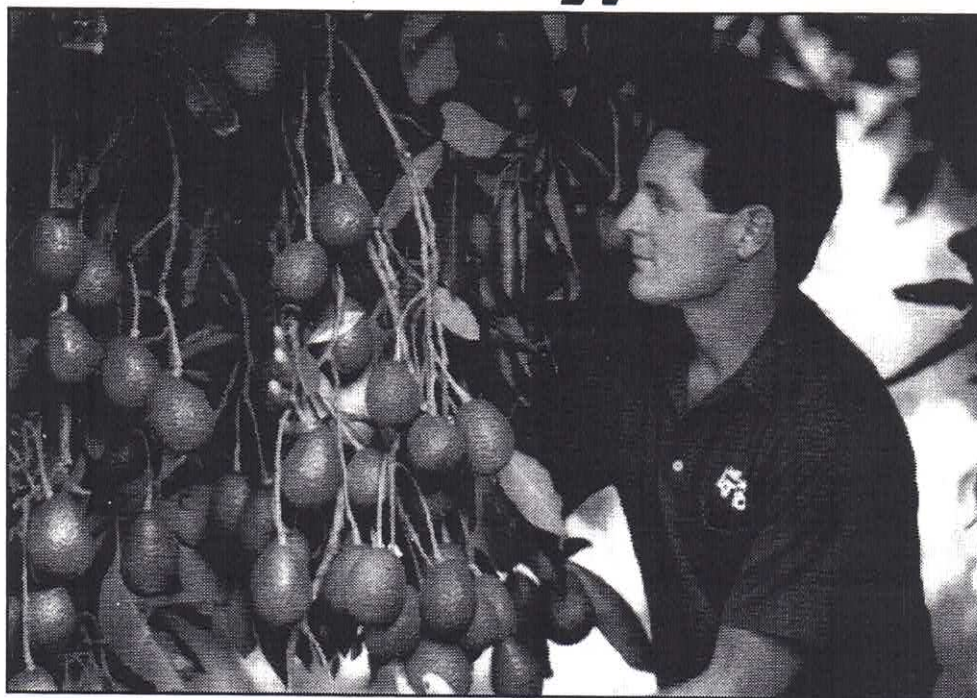


Fallbrook Ag-Laboratory, Inc.



HASS
AVOCADOS

PHOTOS TAKEN
NOVEMBER 6, 1991

THE BOTTOM LINE IS RESULTS!

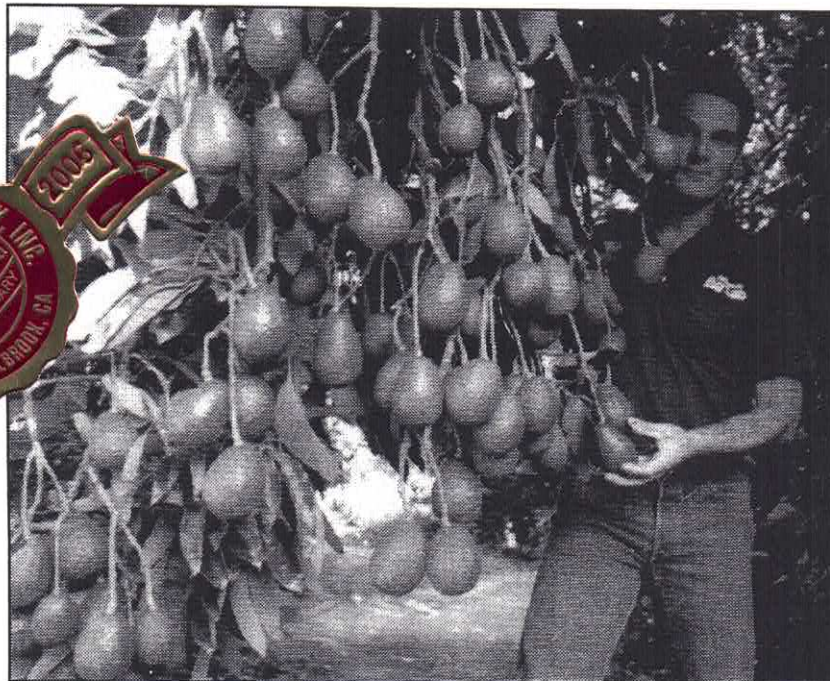
FALLBROOK AG-LABORATORY, INC.

- Leaf & Soil Analysis
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- Root Rot Testing
- Water Analysis
- Insect Management (Mite & Thrips Survey)
- Watering & Fertilizing Recommendations

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- Plant Pathology
- Agricultural Feasibility Study
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- Accurate Crop Estimates

HASS
AVOCADOS



Rick Marrocco

Entomologist

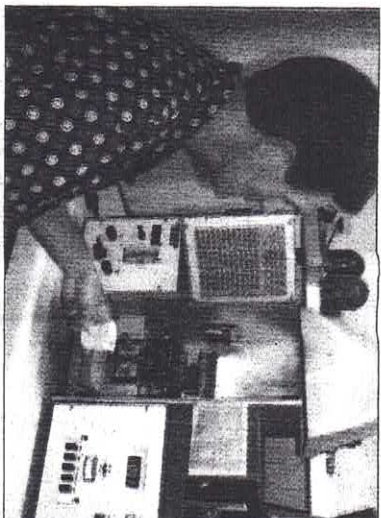
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All work done on premises.

Fallbrook 'plant detective' investigates how to produce the cream of the crop

Entomologist Rick Marrocco demonstrates how an atomic absorption spectrophotometer works at his business, Fallbrook Ag Laboratories Inc. Marrocco has owned the business since 1980.

LORELL FLEMING
STAFF
PHOTOGRAPHER



LORELL FLEMING
STAFF WRITER

FALLBROOK — Rick Marrocco snickers at a reporter's suggestion he adopt a new job title: "Rick Marrocco... plant detective."

But the title isn't too far off the mark.

Marrocco is an entomologist and owner of Fallbrook Ag-Laboratory Inc., which offers diagnostic and preventative services for any agricultural or landscape commodity.

Those services include leaf and soil analysis, insect evaluations, water analysis, insect management,

plant pathology, and soil and water testing.

With about 3,700 clients, Marrocco said about 95 percent of what he treats are avocado trees. The rest is a mixture of golf courses, nurseries, landscape plants and residential plants, he said.

"We make about 1,500 field calls annually," Marrocco said from his company headquarters at 455 E. Alvarado St.

"It's tough to efficiently get around to them all, but we do it. It's just a delight to see the growers, who are always in a good mood," Marrocco said.

Charges for lab work varies, rang-

ing from \$7 for a water analysis to \$88 for an extensive leaf analysis, which includes lab work, sampling and recommendations. Marrocco charges \$60 an hour for an appointment at a customer's grove, garden or landscape area, with a minimum one-hour charge.

Pete Prossen — a satisfied client of Marrocco's for about eight years before Prossen sold his Fallbrook avocado groves in 1998 — said Marrocco's services are worth the cost. Prossen was so pleased that he had Marrocco manage his groves for about two years before the orchard

'Plant detective' sees solid future for Ag-Laboratory

Continued from B-1

was sold.

"He unlocked the secrets of getting good production and good quality, which is nutrition and preventative care," Prossen said. "At that time, those secrets were not so widely known."

Nearly 70 percent of his work is preventative analysis — coming up with ways to keep plants healthy and to increase crop yields. Preventative care on a healthy plant can be just as challenging as figuring out what's wrong with an ailing one, Marrocco said.

"It's even tougher to fine-tune a healthy grove to make it more productive," he explained.

"It's like any nutrition program: A person can't just eat bread. You have to know what else to eat with the bread to get the full nutrition

'He unlocked the secrets of getting good production and good quality, which is nutrition and preventative care.'

— PETE PROSSEN
Fallbrook Ag-Laboratory client

Marrocco's dogged, detective-like curiosity about bugs and plants has been with him since he was a child, he said.

"I was the little kid who chased butterflies with a butterfly net. I caught a few, and I studied them," Marrocco recalled. "I was into bugs and reptiles, too. I had nine snakes."

The Riverside native initially wanted to become a veterinarian. But while in college, his interests shifted to entomology and plant pathology.

After graduating from Cal Poly Pomona in 1973, Marrocco said he landed a job working with entomologist Ron In-

laboratory. He bought out Inman around 1980 and took over the lab.

Marrocco said he sees a solid future for the Fallbrook Ag-Laboratory.

"There's always going to be a need for an ag and plant laboratory, as long as there's an ag industry — and I'm sure there will always be an ag industry. But I don't think I'll be changing my title to 'plant detective,'" Marrocco said.

For more information about the services provided at the Ag-Laboratory, call (760) 728-4828.

Contact staff writer Lorell Fleming at (760) 731-5798.

➤ PLANT, B-4



AVOCADO CONSULTANT PUT TO TEST

Story and photos
by Howard Seelye

For the past 25 years Richard (Rick) Marrocco has been advising California avocado growers on how to improve their trees and increase crop yield. Now he is taking his own advice, with what appears so far to be spectacular success.

Less than two years ago the Fallbrook entomologist, who has worked at the Fallbrook Ag Lab for 25 years, 18 as owner, bought an impressive, mountainous 100-acre ranch in Rainbow Heights, east of Fallbrook. The ranch had fallen on hard times, and Marrocco was invited to oversee the avocado groves four years ago after the owner died. Marrocco managed the ranch during the three years it took him to buy the property out of probate.

Now, he says, he is having the time of his life, doing what he has been telling others to do all these years.

What he has done so far is strip the property of 2,000 macadamia trees, take out acres of citrus and concentrate on the 4,000 Hass trees on the ranch, while preparing the hillsides for another 5,000 avocado trees.

Howard Seelye is a California Grower field editor based in Fallbrook.

The first year Marrocco managed the grove, production was 2,700

compiled yet, Marrocco estimated that there would be 16,000 pounds per acre this year and now projects 1999-2000 about the same.



Always controversial, Rick Marrocco has advocated girdling avocado trees almost yearly to halt the return flow of carbohydrates from leaves to roots.

pounds per acre. The following year, 1996-97, crop yield jumped to 8,000 pounds per acre and last year doubled to 16,000. While final figures aren't

tem and kept to 70 parts per million. Also he keeps the pH range of the soil at 5.5 to 6.0 ppm all year long. Further, the soil must dry out between

It's The Water

The most astounding and probably controversial program Marrocco follows is extremely heavy watering, something he always has advised his customers, who over the years have numbered 3,000 growers from Mexico to Morro Bay.

For large trees Rick pours on 576 gallons per tree (reduced to 500 gallons with evaporation) per week over a 48-hour period, using spinners emitting 12 gallons per hour. Not only does he water for long periods, but he has two spinners per tree, maintaining that the best way to grow avocados is to have the acreage completely covered when watered.

For medium-sized trees water is reduced to 396 gallons (300 net) for 33 hours and small trees receive 96 gallons per tree from an eight-hour set.

Marrocco's theory is that with extensive watering, chloride salts are pushed below the root system



Rick Marrocco is now practicing what he used to preach on a 100-acre Rainbow Heights ranch.

irrigations as part of his regimen.

In addition he injects mature, healthy trees three times a year with phosphorous acid and takes his own advice on a sound fertilizing program, applying fertilizer through the irrigation system. Potassium thiosulfate is applied as needed by leaf analysis, with zinc applied by hand in a narrow band, Marrocco points out. While fertilizing by hand-spreading versus injection through the irrigation system has been another point of controversy among avocado growers, Marrocco believes that better distribution of fertilizer is made when added to water.

Then there is the rigid program of injecting phosphorous acid into the tree trunks, a procedure which some industry observers maintain can kill a tree. Not

so, says Marrocco. "Look at these trees, are they healthy looking? Are they dying?" he asks a visitor.

Marrocco girdles healthy trees nearly every year, another procedure which has industry experts split. Marrocco uses an angled, welded bar, mounted with a square blade. Demonstrating girdling, he strips a ring of bark and cambium from a major branch of a tree three-eighths of an inch wide down to the bare wood.

Girdling allows water to rise from the root system to the branches but the girdled branch stops the return flow of carbohydrates to the roots, thus providing food for the eventual fruit, Marrocco explains.

Controversial Ideas

Marrocco, a voluble 49-year-old native of Riverside, has his admirers and detractors in the avocado industry. Most controversial of his projects

was the embrace he made of the newly developed Gwen variety, which 10 years ago was touted as the avocado of the future.

Marrocco grafted an estimated 30,000 trees to the Gwen, which

never approached expectations and now has dwindled to an estimated 1,000 trees. Somewhat chagrined by the whole episode, Marrocco has been busy in recent years re-grafting Gwens to Hass.

While there are those in the industry who deride Marrocco's methods, nevertheless industry observers admit that growers who have taken his advice have done well.

One of those who recognize Marrocco's expertise is Al Snider, longtime member of the California Avocado Commission who also has served as its chairman.

Speaking of Marrocco and his sometimes controversial methods, Snider says, "If you do something you can be controversial" noting that Marrocco has done many things, most of which have been good for the industry.

After graduating from Cal Poly, Pomona, Marrocco arrived in north San Diego County in 1973 to work for Ron Inman in setting up Fallbrook Ag Lab. During his time in Fallbrook he traveled each week to study under Drs. George Zentnyer, Michael Coffey, J.A. McMurtry, Tom Embleton and John Menge at UC Riverside.

Seven years later he took over Fallbrook Ag Lab, which he still runs with his wife, Gayle, who holds down the office while Rick is busy injecting, girdling or grafting others' trees, all the while chatting with advice.

Evenings and weekends are spent on his ranch, where 700 new young avocado trees have been planted with more to come.

Rick, his wife and their two sons form the nucleus of the crew, along with six others, four of them full time grove workers.

After years of advising others, Marrocco's ranch, a spic and-span semi-resort, sporting a three-acre lake, four-acre park, hiking trails, miles of paved roads, a waterfall and a heavily forested hillside, takes a good deal of his time. And advice. **CG**



Rick Marrocco is concentrating on avocado production on his 100-acre orchard. He has cleared macadamias and citrus and plans to plant 5000 more avocados (Hass not Gwen).

Farmer achieves blooming success

■ Fallbrook entomologist now doing what he has told others to do

For the past 25 years Rick Morrocco has been advising California avocado growers on how to improve their trees and increase crop yield.

Now he is taking his own advice, thus far with what appears to be spectacular success.

Less than two years ago the Fallbrook entomologist, who has worked out of Fallbrook Ag Lab for 25 years, 18 as owner, bought a spectacular mountainous 100-acre ranch in Rainbow Heights.

The ranch had fallen on hard times, until Morrocco was invited to oversee the avocado groves four years ago after the owner, Earl Sawyer, died.

Morrocco managed the ranch during the three years it took him to buy the property out of probate.

Now, he says, he is having the time of his life, doing what he has been telling others to do all these years.

What he has done so far is strip the property of 2,000 macadamia trees, take out acres of citrus and concentrate on 4,000 Hass trees on the ranch, while preparing the hillsides for another 5,000 trees.

The first year Morrocco managed the grove, production was 2,700 pounds per acre. The following year, crop yield jumped to 8,000 pounds per acre and last year doubled to 16,000 pounds. How does he do it? Basically, Morrocco says heavy concentration of water is the key to his success.

In addition Morrocco injects mature, healthy trees three

times a year with phosphorous acid, and takes his own advice on a sound fertilizing program, applying fertilizer through the irrigation system.

The most astounding and probably controversial program Morrocco follows is extremely heavy watering, something he always has advised his customers, who over the years have numbered 3,000 growers from Mexico to Morro Bay.

He waters mature trees lightly for 48 hours, middle-sized trees for 36 hours and young trees for eight hours.

He also does something few growers do, placing sprinklers in between trees so that the ground is completely covered during watering cycles.

Morrocco, a voluble 49-year-old native of Riverside, has his admirers and detractors in the avocado industry.

Most controversial of his projects was the embrace he made of the newly developed Gwen variety, which 10 years ago was touted as the avocado of the future.

After graduating from Cal Poly Pomona, Morrocco arrived in North San Diego County in 1973 to work for Ron Inman in setting up Fallbrook Ag Lab. Seven years later he took over the lab, which he still runs with his wife, Gayle.

So after years of advising others, Morrocco's ranch, a spic-and-span semi-resort sporting a three-acre lake, four-acre park, hiking trails, miles of paved roads, a waterfall and a heavily-forested hillside, takes a good deal of his time. And advice.

Howard Seelye writes a biweekly column for the North County Times. He can be reached at (760) 723-9099 or howglo@aol.com.

SACHSE, JAMES & LOPARDO

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July 26, 2002

Rick Marrocco
Fallbrook Ag-Lab
P. O. Box 1269
Fallbrook, Ca. 92088-1269

Re: Rancho Viejo, LLC v Tres Amigos, LLC

Dear Rick:

The California Court of Appeals has ruled in favor of Tres Amigos on the water runoff case that you helped us on.

It is a very important ruling, because the Court not only held in favor of our clients, but ordered the decision published. It was a unanimous decision by the three judges of the Court of Appeal, and as a "published" decision, it will now become the official California law on this subject. It will be binding on all California trial courts.

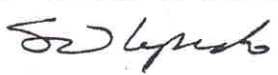
This is a very important victory for the farming industry as a whole, and avocado farmers in particular.

I also want to thank you very much for your assistance on the case. The Court of Appeal was highly influenced by your testimony and expertise. The Court acknowledged this in the written opinion on page 21 where the Court of Appeal extensively quoted from the Declaration that you wrote.

Again, thank you very much for your help. This is a victory for all of avocado farming, and is well worth savoring.

Very truly yours,

SACHSE, JAMES & LOPARDO

BY: 

STEPHEN V. LOPARDO

SVL:tp

Enc.

trees require occasional "leaching" in addition to regular irrigation to leach out traces of saline in the irrigation water, regardless of whether the water comes from wells or public sources. He opined, based on his decades of experience in the avocado and citrus industries, respondent's "agricultural activity and operation is, and has been, conducted and maintained for a commercial purpose in a manner consistent with proper and accepted customs and standards, as established and followed by similar agricultural operations in the same locality." He concluded, "[Respondent's] grove has been in compliance with such customs and standards for many more than three years, probably 20 years."

Respondent met its burden of producing competent and admissible evidence establishing the customary character of its irrigation methods with Marrocco's declaration, which set forth Marrocco's personal knowledge and competency. (Code Civ. Proc., § 437(c), subd. (d); e.g., *Guthrey v. State of California* (1998) 63 Cal.App.4th 1108, 1119-1120.) Appellant does not contest Marrocco's expertise, and the expert explained that respondent's irrigation method was an approved and customary method for avocado growers without access to metropolitan water, and that it had been followed by similar agricultural operations for over three years.¹¹ Thus, the burden of production

¹¹ In part, Marrocco averred: "The Tres Amigo Grove is in the Rainbow Municipal Water District. I am very familiar with groves that buy water from Rainbow Municipal Water District. I professionally consult and manage thousands of acres of avocados in this District. I also own and live on an 100 acre avocado grove that uses Rainbow Municipal Water District water. All of these groves routinely leach. In addition, I am personally aware of thousands of acres of other groves located outside the Rainbow Municipal Water District that use well water. These groves also require regular leaching.

IV. *Appellant Failed to Meet Its Burden to Raise Issues of Material Fact as to the Elements of Section 3482.5*

"For section 3482.5, subdivision (a)(1) to apply, defendants must satisfy seven requisites: The activity alleged to be a nuisance must be (1) an agricultural activity (2) conducted or maintained for commercial purposes (3) in a manner consistent with proper and accepted customs and standards (4) as established and followed by similar agricultural operations in the same locality; the claim of nuisance arises (5) due to any changed condition in or about the locality (6) after the activity has been in operation for more than three years; and the activity (7) was not a nuisance at the time it began." (*Souza, supra*, 59 Cal.App.4th at pp. 874-875.)

Appellant contends that, assuming section 3482.5 governs its causes of action, it raised material factual issues as to whether certain requisites of the statute are satisfied. Specifically, appellant maintains its evidence raises disputes as to (1) whether respondent's irrigation methods were conducted or maintained in a manner consistent with proper and accepted customs and standards followed by similar agricultural operations in the same locality; (2) whether its claim arose due to a changed condition in or about the locality; and (3) whether each parties' actions were reasonable. We disagree.

A. *Accepted and Customary Irrigation Methods*

In support of its motion, respondent submitted the declaration of expert Richard Marrocco, who explained that virtually 100 percent of avocado groves in Southern California need massive amounts of irrigation to make up for the lack of rainfall because seasonal rainfall is insufficient to sustain the trees. Marrocco further explained avocado

Rick Marrocco
Fallbrook Ag. Laboratory, Inc.
PO Box 1269
Fallbrook, CA 92088

Re: Production Figures-1999

Dear Rick:

...thought you might like to have these production figures for 1999. This year was the highest production we have every experienced.

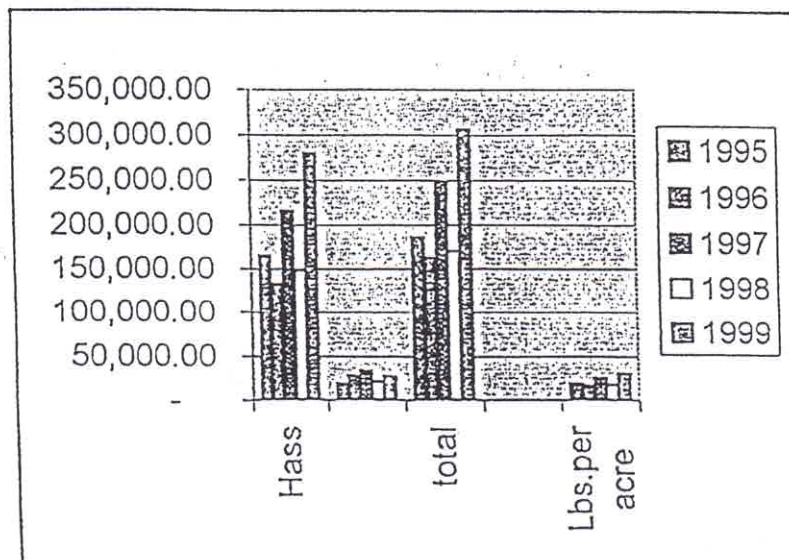
Thanks for your excellent assistance and advice.

Sincerely,

P.S. Use this chart as you wish Rick, but if possible, don't mention my name. Thanks,

Farm Production by Year

	<u>Hass</u>	<u>Zuts</u>	<u>total</u>	<u>Lbs.per acre</u>
1995	165,531.00	18,909.00	186,435.00	18,391.00
1996	133,411.00	28,028.00	163,435.00	16,144.00
1997	215,777.00	33,658.00	249,435.00	24,944.00
1998	149,065.00	21,052.00	170,117.00	17,011.00
1999	279,150.00	27,177.36	306,327.36	30,632.70



Exactly 1000 Hass trees = 279# per tree

Natural enemies

Predator mite may offer best means of control of Perseae threat

9-9-93

The means to halt the massive increase of the Perseae mite, which attacks avocado leaves, has been attained, according to Len Francis of Temecula. Control may be established in a few years, Francis said, in a cautiously optimistic report to the California Avocado Commission.

The Perseae mite, *Oligonychus perseae*, a tiny spider the size of a pinhead, has become a serious threat to the avocado industry. Some Fallbrook groves have been devastated. Many other orchards in San Diego County, including groves in Bonsall, Valley Center, Vista and Escondido, have experienced significant defoliation and loss of fruit.

The mite attacks the underside of avocado leaves, spinning a web which protects its eggs from predators. Eventually the foliage drops, exposing fruit to the elements, causing sunburn and droppage.

Infestation in the Perseae mite is now showing up in small numbers in the Temecula area of Riverside County, while colonies of mites have seemed to have lightened in the original Highland Valley groves of Escondido following heavy

defoliation and fruit loss in 1992, according to Francis.

Speaking to the Industry Affairs committee of the Commission, Francis said that it is very fortunate that the Perseae, which appeared in large numbers in California two years ago

with no natural enemies, can now be brought under control in the foreseeable future.

"We now have the means to combat the Perseae," said Francis, an avocado grove manager who is the coordinator of the California Avocado Society's production research program, funded by grower assessments levied by the Avocado Commission.

Importation and commercial rearing of the predator

See Predator, page B5



Dick O'Brien/Enterprise

PREDATOR MITES are installed on an infested tree by Rick Morocco of Fallbrook Ag Lab. Spreading from the small bag attached to a branch, the predators eliminate the Perseae mite, traveling from branch to branch, and, finally, from tree to tree.

FERTILIZATION

Hass Avocados

State of the Art

BY RICHARD MARROCCO

Can a mature Hass orchard in arid, acid, sandy soils produce 30,000 pounds per acre?

Thousands of leaf analyses and years of trial and error have resulted in the implementation of very logical fertilizer scheme imaginable.

With consistent heavy production of Hass being the goal and with fertilizer costs in mind, modern fertilizer programs have been developed.

Zinc

In the past, zinc has been applied in a narrow band at the drip line at a very high rate, typically in the winter months, an application which lasts from three to six years. The band solves two problems: first, tying up with the soil itself; and secondly, tying up with phosphorous which is broadcast later in a complete NPK (nitrogen, phosphorous, and potassium) fertilizer. Zinc was also sprayed on the foliage, at first only in July

and eventually in September or both July and September, to achieve higher production. Then chelated zinc was injected through the irrigation system several times a year. Eventually we found out that 12 percent liquid zinc sulfate worked as well as the more expensive chelate.

As time went on, it became obvious that applying zinc late in the season (one application in August or September), allows much better production than applications several times a year or in July. Zinc is an element which is only incorporated into the leaf as it grows. Once a leaf is fully mature, it won't take on any more zinc unless it is foliarly applied. Some of the largest leaves grown on a Hass tree develop in August, so it is logical to apply zinc in this time frame. Also, applying zinc to August leaves prevents zinc in the foliage from dropping off during the following spring bloom. Typically, a non-water-stressed tree with little chloride damage and the like will keep its leaves about a year. The early spring flush (June and July) drops off during the next year's bloom. So the August applied zinc catalyst would continue to influence the tree during the bloom the following year, thus achieving much higher production than other methods of timing.

Fertilizer programs are just not effective unless the root system is well-oxygenated and salt free.

Phosphorus

Phosphorus is also extremely important to Hass avocado trees in southern arid, sandy soils. After a five-year study designed to prove that Hass avocados require more than .08 phosphorus in leaf tissue analysis, UCR's Dr. Tom Embleton approved the change in the University guidelines up to a minimum of .10 phosphorus in leaf analysis to be sufficient. For maximum production I feel .14 to .16 is best.

The problem with phosphorus is when to put it on and how. Phosphorus also ties up the cation exchange system of the soil like zinc. To beat the soil tie-up problem, we found applying phosphorus all at one time in a single irrigation watering achieved the highest leaf levels. The other dilemma is that phosphorus combines with zinc in the soil, making both zinc and phosphorus unavailable. Scientists have also shown that there is an interference between elements if present in the plant at the same time.

Fortunately, a mature leaf will easily incorporate additional phosphorus into the leaf tissue. Keeping the zinc tie-up problem in mind, phosphorus was applied six months later in the form of white phosphoric acid with spectacular results. This enabled the August "zinced" leaf to take on phosphorus without the interference

Thousands of leaf analyses and years of trial and error have resulted in the implementation of every logical fertilizer scheme imaginable.

The bottom line for nutrients," Grangetto says, "is to determine what gives you optimum results. Listen to what your trees are telling you through visual assessment and tissue testing.

problem and the soil zinc-phosphorus tie-up problem. So by February, before the bloom starts, we have the largest leaves packed with two critical elements, which will remain on the tree through the bloom.

Potassium

To supply some potassium, we added potassium chloride to the white phosphoric acid to make a 0-20-7.5, which is adjusted up if the potassium is below .75 in the leaf analysis. No negative effect has been measured due to the addition of chloride in the potassium chloride on well-irrigated groves.

Nitrogen

Now that we have phosphorus, zinc, and potassium supplied to the tree, what about nitrogen? Two things to consider: the pH of the soil and timing. Nitrogen uptake does not interfere with phosphorus, zinc, or potassium, so any time of the year is fine—taking into consideration prevention of vegetation during the bloom which is essential for a good set.

The highest production has been achieved by spreading nitrogen applications from February to November, keeping amounts applied to a minimum, especially in the early part of the season. Enough nitrogen should be supplied during the year on Hass to reach leaf analysis levels of 2.2. This helps achieve high starch production for root system reserves, reducing severe production cycles on individual trees.

The pH must be monitored religiously. Continued use of ammoniacal nitrogen can drive the pH below 5.5 and eventually cause aluminum to link with phosphorus, causing a severe phosphorus deficiency. This brings the plant to a dead halt. Low pHs have also caused manganese toxicity, killing the tree. Therefore, UN-32 is typically alternated with CAN-17 to adjust the pH.

Richard Marrocco of Fallbrook Ag-Laboratory evaluates groves, consults on pest control, and provides surveys for some 2,000 acres of avocados and citrus.

Nitrate Nitrogen raises the pH. A fine paper by Jon Tracy clearly explains the mechanics of soil pH.

Today's "State of the Art" fertilization program is as follows:

February (first week):

Inject .15 to .25 gallons per tree (15 to 25 gallons per 100 trees) of white phosphorus acid and potassium (0-20-7.5) fertilizer at one time, to be injected all in one irrigation. (Note: 15 to 25 gallons per 100 rate is determined by preceding year's leaf analysis; also same for N, K, and Z.)

February-July:

Inject .07 gallons per tree (7 gallons per 100 trees) of CAN-17 fertilizer every other week for a total of .8375 gallons per tree (83.75 gallons per 100 trees) in 12 applications. (Actual nitrogen will equal 1.80 pounds per tree.)

August (first week):

Inject .18 to .30 gallons per tree (18 to 30 gallons per 100 trees) of 12 percent liquid zinc sulfate fertilizer once, to be injected all in one irrigation.

August-November:

Inject .0425 gallons per tree (4.25 gallons per 100 trees) of UN-32 fertilizer every other week for a total of .34 gallons per tree (34 gallons per 100 trees) in eight applications. (Actual nitrogen will equal 1.2 pounds per tree.)

Total actual nitrogen for the season will equal 3.0 pounds per tree.

If the pH drops, more CAN-17 is used; conversely, if the pH remains high, more UN-32 is used. All other elements are usually in good supply because of our very salty source of water, laden with minerals.

Fertilizer programs are just not effective unless the root system is well-oxygenated and salt free. This can only be done with a lavish use of water to leach the chloride salts and a long enough duration between irrigations. Thus high rates of water used infrequently will stimulate heavy production when a good fertilizer program is implemented.

Helpful Fertilizer Hints

Leffingwell district manager Ken Gemmill offers the following suggestions for maximizing your fertilizer benefits:

- Decide fertilization is as important as your other inputs.
- Spend time with your trees, listen to what they are saying, and respond to their needs.
- Don't make micronutrients second cousins.
- Do tissue testing.
- Don't expect your tree to have the same needs six months after your last tissue test. Re-test prior

to every application and modify your program accordingly.

- Carefully time your applications.
- Don't rely exclusively on the results of your tissue test. If a nutrient is in the "adequate" range, yet the tree shows signs of wanting more, believe the tree.
- Always seek a balanced approach to fertilization by knowing what nutrients affect the absorption of others and plan your program accordingly.
- Use every resource available and question everyone you can to develop the best fertilizer program ever.

MINOR ELEMENTS MAKE A MAJOR DIFFERENCE

BY BETSY BLANCHARD CHESS

All plants need at least 16 different elements for proper growth. The basic building blocks of plant tissue are carbon, hydrogen and oxygen, but also important are nitrogen, phosphorous, potassium, calcium, magnesium and sulfur. This group of nutrients are known as major or macrolelements. The minor or microelements include boron, zinc, iron, manganese, copper, molybdenum and chlorine.

Just because they're called minor elements, doesn't mean they're not important in nature's scheme of things. They are as important to plants as the macronutrients, although plants don't usually require as much of them. And all the elements, major and minor, have a function in root

fertilization was not as common as it is today, one of the three major nutrients was

the first limiting growth factor. Today, with good NPK fertilization common, the spot-

responded to the current year's fertilizer inputs, so we can write an easy-to-follow program that tells you when, how much, and what kinds of fertilizer to apply next year."

Most labs recommend that a grower do leaf, soil and water analysis in order to have a complete profile of nutrient needs and availability. Municipal water companies do monthly water sampling and can provide a grower with an idea of the components in his irrigation water. Tissue or leaf sampling should be done from May through July for deciduous trees and from August 15 through October 15 for citrus and avocados. This insures that samples are taken from spring leaves which will be supporting next year's production. Annual plants can be tested from spring through the fall.

Walk Your Grove

Leaf samples should be taken by walking a broad loop though a representative block of trees, taking leaves from all quadrants of the trees.

Root-depth soil samples should be taken along the same path, then mixed and sub-sampled for analysis.

Leaves are then washed, carefully dried and then crushed into a powder for sampling. Kamal

Sakoury of California Growers Laboratory, Inc. in Fresno emphasized the importance of having samples analyzed by California laboratories which use the methodology developed by the University of California. "Each crop is different, each test is different. The University of California has developed optimum levels and ways to test for them which should be followed," he said.

Soil pH affects micronutrient availability sharply. Usually availability decreases as

Copper deficient lemon tree.

light has shifted to micronutrients.

Fertilizer technology

Today's high analysis production removes impurities much better than older manufacturing processes. Thus micronutrients are not so commonly provided as "incidental" ingredients in fertilizer.

According to Mary Matava of Agri-Service, in Fallbrook, micronutrients are not "cure-alls." Any one of the 13 nutrients can limit growth and yields or can even cause plant death when deficient. "You can't go off on a tangent. To assign special value to micronutrients is incorrect and misleading," she says.

Test, Test, Test

Micronutrients fertilization should be treated as any other production input. If a micronutrient deficiency is suspected, a grower can pinpoint it through soil tests, plant analysis and/or field observation.

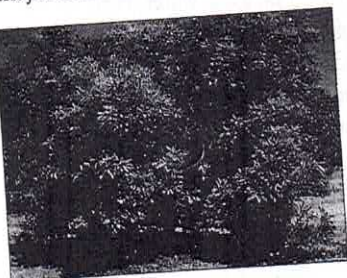
Jim McDonald of McDonald Agri-Science, also in Fallbrook, an agricultural

consulting service, explained that soil analysis tells you what is in the soil around your plants and trees, but does not tell a grower what nutrients are available for the plant's use. "Leaf analysis tells you how well your trees

These avocado leaves show a deficiency of zinc.

Too much of a Micronutrient can cause trouble. This lemon tree has been damaged by boron.

Ben Faber photo



Avocado tree shows the effect of iron deficiency.

soil can limit plant growth even when all other essential nutrients are present in adequate amounts.

The rise in interest about micronutrients in a grower's fertilization program is due to three factors:

Crop yields

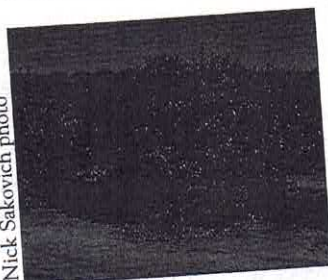
Increasing per-acre yields of any tree crop remove higher amounts of micronutrients. As more and more of these trace elements are removed from the soil, some soils can't release enough of them to meet today's high-yield crop demands.

Past fertilizer practices

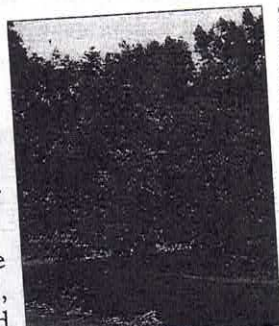
When crop yields were not so high and nitrogen, phosphorous, potassium (NPK)

Betsy Blanchard Chess is the editor of the Ventura County Farm Bureau Broadcaster, and a frequent California Grower contributor.

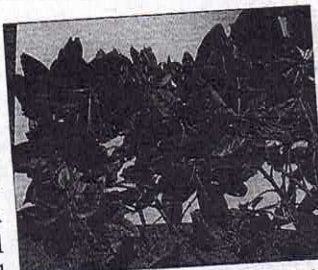
Nick Sakovich photo



Nick Sakovich photo



Ben Faber photo



pH increases or as soil becomes more alkaline. Generally soils in San Diego and Riverside counties tend to be lower in pH while soils in Ventura and Santa Barbara counties tend towards alkalinity.

Micronutrient	pH Range for Max Availability
Boron	5.0-7.0
Copper	5.0-7.0
Iron	4.0-6.5
Manganese	5.0-6.5
Molybdenum	7.0-8.5
Zinc	5.0-7.0

In very low pH soil, some micronutrients can become soluble enough to be toxic to plants. Manganese, for example, can inhibit root growth in some acid soils. Liming the soils to more neutral pH values reduces the danger of toxicity.

The tricky thing about micronutrients is that their relative amounts in the soil, especially metals, determine their availability, and may be more important than absolute amounts of each. This relationship can make soil tests misleading, unless the levels of other macro and microelements are considered.

Fortunately for most growers in California, especially those in the south, only a few micronutrients need to be added to a fertilization program. Says Rick Marrocco of Fallbrook Ag-Lab, "We do tissue, leaf and soil analysis and write fertilization programs for 2500 avocado clients. The reality is I'm aware of only two, (deficient

micronutrients) period." He continued, "I don't write anything off, but I don't have scientific evidence that aside from zinc and iron, we have other micronutrients deficient here."

Marrocco said zinc is needed to increase production and size of avocados, and suggesting either foliar or soil applications. Soil pH is important as high levels of phosphorous can tie up zinc availability and vice-versa.

Iron is the other micronutrient deficiency Marrocco sees on avocados.

Jim McDonald also recommends application of iron. He suggests injecting chelate iron at points around the drip line, usually in June.

McDonald also recommends applications of zinc and manganese in low pH soil. He suggests a combination of soil and foliar applications. "Foliar application of zinc provides a quick shot in the arm. I've seen results in three weeks, whereas a soil application may take six to nine months before you see results. Neither zinc nor manganese move well from the site of application. But once you've applied them through the soil, it may be four to six years before you need to do it again."

Copper and boron are other micronutrients a citrus and avocado grower in Southern California needs to be aware of. According to McDonald, copper deficiencies in San Diego and Riverside counties are rare, but can be handled by foliar spraying.

The jury seems to be out in regards to the need for boron. According to McDonald, boron levels in San Diego range from low to

the barely optimum range, but that an excess of Boron "can do more harm than good." Mary Matava says she seldom sees a deficiency and then, "only if well water is low in boron." Marrocco is skeptical about the need for added boron, but suggests a tri-yearly foliar spray which includes boron along with other elements if growers would like to experiment.

In the Central Valley, pistachio trees do need boron, however, to prevent "crinkle leaf," says Kamal Sakoury. In addition, zinc is important for pistachios, almonds and grapes. In the last three to four years, copper deficiencies have appeared in young almond trees in the Madera area. Nat Dellavalle of Dellavalle Laboratory in Fresno emphasizes the need for good professional help in diagnosing just what your crop need. "Zinc is used routinely in some areas on peaches and plums, but foliar applications can be toxic and defoliate a tree. Too much zinc or iron can cause russetting." He continued, "There are times when you can generalize and times when you jolly well better not!"

If it were easy, everyone would be a grower, but for most of the consultants the most important factor is water, both for the delivery of many needed nutrients and for its role in leaching harmful salts below the root zone. Said Mary Matava, "Don't bother with fertilization if you're not going to irrigate properly."

Rick Marrocco agreed, "The bottom line for heavy production is heavy irrigation."

Quality Control Measures And Guidelines Used In California Labs

by Kamal Sakoury, M.S.

Soil, plant, and water analysis are the grower's best guide to the wise and efficient use of fertilizers and soil amendments. These tools are the first step toward high yields, maximum profit, and correct management practices.

Useful recommendations from these tests require accurate sampling, analysis and quality control. Interpretations must be based on sound research and judgement.

The question may arise whether plant or soil analysis should be used for diagnosing crop nutrient requirements while making fertilizer recommendations. The answer is that both methods may be complementary and not contradictory to each other.

In 1971, Dr. Homer D. Chapman, Professor of Soil and Plant Nutrition, University of California, Riverside, wrote: "It is evident that as we look to the future, there will be an increasing need to use plant and soil analysis methods to guide and optimize fertilizer usage to conserve natural resources and decrease or prevent pollution." This view is largely confirmed today with the renewed interest in reducing chemical usage, and increased organic farming within California.

With these basic considerations in mind, soil, plant, and water analysis are crucial methods in diagnosing the nutrient status of both the plant and the soil. Plant analysis has to be considered as a valuable complement to soil analysis. This is an important tool in determining the fertilizer needs of many crops.

The sampling procedure for each crop should be clearly specified, i.e., "sampling stations," and should be carried out under close supervision.

Analytical methods should be both simple and accurate. Whenever possible, the most efficient instruments should be used.

It is advisable to check methods through participation in sample exchange programs, or by means of reference sample. In California, we use the National Bureau of Standards as a method of quality control.

The correlation between plant and soil analysis should be studied systematically.

Analytical services should be used in close relationship with the University and the Extension Service.

the soil in normal seasonal rains, causes tipburn on trees has long been identified. But most growers don't feel the salt build-up has affected fruit size or crop size. Stan Roberts of Ag Land Services, a management company based in Somis, however, wonders aloud, "We've had reasons for the last few low crop years. We could blame them on climatic problems; the freezes or the hot spell. Maybe these problems are masking salt problems."

Mike Mobley, owner of Progressive Land Management in Ventura, sees salts affecting next year's crop. "The salt damage is really evident on the trees. They can't set a bloom because there is not enough leaf surface to be healthy."

If push comes to shove and this drought makes the bleakest "what if?" scenarios a reality, growers all over the Southland will have to make some hard choices. For some, like Don Reeder of Pro-Ag in Somis, whose company manages about 1200 acres of avocados, "We could be forced to pick early. We could survive one year of cutbacks, but we'll have to cut back operations if we're reduced by too much."

To Glenn Parks, a large grower in Goleta, further cutbacks means, "We'll abandon the poorer producing areas and reserve what water we have. We either water everything half way and lose it all or throw away half and have a fair crop on what remains."

The drought has only emphasized what all who live in Southern California have known, but tend to push to the back of our minds: The viability of agriculture, indeed of life, in this area depends on water.

Perspectives (from page 20)

change this situation through statutory language stipulating that all irrigated agriculture is eligible for disaster assistance if a grower's water supply is taken from him by municipal or other authorities as a result of a disaster condition. We will keep you informed on our progress.

In the meantime, while we cannot control the weather patterns that are blocking seasonal storms from Southern California, as an industry we can make sure we are using the most efficient water conservation techniques available to us. Our goal continues to be keeping our domestic customers and consumers supplied with our nutritious, healthful and tasty fruit throughout this year and in the future.

How Much Water?

BY RICHARD P. MARROCCO, FALLBROOK AG-LABORATORY

Over the last 15 years, Fallbrook Ag-Lab has followed the watering programs as well as fertilizer programs on some of the highest producing avocado groves in the industry.

Any grove averaging 10,000 pounds per acre of Hass avocados, consistently is receiving a minimum of 300 gallons per tree per week. Most high producing orchards receive at least three acre-feet of water per acre annually.

Unfortunately, there are no short cuts on water, the more the better.

To induce consistent heavy crops in Hass orchards, it is critical to keep the chloride salts below the root zone by leaching. Also, it's critical to give enough time between irrigations to dry out the soil profile to enable oxygen to move through the soil pore spaces. Oxygen moves very slowly through a wet soil and will cause anaerobic conditions rapidly. It takes oxygen for the normal cation exchange to occur around the roots. If the electrical conductivity or chloride is too high in the root zone, severe damage will occur during the drying cycle between irrigations due to the uptake of chloride salts. Every

orchard's requirements are different, but long, infrequent irrigations are best, leaching salts and leaving enough time between irrigations for oxygen to return.

Keep in mind that for each acre-foot of water, one receives roughly one ton of salts per acre. A properly irrigated orchard will receive at least three tons of salt per acre per year. At the end of each season, a grove must be irrigated aggressively until it receives at least three or four inches of rainfall in one week. One inch of rain is not adequate to leach accumulated annual salts; in fact, it puts perimeter salts in solution which intrude on the root zone, aggravating the already precarious tipburn burden.

Keep watering until salts are leached at the end of each season. On light rain years, orchards must be leached heavily in fall and spring.

Probably the most critical water management time is during the bloom. The soil must be salt free at this time to help induce heavy sets. A good way to determine if salts have been leached adequately is to take EC soil tests below the zone. The EC is the conductivity of the saturation

AVOCADOS

extract from a soil, expressed in millimhos per centimeter at 25 degrees centigrade. This is an index of the total salt content of the soil.

An EC of less than 2 indicates no salinity problem. An EC of 2 to 4 restricts growth of salt sensitive crops. An EC of 4 to 8 restricts growth of many crops. With an EC of 8 to 16, only salt tolerant crops do well. If the EC is greater than 16, only few very salt tolerant crops survive.

If the EC in the root zone and six to 13 inches below is not lower than 2, keep leaching. Good year-round water management is critical for heavy production.

Richard Marrocco of Fallbrook Ag-Laboratory evaluates groves, consults on pest control, and provides surveys for some 2,000 acres of avocados and citrus.

Sufficient Water is Important

By Richard P. Marrocco, Entomologist
Fallbrook Ag-Laboratory, Inc.

Over the last nineteen years, Ag-Lab has followed the watering programs as well as the fertilizer programs on the highest producing avocado groves in the industry.

Any mature grove averaging 10,000 pounds per acre of Hass avocados consistently is receiving a minimum of 300-400 gallons per tree, per irrigation. Most high-producing orchards receive at least three to four acre feet of water per acre annually. The production record holders have received six acre feet per year.

Unfortunately, there are no short cuts on water: the more the better.

To induce consistently heavy crops in Hass orchards, it is critical to keep the chloride salts below the root zone by leaching. Also, it is critical to give enough time between irrigations to dry out the soil profile to enable oxygen to move through the soil pore spaces. Oxygen moves very slowly through a wet soil, and will cause anaerobic conditions rapidly. It takes oxygen for the normal cation exchange to occur around the roots. If the electrical conductivity (EC) or chloride is too high in the root zone, severe damage will occur during the drying cycle between irrigations due to the uptake of

chloride salts. Every orchard's requirements are different, but long, infrequent (weekly) irrigations are best, leaching salts and leaving enough time between irrigations for oxygen to return. The most days between irrigations should be seven to ten in winter months, and at

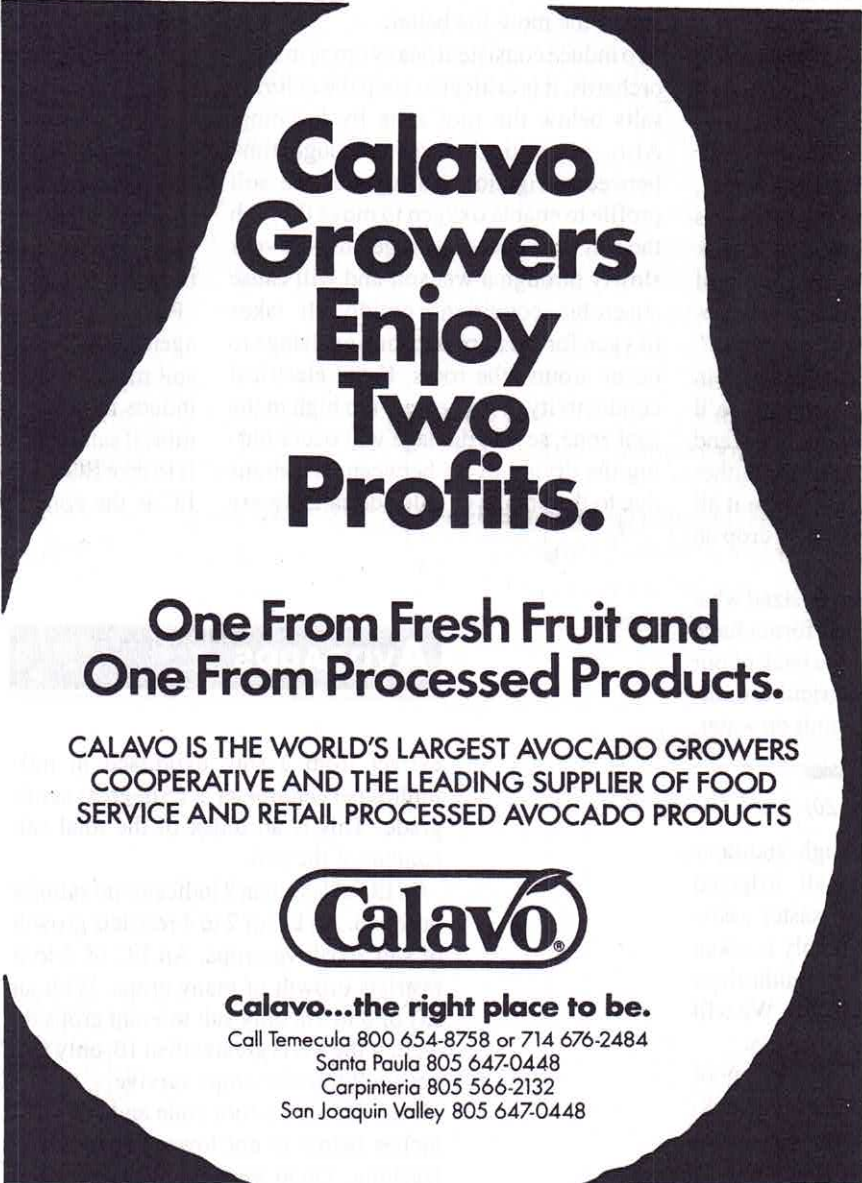
least four to seven in mid- to late-summer months, as an average. If possible, with weather over 90 degrees with low humidity, the trees should be irrigated with 100 gallons a day to prevent stress.*

A Good Rule of Thumb

Irrigate trees with 300 gallons of water per irrigation, per tree, per week. When temperatures are under 85 degrees, this would be the norm. When temperatures range from 85 to 95 degrees, or are forecast to be in that range, irrigate twice a week with 300 gallons per irrigation. Said differently, when the temperature is mild, apply 300 gallons per tree per week; when it is hot, apply 600 gallons weekly. When it is very hot, with

temperatures up around 100 degrees, put down 300 gallons; then immediately begin to irrigate every day, if possible, with 100 gallons per tree per day until temperatures drop to 85 degrees or lower.

(Continued on page 11)



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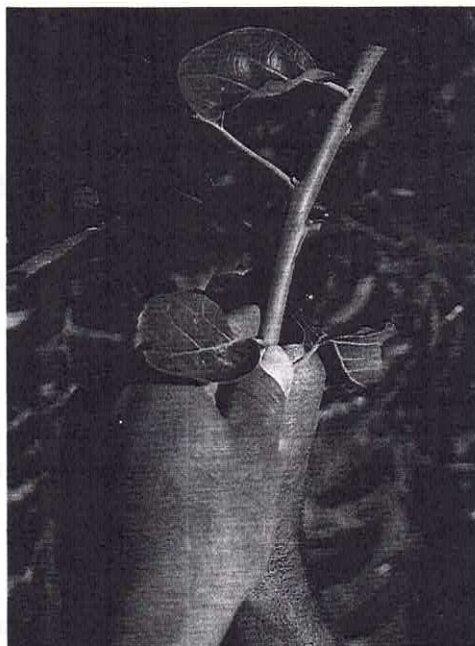
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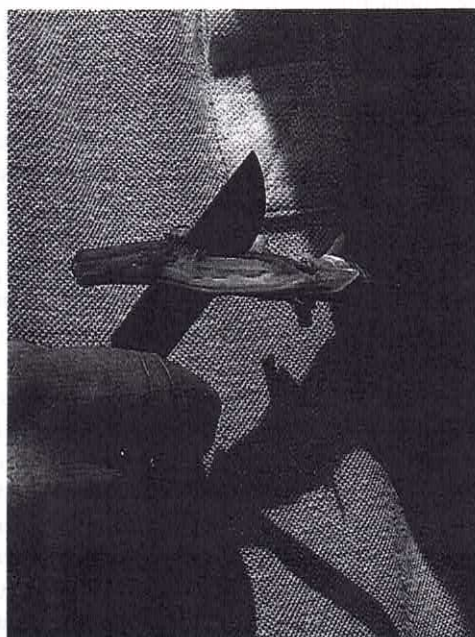
BORN AGAIN TREES

COVER

Born Again: Large sick avocado trees can be grafted, thus reducing the load on the root system, according to Richard Marrocco, grafting expert. This stimulates new vigor and in connection with new chemical technology, the trees will recover and grow indefinitely. The subject tree must retain some sign of life, however. To speed heavy production and dollar returns the trees can be grafted to a precocious heavy producer, the Gwen. Photos by Miles Burke. Story on page 14.



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4



Born Again Trees

Grafting

About seven years ago Richard Marrocco, entomologist and president of Fallbrook Ag-Laboratory, Inc., discovered he had encountered a slow period in leaf analysis and root rot testing due to the avocado recession.

To supplement his lab duties he decided to go into grafting. With the Gwen avocado on the horizon, and thinking everyone would want one, he geared up for that variety, only to find he was about the only one doing Gwens. As this is written, the laboratory has grafted well over 35,000 trees to Gwen.

Most grafting operations are with shoots because of a limited supply of

The key to grafting is perfect budwood selection and great manual dexterity

budwood selection and great manual dexterity, Marrocco told *California Grower*. He has also experienced an increase in takes by encapsulating the bud sticks in Parafilm, a material that is used not only in most laboratories, but on burn patients also.

Fewer special skills are needed for shoot or sucker grafting. It is also more cost effective than bark grafting with fewer problems with eventual breakage. Marrocco also recommends a splice technique for shoot/sucker grafting.

Bark grafting, on the other hand, presents a dilemma. First, it is touchy to get takes with bark grafts because the stump may be too wet or too dry. Second, it is difficult to know how much water to apply to a stump graft for a good take. Third, tar used on a bark graft increases the humidity factor in the stump so the scion does not become excessively dry. Increasing humidity aggravates soft rot (poria disease) at the stump. Marrocco will perform both bark and shoot grafts, but he greatly prefers the sucker graft.

Marrocco has, over the past seven years, developed two sheets of instructions, which he notes is now appearing in print for the first time, on shoot or sucker grafting. The instructions have been constantly altered over time, based on questions and comments by growers.

Here are the instructions with accompanying art based on photographs taken in the field. (The grower is first advised to draw an exact map of the grove location and trees to be grafted.)

1. Cut tree off one to two feet above the soil line; two feet is preferred.

2. The goal is to keep the soil moist but not soggy and to prevent drowning of stumps. If irrometers are present use a one-foot centabar reading of 25 to 30 to turn on the water. Avoid over-irrigation. Stumps can drown or cease to grow with too much water. In general, reduce water 50 to 75 percent of what the mature tree

was getting depending on soil type. Do not change the irrigation pattern. Approximately 25 to 50 gallons

of water per tree every four to eight days is required.

3. Do not fertilize grafted trees for 6-12 months. The second year, fertilize the same as a two- or three-year-old tree.

4. All cut ends should be bordeauxed. Mix four pounds of bordeaux with one gallon of white latex paint and dilute the entire mixture with 50 percent water, or mix the bordeaux in water to the consistency of paint; then paint all cut ends, then white latex over everything. Do not tree seal (tar mixture) cut end of trunk. The above will help prevent soft heart rot (porea). A bordeaux mixture is not necessary on bark. The stump should reflect heat from the sun.

5. Shoots will take approximately three to five months to appear. Begin removing shoots immediately leaving only three, two of them to be grafted. When the shoots are two to three feet tall, remove side branches up one foot, leaving leaves, cut side branches, and whitewash lower foot (Diagram A). When the side branches have been removed and the shoots are at least two feet tall, call us. It is time to graft. Side branches should not be cut off any closer to main stalk than one inch. They will naturally abscise.

6. Whitewash the entire shoot just below the scion (bud stick) on the south side. Whitewashing is very important; stump and bottom of shoot should be kept white at all times until the tree is big enough to shade the stump and new green shoot. Thus, whitewashing may have to be done more than once, even the second year. If it has been papered, open top of papers 30 to 40 days after grafting.

7. Pests such as snails, ants, earwigs and so on, must be baited once a month. If not controlled, the snails will consume all new growth tissue and the scion will die.

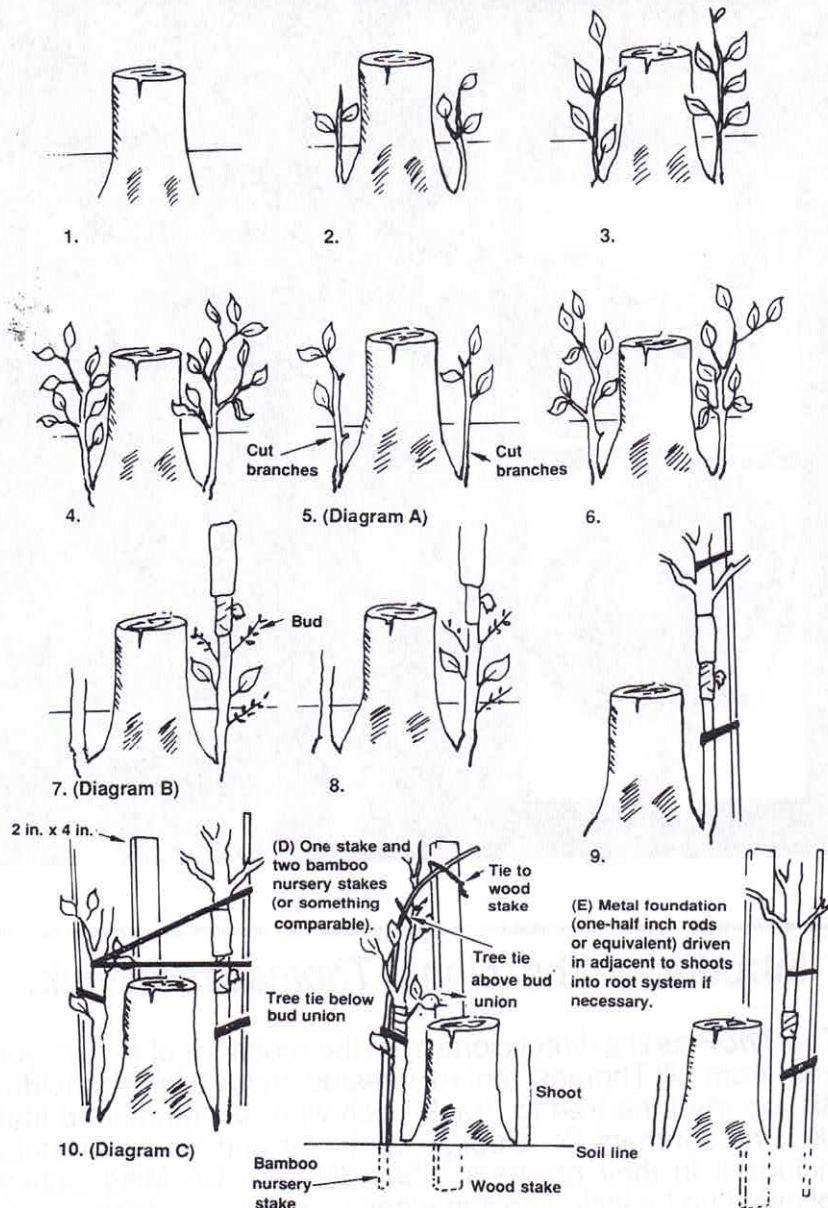
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Photos from top left: 1. Selection of budwood is a critical step and must be in the correct stage of development for a successful graft. 2. Budwood (scion) is encapsulated within a Parafilm tape. 3. Scion must be planed perfectly flat with extreme care. 4. Closeup of the correct slicing technique. 5. The sucker to be grafted must match perfectly with the scion cut. 6. Parafilm is also used to attach the scion to the sucker.

budwood. However, Marrocco feels shoot grafts show more merit than bark grafts because there is a higher percentage of takes and shoots are more durable and less prone to poria heart rot.

The key to grafting is perfect

GRAFTING



1. Cut trees one to two feet from ground; whitewash and bordeaux mixture, and reduce water (depending on rainfall and soil type).
2. Cut off all but two shoots; root shoots are preferable, one each side of tree if possible.
3. The two shoots grow very rapidly.
4. Remove all side branches leaving one-inch stubs. Do not remove large leaves on shoots. (Diagram A)
5. Side branches removed, leaves left intact. Whitewash lower one foot of shoot with 50 percent latex paint; no bordeaux. (Diagram A)
6. When shoots are two to three feet tall, they are ready to be grafted.
7. Remove new growth and buds below the graft. Both trunk and shoots should

- have buds removed. Not on grafted scion. (Diagram B)
 8. Wait four to six weeks to stake. Scions cannot be bumped after grafting.
 9. Stake and tie as soon as graft appears above the paper.
 10. Tree tie above and below the bud union. Continue tying the graft as it grows. (Diagram C)
- Four to six weeks following grafting, aggressive staking must occur because shoot grafts are very tender for six to eight months. Ideally, two stakes should be used so that the graft can be supported from both directions. If one is used, several approaches are possible. (Support must be implemented when scion is five inches long.)

Squirrels must also be baited and kept under control as they also chew on the scions. We have even had problems with crows and ravens destroying grafts.

8. Remove all new growth and buds on the shoots and trunks, except the buds on the new bud sticks. (Diagram B).

9. Four to six weeks **after grafting**, stake with two nursery stakes at least two feet longer (higher) than the bud union or one wooden stake and two bamboo nursery stakes. (Diagram D). Support the shoot immediately below the graft. As soon as practical, support above the bud union with tree tie tape or similar as soon as the graft grows (do not use twine). (See Diagram C). (Grafts cannot be bumped for four to six weeks after grafting. Once they grow, grafts are quite delicate and must be supported immediately, very aggressively.)

10. Please let us know about any no-takes as soon as possible.

11. It may be necessary to prune the scion to prevent breakage because of rapid succulent new growth.

12. Do not skirt for several years. This will help support the young graft and avoid trunk breakage due to heavy winds. Only skirt to enable a good wetting pattern.

13. For frost prevention, direct spitter on new graft and continually water when temperature drops below 30 degrees.

14. Please study Diagram D.

Controlling Poria

Richard Marrocco offers some kind words to growers regarding heart rot fungus on avocado trees.

"Due to humid summers, the avocado industry is plagued with heart rot in grafting or cut stumps," he writes.

"Poria, a heart-rot fungus, can eventually rot out the stump and the graft will blow over. To prevent this problem, all cut ends of tree stumps should be bordeauxed at the time they are cut, not tarred or tree sealed. The tree seal keeps the humidity high, causing the cut ends to rot.

"If Poria has already taken hold in stumps or grafts, chainsaw out all soft wood and bordeaux the fresh cut end. Do

not tar or tree seal. The bordeauxing may have to be repeated several times a year until the cut ends heal.

A Word About Gwen

Early in the game, Richard Marrocco became a Gwen avocado enthusiast, taking a personal interest in the variety which is, after all, genetically a Hass grandchild. He says we have Dr. Bob Bergh, specialist at the University of California, Riverside, and his colleagues, to thank for the 1986-87 study on breeding improved avo-

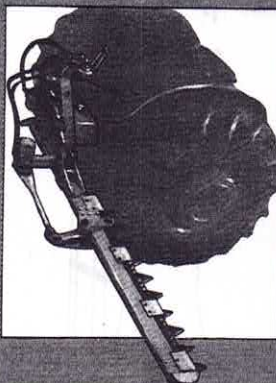
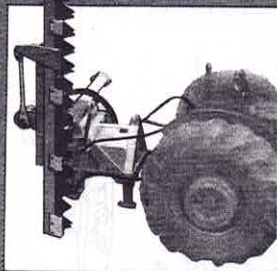
All cut ends of tree stumps should be bordeauxed at the time they are cut, not tarred or tree sealed.

cado varieties. Based on field testing at the South Coast Field Station, Hass produced 8,000 pounds of fruit per acre; compared to 64,000 (that's right) pounds per acre for Gwens. It was expected that Gwen would at least double Hass production. Calavo Growers soon got the message, as did Index, and the Gwen became a success story, and Marrocco swears by it in grafting avocado.

Richard Marrocco of Fallbrook Ag-Laboratory is at present pursuing a Master of Science degree in Pest Management at U.C. Riverside and has a B.S. degree in zoology-entomology at California State Polytechnic University, Pomona, 1973 and an Associate of Arts degree in zoology at Riverside City College, 1971. He evaluates groves, consults with grove managers in pest control, and provides surveys for some 2,000 acres of avocados and citrus in San Diego and Riverside Counties.

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Essential Leaf Analysis

BY RICK MARROCCO

Leaf analysis is an essential procedure for avocados. Without leaf analysis the exact nutritional status and direction of the tree is in doubt. A standard "rule of thumb" fertilizer program may work for several years, then trees may begin to alternate slightly, sometimes drastically, producing well perhaps every third year or less. They may even appear to suffer from avocado root rot, maintaining an unthrifty appearance, with small leaves and the like.

In the arid acid sandy soil of hillside avocado groves in some sections of California, phosphorus deficiency can occur and/or can be induced. These soil types just don't contain enough phosphorus to sustain a Hass tree more than five years. Another common occurrence is that when ammoniacal fertilizers drive the pH level below 5.5, the aluminum in the soil will permanently tie up the available phosphorus. In this case, the pH must be raised by the use of nitrate nitrogen which allows the bicarbonate salt in the water source to elevate the pH. Once the pH is above 5.5, the phosphorus will no longer tie up, provided zinc (which can do the same with phosphorus) is not applied at the same time.

Another cause of severe alternation of the Hass avocado tree is lack of nitrogen. Nitrogen deficiency causes a general chlorosis (reduced chlorophyll), thus a lack of starches and eventually a depleted root system that leads to a breakdown in production. Application of zinc is also critical to the prevention of minimized production and/or inferior small, round fruit. It is important to apply zinc properly to

avoid tie ups with phosphorus. Potassium application creates a few concerns. We recommend regular applications to prevent deficiencies.

The tissue analysis levels preferred in a well-irrigated, (non-stressed) Hass avocado tree with a pH between 5.5 and 6.5 are as follows:

Nitrogen: at least 2.2 percent

Phosphorous: .14 to .16 percent

Potassium: anything just above .75 percent

Zinc: from 40 ppm to 100 ppm, 70 is adequate for maximum production

The soil perimeters should also be followed religiously:

Soil pH: 5.5 to 6.5 (saturated paste) sample from root zone

Soil EC: less than 1.5 root zone sample (soil extract)

Soil Chlorides: less than 100 mg/L root zone sample. See chart page 8.

If district water contains salts, all other elements are usually in good supply. Heavy producing Hass orchards receive three acre feet of water annually, one acre foot of water contains one ton of salts. Thus each acre in a well-irrigated orchard will receive three tons of salt laden with all the essential elements.

Proper leaf analysis is ideally performed on four to six-month old leaves picked after August at the beginning of the avocado season, from non-fruiting terminals on north, south, east and west sides of individual trees which randomly represent a block in question. The leaves from a weak section should be picked separately. Do not mix weak trees with healthy ones. Immediately refrigerate, then wash

Avocado Marketing Data

(as of July 1, 1989)

Shipments (mm/lbs)

Variety	Week Av.	Total	Begin
Hass	6.2	26.6	0.65
Fuerte			Harvest Completed
Zut/Bac			Harvest Completed
Others	0.4	1.7	0.51
TOTAL	6.6	28.3	0.64

Prices (Cents Per Pound)*

Low	High	Ending	30-Day Average
0.64	0.71	0.66	0.68
0.40	0.51	0.45	0.44
0.63	0.69	0.64	0.67

*Prices are projections only based on #1 Fruit AMRIC Prices.

Commentary:

According to projections based on AMRIC, the June 1989 average price per pound was around \$0.67 for all varieties. For most of the month, the market was stable.

Shipments for June 1989 averaged 6.6 million pounds a week. Total shipments for the month were 28.3 million pounds. The weekly shipment level was expected to decrease to around +/- 6 million pounds during July. The Year-to-Date shipment level is still 15% behind pre-season projections. Handlers are urging growers to carefully coordinate the harvest of the remaining crop in an effort to maximize returns through the end of the season.

NEXT 30-DAY SHIPMENT OUTLOOK (IN MILLION POUNDS) JUNE 1989 (Projection Only)

Variety	Week Av.	Total
Hass	6.0	25.8
Fuerte	0.0	0.0
Others	0.2	0.9
TOTAL	6.2	26.7

and heat dry leaves to kill them as quickly as possible. If samples are left to die slowly, they continue to metabolize, disturbing the tissue analysis levels and insuring the development of misleading data. This is very important: Leaf analysis and accurate fertilization only work if the grove is irrigated properly. To induce consistently heavy crops in Hass orchards, it is critical to keep the chloride salts below the root zone by leaching. Also, it is critical to allow enough time between irrigations to dry the soil profile so that oxygen can move through the soil pore spaces. Oxygen moves very slowly through a wet soil and will rapidly cause anaerobic conditions. It takes oxygen for the normal cat ion exchange to occur around the roots. If the EC (Electrical Conductivity) or chlorides are too high in the root zone, severe damage will occur during the drying cycle between irrigations due to the uptake of chloride salts. Every orchard's water requirements are different, but long infrequent irrigations are best for leaching salts to allow enough time between irrigations for oxygen to return. The cat ion exchange is also hampered by a too low or a too high pH.

Wheat Combination

Escondido grower Earl Bishop applies practices learned with other crops to avocados. For instance when his trees were two months old, Bishop mulched the floor of his avocado grove with fresh wheat straw. After the winter rains, the viable wheat seed sprouted beneath the trees.

"In my rounds through the avocado fields, I'll pull a head of wheat. I've grown a lot of wheat for grain, so I know that to grow four ton of wheat, you need to have 12 to 13 kernels long on a head. In spring I had eight kernels to the head and knew my avocados needed more nitrogen." He immediately planned a tissue test. Bishop's attention to nutrients has pushed his 18-month-old avocado trees to a lush seven-foot tall.

Bishop knows fertilization is a basic concern in producing strong trees and high quality, large quantity fruit. Both have, in the past, produced crops by supplying only the trees' basic needs. But Bishop knows that farming in California with its rising land prices and faster rising water costs, no grower worth his lemons or avocados can settle for just the basics.

Trickling Water Technique

BY JACK SHEPHERD

Flooding to basins; furrows to overhead sprinklers; under-tree sprinklers to drip. Then micro-irrigation (drip and mini-sprinkler).

Thus systems to apply water to avocado trees have evolved. Though the first four are seldom seen in these times, they were "state of the art" in the avocado industry's early years.

Drip (or trickle) irrigation as a new technique in avocado culture marked a major development. Its introduction, which must be heavily credited to former farm advisor for San Diego County, Don Gustafson, made feasible the planting of thousands of hillside acres of avocados.

But, hold! A peek into history reveals that "drip irrigation" is in fact not new at all—just a system revisited and improved. At an irrigation symposium at the Mission Inn in Riverside in 1917 (72 years ago) discussion leader Dr. Lester Keller of Yorba Linda told of irrigating his avocados by a drip system of his own design: Pipe "uprights extend above the ground 2.5 feet from the tree. . . On top of this pipe I have placed a gas-cock instead of a faucet. . . The first year, I basined the trees, and turned on the faucet with a slow stream every ten days. The second year, the basins were leveled and the drip system started, watering the trees every two weeks. The drip runs for 48 hours. . . two

to four barrels per tree. . . so slowly that it does not run off. A one-half inch pipe extends down from the faucet to one side or the other of the tree for distributing the water as it is required."

William A. Spinks of Duarte—"father" of the infamous Spinks variety—thought Dr. Keller was applying too much water, but agreed that drip irrigation had its place: "The drip system of irrigation is my own invention, and I believe is valuable for certain kinds of work. It is especially important to save water; and where the planting is on a hillside or any place that is difficult to comply with ordinary methods." T.U. Barber of Puente worried: "The constant drip irrigation which Dr. Keller is practicing will develop what are often termed water shoots. . . subject to damage by both frost and wind. . . I am sure we all hope the winter will be mild so that Dr. Keller will not have to grow new trees."

California Avocado Association President William H. Sallmon later recalled that Dr. Keller "stands almost, if not quite, alone in his advocacy of the constant drip irrigation which he practices on his nine-acre avocado grove." That was then. Now, Dr. Keller stands vindicated by estimates that 60-70 percent of present-day avocado groves are micro-irrigated. So, evolution brought us a sophisticated system. What we most need now is sophistication in water management.

Suppressive Soil Organisms

STAFF REPORT

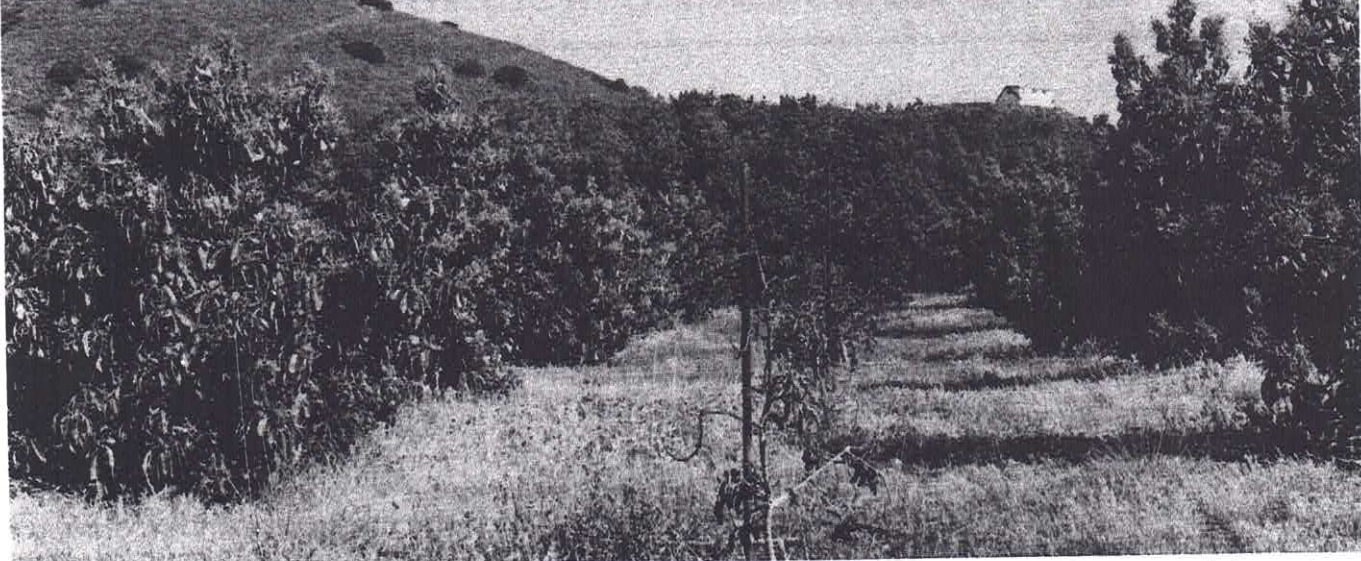
Phytophthora control linked to organisms in Australian rain forest conditions is under study. According to Dr. Tony Whaley, extension specialist who spoke at a growers meeting in Riverside County, the rain forest is dotted with a plant species which are susceptible to *phytophthora cinnamomi*. But not one rain forest species is dying. Thus scientists believe this condition exists because of suppressive soils which develop in the rain forest environment.

"We have been extracting various organisms out of these soils and culturing them, and we have demonstrated conclusively that we can get *phytophthora* control if we can utilize these organisms in an orchard situation," Dr. Whaley said.

Suppressive soils is also a topic addressed by Dr. Mike Coffey of UC Riverside. After screening about 200 organisms in a California avocado grove, he and his colleagues came up with "strain TW." Research is now in progress to find good methods of utilizing this strain. They are testing a granular formulation of the product, Dr. Coffey reports, and also are considering an application method involving impregnating TW into a lignocellulose fiber material that might be used as a biodegradable container.

CG

Hass Said To Need More Phosphorus



This research plot in Rancho California proved that control trees (center row) treated only with nitrogen and zinc and no phosphorus would not prosper compared to rows on the right and left. Trees on the left were treated with 16-10-0. Trees on the right were treated with 15-15-15 and did equally well, according to researcher Jon Tracy.

Staff Report

Fallbrook — There is compelling evidence that Hass avocado trees need more phosphorus (P) from fertilizers than previously believed.

This is the word from UCR's venerable Dr. Tom Embleton after observing a series of trials carried out by Jon Tracy, a UCR graduate, working with Richard Marroco, an entomologist who also owns the Fallbrook Ag-Laboratory.

Embleton told growers meeting here in late March that previously acceptable leaf analysis levels of .08 for Fuerte should be increased to .10 in Hass.

"Although a fruit yield increase from added phosphorus has not been documented as yet, ...the vegetative response to additions of phosphorus is clear," Embleton wrote in a statement he gave *California Grower* and which accompanies a paper Tracy submitted to the California Avocado Society *Yearbook* last December.

Embleton also noted that "I have observed the progress of the experiments reported by Tracy and concur with his conclusion that a leaf phosphorus value below 0.10 percent on a dry weight basis in spring-cycle leaves sampled in the mid-August to mid-October period likely indicates phosphorus deficiency for the Hass avocado."



Researcher Jon Tracy

These phosphorus fertilizer applications are not to be confused with the phosphorus acid which is receiving good results in treating root rot by injection in avocado trees in Australia, according to San Diego Farm Advisor Dr. Gary Bender at whose grower seminar Embleton appeared.

In his research paper, Tracy notes that phosphorus (P) deficiency in San Diego-Rancho California groves "is seen to be significant."

His research involved establishing the existence of phosphorus deficiency in some rows (control), along with uniform applications of nitrogen, zinc and water in other rows. In his tests begun in 1983, typical treatments on 20-month-old Hass consisted of +P = 0.15 pounds of P_2O_5 per tree or +P and +K = 0.15 pounds of P_2O_5 and 0.15 pounds of K_2O per tree. (The percent P reported on a fertilizer bag is actually expressed as P_2O_5 equivalent.)

Commenting on his experience with the number of groves low in phosphorus, Marroco said "I am making literally hundreds of recommendations for the use of white phosphoric acid based on Jon Tracy's work as well as my own field observations and some excellent studies done on clients' orchards. Keep in mind that the timing is critical because phosphorus interferes with or ties up zinc."

"It is obvious we're getting an increase in production especially if nitrogen, phosphorus, zinc and water are well supplied. It is amazing the amount of groves low in phosphorus. People often use too much of the wrong element and not enough of the proper element and not enough of the proper element at the appropriate time."

Regarding phosphorus applications, Embleton suggested banding it around drip lines around the tree. Applying it through drip lines, however, will carry it much deeper, he said.

Embleton went on to make these points at the Fallbrook meeting:

- Experience with citrus and avocados shows that the timing of nitrogen applications has no effect on production. "The amount applied matters."
- Don't apply any nutrient until the need is proved.
- Economize by following leaf analysis. Over fertilization in citrus and avocados is a major problem. □

Microscopes Rank With Chemicals In War Against Phytophthora



Entomologist Richard Marrocco says the industry's "sloppy" procedures often lead to the spread of root rot.

In more ways than one, the last line of defense against the disastrous root rot which has economically crippled California's avocado industry for years is a guy in a laboratory peering through a microscope.

It is the researcher who has come up with today's fungicides and resistant rootstocks as well as the ability to diagnose the presence of *Phytophthora cinnamomi* in the grove.

Today, a handful of agricultural labs around the state — and in other states — is enabling growers to more accurately diagnose their groves than ever before.

Sadly, while the defense and offense against root rot have never been stronger, there has never been more root rot than today.

As groves have proliferated, so too has *Phytophthora*. When Rancho California's first groves were developed in virgin soil, *Phytophthora*

'Most root rot situations could have been prevented. Basically, we've got a sloppy system which is lazy in prevention.'

appeared almost with the first planting — a situation called "tragic" by no less a figure than Dr. G. A. Zentmyer, the University of California's (Riverside) expert for almost 40 years.

One man who recently addressed himself to this problem of spreading root rot is Richard P. Marrocco, president of Fallbrook Ag-Laboratory, Inc., in Fallbrook, California.

Marrocco was singled out by *Avocado Grower* for a brief interview as typifying the type of professional help now available to growers.

His lab has identified over 150,000 samples as positive for *Phytophthora* and he has personally taken over 60,000 samples in the field.

Recently he told a reporter there were several factors in the "picture" of root rot problems in the industry and he identified them as:

1. The industry, because of competitive pressures is often "sloppy," and this allows root rot to proliferate.

2. Eradication of the disease, which might begin with certification for all ornamentals sold (the host list now numbers some 950 plants), is simply too expensive in terms of dollars and time.

"Most root rot situations could have been prevented," Marrocco recently noted. "Basically, we've got a sloppy system, a system which is lazy in prevention. We move it around ourselves, on shoes, tools and bins, among other things."

Stressing the amount of root rot he currently finds, Marrocco noted:

"Probably 50 to 60 percent of all groves have root rot. Most larger groves have some small amounts."

"The whole system is really at fault. The problem is that in order to take the proper precautions you need to slow down, but if you slow down, you can't compete. *Phytophthora* is easily prevented in groves but given our system, there is no room for prevention"

Marrocco indicated that one of the biggest potentials for moving the disease around was in taking root samples for the disease.

"We really don't encourage growers to take their own samples. Experience has a lot to do with it. For instance, you bypass obviously healthy trees and look to the traffic patterns and susceptible roots which are not too degraded and not too healthy."

The spread of root rot remains a

chief concern. Researchers at UCR sum up the situation this way:

All spore stages can actively transmit the disease. The following are some common avenues for root rot to be moved: roots, soil, gopher holes, running water, film of water, and organic matter.

All spore forms and sporangia are microscopic in size and can be transported easily by moving water. Running water also transports soil, small roots and other organic matter containing the fungus.

Gopher holes are notorious for having water run down them great distances underground. Usually water pumped out of a permanent pond for irrigating does not have the fungus, but caution should be taken to make sure.

If there is any indication that there are spores present, then water pumped onto the grove should be chlorinated or treated to kill the fungus.

Early detection is a key to controlling the spread of root rot in your grove. Watch your trees for these signs, researchers counsel:

- Leaves may be smaller and paler than normal.
- Leaves may be wilted.
- New growth may be stunted, deformed or totally absent.
- Leaves may drop, giving the tree a sparse appearance.
- Soil may tend to stay wet longer because lack of healthy feeder roots restricts the ability of the tree to absorb moisture.
- Infected trees may set an abnormally heavy crop because the loss of roots has a girdling effect on the tree.

When The Question Is Root Rot The Answer Is Fallbrook Ag-Lab

Where do you look for root rot?

Suspicious looking avocado trees: Look for early symptoms. Weak, nutrient deficient, wilted, or tip-burned avocado trees should always be tested for root rot. Don't wait for obvious signs; early detection is the best cure.

Other plantings: Over 900 plants are known to support the root rot fungus, including fruit trees, pine trees, and ornamentals. Avoid plants that are host of the fungus or have them tested before they are planted.

Traffic patterns: Bin stops, tool locations, dumps, filter stations, fertilizer injector or storage areas should be checked regularly.

Top Row: Rick Marrocco, Entomologist; Berry Francis, Soil Scientist; Jonathan Tracy, Soil Scientist;
Second Row: Peggy Oelschlagel, Bookkeeper; Mary Reisman, Lab Helper; Joy Engler, Lab Assistant; Dr. Allen Troxel, Plant Pathologist;
Bottom Row: Kathy Frank, Typist; Sharon Hamman, Office Manager; Heather Hester, Soil Scientist; Dorothy Troxel, Lab Technician; Teresa Machado, Lab Helper.



Experience is the key to our success — We know where, when and how to test for root rot. Our staff is knowledgeable in all aspects of root rot testing. Root and fruit traps, as well as *Persia indica* tests, are double plated for more accurate results. And all work is done in our lab by specialists who take their business seriously.

Don't let root rot go undetected in your orchard. Ask about our quarterly or bi-annual surveys which include soil pH, root rot testing, leaf analysis and consultation at reasonable prices.

- Leaf & Soil Analysis
- Grove Evaluations
- Root Rot Testing
- Water Analysis
- Insect Pest Management
- Agricultural Feasibility Studies

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Our Mission: To provide California Avocado Growers a means to achieve optimum profitability, now and in the future, through focused research, global collaboration, and effective communication of results.

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Entomology Pricing and Service for 2017

Monthly visits are typically adequate plus insight developed from surrounding groves. I work the coast, inland to Palomar and Ramona and can usually predict infestations and trends.

Monthly cost for this service is \$3.00 per acre with a \$90.00 minimum for small orchards, payable at the beginning of each month.

This does not include any aspect of disease, leaf or soil analysis which is a separate service. Proper leaf analysis, etc..., entails a lot of time and experience to achieve accurate results. Thus, billing for these services will be separate.

A handwritten signature in black ink that reads "Richard P Marrocco". The script is cursive and fluid.

RICHARD P MARROCCO
Entomologist
Cal-State Advisor
License #073561

Richard P Marrocco
PO Box 1269
Fallbrook CA 92088
(760) 728-4828

Resume 2011

Education

Associate of Arts Degree in Zoology-Riverside City College-3 years

Bachelor of Science Degree in Zoology/Entomology-Cal Poly Pomona-3 years

University of California, Riverside-Pathology, Plant Nutrition, Leaf & Soil Analysis-4 years

Experience

1973: Entomologist-Ventura to Fallbrook California Area of Responsibility

1974:Went back to school at UCR to set up Fallbrook Ag-Lab while working as an entomologist.

1978:Fallbrook Ag-Lab opened for business.

1978-2011:Fallbrook Ag Lab services avocado groves from Morro Bay, California to Cordoba Mexico.

Fallbrook Ag-Lab, owned and operated by Richard P Marrocco, currently has over 3000 Avocado Grower clients and advises on all aspects of managing avocados from nutrition, leaf, soil, water analysis, entomology, pathology, harvesting and orchard development.

Richard P Marrocco is the sole principal of Fallbrook Ag-Lab and also owns 100 acres of avocados in Fallbrook California.