

Reduction of Root Rot Caused by *Phytophthora cinnamomi* in Grapevines by Chemical Treatments

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ABSTRACT

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In glasshouse and field trials, fosetyl Al applied as a spray and metalaxyl applied as a soil drench significantly reduced *Phytophthora cinnamomi* root rot of 99 Richter grapevine rootstock. Application of methyl bromide, dazomet, or metalaxyl to infested nursery soil before planting significantly reduced root rot, but the pathogen became reestablished in the soil. To reduce the disease effectively in nurseries, chemical soil treatment should be followed by regular applications of appropriate fungicides to the growing vines.

Root rot caused by *Phytophthora cinnamomi* Rands is a serious disease of grapevines in nurseries. The pathogen spreads from infected vines to healthy vines in vineyards (11). This situation and the wide distribution of the pathogen in vineyard soils in the Western Cape Province of South Africa (10) complicate the development of effective control measures for root rot.

Several fungicides have been tested with varying success for the control of *P. cinnamomi* on crops other than the grape (3,4,13,17). Metalaxyl and fosetyl Al are promising systemic fungicides specific to oomycetous pathogens (2,6,8,9,14,18).

This study evaluated different fungicidal treatments of 99 Richter grapevine rootstocks growing in soil infested with *P. cinnamomi*. The feasibility of treating infested nursery soil with chemical compounds before planting the rootstock also was investigated.

MATERIALS AND METHODS

Fungicides. The following compounds were used: dazomet 98G (Basamid-Granular), ethazol 24EC (Terrazole), fenaminosulf 70WP (Bayer 5072), metalaxyl 25WP (Ridomil), fosetyl Al 80WP (Aliette), prothiocarb 70EC (Previcur), and methyl bromide (Meth-O-Gas).

Glasshouse trial. Cuttings (20 cm) of 99

Richter, rooted in sterilized sand in a glasshouse (about 25 C), were transplanted singly into 18-cm-diameter pots containing a sterilized V.O.R.I. (Viticultural and Oenological Research Institute) potting mixture. Inoculum of *P. cinnamomi* was prepared by adding 100 ml of water to a 7- to 10-day-old culture of the pathogen growing in potato-dextrose agar in a 90-mm-diameter petri dish. The culture was macerated in a Waring Blendor. Inoculation was achieved by making four 8-cm-deep holes in the potting mixture around each vine 3 wk after planting. The inoculum (consisting of one culture per hole) was introduced and the holes were refilled.

Fourteen days after inoculation, ethazol (5 g a.i./m²), fenaminosulf (12 g a.i./m²), metalaxyl (2 g a.i./m²), fosetyl Al (16 g a.i./m²), and prothiocarb (12 g a.i./m²) were applied in a 1-L volume of water to separate pots as soil drenches. Fosetyl Al (3.2 g a.i./L) also was applied as a spray until runoff. Three additional applications of the fungicides were made at 4-wk intervals. No fungicide was applied to the control vines. A randomized complete block design with 10 replicates and five vines per treatment was used. After 6 mo, dead vines were counted and

isolations were made from the roots of surviving vines (10).

Field trials. Trials were conducted at two nursery sites heavily infested with *P. cinnamomi*. The presence of the pathogen within the sites was determined by lupin baiting soil samples from 1-m² sample areas (5).

Trial 1. The experimental area was divided into 20 4-m² plots; 160 20-cm 99 Richter cuttings were planted 8 cm apart in rows spaced 30 cm apart in each plot.

Eight weeks after planting, soil drenches of ethazol (5 g a.i./m²) and metalaxyl (2 g a.i./m²) as well as a foliar spray of fosetyl Al (3.2 g a.i./L) were applied. Fungicides used as drenches were applied evenly over the soil surface. Fosetyl Al was sprayed onto the vines until runoff. Each treatment as well as the control was replicated five times in a randomized block design with 160 vines per plot. Four additional applications of the fungicides were made at 4-wk intervals.

Only plots that had received soil drenches were irrigated (25 mm of water) immediately after application of the fungicides. All plots were then watered at weekly intervals for 8 mo.

Dead vines were counted 10 mo after planting. The presence of the pathogen in roots of surviving vines was determined by isolations on agar medium (10). Root and shoot mass and shoot length of individual vines also were recorded.

Trial 2. Twenty 8-m² plots were selected for the treatments and the control. A randomized complete block design with four replicates and 320 vines per plot was used. Metalaxyl (2 g a.i./m²) and fosetyl Al (16 g a.i./m²) were applied as drenches. Dazomet granules (50 g/m²)

Table 1. Effects of different fungicidal treatments on the severity of root rot of 99 Richter rootstock inoculated with *Phytophthora cinnamomi* in a glasshouse

Fungicide	Application method	Dosage (a.i.)	Dead vines (%)	Surviving vines with infected roots (%)
Control	...	...	37	41
Fosetyl Al	Soil drench	16 g/m ²	33	38
Fenaminosulf	Soil drench	12 g/m ²	28	35
Prothiocarb	Soil drench	12 g/m ²	27	33
Ethazol	Soil drench	5 g/m ²	24	30
Metalaxyl	Soil drench	2 g/m ²	13	11
Fosetyl Al	Foliar spray	3.2 g/L	9	13
D value ($P = 0.05$)			10.2	14.2

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Table 2. Effects of three fungicidal treatments on 99 Richter grapevine rootstock growing in a nursery soil naturally infested with *Phytophthora cinnamomi*

Fungicide	Application method	Dosage (a.i.)	Dead vines (%)	Surviving vines with infected		Root mass (g)	Shoot mass (g)	Shoot length (cm)
				roots (%)	roots (%)			
Control	...	...	18.0	33.8	111.7	99.8	9.5
Ethazol	Soil drench	5 g/m ²	11.0	26.5	114.3	110.2	10.2	
Fosetyl Al	Foliar spray	3.2 g/L	4.3	10.6	125.9	14.2	12.8	
Metalaxyl	Soil drench	2 g/m ²	4.1	11.5	125.3	114.1	12.6	
D value (<i>P</i> = 0.05)			3.2	12.2	21.0	20.4	2.4	

Table 3. Effects of chemical treatments of a nursery soil naturally infested with *Phytophthora cinnamomi* on the subsequent growth of 99 Richter grapevine rootstock

Compound	Application method	Dosage (a.i.)	Dead vines (%)	Surviving vines with infected		Root mass (g)	Shoot mass (g)	Shoot length (cm)
				roots (%)	roots (%)			
Control	...	...	47.0	20.0	98.1	46.8	6.3
Fosetyl Al	Soil drench	16 g/m ²	40.0	15.0	104.6	48.2	6.6	
Metalaxyl	Soil drench	2 g/m ²	26.5	10.0	143.6	53.4	7.2	
Dazomet	Granules	50 g/m ²	21.6	4.0	159.7	73.6	9.7	
Methyl bromide	Fumigant	125 g/m ²	17.5	3.0	146.4	62.5	9.7	
D value (<i>P</i> = 0.05)			19.3	8.2	20.9	11.1	2.7	

were distributed and worked into the upper 20 cm of soil with a Rotavator. Methyl bromide was applied as a gas under a black 0.25-mm polyethylene sheet, which was removed 4 days later. After treatment, all plots except those treated with methyl bromide were irrigated (25 mm of water).

Four weeks after the chemical treatments, 20-cm 99 Richter cuttings were planted 8 cm apart in rows spaced 30 cm apart. Treatments were evaluated after 10 mo. Soil samples from each plot were assayed for *P. cinnamomi* by the lupin baiting method 1, 3, and 9 mo after the compounds were applied.

RESULTS

Glasshouse trial. Fosetyl Al applied as a spray and metalaxyl applied as a soil drench effectively reduced root rot (Table 1). Ethazol applied as a drench also reduced mortality significantly but was less effective than fosetyl Al and metalaxyl. No other treatment gave significant control.

Field trials. *Trial 1.* Fosetyl Al and metalaxyl effectively reduced mortality and root rot of grapevines in infested nursery soil (Table 2). Shoot length also was increased significantly. Ethazol reduced mortality to some extent, but there was no reduction in infection or increase in shoot length. None of the treatments had a significant effect on root or shoot mass.

Trial 2. Soil treatment with metalaxyl, dazomet, or methyl bromide reduced mortality of vines (Table 3). These compounds also reduced root infection and increased root mass. The dazomet and methyl bromide treatments were the only ones resulting in increased shoot

mass and length. Fosetyl Al had no effect on mortality, root infection, or growth of vines.

P. cinnamomi was detected after 1, 3, and 9 mo in control plots and plots treated with fosetyl Al but only after 9 mo in soil treated with metalaxyl, dazomet, and methyl bromide.

DISCUSSION

Glasshouse and field trials showed that fosetyl Al spray and metalaxyl drench significantly reduced root rot of grapevines planted in soil infested with *P. cinnamomi*. Fosetyl Al drench reduced *P. cinnamomi* root rot of avocado (18) but was not effective on grapevines in this trial.

The application of chemicals to soil before planting is expensive and is usually limited to nurseries. In our investigation, methyl bromide, dazomet, and to a lesser extent, metalaxyl reduced root rot of grapevines in nurseries. Although apparently less effective, metalaxyl has little effect on microorganisms antagonistic to *P. cinnamomi* (1), whereas dazomet and methyl bromide are wide-spectrum soil fumigants. Reestablishment of *P. cinnamomi* in treated nursery soil suggests soil treatments should be followed by fungicidal treatments of growing vines.

Grapevine nursery soil should be treated with a drench of metalaxyl (2 g a.i./m²) before planting. Planted vines should receive five monthly drench applications of metalaxyl or monthly sprays of fosetyl Al (3.2 g a.i./L) beginning when shoots are 10 cm long. Fosetyl Al spray has the additional advantage that it is also effective against *Plasmopara viticola* (12,15). Although

metalaxyl is taken up by the roots and is translocated upward in other crops (7,16), the soil drench rate for control of *P. cinnamomi* is probably too low to have any effect on *P. viticola* on nursery vines.

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