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A NEW PHOSPHOROUS ACID FORMULATION FOR THE EFFECTIVE CONTROL OF *PHYTOPHTHORA* ROOT ROT OF AVOCADO ORCHARDS

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SUMMARY

Avoguard 500 SL is a new phosphorous acid formulation developed in South Africa for the fast, efficient and economic control of *Phytophthora* root rot of avocado trees. The product is specifically formulated for quicker uptake and less phytotoxicity on avocado trees. Residue results show increased levels of active ingredient in the roots persisting for longer thus giving more effective and longer lasting protection against infection. Threes severely affected by root rot was recovered to an excellent condition using only two injections with Avoguard 500 SL, proving the benefit that this product can provide avocado producers. Avoguard 500 SL is a great new tool to use in the control and management of root rot in avocado orchards.

Key Words: *Phytophthora*, root rot, phosphorous acid.

INTRODUCTION

Root rot of Avocado trees has been the most destructive and economically limiting factor in avocado production worldwide (Pegg *et al.*, 2002). The disease is caused by *Phytophthora cinnamomi* and was first described by Rand in 1922 and first reported on avocado in Puerto Rico in 1929 (Tucker, 1929). In all the years that this problem has been researched no one solution has been

found and an integrated approach seems to be the only answer to control and manage this disease (Coffey, 1987; Erwin and Ribeiro, 1996). An integral part of this disease management strategy is the phosphorous acid based fungicides.

Phosphorous acid based fungicides are totally systemic and move both upward and downward in the tree, making is possible to apply the product to the tree as a trunk paint, foliar spray as well as trunk injections (Menge, 1999). The different applications all have some success but it seems form trials done that the best and most effective way of treating badly affected trees is through trunk injections (Menge, 1999).

The technique of using trunk injection of phosphorous acid to treat root rot in avocado was developed on the Westfalia Estates in South Africa in the early eighties (Darvas *et al.*, 1983) and after successful field-testing registration was given for trunk injection using potassium phosphonate in Australia (Pegg *et al.*, 1985).

A prominent avocado consultant in the Schagen area in Mpumalanga Province of South Africa, Dr Anthon Hough, investigated different compounds to dissolve phosphorous acid in order to improve the uptake, transport and to reduce phytotoxicity to trees. Ocean Agriculture formulated Avoguard 500 SL. Avoguard 500 SL contains a high level of phosphorous acid, which makes it possible to use less product, and is very rapidly translocated in the tree, making injections time efficient as well as giving rapid and long lasting protection against *Phytophthora* root rot.

MATERIALS AND METHODS

Trials were conducted to confirm the enhanced uptake and effective control of Avoguard 500 SL. The first trial was conducted on three farms in the Mpumalanga and Northern Provinces of South Africa, Shagen Nursery, Koeltehof Estates and Humor Farm. Trees were injected with a standard potassium phosphonate product and Avoguard 500 SL at the same rate of active ingredient, 0.4 g / m^2 in order to compare the levels of phosphorous acid in the roots after treatment. Two applications were done in the season coinciding with the periods of most active root growth. Holes of size 4.5 – 4.8 mm were drilled around the circumference of the tree and the phosphorous acid products were applied with veterinary syringes. The standard potassium phosphonate was diluted to 10% active ingredient and 20 ml injected per syringe, in order to apply the recommended 0.4 g / m^2 drip area (South African Avocado Growers Association, SAAGA, recommendation). Because of the increased active ingredient in Avoguard 500 SL (500g / litre) only 3.6 – 7 ml was needed per syringe, depending on the size of the tree.

Samplings of trees roots were done 4, 8 and 12 weeks after the second application. The pale feeder roots were sampled at three positions for each tree. The first sample was taken near the trunk, the second midway between the trunk and the drip perimeter and the last on the drip perimeter. The samples were combined for the three sampling positions and the three replicates taken. Roots were placed in cool bags and frozen as soon as possible. Root residue analysis was done at SGS accredited laboratories in South Africa.

A second trial was conducted to confirm the ability of Avoguard 500 SL to recover severely root rot affected trees. The orchard trial was started in July 2001 on eight-year-old Fuerte trees on Thomas rootstock with a drip area of approximately 10 m^2 per tree. Trees showed severe root rot symptoms and were severely defoliated. Trees were injected on July 2001 and again on 4 January 2002, using the recommended rate for poor condition trees of 0.5g active ingredient / m^2 drip area. The condition of the trees was assessed on 17 October 2002, using the rating structure shown in table 1. Trees were firstly placed in to one of three primary groups, (1) healthy, (2) transitional and (3) weak, the primary groups were then sub divided each into three secondary groups,

(i) good, (ii) medium or (iii) poor. Results are expressed as the percentage of the trees falling into each category.

RESULTS AND DISCUSSION

Root residue analysis form the first trial done shows that Avoguard 500 SL applied at a standard rate of 0.4g a.i. / m^2 resulted in an average of 37% more phosphorous acid in the roots than the standard potassium phosphonate. Over time the levels of phosphorous acid dropped in the roots as it got diluted through tree growth, however Avoguard 500 SL persisted at higher levels in the root giving effective control over an extended period. The detailed results are given in table 2.

On evaluation of the efficacy trial on 17 October 2002 the trees had improved greatly and the results was impressive with trees having a dense rich and dark green canopy, most injected trees was in excellent condition and did not seem to need further treatment in the near future (see figure 1). A 100% of the Avoguard 500 SL injected trees were rated in primary group 1 (Healthy trees) in the control only 25% was rated in primary group 1, 50% was rated in group 2 (Transitional trees) and 25% was rated in group 3 (Seriously affected trees). The results are summarised in table 3.

CONCLUSIONS

Avoguard 500 SL was between 30 and 40% more effective than standard potassium phosphonate in terms of the levels of active ingredient (phosphorous acid) in the roots 4 weeks after injection. Observations done in the field showed that Avoguard 500 SL was taken up by the trees in a shorter time than the standard treatment, and the injection wounds callused over quickly, with no bleeding of sugars from the wounds (see figure 2). Avoguard 500 SL has the ability to improve the condition of threes severely damaged by root rot within a season, which has great economic implications for growers.

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Table 1: Avocado rating structure

Primary groups	Secondary groups
1 Tree appears healthy	1 Excellent leaf canopy
	2 Very good canopy
	3 Good canopy
2 Tree in transitional state	4 10% tinning of canopy
	5 20% tinning of canopy
	6 30% tinning of canopy
3 Poor tree condition	7 50% tinning of canopy
	8 75% tinning of canopy
	9 >75% tinning of canopy

Table 2: Phosphorous acid residue results

Farm	Timing of sample	Phosphorous acid residue in roots (ppm)	
		Standard potassium phosphonate	Avoguard 500 SL
Schagen	4	17.4	28.8
Kloetehof	5	16.7	22.1
Humor	4	16.0	29.2
Humor	8	12.8	15.3
Schagen	12	5.9	10.2

Table 3: Detailed rating results

Ratings	Untreated control	Avoguard 500 SL injection
1 Excellent leaf canopy	20%	95%
2 Very good canopy	5%	5%
3 Good canopy	0%	0%
4 10% tinning of canopy	15%	0%
5 20% tinning of canopy	20%	0%
6 30% tinning of canopy	15%	0%
7 50% tinning of canopy	10%	0%
8 75% tinning of canopy	5%	0%
9 >75% tinning of canopy	10%	0%

Figure 1: Control tree (right) and Avoguard 500 SL injected tree (left)

Figure 2: Avoguard injection would after one month (right) and after four months (left)