

## **CORRELATION OF SOIL SERIES AND AVOCADO ROOT ROT DAMAGE IN THE FALLBROOK AREA**

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A survey completed in 1960 in the Fallbrook area of San Diego County has shown a close correlation between the soil series on which avocados are grown, the severity of tree damage and the rate of spread of the avocado root rot fungus, **Phytophthora cinnamomi**. Similar studies now in progress in other avocado districts of California also show these relationships.

It has been recognized for a number of years that occurrence and severity of avocado root rot are related to soil drainage. Huberty (1) and Huberty and Pillsbury (2) noted great differences in permeability of surface soil and subsoil in some of the soils on which avocado "decline" developed, and stated that Merriam and Los Flores types were problem soils. Zentmyer (3) reported that root rot is universally a disease of poorly drained soils, and in California occurs on soils having a permeable surface horizon of relatively shallow depth underlain by an impervious layer, and on soils that drain slowly throughout the profile. Gustafson (4) reported that many acres were lost due to cinnamon fungus as a result of avocado groves being planted on heavy clay soils such as the Merriam series. However, little actual data has been available on the various soil types in which root rot damage occurs.

Goodall (5) in Santa Barbara County in 1955 rated a number of soils as to their susceptibility to root rot development. These were classified as: 1) Deep Valley soils, which are well drained, with little damage likely even when fungus is present, 2) Valley soils with some profile development, 3) Hillside Primary soils, showing impaired drainage and usually of heavy clay texture, and finally, 4) Terrace soils, which because of impervious clay pans are poorly drained and the most susceptible to root rot damage.

The method used in the present surveys was to outline on an acetate overlay all of the known root rot locations where avocado trees have been killed or damaged. These overlays were then placed on Soil Conservation Service soils maps of the same scale (1"=660'), and the different soils were designated and the acreage computed.

To obtain an estimate of the avocado acreage grown on the various soil series, a sample area one-half mile wide and six miles long was used. This three-square-mile strip traversed what was considered the most extensive plantings in the Fallbrook area. The results, Table 1, show that over 60% of the avocados are planted on the Fallbrook

series, over 20% on Merriam, approximately 6% on Vista, and the remainder are series such as Hanford and Ramona.

Table 1. Results of Three Square Mile Strip Survey.<sup>1</sup>

Soil Series	Avocado Acreage on Various Series	
	Acres	%
Fallbrook	638	69.0
Merriam	205	22.2
Vista	52	5.7
9 X <sup>2</sup>	14	1.5
Hanford	11	1.2
Ramona	4	.4
	924	100%

<sup>1</sup>3 sq. mi.=1920 acres.

<sup>2</sup>Land essentially destroyed by erosion, undifferentiated.

In the Fallbrook area, 136 separate root rot locations were outlined, ranging from one tree to as much as 7¾ acres in size; the average size was approximately .9 acres. As is shown in Table 2, the two soil series, Merriam and Fallbrook, are most closely associated with root rot damage. In many cases both the Merriam and Fallbrook soils were jointly involved in what was considered one root rot location (Figure 1).

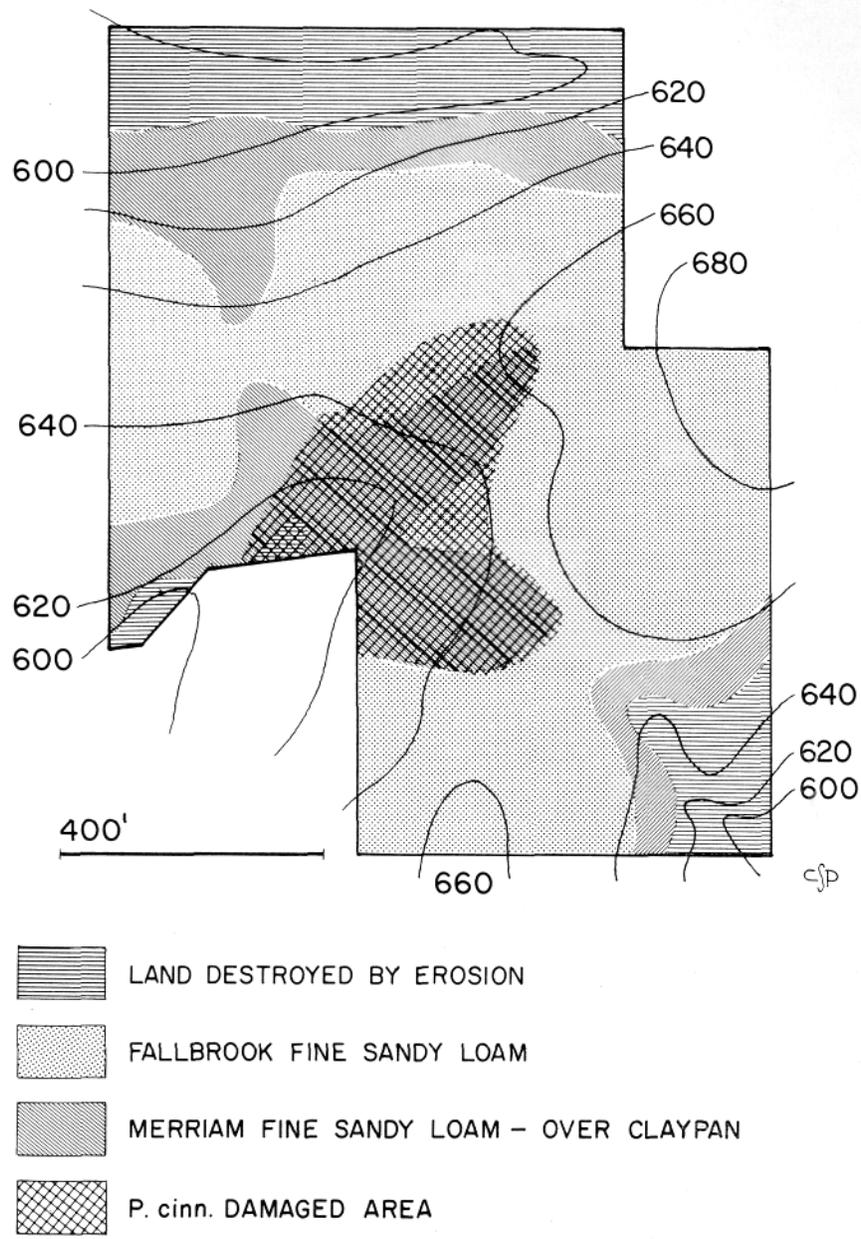


Figure 1. A Fallbrook avocado grove plot plan, showing soil series, elevations, and root rot area.

Table 2. Avocado Root Rot Damage on Fallbrook Area Soil Series.

Soil Series	Number of Root Rot Locations on Various Series	Total Acres Damaged
Fallbrook	86	51.19
Merriam	95	60.04
Vista	6	1.84
9 X	10	4.55
Hanford	0	0.00
Ramona	1	.06
Honcut	4	7.30
	202 <sup>1</sup>	124.98 Acres

<sup>1</sup>Difference between 136 in the text and 202 is separation of original root rot locations into various series.

The Merriam soils are developed on old alluvial deposits, originating mainly from granitic rocks. Merriam soils are characterized by a pronounced reddish-brown surface soil, but are underlain by a compact claypan horizon which restricts drainage. The Fallbrook series soils are developed on granitic bedrock on rolling or hilly land; are slightly more mature than the Vista series, and have been developed on parent material showing a further stage in weathering. The Fallbrook series are associated with and similar to the Vista series, but have a higher clay content and a more dominant red color and are known locally as "red granite soils." The Vista series occur on uplands and are developed in place on granite and are noted for adequate internal drainage. They differ from the related and associated soils of the Fallbrook series by their browner or less red color and less mature soil development. To list these three soils, in order of internal drainage, the Vista would be number one or the best, next the Fallbrook, and finally the Merriam series as the one with poorest drainage.

Two other interesting correlations were: 1) The frequency that root rot damaged areas were essentially outlined by the soil series lines on the maps (Figure 1), and 2) the close relationship of the incidence of damage and the general slope of the land which is shown by the elevation lines. As is often observed in the field, trees in the low areas, if attacked by the cinnamon fungus, are often killed or damaged relatively soon; as the disease progresses up the slope, the rate of damage is often markedly slowed. This rate of damage is, of course, influenced not only by slope and soil series, but by other factors such as moisture, extent of root system, and soil and water movement.

To classify then the three major avocado soil series in Fallbrook as to susceptibility to root rot damage: 1) Vista is the least susceptible, 2) Merriam the most susceptible, and should not be planted to avocados; and finally, 3) the Fallbrook series must be considered problem soils, especially those that are well developed or closely associated with Merriam soils (Figure 1).

The authors feel that this survey, and subsequent studies in other areas, should have practical value, not only for avocado growers planning new groves, but also for those who already have an infestation of root rot. Certainly those planning new groves should contact their local farm advisor and Soil Conservation Service to help determine which soils would be best suited and least susceptible to the root rot fungus. For those who already have an infestation in their groves a knowledge of the soils that are involved

and the extent or boundaries of the various soil series would be of help in deciding the measures to be taken to either control or to limit the spread of the fungus.

### **LITERATURE CITED**

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