



**ICAR- Indian Institute of Horticultural Research**  
Hesaraghatta Lake Post, Bengaluru - 560 089



# NEMATODE MANAGEMENT IN VEGETABLE CROPS



Sponsored by: National Bank for Agriculture and Rural Development, Bengaluru

Published by  
**Dr. M. Anandaraj,**  
Director  
IIHR, Bengaluru- 560 089

**IIHR Technical Bulletin No. : 47**

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2015

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*Printed at:*

**Navbharath Press**

No. 10, Sirur Park 'B' Street  
Seshadripuram, Bangalore - 560 020

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# Nematode management in vegetable crops

Nursery seedlings of vegetable crops produced in Karnataka and various parts of India are infested by several plant parasitic nematodes. These nematodes attack the root system of seedlings in nursery beds. Galling of the roots and stunted growth of roots as well as seedlings are the manifestations of nematode damage in the nursery beds. Nematodes such as *Meloidogyne incognita*, *M. javanica* (root-knot nematodes), *Rotylenchulus reniformis* (reniform nematode), *Heterodera sp.*, (cyst nematodes) are important among the nematodes attacking seedlings of horticultural crops in nursery beds.

## Management of nematodes in the nursery beds

Securing healthy seedlings of any crop from the nursery beds is essential to ensure optimum plant population stand, good growth of the crop and higher yields. If nursery beds harbor heavy populations of nematodes, it results in very weak seedlings with poor root growth. Seedlings with stunted root system cannot establish well after transplanting. Nematode attack on the root system makes the seedlings weak and also vulnerable for the infection by secondary pathogens (soil borne fungi and bacteria). Nematodes damage also results in breakdown of the resistance against pathogenic fungi and bacteria. Further, nematode infected nursery seedlings facilitate the spread of the nematodes in the main fields making the problem more difficult to manage in a larger area. Hence it is inevitable to manage the nematodes in the nursery beds. Almost all the horticultural crops are attacked by either one or more of the above mentioned nematodes.

## MANAGEMENT METHODS

**Methods for producing disease free seedlings under poly-house or shade net (protected) conditions**

### METHODS OF TREATMENTS

#### 1. Seed treatment

- *Pseudomonas fluorescens* and/ or *Trichoderma harzianum* can be used as seed treatment or seed dressing agent.

Seed treatment with biocontrol agents



- Dosage – 15 to 20 grams of talc formulation of *P. fluorescens* and/ or *T. harzianum* /kg of seed.

## 2. Substrate treatment

### A. Coco-peat

Coco-peat or any substrate prepared by mixing Neem cake @ 50kg + carbofuran or phorate @ 5Kg + *Trichoderma harzianum* + *Pseudomonas fluorescens* each at the rate of 2 kg /ton, can be used for producing the seedlings of horticultural crops especially vegetable crops such as tomato, egg plant, capsicum, cauliflower, cabbage, chilies, onion.



A B C

**A - Biopesticide treated, B - Control, C-Biopesticide treated**

*Substrate (coco-peat) treatment and seedling grown by treating seeds and substrate with the formulations of bio-agents*

### Methods for producing the seedlings of vegetable crops in raised nursery beds in open field conditions.

- Apply Neem cake or Pongamia cake or Castor cake @ 500g/sq.m followed by solarization of the nursery beds and leave the raised nursery beds for a period of 20 days.



- Apply carbofuran or phorate @ 50g/sq.m in case where the nematode densities are higher
- Apply formulations of *T. harzianum* / *Pseudomonas fluorescens* and *Paecilomyces lilacinus* (each 50g/sq.m) to the nursery beds along with above mentioned botanicals or chemicals.

After addition of above nursery beds have to be watered at 4 days interval for proper decomposition. At least 15 days are required for complete decomposition of these botanicals and hence a fortnight before sowing the seeds, nursery bed soil has to be incorporated with botanicals and bio-pesticides.

IIHR, Bengaluru has developed mass production protocols of *Pseudomonas fluorescens* 1% W. P. (an effective bio-bactericide and also has nematicidal properties), *Trichoderma harzianum* 1% W. P. & *Trichoderma viride* 1.5 % W. P. (effective bio-fungicides and also have nematicidal properties) and *Paecilomyces lilacinus* 1% W. P. & *Pochonia chlamydosporia* 1 % W. P. (effective bio-nematicides). These bio-pesticide formulations that manage nematodes in horticultural crops, are also patented.

**Patented Innovation:** Arka – Organic Plant Growth Enhancer and Yield Promoter is the bio-pesticide developed by IIHR, Bengaluru. It is an organic formulation, consists of *Pseudomonas fluorescens* and *Trichoderma harzianum*. Patents from 4 countries were granted for this innovation. United States (US) patent – No: US 7,923,005 B, Australian patent – No. AU 2007216174 B2, Indian patent - No.250779 and Thailand patent – No. 7621, (Innovators: Dr. M. S. Rao, Principal Scientist, Division of Entomology & Nematology, & Dr. N. Ramachandran, Former Principal Scientist and Head, Division of Pathology, IIHR, Bengaluru).



**Method of seed treatment with the IIHR patented organic formulation of bio-agents:**

- ✓ This formulation can be used as a seed treatment or seed dressing agent.
- ✓ Dosage – 15 to 20g of formulation/kg of seed.

## Method of substrate treatment with IHR patented formulation of bio-agents:

- ✓ This formulation can be used for treatment of coco-peat (substrate) in which seedlings are grown under shade net or protected conditions.
- ✓ Dosage – 5 to 10g of formulation/kg of coco-peat (substrate).

## Method of soil treatment in raised nursery beds with IHR patented formulation of bio-agents

- ✓ This formulation can be used for treatment of soil (substrate) in raised beds in which seedlings are grown in open field conditions.
- ✓ Dosage – 50 to 100g formulation / m<sup>2</sup>.



*Raised nursery beds enriched with IHR patented organic formulation of bio-agents*

## Management of Nematodes on vegetables in open fields

Capsicum, tomato, brinjal, chillies, cabbage, cauliflower, cucumber, carrot, okra, beans when cultivated in open field conditions also are attacked by various nematodes (root-knot nematode - *Meloidogyne incognita*) and reniform nematode – *Rotylenchulus reniformis*) and fungal or bacterial pathogens resulting in considerable losses. Use of nematode infected seedlings of transplanted vegetables produces inferior quality vegetables as the nematodes carried along with the seedlings multiply rapidly in the main field conditions. Non-transplanted vegetables such as okra, carrot, cucumber and beans sown in nematode infested fields attack their root system and multiply rapidly in the main field conditions affecting the crop productivity adversely.



Nematodes feed on root-system and damage the root-system thoroughly. Nematodes make the plant weak and also vulnerable for the infection by secondary pathogens (soil borne pathogenic fungi and bacteria). Nematode damage also results into the breakdown of the resistance against pathogenic fungi and bacteria. Nematodes along with these pathogens can cause loss to the tune of 40 – 70% in these crops.

**Nematode management Solutions:**

Research conducted at ICAR- Indian Institute of Horticultural Research, Bengaluru for the last 15 years to come out with an alternative technology for chemical pesticides, which are costly and are also hazardous to human health and environment, resulted in developing the technology of management of nematodes using various bio-pesticides.

Protocols for mass production of *Pseudomonas fluorescens* 1% W. P. (an effective bio-bactericide and also has nematicidal properties), *Trichoderma harzianum* 1% W. P. & *Trichoderma viride* 1.5 % W. P. (effective bio-fungicides and also have nematicidal properties), and *Paecilomyces lilacinus* 1% W. P. & *Pochonia chlamydosporia* 1 % W. P. (effective bio- nematocides) have also been developed by Dr. M. S. Rao. The technology of production of these effective and eco-friendly products have been patented.



**Nematode problems in capsicum**

**Success story of Nematode Management in chillies (Anaheim type) and capsicum using bio-pesticides**



## Success story of Nematode Management in Tomato using bio-pesticides



## Success story of Nematode Management in Cauliflower & Brinjal using bio-pesticides



## Success story of Nematode Management in Cucumber using bio-pesticides



### Methods of management of nematodes in the main field:

#### Step 1: Soil application.

Land should be thoroughly ploughed and soil should be brought to fine tilth. Beds are to be prepared after bringing the soil to fine tilth. Add recommended doses of fertilizers. Also add carbofuran or phorate @ 20 – 25 kg + 200g neem/ pongamia/ mahua cake per acre. Maintain optimum moisture in the beds for proper decomposition of neem/ pongamia/ mahua cake.

For organic farming, apply two tons of FYM or 500 kg of neem cake / pongamia cake or one ton of vermi-compost enriched with *Pseudomonas fluorescens* +



*Trichoderma harzianum* + *Paecilomyces lilacinus* during the land preparation or on the beds 5 – 10 days before sowing seeds or transplanting the seedlings.

### **Process of Enrichment of FYM**

- One ton of well decomposed FYM has to be enriched by mixing with 2 kg each of *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus* formulation under shade. 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 FYM for maximum multiplication of and homogenous spread of the microorganisms in the entire lot of FYM.

### **Process of Enrichment of Neem cake**

- 1 ton of neem cake has to be enriched by mixing with 2 kg each of IIHR patented *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 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 each of IIHR patented *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 and homogenous spread of the microorganisms in the entire lot of vermicompost.

### **Step 2: Spraying:**

The IIHR patented organic formulation containing *Pseudomonas fluorescens* & *Trichoderma harzianum* has to be sprayed on the plants at regular intervals of 30 days at a dosage of 5g/ lit or 5ml/ lit.

### **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 30 days.

### **Application of the bio-pesticides to a standing crop**

It is possible that farmers would not have prepared beds or main field initially as mentioned above and still 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 two tons of FYM or 500 kg of neem cake / pongamia cake or one ton of vermicompost enriched with *Pseudomonas fluorescens* + *Trichoderma harzianum* + *Paecilomyces lilacinus* on the beds around the rhizosphere of the plants.

### **Step 2: Spraying:**

The IIHR patented organic formulation containing *Pseudomonas fluorescens* & *Trichoderma harzianum* has to be sprayed on the plants at regular intervals of 30 days at a dosage of 5g/lit or 5ml/lit.

### **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 30 days.

- **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.**

For products or technologies of bio-pesticides – *Pseudomonas fluorescens* 1% W.P., *Trichoderma harzianum* 1% W. P., *Trichoderma viride* 1.5% W. P., *Paecilomyces lilacinus* 1% W. P., *Pochonia chlamydosporia* 1% W. P. and product of patented technology and patented organic formulation please contact:

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