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Progress in Avocado Pathology Research at Merensky Technological Services

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ABSTRACT

A summary of research findings from various projects is given: (1) Biocontrol of root rot by antagonistic micro-organisms was evaluated under field conditions. Only soil populations of antagonist *Trichoderma hamatum* increased over the period 1992-1995 in all four trial blocks when applied on its own or in combination with other antagonists to Mass or Fuerte trees. (2) In the rootstock breeding programme, 8 selections have been made so far. The new rootstock selections will be evaluated for root rot resistance and yield under field conditions. (3) In healthy orchards tree health can be maintained by only one injection round per year or possibly a 5 % stem paint of H_3PO_3, while the injection procedure can be speeded up with less detrimental effects on the trunk by using a 20 % solution (partially neutralized) combined with half the number of injection points (syringes). (4) No significant difference in sensitivity of *Pc* isolates from soil of phosphite-treated trees or untreated trees were detected during 1995. (5) During the 1994/95 season, triadimenol applied to the soil or injected into the tree controlled sooty blotch, but not black spot, while triflumizole controlled black spot, but not sooty blotch. Copper oxychloride at 170 g a.i./100 ℓ or copper ammonium carbonate at 198 g a.i./100 ℓ at the second spray date controlled black spot as effectively as copper oxychloride at 255 g a.i./100 ℓand copper ammonium carbonate at 330 g a.i./100ℓ.

BIOCONTROL OF AVOCADO ROOT ROT IN THE ORCHARD

Biocontrol of root rot by three fungal antagonists *(Paecilomyces lilacinus, Aspergillus candidus,* and *Trichoderma hamatum)* has been tested in the field since 1992. Treatments were applied to nursery medium (1991 before planting) and subsequently annually to soil of newly planted Fuerte and Hass orchards planted in 1992, as well as to soil of established Fuerte and Hass orchards planted in 1980 (Duvenhage & Köhne, 1995). Tree condition and yield, antagonist and *Phytophthora cinnamomi (Pc)* populations, and suppressiveness of the soils are monitored annually as described by Duvenhage & Köhne (1995).

Antagonist populations in the untreated soil (control) did not change significantly (data not shown) over the period 19921995. Population's *of Paecilomyces lilacinus* increased significantly when applied on its own to newly planted Hass and Fuerte trees (figures 1-8). Populations *of Aspergillus candidus* increased significantly when applied on its own to newly planted or established Fuerte trees, or when applied in combination with other antagonists to established Fuerte and Hass trees (figures 1-8). Populations of

Trichoderma hamatum increased significantly when applied on its own or in combination with other antagonists to newly planted and established Hass or Fuerte trees (figures 1-8). No changes in tree condition, yield, *Pc* populations or suppressiveness of the soils were found (data not shown).

OBTAINING AND EVALUATING NEW ROOTSTOCK CROSSES FOR PC RESISTANCE AND YIELD

This project is aimed at developing new rootstocks with better resistance to root rot, and better yields of high-quality fruit than with the rootstocks presently available. The project is carried out in conjunction with the ITSC rootstock selection programme and forms part of the South African Avocado Growers' Association's breeding and selection programme. Currently, budwood of new rootstock selections is being propagated for the production of clonal trees. However, the budwood propagation block was badly damaged by hail during December 1995, and this has set back propagation of the selections by approximately 6 months. Propagation material of the selections made by MTS will be handed over to the South African Avocado Growers' Association for evaluation under various climatic conditions.

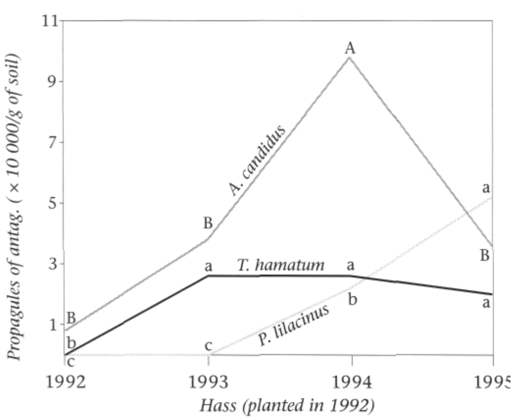

Figure 1
Antagonist populations in soils treated with various antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05

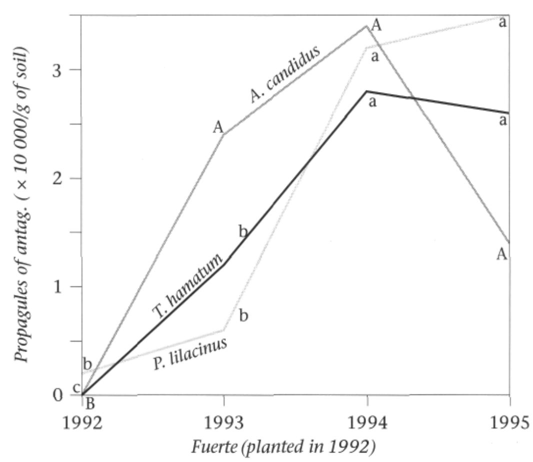

Figure 2
Antagonist populations in soils treated with various antagonists.
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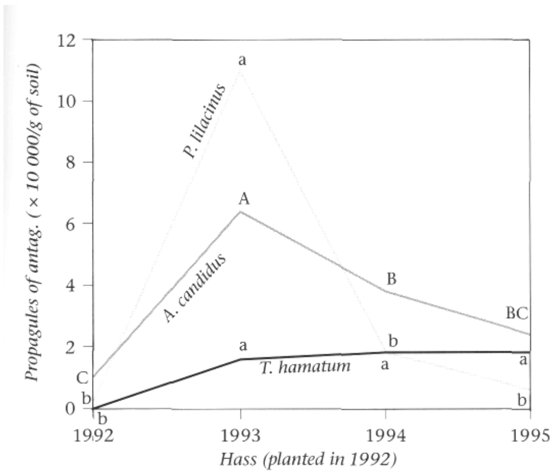

Figure 3

Antagonist populations in soils treated with a combination of 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)

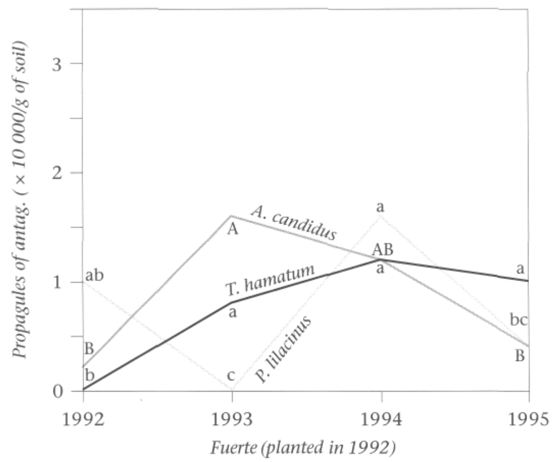

Figure 4

Antagonist populations in soils treated with a combination of 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)

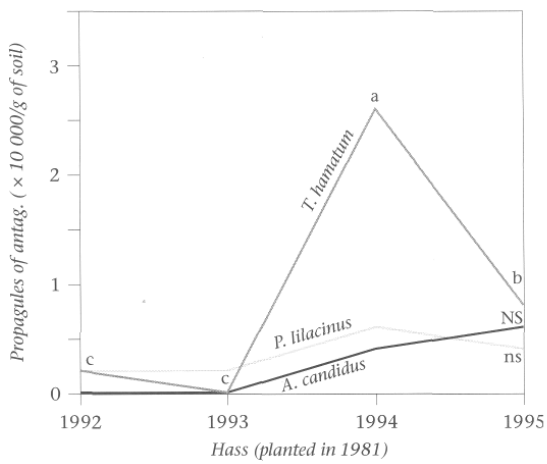

Figure 5

Antagonist populations in soils treated with various 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)

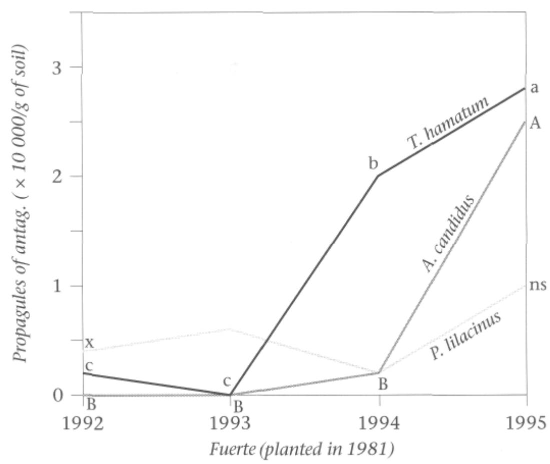

Figure 6

Antagonist populations in soils treated with various 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)

IMPROVEMENT OF H_3PO_3 SCHEDULING

Avocado trees throughout South Africa are usually injected twice a year with a 5-10 % solution of H_3PO_3 (un-neutralized or partially neutralized with KOH to pH 5,5-6). The injection technique of Buitendag & Bronkhorst (1980) modified by Darvas *et al.,* (1983) is widely used to inject 20 ml of H_3PO_3 solution per injection hole at a rate of 0,4 g a.i./m^2 canopy area. This is still the most popular method of injecting although other injection equipment has been evaluated (Duvenhage & Köhne, 1995). Avocado trunk injection should be timed to coincide with maturity of the spring and summer leaf flushes as this results in up to 5 times higher phosphonate concentrations in the roots than when injecting during active leaf flush periods (Pegg, Whiley & Hargreaves, 1990). The aim of these experiments, which were started in 1992, was to reduce the labour intensiveness, and the detrimental effect of injection on the tree trunks.

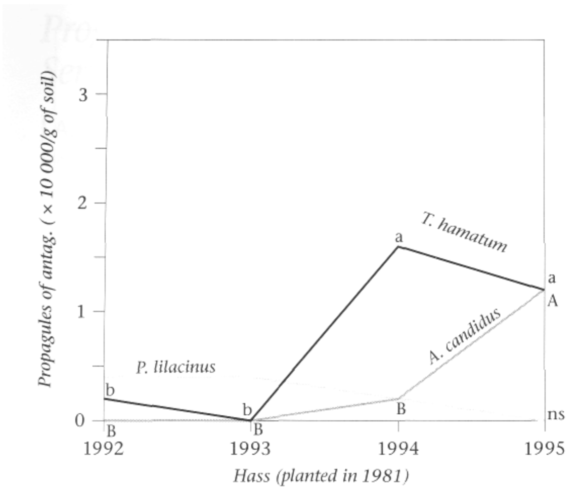

Figure 7
Antagonist populations in soils treated with a combination of three antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

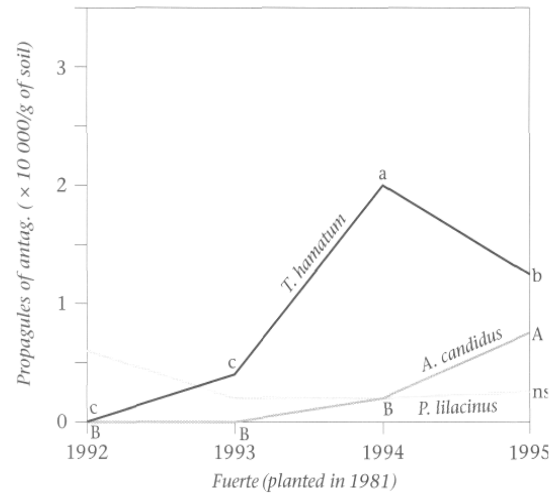

Figure 8
Antagonist populations in soils treated with a combination of three antagonists.
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

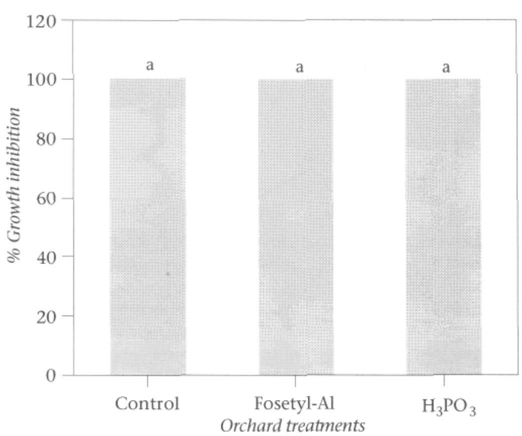

Figure 9
In vitro growth inhibition of *Pc* by H_3PO_3 (Nov. '95)
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

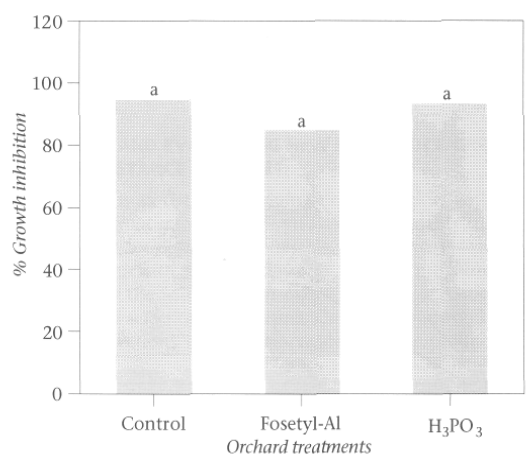

Figure 10
In vitro growth inhibition of *Pc* by fosetyl-Al (Nov.'95).
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

Fuerte avocado trees planted in 1980 were used for the trial using ten trees per treatment. At the start of the trial, trees had an average tree condition rating of 2,5 (rated on a scale of 0-10; where 0 = totally healthy, and 10 = dead) and an average yield rating of 3,5 (rated on a scale of 1-5; where 1 = poor yield, and 5 = excellent yield). For the standard injection treatment 10 % H_3PO_3 was used for round 1 (October/November after the spring flush; at 0,4 g a.i./m^2 canopy area) and 5 % for round 2 (January/February after the summer flush; at 0,2 g a.i./m^2 canopy area), while control trees were un-injected. Further treatments included doubling the concentrations while halving the number of injection points, or injecting only round 1 with 10 % or 20 % H_3PO_3 (using half the injection points), and 5 % stem paint (applied to the thin bark at a rate of 0,4 g a.i./m^2 canopy area or 0,8 g a.i./m^2 canopy area.) Trees were rated annually for tree condition during July, and for yield during February, according to the ratings mentioned previously.

The control treatment resulted in the tree condition declining significantly over the trial period (1992 to 1995), but none of the other treatments resulted in significantly improved or deteriorated tree condition (results not shown). However, injection treatments receiving the standard injection concentration and number of syringes (at round 1 and 2, or round 1 only), or the doubled concentrations combined with half the number of syringes, resulted in slightly increased yield, while no yield decrease occurred for any treatment over the trial period (19921995). In conclusion:

- The standard injection procedure after the spring and summer growth flushes or spring growth flush only, maintains tree health and yield. Injecting after the spring flush only should therefore be considered for maintaining tree health of healthy orchards.
- The number of injection points (syringes) can be halved when using a 20 % solution of H_3PO_3 (partially neutralized) for round 1, and a 10 % solution for round 2.
- The use of a 5 % H_3PO_3 stem paint after the spring and summer growth flushes holds promise for maintaining tree health.

MONITORING RESISTANCE OF *PHYTOPHTHORA CINNAMOMI* TO PHOSPHITES

The purpose of this study was to detect the development of any H_3PO_3 resistant *Pc* strains. Tests are repeated annually to monitor the phosphite sensitivity of *Pc* isolates from soil of treated and untreated trees. Isolates of *Pc* from soil of trees treated with fosetyl-Al or H_3PO_3 continuously since 1981, or untreated were isolated during 1995 and tested for sensitivity to fosetyl-Al or H_3PO_3 *in vitro* as described by Duvenhage (1994a). Inhibition by H_3PO_3 or fosetyl-Al of *Pc* isolates from soil of treated or untreated trees did not differ significantly (figures 9 and 10), but followed a similar trend as in previous years (Duvenhage, 1994a; Duvenhage & Köhne, 1995).

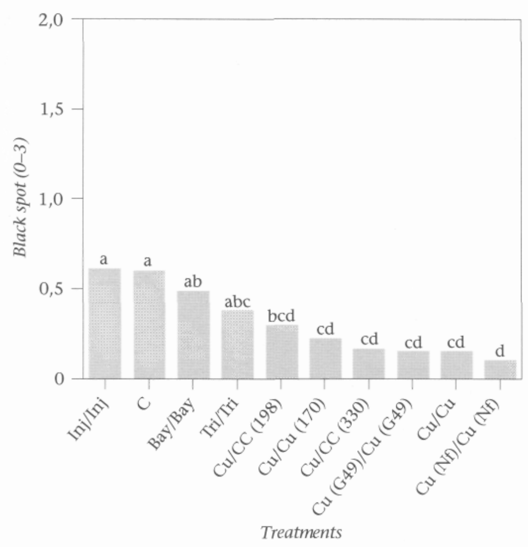

Figure 11
The effect of pre-harvest treatments on black spot of Fuerte.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

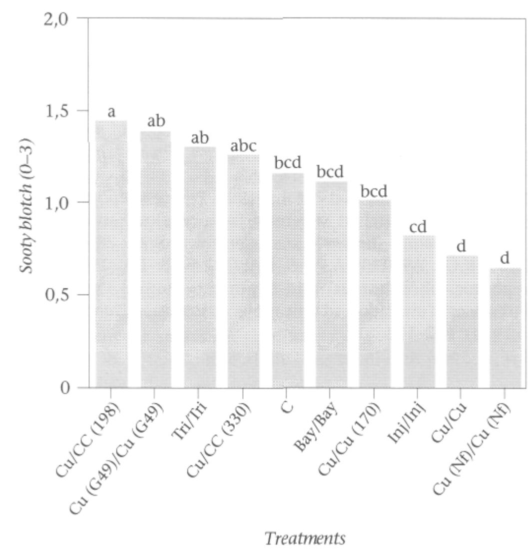

Figure 12
The effect of pre-harvest treatments on sooty blotch of Fuerte.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

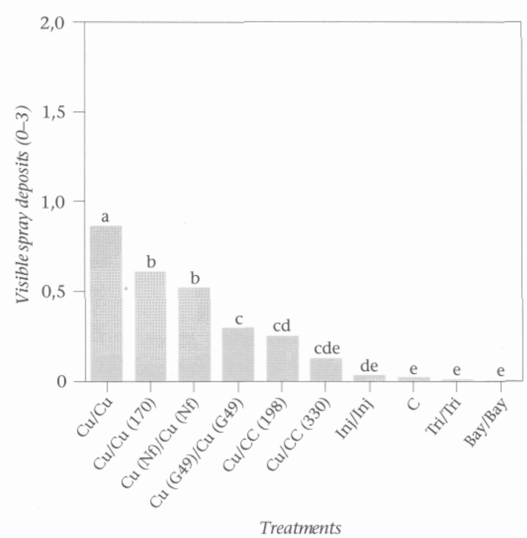

Figure 13
Visible spray deposits resulting from pre-harvest fungicide treatments of Fuerte.
Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

CONTROL OF AVOCADO BLACK SPOT BY ORGANIC AND INORGANIC FUNGICIDES

This is a continuation of the trail which was started in 1992. Various copper fungicide treatments were tested in an attempt to reduce rates of copper fungicide application and visible spray deposits. Organic fungicides were also evaluated as alternatives to copper fungicides. Fruit from each treatment was evaluated at harvest for black spot, sooty blotch, and visible spray deposits, and for post-harvest diseases and disorders at ripening after cold storage for 4 weeks, as previously described (Duvenhage, 1994b). The treatments are shown in table 1.

During the 1994/95 season injections of triadimenol (Bayfidan), although applied 8 days before copper sprays (to facilitate timely translocation to above-ground parts) did not control black spot (figure 11). This corresponds with results obtained during the 1993/94 season (Duvenhage & Köhne, 1995). However, sooty blotch was controlled (figure 12). Granular triadimenol, applied to the drip area 4 weeks before copper oxychloride sprays (to facilitate timely translocation to above-ground parts) did not control black spot (figure 11). This was also found during previous seasons (Duvenhage, 1994b; Duvenhage & Köhne, 1995). Sooty blotch was controlled to some extent (figure 12).

Triflumizole application confirmed the results of the previous season (Duvenhage, 1994b) by controlling black spot, but not sooty blotch, and leaving significantly less spray deposits on fruit than do copper oxychloride sprays (figures 11, 12 & 13). In agreement with previous results (Duvenhage, 1994b; Duvenhage & Köhne, 1995) copper oxychloride (170 g/100 ℓ. water) or copper ammonium carbonate (198 g or 330 g/100 ℓ water) at the second date controlled black spot and sooty blotch effectively, while leaving less visible spray deposits than copper oxychloride sprays applied at 255 g/100 ℓ water (figures 11, 12 & 13). Addition of G49 (wetter) or Nu-film-P (sticker) to copper oxychloride sprays (255 g/100 ℓ water) did not significantly influence black spot or sooty blotch control (figures 11 & 12), confirming results of the previous season (Duvenhage & Köhne, 1995), but resulted in significantly less visible spray deposits (figure 13).

ACKNOWLEDGEMENTS

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Table 1
Details of black spot control treatments applied at various dosage rates

Treatment abbreviation	*Treatment applied on 94-11-09*		*Treatment applied on 95-01-11*	
	Chemical	*Rate*	*Chemical*	*Rate*
C	Control	—	Control	—
Cu/Cu	Cu-oxychloride WP	*255 g	Cu-oxychloride WP	*255 g
Cu/Cu (170)	Cu-oxychloride WP	*255 g	Cu-oxychloride WP	*170 g
Cu/CC (198)	Cu-oxychloride WP	*255 g	Cu-ammonium carbonate SL	*198 g
Cu/CC (330)	Cu-oxychloride WP	*255 g	Cu-ammonium carbonate SL	*330 g
Cu (G49)/Cu (G49)	Cu-oxychloride WP + G49	*255 g †12 ml	Cu-oxychloride WP + G49	*255 g †12 ml
Cu(Nf)/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	‡0,08 g	Triadimenol GR	‡0,08 g
Inj/Inj	Triadimenol EC	‡0,08 g	Triadimenol EC	‡0,08 g
Tri/Tri	Triflumizole EC	*9,0 g	Triflumizole EC	*9,0 g

*Rate of active ingredient used per 100 ℓ of water sprayed on the tree.
†Rate of product used per 100 ℓ of water sprayed on the tree.
‡Rate of active ingredient used per square metre of drip area under the tree.

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