South African Avocado Growers' Association Yearbook 1997. 20:116-118

Biocontrol of Root Rot in Avocado Orchards and Monitoring for Resistance of Phytophthora Cinnamomi *to Phosphites*

J A Duvenhage • J S Köhne
Merensky Technological Services, P.O. Box 14, Duivelskloof 0835. E-mail: mts@ilink.nis.za

ABSTRACT

Biocontrol of root rot in two Hass and two Fuerte orchards started in 1992. Populations of the antagonists Paecilomyces lilacinus *and* Aspergillus candidus *increased since 1992, but declined sharply during 1996, while populations of* Trichoderma hamatum *maintained high levels. In one of the Fuerte orchards, trees treated with* A. candidus *or* T. hamatum*, or a combination of* R. lilacinus*,* A. candidus *and* T. hamatum *stayed healthy, while tree condition of the untreated control trees declined.*

In vitro *growth inhibition by H_3PO_3 or fosetyl-AI of* Phytophthora cinnamomi *isolates obtained during 1996 from soil of continuously treated or of untreated trees did not differ significantly. However,* P. cinnamomi *from treated trees tended to be less inhibited by H_3PO_3 or fosetyl-AI than* P. cinnamomi *from untreated trees.*

BIOCONTROL OF ROOT ROT IN THE ORCHARD

Since 1992 three fungal antagonists *(Paecilomyces lilacinus, Aspergillus candidus* and *Trichoderma hamatum),* which have previously been proved to control root rot of avocado under glasshouse conditions (Duvenhage & Kotzé, 1993), were tested under orchard conditions. Firstly, antagonist treatments were applied to the planting medium of Fuerte and Hass trees on Duke 7 rootstock at transplant in the nursery, and subsequently annually to the soil after planting in the field in 1992 (Duvenhage & Köhne, 1995). Secondly, antagonist treatments were applied to the soil of Fuerte (Guatemala seedling rootstock) and Hass (Duke 7 rootstock) trees planted in 1981. Tree condition and yield, populations of antagonists and *Phytophthora cinnamomi,* and suppressiveness of soils were monitored annually as described by Duvenhage & Köhne (1995).

Populations of *P. lilacinus,* when applied on its own to Hass and Fuerte trees planted in 1992, were found to be significantly higher in 1995 than in 1992, but declined sharply in 1996 (figure 1 to 8). Populations of *A. candidus,* when applied on its own to Fuerte trees planted in 1981 or 1992, or when applied in combination with other antagonists to Fuerte and Hass trees planted in 1981, were found to be significantly higher in 1995 than in 1992, but also declined sharply in 1996 (figure 1 to 8). However, populations of *T. hamatum* continued to be significantly higher in 1996 than in 1992, except when applied on its own to Fuerte trees planted in 1992, or in combination with *P. lilacinus* and A. *candidus* to Hass trees planted in 1992 (figures 1 to 8). These changes may be explained by the exceptionally high rainfall which occurred early in 1996 that could affect sporulation of the antagonists, and are reflected by the population numbers. However, Fuerte trees planted in 1992 and treated with *A. candidus* or *T. hamatum,* or a combination of *P. lilacinus, A. candidus* and *T. hamatum* stayed healthy since planting, while tree condition of the untreated control trees declined (figure 9). Tree condition of other trial orchards did not differ significantly (data not shown). Yield, *P. cinnamomi* populations, and suppressiveness of soils did not differ significantly (data not shown).

MONITORING FOR RESISTANCE OF *PHYTOPHTHORA CINNAMOMI TO* PHOSPHITES

Phosphites are the only group of chemicals available as regular use for avocado root rot control, and have been used since the early eighties (Darvas *et al.* 1983). Strains of *Phytophthora capsici* with tolerance to fosetyl-AI and H_3PO_3 have been cultured under laboratory conditions by exposure to chemical mutagens (Bower & Coffey, 1985), and repeated use of phosphites may lead to *Phytophthora cinnamomi* developing resistance/tolerance towards phosphites. Therefore, the sensitivity of *P. cinnamomi* isolates from the soil of untreated trees and trees treated with phosphites for the longest continuous period in the world (i.e. since 1981), has been tested since 1992 (Duvenhage, 1994; Duvenhage & Köhne, 1995; 1996). *In vitro* growth inhibition by H_3PO_3 or fosetyl-Al of *P. cinnamomi* isolates obtained during 1996 from soil of continuously treated or of untreated trees did not differ significantly (figures 10 & 11). However, *P. cinnamomi* from treated trees tended to be less inhibited by H_3P0_3 or fosetyl-Al than P. cinnamomi from untreated trees.

ACKNOWLEDGEMENTS

The authors wish to thank the management of Westfalia Estate for the use of experimental orchards, and Mrs. K. Coetzee and J. Modipa for technical assistance. Our thanks also to SAAGA and Westfalia Estate for financial support.

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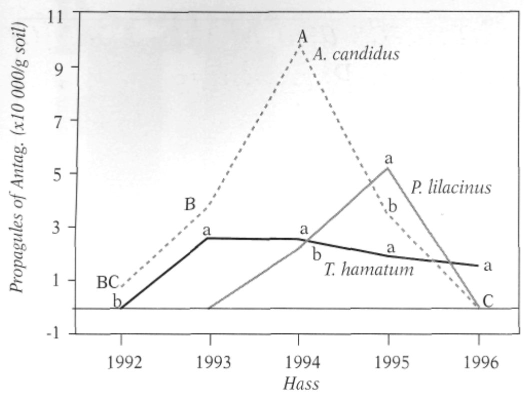
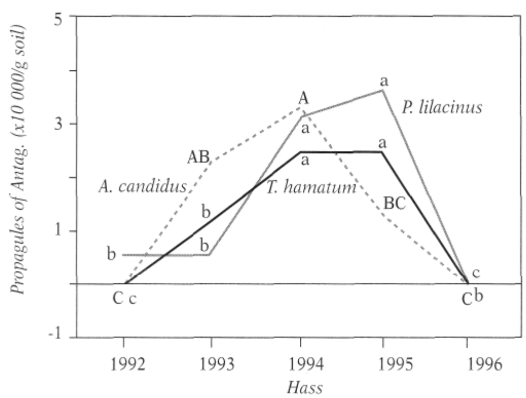


Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

Figure 1
Antagonist populations in soils to which different antagonists were applied since 1992 (trees planted in 1992)



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 to which different antagonists were applied since 1992 (trees planted in 1992)

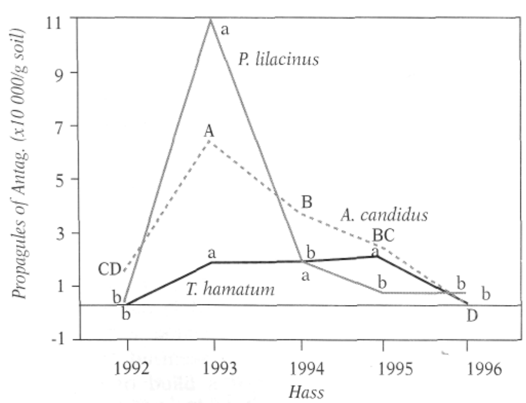


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Figure 3
Antagonist populations in soils to which a combination of all three antagonists was applied since 1992 (trees planted in 1992)

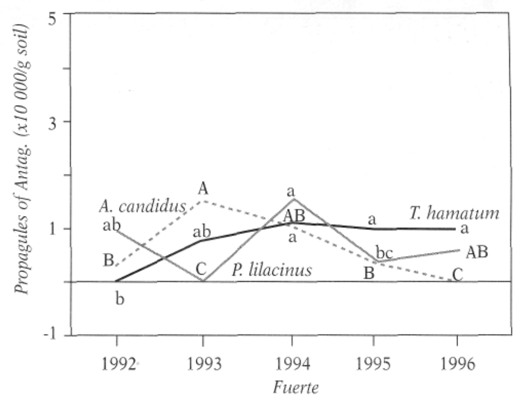

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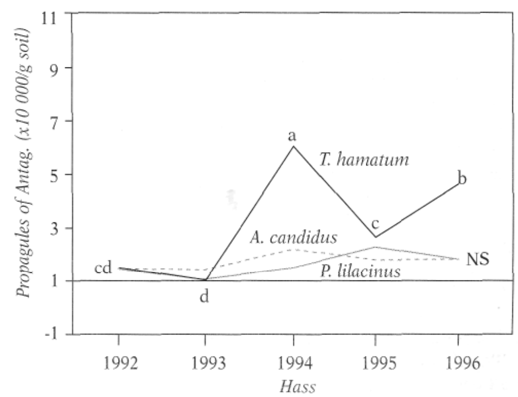
Figure 4
Antagonist populations in soils to which different antagonists were applied since 1992 (trees planted in 1992)



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 to which different antagonists were applied since 1992 (trees planted in 1981)

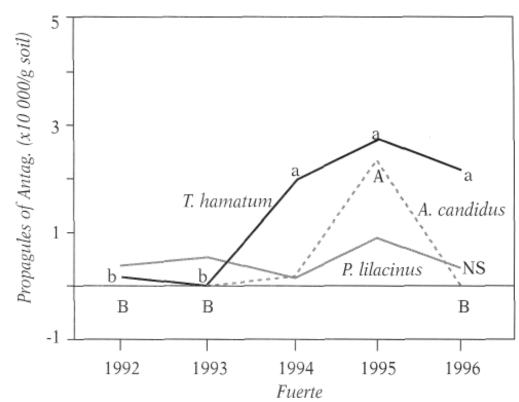


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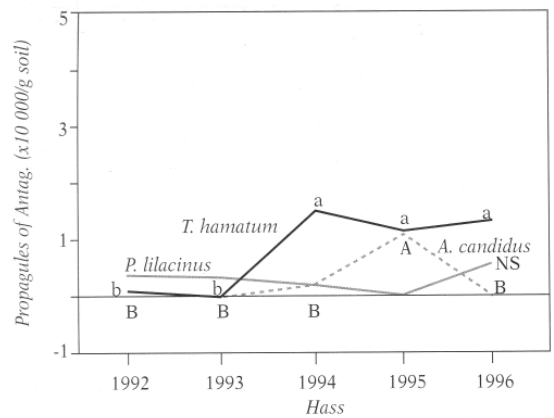
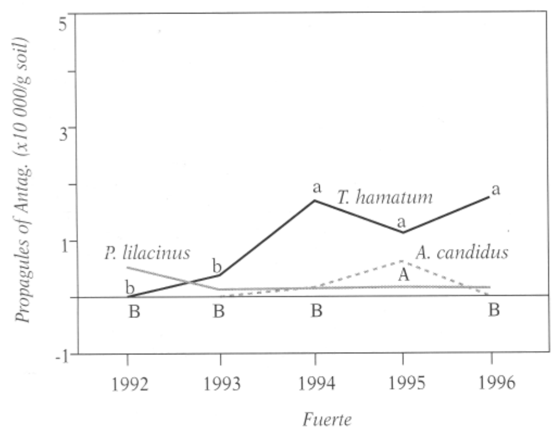
Figure 6
Antagonist populations in soils to which different antagonists were applied since 1992 (trees planted in 1981)



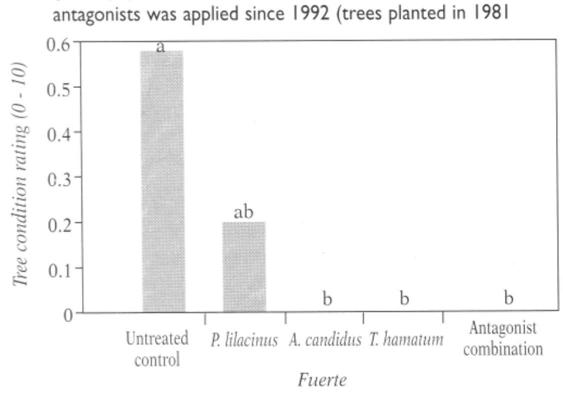
Data points on the same curve not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

Figure 7
Antagonist populations in soils to which a combination of all three antagonists was applied since 1992 (trees planted in 1981)



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 to which a combination of all three antagonists was applied since 1992 (trees planted in 1981



Bars not accompanied by the same letter are significantly different according to Duncan's multiple range test (P = 0,05)

Figure 9
Tree condition in January 1997, as influenced by antagonist applications (trees planted in 1992)

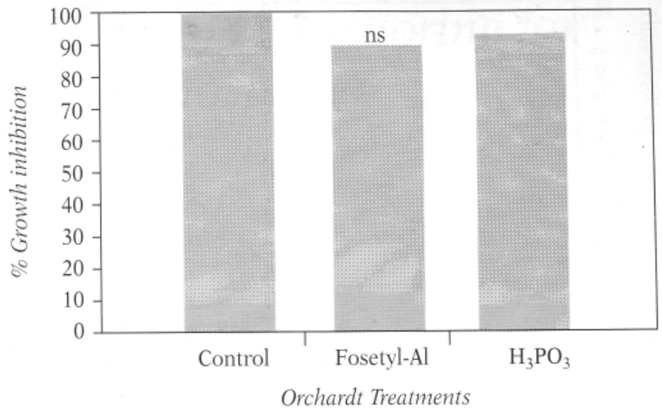


Figure 10

In vitro growth inhibition of *P. cinnamomi* by H_3PO_3 after 16 years of orchard treatment (Sept. 1996)

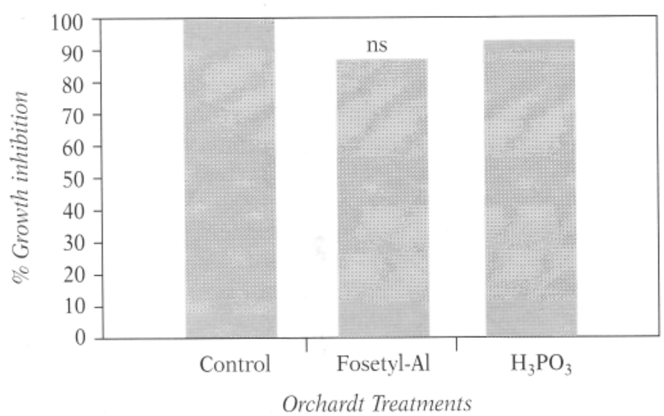


Figure 11

In vitro growth inhibition of *P. cinnamomi* by H_3PO_3 after 16 years of orchard treatment (Sept. 1996)