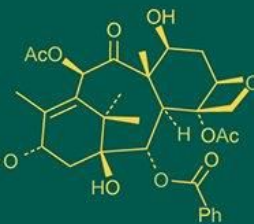


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Biomangement of *Meloidogyne incognita* in elephant foot yam

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Abstract

Elephant foot yam (EFY) (*Amorphophallus paeoniifolius*) is one of the major tuber crop grown in India particularly in Andhra Pradesh State in an area of 4,607 Ha with productivity of 45-50 t/ha. This tuber is mainly used as a vegetable and also for medicinal purpose. Due to the continuous supply of fertilizers and irrigation for entire crop growth period it is effected with several pests and diseases including parasitic nematodes which affects the tuber yields significantly by forming galls which later makes the tubers decay due disease complex and becomes unfit for consumption or for seed purpose . These parasitic nematodes alone or with causing disease complex may cause yield reduction significantly up to 10-40%. In view of this, a research experiment was conducted during 2019-2021 with seven treatments and three replications with RBD at Dr. YSRHU-HRS, Kovvur, to find out the best effective bio management practice against parasitic nematode since this crop is used as vegetable as a whole and also to revalidate the efficacy of Carbofuran 3G against the nematode management. The research experiments results reveals that, out of seven treatments, soil application of neem cake @ 1.5 t/h + FYM @ 500 kg/ha + planting treated seed tuber with *Trichoderma viride* (dipping tubers for 15 mins) + soil application of microbial consortium (*T. viride*-1 kg + *Pseudomonas fluorescens* 1 kg + *Paecilomyces lilacinus* 1 kg enriched on FYM (1.5 ton) at the time of planting @ 100g/plant) and again at 90 days DAP @ 150g/plant recorded the lowest nematode load of 15.1 J2/200 cc soil and 2.3 females/5 g root tissue with highest yield of 45.55 t/ha compared to control with 317 J2/200 cc soil & 20.5 females per 5 g root tissue with yield of 13.33 t/ha. The chemical management *i.e.*, application of Carbofuran 3G is also effective in managing the parasitic nematode with recording final nematode population of 19.8 J2/200 & 7.3 females/5 g which also can be considered as an alternative to the biomangement. With these results, the parasitic nematodes in elephant foot yam can be effectively managed in a safer, sustainable manner by adopting bio management practices.

Keywords: Parasitic nematodes, biomangement, elephant foot yam, Mustard, *Paecilomyces lilacinus*, *Trichoderma viride* and *Pseudomonas fluorescens*

Introduction

Elephant foot yam (*Amorphophallus paeoniifolius*) is one of the important staple food crop grown in India in an area of 40,000 Ha with production of 9.7 MT with an average yield of 28 MT/Ha (Horticultural statistics at a glance, 2024). In India, Andhra Pradesh is one of the major tuber-cultivating state with an area of 5000 Ha with production of 3 MT, particularly in Guntur, Krishna, East Godavari, West Godavari, Chittoor, Vizianagaram and Srikakulam districts. This crop is mainly planted during the second fortnight of February-April and is well grown under irrigated conditions.

Nowadays, Horticulture crops are more affected with various biotic agents out of which plant parasitic nematode is one of the important pathogen causing yield reduction significantly & even causing total failure of the crop too (Jones *et al.*, 2013) ^[4]. These Plant parasitic nematodes mostly feed on underground plant tissues, such as roots, rhizomes, tubers, bulbs and express symptoms on the aerial parts which are often confused with those of other biotic or abiotic agents (Perry *et al.*, 2009) ^[6]. Parasitic nematode such as *Meloidogyne* spp. and *Pratylenchus* spp are highly polyphagous in nature, which can infect many species of plants (Jones *et al.*, 2013) ^[4]. Thirteen genera of plant parasitic nematodes have been reported from banana in East Godavari, West Godavari, Guntur and Nellore districts of Andhra Pradesh. Root knot nematode incidence is been identified in Elephant foot yam, Colocasia, and sweet potato in growing areas of Andhra Pradesh by forming galls and lesions, the chief

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characteristic symptom of Parasitic nematode incidence (Byju *et al.*, 2025) [2]. The present management for root-knot nematodes is by using pesticides which are non-specific, highly toxic and expensive. In view of this, a research experiment on biomanagement of parasitic nematodes was carried out during the year 2019-21 for effective control of parasitic nematodes, which is effective, less expensive, safe for humans and sustainable.

Materials and Methods

The research trial was carried out in a Randomized Block Design (RBD) with 7 treatments and 3 replications. Cultivar Gajendra is planted with a spacing of 60 × 45 cm and was given a regular dosage of fertilizer and irrigation to its capacity as per the local agronomical conditions. The field selected for this research trial, is been habituated with this crop for the last 5 years and was observed with the incidence of *Meloidogyne* spp with symptoms such as yellowing, wilting, followed by galls and lesions on tubers. Initial nematode population (INM) and at every three months interval in soil analysis was estimated for 200 cc of soil and in the root tuber @ 5 g/root tissue after crop harvesting. Microbial consortium {*Trichoderma* spp @ 1 kg + *Pseudomonas fluorescens* @ 1 kg + *Paecilomyces lilacinus* @ 1 kg enriched on FYM (1.5 t/ha) + Neem cake (10 kg)} was applied @ 100 g per plant at the basal portion and again second time after 90 days of planting. The initial and final nematode population (INM & FNP) was estimated

with modified Baermann funnel technique and detection of sedentary endoparasitic nematode per 5 g. root tissue was with root staining technique.

Statistical analysis was carried out using RBD. The data was statistically analyzed (Gomez and Gomez, 1984) using the GENSTAT statistical package (version 13.0). The data was subjected to angular transformation wherever necessary. Data were subjected to analysis of variance (ANOVA) at significant levels ($p < 0.05$), and treatment means were compared by critical differences (CD).

Results and Discussion

Out of the seven treatments evaluated, the treatment i.e., soil application of neem cake @ 1 t/ha + FYM 2 t/ha + tuber treatment with *Trichoderma viride* (dipping tubers for 15 mins) + Soil application of microbial consortium @ 100 gm/per plant and again 150gm after 90 days after planting + Raising Indian mustard crop upto flowering stage and incorporating the same into the main field has recorded the lowest nematode load of 15.1/200 cc soil and 2.3/5 g. root tissue with highest yield of 45.5 t/ha compared to local control of 317 J2/200cc soil and 20.5 females/5 g root tissue with yield of 13.3 t/ha (Table 1). Soil application of Carbofuran 3G @ 20 Kg/ha under chemical management is also very effective in reducing the parasitic nematode load with 19.8 J2/200 cc soil along with 7.3 females per 5 g root tissue by giving higher yields 44.00 t/ha similar trend was observed during 2020-21.

Table 1: Impact of soil amendments and bio-agents on nematode incidence and yield of elephant foot yam

S. No	Treatments INP-18 J2/200CC soil	Nematode load (J2 per 200 cc soil/ 5 g Root tissue)		Yield (t/ha)	
		2019-20	20-21	19-20	20-21
1	Soil application of neem cake @ 1.5 t/h + FYM @ 2/ha + seed treatment with <i>Trichoderma viride</i> (dipping tubers for 15 minutes)	121/16.1	112.3/16.1	42.79	42.66
2	Soil application of microbial consortium (<i>T.viride</i> -1 kgs + <i>Pseudomonas</i> Spp-1 kg + <i>Paecilomyces lilacinus</i> -1 kg, enriched on FYM & Neem cake @ 100 g/plant at planting and second time at 90days of planting @ 100g/plant.	98.1/12.3	77.3/14.2	42.88	40
3	Raising Indian mustard crop up to flowering stage and incorporating the same into the main field.	116.3/11.3	111.3/15.1	42.22	37.33
4	T1 +T3	113.8/10.9	119.9/12.9	39.55	30.33
5	T1+T2+T3	15.1/2.3	16.2/1.98	45.55	46.17
6	Soil application of Carbofuran 3G @ 20 Kg/ha	19.8/7.3	10.9/4.9	44.00	43.33
7	Control	317/20.5	270.09/14.9	13.33	23.00
	CD(>0.005)	5.11	4.9	2.33	NS
	SE(m)	2.18	1.19	6.89	3.8

The present results clearly indicates that, integrated nematode management approach involving organic amendments, biological agents along with raising non host crops such as Indian mustard significantly reduced nematode populations and has improved yields significantly compared to the control. Soil application of neem cake (1.5 t ha⁻¹) along with FYM (500 kg ha⁻¹) played a crucial role in suppressing nematode populations by releasing nematicidal compounds such as Azadirachtin, ammonia, and fatty acids during decomposition, while simultaneously enhancing soil microbial activity and nutrient availability (Akhtar & Malik, 2000; Stirling, 2014) [1, 9].

Tuber treatment with *Trichoderma viride* through dipping for 15 minutes provided early protection against nematode invasion by rapid colonization of the rhizosphere and induction of plant defense mechanisms. *Trichoderma* spp. are known to parasitize nematode eggs and juveniles and

also produce secondary metabolites that inhibit nematode development (Rao & Reddy, 2011) [7]. The periodic soil application of a microbial consortium consisting of *T. viride*, *Pseudomonas* spp., and *Paecilomyces lilacinus*, enriched with FYM and neem cake, ensured sustained antagonistic pressure on nematodes throughout the cropping period.

Among the consortium components, *Pseudomonas* spp. contributes to nematode suppression through the production of antibiotics, hydrogen cyanide, and siderophores, which interfere with nematode survival and reproduction (Siddiqui & Mahmood, 1999) [8]. *Paecilomyces lilacinus* is a well-known egg-parasitic fungus that effectively reduces egg viability and hatch of root-knot and lesion nematodes, thereby lowering nematode multiplication rates in soil and roots (Stirling, 2014) [9].

In addition, raising Indian mustard as a trap/biofumigation crop and incorporating it at the flowering stage significantly

contributed to nematode suppression. Mustard residues release glucosinolates and their hydrolysis products such as isothiocyanates, which are toxic to plant-parasitic nematodes and reduce soil nematode populations (Kankam *et al.*, 2015) [5]. The combined effect of organic amendments, bioagents, and biofumigation created a biologically suppressive soil environment unfavorable for nematode survival and multiplication. These findings corroborate earlier reports that integrated use of organic amendments and biological agents not only suppress nematode populations but also enhance crop productivity in a sustainable and eco-friendly manner (Akhtar & Malik, 2000; Rao & Reddy, 2011) [1, 7].



Fig 1: Experimental field view of the Elephant foot yam



Fig 2: Healthy Elephant foot yam tubers

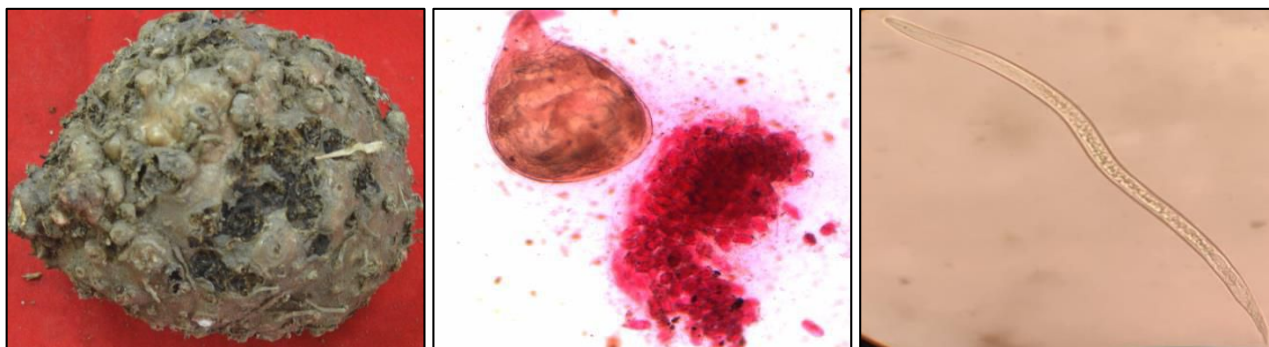


Fig 3: Nematode (*Meloidogyne incognita*) infested tuber.

Conclusion

The present study conclusively demonstrates that integrated biomanagement practices are highly effective in suppressing *Meloidogyne incognita* populations and enhancing productivity of elephant foot yam under field conditions. The combined application of neem cake, FYM, *Trichoderma viride* tuber treatment, periodic soil application of a microbial consortium (*T. viride*, *Pseudomonas fluorescens* and *Paecilomyces lilacinus*), along with biofumigation through Indian mustard incorporation, resulted in the lowest nematode population in both soil (5.1 J2/200 cc) and root tissue (3.3 J2/5 g) and achieved the highest tuber yield (45.3 t ha⁻¹) over two seasons. Compared to the untreated control, which recorded very high nematode incidence and poor yield, this integrated approach proved superior even to chemical control, highlighting its sustainability and safety. The results clearly indicate that ecologically sound nematode management strategies can effectively replace chemical nematicides, improve soil health, and ensure stable yields in elephant foot yam cultivation. Hence, this integrated biomanagement module

can be recommended as a farmer-friendly, cost-effective, and environmentally safe strategy for managing root-knot nematodes in elephant foot yam-growing regions.

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Authors Declaration

The author and co-authors declare that they have no potential conflict of interest that could have appeared to influence the work reported in this paper.

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