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AVOCADO SOIL AND ROOT ROT SURVEY OF DADE COUNTY, FLORIDA

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INTRODUCTION

Avocado root rot, caused by the soil-borne fungus *Phytophthora cinnamomi* Rands, is the most serious disease affecting avocado trees in many parts of the world. The causal organism, which thrives in wet soils, was first described by Rands (9) in 1922 on cinnamon trees in Sumatra. It was subsequently reported in this hemisphere as causing damage to avocado trees in Puerto Rico (12), Cuba (5), California (13), Honduras (16), Florida (14) and Texas (8). In California alone an estimated 4,500 acres of avocado trees have been damaged or killed by this disease (15).

Stevens and Piper (11) stated in 1941 that young avocado trees in Florida frequently decline and die shortly after planting, and that decline was often noted in large bearing trees after several successive crops. Wolfe *et al.,* (14) reported in 1949 that Florida avocados are sensitive to submergence and water logging of the soil if the fungus *P. cinnamomi* is present. Ruehle (10) later found that where a few trees had been killed in low areas following a flash pod, the disease slowly spread outward in subsequent years, although actual flooding did not occur in these years. Zentmyer (unpublished data) in 1959 cultured *P. cinnamomi* from three of four avocado tree sites sampled in the Homestead, Florida, area.

The survey reported herein was made to determine possible causes of poor growth and death of some avocado trees in Dade County, due to problems in the soil—primarily root rot.

SOILS AND ROOT ROT DAMAGE

In previous surveys and investigations in other areas, the soils in which avocados are grown and the incidence and degree of tree damage caused by *P. cinnamomi* have been closely correlated. In California, Wager (13) found avocado trees dying in soils which had poor internal drainage, and later work by Huberty and Pillsbury (6) confirmed these observations. Goodall (4) in 1958 correlated various soil series in Santa Barbara County in California with tree damage caused by the avocado root rot fungus. Subsequent California avocado area root rot soil studies by Burns *et al.,* (2 and 3) have closely correlated soils with poor internal drainage with incidence and degree of tree damage and spread of the fungus.

DADE COUNTY AVOCADOS AND SOILS

About 6,500 of Florida's 6,800 acres of avocados are located in Dade County (1). The soils of Dade County are placed in 15 series and 6 miscellaneous land types (7). Most of the avocados are grown on the soils of the Rockdale series. These soils comprise about 165,000 acres of the county and consist of two textures—the Rockdale fine sand-limestone complex, and the Rockdale fine sandy loam-limestone complex. As can be seen from the map (Fig. 1) the soil texture division line runs approximately east and west across the main avocado growing area, north of Naranja. The Rockdale fine sand, north of this line, consists of deposits of fine sand on the surface and in cavities of the porous limestone. The Rockdale fine sandy loam-limestone complex to the south, consists of deposits of a reddish-brown mixture of sand and clay on the surface or in the porous limestone cavities.

The underlying material of the Rockdale series is porous oolitic limestone and drainage in these soils is excessive. The soil reaction ranges from pH 7.0 to pH 8.0. The organic matter content is low and the native vegetation consists of pine, palmetto and miscellaneous grasses. The elevation above sea level ranges from 8 to 14 feet.

There are a few avocado groves on the Perrine marl soils. Various phases of this series comprise about 305,800 acres in the county (7). The surface soil is a light brown or brownish-gray friable marl of silt loam texture. The subsoil is lighter colored marl, underlain by Miami oolite. Surface and subsurface drainage is generally very poor.

This is the main reason few growers have risked planting on these soils.

The soil reaction of the Perrine marl soils range from a pH of 7.0 to a pH of 8.5 and the organic matter content from 5 to 15 percent. Native vegetation on these soils consists of a mixture of sawgrass, myrtle, bay and cypress. The elevation above sea level of most areas of this soil that are suitable for cultivation is about 5 feet.

SOIL SAMPLING METHODS

Soil samples were collected in the same manner as described by Zentmyer *et al.,* (15). With a trowel or small spade, several cupfuls of soil from three locations around the suspected tree were taken within the drip line of the tree and in the main root zone. Samples included soil and, if possible, small feeder roots from as moist an area as possible. The top inch of soil and mulch were scraped off and samples were taken from the next 6 to 12 inches of soil. These samples were composited in polyethylene bags to prevent drying out and were stored in cool places until tests were made. A total of 34 samples were taken from different tree sites. These sites were located in avocado groves throughout the county and included 16 different groves.

DISEASE IDENTIFICATION

The two common methods used in California to identify root rot are the root test and soil test (15). Both of these methods were used in this study. *P. cinnamomi* was found in 14 of 34 samples examined*. These 14 positive samples involved 8 of the 16 groves sampled.

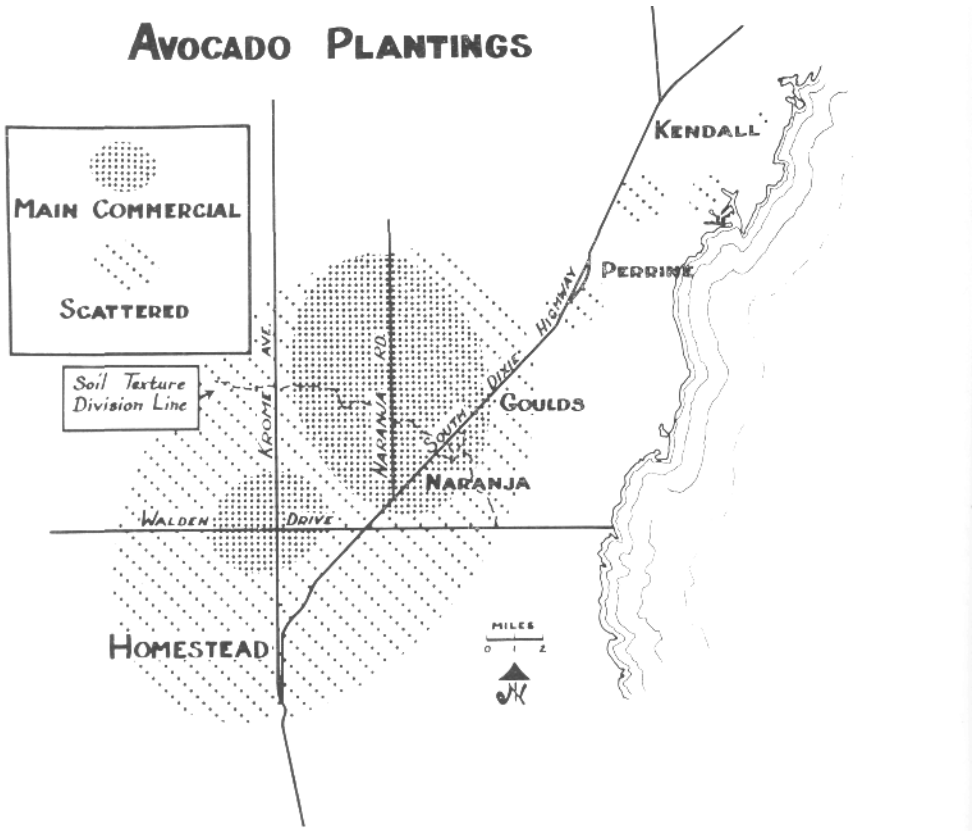

Figure 1.—Dade County avocado plantings. North of the soil texture division line is Rockdale fine sand—south is Rockdale fine sandy loam. Not shown are finger glades of Perrine marl soils—mostly unplanted.

The soil test is a relatively simple and practical one. A firm unscarred, mature green-skin avocado fruit was placed in a waxed paper cup containing the soil sample. The surface was flooded with water and the fruit left on the soil for four or five days. If the root rot fungus was present, firm brown to purplish-brown spots developed characteristically at the water line or occasionally below this line. These spots usually developed in approximately 4 to 8 days after placing the fruit in the infested soil. Portions of the flesh from each suspicious spot were subsequently placed on agar plates for further identification.

In the root tests, small blackened feeder roots were selected from a soil sample, dipped briefly in 70 percent ethyl alcohol, blotted on a paper towel and put on cornmeal agar. Often within 24 hours, if the fungus was present, characteristic fan-shaped growths developed around the roots. Slide mounts of each suspected growth were made and examined microscopically.

Positive detection of this soil fungus is difficult, especially where the infestation is light (15). A very small amount of the fungus may be present, even though the laboratory test is negative.

SOIL ANALYSIS

Portions of most of the soil samples were analyzed for pH, calcium, magnesium, phosphorous, potassium and nitrogen. The analyses were made by the University of Florida Agricultural Extension Service laboratory at Gainesville, and the results are given in Table 1.

As can be seen from these data there was considerable variation between the samples taken December 22, 1964. A similar variation was found in tree sites sampled May 17, 1965; however, the mean of these 19 samples (Table 1) was similar to that of the previous 8 samples.

An analysis for iron in the first 8 samples was negative. Certainly iron deficiency symptoms have been seen on avocados in Florida for a number of years (10).

Soil textures of the samples ranged from sands to sandy clay loams—the majority were sandy loams.

Even though many of the samples were from trees in poor condition, it was difficult to conclude that of the elements analyzed, any—with possible exception of iron—were generally more than contributing factors.

Table 1. Results of soil analysis of avocado tree sites.

Sample	pH	Pounds Per Acre				PPM
		CaO	MgO	P_2O_5	K_2O	NO_3
			(Sampled 12-22-64)			
1	6.8	90,948	995	131	264	20 +
2	7.3	105,482	3,220	65	624	65 +
3	7.3	89,128	2,748	131	624	65 +
4	7.4	28,548	1,472	135	472	20 +
5	7.2	18,564	1,049	128	278	65 +
6	7.4	31,278	1,049	155	472	20 +
7	7.4	105,482	3,028	128	1,430	65 +
8	7.2	51,662	28	124	780	65 +
Mean	7.3	61,365	1,699	125	618	48 +
			(Sampled 6-17-65)			
19 samples Mean	7.8	62,602	2,073	356	727	54 +

NEMATODES

The burrowing nematode, *Radopholus similis* (Cobb) Thorne, and a meadow nematode, *Pratylenchus pratensis* (de Man) Filipjev, were reported on avocados by DuCharme and Suit (10) in 1953.

During microscopic studies to determine the presence of *P. cinnamomi* in this survey a

number of nematodes were observed. Subsequently, Dr. V. G. Perry of the Department of Entomology, University of Florida, identified reniform nematodes, *Rotylenchus* sp. in three soil samples. In one of the samples taken from a tree in a very poor condition, the nematodes were numerous enough to have contributed to its condition.

SUMMARY AND CONCLUSIONS

Most of the 6,500 acres on which avocados are grown in Dade County, Florida are grown on the well-drained Rockdale series soils. Although *Phytophthora cinnamomi,* the fungus that causes root rot, was found in 14 of the 34 sites sampled —involving 8 of the 16 groves—it is not believed to cause extensive damage to avocado trees in Dade County. A damaging outbreak of root rot is not anticipated in avocados growing on well-drained soils. Decline of avocado trees in Dade County might be due to poor mineral nutrition in some groves or to occasional flooding in low areas. The occurrence of large numbers of *Rotylenchulus* sp. in one sample indicates that nematodes might also contribute to the loss of avocado trees in some locations.

Figure 2.—Avocado root rot fungus was isolated from these trees in a planting north-east of Perrine. The soil is a Rockdale fine sand.

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