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Effect of Compost Along with Bio Agents on Root Knot Nematode (*Meloidogyne spp*.) in Okra (*Abelmoschus esculentus* L., Walp)

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Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

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ABSTRACT

Okra [*Abelmoschus esculentus* L., Moench] a native of South-Africa and commonly known as 'Bhindi' is an annual malvaceous vegetable crop, especially grown in tropical and subtropical climates. It is also called "perfect villager's vegetable". Root-knot nematodes are considered among the top five major plant pathogens and the first among the ten most important genera of plant parasitic nematodes in the world. Amongst nematodes, root-knot nematode (*Meloidogyne incognita* and *Meloidogyne javanica)* causes severe damage to okra. *Trichoderma viride, Pseudomonas fluorescene* and *Rhizobium* were tested under field conditions during Rabi 2020-2021 for their efficacy against the Root knot nematode and growth & nematode population.

Keywords: Meloidogyne incognita; pseudomonas fluorescence; rhizobium; root-knot nematode of okra; trichoderma viride.

1. INTRODUCTION

Okra [*Abelmoschus esculentus* L. Moench] a native of South- Africa and commonly known as 'Bhindi' is an annual malvaceous vegetable crop, especially grown in tropical and subtropical climates [1]. India ranks first in the world with 3.5 million tonnes (70% of the total world production)

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of okra produced from over 0.35-million-hectare land[2]. In India, total grown in an area of 511 hectare having total production of 6219 million tons with the productivity of 12.0 million tons per hectare[3]. Dry seed contains 13-22% edible oi; and 2024% protein [4]. The production of okra also suffers from several pests (fruit borer, white flies, jassids, thrips, mites etc.) and pathogens (yellow vein mosaic, powdery mildew, root rot etc.) including nematodes [5]. Plant parasitic nematodes viz. *Meloidogyne incognita, Meloidogyne javanica, Rotylenchulus* spp., *Tylenchorhynchus* spp., *Hoplolaimus* spp., *Aphelenhusavenae, Nothotylenchus* spp., *Helicotylenchus* spp., *Hemicriconemoides* spp., *Longidorus* spp., *Paralongidorus* spp., *Trichodorus* spp., *Paratrichodorus* spp., *Ditylenchus* spp., *Tylenchus* spp., *Rotylenchulus* spp., *and Xiphinema* spp, were found associated with okra in India [6]. Root-knot nematode (*Meloidogyne incognita* and *Meloidogyne javanica*) causes severe damage to okra [7].

Severe attack of root-knot disease caused by *Meloidogyne* spp [8]. On okra and yield losses up to 27% [9]. Rootknot nematodes (RKN) are sedentary endo-parasite and is among the most damaging agricultural pests, attacking a wide range of crops [10].

The suppressive effect of botanicals amendment on soil phyto-nematode populations is largely variable and scarcely predictable, as depending on starting raw materials, type of composting process and the maturity of final product incorporated into the soil. Keeping inview the following objectives were taken:

- Effect of treatments on the number of Root Knot nematode in the roots of Okra.
- Effect of treatments on the Plant growth parameters of Okra.

2. MATERIALS AND METHODS

Keeping in view, the experiment was conducted in nematode infested soil at the courtyard of Department of Plant Pathology, SHUATS, Prayagraj, Uttar Pradesh during *Rabi* season in the year 2020-2021. The soil sample was collected from the infested field and processed in laboratory by following cobbs decanting and sieving technique followed by modified Baermann funnel technique to estimate the nematode population. Before laying out the experiment it was assured that the experimental field possess 2 larvae/gm of soil.

The selected field was dug up and the soil become pulverized and then whole location was divided into sub-plots and specified in randomized block design with six treatments *viz*., vermi compost @ 8 t/ha, spent mushroom compost @ 8 t/ha was used as basal application. These were incorporated into the soil by forming specific ridges according to the crop spacing and covered by thin layer of soil. The field was irrigated for fifteen days at regular intervals to enhance decomposition process. After fifteen days, seed treatment was done with *Trichoderma* @10gm/kg, *Pseudomonas* @10gm/kg, *Rhizobium*@5gm/kg of seed where, vermi compost and spent mushroom compost was incorporated initially. Each treatment was replicated four times with plot size of 2.5 × 1 m^2 each and local variety seed was sown with a spacing of 45 × 30 cm. Root knots in the root system and plant growth parameters of okra was recorded at 30, 45, 60 days after sowing of the crop. The records have been subjected to th3e statistical analysis.

At 60 days after sowing the root knots in the roots of okra are identified. The galled roots were removed and washed thoroughly with sterile water. a gall is placed on the sterile slide using sterile forceps and teared using a sterile needle and examined under microscope. Eggs and female Meloidogyne were identified when observed under microscope. Mature females are swollen, melon like with elongate neck at anterior end, forms perineal patterns, short stylet with well-developed basal knobs, eggs laid in gelatinous matrix outside the body, tail absent. Males are vermiform, 1.5-2.0 mm long, basal knobs; oesophageal glands overlap intestine ventrally; tail elongate conoid with pointed tip.

3. RESULTS

The result presented in table 1 revealed that all the treatments were statistically significant and decreased the number of root knots in the roots of okra as compared to control. Among the bio agents used, the treatment T6- Vermicompost + SMC+ *Trichoderma* spp.+ *Pseudomonas* spp.+ *Rhizobium* (17) significantly decreased the root knots in the root system (57) in okra when compared to other bio agents. The treatments (T_6, T_4), (T_2, T_5) and (T_1, T_3) are not significantly differ from each other.

Table 1. Effect of compost along with bio-agents on the number of root knot nematodes on the roots of okra at 60 DAS

Tr no.	Treatments	Number of root knots
T0	Control+ Vermicompost+ SMC	57
T1	Vermicompost+ SMC+ *Trichoderma* spp.	50
T2	Vermicompost + SMC+ *Pseudomonas* spp	31
T3	Vermicompost+ SMC+ *Rhizobium*	51
T4	Vermicompost + SMC+ *Trichoderma* spp.+ *Pseudomonas* spp.	26
T5	Vermicompost + SMC+ *Trichoderma* spp.+ *Rhizobium*	34
T6	Vermicompost+ SMC+ *Trichoderma* spp.+ *Pseudomonas* spp.+ *Rhizobium*	17
	F- test	S
	S. E. (d) ±	1.91
	C. D. (5%)	3.93

Plate 1. Root knots in the root system of okra at 60 days after sowing

Plate 2. Root knots of T0 and T6 in the root system of okra at 60 days after sowing

Table 2. Effect of bio agents along with bio agents on plant growth parameters of okra

Treatments	Plant height (cm)	Root length (cm)	Root weight (gm)
T0	25.13	10.12	10.25
T1	35.27	11.50	9.65
T2	41.85	12.62	8.93
T3	32.35	11	9.90
T4	44.45	13.35	8.43
T5	38.35	12.20	9.13
T6	51.50	13.70	8.25
F-test	S	S	S
S. E (d) ±	0.75	0.29	0.40
C.D. (5%)	1.58	0.60	0.84

The result presented in table 2 revealed that all the treatments were statistically significant and increased the plant growth parameters of okra. Among the Bio agents, the treatment T_6- Vermicompost + SMC + *Trichoderma* spp. + *Pseudomonas* spp. + *Rhizobium* (19.01cm) significantly increased the plant height of okra. Among the Bio agents the treatments (T_6,T_4), (T_2,T_4), (T_2,T_5) and (T_1,T_5) found non-significant to each other. The treatment T6- Vermicompost + SMC + *Trichoderma* spp. + *Pseudomonas* spp. + *Rhizobium* (37.20 cm) significantly increased the plant height of okra. Among the Bio agents the treatment (T_1,T_3) found non-significant to each other. The treatmentT6- Vermicompost + SMC + *Trichoderma* spp. + *Pseudomonas* spp. + *Rhizobium* (51.50 cm) significantly increased the plant height of okra. Among the treatments (T_6, T_4), (T_2,T_4), (T_2,T_5) and (T_1,T_5) found non-significant to each other.

The result presented in table 2 revealed that all the treatments were statistically significant and decreased the root weight of cowpea as compare to control. The treatments T6- Vermicompost + SMC + *Trichoderma* spp.+ *Pseudomonas* spp.+ *Rhizobium* (8.25 gm) significantly decreased the root weight due to the less number of root knots in root system of okra The treatments (T_3,T_1), (T_3,T_1,T_5), (T_1,T_5,T_2), (T_5, T_2, T_4) and (T_2, T_4,T_6) found non-significant to each other. Highest root weight was recorded in control T0- (10.25 gm) due to higher number of root knots in the root system of cowpea. The present investigation indicates that Vermicompost + SMC + *Trichoderma* spp.+ *Pseudomonas* spp.+ *Rhizobium* into the soil used as an effective treatment for root knot nematodes and to develop eco-friendly strategy for the management of root knot nematodes of okra.

4. DISCUSSION

Probable reason for such finding may be due to the inhibitory impact of bio agents because of the nemato-toxic compounds present in the bio agents which help to reduce the severity of the nematodes in the soil and plants [11]. Application of Trichoderma had a significant effect on root knot nematode population and found toxic to *Meloidogyne* spp. due to Myco-parasitism mechanisms involved in the antagonisms of *Trichoderma*.

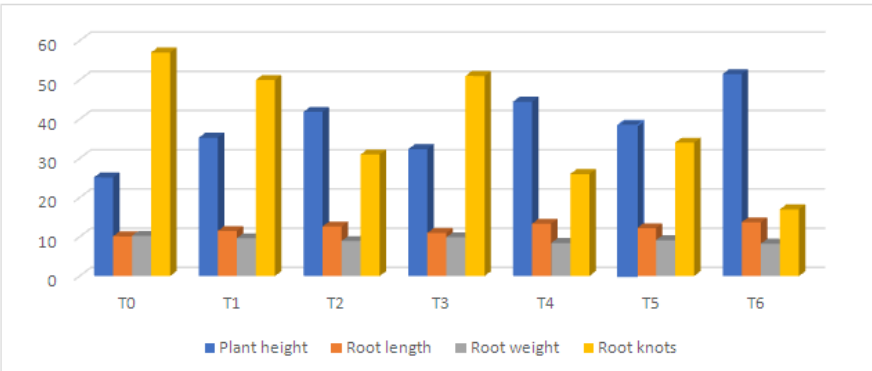

Fig. 1. Effect of bio agents along with bio agents on plant growth parameters of okra

Bio-agents like *Trichoderma* possess many qualities and they have great potential use in agriculture such as amend abiotic stresses, improving physiological response to stresses, alleviating uptake of nutrients in plants, enhancing nitrogen-use efficiency in different crops, and assisting to improve photosynthetic efficiency. Myco-parasitism is one of the main mechanisms involved in the antagonisms of *Trichoderma* as a bio-control agent. The process apparently includes, chemotropic growth of *Trichoderma*, recognition of the host by the myco- parasites, secretion of extra cellular enzymes, penetrations of the hyphae and lysis of the host. *Pseudomonas* embodies an attractive bio-control agent because of their catabolic adaptability, their outstanding root-colonizing abilities, and their capacity to produce a wide range of antifungal metabolites. Among various *Pseudomonas* species, fluorescent *Pseudomonas* has received particular attention as biocontrol agent of choice. *Pseudomonas* exerts its biocontrol activity through direct antagonism of phytopathogens and induction of disease resistance in the host. *Rhizobium* has bio control efficency against root knot nematode. *Rhizobium* inhibits the growth of the nematodes by suppressing infection caused by root knot nematode

5. CONCLUSION

In the present study on the basis of observation, it was found that for managing the root knots in the root system of okra, Vermicompost + SMC+ *Trichoderma* spp.+ *Pseudomonas* spp.+ *Rhizobium* (17) was significant in comparison to control (57). Hence from present study it can be concluded that Vermicompost + SMC+ *Trichoderma* spp.+ *Pseudomonas* spp.+ *Rhizobium* can be used effectively to reduce the root knots and to increase the plant growth of okra.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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