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Control of Nematodes in Tomato with *Paecilomyces lilacinus* Strain 251

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Summary

A project testing the efficacy of a commercial product of *Paecilomyces lilacinus* strain 251 (MeloCon WG) for control of nematodes on tomato (Burpee "Orange Pixie" hybrid) and cucumber (Ferry-Morse "Marketmore 76") in Hawaii was installed in February, 2003. There were three treatments with four replicates in a randomized complete block. The treatments were: (1) MeloCon, (2) Vapam, and (3) untreated check. The tomatoes were harvested in three rounds and data taken were numbers and weight of small and medium fruits. The tomato variety was a cherry tomato and the fruits were essentially all the same size with a few small ones. Results were compiled as totals per plot and averages per plant. Data were analyzed using Statistix 7 computer program giving ANOVA for each total and average. Comparison of means was performed using LSD at the 95% level (significant difference greater than 0.050). The means were consistent for every total in that the MeloCon treatment fruit yield was greatest, Vapam a close second, and the untreated check lower. Due to the rather large variation in the test, only the medium size average fruit weight showed a significant difference between means. However, the consistency of the results indicates that there was a very real effect of MeloCon in protecting tomato plants against nematode damage. The visual root galling ratings bear this out. The soil nematode counts at harvest show high numbers of root-knot nematodes and low to high numbers of reniform nematodes. The overall results indicate that MeloCon was as effective as Vapam soil fumigant and significantly better than no treatment for control of nematodes in tomato.

Introduction

A project testing the efficacy of MeloCon WG (6% by weight *Paecilomyces lilacinus* strain 251) for control of nematodes on tomato (Burpee "Orange Pixie" hybrid) and cucumber (Ferry-Morse "Marketmore 76") in Hawaii was installed in February, 2003. The test site was the Hawaii Agriculture Research Center farm at Kunia, Island of Oahu, Hawaii. The field plots location, layout, and all field event dates were recorded as they occurred. The project was unfortunately affected by severe, unexpected storms, wind and flooding, but was nonetheless carried through and data were taken.

Paecilomyces lilacinus is a soil-inhabiting fungus that is capable of parasitizing nematode eggs, juveniles and females, and reducing soil populations of plant parasitic nematodes. It was first discovered in soil and observed to control root-knot nematodes on potato in Peru by P. Jatala, *et al*. (1979). Subsequent tests on potted plants and field plots have shown the fungus to control a range of nematode species on a number of crops worldwide (Jatala, 1985; Alamgir Khan, 1997). Its effectiveness was comparable to several chemical nematicides tested.

MeloCon WG is registered and sold in other countries as BioAct WG. While some *Paecilomyces* species were reported to cause allergic reactions and eye and skin infections in humans or animals, the strain 251 used in this study was reported to pose no significant risks to humans (Federal Register, Nov. 2003). Notice of filing for establishing a tolerance and registration for use on food crops was published by the EPA (Federal Register, Nov. 2003).

Procedures

Importation

Although *Paecilomyces* ssp. are listed by the Hawaii State Quarantine Branch as 'non-restricted' microorganisms, its formulation as a commercial product and application in field plots necessitated obtaining a state import permit and registration. A permit was therefore applied for and obtained from the State of Hawaii Plant Quarantine Branch for import, field plot, and lab testing of *Paecilomyces lilacinus* strain 251. The product arrived in Hawaii and was placed in storage at -20°C in a secured, certified laboratory.

Field installation

The field plots were installed at the Hawaii Agriculture Research Center farm, Kunia Rd. Oahu, HI. Mulch and drip tubing were laid, plots were measured, staked and tagged and preplant soil nematode counts were taken. There were four replicate plots per treatment. Tomato plots were two rows of 10 ft each and contained 8 plants at 18 in spacing. Cucumber plots were one row, 20 ft and contained 6 plants at 24 in spacing.

Treatments

There were three treatments: (1) MeloCon; (2) Vapam HL; and (3) untreated check. *Paecilomyces* was applied preplant to the treatment 1 plots. Application rate was 0.2 g MeloCon per 500 ml water in each plant hole. All treatments were applied following label directions and safety requirements. Vapam HL (sodium methyldithiocarbamate 42%) was applied to the treatment 2 plots. Application was by injection under mulch at the rate of 65 ml per plot (37.3 gal/A). Tomato (Burpee "Orange Pixie") and cucumber seedlings were transplanted from greenhouse flats to the field plots on 3/9/04. Treatment 1 seedlings received a drench of MeloCon at the rate of 1 g per 100 seedlings. The cucumbers died from wind damage and possible herbicide spray drift. Cucumber (Ferry-Morse "Marketmore 76") were reseeded directly into the planting holes. Success insecticide (spinosad 22.8%) was applied at 5 lb/A by overhead spray along with 15-15-15 fertilizer. Asana insecticide (esfenvalerate 8.4%) was applied at a rate of 8 oz/A once during crop growth. Malathion was sprayed at a rate of 20 ml/gal water over the project area. A second application of MeloCon was applied at six weeks postplant at a rate of 0.2 g/200 ml water per plant. All treatments were applied following label directions and safety requirements.

Data collection

Tomatoes were harvested in three rounds. The numbers and total weight (kg) per plot of small and medium fruits were recorded. The tomato variety was a cherry tomato and the fruits were essentially all the same size with a few small ones. Results were compiled as totals per plot and averages per plant. Root damage evaluation and soil sampling for nematode populations and *Paecilomyces* took place after final harvest. At that time also plots were tested for the presence of *Paecilomyces* following the procedure and selective medium published by Mitchell *et al.* (1987).

Results

Tomato yield results are presented in Table 1. Data were analyzed using Statistix 7 computer program giving ANOVA for each total and average. Comparison of means was performed using LSD at the 95% level (significant difference greater than 0.050). The results were consistent in that fruit numbers and weights in the MeloCon treatment yield were greatest in every case. Vapam was a close second and the untreated check lower. Due to the rather large variation in the test, only the medium size average fruit

weight showed a significant difference between means. However, the consistency of the results indicates a very real effect of MeloCon in protecting tomato plants against nematode damage. The visual root galling ratings bear this out (Table 2). The soil nematode counts at harvest show high numbers of root-knot nematodes and low to high numbers of reniform nematodes in all treatments (Table 3). For some reason, the replicate 1 plots had lower numbers of root-knot nematodes in all three treatments. *Paecilomyces* was isolated after harvest from the MeloCon-treated plots at the rate of roughly 1 x 10^5 cfu/g soil and also, in lower numbers, from the untreated plots. No phytotoxicity was observed. The overall results indicate that MeloCon was as effective as Vapam soil fumigant and significantly better than no treatment for control of nematodes in tomato.

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Table 1. Tomato Yield

Comparison of means of average fruit weights (kg) per plant

Treatment	*Small*	*Medium*	*Total wt./trt.*
MeloCon	0.18 a	1.35 a	43.25
Vapam	0.15 a	1.16 ab	41.75
Control	0.11 a	0.92 b	32.50

Comparison of means of average fruit number per plant

Treatment	*Small*	*Medium*	*Total no./trt.*
MeloCon	8.3 a	36.5 a	1274
Vapam	7.0 a	31.1 a	1219
Control	4.4 a	25.7 a	964

* means in the same column followed by the same letter do not differ at the 95% level.

Table 2. Tomato Root Damage Ratings at Harvest 5/24/04

	Total Plant No.	*Average Knots Rating/Plant*	*Average Feeder Root Rating/Plant*
MeloCon	28	2.07	2.39
Vapam	32	2.06	2.15
Control	32	2.25	2.25

root-knot rating: 1 = none, 2 = few, 3 = many, 4 = very severe galling
feeder root rating: 1 = extensive, 2 = some, 3 = few, 4 = very few to none

Table 3. Tomato Nematode Counts at Harvest 5/24/04

MeloCon			
rep 1	root-knot - 6,	reniform - 9,	pin - 3
rep 2	root-knot - 379,	reniform - 421	
rep 3	root-knot - 496,	reniform - 12	
rep 4	root-knot - 296,	reniform - 186,	spiral - 1
Vapam			
rep 1	root-knot - 18,	reniform - 47	
rep 2	root-knot - 52,	reniform - 40,	pin - 3
rep 3	root-knot - 210,	reniform - 2	
rep 4	root-knot - 116,	reniform - 7	
Control			
rep 1	root-knot - 80,	reniform - 33	
rep 2	root-knot - 382,	reniform - 120	
rep 3	root-knot - 392,	reniform - 44	
rep 4	root-knot - 208,	reniform - 8	