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Biocontrol potential of *Pseudomonas fluorescens* (Migula) against root-knot nematode, *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 on tomato

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ABSTRACT : Studies were conducted in greenhouse to assess the biocontrol potential of three strains of *Pseudomonas fluorescens*(Migula) *viz.*, Pf-1, Pf-2 and Pf-3 at high (8×10^8 cfu/g) and low (4×10^8 cfu/g) dosages, as seedling bare root dip treatment against *Meloidogyne incognita* (Kofoid and White,1919) Chitwood, 1949 on tomato. The plant growth was significantly better in all the treatments with the bacterium. The strain Pf-1 performed significantly superior to the other two strains at both the dosages. The bacterial treatment also reduced the level of infestation by the nematode, which was dosage dependent. The strain Pf-1 was superior to the other two. The nematode suppressing ability of the bacterial strains appeared to be related to their root-colonising ability.

KEY WORDS : *Meloidogyne incognita*, Plant Growth Promoting Rhizobacteria (PGPR), *Pseudomonas fluorescens*, tomato

Biological control of plant-parasitic nematodes can be achieved by using various antagonists that indirectly inhibit nematode activity and development. There have been a number of attempts to identify bacteria with activity against plant-parasitic nematodes with most interest being centered on chitinolytic and rhizosphere inhabiting bacteria. Fluorescent *Pseudomonas* spp. have emerged as the largest and potentially most promising group of plant growth promoting rhizobacteria involved in the biocontrol of plant-parasitic nematodes (Oostendorp and Sikora, 1989). These bacteria are used as soil inoculants and as seed dressing materials because of their potential for rapid and aggressive root colonisation. *Pseudomonas fluorescens* (Migula) strains A-59, T-58 and P-523 when applied as a seed or tuber treatment were shown to inhibit early root penetration by *Heterodera schachtii* (Schmidt, 1871) and *Globodera pallida* (Stone, 1973) Mulvey and Stone, 1976 in sugarbeet and potato, respectively under greenhouse and field conditions (Racke and Sikora, 1985; Oostendorp and Sikora, 1989; Hoffmann and Sikora, 1992). *Meloidogyne incognita* (Kofoid and White, 1919) Chitwood, 1949 galling on tomato, cucumber and clover was also suppressed by the application of bacterial soil drenches or root treatments in greenhouse studies (Zevaleta-Meija and van Gundy 1982; Becker *et al.*, 1988). The present study was carried out to assess the biocontrol potential of three native strains of *P. fluorescens* against *M. incognita* and its growth promoting effect on tomato.

MATERIALS AND METHODS

Pot culture studies in green house were conducted at Department of Nematology, TNAU during 1995 to evaluate three strains of *P. fluorescens viz.*, Pf-1, Pf-2 and Pf-3 against *M. incognita* infecting tomato (CV. CO3). The bacterial isolates were maintained on King's B medium, then transferred to King's B broth and allowed to multiply for two days. The broth (400 ml) containing the bacteria was mixed with 1 kg of sterilised fine talc and sieved through 200 mesh sieve (Vidhyasekaran and Muthamilan, 1995). The product containing 15×10^8 cfu/g was suspended in tap water to give a concentration of 8×10^8 or 4×10^8 cfu/g. Fifteen-day-old tomato seedlings raised in sterilised soil were lifted from seedling pans, washed free of soil and dipped in the bacterial suspension for 30 minutes with intermittent agitation.

The experiment consisted of seven treatments, six constituting bare-root dip in bacterial suspensions at low dosage (4×10^8 cfu/g) and at high dosage ($8 \times$

10^8 cfu/g); the seventh treatment being the untreated check which received 30 minutes dip in sterile water. A randomised block design was used with five replications under each treatment.

Five seedlings from each treatment were transplanted to each replicate in 3 kg capacity clay pots, containing *M. incognita*- infested (2 juveniles/g soil) red loamy soil. Two identical experiments were conducted. Observations on plant growth parameters, nematode populations and bacterial root colonisation were recorded, forty five days after transplanting. The data were pooled and subjected to analysis of variance.

RESULTS AND DISCUSSION

Plant growth was significantly higher in all the treatments receiving the growth promoting bacteria irrespective of the strain, at both low as well as high dosages (Table 1). The increase in shoot and root weight in low dosages ranged from 45.2 to 178.0% and 23.6 to 164.0% and at high dosages from 68.1 to 208.0 % and 41.7 to 198.6 %, respectively. The strain Pf-1 performed significantly better than the other two strains at both the dosages.

Root treatment with *P. fluorescens* also reduced the level of infestation by the nematode, which was dosage dependent, with significant differences existing between the three strains. The per cent reduction in number of galls, number of egg masses and soil population ranged from 14 to 64, 20 to 60 and 14 to 53, respectively, over control (Table 1), with the strain Pf-1 being the best.

The results demonstrate the effectiveness of *P. fluorescens* as a potential biocontrol agent against *M. incognita*. The mechanism responsible for the reduction of nematode population may be related to the ability of the bacteria to envelop or bind the root surface with carbohydrate-lectin, thereby interfering with normal host recognition (Oostendorp and Sikora, 1990). This view is supported by the fact that the most antagonistic strain of bacteria found in the study had the best colonising ability on the tomato roots.

Table 1. Effect of *P.fluorescens* on *M. incognita* population and tomato plant growth*

Treatment	Plant growth		Nematode population			No.of bacterial colony forming units/g root ($x10^8$)
	Shoot wt.(g)	Root wt.(g)	No.of galls /root system	No.of Egg masses/root system	Nematode population/ 250 ml soil	
P. fluorescens strain -1 (H)	28.8^g	4.3^f	76.0^a	38.0^a	324.0^a	28^e
P. fluorescens strain -1 (L)	26.0^f	3.8^e	94.0^b	45.0^b	386.0^b	18^d
P. fluorescens strain -2 (H)	20.9^e	3.3^d	104.0^c	49.0^c	400.0^c	15^c
P. fluorescens strain -2 (L)	17.3^d	2.7^c	121.0^d	59.0^d	454.0^d	10^b
P. fluorescens strain -3 (H)	15.7^c	2.0^b	161.0^e	66.0^e	544.0^e	7^a
P. fluorescens strain -3 (L)	13.6^b	1.8^b	181.0^f	74.0^f	595.0^f	5^a
Control	9.4^a	1.4^a	209.0^g	93.0^g	687.0^g	

* Pooled data from two experiments
H - High dose - 8 x 10^8 cfu/g
L - Low dose - 4 x 10^6 cfu/g
Column figures followed by different letters are significantly different from each other at 5% level

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