



Biomangement of citrus nematode *Tylenchulus semipenetrans* Cobb on lemon, *Citrus limonia* L.

S.P. Deepa, S. Subramanian and S. Ramakrishnan

ABSTRACT

An experiment was conducted on a nine - year old citrus, *Citrus limonia* L. garden affected with citrus nematode *Tylenchulus semipenetrans* heavily to evaluate the biocontrol potential of *Pseudomonas fluorescens*, *Trichoderma viride*, *T. harzianum* and *Pochonia chlamydosporia* in the management of citrus nematode. The above bioagents were inoculated in talc formulation at a depth of 20-30 cm and 120 cm away from the trunk of the tree and compared with carbofuran 3G (100g/tree) as chemical check and untreated control. Observations were made on citrus nematode population and fruit yield one year after the delivery of the above test bioagents. The observations revealed that all the bioagents are effective to reduce the citrus nematode population and to increase the fruit yield of *Citrus limonia* L. Among them the use of *P. fluorescens* available commercially as talc formulation @ 20 g/tree is most effective to reduce *T. semipenetrans* population (71.49 %) and to increase the fruit yield three fold compared to untreated control.

Key words: Biocontrol agents, carbofuran, *Citrus limonia* L., *Tylenchulus semipenetrans*

INTRODUCTION

India is one among the leading citrus growing countries of the world. Citrus is the largest group of fruit produced over an area of 8,43,000 hectares and contributed to total production and productivity of fruits as 75,87,000 MT/annum and 9 MT /ha respectively. In Tamil Nadu, *Citrus* spp. are being grown over an area of 10297 ha with the total production of 24,766 MT/annum and productivity of 4.49 MT/ha. The yield of mature trees got reduced by 30-50 per cent due to citrus nematode, *Tylenchulus semipenetrans* (Baines *et al.*, 1962). Although measures are in practice to manage the nematode population through chemical pesticides not much work has been carried out on biomangement of citrus nematodes. Hence an attempt has been made to evolve suitable biomangement strategy through the present study for the management of citrus nematode.

MATERIALS AND METHODS

A field experiment was conducted at Irur village of Perambalur district in Tamil Nadu to evaluate the efficacy of biocontrol agents against *T. semipenetrans* on lemon. Trees infested with slow decline were selected and used to impose the treatments replicated five times.

Nematode population prior to the application of biocontrol agents was assessed. Nematode population in roots and soil were recorded after the application of biocontrol agents at

three months interval for a period of one year. Number of fruits and their weight were also recorded for a period of one year after the initiation of field experiment.

RESULTS AND DISCUSSION

All the bioagents caused significant reduction in *T. semipenetrans* population compared to control. The bioagent *P. fluorescens* treated plants recorded the least nematode population in soil followed by carbofuran compared to untreated control (Table 1). Similarly the lowest number of citrus nematode females was found in *P. fluorescens* treatment accounting for 79.16 per cent reduction over control. *P. fluorescens* recorded the highest fruit weight over control. The next best treatment was carbofuran.

With regard to yield among the different treatments, *P. fluorescens* recorded the highest fruit yield followed by carbofuran. The increase in fruit yield recorded in other treatments viz., *T. harzianum*, *T. viride* and *P. chlamydosporia* was 230.97, 191.40 and 81.66 per cent, respectively over control.

The results revealed that among the biocontrol agents, *P. fluorescens* as soil application was found to be highly effective against *T. semipenetrans*. The present findings were in accordance with Shanthi *et al.* (1999) who reported that application of talc formulation of *P. fluorescens* (TNAU strain Pf1) (15×10^8 cfu/g) at 20 and 40g/tree retarded the multiplication

Table 1. Efficacy of biocontrol agents on *T. semipenetrans* in lemon

Treatments	Nematode population /200cc soil*	Per cent decrease over control	Female population /g of root*	Per cent decrease over control	Fruit weight /fruit (g)**	Per cent increase over control	Fruit yield (Number of fruits/tree)**	Per cent increase over control
<i>P. fluorescens</i> @ 20g/tree	119.52 (10.94)	71.49	3.00 (1.72)	79.16	60.74	90.00	836.89	279.43
<i>T. viride</i> @ 20g/tree	161.76 (12.71)	61.42	3.80 (2.18)	72.22	40.16	26.00	642.72	191.40
<i>T. harzianum</i> 20g/tree	139.04 (11.79)	66.84	4.00 (1.99)	73.61	45.44	42.00	729.99	230.97
<i>P. chlamydosporia</i> @ 20g/tree	240.00 (15.49)	42.76	6.40 (2.31)	55.55	37.06	16.00	400.67	81.66
Carbofuran 3G @ 3g a.i. /tree	126.08 (11.22)	69.93	3.60 (1.89)	75.00	55.35	73.00	745.32	237.92
Control	419.36 (20.47)	-	14.40 (3.78)	-	32.00	-	220.56	-
CD (P=0.05)	1.445	-	0.75	-	1.441	-	4.26	-

* Pooled mean of four observations;** Pooled mean of three pickings of fruits; Figures in parentheses are “n+1 transformed values

of *T. semipenetrans* significantly on sweet orange and lemon. In support of the present finding Rajendran *et al.* (2001) reported that *P. fluorescens* and mycorrhizal fungi could be used as successful biocontrol agents for the management of *T. semipenetrans* and *Meloidogyne* spp. in citrus.

Trichoderma viride, *T.harzianum* and *P. chlamydosporia* were also found to improve the growth characters and suppress the nematode population significantly compared to control. These findings are in agreement with those of Walter and Kaplan (1990) who reported that *P.chlamydosporia*, was capable of infesting *T. semipenetrans* egg masses and thereby reduced the nematode population buildup. The biocontrol efficacy of *T. harzianum* against *T. semipenetrans* in *C. jambhiri* seedlings was also reported by Walode *et al.* (2008). Senthamarai *et al.* (2006) reported that soil application of *T. viride* at the rate of 2.5 kg/ha recorded increased plant growth and reduced *M. incognita* population compared to control in coleus.

Therefore the study concluded that the citrus nematode *T. semipenetrans* can be managed using the plant growth promoting rhizobacterium *P. fluorescens* (20g/tree) most effectively. The other bioagents viz., *T. harzianum*, *T. viride* and *P. chlamydosporia* also effective at varying level.

REFERENCES

Baines, R.C., Martin, J. P., DeWolfe, T. A., Boswell, S. B. and Garber, M. J. 1962. Effect of high doses of D-D on soil organisms and the growth and yield of lemon trees. *Phytopathology*, **52**:723.

Rajendran, G. Ramakrishnan, S. and Subramanian. S. 2001. Biomangement of nematodes in horticultural crops. *South Indian Horticulture*, **49**: 227-230.

Senthamarai, M., Poornima, K. and Subramanian, S 2006. Nematode disease complex involving *Meloidogyne incognita* and *Macrophomina phaseolina* on *Coleus forskohlii* Briq. *Indian Journal of Nematology*, **36**:181-184.

Shanthy, A., Rajeshwari, S., Sivakumar, C. V., Sundarababu, R.S., Dhawan, C. and Kaushal, K. K. 1999. Field evaluation of rhizobacterium, *Pseudomonas fluorescens* for the management of citrus nematode, *Tylenchulus semipenetrans*. In: *Proceedings of Nail. Sympo. Rational Approaches in nematode management for sustainable Agric.* Anand, India. 38-42 **PP**.

Walode, N. B., Sinha, A. K. and Neog, P. P. 2008. Biological control of citrus nematode *Tylenchulus semipenetrans* on *Citrus jambhiri*. *Indian Journal of Nematology*, **38**: 244-246.

Walter, D. E. and Kaplan. D.T. 1990. Antagonists of plant parasitic nematodes in Florida citrus. *Journal of Nematology*, **22**: 567-573.

S. P. Deepa, S. Subramanian and S.Ramakrishnan
Department of Nematology, Centre for Plant Production Studies, Tamil Nadu Agricultural University, Coimbatore-641 003. Tamil Nadu, India

Received: October 11, 2011

Revised: October 20, 2011

Accepted: November 12, 2011