

Original Research Article

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Efficacy of *Nematoctonus robustus* along with Organic Amendment for the Management of Rice Root Knot Nematode *Meloidogyne graminicola*

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ABSTRACT

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The efficacy of *Nematoctonus robustus* along with neem cake, FYM and Vermi compost was assessed either singly or in combination as soil application for management of rice root knot nematode, *Meloidogyne graminicola* in transplanted rice variety MTU-7029. Observation were recorded on rice plant growth parameter as shoot and root length, fresh weight, shoot and root weight, nematode root galls, eggs masses, females and juveniles. Application of *Nematoctonus robustus* 30g/kg soil and neem cake 15g/kg soil enhanced rice plant growth parameter such as shoot length (29.4 cm), root length (14.0 cm), fresh weight of shoot (2.267 mg) and fresh weight of root (0.448) even in the presence of the nematode. Fewest root gall (2.0), population of egg masses (348.7), population of females (3.6) and population of juveniles (1.7) of *Meloidogyne graminicola* were recorded in the application of *Nematoctonus robustus* 30g/kg soil + FYM 50g/kg soil and *Nematoctonus robustus* 30g/kg soil + Vermicompost 50g/kg soil.

Introduction

Root knot Nematodes, *Meloidogyne* spp. have been reported infecting rice crops is found wide but *Meloidogyne graminicola* is a serious pest of upland rice and nurseries grown on well drained soils. Rice plays an important role in the livelihood of the people of India. Fresh water availability for irrigation is decreasing worldwide because of increasing competition from urban and industrial development, degrading irrigation infrastructure and deteriorating water quality (Molden, 2007). This nematode was recorded during 2009- 10 in Bulandshahr district of Uttar Pradesh, causing an average yield loss of 20-25% and in some case to the tune of 50-

60% loss (Pankaj *et al.*, 2010). The disease can assume epidemic proportion causing extensive damage to the crop. The nematode infestation is manifested by root galling, yellowing, stunting and wilting of the plant. The rice root knot nematode, *Meloidogyne graminicola* completes its life cycle in 15 days at 27-37°C (Jaiswal *et al.*, 2010). *Meloidogyne graminicola* is one of the most predominant pests associated with rice under upland condition (Bridge *et al.*, 1990) and cause substantial yield losses (Protet *et al.*, 1995, Soriano *et al.*, 2000) Biological control of plant parasitic nematodes is regarded as an important component of integrated nematode

management system and it acts as an alternative to various chemical Pesticides due to their self-sustaining action. The control of plant parasites nematodes is a difficult task, and mainly depends on chemical nematicides for decades and remarkable reduction of nematode population has been achieved (Akhtar and Malik 2000). Although soil nematicides are effective and fast-acting, they are currently being reappraised with respect to the environmental hazards and human health (Wachira *et al.*, 2009). In addition to that they are relatively unaffordable to many small scale farmers.

Hence an eco-friendly and environmentally safe technique is aimed incorporating bioagents in the management of root knot nematode under field conditions. Musabyimana and Saxena (1999) have reported that application of neem cake at 100 g/plant reduced the numbers of *Pratylenchus goodeyi* and *Meloidogyne* spp. in banana.

One way to reduce water and labour requirement is to grow dry seeded rice instead of the puddled transplanted rice (Yadav *et al.*, 2010; Jain *et al.*, 2007) have worked out the monetary loss to the extent of 4779.00 million rupees in rice due to *Meloidogyne graminicola*, *Heterodera oryzicola* and *Aphelenchoides besseyi* causing an average yield loss to the tune of 10.54%. However, crop losses to the extent of 60-100% have also been reported (Dabur and Jain. 2005). Use of organic amendments and bio-control agents are some of the exciting and promising means of management practices which aims at the suppression of nematode population to manageable limits.

Materials and Methods

The pot experiment was arranged in a green house in completely randomized block design (CRD) to accommodate soil application of rice plant with using mass culture of bio

control agent *Nematoctonus robustus* by mixing in sick soil @ 1kg/ pots with susceptible varieties of MTU-7029 on the basis of application with different organic substrates like Vermi-compost, Farm Yard Manure (FYM), and Neem cake at the Institute of Agricultural Sciences, Department of Mycology and Plant Pathology, Banaras Hindu University, Varanasi, Uttar Pradesh.

The composite sick soil of each pot was filled in three earthen pots 15 @ 1 kg per pot and kept in green house at 25-35^C temperature and 25 sprouted rice seeds (variety MTU-7029) with mixing different organic substrates as Vermi compost, FYM, Neem cake and *Nematoctonus robustus* were sown to each pot and irrigated daily after 20 days of sowing the seedling of each pot of all soil samples were uprooted and carefully washed under running tap water and number of root galls, shoot and root length, fresh weight of root and shoot, population of eggs, juveniles and females per seedling was determined.

The treatments were- T₁ Vermicompost 10 gram + Sick Soil + MTU-7029, T₂ Vermi compost 50 gram + Sick Soil + MTU-7029, T₃ FYM 10 gram + Sick Soil + MTU -7029, T₄ FYM 50 gram + Sick Soil + MTU-7029, T₅ Neem Cake 10 gram + Sick Soil + MTU -7029, T₆ Neem Cake 15 gram + Sick Soil + MTU-7029, T₇ *Nematoctonus robustus* 30 gram + Vermicompost 10 gram + Sick Soil + MTU-7029, T₈ *Nematoctonus robustus* 30 gram + Vermicompost 50 gram + Sick Soil + MTU-7029, T₉ *Nematoctonus robustus* 30 gram + FYM 10 gram + Sick Soil + MTU-7029, T₁₀ *Nematoctonus robustus* 30 gram + FYM 50 gram + Sick Soil + MTU-7029, T₁₁ *Nematoctonus robustus* 30 gram + Neem Cake 10 gram + Sick Soil + MTU-7029, T₁₂ *Nematoctonus robustus* 30 gram + Neem Cake 15 gram + Sick Soil + MTU-7029, T₀ (Control) – Only nematode infected soil (*Meloidogyne graminicola*) with MTU- 7029.

Mass culture preparation of *Nematoctonus robustus*

Sorghum, barley grains and straw of wheat were tested for the growth of *nematoctonus robustus* in mass culture. Barns and straw were powdered and grains were spitted in warring blender before addition of desired amount of water. Substrates and water were taken as follows: Sorghum grain 20 gram + 35 ml water, wheat straw 5 gram + 40 ml water, Barley grain 20 gram + 35ml water. Each substrate was taken in to a 250 ml conical flask and moistened with desired amount of water as mentioned above.

The flasks were plugged with cotton and sterilized two times at 15 psi for 20 minutes. A 10 mm fungal disc was cut from the periphery of the 15 days old culture of isolate a by a sterilized cork borer and inoculation in the centre of a substrate contained in a flask with the help of sterilized inoculation on needle. One fungal disc was inoculated in to each flask five replications were maintained for each treatment. The inoculated flasks were incubated at 25+- 1°C. Visual rating was made to assess the growth of *Nematoctonus robustus* after 25 days of inoculation.

Results and Discussion

An investigation was carried out to study the Bio control Potential of root knot nematode *Meloidogyne graminicola* on rice and its management through organic amendments. Different growth parameter was taken to assess the infestation and bio potentiality of root knot nematode and *Nematoctonus robustus* respectively.

The experimental results represented in table 1 revealed that the shoot length of rice plant significantly increased in T₁₂ (29.4 cm) followed T₁₀ (27.8 cm), T₈ (24.0 cm), T₁₁ (22.7cm) and T₉ (21.7 cm) as compared with other treatment. Among the treatment T₇

(20.2cm), T₆ (19.6 cm), and T₂ (18.5 cm) were found non-significant from each other significantly increased the shoot length as compared with untreated control T₀ (10.23cm). The root length of rice as significantly increased in T₁₂ (14.0 cm), T₁₀ (12.8cm) and T₈ (9.9 cm) as compared with T₉ (7.5 cm), T₁ (3.1cm) and T₀ (1.86 cm).

The fresh shoot weight of rice plant was significantly increased in T₁₂ (2.267 mg), T₁₀ (1.26 mg) and T₈ (0.777 mg) as compared with T₀ (0.115 mg) and T₁ (0.297 mg). Fresh root weight in treatment T₁₂ (0.448 mg), T₁₀ (0.356) and T₈ (0.276 mg) significantly increased from T₀ (0.110 mg), T₁ (0.150 mg) and T₃ (0.161 mg) respectively.

The number of root galls was significantly increased in T₀ (39.0), T₁ (17.3), T₃ (16.0) and T₄ (12.0) as compared with T₁₂ (2.0), T₁₀ (3.0), T₈ (8.0) and T₁₁ (8.7). These treatments were significantly different from all the other treatment. Significantly more galls (39.0) were recorded in the control (T₀) than all other treatment.

The number of eggs population was significantly increased in T₀ (964.0), T₁ (761.7) and T₃ (742.7) as compared with lowest eggs population T₁₂ (348.7), T₁₀ (422.7) and T₉ (650.3). Lowest eggs population was recorded in T₁₂ (348.7) and greatest number of eggs mass population was recorded in the untreated control (T₀) and mass eggs population observed (964.0) than all other treatment.

The number of females in various treatments showed that significantly maximum number of females T₀ (25.1), T₁ (21.5) and T₃ (17.1) compared with in T₁₂ (3.6), T₁₀ (6.3) and T₈ (7.1) respectively. Lowest number of females in T₁₂ (3.6) and maximum number of females in untreated control (25.1) were recorded.

Table.1 Plant growth and nematode population in rice MTU- 7029 with *Nematoctonus robustus*, Neem cack, FYM, vermicompost at soil application

| Treatment | Shoot Length (cm) | Root Length (cm) | Fresh weight of Shoot (mg) | Fresh weight of Root (mg) | No. of Root Galls | Population of eggs | No. of Females | No. of Juveniles |
|--------------------------|-------------------|------------------|----------------------------|---------------------------|-------------------|--------------------|----------------|------------------|
| T ₁ | 15.9 | 3.1 | 0.297 | 0.150 | 17.3 | 761.7 | 21.5 | 17.3 |
| T ₂ | 18.5 | 4.5 | 0.354 | 0.182 | 11.7 | 720.7 | 16.5 | 13.7 |
| T ₃ | 16.9 | 3.6 | 0.312 | 0.161 | 16.0 | 742.7 | 20.5 | 16.7 |
| T ₄ | 17.5 | 3.9 | 0.337 | 0.173 | 12.0 | 732.0 | 17.1 | 14.3 |
| T ₅ | 18.9 | 5.6 | 0.398 | 0.193 | 11.0 | 709.3 | 14.9 | 13.3 |
| T ₆ | 19.6 | 6.3 | 0.412 | 0.227 | 10.7 | 692.3 | 14.3 | 10.7 |
| T ₇ | 20.2 | 6.9 | 0.487 | 0.233 | 10.0 | 672.7 | 12.4 | 8.3 |
| T ₈ | 24.0 | 9.9 | 0.777 | 0.276 | 8.0 | 562.3 | 7.1 | 3.7 |
| T ₉ | 21.7 | 7.5 | 0.510 | 0.262 | 9.7 | 650.3 | 10.9 | 7.3 |
| T ₁₀ | 27.8 | 12.8 | 1.26 | 0.356 | 3.0 | 422.7 | 6.3 | 2.7 |
| T ₁₁ | 22.7 | 8.6 | 0.585 | 0.269 | 8.7 | 595.3 | 8.4 | 5.7 |
| T ₁₂ | 29.4 | 14.0 | 2.267 | 0.448 | 2.0 | 348.7 | 3.6 | 1.7 |
| T ₀ (Control) | 10.23 | 1.86 | 0.115 | 0.110 | 39 | 964 | 25.1 | 25.66 |
| CV | 5.79 | 10.92 | 9.61 | 8.05 | 14.10 | 10.35 | 8.51 | 19.53 |

The number of juvenile's treatment varied between 1.7 and 25.66 among the treatment fewest juveniles were recorded T₁₂ (1.7), T₁₀ (2.7) and T₉ (3.7) compared with in T₀ (25.66), T₁ (17.3) and T₃ (16.7). Significantly more galls (25.66) were recorded in the untreated control (T₀) than in all other treatment.

The present investigation on the integration of four components viz., a bio-control agent (*Nematoctonus robustus*), an organic amendment (Neem cake, F.Y.M. and Vermi compost) for the management of *Meloidogyne graminicola* in rice pot experiment revealed that all the four were compatible with each other in reducing the root galls, eggs population, females and juveniles and enhancing rice shoot and root length, fresh weight of shoot and root weight.

The combination treatments were more effective than individual treatment perhaps due to the additive effect of the bio-control agent and organic amendment. Biological control agents of soil born pathogen when applied to soils in combination with organic materials reduced nematode occurrence (Rodriguez-kabang *et al.*, 1987; Mittal *et al.*, 1995; Chen *et al.*, 2000; Youssef *et al.*, 2008).

Use of organic amendments along with nematicides proved to be effective for managing *H. oryzae* in rice (Prasad *et al.*, 1986). Combination of chitin amendments, neem cake and *P. fluorescens* was effective in reducing *H. oryzae* population both in soil and root (Swarna kumara *et al.*, 1999).

Akhtar and Mahmood (1996) found a significant reduction of plant parasite and increase of predatory and free-living nematodes after application of all tested materials after an application of different rates of oilcakes of Neem (*Azadirachta indica*) and castor (*Ricinus communis*), composted manure and urea, as well as using of composted manure combined with *Tagetes erecta*. Mishra (1996) states that the Neem formulations are most effective control of root knot nematode *Meloidogyne spp.*

as compared to other botanicals found to be most effective in reducing egg masses of the nematode on rice plant. Fertinmakil a pesticide combination of neem cake and a fungicide was found to be effective in reducing nematode population and increasing root length on wheat (Khan *et al.*, 2007).

Nematoctonus robustus with Neemcake (29.4 cm) significantly increased shoot length, (14.0 cm) root length, (2.267 cm) fresh weight of shoot, (0.448 gm) fresh weight of root, and reducing of (2.0 gm) root galls, (348.7) population of eggs mass, (3.6) population of females and (1.7) population of juveniles as a compared with untreated control (T₀).

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