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Evaluation of organic composts on root-knot nematode (*Meloidogyne incognita*) of okra (*Abelmoschus esculentus* L.)

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Abstract
The present study was carried out in nematode infested soil at the experimentation field of the Court yard of Department of Plant Pathology, SHUATS in a randomized block design (RBD) during *Kharif season* 2021 to evaluate the different organic composts, T_1-spent mushroom compost + FYM, T_2- Vermicompost + FYM, T_3-Neem cake + FYM, T_4-Spent mushroom compost + Vermicompost + FYM, T_5-Vermicompost + Neem cake + FYM, T_6 - Spent mushroom compost + Vermicompost + Neem cake + FYM was used as basal application along with untreated control. The result revealed that T_6 - Vermicompost + spent mushroom compost + Neem cake + FYM plant height (cm), Root length (cm), Root weight (gm), Root knots are significantly superior. plant height (cm), at 30,60, and 90 DAS (52.13,79.66 and 95.3 cm) comparison to other treatments and the minimum Root weight (gm) was recorded at 60,75 and 90 DAS in T_6 – Vermicompost + spent mushroom compost + Neem cake + FYM (5.7,8.17 and 11.35 gm) as compared to other treatments. The maximum Root length (cm) was recorded at 60,75 and 90 DAS in T_6 Vermicompost + spent mushroom compost + Neem cake + FYM (18.70,20.15 and 20.36 cm) as compared to other treatments and The minimum nematode intensity was recorded at 60,75 and 90 DAS in T_6 – Vermicompost+ spent mushroom compost + Neem cake + FYM (4,16 and 56) as compared to other treatments. Thus, the use of organic compost can be exploited for the management of root knot nematode (*Meloidogyne incognita*) of okra.

Keywords: *Meloidogyne incognita*, neem cake, okra, organic compost, root-knot nematode, spent mushroom compost, vermicompost

Introduction
Okra [*Abelmoschus esculentus* (L.), Moench], also known as lady's finger, bhindi and gumbo; is a flowering plant valued for its edible fruits and belongs to the family of *malvaceae*. Okra is a nutritious and delicious vegetable, fairly rich in vitamins and minerals. (Haque *et al*., 2015) [4] The global okra production is estimated to be around 9.96 million tons, India leading with 6.18 million tons followed by Nigeria with 1.82 million tons (Ibitoye 2022) [1].

Okra is a nutritious vegetable which plays important role to meet the demand of vegetable are scanty in the market. Mature okra seeds are good sources of protein and oil (Priya singh *et al*., 2018) [5]. Its fruits have high nutritive, medicinal and industrial value and export potential. Its fruits are rich in vitamins, calcium, potassium and other mineral matters. okra contains highest amount of iodine which prevents from goiter disease and often recommended by nutritionists because it control cholesterol level and weight reduction programme. Okra is very effective is frightening against ulcers, physiological conditions and depressions. The antioxidant activity of this crop is due to presence of vitamin A, B and C that prevents the oxidant damages by free radicals also helps in lowering down the aging process (Rajesh *et al*., 2018) [2]

Root-knot nematode, *Meloidogyne incognita*, is one of the most important pests of vegetable crops, forms knots or galls in infected roots, and causes significant damage. Root knot nematodes were first reported in 1855 by Berkeley, who observed them causing damage on cucumbers. The estimated overall annual yield loss in the world's major crops to damage by plant parasitic nematodes is reported to be 12.37% and Root-knot nematode (*M. incognita*) causes severe damage to okra. The overall losses of vegetables caused by root-knot nematodes have been estimated by 50–80%. Root-knot nematodes cause severe growth reductions and formation of galls on okra**.** Root-knot nematodes are major pests of okra which can cause root galling, wilting, leaf chlorosis, plant growth stunted and reduction of photosynthetic pigments which resulting in yield reduction, reduced shelf-life and poor fruit quality. When plants uprooted, the numerous, small to very big sized galls were observed on tap roots as well as

lateral roots ultimately resulted poor development of root system. (Prajapati *et al*., 2018) [8]. The nematode infection induces extensive galling and root damage. Vegetables crops usually are among the most susceptible and worst affected by these nematodes. Root systems may be deformed, and underground organs damaged and become unmarketable. (Anwar *et al.*, 2010) [6]

Materials and Methods

The present study was carried out in nematode infested soil at the experimentation field of the Court yard of Department of Plant Pathology, Sam Higginbottom University of Agriculture, Technology and Sciences during *Kharif season* 2021.

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., T_1 = spent mushroom compost + FYM, T_2 = vermicompost + FYM, T_3 = Neem cake + FYM, T_4 = Spent mushroom compost + Vermicopost + FYM, T_5 = Vermicompost + Neem cake + FYM, T_6 = Spent mushroom compost + Vermicompost + Neem cake + FYM 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 experiment was laid out in a randomized block design with 7 treatments and 3 replications. The field was irrigated for fifteen days at regular intervals to enhance decomposition process. Each treatment was replicated four times with plot size of 2 × 1.5 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 60, 75, 90 days after sowing of the crop. The plant growth parameters i.e., Plant height (cm): Recorded from the base to the tip of the leaf at 30, 60, 90 days after sowing and at harvest in centimeter. Root Length (cm): Recorded from the base to the tip of the root at 60, 75, 90 days at harvest in centimeter. Root weight (g): Fresh and dry root weights were recorded at the time of harvest. After uprooting the plants, the root and portion of the plants were cut and dried in an oven at 60°C till the constant weight was reached and the dry weight was noted down.

Result and Discussion

Effect of treatments on plant height (cm) of okra

The data presented in table 1 reveals the effect of *Meloidogyne incognita* on plant height (cm) of okra at 30, 60 and 90 DAS under field conditions. The result indicates that T_6–Spent mushroom compost + vermicompost + Neem cake + FYM was significantly superior over all the other treatments showing maximium height at 30 DAS (52.13 cm), 60 DAS (79.66 cm) and 90 DAS (95.3 cm) Followed by T_5 - vermicompost + Neem cake + FYM. 30 DAS (49.13 cm), 60 DAS (77.46 cm) and 90 DAS (92.4 cm), Neem cake+ FYM. 30 DAS (46.73 cm), 60 DAS (74.2 cm) and 90 DAS (85.86 cm), Vermicompost + SMC+ FYM 30 DAS (44.93 cm), 60 DAS (72.4 cm) and 90 DAS (90.86 cm), Spent mushroom compost + FYM 30 DAS (44.4 cm), 60 DAS (69.13 cm) and 90 DAS (89.2 cm), Vermicompost + FYM 30 DAS (43.93 cm), 60 DAS (67.66 cm) and 90 DAS (84.53 cm), compare to control 30 DAS (42.93 cm), 60 DAS (66.46 cm) and 90 DAS (79.33 cm). The statistical analysis of data showed that all treatments were found significant over control.

Effect of treatments on Root length (cm) of okra

The data presented in table 2 reveals the effect of *Meloidogyne incognita* on Root length (cm) of okra at 60, 75 and 90 DAS under field conditions. The result indicates that T_6–Spent mushroom compost + vermicompost + Neem cake + FYM was significantly superior over all the other treatments showing maximum Root length at 60 DAS (18.70 cm), 75 DAS (20.15 cm) and 90 DAS (20.36 cm) Followed by T_5 - vermicompost + Neem cake + FYM. 60 DAS (16.42 cm), 75 DAS (16.77 cm) and 90 DAS (17.01 cm), Neem cake+ FYM. 60 DAS (14.44 cm), 75 DAS (15.01 cm) and 90 DAS (15.99 cm), Vermicompost + SMC+ FYM 60 DAS (12.90 cm), 75 DAS (14.88 cm) and 90 DAS (14.98 cm), Spent mushroom compost + FYM 60 DAS (12.99 cm), 75 DAS (14.10 cm) and 90 DAS (14.78 cm), Vermicompost+ FYM 60 DAS (11.42 cm), 75 DAS (12.74 cm) and 90 DAS (13.77 cm), compare to Control 60 DAS (9.12 cm), 75 DAS (10.13 cm) and 90 DAS (10.46 cm). The statistical analysis of data showed that all treatments were found significant over control.

Effect of treatments on Root weight (gm) of okra

The data presented in table 3 reveals the effect of *Meloidogyne incognita* on Root weight (gm) of okra at 60, 75 and 90 DAS under field conditions. The result indicates that T_6–Spent mushroom compost + vermicompost + Neem cake + FYM was significantly superior over all the other treatments showing minimum root weight at 60 DAS (5.7 gm), 75 DAS (8.17 gm) and 90 DAS (11.3 gm) Followed by T_5 - vermicompost + Neem cake + FYM. 60 DAS (5.9 gm), 75 DAS (8.35 gm) and 90 DAS (11.46 gm), Neem cake+ FYM. 60 DAS (6.2 gm), 75 DAS (8.5 gm) and 90 DAS (11.6 gm), Vermicompost + SMC+ FYM 60 DAS (6.4 gm), 75 DAS (8.66 gm) and 90 DAS (11.7 gm), Spent mushroom compost + FYM 60 DAS (6.36 gm), 75 DAS (8.82 gm) and 90 DAS (11.9 gm), Vermicompost+ FYM 60 DAS (6.5 gm), 75 DAS (9.05 gm) and 90 DAS (12 gm), compare to Control 60 DAS (7.03 gm), 75 DAS (10.48 gm) and 90 DAS (13.83 gm). The statistical analysis of data showed that all treatments were found significant over control.

Effect of treatments on Root-knots number per plant of okra

The data presented in table 4 reveals the effect of *Meloidogyne incognita* on Root-knots number per plant of okra at 60, 75 and 90 DAS under field conditions. The result indicates that T_6–Spent mushroom compost + vermicompost + Neem cake + FYM was significantly superior over all the other treatments showing minimum root-knots per root system at 60 DAS (4), 75 DAS (16) and 90 DAS (56) Followed by T_5 - vermicompost + Neem cake + FYM. 60 DAS (12), 75 DAS (27) and 90 DAS (77), Neem cake+ FYM. 60 DAS (20), 75 DAS (40) and 90 DAS (86), Vermicompost + SMC+ FYM 60 DAS (20), 75 DAS (43) and 90 DAS (92), Spent mushroom compost + FYM 60 DAS (35), 75 DAS (53) and 90 DAS (101), Vermicompost + FYM 60 DAS (40), 75 DAS (70) and 90 DAS (111), compare to Control 60 DAS (57), 75 DAS (80) and 90 DAS (121). The statistical analysis of data showed that all treatments were found significant over control.

Table 1: Effect of organic compost on plant height (cm) of okra at 30, 60 and 90 DAS

Tr. No.	Treatment details	30 DAS	60 DAS	90 DAS
T_0	Control + FYM	42.93	66.46	79.33
T_1	Spent mushroom compost + FYM	44.4	69.13	89.2
T_2	Vermicompost+ FYM	43.93	67.66	84.53
T_3	Neem cake+ FYM	46.73	74.2	85.86
T_4	Vermicompost + SMC+ FYM	44.93	72.4	90.86
T_5	Vermicompost + Neem cake+ FYM	49.13	77.46	92.4
T_6	Vermicompost + SMC + Neem cake+ FYM	52.13	79.66	95.3
F test		S	S	S
S.E(d)±		1.28	0.93	1.75
C.D(0.05)		2.80	2.03	3.23

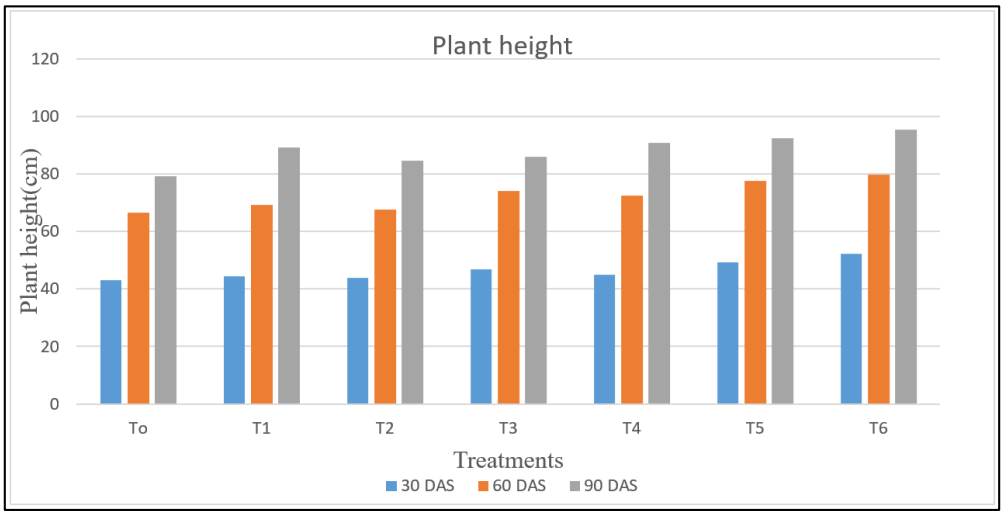

Fig 1: Effect of organic compost on plant height (cm) of okra at 30, 60 and 90 DAS

Table 2: Effect of organic compost along on Root length (cm) of okra at 60, 75 and 90 DAS

Tr. No	Treatment details	60 DAS	75 DAS	90 DAS
T_0	Control + FYM	9.12	10.13	10.46
T_1	Spent mushroom compost + FYM	12.99	14.10	14.78
T_2	Vermicompost+ FYM	11.42	12.74	13.77
T_3	Neem cake+ FYM	14.44	15.01	15.99
T_4	Vermicompost + SMC+ FYM	12.90	14.88	14.98
T_5	Vermicompost + Neem cake+ FYM	16.42	16.77	17.01
T_6	Vermicompost + SMC + Neem cake+ FYM	18.70	20.15	20.36
F- test		S	S	S
S.E(d)±		0.68	0.67	0.72
C.D (0.05)		1.43	1.42	1.36

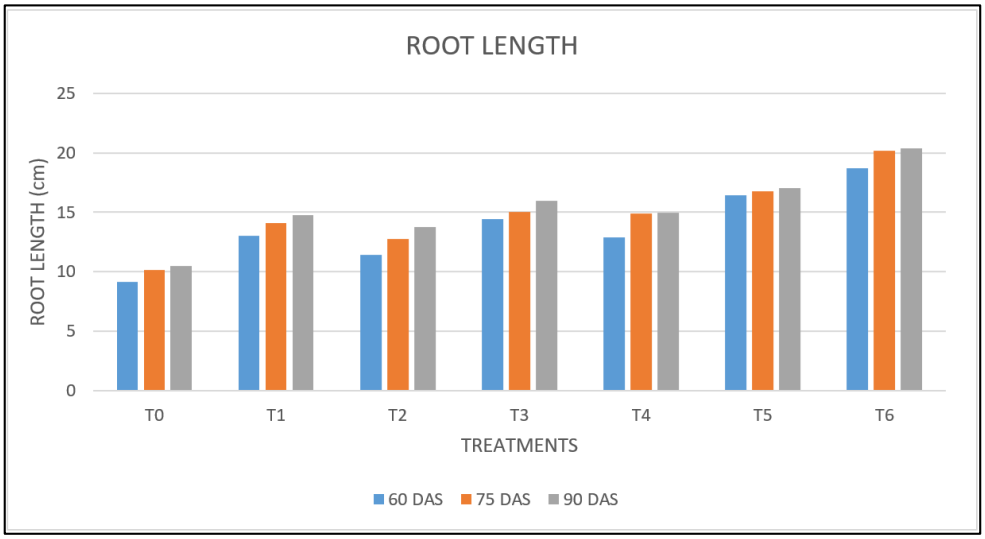

Fig 2: Effect of organic compost on plant Root length (cm) of okra at 60, 75 and 90 DAS

Table 3: Effect of organic compost along on root weight (gm) of okra at 60, 75 and 90 DAS

Tr. No	Treatment details	60 DAS	75 DAS	90 DAS
T_0	Control + FYM	7.03	10.48	13.83
T_1	Spent mushroom compost+ FYM	6.36	8.82	11.9
T_2	Vermicompost+ FYM	6.5	9.05	12
T_3	Neem cake+ FYM	6.2	8.5	11.6
T_4	Vermicompost + SMC+ FYM	6.4	8.66	11.7
T_5	Vermicompost + Neem cake+ FYM	5.9	8.35	11.46
T_6	Vermicompost + SMC + Neem cake+ FYM	5.7	8.17	11.3
F- test		S	S	S
S.E(d)±		0.21	0.32	0.27
C.D(0.05)		0.43	0.67	0.56

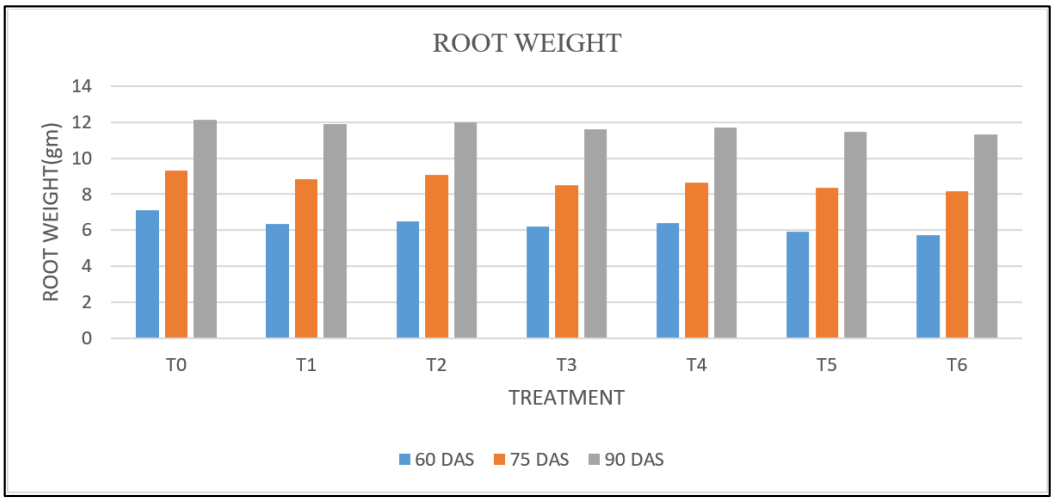

Fig 3: Effect of organic compost on root weight (gm) of okra at 60, 75 and 90 DAS

Table 4: Effect of organic compost on the number of root-knot nematode in roots of okra 60, 75 and 90 DAS.

Tr. No	Treatment details	60 DAS	75 DAS	90 DAS
T_0	Control + FYM	57	80	121
T_1	Spent mushroom compost+ FYM	35	53	101
T_2	Vermicompost+ FYM	40	70	111
T_3	Neem cake+ FYM	20	40	86
T_4	Vermicompost + SMC+ FYM	20	43	92
T_5	Vermicompost + Neem cake+ FYM	12	27	77
T_6	Vermicompost + SMC + Neem cake+ FYM	4	16	56
F-test		S	S	S
S.E(d)±		2.23	2.16	1.52
C.D(0.05)		4.85	4.70	3.30

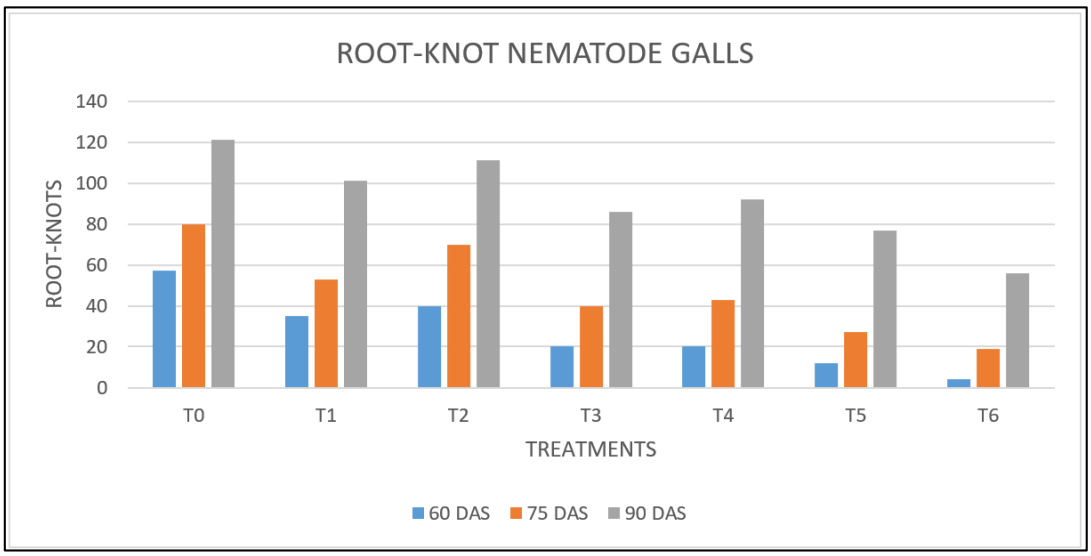

Fig 4: Effect of organic compost on the number of root-knots in roots of okra at 60, 75 and 90 DAS

Fig 1: Root-knot in Root System of okra at 60 DAS

The above findings are in agreement with (Kedarnath *et al.*, 2015) [3] who investigated that various management practices for their efficiency against meloidogyne incognita on okra by examining the population levels of the nematodes in roots as well as on growth and development of okra plant. Similar result were obtained by (Baliah *et al.*, 2017) [7] who investigated the effect of microbially enriched vermicompost on the growth and biochemical characteristics of okra (*Abelmoschus esculentus* L. Monech).

Conclusion

From the present study, organic compost, have strong nematocidal activity which is identified against *Meloidogyne incognita*. It is concluded that among treatments, the maximum plant height, Root length, and minimum Root weight and minimum number of root-knots in the root system was found in spent mushroom compost + vermicompost + Neem cake + FYM. Use of organic compost neem cake, Vermicompost and Spent mushroom in the field would be considered as beneficial and eco-friendly. However, the present study was limited to one crop season is *Kharif season* 2021 under Prayagraj conditions.

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