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ORIGINAL PAPER

Bio Management of Root knot Nematodes in Vegetables

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INTRODUCTION

Root knot nematodes are severe damaging pests in Vegetable crops. In overall Plant-parasitic nematodes cause 21.3 per cent crop losses amounting to Rs. 102,039.79 million (1.58 billion USD) annually in different crops. In India in Horticultural crops monetary loss due to nematodes is Rs. 50,224.98 million with yield loss 23.03 per cent annually. In Vegetable crops due to plant parasitic nematodes monetary losses amounting to Rs.14461.22 million with 19.6 per cent yield losses In Protected cultivation, an overall average annual yield loss in major horticultural crops due to nematodes goes up to 60% (Kumar *et al.*, 2020). Root-knot nematodes (Meloidogyne spp.) are the most frequently observed and 34 damaging plant-parasitic nematodes in vegetable production. Root-knot nematodes are obligate sedentary endo parasites, that induce the formation of giant cells in the roots, from which the nematode feed to complete its life cycle (Baldacci-Cresp *et al.,* 2015). The availability of water and nutrients to the plant decreases while the giant cells are located close to the root systems xylem and phloem. As the giant cells are located close to the xylem and phloem, availability of water and nutrients to the plant decreases (Siddiqui *et al.,* 2014). Hence, for managing Root knot nematodes, Integrated Nematode Management (INM) is better approach. Among them, biological management of Root knot nematodes is can be achieved by inoculation with effective antagonists. Biological management of Root knot nematodes main aims to manipulate the parasites, predators and pathogens of nematodes in the rhizosphere in order to control the plant parasitic nematodes.

BIOLOGICAL CONTROL -ANTAGONISTS

Antagonists are colonizing in the soil and remain active (inoculation strategy). Effective biological antagonists are generally belonging to the 1. Fungi and 2. Bacteria group. These antagonists feed or parasitize the nematodes or release secondary metabolites which are having nematicidal activity.

1. Fungal antagonists

This group categorized into three groups based on their mode of action. The detailed information furnished in below-

1.1. Nematode trapping fungi

Fungal antagonists *viz.*, *Arthrobotrys spp. and Monacrosporium* spp. are trap nematodes in constricting rings and adhesive nets respectively. Their predation mechanism involves the association between a lectin secreted by the fungus and a carbohydrate secreted by the nematode cuticle. However, their predation is specific to certain nematode species and restricted availability of these antagonists in soil limits their potential use. (Manjunatha T. *et al.*, 2014)

1.2 Egg parasites

Paecilomyces lilacinus 1% W. P. *and Pochonia chlamydosporia* 1 % W. P. are effective bionematicides. *P. lilacinus* and *P. chlamydosporia* are the potential fungal antagonists successfully control by parasitizing eggs and females of root knot nematode. (IIHR, Bengaluru)

1.3 Toxin producing fungi

Aspergillus spp. (*Aspergillus niger, Aspergillus fumigates, Aspergillus terreus*), *Trichoderma* spp. (*Trichoderma viride, Trichoderma harzianum*) *Rhizoctonia bataticola*, *Alternaria alternata*, *Aspergillus flavus*, *Penicillium chrysogenum*, produce toxin which act as antagonists against plant parasitic nematodes. Most prominently the filamentous fungi, *Trichoderma harzianum1% W. P. & Trichoderma viride 1.5 % W. P* strains commercially used for the management of root knot nematodes infesting vegetable crops and the effective bio-fungicides. (IIHR, Bengaluru)

2. Bacterial antagonists

This group categorized in to two major groups viz., Nematode parasites (*Pasteuria penetrans*) and Nematode antagonistic rhizobacteria (Plant growth promoting rhizobacteria).

2.1. *Pasteuria penetrans:* It is obligate parasite produces adhesive endospore which inhibits reproduction activity in the root knot nematode.

2.2 Nematode antagonistic rhizobacteria: Plant Growth Promoting Rhizobacteria (PGPR) having four multiple mode of actions such as i. competition ii. Antibiosis iii. plant growth promotion and iv. induction of systemic resistance against, plant parasitic nematodes including root knot nematodes, fungal and bacterial pathogens infecting a

wide range of host plant species. *Pseudomonas fluorescens* 1% W. P. an effective bio bactericide and also has nematicidal properties.

MODE OF APPLICATION BIO AGENTS

1. **Method of seed treatment with bio-agents:**

Formulation can be used as a seed treatment or seed dressing agent. Dosage – 15 to 20 grams of formulation /kg of seed.

2. **Method of substrate treatment with bio-agents**

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

3. **Enrichment process:**

One ton of Neem cake/ Vermicompost/ 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 -21 days.

4. **Seed treatment** - 15 to 20 g of formulation /kg of seed.

5. **Nursery treatment**: For transplanted vegetable crops such as tomato, brinjal and chilli, nursery beds treated with antagonists (*Trichoderma harzianum*, *Paecilomyces lilacinus* or *Pseudomonas fluorescens*) @ 50g/m^2 area.

6. **Substrate treatment** - 5 to 10 g of formulation/kg of coco-peat (substrate). iii. Preparation of beds: Bio-pesticides enriched FYM@ 5kg/sq.m + bio-pesticides enriched neemcake @ 250g/sq.m or bio-pesticides enriched vermicompost @ 1kg have to be mixed in top 12 cm of soil in the beds.

7. **Spraying, drenching/ drip irrigation**: Formulation sprayed on the plants, applied through drip / by drenching at regular intervals at a dosage of 5g/ lit.

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