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Evaluation of avermectin and its combination with nematicide and bioagents against root knot nematode, *Meloidogyne incognita* in tomato

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ABSTRACT: **Studies on compatibility of avermectin with carbofuran 3G, *Pseudomonas fluorescens* and *Trichoderma viride* for the management of *Meloidogyne incognita* in tomato revealed that combination of seedling root dip with avermectin 75% and soil application of carbofuran 3G @ 1kg a.i ha^{-1} recorded maximum shoot length of 36.90cm, fresh shoot weight of 16.80 g, dry shoot weight of 5.2g, and fruit yield of 290.50g / plant. It was followed by avermectin + *P. fluorescens* and avermectin + *T. viride*. Maximum reduction in number of *M. incognita* adult females (14.33), number of egg masses/g root (6.33), number of eggs per egg mass (105.33), soil nematode population (105.67) and root knot index (1.0) was recorded in plants treated with avermectin + carbofuran 3G, followed by combined application of avermectin with *P. fluorescens* or *T. viride.***

KEY WORDS: Avermectin, *Meloidogyne incognita*, nematicide combination, tomato

INRODUCTION

In recent years the use of Avermectins, a new class of metabolites produced by *Streptomyces avermitilis*, which is a commonly occurring soil borne actinomycete has been found to be most promising to control nematodes that infest animals and plants. Avermectins are unique macro-cyclic lactones with excellent nematicidal and insecticidal properties (Ostlind *et al*., 1981; Birtle *et al*., 1982). Despite their environmental safety and nematicidal potential, avermectins have not been fully exploited in the sustainable agriculture strategy for pest management. The present study was undertaken to evaluate the bio-control potential of avermectin, obtained from native *S. avermitilis* isolate and its compatibility with other bioagents and chemical nematicides.

MATERIALS AND METHODS

Healthy tomato seedlings (cv. Co5) were planted @ three seedlings/pot filled with 5 kg steam sterilized soil mixture. The pots were watered periodically and one week after planting, seedlings were thinned to one per pot and inoculated with freshly hatched second stage juveniles of *Meloidogyne incognita*. Various treatments tested were T_{1-} Avermectin 75% seedling root dip alone, T_{2-} *Pseudomonas fluorescens* alone @ 2.5kg ha^{-1}, T_{3-} *T. viride* alone @ 2.5kg ha^{-1}, T_{4-} Carbofuran 3G alone @ 1kg a.i ha-1, T_{5-} T_1 + T2, T_{6-} T_1 + T_3, T_{7-} T_1 + T_4 and T_{8-} Control. The above treatments were replicated thrice in completely randomized block design and the pots were maintained under glass house conditions. At 90 days after planting, the plants were uprooted with roots intact and observations on height of the shoot (cm), length of root (cm), fresh shoot weight (g), and fresh root weight (g) dry shoot weight (g), were recorded. Besides, nematode population / 200 g soil, number of adult female / g root, number of egg masses / g root, number of eggs / egg mass and root knot index were also recorded.

RESULTS AND DISCUSSION

All the treatments were significantly superior to untreated control in improving the shoot length. Avermectin 75% seedling root dip recorded a shoot length of 25.37cm, which was 64.74% higher over untreated control. But, the combined application of avermectin with carbofuran 3G recorded the maximum shoot length of 36.90cm, with 139.6 per cent increase over control. It was followed by avermectin + *P. fluorescens* and avermectin + *T. viride.* Similarly significant increase in other pant growth characters such as root length, fresh shoot weight, dry shoot weight,

fresh root weight and dry root weight was recorded in combined treatment of avermectin with carbofuran, *P. fluorescens* and *T. viride* (Table 1). The plant receiving combination treatment of avermectin + Carbofuran 3G recorded the maximum fruit yield of 290.50g / plant, with 151.51 per cent increase over control. It was followed by avermectin + *P. fluorescens* (272.10g), avermectin + *T. viride* (256.0g) and carbofuran 3G alone (230.90). Avermectin 75% as seedling root dip recorded 90.9 per cent increase in fruit yield compared to 151.51 and 135.58 per cent increase by avermectin in combination with carbofuran 3G and *P. fluorescens,* respectively. Similar to the present results obtained, Mani *et al*. (1998) reported increased plant growth and tuber yield of potato due to combined application of *P. fluorescens* @ 10kg with carbofuran 3G @ 1kg a.i / ha. Ravi *et al.* (2000) also reported that integration of neem cake @ 250g + *T. viride* @ 20g + carbofuran 3G @ 10g for

Table 1. Effect of combined application of avermectin with nematicide and bio-control agents on plant growth characters of tomato inoculated with *M. incognita*

Treatments	Shoot length (cm)	Fresh shoot weight (g)	Dry shoot weight (g)	Fruit yield (g / plant)	Root length (cm)	Fresh root weight (g)	Dry root weight (g)
Avermectin 75% (AVM) root dip	25.37	13.66	4.21	220.50	22.18	6.82	1.69
P. fluorescens alone @ 2.5kg ha^{-1}	24.42	13.41	4.20	215.90	21.20	6.63	1.58
T. viride alone @ 2.5kg ha^{-1}	20.10	12.30	3.85	190.50	17.70	6.09	1.32
Carbofuran @ 1kg a.i ha^{-1}	26.95	14.10	4.32	230.90	23.65	7.12	1.89
AVM + *P. fluorescens* alone @ 2.5kg ha^{-1}	33.60	15.91	4.97	272.10	28.00	8.15	2.35
AVM + *T. viride* alone @ 2.5 kg ha^{-1}	30.10	15.03	4.66	256.00	25.80	7.67	2.13
AVM + Carbofuran @ 1kg a.i ha^{-1}	36.90	16.80	5.28	290.50	30.30	8.70	2.59
Control	15.40	7.27	2.21	115.50	9.90	2.96	0.96
CD (P = 0.05)	3.31	0.88	0.30	17.20	2.21	0.51	0.23

Table 2. Effect of combined application of avermectin with nematicide and bio-control agents against *M. incognita* on tomato

Treatments	No. of females per g of root	No. of egg masses per g of root	No. of eggs / egg mass	Nematode poulation in 200g soil	Root Knot Index
Avermectin 75% (AVM) root dip	22.33	13.50	122.33	128.33	2.0
P. fluorescens alone @ 2.5kg ha^{-1}	23.00	14.00	126.33	131.67	2.33
T. viride alone @ 2.5kg ha^{-1}	27.00	17.33	135.33	150.33	3.0
Carbofuran @ 1kg a.i ha^{-1}	21.66	12.00	120.33	125.67	2.00
AVM + *P. fluorescens* alone @ 2.5kg ha^{-1}	16.66	8.33	110.33	112.00	1.33
AVM + *T. viride* alone @ 2.5 kg ha^{-1}	18.66	10.33	116.67	118.67	1.67
AVM + Carbofuran @ 1kg a.i ha^{-1}	14.33	6.33	105.33	105.67	1.0
Control	48.66	28.33	278.33	300.33	5.0
CD (P = 0.05)	2.21	1.80	5.50	6.30	0.32

Radopholus similis control resulted in increased plant growth and yield of banana.

Avermectin in combination with carbofuran 3G effected maximum reduction in number of females / g root to 14.33, number of egg masses / g root to 6.33, number of eggs / egg mass to 105.33 and root knot index to 1.0. It was followed by avermectin + *P. fluorescens* and avermectin + *T. viride*, which recorded reduced soil population of 112.0 and 118.67, respectively (Table 2). Similarly Rangaswamy *et al*. (2000) had reported that *Pasteuria penetrans* alone or in combination with neem cake, parasitized the nematode juveniles and adults, whereas *T. viride* alone or in combination with either neem or castor cake was most effective in parasitizing the egg masses of the nematode. The present studies clearly indicate that avermectin is the compatible with carbofuran 3G and biocontrol agents like *P. fluorescens* and *T. viride* and could be used in combination for maximizing their bio-control potential against root knot nematode.

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