California Avocado Society 1991 Yearbook 75:101-117

The Israeli Ways

H. Leonard Francis
Production Research Controller, California Avocado Society

Preface

A couple of other articles have been written about this research liaison trip, hitting specific points and being short and direct, and a more extensive oral report was made at the Society's 1990 annual meeting. For this permanent record, I was asked to transcribe my tape recorded notes as I made them: in chronological, narrative form. Please join me and my Israeli friends as we surveyed this historical, biblical, modern, troubled, innovative, beautiful country. *—H.L.F.*

I arrived in Israel, at Ben-Gurion airport, Tel Aviv, at 7:00 p.m. Saturday, May 18th, rented a car from Hertz, and headed into Tel Aviv to try to find the Mariah Hotel. It was already dark. The project was a little tricky, as parts of Tel Aviv are quite new and other parts are quite old (the old city of Jaffa). I was of the understanding that the Mariah Hotel was outside of Tel Aviv, before I got there. It turned out to be on the coastline of the Mediterrean, between the Sheraton and the Hilton Hotels. It is a "super" place, except that I couldn't find any place to park. It is the vacation center of Israel—very busy. At 10:00 p.m., I called Ilan Eshel to report my arrival, but there was no answer.

May 19th. It is Sunday. I got up at 5:30 a.m. and at about 6:00 successfully called Han, who told me to call Dr. Ben-Ya'acov about 7 o'clock. I went out for a long walk. On my return, I contacted Dr. Ben-Ya'acov, and headed for a destination about 55 km north, intending to arrive there around 9:00 a.m. On the way to Hadera, I noticed smoke coming from the hood of my rented Malaga. Someone, it turned out, had forgotten to put the oil cap on, and I wound up with oil everywhere, including my shirt.

It was of interest, while driving along the coastal highway en route to Hadera, to note the kibbutzim (Israeli farm settlements) indicated by circles on my map. A typical kibbutz appeared to be a town larger than my own town of Temecula, with much bigger and newer buildings. Each one probably has five to ten thousand people. This was an error, I realized later as I visited some of the kibbutzim. I was mistaking small towns for kibbutzim. It was also interesting to see an occasional car just pushed

off to the side of the road and completely demolished. They did not appear to be the consequence of anything like "artillery problems." Soldiers were seen occasionally

along the way, apparently on leave. The last couple I saw were black. What Israel refers to as "towns"—such as today's destination, Hadera—appear to be decent sized cities of probably 40 to 50 thousand people. Hadera has the largest power producing station, entirely powered by coal.

Dr. Ben-Ya'acov met me at his office. He explained that today was a Hebrew holiday celebrating the First Harvest. We would only be able to see a few people because of the holiday. It was also Sunday.

Dr. Ben-Ya'acov related that there are between eight and nine thousand hectares of avocados in Israel—roughly 20,000 acres. The mid-coastal area and the north coastal area and the western Galilee valley contain about 80% of the Israeli industry.

Just before the Kibbutz Ma'agan Michael, I drove past a village whose residents are of Egyptian ancestry. Most of them are black. The village looks as though it were on an atoll. It is well over 100 years old.

At the Kibbutz Ma'agan Michael, most of the avocados are on West Indian selections developed by Dr. Ben-Ya'acov because of the salinity problem. One of the problems with this is that they are very sensitive to soils with poor aeration, so part of Dr. Ben-Ya'acov's selection process was to develop a West Indian rootstock that still had salinity tolerance and could be grown in heavy soils. The West Indian stock that is now used in Israel is clonal.

The Hass avocado here at Ma'agan Michael is at the same stage of bloom that we are in southern California. The Wurtz variety is already finished with its bloom.

Data from every tree within almost 60 acres of Ma'agan is all on computer. The original test plots from 1973 are still being computerized. By accumulating all the annual yield production on each seedling with the respective scion tops, on the Fuertes they were able to determine that clonal rootstocks had great tolerance to salinity, and maybe some other things, supporting their reasoning for that clonal stock. But the most productive selection just happened to be a specific scion (No. 376 in this case) on a seedling rootstock; the results were duplicated on different seedling rootstocks still having the same production, so it was not the stock in this case, it was the scion. There were a couple of instances of this scion on other seedling rootstocks that did not do too well. The best combinations of this Fuerte on specific stocks, in this case usually seedlings, are better production-wise, looking like they are 20% to as much as 50% better, than the best selection of Hass and Ettinger.

At this particular grove, Hilial, the manager of the avocado branch of Ma'agan Michael, has Wurtz and Hass trials, now three years old. The bloom was very heavy; but the set is very poor even though they have bees right at the end of the trial block. On the other side of a cypress windbreak, there are trees of Ettinger, an avocado variety they think is a good pollinator. Everything should be ideal here for cross pollination. One of the situations is that at the other end of their experimental plot is a pomelo grove, and they

have observed that bees go straight to the pomelo flowers, by-passing the avocados. At the Hass trees right next to the bees—and within forty feet of the Ettinger trees—I could not see any difference in production—poor. The trees with the poor set are only three years old. Even though they had a tremendous bloom, they didn't set. On the other side of the windbreak, next to the Ettingers, are Hass trees that appear to be 8-10 years old; bees are within three rows; the fruit set is tremendous. Roughly ten trees away from the Ettingers, the fruit set seems to be just as heavy as right next to the Ettingers. Was age of the tree the factor? I don't know.

Ben-Ya'acov's field research has found that production closer to the Ettinger and away from the Ettinger seems to be about the same, and yet parentage of the fruit changes so that the trees farther away from the Ettinger are essentially selfing, or Hass x Hass, but the production hasn't changed; it is just as good. As will be mentioned later, this is not the case with other avocado areas of Israel.

Kibbutz Ma'agan has roughly a population of 1,200, of which 500 are adult. There are 110 acres of avocados, cared for by four adults. Some youths work in the avocados, especially when there is picking or weeding. Most kibbutzim have fewer than 1,000 people. Other comments on the kibbutz system are made later in this text.

Hilial and Dr. Ben-Ya'acov are very "up" on Dr. Bergh's selection 0028; it is a green fruit and highly productive here. One of the most interesting West Indian clonal rootstocks being used is No. 44; they seem to see absolutely no problems with it, and it does have the salt tolerance.

On the Ma'agan kibbutz, they have strictly drip irrigation. They irrigate every night except when there is rainfall. All of the system is automated with Bermad shut-off valves. There are as many as two rings of drip hoses with a metaphim dripper insert, 8 to 12 drippers per tree. The soil is a loamy clay.

There are some independent farms in this area. Those under ten acres are called a "moshav."

Dr. Ben-Ya'acov believes that almost all West Indian rootstocks can tolerate 400 parts per million of chloride. We need to have the University of California cooperate, through me, with Dr. Ben-Ya'acov on importing some of the strongest West Indian rootstocks tolerant to salinity. California has salt-sensitive rootstocks. It would be nice to not have burned leaves caused by our saline water.

Dr. Ben-Ya'acov believes that, because in South Africa where so many seedlings of West Indian types have escaped root rot, and because almost fifty selections also have escaped root rot in the orchard there in Israel that developed root rot, most West Indian stock tends to be tolerant to root rot.

Dr. Ben-Ya'acov explained: the Volcani Center is the center of practical research for the Ministry of Agriculture. It is the Volcani Center that Dr. Ben-Ya'acov and E. Lahav work

for, as does Datto. For basic information, the Avocado Committee for Israel is made up of Extension, the Volcani Center, and the growers' organization. The Volcani Center and Extension are part of the Ministry of Agriculture.

One characteristic that we saw in the field with the more successful clonal West Indian rootstock—with Fuerte, for example—was an overgrowth to a limited extent, where the rootstock is smaller in caliper than the scion.

On a trial with Fuertes and Ettingers where they are using sewage water for comparison with normal water for irrigation, there is a definite difference in tree color, leaf canopy, and what appears to me a striking difference in fruit set. The sewage water seems to produce a greater fruit set, a greater retention of old leaves, and faster development of new leaves. It would be very interesting to follow up with Dr. Ben-Ya'acov in subsequent years. Nutrients other than just N-P-K could be involved.

Dr. Ben-Ya'acov has a germplasm trial planted in a known root rot area. He has this germplasm planted into high salinity and drought conditions. Walking in this germplasm plot on root rot infected soil, there are definitely trees that have died, some that are almost all gone, and many trees that are surviving well. Many healthy selections have even been grafted with Wurtz—the Wurtz being a smaller tree won't take much space. Some of these healthy germplasm trees are cloned selections from survivor trees in known root rot areas. This particular plot is also quite high in salinity. There are some definitely root rot tolerant trees growing in highly-saline conditions. One in particular is the Aquila from Mexico. On one Aquila I observed, a couple of branches were grafted over to Wurtz with no problem; there were even Wurtz fruit in evidence. There appears to be graft compatibility. Next to this Aquila tree was a Mexican seedling that had died because of root rot. There are some excellent selections of Day, from Florida, and an 804 that are both West Indian and show excellent *cinnamomi* tolerance. They also look great after being grafted to Wurtz. Each replication is good.

I need to mention that the soil here has poor aeration. It is quite heavy.

Some of the other selections in the planting include a couple of Mexican selections—the 49's look good. Among other West Indian selections are the 55's, 66, and 69 (all look good). *P.c.* tolerance and graft compatibility appear to be present. I intend to have Dr. Menge (UC/Riverside) coordinate with Dr. Ben-Ya'acov to bring, or have some of these selections sent over, to UC/Riverside for testing. These are already clonal, so we will need to take the necessary preparations to send vegetative material. *[Note:* Within two months after this trip, six selections are now in the quarantine program at UC/Riverside.]

It is just amazing to be driving along and see so many soldiers at what looks like rest stops, actually bus stops, and they will be hitchhiking. You don't see them hitchhiking other than at these stops, and they'll have their Uzis and other weapons with them as they are hitchhiking. Women soldiers are given free passage on public transportations systems; the men must pay.

At the end of this Sunday the 19th, I followed Dr. Ben-Ya'acov to his home, from which we went north toward Haifa to attend a holiday celebration at another kibbutz. This was an excellent celebration of the First Harvest of the year, in which almost the whole kibbutz turned out, in stands and sitting on bales of hay. A lot of invited guests, and most of the people of the kibbutz, participated in the celebration in bringing some of their products—first harvested products of the season. They also did various dances. It was beautiful to see a child carrying a cage with new chicks or ducklings, or another walking a kid goat, and a girl with a plastic bag of water with a swimming fingerling fish.

I had a tasty dinner with Avraham Ben-Ya'acov and his wife, Connie; and then Avraham showed me the way to the Hotel Bet Maimón in Zichron Ya'akov. The hotel sits high on a hill and overlooks the Mediterranean.

Once in my room, I took time to contemplate the next day and collect my thoughts. A subject of interest and confusion to me is the kubbutzim system. The kibbutzim, such as the kibbutz I visited today, are a major part of the settlement of Israel. It is a system centralized in Tel Aviv, but each individual kibbutz is initially developed by a group with the same ideological concerns. It is a very socialistic system on the basis that everyone puts in what they are able to, and receives all that they need as best as the kibbutz can provide it. This includes complete education and complete living accommodations.

Most kibbutzim are self contained; they will grow enough gardens and animals to sustain themselves with food, and then generate three or more industries on the kibbutz for their capital income. The kibbutz at Ma'agan Michael had a plastics factory, as well as over 500 acres of agriculture. Everybody on the kibbutz is responsible for a labor or service that is necessary for the well-being of the kibbutz, the productivity of the kibbutz. In addition, such things as working in the kitchen, washing dishes, and guarding the kibbutz are scheduled as extra time—including weddings. Everyone has to participate in a wedding or a special holiday. Everyone is expected to volunteer his time for such activities, say, four times a year.

Everyone, including doctors, receives only the basic accommodations and the same income. The profits of the kibbutz usually go into expansion of the kibbutz, tax payments, payment for the higher education of those who want to go on, and even vacations. Doctors or lawyers who work off the kibbutz but still live there, and even those who live in town but are still active members of the kibbutz, give their entire income to the kibbutz and the kibbutz pays all of their expenses. When such doctors and lawyers are at the kibbutz, they still do such menial chores as washing dishes.

Originally, and on some kibbutzim to this day, the children live in a central area; they do not live with their parents. They would spend, say three to four hours at the end of the day with their parents, with dinner in the common area—the common cafeteria. After dinner, the children would return to their dormitory.

Monday, May 20th. It's 6:00 a.m. I am leaving the Mediterranean on my way to Tiberus and the Sea of Galilee to meet Ilan Eshel. Along the way, I picked up four soldiers just

coming out of Zichron Yaakov and headed for the air force base—yes, fully armed. When I dropped them off about halfway between Yaakov and Tiberus, they made sure that another military man heading toward Tiberus would ride with me and give me directions. This one, I dropped off before Tiberus; he was heading for the Golan Heights, where his base is. He said he was from a kibbutz in the Vedi Medic ("vedi" means "valley"), where he worked in a dairy. He has been in the army for only six months, and has another *2½* years to go. He said his kibbutz did grow some avocados, along with almonds. I thought by looking at a map that it might be pretty cold there; and he said that two years ago it did freeze the avocados, but that this year they had some fruit again. His kibbutz is in a major agricultural area called the Yezreel Valley. As I left the Yezreel Valley, I went over a slight mountain range that gets up to maybe 2,000 feet. To make the drive easier, I was advised to make a right turn before Tiberus, which placed a hill between me and the Sea of Galilee, which I was unable to see. I was amazed at how much open area there is, and how much of it is used for agriculture—virtually all the foothills and valleys. It is only the rock and the mountain tops that are not being farmed. Eventually, I turned east toward Kineret, and almost immediately came into view of the Sea of Galilee, very overcast and a little eerie in a way that brought a tingly feeling to my chest. I pulled to the side of the road to observe and reflect for a brief moment. It was hard to believe that I was on the southern tip of the Sea of Galilee, entering the Jordan Valley, and here are bananas and mangos. I continued southeast on toward Masada and Shar Hagolan, where I met Ilan and his wife, Rumie. It is 8:00 a.m. and just in time for breakfast in their kibbutz cafeteria. Avocado groves at Shar Hagolan are mostly Ettingers on the sides and every fifth row, with Fuertes being the other four rows. There are Pinkertons at the bottom of the grove. The Pinkertons crop to come off this year must be at least 30,000 pounds per acre. The Israelis are finding that Pinkerton is conducive to mechanical pruning right after harvest. It doesn't seem to affect flowering too much, and yield isn't affected. They find that they can also prune Fuertes and hold off orchard thinning for two or three years. The Fuertes they grow here are selected cultivars of Fuerte for higher production. With the Fuertes, besides having the Ettinger as side rows and every fifth row for windbreaks and cross pollination, every ninth tree — a three by three pattern—they have grafted in Topa Topa for pollination. In some cases, the Topa Topa is almost half the tree; in others, it is only a very small branch because the Fuerte wasn't pruned back. Definite influence can be seen in the Fuerte trees adjacent to the Topa Topa grafts in the form of markedly increased production.

A quick comment on zinc: They don't apply it. They don't think they have a zinc deficiency problem. They can grow organic produce just by adding manure for fertilizer and not using herbicides (having to do physical cutting of the weeds). Using zinc or herbicides would be "chemical farming."

The Jordan Valley is the area around the Sea of Galilee, so named because the Jordan River feeds the sea from here north and exits on the south end. In the Jordan Valley, Hass produces as many pounds per acre as along the Mediterranean, but the fruit is very small because of the high temperature. Conversely, the high temperature is good

for Pinkertons and Reeds, which would normally have the problem of large size fruit; but in this area, 10-ounce fruit is common.

Just a comment on rootstocks again: On the West Indian seedling rootstocks in their older orchards where their soil is 7.5 to 7.8 alkaline and their water has 250 to 280 parts per million of chloride, I saw no tip burn and very little iron chlorosis. Colorado River water, a major chloride problem source, has only 75 ppm chloride. Their Reeds, also on West Indian, have tremendous production. It seems as though just about every flower here in May became a fruit. Of course, they will shell off probably three-fourths of it. The Reeds are also pruned back every year, to a height of about ten feet. This does not seem to influence their production adversely, and the trees are becoming wider, rather than upright. Even with the excellent production they have with the Reed, the Israelis are still trying to find a cross pollinator—the reason being that, even though they set fruit, they want to be sure the fruit is strong enough to withstand heat; and cross-pollinated fruit does stay on much better under stress. They are experimenting with a West Indian type, the Samiel. By isozyme analysis of their crop last year, they determined that 60 % of the fruit next to the Samiel was cross-pollinated to the Samiel, another 30% being cross-pollinated to the Ettinger or the Fuerte, with only maybe 10 % being self-pollinated. They believe the Ettinger is definitely a cross-pollinator for the Pinkerton, converse to southern California where we are thinking that the Pinkerton blooms so early that nothing else is around to pollinate it. California has just experienced two poor years in a row for Pinkerton production.

There is an excellent set of Pinkerton fruit here, with the Ettinger every seventh row. Their isozyme analysis shows that 80 % of the set fruit is parented by Ettinger. A very interesting point about the Pinkerton is that the Israelis find that they can just snap pick it, instead of having to use clippers. There has been no problem with snap picked fruit after its export journey to Europe. The technique is not to snap, but to press with the thumb to break the stem right at the base of the fruit. Again, pruning is not a problem; they are pruning at a height of three meters—about 10 feet - so they don't have to use mechanical equipment to assist them in their harvest. Because of their drought situation, they are doing a lot of grafting over to other, more productive varieties. Fuertes, for instance, are being grafted over to Pinkertons. They have found where they have done heavy pruning to reduce water needs, it definitely knocked down production. To clarify: They did their pruning in January or February; and of course with bloom coming in May, if they pruned off most of the branches, they were not going to get any bloom, so this was to be expected.

As an experiment station here in the Jordan Valley, the Semeck Experiment Station has as one of its reasons for being, to evaluate different varieties not just of avocado, but also of mango, litchi, and sapote. It is because of their testing of Pinkerton here in the Jordan Valley that they found it to be their best variety. If they had left it up to the Volcani Center's finding in other areas in Israel, the Pinkerton would not be planted here. In fact, the pactobutrazol sprays trial here at the experiment station show that the most interesting one is on Pinkerton where they have somewhat of a "necked fruit" problem, but with the pactobutrazol the fruit is more pyriform— more Fuerte-shaped—

and the leaf structure and the size of the tree look entirely different; the leaves are smaller, but the leaf whorl seem to be about the same. It seems that the pactobutrazol effect on leaves causes them to be smaller in addition to the distance between whorls being shorter. Ilan finds here in the Jordan Valley that the Pinkerton as an individual tree will alternately bear, but the entire grove tends to be fairly consistent. After Shar Hagolan, we headed toward Tiberus, driving along the west side of the Sea of Galilee. The sea is about 20 km long, violin-shaped. It varies in width from 10-12 km down to one km. Its water quality is roughly 800 parts per million; unfortunately, there are about 250 parts per million of chloride.

The Jordan Valley, where Ilan Eshel's kibbutz is, is 200 meters below sea level, and part of this area—the North Jordan area, North Galilee area - is about 100 meters above sea level. The ruins of Hattim are in this upper Sea of Galilee. A large Crusader contingent was garrisoned here. They were all killed in a battle with the moslems at Hattim. Barry Dugan is the grower we are visiting in this area communal mashov—very similar to a kibbutz. A communal mashov is different from and larger than a regular mashov, which is individually owned.

This upper Jordan area has had success with litchis; and because of the drought and the lack of water, they are pushing out avocados and will plant litchis. It is an easy decision to push out Fuertes here, as they have been yielding only about 2,000 pounds per acre. Pinkertons and Reeds are being retained.

Ilan Eshel took me on a nice excursion to the Golan Heights—in fact, tracing the path over which he, as a tank battalion commander, brought his five tanks during the Yom Kippur War. At the Golan Heights boundary between Israel and Syria, I took a picture of Ilan with his rifle: no Israeli is allowed at that point without weapons. We went up to and through the demilitarized zone positioned by the United Nations forces between Israel and Syria.

A personal note: I couldn't stand being at the Sea of Galilee and not jumping in. I got in only about three feet deep, though, because fish started nibbling my toes and legs so vigorously that I couldn't stand it and got out quickly (no flesh missing, or even bruises).

An interesting point was brought out by Ilan: The quality of the water from the Sea of Galilee is improving each year because of control of three or four mineral springs at the north end of the sea. They have been diverted into a canal, so instead of having alkaline, saline water going into the lake, it by-passes the lake entirely and drains off in the bottom end of the Jordan Valley into water that is not used for agriculture, only for fish.

Leaving the Sea of Galilee, I headed for Nahariya, north of Acre and close to the Lebanon border. It is a beautiful, old city. The eucalyptus trees lining the street on which my hotel is located are at least forty years old, but the city is much older than that. This northwest area is where most of the first plantings of avocados were established in Israel.

I'll call Dr. Emi Lahav tonight to learn my itinerary for the next two days. Dr. Lahav is a horticulturist with the Ministry of Agriculture, like Dr. Ben-Ya'acov. He is based out of the Volcani Center, south of Tel Aviv, but his designated area of responsibility is this northwest quadrant of Israel. A healthy breakfast started Tuesday morning, May 21. Most of my Israeli breakfasts consisted of cereal and milk, most vegetables and fruit in season, and usually there were yogurt, rolls, hard boiled eggs, and sometimes cooked fish. Breakfast was usually included with the hotel room.

Dr. Lahav met me at 8:00 a.m. I had met Emi while he was on sabbatical at UC/Riverside, and again at the World Avocado Congress in April. He began our excursion with a visit to the grove of his predecessor, Beni Gefen. Beni is enjoying retirement and working his mashov. One point from Mr. Gefen was that Hass and Ettinger are thumb-picked here; no clippers are used. They still use clippers on the Fuerte.

This area's growers very seldom apply zinc—only if their leaf analysis is below 20 ppm. Beni's grove is also one of the few I saw that had a thinning program. The spacing was originally 16 x 16 feet. He removed every other row on his first thinning two years ago. He is now removing trees in the remaining rows that have a poor production record. Production on Hass and Fuerte is improved by girdling. This is the area where Israel determined the best time to girdle is in November. Beni fully believes in girdling. He girdles a different branch on each tree each year. I recalled my girdling trial on Zutanos in Corona in 1973-75. It definitely would increase fruit set, but Zutanos have too few branches. I was to see a lot of girdling of Fuertes before my trip was over.

Emi wanted to show me their Acco Experiment Station. He had arranged for us to meet Dr. Steinhardt and Dr. Gallum. Dr. Gallum is the regional director of the Extension Service for this area. Dr. Steinhardt is with the Volcani Center, and has a salinity trial on avocados at the station. Levels of chloride from 70-400 ppm are being evaluated on Mass and Ettinger on two of the best West Indian rootstocks and a highly-chloride-tolerant Mexican rootstock. All rootstocks are influenced by the increased chloride levels. The Mexican is doubly affected, with weaker trees and low production. Increased water definitely increases production at all chloride levels. Increased nitrogen is also being a benefit to offsetting chloride effects. The problem they are having with the trial is that the trees and treatments are becoming crowded. They are not sure what to do to be able to continue the project.

A major benefit of this liaison trip is that each of the researchers I visited gave me copies of their research publications. Much of the data from this research will help in establishing our own trials, avoiding duplication, and modifying accordingly.

Dr. Lahav showed me a pruning/thinning trial on Mass avocados. They are studying treatments of hedging every year, topping and hedging every year, hedging every two years, topping and hedging every two years, and a control of no pruning. The trial is only one year old. The world industry looks forward to their results.

They also have a nitrogen trial, studying different forms of nitrogen and nitrogen at different rates. The nitrogen rates vary from 64 pounds per acre to 512 pounds per acre. They utilize a sophisticated hydraulic system for injecting through the water. These trials are only a couple of years old, with no data of results available yet.

I was very impressed with the Acco Experiment Station. It is probably three times as large as our South Coast Field Station—certainly so, for
avocado acreage.

Dr. Gazit will be meeting with me at the Volcani Center tomorrow, but I got to see a couple of his pollination trials here at Acco. This was a major reason for the in-person visit to Israel: to see the trials, the techniques, the conditions under which the research is conducted.

One definite condition difference between Israel's avocado areas and California's is the soil. Israel's is invariably loam or clay loam, and 2-6 feet of top soil. This compares to our 0.5-1.0 foot of top soil for 60% of our acreage. I suggest only 10% of our acreage has more than 2 feet of top soil. Our next stop was about 10 miles north to the Milouot regional enterprise's packing facility for avocados. It is about twice the size of Calavo's Temecula, California plant. There are several other packing facilities here for other crops, such as citrus, different vegetables, and even poultry. Agriculture exports are a major part of Israel's economy. I understand there are a couple of other packing plants in Israel similar to Milouot's.

The rest of the afternoon was an excursion to the Lebanon border, Rosh Hanikra, where the mountain meets the sea. Emi and I took a cable car ride down to a ridge on a cliff that once was the railway to Beirut; it allowed us access to a grotto. The waves of the sea were really crashing into the caverns of the grotto—spectacular!

Avocado groves located south of the Lebanon border.

The day ended with a quiet dinner of Chinese food with Dr. and Mrs. Lahav at a quaint restaurant in Nahariya.

Wednesday was going to be an intense day of meeting with as many researchers as possible at Volcani Center in Bet Dagan. Bet Dagan is about ten miles south of Tel Aviv, about a 90-mile drive from Nahariya. We left at 6:00 a.m. Along the way, we drove past Haifa, Israel's third largest city. It sits on a peninsula jutting into the Mediterranean. Traffic jams are not reserved for Los Angeles; it took 90 minutes to go 15 miles in the Tel Aviv area.

At the Volcani Center, Dr. Ben-Ya'acov greeted us at the door of the conference room where extension specialists were having their weekly planning session. For the rest of the day, and most of the next morning, I met with as many of the researchers working on avocados at Volcani as I could. They were scheduled in 30-60 minute sessions. I am indebted to all of them for their willingness to share their time and knowledge with me in what had to seem hurried fashion. I do feel I at least acquainted myself with each researcher, learned of their previous works, and asked several questions pertinent to our problems and needs.

Dr. Gazit met with me first. Pollination is his main area of research on avocados. Increasing production is his major emphasis. This is true of all of Israel's researchers, although fruit quality is always considered. Dr. Gazit's main associate is Dr. Chemda Degani, whom I met with later in the day. It is their work that has convinced Israeli farmers that they need bees and they need cross pollinators. Once fruitlets are set, Dr. Degani can begin her isozyme analyses to determine parentage of the fruitlets. She has

perfected isozyme techniques enough to feel at least 90% confidence in her determinations.

Doctors Gazit and Degani have shown that where Hass trees had Ettinger avocado trees in the vicinity, 90-plus percent of the mature Hass fruit had Ettinger as the male parent. They showed me that there is an amazing transition during the fruit development to fruit maturity period in relation to percentage of self pollination versus cross pollination. Fruitlets one month old can be as high as 99% selfed. (This is the period when there may be 10,000 or more fruitlets per tree). As the fruitlets drop off, fewer and fewer of the remaining fruit are selfed; more are cross pollinated. Finally, of the mature fruit, less than 10% were selfed, or of Hass x Hass parentage. Both Gazit and Degani concur this would not always be the case; but in certain conditions, *e.g.,* climatic, this was the case. This could have been California's situation when the hot springs of 1989 and 1990 resulted in poor crop production. We have very few cross pollinators such as Zutanos and Bacons scattered throughout our groves, as they have been cut down. Selfed flowers and fruitlets could have been too weak to withstand the heat stress. (Cross pollinated fruit is stronger.)

Doctors Gazit and Degani keep finding Ettinger to be a strong pollinator, but at the same time they have found that Ettinger doesn't need a cross pollinator. Its fruit is almost always selfed.

I discussed (UC/Riverside) Dr. Clegg's work on avocado genetics and his use of RFLPs and potential genetic engineering and new variety development. In addition to Dr. Degani, I talked about this with Dr. Uri Lavi, a geneticist. Dr. Lavi is doing genetic work similar to Dr. Clegg's. He doesn't believe a full genetic map is necessary; work only with those traits the industry is interested in, and modify them with various techniques. It's lunch time, and boy am I hungry! Dr. Bar Yoseph met me at the cafeteria. Dr. Bar Yoseph is a virologist. I had to admit that currently we don't believe we have a virus problem, although Dr. Dodd (in California) has shown to us that we do have viruses; we just haven't determined them to be detrimental. Dr. Bar Yoseph is using a virus to stunt the growth of avocado plants. This could result in a short tree that is productive but doesn't need pruning or thinning.

About three hours were spent with Dr. Reuveni and his technician, Elisa. Dr. Reuveni believes plant breeding to get a more productive variety is our answer to economic stability. But, instead of cross breeding different varieties to get special traits and qualities, he radiates a desirable variety to get mutations of that variety. He is doing this mostly on citrus, mango, and litchi.

My day was about to end. Dr. Lahav arranged for a special rate at the Maxim Hotel in Tel Aviv. I was to spend the next four nights there. This would be my base as I worked with the members of the Volcani Center. Another dynamic day was lined out for Thursday. I was on my own to find the Volcani Center, specifically the Entomology Department. Dr. Wysoki, Volcani's director of plant protection, was in his office waiting for me at 7:30 a.m. Dr. Wysoki is a good friend of Dr. Jim McMurtry, our biological pest

control expert at UC/Riverside. Some promising predaceous mites have been sent to Dr. McMurtry by Dr. Wysoki to help our brown mite control program.

A tour was given of their greenhouses where various parasites and predators are being evaluated and reared. Their current problems are giant Amorbia, pyriform scale, and greenhouse thrips. Interestingly, thrips is not a problem on Hass in Israel. They are certainly aware of the *Thripobius* parasite. Their advice to me for our well being is to be sure Dr. McMurtry is able to maintain a stock supply of *Thripobius* for those times when we'll need it; private insectaries will not be able to afford to do so.

Earlier, when I first arrived at the Plant Protection Department, a young lady directed me to Dr. Wysoki's office. She was now introduced to me as Michele Klein. Michele was to ride with me to Rehovat to introduce me to her father, Dr. Isaac Klein. Dr. Klein researches irrigation and salinity problems. Fortunately, avocado is one of the crops he works with.

I said goodbye to Michele and headed south to Givat Brenner Kibbutz with Dr. Klein. Givat Brenner is in a beautiful agricultural area on the interior coastal plain, just north of the Gaza Strip by about 30 kilometers (18 miles). Messrs. Isaac Guil, Agricultural Extension, and Zvi Harat, orchard manager of Givat Brenner, met us at the center of the kibbutz. We immediately headed out to see some of the avocado research projects. Kibbutz Givat Brenner is a very cooperative research resource for the Volcani Center. Mr. Zvi Harat sees cooperating with the researchers as his best way of finding answers to his own questions on avocado culture. He is an enthusiastic farmer-researcher. Almost every block of the kibbutz orchards has an experiment being conducted. We were going to see irrigation, fertilization, pollination, and pruning trials. Five of Dr. Gazit's pollination trials are here at Givat Brenner.

The three hours I spent at Givat Brenner could easily have been at least two days. This was not realized until I was on my flight back. I was given some of their research publications. It was then I was able to comprehend more fully what they were telling me in the field. Of course, much of what I was seeing are new projects that haven't been written on yet. Yet, as said earlier, a major objective of mine was to see the locations and conditions of the research trials I had heard about.

So here I was at the location of an irrigation research project that we in California basically duplicated on a limited scale in one sense, and expanded on in others. The project is now in its seventh year. They compared irrigation levels of 70%, 100%, and 130% of normal. They found that Ettinger and Fuerte yield increased 32% and 15%, respectively, under the 130% regime. The yield of Hass was *not* affected. The trees are on West Indian rootstock. If for no other reason, we needed our own project because our trees are on Mexican rootstocks that are salt sensitive We need a West Indian-Mexican rootstock irrigation-salinity trial. The salinity research by Dr Oster of UC/Riverside needs to be thoroughly evaluated. They have quite a comprehensive pruning program here at Givat Brenne: Zvi hasn't compared a non-pruned to pruned program. He says the trees *must* be pruned to maintain height and to keep the orchard

open for mechanical traffic and ease of harvest. They prune all varieties. They maintain the trees at 10 feet in height and 12-15 feet wide. Pruning is done just after harvest (March-April), just prior to, or even during, bloom, every year.

There is an experiment using mini-sprinklers above the trees to create a cooling effect during bloom. Dry, hot winds during bloom caused a major crop loss a couple of years ago. No results have been reported from this trial yet.

Coffee, juice, and rolls were provided for our post-field discussion. Continued communication was definitely agreed upon. I will be sending copies of our research proceedings to Dr. Ben-Ya'acov each year for distribution and library availability. They do not have similar publications, but are willing to send me copies of individual project final reports. Normally these are all in Hebrew-a major communications drawback. Those published in international publications, however, are usually in English. Knowing now of specific trials and the respective researchers, I plan to ask them directly for their results.

It was now time to head southeast to the Gilat Research Station at the edge of the Negev desert. About an hour's drive would get me there, had imagined the Negev to be like our Coachella and Imperial deserts, low and hot By visual appearance it is similar: very sparse vegetation, bare ground arid. I didn't realize it, but I had actually inclined modestly in elevation- any creeks or streams would flow toward the Mediterranean. This was not evident to me at the time, as none were flowing due to drought Dr Eli Tomar was my contact at the Gilat Research Station. Dr. Tomar has a 10 acre, 10 year old irrigation trial here. Drip is compared to microjet spitters at 50%, 65%, 75%, 90%, 100%, and 110% of normal. They started their determination of water requirements with a Class A pan but later switched to use of tensionmeters as their preference. They have found a straight-line relationship to yield: the more water, the more yield with both types of irrigation. When considering water costs, treatments as 75%, 90%, 100%, and 110% are equal in net return per acre.

The project also includes three levels of salinity. The salt levels are adjusted by injection into the water for the different irrigation regimes. The project is very comprehensive.

תגובת זני האבוקדו אטינגר, פוארטה והאס בשנות הפוריות הראשונות לכמויות מים בהשקיה

ניסוי השקיה 1984-1988
גבעת ברנר

Title page of research report published in Hebrew. A barrier to easy communication between American and Israeli scientists is obvious.

Dr. Eli Tomar at the irrigation and fertilization controls at the Gilat Research Station at the edge of the Negev desert.

Here, I was once again impressed by the fact that they are blessed with a deep loam soil. Given enough water of good quality, this whole country could be the Los Angeles Basin before there were houses and 20 million cars.

Irrigation frequency is not a major concern when there is a deep loam soil. Eli's most frequent irrigation regime is once a week.

I was too close to Beer Sheva to not drive another 15 miles south to have dinner with Eli. This was to be my second time to eat "Oriental" food, the first having been in Acco with Emi Lahav. "Oriental" to the Israelis is not Chinese or Japanese food; it is Arabic: pita bread, chick peas, shish kebab. Eli explained to me what Beer Sheva means. I had learned earlier that Sheva means "seven" (Bath Sheva means "seventh daughter," I think). "Beer," explained Eli, means "well", as in "water well." Beer Sheva means "Seven Wells." Down in the oldest part of town is an outdoor restaurant. There is an enclosure around a rock basin with water visible about five feet down: Abraham's Well. Right back to the Book of Genesis - what a moment.

Leaving Beer Sheva to go back to Tel Aviv, I again participated in the courtesy of picking up hitchhikers. These were four young people, unarmed: two young ladies, two young men. They spoke very little English, but Tel Aviv was their apparent destination. It did not seem that Hebrew was their native language, either; I was to learn that they were Russian immigrants and had been in Israel for only six months. Each was from a different area of the Soviet Union. (This could be a whole other story.) They were living just south of Tel Aviv, close to Rishon. They showed me the building that was hit by an Iraqi Scud missile that resulted in the only mortalities in Israel from the Scud attacks during "Desert Storm."

My liaison trip had to end sometime, but not before an excursion to Jerusalem with Dror Hadar on May 25. Dror is a Ph.D. candidate in entomology. After our sightseeing of Jerusalem and Bethlehem, Dror invited me to have a swim and dinner at his Kibbutz Nachshomin, of which he is secretary. This was an unplanned stop, but greatly appreciated. Avocados are grown on the kibbutz, and I was able to see the effect of a heavy pyriform scale population on Nabal avocados. Fortunately, this scale is not a problem on Hass, and they have a good parasite for it: *Metaphycus stanlii.*

It was from Dror that I learned that the giant Amorbia is enough of a problem in the West Galilee Valley that they spray Bt *(Bacillus thuringiensis)* for it almost every year.

My last hosted night in Israel was shared over dinner with Dror and his wife, Leah, and their two boys, Neal and Omir. I can't think of a more pleasant memory on which to end this report of an exciting, educational research liaison from which significant benefits for all avocado growers will in time develop.