

EVALUATION OF APPLICATION TECHNIQUES OF FOUR FUNGICIDES FOR THE CONTROL OF PHYTOPHTHORA ROOT ROT ON AVOCADO SEEDLINGS

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OPSOMMING

Metalaksiel, Fosetiel AI Etridiazool en 'n eksperimentele swammiddel (D4562 en D4598) was as inwas, blaarspuit, stamverf of sponsband toepassings getoets vir doeltreffendheid teen Phytophthora wortelvrot op avokado saailinge. Etridiazool en Metalaksiel as grondinwas en Metalaksiel en Fosetiel-AI as stamverf behandelings net wortelvrot van saailinge gemokuleer met P. cinnamomi-K (nog nie blootgestel aan Metalaksiel nie) beheer. Metalaksiel grondinwas behandeling net nie wortelvrot van saailinge gemokuleer met P. cinnamomi-R, (vooraf vir 5 jaar aan Metalaksiel grondinwas behandeling blootgestel) beheer nie. Ander effektiewe behandelings net steeds wortelvrot van saailinge gemokuleer met P. cinnamomi-R, beduidend beheer.

SUMMARY

Metalaxyl, Fosetyl-AI, Etridiazole and an experimental fungicide (D4562 and D4598), were tested as soil drench, foliar spray, stem paint or sponge band applications for efficacy against Phytophthora root rot on avocado seedlings. Etridiazole and Metalaxyl as soil drench and Metalaxyl and Fosetyl—AI as stem paint treatments controlled root rot of seedlings inoculated with P. cinnamomi-C (not previously exposed to Metalaxyl). Metalaxyl soil drench did not control root rot of seedlings inoculated with P. cinnamomi-R (previously exposed to Metalaxyl soil drench treatments for five years). Other effective treatments still significantly controlled root rot of seedlings inoculated with P. cinnamomi-R.

INTRODUCTION

Chemical control of *Phytophthora* root rot was reported by Darvas, (1982) on replanted young avocado trees. Snyman (1982) in a study with avocado seedlings in the green house showed that control was obtained with Metalaxyl soil drench, but that foliar sprays of Fosetyl-AI were not effective. Snyman (1982) showed that stem paint applications of Metalaxyl and Fosetyl-AI resulted in good control of root rot. This study reports on the efficacy of four systemic fungicides applied to seedlings as a soil drench, foliar spray, stem paint and a new sponge band technique.

MATERIALS AND METHODS

Treatments tested were:

Metalaxyl 5G as a soil drench, at 2,5 g a.i./m².

Metalaxyl 25% WP as a stem paint, at 7 g and 125 g a.i./ℓ.

Metalaxyl 25% WP as a sponge band, at 1 g a.i./seedling.

Fosetyl-AI 80% WP as a sponge band, at 1 g a.i./seedling.

Fosetyl-AI 80% WP as a stem paint, at 10 g, 100 g and 400 g a.i./ℓ.

Etridiazole 41% EC as a soil drench, at 10 g a.i./m².

Etridiazole 41% EC as a stem paint, directly on the stem (both sides).

D4562 80% EC as a foliar spray, at 0,1 ml and 1 ml a.i./ℓ.

D4598 80% OC as a stem paint, directly on the stem (on one side and on both sides).

The drench, stem paint and foliar spray treatments were applied every 6 weeks starting one month after planting. The sponge band treatments were replenished after 12 weeks. CaCl₂ was added together with the fungicide to the sponge bands to keep them moist.

Avocado seedlings of the Edranol variety approximately 5 months old were obtained from Westfalia nursery. Two seedlings were planted per plastic planting bag (10ℓ) in soil collected from Westfalia Estates. This served as one experimental unit. Plants were placed in the greenhouse with temperatures ranging from 15°C to 33 °C.

Seedlings were inoculated with *P. cinnamomi-C* or *P. cinnamomi-R* inoculum. For preparation of *P. cinnamomi-C* inoculum *P. cinnamomi* isolates collected from soil, void of any previous Metalaxyl treatments, were cultured on an autoclaved barley-perlite mixture (1:1). This was mixed with sand (1:10) and 200 ml of the last mixture was added to a planting bag. For the *P. cinnamomi-R* inoculum the same procedures were followed using *P. cinnamomi* isolates collected from soil previously treated for 5 years with Metalaxyl 2,5 g a.i./m² soil drench two times in the growing season.

The mean increase in stem diameter of the seedlings was used as criterium for control of root rot.

RESULTS

Phytotoxicity:

Stem paint treatments: D4598 stem paint treatments caused necrosis of the green stems within a week and severely burnt the young bark. Etridiazole stem paint caused similar symptoms.

Sponge band treatments: Underneath both Metalaxyl and Fosetyl sponge bands small black necrotic spots developed after approximately 5-6 months of application of the sponge bands. Young leaves showed leaf roll symptoms and older leaves developed necrotic areas between the veins which extended to the tips of the leaves. This was probably caused by the CaCl₂ added to the sponge bands. Control of root rot of avocado seedlings inoculated with *P. cinnamomi-C*:

Seedlings treated with Etridiazole soil drench at 10 g a.i./m², Metalaxyl soil drench at

2,5 g a.i./m², Metalaxyl stem paint at 125 g a.i./ℓ and Fosetyl-AI stem paint at 100 g a.i./ℓ and 400 g a.i./ℓ had a significantly higher increase in stem diameter compared to untreated trees (Table 1). Seedlings treated with Fosetyl-AI sponge band at 1 g a.i. per seedling, also had a significant increase in stem diameter, but was not included in the presented analysis (Table 1) because of phytotoxic symptoms. Other treatments did not result in a significant difference from untreated seedlings.

Control of root rot of avocado seedlings inoculated with *P. cinnamomi-R* compared with *P. cinnamomi-C*. Avocado seedlings inoculated with *P. cinnamomi-R* (PcR) and treated with Metalaxyl 2,5 g a.i./m² soil drench did not increase in stem diameter as did seedlings inoculated with *P. cinnamomi-C* (PcC) and treated in the same way. This indicated that root rot in PcR inoculated soil was not controlled by the Metalaxyl soil drench. A significant difference in increase in stem diameter was found between PcC and PcR after treatment with Metalaxyl (Table 2). The stem paint applications of Metalaxyl showed little difference between PcC and PcR. Seedlings treated with 125 g a.i./ℓ Metalaxyl as a stem paint showed no difference in stem diameter between PcC and PcR (Table 2).

Seedlings treated with Fosetyl-AI, Etridiazole, D4562 and D4598 responded equally well to the treatments independent of the inoculum used. In a comparison similar to that of Table 2 there was no difference between PcC and PcR in sensitivity to the fungicides (Table 3).

TABLE 1: The mean increase in stem diameter of avocado seedlings planted in *P. cinnamomi-C* inoculated soil.

Fungicide	Application	Dosage	Mean increase in stem diameter (mm)
Control (no treatment)			1,25 de'
Metalaxyl 5G	soil drench	2,5 g a.i./m ²	2,50 a
Metalaxyl 25 WP	stem paint	7 g a.i./ℓ	1,88 abcd
Metalaxyl 25 WP	stem paint	125 g a.i./ℓ	2,13 abc
Metalaxyl 25 WP	sponge band	1 g a.i.	(1,25) ²
Fosetyl-AI 80 WP	sponge band	1 g a.i.	(2,19)
Fosetyl-AI 80 WP	stem paint	10 g a.i./ℓ	1,63 bcde
Fosetyl-AI 80 WP	stem paint	100 g a.i./ℓ	2,38 ab
Fosetyl-AI 80 WP	stem paint	400 g a.i./ℓ	2,38 ab
Etridiazole 41 EC	soil drench	10 g a.i./m ²	2,63 a
Etridiazole 41 EC	stem paint	direct 2x	(0,44)
D4562 80 EC	foliar spray	0,1 ml a.i./ℓ	0,88 e
D4562 80 EC	foliar spray	1 ml a.i./ℓ	1,50 cde
D4598 80 OC	stem paint	direct 1x	(1,13)
D4598 80 OC	stem paint	direct 2x	(1,50)
C.V.			39%

1. Means followed by the same letter do not differ significantly (Duncan, P ≥ 0,05)

2. Treatment caused phytotoxic symptoms.

TABLE 2: Mean increase in stem diameter of avocado seedlings inoculated with *P. cinnamomi*-C or *P. cinnamomi*-R and treated with Metalaxyl.

Fungicide treatment	Mean increase in stem diameter (mm)	
	<i>P. cinnamomi</i> -C	<i>P. cinnamomi</i> -R
Metalaxyl soil drench 2,5 g a.i./m ²	2,5	1,1
Metalaxyl stem paint 125 g a.i./ℓ	2,1	2,2
Metalaxyl stem paint 7 g a.i./ℓ	1,9	1,3
Metalaxyl sponge band 1 g a.i.	(1,25) ¹	(1,17)
MEAN	2,2 a ²	1,4 b
C.V.	45%	

1: Treatment caused phytotoxic symptoms.

2: Means followed by the same letter do not differ significantly (Duncan, $P \geq 0,05$).

TABEL 3: Mean increase in stem diameter of avocado seedlings inoculated with *P. cinnamomi*-C and *P. cinnamomi*-R and treated with various fungicides.

Fungicide treatment	Mean increase in stem diameter (mm)	
	<i>P. cinnamomi</i> -C	<i>P. cinnamomi</i> -R
Etridiazole soil drench 10 g a.i./m ²	2,6	2,5
Fosetyl-AI stem paint 400 g a.i./ℓ	2,4	2,5
Fosetyl-AI stem paint 100 g a.i./ℓ	2,4	3,0
Fosetyl-AI stem paint 10 g a.i./ℓ	1,6	2,5
D4562 foliar spray 0,1 ml a.i./ℓ	0,9	0,0
D4562 foliar spray 1 ml a.i./ℓ	1,5	1,3
MEAN	1,9a	2,0a
C.V.	45%	

1: Means followed by the same letter do not differ significantly (Duncan, $P = 0,05$).

DISCUSSION

Etridiazole 10 g a.i./m² soil drench, Metalaxyl 2,5 g a.i. soil drench, Metalaxyl 125 g a.i./ℓ stem paint and Fosetyl-AI 400 g.a.i .and 100 g a.i. stem paint treatments controlled root rot of avocado seedlings. Observations indicate that the repeated use of Metalaxyl at effective rates as a soil drench might have caused resistance of *P. cinnamomi* Metalaxyl.

Other effective treatments previously mentioned were still successful in controlling root rot where Metalaxyl soil drench failed.

Where Metalaxyl and Fosetyl-AI were applied with the sponge band, phytotoxicity was observed. It is not clear however, whether the phytotoxicity was due to the inclusion of $\text{Ca}(\text{Cl})_2$. This is under investigation at the moment.

LITERATURE CITED

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