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Progress Report on Plant Pathology Research at Merensky Technological Services

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BIOCONTROL OF AVOCADO ROOT ROT IN THE ORCHARD

Four field trials are underway to evaluate whether fungal antagonists, previously found to effectively control avocado root rot under glasshouse conditions (Duvenhage & Kotzé, 1993), are effective against root rot in the orchard.

Established orchards

Two avocado blocks, a Hass block planted in 1981 on Duke 7 rootstocks, and a Fuerte block planted in 1980 on Guatemalan seedling rootstocks, have been treated with antagonists since 1992. Three fungal antagonists, *Paecilomyces lilacinus* (PREM 50933), *Aspergillus candidus* (PREM 50935) and *Trichoderma hamatum* (PREM 50938), and also a mixture of all three, were applied annually during October/November as a spore suspension at 10 propagules/gram soil (calculated for the top 10 cm of soil). Due to poor tree condition of the Hass block, trees received fosetyl-Al injections for root rot control until January 1993 after which injections were terminated. The tree condition and yield, antagonist and *Phytophthora cinnamomi (Pc)* populations, and suppressiveness of the soils are monitored annually. To date none of these criteria have been significantly influenced by the antagonist applications.

Newly planted orchards

During November to December 1992 a trial block of each of Fuerte and Hass on Duke 7 rootstocks was planted with nursery trees of which the growth medium had been amended with antagonists. Red millet seed inoculum of the antagonists was used for amendment at 10 propagules/g growth medium. The trees are treated annually with antagonist spore suspensions as described previously, and evaluated on the same aspects as mentioned above. Populations of antagonists increased significantly, over the period from 1992 (before planting) to 1994, in soils treated with the different antagonists (Figures 1 & 2), while antagonist populations in the untreated soil (control) did not change significantly (data not shown). Although there was a tendency for the antagonist populations to increase in soils treated with a combination of all three antagonists, over the period from 1992 (before planting) to 1994, the increases in the different antagonist populations were not always significant (Figures 3 & 4).

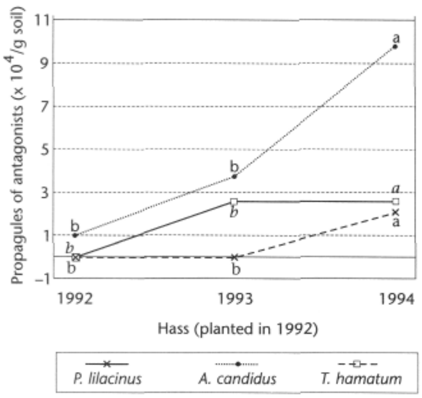

Figure 1
Antagonist populations in soils treated with different antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

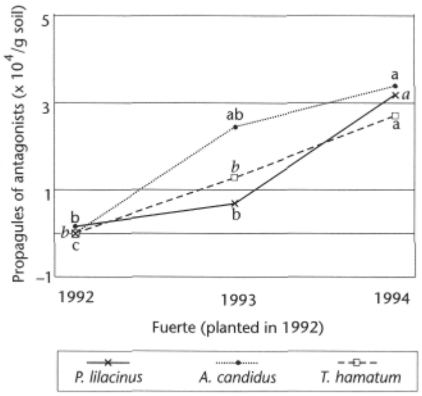

Figure 2
Antagonist populations in soils treated with different antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

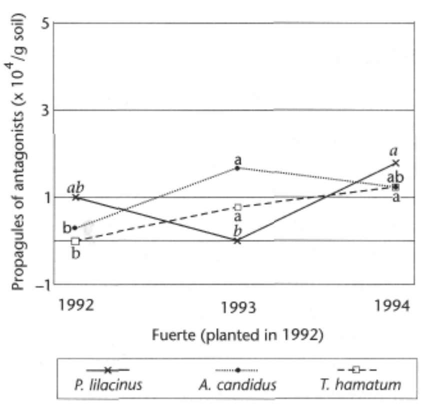

Figure 3
Antagonist populations in soils treated with a combination of all three antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

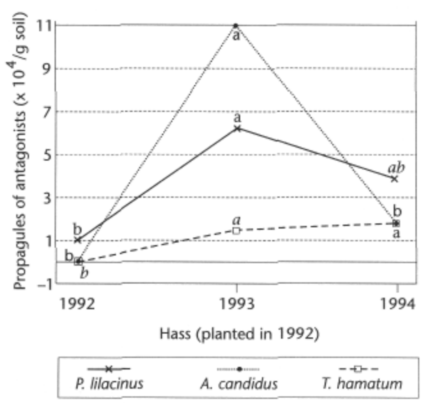

Figure 4
Antagonist populations in soils treated with a combination of all three antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

OBTAINING AND EVALUATING NEW ROOTSTOCK CROSSES FOR RESISTANCE TO *PHYTOPHTHORA CINNAMOMI (PC)* AND YIELD

In order to obtain rootstocks with better resistance or tolerance to root rot and better horticultural characteristics than currently used rootstocks, a breeding programme was started a number of years ago. The Merensky Technological Services rootstock breeding programme containing different rootstock parents with known resistance or tolerance to *Pc* has already produced approximately 600 seed crosses to date (1994). The seedlings were tested for their resistance to *Pc* root rot by planting in *Pc* inoculated vermiculite, and visual evaluation of the root system of each seedling for root rot symptoms after 6 weeks. So far 8 promising new rootstock selections have been made, which will later be planted in a root-rot-prone field site and evaluated for root rot symptoms and yield. Material of each selection is now being propagated and the first trees (36 of each rootstock selection) will be planted in the field site during 1996. All rootstocks will be grafted with Hass and will be compared with Hass on Duke 7 rootstocks as the standard.

IMPROVEMENT OF H_3PO_3 APPLICATION METHODS AND SCHEDULING

Currently a 10% phosphorous acid treatment injected during October/November and January/February is used widely to control root rot. Due to the labour intensiveness of the injection procedure and the detrimental effect of prolonged injection on the tree trunk the following procedures are under investigation:

- using fewer syringes with a higher concentration of H_3PO_3,
- injecting only during October/November,
- mechanization of injection to improve the injection method,
- Using a stem paint of H_3PO_3 instead of injection.

A field trial was started during 1992 using a Fuerte orchard planted in 1980 on Guatemalan seedling rootstocks. Tree condition and yield have been monitored annually. To date, no treatment differs significantly from the untreated control or the standard injection procedure. Differences should however become more apparent as the trial proceeds.

In a separate evaluation the efficiency of two types of mechanical injectors was tested. Results are as follows:

Phillips gas gun	Rawlins injector
Gas operated.	Manually operated.
Gas bottle to be refilled after 240 injections.	No gas bottle used.
Difficult to inject total volume of fluid.	Too much pressure causes bark-splitting.
Takes 10–40 sec. to inject 20 ml.	Takes 5–30 sec. to inject 20 ml.

Phillips gas gun	Rawlins injector
Adjustable injection volume (must be checked regularly).	Pre-set injection volume of 10 ml.

General remarks on the two mechanical injectors:

- Economical when labour costs are high and skilled labour is available
- Injection is slow when sap movement is slow (applies for any method of injection). This is influenced by:

  -Time of day

  -Type of weather

  -Water status of tree

  -Tree health
- Hass usually injects easier than Fuerte.
- Difficult to measure injection efficiency in terms of the actual volume injected and remaining in the tree.
- A 6 mm wood auger drill with one vertical cutting edge (Irwin drill) facilitates faster absorbtion of the liquid. Highest efficiency is obtained when holes are drilled 50-80 mm deep radially into trunk with a slight downward slope.

MONITORING RESISTANCE OF *PHYTOPHTHORA CINNAMOMI* TO PHOSPHITES

In order to monitor possible resistance of *Pc* to phosphites, isolates of *Pc* from orchard trees treated with fosetyl-Al or H_3PO_3 since 1981, have been obtained annually and tested for sensitivity to these compounds *in vitro* (Duvenhage, 1994a). Isolates obtained during 1994 from trees treated with H_3PO_3 in the orchard, were significantly less inhibited by H_3PO_3 and fosetyl-Al *in vitro* than isolates from trees receiving no orchard treatment (control) or fosetyl-Al (Figures 5 & 6). However, inhibition by H_3PO_3 or fosetyl-Al of isolates from fosetyl-Al treated trees did not differ from isolates from control trees (Figures 5 & 6). These results correspond with findings reported previously (Duvenhage, 1994a).

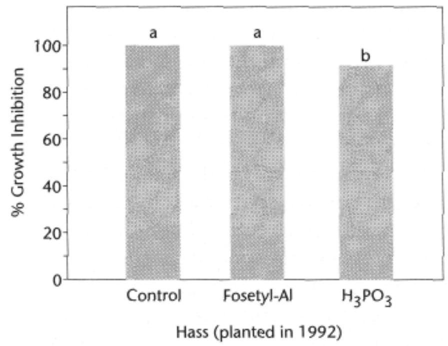

Figure 5
In vitro growth inhibition of *Pc.* (Nov. '94) by H_3PO_3.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

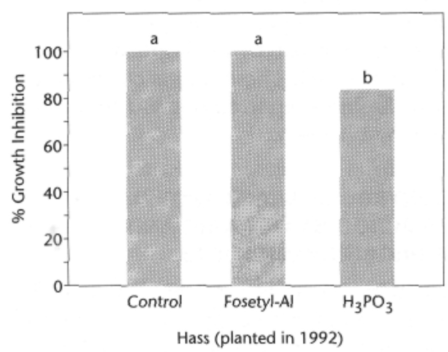

Figure 6
In vitro growth inhibition of *Pc.* (Nov. '94) by fosetyl-Al.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

CONTROL OF BLACK SPOT OF AVOCADO BY ORGANIC AND INORGANIC FUNGICIDES

The trial was started in 1992 with the objective of reducing copper application to trees and visible spray deposits on fruit. Different copper formulations and organic fungicides were evaluated since 1992 (Table 1) for control of black spot and sooty blotch, as well as the amount of visible spray deposits on the fruit at harvest, as described by Duvenhage (1994b). Fruit from the different treatments were also stored to simulate sea export and evaluated for post-harvest diseases and disorders as described earlier (Duvenhage, 1994b). Ten trees in a Fuerte orchard planted in 1980 were used for each treatment.

Table 1
Treatments applied at different spray doses.

Treatment abbreviation	*Treatment applied on 93–11–09* *Chemical*	*Rate*	*Treatment applied on 94–01–05* *Chemical*	*Rate*
C	Control	—	Control	—
Cu/Cu	Cu-oxychloride WP	* 255 g	Cu-oxychloride WP	* 255 g
Cu/Cu (170)	Cu-oxychloride WP	* 225 g	Cu-oxychloride WP	* 170 g
Cu/CC (198)	Cu-oxychloride WP	* 255 g	Cu-ammoniumcarbonate SL	* 198 g
CU/CC (330)	Cu-oxychloride WP	* 255 g	Cu-ammoniumcarbonate SL	* 330 g
Cu/Cu (+G49)	Cu-oxychloride WP +G49	* 255 g **12 ml	Cu-oxychloride WP +G49	* 255 g **12 ml
Cu/Cu (+Nf)	Cu-oxychloride WP +Nu-film-P	* 255 g **15 ml	Cu-oxychloride WP +Nu-film-P	* 255 g **15 ml
B/B	Triadimenol GR	#0,04 g	Triadimenol GR	#0,04g
Inj/Inj	Triadimenol EC	#0,04 g	Triadimenol EC	#0,04g
Tri/Tri	Triflumizole EC	*9.0 g	Triflumizole EC	*9.0 g

*Rate of active ingredient used per 100 litres of H_2O sprayed on the tree.
**Rate of product used per 100 litres of H_2O sprayed on the tree.
#Rate of active ingredient used per square metre of drip area under the tree.

During the 1993/94 season, injections of triadimenol (Bayfidan) did not give as promising results as in the 1992/1993 season (Duvenhage, 1994b), and resulted in significantly more black spot and sooty blotch when compared to two copper oxychloride sprays (Figures 7 & 8). In future, injections should be applied one to two weeks before anticipated copper oxychloride sprays are due. This should facilitate timely translocation to above ground parts. As found previously (Duvenhage, 1994b), granular triadimenol applied to the drip area did not control black spot or sooty blotch (Figures 7 & 8). Earlier application of granular triadimenol (four to six weeks before anticipated copper oxychloride sprays are due) might also facilitate better translocation from roots to above ground parts by the time protection is needed.

A new chemical, triflumizole, while it failed to control sooty blotch, gave good control of black spot and left significantly less visible spray deposits on fruit when compared to copper oxychloride sprays at the second date (Figures 7, 8 & 9). Also, in agreement with previous results (Duvenhage, 1994b), application of copper oxychloride (170 g/100 litre H_2O) or copper ammoniumcarbonate (198 g or 330 g/100 litre H_2O) at the second date controlled black spot and sooty blotch effectively and reduced visible spray deposits (not significantly for copper oxychloride; 170 g/ 100 litre H_2O) when compared to copper oxychloride spray applied at 255 g/100 litre H_2O at the second date (Figures 7, 8 & 9). Addition of G49 (wetter) or Nu-film (sticker) to copper oxychloride sprays (255 g/100 litre H_2O) did not significantly influence control of black spot, sooty blotch, or visible spray deposits (Figures 7, 8 & 9).

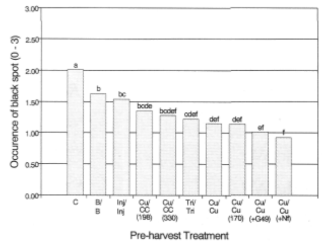

Figure 7
The effect of pre-harvest treatments on black spot of Fuerte.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

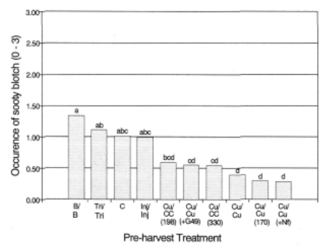

Figure 8
The effect of pre-harvest treatments on sooty blotch of Fuerte.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

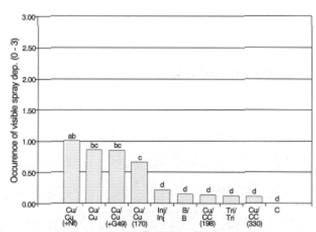

Figure 9
Visible spray deposits resulting from pre-harvest treatments of Fuerte.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05).

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