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 cinnamoni 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 waterlogging of the soil if the fungus P. cinnamoni is present. Ruehle (10) later found that where a few trees had been killed in low areas following a flash flood, the disease slowly spread outward in subsequent years, although actual flooding did not occur in these years. Zentmyer (unpublished data) in 1959 cultured P. cinnamoni from three of four avocado tree sites sampled in the Homestead, Florida, area.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. cinnamoni 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 1968 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 a 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. cinnamoni* was found in 14 of 34 samples examined*. These 14 positive samples involved 8 of the 16 groves sampled.

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*J. W. Kimbrough, Department of Plant Pathology, University of Florida, Gainesville, assisted in this identification.

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**AVOCADO PLANTINGS**

![Map of avocado plantings in Dade County](image)

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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 was 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.

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

<table>
<thead>
<tr>
<th>Sample</th>
<th>pH</th>
<th>CaO</th>
<th>MgO</th>
<th>P₂O₅</th>
<th>K₂O</th>
<th>NO₃</th>
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<tbody>
<tr>
<td></td>
<td></td>
<td>(Sampled 12-22-64)</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>1</td>
<td>6.8</td>
<td>90,948</td>
<td>995</td>
<td>131</td>
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<tr>
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<td>7.3</td>
<td>105,482</td>
<td>3,220</td>
<td>65</td>
<td>624</td>
<td>65</td>
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<tr>
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<td>7.3</td>
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<td>2,748</td>
<td>131</td>
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<tr>
<td>4</td>
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<td>28,548</td>
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<tr>
<td>5</td>
<td>7.2</td>
<td>18,564</td>
<td>1,049</td>
<td>128</td>
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<tr>
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<td>7</td>
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<td>3,028</td>
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<td>61,365</td>
<td>1,699</td>
<td>125</td>
<td>618</td>
<td>48</td>
</tr>
</tbody>
</table>

(19 samples) (Sampled 6-17-65)

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. cinnamoni 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, Rotylenchulus 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.

Acknowledgement

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Literature Cited


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.
CARAMBOLAS FOR POTENTIAL USE IN GIFT FRUIT SHIPMENTS

W. GRIERSON AND H. M. VINES

ABSTRACT

Carambolas were found to have excellent keeping quality, particularly if held below 50° F and protected from mechanical damage. Even at 70° F they kept in attractive condition for 2 weeks. Fruit of the strain selected by Dr. H. S. Wolfe and propagated at the Sub-Tropical Station were found to be palatable to 80 percent or more of tasters. Palatability was associated with sugar/acid ratios of 14 or less. It is suggested that carambolas be tested as "conversation pieces" to add interest and attractiveness to high quality citrus gift fruit packs.

INTRODUCTION AND REVIEW OF LITERATURE

Carambolas (Averrhoa carambola L.) are an unfailing conversation piece. In a fruit bowl in the home, in a demonstration fruit display, or elsewhere, their exotic appearance and pleasant aroma inevitably occasion comment and inquiry. Nevertheless, they have never achieved market acceptance in the United States. This is probably due to the general public's apprehension of anything obviously exotic, and also because the few grown in Florida have been of very poor quality compared with the sweet selections grown in their native China.

The climatic limitations, culture, and growth habit of the carambola have been described by others (1, 5, 6). Its botany and structure are described in some detail by Winton and Winton (7). For the purposes of this paper, it will suffice to say that the carambola is an ornamental evergreen tree growing to a height of 25 feet or more in good soil. The golden-yellow waxy star-shaped fruit are borne in clusters beneath the leaf canopy, usually in 2 or 3 distinct crops throughout the winter months.

An improved selection (originally propagated by Dr. H. S. Wolfe) is now available from the Sub-Tropical Experiment Station, Homestead, Florida in limited amounts (2). The problem of introducing them to a suspicious public remains. A possibly worthwhile approach is to consider them as "conversation pieces" to go into high quality gift packs of citrus and other fruits. A single carambola as a centerpiece would be ornamental and interesting and would be sure to be sampled by the recipient. A tissue wrap on or around this single fruit could carry its name, history, and methods of use (fresh, in "ades" or in fruit salad, in which its star-shaped transverse sections are most ornamental). A possible sales point could be mention of the surprising high vitamin content. Carambolas compare favorably with citrus fruits in Vitamin C, thiamine, riboflavin, and niacin content (3, 4).

Such a wrapper could be expected to be retained for its curiosity value by many gift fruit recipients, and would make an excellent medium for carrying the shipper's name, address, and an invitation to reorder.

Thus, if such an approach proved practical,