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AVOCADO CULTURE AND AVOCADO DISEASES IN AUSTRALIA AND THE SOUTH PACIFIC

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This report concerns avocado culture and avocado diseases in Australia and various areas of the South Pacific, as seen during a sabbatical year spent in that area in 1964-65. Avocado production is in the fairly early stages in this area in general, but is increasing considerably, particularly in Queensland and New South Wales in Australia.

AUSTRALIA

The principal region of avocado acreage in this huge country is in the central east coast, comprising parts of the states of New South Wales and Queensland. Compared to avocado production in California, the industry is quite small in Australia, but there is considerable interest and a number of new plantings are being made. In this principal area of avocado culture there are at present about 300 acres of avocados.

The principal varieties grown in Australia are of California origin; very few Florida varieties are used. Varieties seen in a number of plantings in the general region from 30 miles south of Brisbane to Nambour (75 miles north of Brisbane) included the following: Edranol. Hass, Hellen, Fuerte, Wright, Nabal, Zutano, Bonita, Rincón, Harms, Regina, Bacon, Elsie, Benik, Anaheim, Ryan, Hazzard, Sharwil, Corona, Mesa, Kay, Shepard, and Mary Martin, and miscellaneous seedlings including seedlings from Topa Topa. Sharwil is a very promising-looking Australian selection, a green fruit, generally slightly larger than Fuerte, with good quality and with a skin somewhat more pebbly than Fuerte. This variety was developed on Mt. Tamborine. south of Brisbane, in a grove formerly owned by Colonel F. V. Sharpe, now owned by Mr. James Wilson.

In northern New South Wales there is also considerable avocado acreage. Here I saw Fuerte, Edranol, Hazzard. Hass. Rincón, Dickinson, Zutano, some Mexican seedlings, and Eastwood. The latter variety is a Fuerte seedling, apparently not as good quality as Fuerte, and a taller-growing tree.

Some of the earliest importations of avocado trees in the Queensland area came from Armstrong's Nursery in Ontario, California, in 1933; these were imported as balled trees. A number of additional importations have, of course, been made since then, including many seeds and budwood selections. Experimental plantings were initiated and maintained by the Queensland Department of Agriculture (now Department of Primary Industries) at the Redlands Experiment Station 25 miles south of Brisbane, and by the New South Wales Department of Agriculture at the Duranbah Experimental planting between Coolangatta and Murwillumbah (the latter planting under the guidance of H. J.

Cann, horticulturist located at the Murwillumbah). At Duranbah the oldest trees are some huge 17-year-old Fuertes. These plots have served as a source of budwood for many plantings in these States. A small, new avocado planting is now being established at the Alstonville Experiment Station in northern New South Wales, under the direction of Drew Leigh.

No irrigation is necessary in most of the Australian avocado areas; in the region from Brisbane to Nambour for example, rainfall approximates 45 to 55 inches per year, with February and March the months of heaviest rainfall. In some of the areas in northern New South Wales rainfall is even heavier than this, running from 60 to 130 inches. Frosts are not common, although in the winter of 1964, there was considerable damage to pineapples and some to avocado trees in the Nambour area.

There are only a few avocado trees in the states of Victoria, West Australia and South Australia. An effort is being made, however, to establish an avocado industry in the Murray Irrigation District in the Eastern section of South Australia. Small test plantings are being made, and the State Department of Agriculture is starting an experimental planting in this area. This location is all under irrigation, as it is an arid region with high summer temperatures. Plantings of Fuerte and Zutano were seen there in early 1965.

A number of avocado diseases were observed in Queensland and northern New South Wales. Here, as in California, Phytophthora root rot is the principal problem, and many acres have been lost to this disease.

Phytophthora root rot—I saw this disease on a number of plantings in Queensland, on 7-to-12-year-old trees, and on a planting of large 24-year-old trees where it was causing severe losses. In this latter grove there were a number of areas of poorly-drained soil, containing considerable red soil with heavy clay at a shallow depth. Pineapple is another plant affected by the same fungus (*Phytophthora cinnamomi*) that causes avocado root rot. One grove combined avocados, pineapples, and macadamias; to date there is little damage from root rot, though a few of the avocados were showing disease symptoms in 1964. There was a severe infection of Phytophthora root and crown rot on pineapples at the Maroochy Experiment Station near Nambour; cultures made there in November. 1964, showed that *P. cinnamomi* was the principal fungus causing this trouble; it was not found on macadamia trees on the same Station.

An experimental planting of avocado varieties at the Bedlands Experiment Station south of Brisbane, comprising about 10 acres, is now nearly entirely removed because of root rot. The planting was made nearly 10 years ago; the soil is poorly drained, with considerable red clay.

Root rot also occurs in northern New South Wales, in the Duranbah Experimental planting, and in several other groves in that area.

Here, as in Queensland, *Phytophthora cinnamomi* was cultured from diseased roots by Department of Agriculture pathologists several years ago; I made additional cultures during visits there in 1964 and 1965. Laboratory studies showed that these Australian isolates of the fungus were very similar to the avocado root rot fungus that we have in California; no differences could be detected.

FIGURE 1. Avocado root rot in 24-year-old Fuerte, Queensland.

FIGURE 2. Avocado root rot fungus killing pineapple plants, Queensland.

In addition to the avocado, *P. cinnamomi* was found attacking a number of other plants in Australia; pineapple, peach, grape, heather, eucalyptus (jarrah, or *Eucalyptus margínala)* trees in Western Australia, *Banksia,* and several other native plants.

Verticillium wilt—The second most common disease observed in Australia was this disease caused by the soil fungus *Verticillium albo-atrum,* which invades the roots and spreads up into the stems and branches in the water-conducting system. This was seen in the Tambourine Mountain area on Edranol trees, and on Fuerte trees in northern New South Wales.

Other diseases—The only other disease seen was one case of crown gall on the trunk of a Fuerte tree in northern New South Wales. No sun blotch was seen in Australia, and there are no records of this virus disease yet from that country.

General—The genus of fungi to which the avocado root rot fungus belongs, Phytophthora, is a common one in Australia. Diseases caused by this group (other than those caused by *P. cinnamomi)* were observed on papaya, pineapple, cowpea, alfalfa, citrus, apple and apricot.

The Australian avocado growers have developed an attractive and informative wrapper for avocados, describing the fruit, its origin, how to ripen and eat it. Prices in general in Australia were very good; early in the season growers were getting three shillings (about 33 cents U.S.) per fruit. Prices were lower later in the main season, but in many Australian markets ranged from two shillings to five shillings (55 cents) per avocado.

NEW ZEALAND

Avocado production is certainly not big business in this country; there is only one

commercial grove, but this is doing very well and there will undoubtedly be additional plantings in the near future. The one grove is the property of Mr. Len Gray, and is located at Gisborne on the east coast of the North Island. There are about 600 avocado trees in this mixed planting, along with citrus and sapote. Rainfall here is about 37 inches per year; the avocados are not irrigated.

Mr. Gray first brought in avocados as seeds from California about 40 years ago; these original seedlings were topworked to various varieties over the years. Some rootstock sprouts from one tree appeared to be a Guatemalan type; there was no anise odor in the leaves and the fruit were larger and had thicker skins than those of Mexican seedlings. Some trees were also brought in bare root from Armstrong's nursery in 1936 and others in 1940.

The principal varieties in this grove are Hass, Fuerte, and Nabal, with a number of excellent trees of each variety. Other varieties include: Hellen, Queen, Anaheim, Mary Martin, Linda, Hazzard, Ormond, and formerly Edranol and Leucadia. Ormond is a selection from one of the original seedling trees. Linda and Queen are not being propagated further. Mr. Gray has picked as many as 1,500 fruit per tree from Nabal trees and 2,100 fruit from Fuertes. A peculiar "carapace" spot was observed on fruit of several Mary Martin trees and also on Nabal in this grove.

Phytophthora cinnamomi has been isolated from avocado in New Zealand by Dr. F. J. Newhook, plant pathologist with the Plant Disease Division, Auckland; the fungus has caused and is still causing considerable damage in New Zealand on Monterery pine and several other conifers, including Lawson cypress, and Monterey cypress, and also ornamental nursery stock. There has been great loss in shelterbelt plantings in particular from *P. cinnamomi* and other species of *Phytophthora;* Dr. Newhook has identified the pathogens and has done much research on the problem. The wet New Zealand climate not only makes the country beautiful and green but also favors development of diseases caused by various species of *Phytophthora;* these include disease problems on apple, strawberry, tobacco, hops and citrus.

PACIFIC ISLANDS

New Guinea—Coconut, cacao and coffee are the three principal agricultural crops of this interesting and primitive area. There are only a few scattered avocado trees in the Territory which is administered by Australia. The largest "grove" that I saw in New Guinea was one of 12 huge old seedling trees at the Keravat Experiment Station about 30 miles from Rabaul on the island of New Britain. These were West Indian type seedlings; most of the scattered trees in New Guinea are of this type. At the Keravat Station also there is a small young planting of grafted trees—Edranol, Ryan and Sharwill. This is a wet area, with over 100 inches of rain. Phytophthora root rot was also seen in New Guinea, and cultures were made of *P. cinnamomi.* Another minor problem in much of this tropical area is algal leaf spot, caused by the alga *Cephaleures.* Another species of Phytophthora causes the severe black pod disease of cacao in New Guinea. A visit was made to the excellent Botanical Garden at Lae, which provided an opportunity to look through their good herbarium collection for native species of *Persea* as possible sources of resistance to Phytophthora root rot. No species of *Persea,* other

than the avocado, were listed from that area, although there are several related genera.

FIGURE 3. Healthy Fuerte, Glasshouse Mt., Queensland.

Fiji—There is not much interest in the avocado in Fiji; there are a few scattered seedling trees of the West Indian type around the countryside. Occasionally some fairly good avocado fruit are seen in the markets. Phytophthora root rot also occurs in Fiji; additional cultures were made. Seed collections were made of some different types of fruit to use in our root rot resistance tests. Dr. Keith Graham, plant pathologist with the Fijian Department of Agriculture, will furnish additional seeds for our tests.

Trust Territory of Pacific Islands—This includes a large number of islands under a United Nations protectorate, administered by the United States, with headquarters on Saipan. I visited the islands of Truk, Ponape, Saipan, and also Guam which is a U.S. possession. In this area again there are many scattered avocado trees, with several small, good plantings. Most of the avocado trees are West Indian seedlings; there has been little effort to date to introduce good commercial varieties. There is one planting in Guam of about 30 trees, and a planting of about 50 trees on Saipan. Root rot also is the main disease problem in this area; isolates of *P. cinnamomi* that I made there are very similar to the California isolates. Phytophthora trunk canker was also observed, and algal leaf spot is common.

This is again an area of high rainfall, ranging from about 90 inches on Guam to over 200 inches on parts of the island of Ponape. Other serious Phytophthora problems included canker and black pod of cacao, and leaf spot of taro.

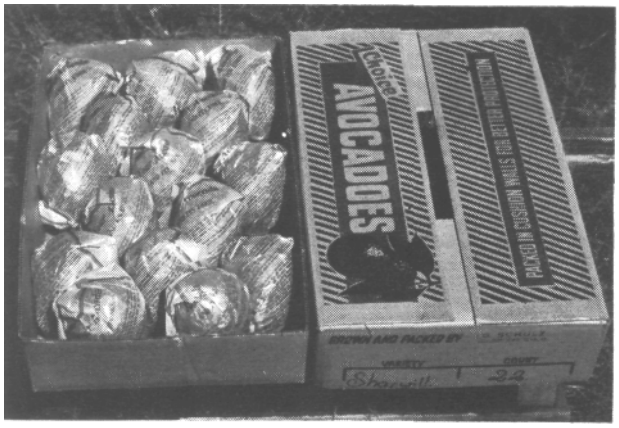

FIGURE 4. Avocado fruit pack in Australia.

FIGURE 5. Healthy 7-year-old Fuerte graft, Gisborne, New Zealand.

RESEARCH OPPORTUNITY

The trip to Australia and the South Pacific thus provided a fine opportunity to observe avocado culture and diseases in that area, to observe and make cultures of diseases caused by Phytophthora and other fungi on many other types of plants, and to do research on the avocado root rot fungus and other species of Phytophthora in the fine facilities of the Waite Agricultural Research Institute, Adelaide, South Australia.

In the areas where Phytophthora root rot was present, search was made for any possible resistant trees, but there was no indication of this. After consulting several botanists and checking through herbaria, it was found that no native species of *Persea,* the genus of plants to which the avocado belongs, occur in that part of the world. There are a few other related genera there, but most of them appear to be quite distantly related to that chances of graft compatibility would be low. Arrangements were made to

obtain seeds of some of these, however, to pursue this possibility, and also to obtain seeds of some different avocado types.

My laboratory research on Phytophthora at the Waite Institute provided some very interesting data on chemotaxis, or the attraction of zoospores of *P. cinnamomi* and two other species of *Phytophthora* for root exudates, and gave some good leads as to types of chemicals exuding from roots that attract these swimming spores to the roots. This research will be continued at Riverside, and should provide significant information leading to better control of the disease. Also data was obtained showing that bacteria in the soil produce some substance that the avocado root rot fungus needs in order to form sporangia (the principal spore stage). This exciting new development in relation to the life cycle of *P. cinnamomi* also should be of great aid in our ultimate control of this serious problem; if we can now determine what the bacteria are producing that stimulates sporangial production we will be in a much better position to counteract this and prevent formation of this important spore stage.

I would like to express my deep appreciation to the following people and organizations for assisting in various phases of these trips to the avocado areas of Australia, New Zealand and other parts of the South Pacific: the California Avocado Society, Fruit Producers Association of Queensland; H. J. Cann, Fred Chalker, Drew Leigh, of the New South Wales Department of Agriculture; Wm. Agnew, John Bur-din, E. Hastie, Curt King, Newton Morgan, Brian Oxenham, J. H. Smith, and Dr. D. Teakle, of Queensland Department of Primary Industries; Mrs. J. Burford, South Australia Department of Agriculture; Dr. Dorothy Shaw, Department of Agriculture, Fisheries and Stock, Papua and New Guinea; John Wormersley, Botanical Garden, Lae, New Guinea; Dr. F. J. Newhook, Plant Disease Division, Auckland, New Zealand; Dr. Keith Graham, Fiji Department of Agriculture; G. Davis, M. N. Sproat, and D. Zaiger, Trust Territory of the Pacific Islands. Also, appreciation is expressed to many growers for the opportunity to visit their plantings, including, in Queensland: W. Collins, N. Greber, A. Armstrong, R. Jowan, Parker's Nursery, G. Schulz, J. Wilson; New South Wales: G. Brown, J. Anderson; South Australia: Dr. G. Moran and E. L. Hussey; New Zealand: L. Gray.

AUSTRALIA NOTE

(The following information is an extract from a letter from Society member Arthur T. Johnson, New South Wales, Australia.)

It may be of interest to some of your members to learn that my plantation is two hundred and eighty road miles south of Brisbane, and I believe this to be the most southern planting attempted in this State of New South Wales.

I have two hundred trees at different ages. Varieties are Fuerte, Rincón, Hass, and Sharwil, the oldest being Fuerte eight years planted and bearing up to eight bushels a tree this season.

If anyone over there should be interested to have more particulars about avocado growing on my holdings, I would be only too pleased to answer anyone's request.

(Mr. Johnson's mailing address may be obtained by reference to the Membership Roster.)