Nematode management under protected cultivation

In India on an average, a national loss of Rs. 21,068.73 millions has been estimated due to plant parasitic nematodes. An overall average annual yield loss in major horticultural crops due to nematodes goes up to 60% under protected cultivation. Rapid spread of nematode infestation through soil, crop residues and indiscriminate use of agro chemicals in horticultural ecosystems is a major concern for crop protection specialists and policy makers.

Demand for high quality, export-oriented horticultural products and need for the availability of horticultural crop produce round the year especially in off season, compelled the growers to cultivate select crops under protected cultivation in 1980s. As a result people started cultivation of horticultural crops under protected conditions in all the states of India. Soon nematode incidence under protected cultivation particularly became severe and led to complete crop losses because of congenial conditions of higher temperature, humidity and use of high agronomic inputs like fertilizers and plant growth promoters in polyhouses.

Symptoms such as chlorosis and stunting appear after sufficient damage is inflicted. The proliferation rates of nematodes in polyhouse cultivation reached up to 10 to 30 folds more than in the open field cultivation. As yet farmers continue to incur losses in crops under protected cultivation without appropriate solutions to problems posed by nematodes. The population build up is very rapid in the polyhouses and nematode population reaches 5 - 6 times of threshold levels within 18 - 24 months, making the polyhouse cultivation a wasteful exercise. In tomato, dynamics of root knot nematode showed enhanced population build up from 1 to 30 juveniles J2/c.c. soil within a period of 6-12 months, which is comparatively higher in contrast to the open cultivation.

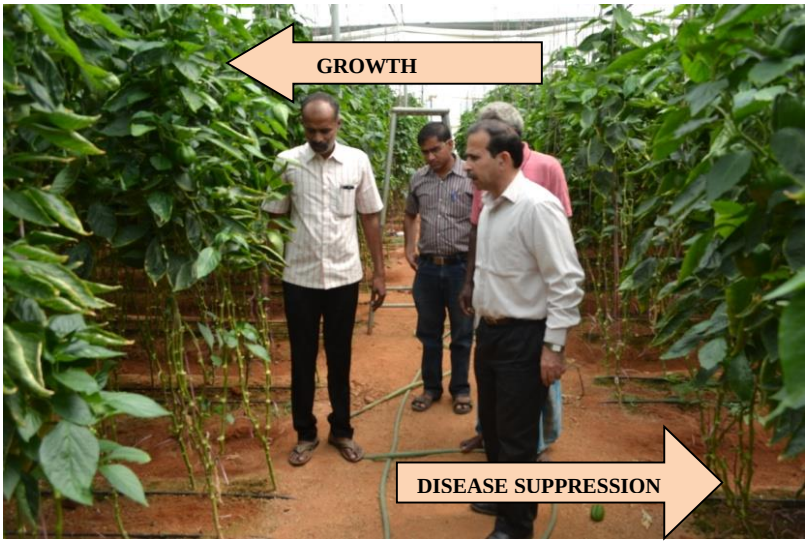
Crops such as capsicum (bell-pepper), tomato, chili, okra, gherkins, muskmelon, watermelon, carnations, roses, gerbera and anthuriums are being grown under protected cultivation (in poly houses/ green houses/ shade nets). These crops are grown throughout India are seriously infested with nematodes such as *Meloidogyne incognita, M. javanica* (root-knot nematodes) and *Rotylenchulus reniformis* (reniform nematode). Nematode problems on all these crops under protected conditions have assumed alarming proportions leading to huge crop losses (up to 80%) in select crops. The nematode infestations exacerbate severity of fungal diseases leading to complete crop losses.

M. incognita infection makes the plants highly susceptible for the attack of *Fusarium oxsporum* f.sp. *dianthi*. *Phytophthora parasitica* + *M. incognita* interact to produce a disease complex in gerbera leading to reduction in the yield around 40 to 60 %. In capsicum a pathogenic bacteria *Ralstonia solanacearum* gets entry into the roots infested by root-knot nematode and together produce wilting disease that reduces yield to 60-70%.

Management practices adopted by farmers include continual use of chemical nematicides, often at higher than recommended rates resulting in build-up of resistance. In addition, biomagnification and environment deterioration due to hazardous chemicals has rendered several cultivated ecosystems unstable and non-profitable.

Nematologists at IIHR, Bengaluru standardized successful management strategies of nematodes and other disease complex using bio-pesticides like *Paecilomyces lilacinus*, *Pochonia chlamydosporia*, *Trichoderma harzianum*, *T. viride* and *Pseudomonas fluorescens*. Farmers who adopted the IIHR technology reduced the use of agro-chemicals to 40 to 45% extent and obtained 30 to 35% increased yields in capsicum, gerbera and carnations.

Revival of capsicum plants after application of the formulation of bio-agents



Success story of the use of formulation of bio-agents


Preparation of beds

- ✓ Land should be thoroughly ploughed and soil should be brought to fine tilth. Before preparation of the beds in the poly-house incorporate 20 tons of FYM enriched with the bio-pesticides in the soil.

- ✓ Raised Beds are to be prepared after bringing the soil to fine tilth. Bed size can be according to the requirement and the type of crop grown.

- ✓ Add recommended doses of fertilizers. Also add carbofuran or phorate @ 50g/sq.m + 200g neem/ pongamia/ mahua cake enriched by bio-pesticides per sq. m.

- ✓ Further incorporate bio-pesticide enriched FYM@ 2kg/sq. m or bio-pesticides enriched vermicompost @ 500g/sq.m in top 18 cm of soil in the beds.

- ✓ Water the beds for 7-10 days for proper decomposition of these organic materials.

Gerbera grown using organic formulation of bio-agents

Plants lost due to nematode infestation

Nematode problem in gerbera

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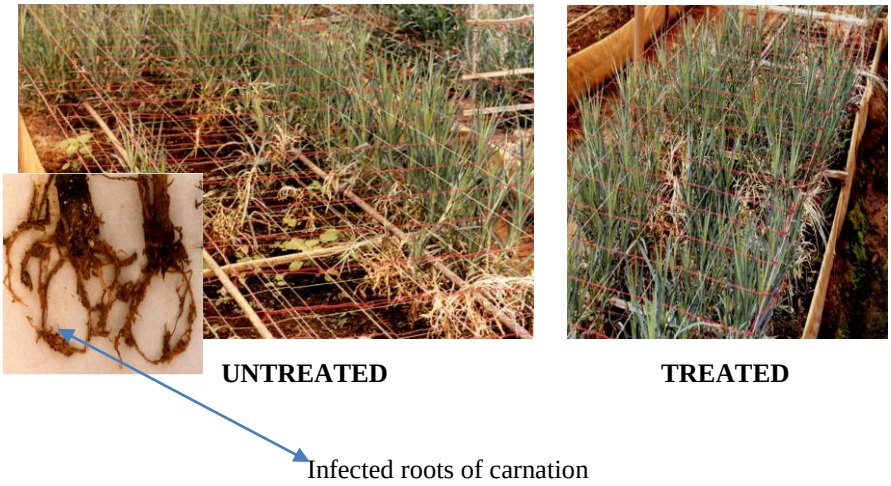

Carnations grown using bio-agents enriched organic materials

Process of Enrichment of FYM

- 1 ton of Farm Yard Manure has to be enriched by mixing with 2 kg of each of *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus*. It has to be covered with mulch and optimum moisture of 25 - 30% has to be maintained for a period of 15 days.

Process of Enrichment of neem/ pongamia/ mahua cake

- 1 ton of neem/ pongamia/ mahua cake has to be enriched by mixing with 2 kg of each of *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus*. It has to be covered with mulch and optimum moisture of 25 - 30% has to be maintained for a period of 15 days.
- Once in a week thoroughly mix the neem cake for maximum multiplication of and homogenous spread of the microorganisms in the entire lot of neem cake.

Process of Enrichment of vermicompost

- 1 ton of vermicompost has to be enriched by mixing with 2 kg of each of *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus*. It has to be covered with mulch and optimum moisture of 25 - 30% has to be maintained for a period of 15 days.
- Once in a week thoroughly mix the vermicompost for maximum multiplication of and homogenous spread of the microorganisms in the entire lot of vermicompost.

Step 2: Spraying:

- The organic formulation containing *Pseudomonas fluorescens* and *Trichoderma harzianum* has to be sprayed on the plants at regular intervals of 20 days at a dosage of 5g/ lit or 5ml/ lit.
- Alternately, take 20 kg of neem/ pongamia/ mahua cake enriched in the above mentioned manner and mix it in 200 litres of water, leave it for a period of 2-3 days. Filter this suspension and use it for spraying by mixing 250ml of suspension in 1 lit. of water at regular interval of 20 days.

Step 3: Drenching or application through drip irrigation system:

- The IIHR patented organic formulation has to be given through drip/ by drenching @ 5g/ lit or 5ml/ lit. at regular interval of 20 days.
- Alternately, take 20 kg of neem/ pongamia/ mahua cake enriched in the above mentioned manner and mix it in 200 litres of water, leave it for a period of 2-3 days. Filter this suspension and use it for drenching at regular interval of 20 days.

Application of the bio-pesticides to a standing crop

- It is possible that farmers would not have prepared beds initially as mentioned above and they observe the infestation of nematodes, soil borne pathogenic fungi and bacteria on the crops. Then these following steps for the management of nematodes, soil borne pathogenic fungi and bacteria need to be taken.

Step 1: Soil application:

- Apply 100 g of neem / pongamia / mahua cake or 250 g of vermicompost enriched with *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus* on 1 sq. m. beds or around the rhizosphere of the plants.

Step 2: Spraying:

- The organic formulation containing *Pseudomonas fluorescens* and *Trichoderma harzianum* has to be sprayed on the plants at regular intervals of 20 days at a dosage of 5g/ lit or 5ml/ lit.
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By following all these methods farmers can get significant increase in the yield of the crops and the cost benefit ratio will be above 1: 3.

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