*Nematol. medit. (1997), 25*: 17-19

*Nematology and Entomology Division, Indian Institute of Horticultural Research, Hessaraghatta Lake (PO), Bangalore - 560089, India*

# INTEGRATED MANAGEMENT OF *MELOIDOGYNE INCOGNITA* ON OKRA BY CASTOR CAKE SUSPENSION AND *PAECILOMYCES LILACINUS*

by
M. S. RAO, P. PARVATHA REDDY and M. NAGESH

**Summary**. Integrated management of *Meloidogyne incognita* on okra (*Abelmoschus esculentus*) under field conditions was standardized by integrating *Paecilomyces lilacinus* with castor cake aqueous suspension. Seed treatment with castor cake suspension (10%) mixed with *P. lilacinus* spores and sowing these treated seeds in the soil drenched with castor cake suspension has proved as effective as application of carbofuran at 2 kg a.i/ha or direct application of castor cake at the rate of 2 tons/ha, in reducing the root-knot index, final population of *M. incognita* and increasing the fruit yield of okra. Further, significant increases in root colonization, propagule density in soil and per cent egg infection by *P. lilacinus* reveal complementary interactive effect between these two components required for their sustainable use in the management of *M. incognita* on okra under field conditions.

*Paecilomyces lilacinus* (Thoms.) Samson is reported to be one of the promising bio-control fungus (Jatala, 1986). Bio-management of *Meloidogyne incognita* (Kofoid *et* White) Chitw. attacking okra (*Abelmoschus esculentus* Moench.) requires the use of large quantities of inoculum of *P. lilacinus*. Hence Walia *et al.* (1991) reported the seed treatment of okra with *P. lilacinus* spore suspension against root-knot nematodes. In our studies (Rao and Reddy, 1992) we found that acqueous suspension of castor (*Ricinus communis* Merr.) cake can support the growth of *P. lilacinus*. So it was thought to use *P. lilacinus* in integration with castor cake suspension for the sustainable management of *M. incognita* on okra under field conditions.

## Materials and methods

Aqueous suspensions of castor cake (10%) were prepared by soaking finely ground oil cake in tap water for 16 hr and later the suspension was filtered by using a muslin cloth. A spore suspension containing $3x10^6$ spores of *P. lilacinus*/ml was prepared by extracting spores from 30 days old *P. lilacinus* culture (*P. lilacinus* grown on paddy grains) by adding sterile tap water with 0.01% Triton X - 100 and passing through a muslin cloth. Double strength of castor cake suspension was mixed with *P. lilacinus* spore suspension (prepared in above mentioned manner) so as to get castor suspension containing $1.5x10^6$ spores of *P. lilacinus*/ml.

IIHR Contribution No. 21/96.

Gum arabic was added (to act as a sticker) at the rate of 200 mg/100 ml before treating the seeds. Okra seeds were immersed in the suspension for 30 min and then dried on sheet of polythene. Other seed lots were also similarly treated with castor cake suspension and/or *P. lilacinus* suspension. Seeds were sown in 2x3 m plots of *M. incognita* infested soil at the Experiment Station of the Indian Institute of Horticultural Research, Bangalore. Observations on initial population of nematodes indicated that before sowing there were 56-72 J2/100 cc of soil. Soil drenches with 20 l of 10% castor cake suspension were applied to appropriate plots which were then sown 15 days later. Untreated seeds were sown as controls. Each treatment was replicated three times in a randomized block design. To compare the efficacy of these treatments, some plots were treated either with carbofuran (3G) 3 or 6 g/sq.m. or castor cake at 100 or 200 g/sq.m.

Observations were made, by harvesting 70 days old plants, on growth parameters, root-knot index (on 1-10 scale of Bridge and Page, 1980), number of nematodes/5 g of roots, nematode population in the soil, and per cent eggs infected by *P. lilacinus*. Root colonisation by *P. lilacinus* was evaluated by carefully washing the root system to remove the soil, blotting dry and weighing. The roots were cut into about 1 cm pieces and at random 1 g sample was crushed in a sterile pestle and mortar. Serial dilutions were made with sterile distilled water and plating was done by using the semi selective medium developed by Mitchell *et al.* (1987). Soil dilution plating was done in the medium for estimating the density of *P. lilacinus* propagules in soil. Parasitization of eggs by *P. lilacinus* was estimated by picking up at random ten egg masses from each plant root system and treating them with 1% sodium hypochlorite solution and counting eggs infected under the microscope. *Paecilomyces lilacinus* was re-isolated from adult females and eggs of *M. incognita*. The fungus was identified by the hyphal conidiophore morphology and colony colour characteristic to *P. lilacinus*.

## Results and discussions

The results revealed that seed treatment with castor cake suspension mixed with *P. lilacinus* spores and soil drench with castor cake suspension (10%) was as effective as carbofuran at 6 g/sq.m. and direct castor cake application at 200 g/sq.m. in reducing root-knot index, final population of nematodes and increasing the plant growth and yield of the okra crop (Table I). This treatment was also significantly effective in increasing root colonization by *P. lilacinus*, its propagule density in the soil and parasitization of *M. incognita* eggs (Table II).

Treating the soil in the field with carbofuran is very expensive. Further, the treatment in which seeds were immersed in castor cake suspension (10%) was as effective as direct application of castor cake at the rate of 100 g/sq.m. or carbofuran treatment at 3 g/sq.m. in decreasing *M. incognita* infestation on okra (Table I). Application of huge quantities of castor cake in the soil is not practical and also 15 days have to be allowed for its decomposition before seeds can be sown. Conversely, relatively small amounts of castor cake are involved in the suspension for the seed treatment or as a drench is very minimal, and sowing can be undertaken soon after drenching the soil. Use of castor cake suspension will facilitate the integration of *P. lilacinus* spores. Seed treatment with the castor cake suspension mixed with the spores of *P. lilacinus* is easy and requires very little inoculum of the bio-agent.

**Acknowledgement**. The authors thank Dr. I. S. Yadav, Director, Indian Institue of Horticultural Research, Bangalore, for providing the facilities.

TABLE I - *Effect of integration of* Paecilomyces lilacinus suspension *(PLS) and castor cake suspension (CCS) on the management of* Meloidogyne incognita *on okra crop growth and yield.*

| Treatment | Plant height (cm) | Plant dry wt. (g) | Root length (cm) | Root fresh wt. (g) | Gall index (1-10 scale) | Nematodes in 5 g root | Final* population (in 100 CC soil) | Yield/ plot of 2x3 mt (Kg) |
|---|---|---|---|---|---|---|---|---|
| PLS-ST | 70.2 | 17.4 | 30.2 | 20.7 | 7.6 | 1593 | 115 | 5.2 |
| CCS-ST | 74.5 | 19.2 | 26.5 | 16.4 | 7.2 | 1847 | 132 | 5.0 |
| CCS-SD | 77.8 | 20.6 | 32.7 | 32.3 | 7.5 | 1704 | 125 | 5.4 |
| PLS+CCS-ST | 73.7 | 19.5 | 34.5 | 24.7 | 5.5 | 1434 | 97 | 5.7 |
| PLS+CCS-ST + CCS-SD | 84.3 | 23.4 | 33.7 | 22.1 | 4.7 | 1247 | 81 | 6.8 |
| CCS-ST + CCS-SD | 80.2 | 21.3 | 31.6 | 20.6 | 5.9 | 1658 | 118 | 6.3 |
| Castor cake 1 ton/ha | 76.2 | 19.5 | 33.5 | 21.6 | 5.6 | 1568 | 111 | 6.5 |
| Castor cake 2 tons/ha | 82.5 | 22.7 | 35.2 | 23.4 | 4.6 | 1372 | 98 | 7.0 |
| Carbofuran 1 kg a.i/ha | 73.4 | 20.5 | 28.7 | 20.4 | 5.2 | 1476 | 102 | 6.4 |
| Carbofuran 2 kg a.i/ha | 75.7 | 21.3 | 38.8 | 20.7 | 4.5 | 1134 | 76 | 6.7 |
| Control | 56.5 | 14.8 | 25.3 | 18.7 | 9.2 | 2356 | 145 | 4.7 |
| CD - 5% | 8.36 | 3.64 | 5.76 | 4.38 | 0.87 | 257.36 | 18.65 | 0.72 |

ST = Seed treatment; SD = Soil drenching.

TABLE II - *Effect of integration of* P. lilacinus *spore suspension (PLS) and castor cake suspension (CCS) on the root colonization, propagule density in soil and per cent egg infection by* P. lilacinus.

| Treatment | Colonization of *P. lilacinus* (CFU/g. of root) | *P. lilacinus* propagule density (CFU/g of soil) | % eggs infected by *P. lilacinus* |
|---|---|---|---|
| PLS-ST | 1865 | 1676 | 43 |
| PLS+CCS-ST | 2676 | 2349 | 46 |
| PLS+CCS-ST + CCS-SD | 3445 | 3576 | 53 |
| Control | – | – | – |
| CD-5% | 284.57 | 340.85 | 2.24 |

CFU = Colony Forming Units; ST = seed treatment; SD = soil drenching.

## Literature cited


BRIDGE R. and PAGE S. L. J., 1980. Estimation of root-knot nematode infestation levels on roots using a rating chart. *Trop. Pest Manag., 26*: 296-298.

JATALA P., 1986. Biological control of plant parasitic nematodes. *Ann. Rev. Phytopath., 24*: 453-489.

MITCHELL D. J., KANUWISHER-MITCHELL M. E. and DICKSON D. W., 1987. A semi-selective medium for the isolation of *Paecilomyces lilacinus* from soil. *J. Nematol., 19*: 255-256.

RAO M. S. and PARVATHA REDDY P., 1992. Prospects of management of root-knot nematode on tomato through the integration of bio-control agents and botanicals. *Indian Phytopath., 46*: 337.

WALIA R. K., BANSAL R. K. and BHATTI D. S., 1991. Effect of *Paecilomyces lilacinus* application time and method in controlling *Meloidogyne incognita* on okra. *Nematol. medit., 19*: 247-249.


Accepted for publication on 1 October 1996.