Madras Agric. J. 89 (1-3) : 41-43 January-March 2002

https://doi.org/10.29321/MAJ.10.A00179

Studies on the standardization of application of *Pasteuria penetrans* for the control of *Meloidogyne incognita* in banana

K. DEVRAJAN, G. RAJENDRAN AND P. THIRUVELAVAN
Department of Nematology, Tamil Nadu Agricultural University, Coimbatore - 641 003, Tamil Nadu.

Abstract: Experiment was conducted to find out the level and appropriate time of application of biocontrol agent *Pasteuria penetrans* (parasitic endospore forming bacterium) for the effective control of *Meloidogyne incognita* in banana. The effectiveness of the bacteria, *P. penetrans* increased with increase in the level of the inoculam of the three levels *viz.* 0.25, 0.50 and 0.75 g kg^{-1} of soil. The highest level of 0.75 g kg^{-1} of soil (one gram dried root preparation contained spore level of 24 x 10^9) reduced the population of *M.incognita* in soil and gall index and increased the female infection more effectively. *P. penetrans* at 0.75 g kg^{-1} soil applied at planting was found to be superior over the chemical carbofuran. The maximum control was obtained by the bacterium applied at planting compared to other timing of applications *viz.* 30 and 60 days after planting. ***(Key words:** Nematode, Biocontrol, Banana, Pasteuria penetrans, Meloidogyne incognita)*

Banana, "Apple of the tropics" is one of the five important fruit crops having the economic usage of all the plant parts. It provides several medicinal and industrial usage. It is one of the biggest single trade items in intemational fruit trade (Abdul Khader *et al.* 1992). Its cultivation has a long history and believed to be grown in the valley of India as early as 327 B.C. However, the prevalence and importance of plant parasitic nematodes as potential pests of banana was realised very late only after the permanent decline of Cuban banana industry due to nematodes. Nearly 34 genera of nematodes are found to be associated with banana in India. Among them, *Meloidogyne incognita* is found to have wider occurrence in Tamil Nadu. Chemical nematicides are widely used to control the nematode population. But it leads to the problems like health hazards, pest resurgence, residual toxicity and adverse effect on beneficial microorganisms. Hence it is necessary to develop biological control methods to avoid the above said problems. The bacterial parasite, *Pasteuria penetrans* can be used for effective control of root knot nematodes *(M. incognita)* (Stirling, 1991). However not much work has been carried out to find the effectiveness of this biocontrol agent. In view of the above facts, the present study was made with the objective of standardising the optimum level and appropriate time of application of *P. penetrans* for the control of *M.incognita* in banana.

Materials and Methods

Present experiment was carried out at the Department of Nematology, Tamil Nadu Agricultural University, Coimbatore during 1995. Uniform sized healthy banana suckers of cv. Robusta were collected. Suckers were trimmed to remove the outer layers and planted in 5 kg pots at the rate of one sucker per pot. Pots were filled with autoclaved pot mixture, that contained sand, red soil and farm yard manure in equal proportion. A month after planting, the plants were inoculated with the nematode *M.incognita* (@ one nematode/g of soil). The biocontrol agent *P. penetrans was* applied as per the following treatments.

Treatment details:

T_1 - *P. penetrans* @ 0.25 g kg^{-1} of soil at planting.
T_2 - *P.penetrans* @ 0.25 g kg^{-1} of soil 30 DAP
T_3 - *P.penetrans* @ 0.25 g kg^{-1} of soil 60 DAP
T_4 - *P.penetrans* @ 0.50 g kg^{-1} of soil at planting
T_5 - *P.penetrans* @ 0.50 g kg^{-1} of soil 30 DAP
T_6 - *P.penetrans* @ 0.50 g kg^{-1} of soil 60 DAP
T_7 - *P.penetrans* @ 0.75 g kg^{-1} of soil at planting
T_8 - *P.penetrans* @ 0.75 g kg^{-1} of soil 30 DAP
T_9 - *P.penetrans* @ 0.75 g kg^{-1} of soil 60 DAP
T_{10} - Carbofuran 3G @ 40 g $plant^{-1}$ at planting
T_{11} - Untreated control.

Table 1. Effect of *Pasteuria penetrans* on *Meloidogyne incognita* in banana cv. Robusta

Treatments	Population per 200cm³ soil					Gall index	Number of egg masses per 5g root	Percentage of females	Percentage of egg
	Days after nematode inoculation								
	30	60	90	120	150				
T_1 *P. penetrans* @ 0.25 g kg⁻¹ of soil at planting.	92.7 (-21.6)	161.0(-7.3)	198.7 (-19.9)	227.3 (-27.1)	358.0 (-1.3)	3.7	15.7	73	82
T_2 *P. penetrans* @ 0.25 g kg⁻¹ of soil 30 DAP	113.0 (-4.5)	158.7 (-8.6)	167.7 (-32.4)	198.0 (-36.5)	331.7 (-8.5)	4.0	16.0	79	84
T_3 *P. penetrans* @ 0.25 g kg⁻¹ of soil 60 DAP	116.3 (-1.7)	127.3 (-2.7)	181.3 (-26.9)	206.7 (-33.8)	277.3 (-23.5)	4.3	16.6	80	84
T_4 *P. penetrans* @ 0.50 g kg⁻¹ of soil at planting	87.3 (-26.3)	113.3 (-34.8)	161.0(-35.1)	193.7 (-37.9)	221.3 (-39.0)	2.0	10.9	82	78
T_5 *P. penetrans* @ 0.50 g kg⁻¹ of soil 30 DAP	112.7 (-4.7)	127.0 (-26.9)	162.7 (-34.4)	169.0 (-45.8)	193.7 (-46.6)	2.3	11.1	87	50
T_6 *P. penetrans* @ 0.50 g kg⁻¹ of soil 60 DAP	112.0 (-5.3)	98.7 (-43.2)	137.3 (-44.6)	170.0 (-45.5)	198.3 (-45.3)	2.7	11.7	89	80
T_7 *P. penetrans* @ 0.75 g kg⁻¹ of soil at planting	48.7 (-58.8)	51.3 (-70.5)	48.7 (-80.4)	139.3 (-55.4)	167.0 (-54.0)	1.7	8.1	89	72
T_8 *P. penetrans* @ 0.75 g kg⁻¹ of soil 30 DAP	51.3 (-56.6)	62.7 (-63.9)	93.3 (-62.4)	101.7 (-67.4)	121.3 (-66.6)	2.0	8.6	91	74
T_9 *P. penetrans* @ 0.75 g kg⁻¹ of soil 60 DAP	111.0 (-6.2)	31.7 (-81.8)	62.0 (-75.0)	71.7 (-77.0)	113.7 (-68.7)	2.3	9.3	93	76
T_{10} Carbofuran 3G@40 plant at planting	21.0 (-82.2)	37.0 (-78.7)	131.7 (46.9)	218.3 (-30.0)	262.7 (-27.6)	2.7	16.0	—	83
T_{11} Untreated control	118.3	173.7	248.0	312.0	362.7	4.7	23.1	—	84
CD (P=0.05)	-0.193	0.191	0.208	0.213	0.230	0.3	1.3	8.5	NS

Figures in the parentheses are percentage decrease over untreated control.

The effectiveness of the bioagent on the control of nematode was determined based on the population in the soil, gall index, number of egg masses per 5g of root, percentage of females infected and percentage of egg hatch. The experiment was conducted in completely randomized design with three replications. The data obtained from different treatments were subjected to statistical analysis following the procedure given by Gomez and Gomez (1984).

Results and Discussion

At 30 days after inoculation, lowest population (21.0 nematodes / 200 cm^3 of soil) was recorded by carbofuran which was 82.2 per cent reduction over untreated plants. Untreated control recorded 118.3 nematodes / 200cm^3 of soil. Sixty days after inoculation, 0.75 g of *P. penetrans* applied 60 days after planting had the lowest population of 31.7 nematodes which was on par with carbofuran treatment. At 90 days after inoculation, plants applied with *P. penetrans* 0.75g kg^{-1} of soil at planting showed the highest reduction of nematode population in soil (80.4 percent over untreated control). At 150 days after inoculation highest value of gall index (4.7) was recorded by untreated control which also recorded the maximum number of egg masses (23.1/5 g of root). *P. penetrans* 0.75g kg^{-1} of soil applied at planting recorded the minimum gall index (1.7) and number of egg masses (8.1/5g of root). Maximum percentage of female infection (93 percent) was found in plants treated with *P. penetrans* 0.75g kg^{-1} of soil at 60 days after planting. Minimum percentage egg hatch of 72 percent was recorded by *P. penetrans* @ 0.75g kg^{-1} of soil applied at 60 days after planting.

Experimental results showed the effectiveness of *P. penetrans* against *M.incognita* affecting banana. There was direct correction in the control of nematodes with the increased inoculation of *P. penetrans*. *P. penetrans* is a prokaryotic endoparasite (Sayre and Wergin, 1977) of juveniles of *M incognita*. Its spores attach to the cuticle of second stage juveniles in the soil resulting in diseased female nematodes which reproduce little or not at all at maturity (Mankar, 1980). Further Brown *et al.* (1985) reported that *P. penetrans* not only prevents the reproduction of *M incognita* but also reduces infertility. These may be the probable reasons for the reduced gall index and number of egg masses in *P. penetrans* applied to banana plants.

References

Abdul Khader, J.B.M.Md., Chellappan, K., Chattopadhayay, P.K. and Anchanam Alagia pillai, O. (1992). Banana. *In:* Fruits: Tropical and subtropical (Bose, T.K. and Mitra,S.K. eds.). Naya Prakash, Calcutta, India. pp. 132-185.

Brown, S.M., Kepner, J.L. and Smart Jr, G.C. 1985. Increased crop yields following application of *Basillus penetrans* to field plots infested with *Meloidogyne incognita*, Soil Biol. *Biochem.* 17: 483-486.

Gomez, K.A. and Gomez, A.A. (1984). Statistical procedure for agricultural research, John Willey and Sons, New York, p.680.

Mankar, R. (1980). Biological control of nematode pests of natural enemies. *Ann. Rev. Phytopathol.* 18: 415-440.

Sayre, R.M. and Wergin, W.P. (1977). Bacterial parasite of a plant nematode: Morphology and Ultrastructure. *J. Bacteriol.*, 129: 1094-1101

Stirling,G.R. (1991). Biological control of plant parasitic nematodes. CAB International, Wallingford, p.282.

(Received: June 2001; Revised: December 2001)