Sustainable Management of Root- Knot Nematode (*Meloidogyne javanica*) on Brinjal

ABSTRACT:

Brinjal (*Solanum melongena*) is an important Solanaceae family vegetable, which is grown all around the world. It is affected by various fungal, bacterial, viral, nematode diseases but it is a major host for root-knot nematode, *Meloidogyne javanica*. Hence, for effective management of root-knot nematode experiment was conducted in field condition using the culture filtrate (3gm/kg soil) of bio-agents (*viz., Trichoderma viride, Trichoderma harzianum, Purpureocillium lilacinum, Pochonia chlamydosporia* and *Pseudomonas fluorescens*). Experimental results showed that all the tested bio-agents significantly improve plant growth characters and reduce nematode population as compared to control. Among the tested bio-agents *T. viride* was found most effective treatment with improve plant growth characters as well as in reducing nematode population over other treatment in field condition.

Key Words: Brinjal, Root-knot nematode, *Meloidogyne* spp., Management, Bio-agent.

INTRODUCTION

Brinjal or aubergine (*Solanum melongena* L.) is a popular and widely consumed vegetable throughout the tropical and sub-tropical regions of the world. It is one of the important rainy and winter season vegetable crops cultivated in various states of India. It is a good source of minerals and vitamins (Russo, 1996; Sadilova *et al.* 2006). Brinjal is infected by number of diseases caused by fungi, bacteria, viruses and nematodes and these diseases cause extensive yield losses (Zeerak *et al*., 2017). Nematodes are hidden enemy of plant. Among the nematodes, root-knot nematode, *Meloidogyne* spp. is an important pest of vegetables all around the world and causes severe damage to brinjal crop (Kamran *et al.*, 2010) in India, the root-knot nematode was first reported through Barber (1901) on tea (*Thea sinensis*) roots from Devala territory of Tamil Nadu, South India. In Rajasthan, it first time reported by Arya (1957) from Jodhpur, while Yadav and Naik (1966) was found *Meloidogyne* spp. and its distribution in the soils of

Rajasthan. The nematode infected plants have reduced root system with less feeder roots (Anwar and Mckenry, 2010). Overall, plant-parasitic nematodes cause 21.3% crop losses amounting to Rs. 102040 million (1.58 billion USD) annually; the losses in 19 horticultural crops were assessed at Rs. 50,225 million, while for 11 field crops it was estimated at Rs. 51,815 million. Among the vegetable crops comparatively more losses recorded in tomato (Rs. 6035.2 million) and brinjal (Rs. 3499.12 million) (Kumar *et al.,* 2020). Management of nematode is more difficult as compare to other pathogen because nematodes attack mainly underground parts of plants (Sikora & Fernandez, 2005). The nematodes control mostly depended on synthetic nematicides (Akhtar & Malik, 2000). Although, nematicides are efficient and fast acting, yet they are currently being reappraised as there are relatively unaffordable to many small-scale farmers. The potential negative effect on environment after prolonged use have led to a total ban or restrict use of most chemical nematicides and an urgent need for safe and more effective alternatives (Zukerman and Esnard, 1994). Biological control of plant parasitic nematodes appears the alternative strategies for management in the soil (Agyarko & Asante, 2005, Collange *et al.* 2011). Bio-products containing a microorganism (bacterium, fungus, virus, protozoan or alga) an active ingredient often referred as microbial pesticides, are host specific and are having potential with regard to integrated pest management (Arora *et al.,* 2000). Fungi and bacteria are the most dominant among microorganism they are soil-borne groups in natural soil ecosystem and some of them have shown great potential effect as biological control agents for root-knot nematodes (Kerry, 2000). Keeping this in view, the present investigations were undertaken to assess the efficacy of bio-agents in brinjal against root-knot nematode *Meloidogyne* spp.

MATERIALS AND METHODS

The experiment conducted for management of root-knot nematode *M. javanica* in brinjal using of bio-agents in field.

I. Raising Nursery and Transplanting:

Brinjal variety marudhar was used in all experiments. Brinjal seedlings were raised in the 1m x 1m size plots and seeds were sown in line. 4-5 weeks old seedlings used for transplanting in main field for various experiments.

II. Bed Preparation and Sampling from Beds:

The beds of 1m length and 1 m width were prepared for the experimental purpose.The soil sampling was done before transplanting of the seedling for determine initial nematode population.

III. Preparation of culture filtrates of fungal and bacterial bio-agents: -

The potato dextrose agar (PDA) for fungal agents and nutrient agar (NA) for bacterial agents were prepared, inoculated with respective bio-agents in 100 ml conical flasks followed by incubation at 30 °C in a shaker for 48 hrs. The cultures were centrifuged at 6000 rpm for 20-30 minutes. The supernatant was kept as a stock solution of cent per cent concentration. One ml of sterilized double distilled water was added on fully grown fresh mother culture of bio-agents *Trichoderma viride, Trichoderma harzianum, Purpureocillium lilacinum, Pochonia chlamydosporia* and *Pseudomonas fluorescens* than scraped with a spade to produce slurry.

IV. **Management of root-knot nematode on brinjal using bio-agents:**

The experiment conducted in pure culture plot infested with root-knot nematode, *M. javanica* (2 J_2/g of soil). Talc–based formulation of *Trichoderma viride, Trichoderma harzianum, Purpureocillium lilacinum, Pochonia chlamydosporia* and *Pseudomonas fluorescens* were added to soil each @ 3g per kg soil on different time interval *i.e.*, at the time of transplanting, 20 and 40 days after transplanting. Six plants of brinjal were maintained in each plot. Each treatment was replicated four times. Untreated check was also maintained for comparison. Plants were harvested after 60 days of transplanting and the observations on plant growth characters and nematode reproduction were recorded. Utmost care was taken right from sowing to till harvest of experiment for proper growth and development of plants.

STATICAL ANALYSIS.

After completion of experiment, data were statically analyzed for interpretation of finding. The critical deference was calculated for comparison of treatment for significant at 5 % level of significance. Summary table along with SEm± and CD were worked out and presented in chapter “Experimental Results”.

RESULT AND DISCUSSION

Management of root-knot nematode in brinjal using bio-agents: - An experiment was conducted to study the effect of bio-agents as soil application on management of root-knot nematode, *M. javanica* on brinjal. Bio-agents *T. viride, T.harzianum, P. lilacinum, P. chlamydosporia and P. fluorescens* were used @ 3g/kg soil. Plants were uprooted 60 days after transplanting and observation were recorded on plant growth characters and nematode reproduction.

A. PLANT GROWTH CHARACTER: -

Shoot length: - Data presented in table showed that all bio-agents significantly increased the shoot length over untreated check. Among the bio-agents the highest shoot length was recorded with *Trichoderma viride* (58.00cm) followed by *Purpureocillium lilacinum* (42.75cm) and *Pseudomonas fluorescens* (38.00cm) @ 3g/kg soil. While, minimum shoot length (23.25cm) recorded with untreated check.

Shoot weight: - Data recorded in table showed that among the tested bio-agents the highest shoot weight was recorded with *Trichoderma viride* (53.00gm) followed by *Purpureocillium lilacinum* (41.15 gm) and *Pseudomonas fluorescens* (33.20 gm) @ 3g/kg soil. While, minimum shoot weight (8.60gm) was recorded with untreated check. Application of bio-agents significantly increased the shoot weight as compared to untreated check.

Root length: - Result presented in table among the bio-agents the highest root length was recorded with *Trichoderma viride* (29.47cm) followed by *Purpureocillium lilacinum* (28.52cm) and *Pseudomonas fluorescens* (27.27 cm) @ 3g/kg soil. Whereas, minimum root length (8.95cm) was recorded with untreated check. Application of bio-agents significantly increased the root length over untreated check.

Root weight: - Data recorded in table showed that bio-agents significantly increased the root weight as compared to untreated check. Among the bio-agents the highest root weight was recorded with *Trichoderma viride* (5.25 gm) followed by *Purpureocillium lilacinum* (4.82 gm) and *Pseudomonas fluorescens* (4.45gm) @ 3g/kg soil. While, minimum root weight (2.37) was recorded with untreated check.

B. NEMATODE REPRODUCTION: -

Number of galls/plant: - Experimental result revealed in table showed that among the bio-agents the minimum number of galls per plant were recorded with *Trichoderma viride* (153.75) followed by *Purpureocillium lilacinum* (238.00) and *Pseudomonas fluorescens* (284.75) @ 3g/kg soil. While, maximum number of galls (397.50) were recorded with untreated check. Application of bio-agents significantly reduced number of galls per plant over untreated check.

Number of egg masses / plant: - Data presented in table showed that application of bio-agents significantly decreased number of egg masses per plant. Among the bio-agents *Trichoderma viride* was observed best treatment with minimum number of egg masses per plant (95.25) followed by *Purpureocillium lilacinum* (107.00) and *Pseudomonas fluorescens* (120.50) @ 3g/kg soil. However, untreated check was observed least treatment with maximum number of egg masses per plant (189.75).

Number of eggs / egg mass: - Data recorded in table showed that among all treatments the minimum number of eggs per egg mass were recorded with *Trichoderma viride* (200.00) followed by *Purpureocillium lilacinum* (212.25) and *Pseudomonas fluorescens* (231.25) @ 3g/kg soil. Whereas, the maximum number of eggs per egg mass (344.75) were recorded with untreated check. Application of bio-agents significantly decreased number of eggs per egg mass over untreated check.

Nematode juvenile/200cc soil: - Data presented in table showed that application of bio-agents significantly decreased nematode juvenile/200cc soil compared to untreated check. Among the bio-agents the minimum number of nematode juvenile/200cc soil were recorded with *Trichoderma viride* (422.75) followed by *Purpureocillium lilacinum* (539.50) and *Pseudomonas fluorescens* (590.50) @ 3g/kg soil. While, the maximum number of juveniles (1233.75) were recorded with untreated check.

Final nematode population:- Application of bio-agents decreased the final nematode population over untreated check. Results presented in table showed that among the bio-agents the minimum nematode population were recorded with *Trichoderma viride* (19469.00) followed by *Purpureocillium lilacinum* (23252.00)

and Pseudomonas fluorescens (28454.75) @ 3g/kg soil. While, maximum nematode population (66654.00) were recorded with untreated check.

The results of experiment on management of root-knot nematode, *M. javanica* on brinjal using bio-agents showed that all bio-agents significantly increased the plant growth characteristics (shoot length, shoot weight, root length and root wight) and decreased nematode reproduction (number of galls/plant, number of egg masses / plant, number of eggs/ egg mass, nematode juvenile/ 200cc soil and final nematode population) over untreated check. Among the bio-agents the maximum plant growth characteristics and minimum nematode reproduction was recorded with *Trichoderma viride* followed by *Purpureocillium lilacinum* and *Pseudomonas fluorescens* @ 3g/kg soil. While, minimum plant growth characteristics and maximum nematode reproduction recorded with untreated check. Similar findings were observed with Meghwal and Baheti (2017) revealed that okra plant growth significantly enhanced with seed treatment of bio-agents. Maximum plant growth and minimum root-knot nematode infection was recorded when seeds were treated with *T. viride* followed by *P. lilacinus* and *P. chlamydosporia* each at 2% over untreated check. Meena *et al*. (2020) evaluated bio-agents efficacy as seed treatment @ 4 g/kg seed as well as added to soil @ 4 g/kg soil against wilt disease complex by *M. incognita and F. oxysporum f. sp. lycopersici.* Among bio-control agent, *Trichoderma viride* was found significantly superior in reduction of nematode population and per cent disease incidence along with increased in plant growth parameters followed by *Paecilomyces lilacinum*.

Kumhar *et al.* (2018) showed that *Pochonia chlamydosporia* at 4 per cent was found most effective followed by *P. chlamydosporia* at 2 per cent and *G. fasciculatum* at 4 per cent to enhance plant growth of maize and to reduce the infection of *Heterodera zeae* on maize. Bhati *et al.* (2022) exhibited that the bio-agents {*Paecilomyces lilacinus* (now known as *Purpureocillium lilacinum*), *Trichoderma harzianum, Pochonia chlamydosporia*, *Pseudomonas fluorescens* and *Glomus fasiculatum* (VAM)} reduced nematode reproduction and enhanced the plant growth of cucumber over untreated check. The highest reduction in root galls, egg masses, egg mass contents and nematode population were recorded with *Trichoderma viride* at 5.0g per plant over untreated check on cucumber in poly-house followed by *Paecilomyces lilacinus* and *Trichoderma harzianum*.

Table No. 1 Effect of bio-agent on plant growth and nematode reproduction in open field

Treatment	Shoot length (cm)	Shoot weight (gm)	Root length (cm)	Root weight (gm)	No. of galls/ plant	No. of egg masses/ Plant	Number of eggs and larvae / egg mass	Nematode juvenile/ 200cc soil	Final nematode population
T. viride	58.00	53.00	29.47	5.25	153.75	95.25	200.00	422.75	19469
T.harzianum	25.75	17.05	14.62	2.15	378.75	185.25	281.75	741.75	52939.25
P.lilacinum	42.75	41.15	28.52	4.82	238.00	107.00	212.25	539.50	23252.00
P.chlamydosporia	29.25	18.48	16.25	4.17	315.00	139.50	249.75	679.75	35522.00
P.fluorescens	38.00	33.20	27.27	4.45	284.75	120.50	231.25	590.50	28454.75
Control	23.25	8.60	8.95	2.37	397.50	189.75	344.75	1233.75	66654.00
SEm±	0.96	1.24	0.71	0.28	1.60	1.34	1.29	3.14	479.93
CD 5%	2.89	3.74	2.14	0.85	4.82	4.04	3.89	9.47	1446.37
CV %	5.31	8.70	6.81	14.72	1.09	1.92	1.02	0.90	2.55
* Average of four replications									
*Dose = @3 gm/ kg soil at the time of transplanting followed by 20 DAT and 40 DAT (Day After Transplanting)									

Plate-1: Over view of bio-agent treated field of brinjal

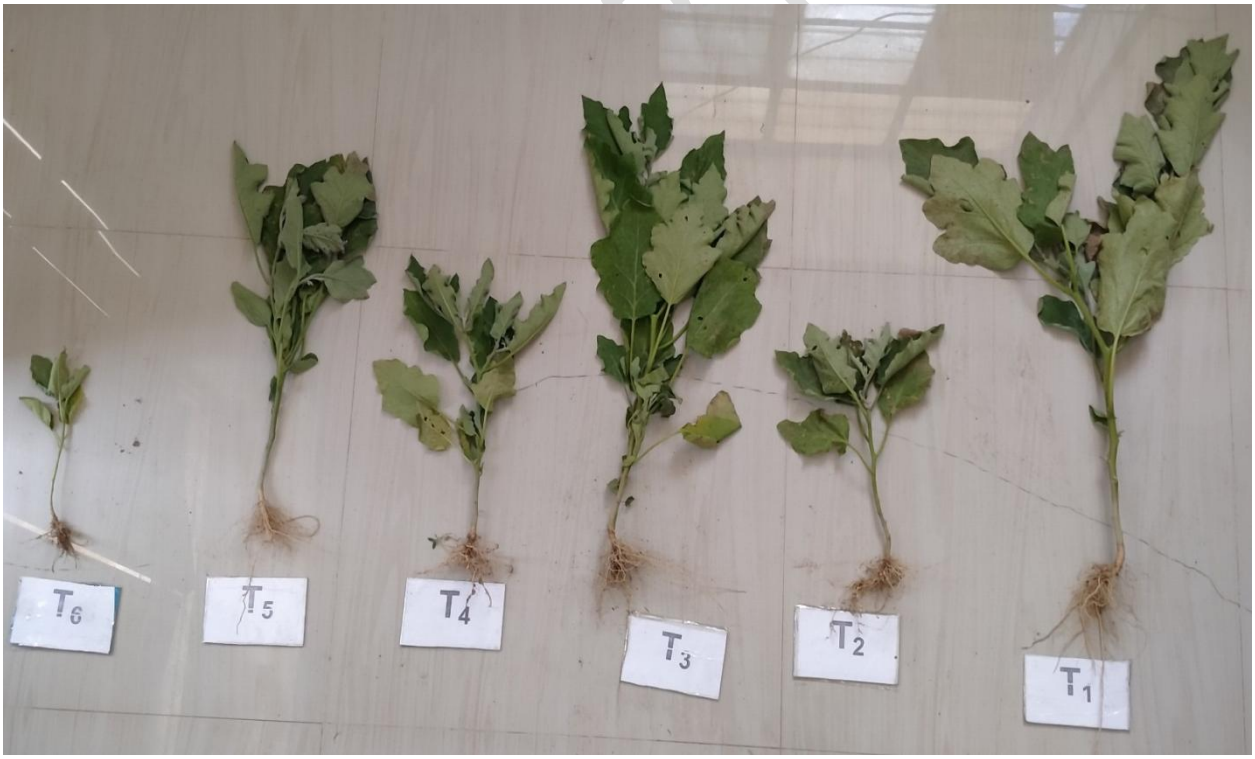

Plate 2 Management of root-knot nematode, *Meloidogyne javanica* on brinjal through bio-agents.

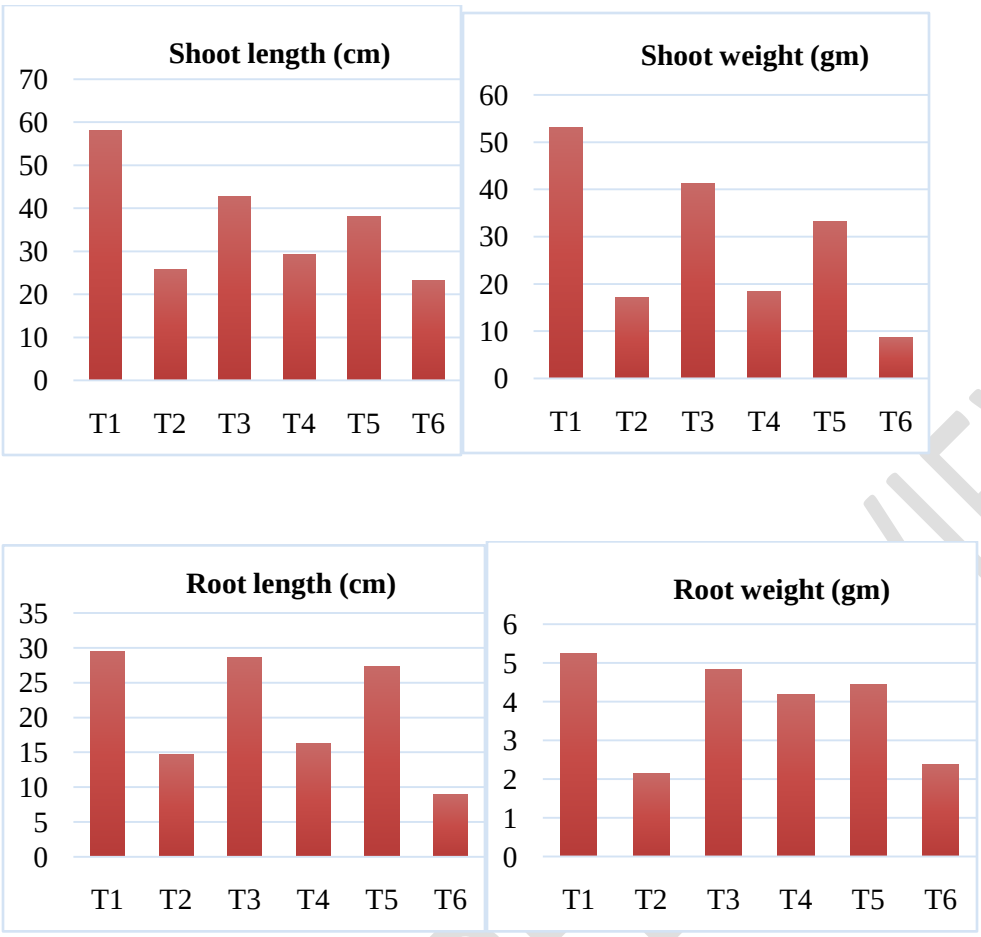

Fig 1. Effect of bio-agents on plant growth characters of brinjal in field condition**.**

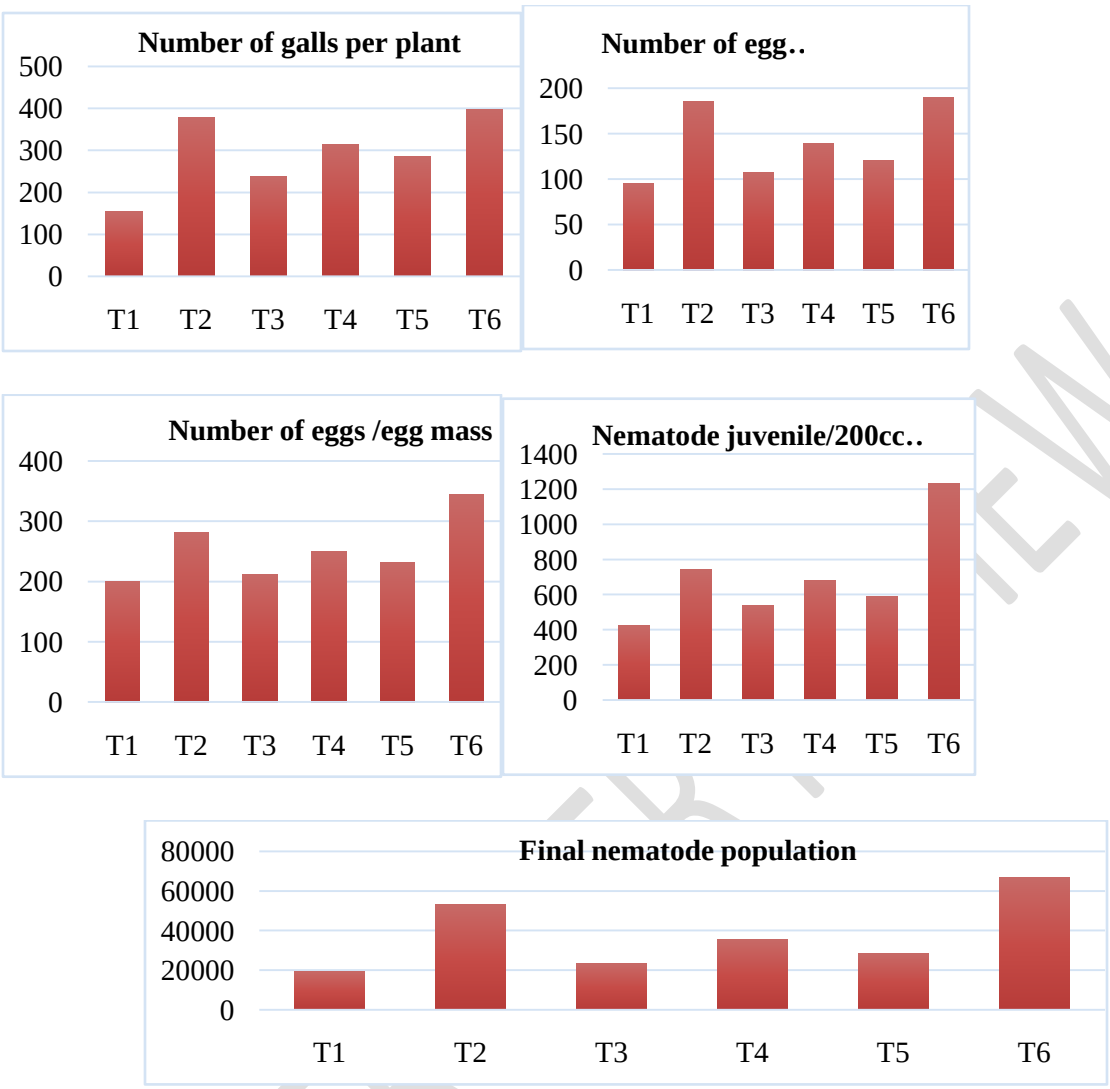

Fig 2. Effect of bio-agents on nematode reproduction on brinjal in field condition.

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