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MULCH EFFECTS ON AVOCADO ROOT ROT

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Abstract

Hass avocado on three types of rootstock (Duke 7, Thomas, and Toro Canyon) and Zutano seedlings were planted in root rot infested soil and treated (or untreated) with mulch, Aliette or gypsum, as well as all possible combinations. Toro Canyon rootstocks produced the largest trees, Duke 7 the smallest. Mulch and gypsum did not affect tree size, however Aliette stimulated tree growth. Mulched trees had increased diseased symptoms while Aliette-treated trees were less symptomatic. Gypsum had no effect on disease ratings.

1. Introduction

Phytophthora root rot is the most limiting disease for avocado production in California, where it has spread to 65-75% of groves. Planting of root rot tolerant rootstocks has increased, but they are not fully resistant to the disease. It is important to create the environment for optimum growth in root rot infested soils to augment planting of tolerant rootstocks.

Soil organic matter added to soils can enhance suppression of root diseases and increase growth and yield of avocado (Broadbent et al., 1974; Peg et al, 1987). Although the exact mechanism of control is not known, absence of the fungus in tropical forests suggests that the fungus does not occur in high organic matter soils (Shea et al., 1975). Biocontrol may be caused by a specific suppressive organism enhanced by the organic matter, such as *Trichoderma* spp. (Papavizas, 1983); a general increase in competitiveness for resource resulting from increased number and diversity of microflora and fauna (Cook et al., 1983); or it may be the general effect on soil physical and chemical conditions that organic matter has in conjunction with earthworm activity (Stephensen et al., 1944).

Although avocado trees produce their own mulch as they mature, this has little bearing on replanting infested lands with young trees. Growers do not mulch young plantings, yet these trees are at greatest risk to Phytophthora attack. Application of thick mulch layers (>5 000 $m^3 ha^{-1}$) has potential to create beneficial conditions for avocado growth while retarding *Phytophthora cinnamomi.*

Newly planted orchards can receive mulch within rows because there are no interfering branches. Such orchards are potentially afforded other benefits, such as weed control, water conservation, nutrients and soil temperature modulation.

The purpose of this project is to evaluate the suitability of mulches derived from eucalyptus tree trimmings to enhance the survivability of avocado trees planted to root rot infested soils. Eucalyptus was used because it is abundant in the Southern California landscape and is relatively inexpensive. Mulching is being tested along with fungicide mulch gypsum interactions.

2. Materials and methods

The trial was initiated March, 1994, in Ventura, CA, an avocado growing region north of Los Angeles. The site is a 2.83 ha block (9% slope), planted to 700 trees in a root rot infested Rincon silty clay loam (fine, montmorillonitic, thermic Mollic Haploxeralfs).

Three resistant rootstocks with Hass scion and a seedling Zutano were planted on alternate rows. Treatments were hand-applied as 15 cm of chipped eucalyptus mulch around the base (2 m^2) of the tree, 10 kg of gypsum and or foliar application of an Aliette solution of 3.5 g l^{-1}. Untreated controls were used in each treatment factor. All trees are irrigated on the same system with 45 lhr^{-1} emitters. The factorial experiment is a four factor completely randomized complete block design with 16 replications. All treatments were reapplied in the summer of 1995.

Tree growth and mortality are monitored by trunk and canopy volume measurements and visually. Disease severity is measured by a visual index (1=healthy, 5=dead). Soil fungal populations were assessed by dilution plating on modified Rose Bengal media. Plant water status was measured by poromitry (LI- 1600; Li-Cor, Lincoln, NE). Soil moisture tension (15 cm depth) was monitored under Thomas rootstocks by pressure transducer (Soil Measurement Systems, Tucson, AZ).

Results were analyzed with SAS and MSTAT-C. Because of significant row and tree position effects, a covariate was used in the factorial ANOVA. Disease Severity observations were log transformed.

3. Results

3. 1. Trunk caliper growth

Trunk caliper growth of the three clonal rootstocks is greatest in Toro Canyon, with Thomas being greater than Duke 7 (table 1). Aliette increased trunk caliper, while gypsum has no direct effect and the mulch-has a negative effect (table 1). Interactions were not significant, but trends show an increase in caliper with applied gypsum on Thomas.

3.2. Disease severity

The most pronounced effect on disease severity (table 1) is with the application of Aliette. Disease severity across all rootstocks is significantly reduced. The use of gypsum has no significant effect, although there is a tendency for reduced disease with its use. Mulch on Zutano, Duke 7 and Thomas increased severity of disease, but had no pronounced effect on Toro Canyon. In spite of the higher levels of disease associated with the mulch, the number of soil fungal genera associated with the mulch is higher (data not shown). Most interactions tested are not significant (Table 2), however mulch X Aliette and mulch X rootstock interactions did affect disease severity.

3.3. Soil and plant moisture effects of mulch

Daily soil moisture tensions (not shown) are higher for the unmulched plots, yet poromitry indicates that plants have similar rates of stomatal conductance.

4. Discussion

In a trial where one treatment significantly alters soil moisture, yet all treatments receive the same amount of water, results can be confounding. The use of mulch promotes both increased biological activity and physical properties. During an irrigation, the water runs off the unmulched plots, whereas it is retained in the mulched plots. This is because surface crusting occurs in the unmulched plots, and with the slope of the land, runoff is exacerbated. In the mulched plots, the soil surface has a granular structure which is promoted by organic matter incorporation by fungal breakdown, insect and earthworm activity.

Increased disease activity under mulches plots may be due to the higher soil moisture content. Equivalent stomatal conductivity in the mulched and unmulched plots indicates that mulch acts primarily to reduce evaporative loss. Increased soil aeration associated with mulch and subsequent disease reductions may only be starting to occur one year post-mulching. Such effects may be overwhelmed by the other mechanisms of moisture retention conferred by mulching.

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Table 1. Main effects of mulch, Aliette, gypsum and rootstock on disease severity and growth of avocados.

Source of Variation	Caliper[z]	DSI[y]
Rootstock		
Zutano seedling	----	0.312a
Duke 7	32.2c	0.176b
Thomas	34.7b	0.216b
Toro Canyon	37.6a	0.095c
Mulch		
mulched	34.2a	0.237a
unmulched	35.4a	0.162b
Gypsum		
applied	35.3a	0.194a
not applied	34.4a	0.205a
Aliette		
applied	35.8a	0.142a
not applied	33.9b	0.257b

[z]Caliper measured in mm. Means followed by the same letter, not significantly different according to LSD,<.05.

[y]DSI is Disease Severity Index: 0=healthy; 5=dead. Data log transformed

Table 2. Significance of main effects and interactions from factorial ANOVA.

Source of variation	Deg. Free	Mean Square		F Value		Probability	
		Cal	DSI	Cal	DSI	Cal	DSI
Mulch (M)	1	615.621	21.4	12.70	25.46	***	+
Gypsum (G)	1	1.982	0.11	0.04	0.15	NS	NS
Aliette (A)	1	270.54	37.3	5.58	44.34	*	***
Rootstock (R)	3	12891.1	90.32	265.87	36.16	***	***
MxG	1	70.85	0.06	1.46	0.07	NS	NS
MxA	1	96.67	4.27	1.99	5.09	NS	*
MxR	3	193.75	3.74	4.00	4.47	**	**
GxA	1	33.83	0.01	0.70	0.01	NS	NS
GxR	3	121.93	0.61	2.51	0.72	+	NS
AxR	3	31.29	1.04	0.65	1.24	NS	NS
MxGxA	1	77.33	0.29	1.59	0.35	NS	NS
MxGxR	3	118.3	1.42	2.44	1.70	+	NS
MxAxR	3	13.47	2.00	0.28	2.39	NS	+
GxAxR	3	97.09	0.46	2.00	0.56	NS	NS
MxGxAxR	3	4.88	0.82	0.10	0.97	NS	NS

NS is nonsignificant, +, *, **, *** are significant at P<0.10, 0.05, 0.01 and 0.001 respectively.