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EFFECT OF DIFFERENT FUNGICIDES AND METHODS OF APPLICATION TO CONTROL AVOCADO ROOT ROT IN SOUTHERN SPAIN

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Abstract

Phosphorous acid (20 %) and Phosetyl-Al as foliar applications, Phosphorous acid (20%) and Phosetyl-Ca as trunk injections, and Metalaxyl as soil drench have been assayed in an avocado orchard with trees severely affected by *Phytophthora cinnamomi* in southern Spain. The trees received four applications of fungicides during two consecutive years (1992 and 1993). Preliminary results revealed an incipient improvement of avocado trees treated with Phosphorous acid or Phosetyl-Ca as trunk injections, although in the first case, the improvement was more noticeable.

Additional index words: chemical control, *Phytophthora cinnamomi,* avocado root rot.

1. Introduction

One of the two most important avocado diseases on the Mediterranean coastal plain of southern Spain is *Phytophthora* root rot, caused by *P. cinnamomi* Rands (López- Herrera and García-Rodriguez, 1987), with a continuous increase of the affected area since 1989 (data unpublished).

This paper report preliminary results from an experiment in which different formulations of fungicides and methods of application were used in an established avocado orchard for control of *Phytophthora* root rot.

2. Material and Method

Ten-year-old Hass avocado trees grafted on Topa-Topa seedlings rootstocks were used for this experiment in an orchard, severely infested by *Phytophthora cinnamomi,* located in Málaga (on the coastal plain of southern Spain). At the beginning of the experiment the trees presented a height index of severity, around 7, in a scale disease severity, 0 to 10 (0 = healthy, 10 = dead) (Darvas *et al.,* 1984).

The treatments used were as follows: Phosphorous acid (PA) (20% solution potassium phosphonate with pH adjusted to 5.8 with potassium hydroxide) and Phosetyl-Ca (AC) (Aliette-Ca-10%/EF 2008-13) as trunk injections (Pegg *et al.,* 1985; Darvas *et al.,* 1984) at rates of 15 ml of commercial formulation per meter of canopy diameter. PA and Phosetyl-Al (AA) (Aliette 80% WP) at rate at 60 ml and 7.5 g of commercial formulation respectively per meter of canopy

diameter, as foliar applications (5 L of spray per tree) and Metalaxyl (R) (Ridomil 5G) at rate 40g/m^2 of commercial formulation as soil drenches. These applications were made on July and November, 1992 and 1993. Twenty trees were used per treatment and there were five treatments and one control replicated four times in randomized blocks. Data were processed using a general analysis of variance with LSD test.

The assessment of results was based on: a) Rating of trees, according to the previous cited scale disease, on July 1992, December 1993, and November 1994. b) Root samples collected on March 1993 and 1994, from eight trees in each treatment (two per block and treatment). Each time, freshly killed roots were removed from each tree, rinsed with tap water to remove soil particles and washed with sterile water. Afterwards, the roots were surface sterilized with 1% NaClO, followed by rinsing in sterile water and plated (ten roots per plate) on acidified (pH 4.8) PDA and CMA with antibiotics and incubated at 24 C in darkness. After two days the colonies of *P. cinnamomi* were identified and the mean frequency, for each treatment and date of isolation, was calculated. c) Fruit yield (Kg/tree) was recorded from each tree at maturity in 1993 and 1994.

3. Results

At 16 months (in 1993), after 3 fungicide applications, the injected PA treatment, was the most effective and decreased the average severity index of trees by 16.41 %. The beneficial effects of PA and AA as foliar applications, and injected AC, were similar among them and smaller than injected PA. The R was no different from the control. At 28 months (in 1994), with one more fungicide application, PA (foliar and injected) and AC decreased the severity of the disease, although the injected PA was 7% more effective. The R showed no differences with the control while the appearance of AA f6liar treated trees was slightly better (table 1).

The frequency of isolation of *P. cinnamomi* from rootlets between the two dates of sampling (March, 1993 and 1994) decreased for all treatments except for the control and was nil in the second year for the PA treatments.

The fruit yield (table 2) was increased only in the case of the fungicides injected, although the PA increased the yield nearly 5 times more than the AC. The rest of treatments decreased the yield.

4. Discussion

We have obtained an important recovering in the health of trees for some of the treatments assayed, considering the high level of mean disease initial rating (around 7) at the beginning of this experiment in contrast with experiments of other authors in which the mean disease initial ratings of trees were around 5 (Wood *et al.*, 1987).

After 3 fungicide applications, the PA injected treatment improved tree health significantly with respect to the rest of treatments assayed. Besides, the nil isolation frequency of *P. cinnamomi* from feeder roots obtained when using PA (injected or foliar) in contrast to the 4 % obtained with AC injected, revealed a better and more rapid translocation of the fungicide into the plant in the first case allowing a better and major protection of the tree roots to invasion by *P. cinnamomi* from the soil.

However, after 4 fungicide applications the AC injected treatment had improved in health to the same extent as the PA injected and similar to PA foliar. Although the improvement was 1.39 units and 1.13 units for PA injected and AC injected respectively, in tree rating over two years,

as opposite to the improvement of 0.7 units for PA foliar during the same time, for trees with a similar initial rating (around 7). This revealed the main absorption power of these fungicides when injected. Although the PA injected was taken up more readily and was more effective than AC injected as noticed by Pegg *et al* (1985). Besides the AC injected effect was smaller than PA injected in the first year but it was dramatically improved in the second year, in agreement with the results of Darvas et al.(1984), and Onsando and Gathungu (1988). The increase of severity index for the AA foliar treatment can be explained by the slow absorption of this fungicide through the foliage, since in this experiment the trees presented a slight foliar mass. The nil effect of R can be explained by a rapid degradation (biological or chemical) of fungicide in the soil, and it should not be used in orchards with a rapid decline of trees as a result of *P. cinnamomi* infection (McKenzie (1984).

In reference to fruit yield, it only seems profitable the applications with fungicides by trunk injection; the low absorption the commercial product by foliar application could be due to the slight foliar mass in trees with a high severity index.

These preliminary results on the control of *P. cinnamomi* in an established avocado orchard on southern Spain, reveals that it is possible to get an incipient recovering of avocado trees severely affected by *P. cinnamomi* only through four applications, during two consecutive years, by using Phosphorous acid or Phosetyl-Ca as trunk injections. However, the former seems to be more effective in basis to the decrease of severity index, the nil isolation frequency of pathogen from feeder roots, and the increase of fruit yield, of the treated trees.

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Table 1 - Yearly evolution of disease rating of avocado trees treated with different fungicides and methods of application.

Treatment	Mean[x] disease rating (S)(0 = healthy; 10 = dead) and mean percentage increase of S (ΔS)				
	S1992	S1993	S1994	ΔS93/92[y]	ΔS94/92[z]
Control	7.28	8.20	8.70	+19.42c	+27.15c
PA foliar	7.27	7.07	6.57	− 3.21b	−10.08a
PA injection	7.05	5.85	5.66	−16.41a	−17.46a
AA foliar	7.60	7.77	8.05	+ 3.01b	+ 6.86b
AC injection	7.03	6.31	5.90	+ 6.71b	−10.83a
R soil drench	6.78	7.55	8.11	+24.75c	+35.25c

[x] average of 20 trees

[y, z] Values in each columm followed by the same letter are not significantly different according to LSD test at P = 0.05.

Table 2 - Fruit yield (FY)[x] (kg/tree) and percentage increase of FY (ΔFY) during two years (1993 and 1994) in avocado trees cv. Hass treated with different fungicides and methods of application.

Treatment	FY1993[y]	FY1994[z]	ΔFY94/93
Control	6.46c	5.36b	−16.02
PA foliar	11.75a	11.01b	− 6.29
PA injection	9.45a	14.07a	+48.88
AA foliar	6.65b	5.13b	−22.85
AC injection	11.31a	12.51a	+10.61
R soil drench	10.42a	8.50b	−18.42

[x] average of 20 trees

[y, z] Values in each columm followed by the same letter are not significantly different according to LSD test at P = 0.05.