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INTEGRATED CONTROL OF AVOCADO DISEASES

HOWARD D. OHR
PLANT PATHOLOGY –
COOPERATIVE EXTENSION SPECIALIST

Cooperating personnel: N. Grech., S. Campbell, B. Faber, G. Witney, G. Bender, J. A. Menge

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We currently have three continuing trials and two trials that are in the process of installation for a total of five trials. These trials are quite large ranging in size from 200 to 500 trees and up to 24 different treatments. The emphasis is on integrated control to maximize the impact on the pathogen and to minimize the impact on the environment. Based upon data gathered from our on-going trial at field 30 at South Coast Field Station the two trials that are currently under installation will be combinations of mulch and chemical treatment. In these trials we are attempting to control root rot with materials that will be readily available and not too expensive to use. The other two on-going trials are chemical trials without mulch. In one we are comparing application methods and it is the only trial with trunk injections. We are de-emphasizing trunk injections due to two factors; one is because of the damage to the trunk caused by multiple injections and the other is due to the fact that Rhone-Poulenc does not intend to label Aliette for that method of application. While foliar sprays are an excellent method of application we feel that the majority of growers with root rot will be better served by chemigation and are therefore emphasizing that method in our trials. The second trial without mulches is a comparison of the response of two different rootstocks to treatment with Aliette.

Trial 1: South Coast Field Station:

This trial is a chemigation-amendment trial at South Coast Field Station field 30 and consists of 24 treatments with 20 replications of each treatment. The experimental design is a randomized block. The trees are Hass with Duke 7 rootstocks planted in May of 1990. Amendments are added once per year as top dressings and data are taken once per year as trunk diameters, canopy volume, visual assessment and yield.

TREATMENTS

1. Inoculated control
2. Aliette 22.6 g/tree 2x/year based on leaf flush
3. Ridomil 2.96 g/tree 2x/year based on leaf flush
4. Alfalfa mulch
5. Plastic ground cover (porous)
6 Alfalfa-plastic
7. Steer manure
8. Gypsum
9. Alfalfa-steer manure
10. Alfalfa-gypsum
11. Plastic-steer manure
12. Plastic-gypsum
13. Alfalfa-plastic-steer manure
14. Alfalfa-plastic-gypsum
15. Steer manure-gypsum
16. Alfalfa-steer manure-gypsum
17. Plastic-steer manure-gypsum
18. Alfalfa-plastic-steer manure-gypsum
19. Aliette 22.6 g/tree 1x/yr
20. Ridomil 2.96 ml/tree 1x/yr
21. Aliette 22.6 g/tree 1x/yr-alfalfa-plastic
22. Ridomil 2.96 ml/tree 1x/yr-alfalfa-plastic
23. Aliette 22.6 g/tree 1x/yr-alfalfa-plastic-manure-gypsum
24. Ridomil 2.96 ml/tree 1x/yr-alfalfa-plastic-manure-gypsum

Results:

The tables were analyzed using Duncan's multiple range analysis. Means followed by different letters are significantly different at the 5 percent level. In the visual assessment (Table 1) we have noticed a marked improvement in all trees with a spread of only 0 to 1. Because this improvement is apparent in our plots in other locations we feel that it is due, in part, to the rain we received this past winter (1992-93) leaching excess salts from the soil. It is interesting to note that in the three objective categories (trunk diameters (Table 2), canopy volumes (Table 3) and 1993 yield (Table 4) the rankings are fairly consistent. In the 1994 yields (Table 5) the trees, for the most part, showed the

effects of alternate bearing. However, there were 5 treatments (Table 6) that yielded well at both harvests. The common factor in these 5 treatments is the presence of the porous plastic ground cloth. Because the plastic is present in the best response treatments and the 1993-94 yields we plan to follow that lead and design trials to determine the treatment value and cost effectiveness of the plastic.

Trial 2: Field 20 UCR.

This trial has been initiated to further explore the combinations of chemigation and mulches that appear successful in field 30 at the South Coast Field Station. In this trial the trees are Hass on Thomas root stock with the following treatments:

1. Untreated control
2. Aliette chemigation
3. Mulch
4. Aliette chemigation + Mulch
5. Aliette stem paint
6. Aliette stem paint + Mulch
7. Aliette stem paint + Mulch + Aliette chemigation

The mulch used is to be common yard waste as obtainable from a city and not a tailored mulch. The reason is to try to keep the cost of the mulch low. Stern injections were not included because of the small size of the trees and foliar application was excluded because of the lack of a large enough area for the number of trees that would be needed.

Miller's, Santa Barbara County

The third and fourth trials are on the Miller ranch in Santa Barbara county and was initiated in 1992. Trial three is on 10 year old Hass on G755 and is a trial to compare different methods of application of Aliette. Treatment methods used were foliar, chemigation, trunk injection and trunk paint with 16 replicates per treatment. A visual rating in the fall of 1993 found that there is no significant difference between treatments but the trunk injection treatment is significantly better than the control.

Treatment	Mean
Control	0.89 a
Trunk paint	0.56 ab
Chemigation	0.53 ab
Foliar spray	0.39 ab
Trunk inject	0.11 b

Treatments followed by different numbers are significantly different at the 1% level.

Trial two at Miller's is on trees that are 2-3 years old. Hass scion on Duke 7 or Thomas rootstocks. Treatments are Aliette chemigation or stem paint. The trial is designed to test the response of the two rootstocks to the two methods of chemical application. There are no significant differences as yet.

Sprinkling, Ventura County

Trial five is situated in the Somis area of Ventura county. It will consist of newly planted trees on 4 rootstocks (Duke 7, Thomas, G2011 and G755A) with 20 replications of each rootstock for each treatment. Treatments are Aliette 1 X per year, Aliette 2 X per year, mulch, Aliette 1 X per year + mulch, Aliette 2 X per year + mulch and the non-treated control. Application of the chemicals will be by chemigation. The mulch will be derived from city yard waste with added gypsum. This site is currently being prepared and installation is projected to be complete by early summer.

SUMMARY

We currently have five trials in operation or installation. Two of these trials are in Santa Barbara County, one in Ventura County ont in field 20 at UCR and the oldest trial, field 30 at South Coast Field Station. These are extensive trials that total close to 2000 trees. Our newest trials are building on the results of the field 30 trial. In field 30 our best results were with various combinations of Aliette, alfalfa, plastic and gypsum. In our new trials we are using combinations of Aliette, composted yard waste (cheaper than alfalfa or custom mulches) and gypsum. We have abandoned the plastic landscape ground cover because of the cost and the labor intensive management it requires. We are attempting to develop methods that are effective, practical and of reasonable cost. Field 30, in its current form, has outlived its usefulness due to the close planting. We are therefore pruning the trees and training them so that we can collect several more years yield data to verify the results that we have obtained to date.

Table 1

Field 30 Visual Rating
September 1993

Treatment	Mean	
Aliette 1x/yr-alfalfa-plastic	0.00	a
Aliette 1x/yr-alfalfa-plastic-manure-gypsum	0.00	a
Ridomil 1x/yr-alfalfa-plastic	0.00	a
Gypsum	0.00	a
Alfalfa-gypsum	0.00	a
Plastic-gypsum	0.00	a
Alfalfa-plastic	0.00	a
Ridomil 1x/yr	0.00	a
Alfalfa-plastic-gypsum	0.05	ab
Manure-gypsum	0.05	ab
Ridomil label rate 2x/yr	0.08	ab
Aliette label rate 2x/yr	0.13	abc
Alfalfa-manure-gypsum	0.13	abc
Alfalfa	0.18	abc
Aliette 1x/yr	0.31	abc
Manure	0.33	abc
Alfalfa-manure	0.34	abc
Plastic	0.53	abc
Alfalfa-plastic-manure	0.53	abc
Plastic-manure	0.63	abc
Plastic-manure-gypsum	0.80	abc
Inoculated control	0.80	abc
Ridomil 1x/yr-alfalfa-plastic-manure-gypsum	0.89	bc
Alfalfa-plastic-manure-gypsum	1.00	c

Table 2

Field 30 Trunk Diameter (mm)
September 1993

Treatment	Mean	
Aliette 1x/yr-alfalfa-plastic-manure-gypsum	114.65	a
Aliette 1x/yr-alfalfa-plastic	101.93	ab
Alfalfa-plastic-gypsum	100.68	abc
Alfalfa-plastic	100.20	abc
Alfalfa-gypsum	99.84	abc
Aliette label rate 2x/yr	97.79	bcd
Plastic-gypsum	97.75	bcd
Alfalfa-manure-gypsum	96.65	bcd
Ridomil 1x/yr-alfalfa-plastic	93.90	bcde
Alfalfa	89.53	bcdef
Manure-gypsum	87.55	bcdefg
Aliette 1x/yr	86.50	bcdefg
Ridomil label rate 2x/yr	85.50	cdefgh
Gypsum	85.40	cdefgh
Ridomil 1x/yr-alfalfa-plastic-manure-gypsum	83.44	defgh
Plastic-manure-gypsum	83.05	defgh
Alfalfa-plastic-manure	82.95	defgh
Alfalfa-plastic-manure-gypsum	78.50	efgh
Alfalfa-manure	78.34	efgh
Manure	76.27	fgh
Ridomil 1x/yr	74.67	fgh
Plastic-manure	71.55	gh
Plastic	71.42	h
Inoculated control	69.85	h

Table 3:

Field 30 canopy volume
September 1993

Treatment	Mean	
Aliette 1x/yr-alfalfa-plastic	516.02	a
Alfalfa-manure-gypsum	507.27	a
Alfalfa-plastic-gypsum	487.59	ab
Aliette 1x/yr-alfalfa-plastic-manure-gypsum	485.64	ab
Alfalfa-gypsum	461.93	abc
Aliette label rate 2x/yr	434.44	abcd
Aliette 1x/yr	432.85	abcd
Plastic-gypsum	431.69	abcd
Alfalfa-plastic	427.29	abcd
Gypsum	388.63	bcde
Ridomil 1x/yr-alfalfa-plastic-manure-gypsum	364.39	cde
Ridomil 1x/yr-alfalfa-plastic	354.63	cdef
Plastic-manure-gypsum	351.12	cdef
Alfalfa-plastic-manure	325.37	defg
Manure-gypsum	324.17	defg
Alfalfa-plastic-manure-gypsum	321.45	defg
Ridomil label rate 2x/yr	303.14	efg
Manure	296.59	efg
Alfalfa	284.51	efg
Ridomil 1x/yr	282.28	efg
Plastic	281.07	efg
Inoculated control	238.80	g
Plastic-manure	224.17	g
Alfalfa-manure	211.59	g

Table 4

Field 30 Yield
Spring, 1993

Treatment	Yield (kg)
Aliette 1x/yr-alfalfa-plastic	14.16 a
Alfalfa-gypsum	12.18 ab
Plastic-gypsum	12.17 ab
Ridomil 1x/yr-alfalfa-plastic	11.02 abc
Alfalfa-plastic-gypsum	10.77 abcd
Plastic-manure-gypsum	10.45 abcd
Aliette 1x/yr-alfalfa-plastic-manure-gypsum	10.2 abcd
Aliette label rate 2x/yr	9.74 abcde
Plastic	9.42 bcde
Aliette 1x/yr	9.42 bcdef
Alfalfa-plastic	9.23 bcdef
Manure-gypsum	8.27 bcdef
Gypsum	7.77 bcdef
Alfalfa-manure-gypsum	7.62 bcdef
Alfalfa-plastic-manure-gypsum	7.40 bcdef
Alfalfa-plastic-manure	7.04 cdef
Ridomil 1x/yr-alfalfa-plastic-manure-gypsum	6.50 cdef
Plastic-manure	6.40 cdef
Manure	6.38 cdef
Alfalfa-manure	6.13 def
Inoculated control	5.07 ef
Ridomil label rate 2x/yr	5.06 ef
Alfalfa	4.51 f
Ridomil 1x/yr	4.48 f

Table 5

Field 30 Yield
February 1994

Treatment	Yield (kg)
Aliette 1x/yr-alfalfa-plastic-manure-gypsum	17.3 a
Alfalfa-plastic	13.6 ab
Ridomil 1x/yr-alfalfa-plastic	10.7 bc
Ridomil 1x/yr-alfalfa-plastic-manure-gypsum	10.0 bcd
Alfalfa-manure-gypsum	8.8 bcde
Alfalfa-plastic-manure-gypsum	8.5 bcde
Alfalfa-plastic-gypsum	8.4 bcdef
Plastic-manure-gypsum	7.9 bcdef
Alfalfa	7.8 bcdef
Aliette 1x/yr-alfalfa-plastic	6.7 bcdefg
Alfalfa-manure	6.6 bcdefg
Alfalfa-gypsum	6.4 bcdefg
Afalfa-plastic-manure	5.9 cdefg
Aliette 1x/yr	5.5 cdefg
Ridomil label rate 2x/yr	5.2 cdefg
Manure-gypsum	4.9 cdefg
Plastic-manure	3.7 cdefg
Plastic	3.5 cdefg
Aliette label rate 2x/yr	3.1 defg
Plastic-gypsum	2.7 defg
Inoculated control	2.4 efg
Gypsum	2.1 efg
Manure	1.1 fg
Ridomil 1x/yr	0.3 g

Table 6

	1993		1994		2 yr ave
	yield*	rank	yield	rank	
Al 1x/yr-alf-pl-man-gyp	10.2	7	17.3	1	13.75
Rid 1x/yr-alf-pla	11.0	4	10.7	3	10.85
Alf-pl-gyp	10.8	5	8.4	7	9.6
Pl-man-gyp	10.4	6	7.9	8	9.15
Al 1x/yr-alf-pla	14.2	1	6.7	10	10.45

*Yields in kilograms

PROJECT TITLE: CONTROL OF TRUNK CANKERS CAUSED BY *P. CITRICOLA*

SUB-PROJECT : CHEMICAL AND CULTURAL CONTROL

A. Surveys.

P. citricola has been isolated from all the major Avocado regions of California. Diseased trees have been dug up in all of the surveyed areas and lesions have been found on all of these trees, generally limited to the crown roots and lower stem. Invariably the tree dies from extensive phloem destruction generally manifesting itself as trunk girdling. From previous work wounding appears to be a pre-requisite for successful invasion by *P. citricola,* and therefore cultural practices leading to wounding in the field (eg de-suckering) have been implicated in the distribution of this disease and hence should be avoided. During the winter and spring of 1993 severe fruit infection by P. citricola was recorded.

B. Chemical control

Pre and post inoculation applications of forsetyl-Al(wp) and/or metalaxyl have provided varying degrees of control in inoculated clonal and seedling rootstocks grafted with Hass. To date these trials have resulted in forsetyl-Al being shown to be superior in the abatement of symptom expression by *P. citicola.* Trunk applications of forsetyl-Al were shown to be effective in the control of this malady in these trials. As in Southern Africa and Australia, it is envisaged that Phosphorous acid will result in similar levels of control but at a lower per unit cost if the product can indeed be registered here.

B.1 Trial 1 Treatments:

1. ALIETTE @ 300g product./LITER lOOMLS/TREE APPLIED AS A TRUNK PAINT OVER THE SCRAPED LESION AREA.

2. AS 1 + POLYACYLAMIDE GEL @ 2g/LITER

3. ALIETTE ROOT DRENCH, 150g/TREE PER 10 GALLONS WATER APPLIED TO DRIP AREA(1.5m RADIUS)

4. RIDOMIL 2E PAINT(25% a.i.), 100 MLS PRODUCT/TREE SPAYED ONTO EXPOSED LESION AREA

5. CONTROL, BARK SCRAPED.

Results: (20 MO AFTER FIRST TREATMENT)

		mean canopy rating	mean lesion area(cm^2)
1.	Aliette	1.5	7.68 a
2.	Aliette + gel	1.5	7.92 a
3.	Aliette drench	1.8	8.94 a
4.	Ridomil	1.85	27.76 b
5.	Control	1.7	63.38 b

Figures followed by the same letter do not differ significantly rom one another according to the Nueman-Kuels test(P=0.05).

B.2 Phosphite Uptake

Trees are planted, and will receive the first treatments of different phosphite formulations, during March.

C. Varietal tolerance

C.1 Replant trial, Fallbrook.

To date no differences in rootstocks in terms of the trunk girth, canopy or visual rating of the trees is apparent. The rootstocks under test are Duke 7, 755b and Thomas. Growth differences were observed between trees under a foliar phosphite program, as compared to those not under such a program. *P. citricola* was found to be abundant in the soil of this site. Trees will be assessed over the next few years for tolerance to *P. citricola.*

Trial 1. South Coast Field Station rootstock tolerance trial.

Ten rootstocks grafted to the cultivar Hass were planted and were root inoculated five years ago with *P. citricola,* in the roots, and in the trunks 18 mo ago. These trees were all sampled in during the past year for the presence of *P. citricola* in the rhizosphere. *P. citricola* was recovered from the majority of the trees. *P. cinnamomi* was also found on the feeder roots of these trees. The experimental block was visually rated for tree health, and lesion development. Trees were pruned during 1993 and hence yields on

these blocks were reduced.

Table 1. 1994

ROOTSTOCK	CANOPY HEALTH	MEAN TRUNK LESION SIZE (CM^2)	YIELD (KG)
TORO	0.45	8.6	24.78*
755A	0.7	3.4	10.07
755B	0.7	17.62	9.86
755C	0.7	2.3	5.57
THOMAS	0.7	11.7	8.3
G6	0.85	17.8	7.55
B. DUKE	0.9	11.47	8.7
D-7	0.9	6.6	9.24
1033	1.14	31.3	5.31

*Only Toro canyon was significantly different in terms of yield from the other rootstocks. All trees were pruned in 1993.