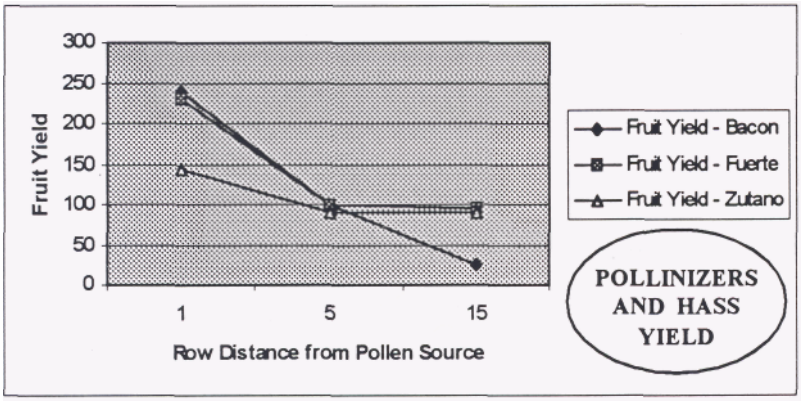
• Genetics and Pollenizer Varieties

Dr. Michael Clegg, a nationally renowned geneticist, was funded to begin the development of the avocado genome map. As part of his genetic mapping, he determined specific genetic identification for most of the prominent varieties — Fuerte, Hass, Zutano, Bacon, Pinkerton — as well as others. At the same tune, industry observations raised the question of whether some varieties could increase Hass production as cross pollenizers. Dr. Clegg had the tools to determine the parentage of Hass fruit. Initially he would do this on heavily set Hass trees close to other varieties such as Zutano, Bacon and Fuerte. Were these other varieties the male parent of fruit on those heavy producing trees? Or was Hass both the male and female parent, as is the case in Australia where good production occurs in large areas where Hass is the only variety present.

Preliminary tests were conducted on fruit from some of the high producing Hass trees next to a Zutano, a Bacon, and a Fuerte. Sure enough, 80% to 100% of this fruit had a male parent of one of those varieties. These were not conclusive tests, but only indicators upon which to base a hypothesis.

Rather than establish new plantings to test these observations, the decision was made to find existing plantings with mature trees where pollenizers were present. UC Farm Advisors helped to find ten locations from Temecula through Santa Barbara with inland and coastal climates.

As the graph below indicates, there is a definite increase in Hass production when pollenized by Fuerte, Zutano or Bacon varieties; the closer to the pollenizer, the higher the production. In the inland areas of Temecula, over the four year trial period, Fuerte and Bacon caused a four fold increase in Hass trees just one row away from the pollenizers when compared to trees fifteen rows away. Zutanos only caused a 250% increase.



The results from the test sites in the coastal climate were also dramatic, but a few anomalies were observed in some test sites. Based on the same comparison of Hass trees one row from the pollenizer variety versus fifteen rows away, Bacon caused a 600% increase in Ventura, but only a 12% increase in a very coastal site in Santa Barbara. Zutano didn't help production in a very low producing grove in Ventura county (only an average of twenty fruits per tree). Both Fuerte sites were later found to have Bacon trees located close to row fifteen, which, of course, obscured the results. However, there was a 25% increase in Ventura, and a 35% increase in Santa Barbara between rows one and five in that test.

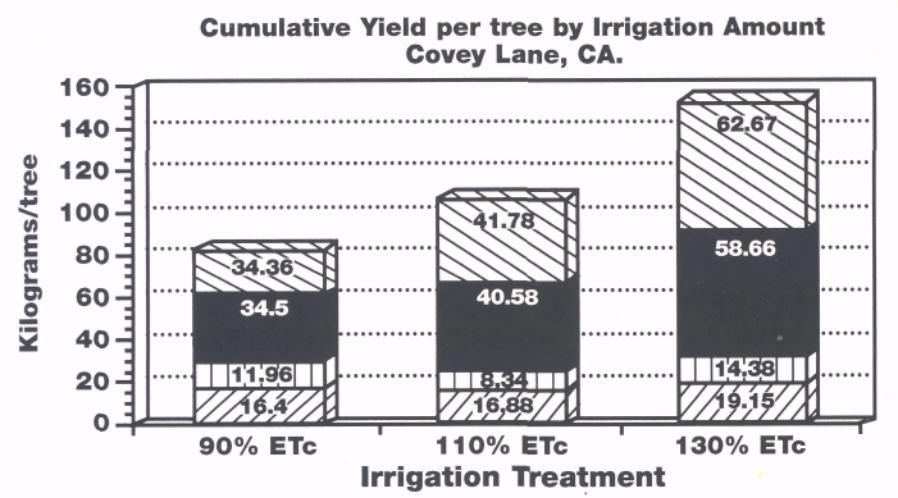
A major objective of these trials has been to monitor the difference between adverse and normal spring weather on fruit set. So far, Dr. Clegg has not had to investigate the parentage of fruit set during adverse spring weather. Hopefully, when adverse weather does occur, the same test sites can be monitored and will not have changed too much.

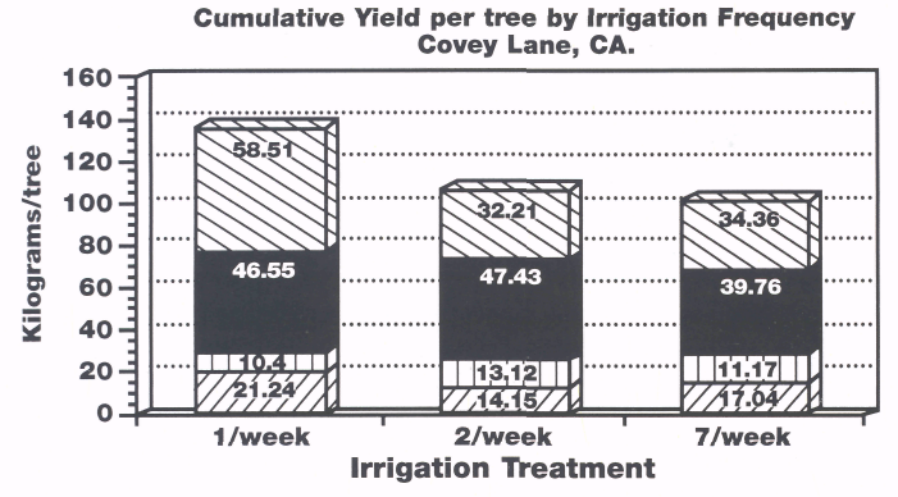
• Irrigation: Is More Better?

The short answer is yes, but it depends upon the unique factors of your avocado grove. The research trial in San Diego County demonstrated that a twenty percent increase in the amount of irrigation volume increased avocado production. More specifically, fifty-five percent more Hass avocados were produced with an irrigation regime of 130% ETc than from a program based on 110% ETc. ETc is an expression of evaporation and plant transpiration based on local weather conditions, after being adjusted for the efficiency of your irrigation system. (Instructions for calculating water requirements can be found on the Avocado Commission's web page fwww.avocado.org) or by writing to the Avocado Society, P.O. Box 4816, Saticoy, CA 92003. Your local UC Cooperative Extension tree specialist will also have information on ETc.) In the irrigation trial, a common irrigation regime of 90% ETc produced an average of eighty kilograms of Hass avocados per tree over a four-year period. Trees receiving water calculated at 130% ETc produced an average of 155 kilograms during that same period. This is close to twice the production by increasing water alone. In the San Diego irrigation trial, 90% ETc was 2.75 acre feet of water, 110% ETc was 3.25 acre feet, and 130% ETc was roughly 4 acre-feet of water per acre per year. Avocado trees appear to love their water.

One component of this irrigation trial compared irrigation frequency and its effect on Hass avocado tree production. This trial began in the midst of the six-year drought of

1987-1992. Some avocado growers speculated that daily irrigation would lessen tree stress and thereby encourage better production. This trial revealed the opposite. Once-a-week irrigations produced a better Hass yield than either twice-a-week or daily irrigations in sandy loam soil near Fallbrook. The Hass trees irrigated weekly yielded an average of about 140 kg per tree over a four year period. The yield from the daily and twice-a-week irrigation regime was about 100-105 Kg over the same period. The total amount of water applied each week was the same for each irrigation frequency regime. See graphs below:





This irrigation trial also allowed some conclusions to be made about the salinity of our water, the amount of water applied, and Hass yield. Most of the water imported into southern California contains over 700 parts per million of salts, of which 70 parts per million is in the form of chlorides — the most damaging salt to avocado production. Soil analysis for electroconductivity (EC) revealed lower salinity from the higher water application treatment. The higher rates of irrigation effectively leached much of the harmful salts away from the avocado trees' relatively shallow root zone. Fewer salts and more irrigation water produced a higher Hass avocado yield.

• Nitrogen: Less is better

In the mid-1980's, many avocado growers and agricultural consultants were of the opinion that if plenty of nitrogen was good, more would be even better. Some agricultural laboratories were raising their recommendations for the optimum level of nitrogen in avocado leaf tissue. Where 100 pounds of actual nitrogen per acre had been the common wisdom, some growers were applying as much as 350 pounds of actual nitrogen per acre. These increased rates of nitrogen application were based on anecdotal field observations: the trees were certainly a darker green. From 1987 to 1994, Dr. Mary Lu Arpaia conducted an investigation into the optimum rates for nitrogen fertilization. This trial demonstrated that rates as high as 350 pounds of actual nitrogen per acre produced less Hass fruit compared to Hass trees receiving 150 pounds of nitrogen per acre per year. The Hass yield from trees given a subsistence level of nitrogen fertilizer — from 0-25 pounds per acre per year — was the same as the yield from trees subjected to excessive nitrogen fertilization. More is not necessarily better when fertilizing Hass trees. Dr. Arpaia's research also found that the Hass fruits harvested from trees excessively fertilized were more prone to chilling injury during normal cold storage.

Moderation in fertilization not only can save growers money, it can also minimize ground water contamination. The issue of ground water contamination will become increasingly important for all of California's farmers in the future.

• Girdling: More production?

The visual observations of increased yield on a few girdled Hass avocado branches in South Africa prompted a girdling trial in San Diego County. An increase in Hass yield was demonstrated under local conditions. Girdling is the practice of removing a 3/8-inch to *1/2* inch band of bark from a branch — not the trunk. If you girdle the trunk you may easily kill the tree. The depth of the cut must be all the way through the bark and cambium down to the heartwood of the branch. To prevent the spread of disease, the girdling tool must be disinfected with alcohol or chlorine bleach after each tree. The months of October and November appear to be the best time for girdling Hass trees, although yield increases were also noted from girdling in February.

• Avocado Plants Developed from Cells

In a major breakthrough, Dr. Richard Litz of the University of Florida, has successfully propagated from cells, the following avocado plants: 'Hass', 'Lamb Hass', 'Thomas', and 'Lulu'. The process he is using is called Somatic Embryogenesis. Even more importantly, he has generated a plantlet that is a hybrid of a totally root rot resistant

Persea relative, *Nectandria sp.* with *Persea americana,* the common avocado plant. Dr. Litz is currently multiplying those hybrid plantlets by his cellular propagation technique. As soon as enough plants have been propagated and grown to sufficient size, they will be screened for root rot resistance and graft compatibility in Dr. John Menge's research program.

In the past, California avocado growers have funded several projects exploring micro-tissue propagation, but without success until now. True-to-type rootstocks have been generated by the clonal propagation technique of etiolation developed by Dr. Frolich in the 1970's. Root rot resistant rootstocks now available at avocado nurseries, such as Duke 7, Thomas, G755, and Toro Canyon are propagated by this quarter century old technique.

Refinements of these novel techniques are still in progress, and field trials must be conducted, but the rootstocks of the future may be generated from test tubes and be fully root rot resistant. Dr. Litz has an article on his work in this yearbook.

• The Realities of Research.

The fruits of avocado research often are slow in appearing, but they do appear eventually. In this article I have recounted the success that we have had in the last five years. I expect to have as much or more to report in the next five years. All avocado growers, through their assessment to the California Avocado Commission (CAC), fund the avocado research program. The practical results of this research are available to all avocado growers through publications such as the *California Avocado Grower,* published by the California Avocado Society and the California Avocado Commission, and *The Subtropical Fruit News,* which is a joint project of the Citrus Research Board, CAC, and the University of California. Research results are also available through the tree fruit specialists of the UC Cooperative Extension — your local county farm advisors. Publications that encapsule the results of avocado research are also sent to the members of the California Avocado Society and are available to all avocado growers by contacting the Avocado Society.

I hope that this article, summarizing the accomplishments of avocado production research over the past five years, stimulates your interest to seek out further information and employ the results of this research in your own groves.