Original Research Article

Efficacy of Some Bacterial Biocontrol Agents as Seed Treatment against Root Knot Nematode, *Meloidogyne incognita* on Tomato

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**Abstract**

Pot experiment was conducted to evaluate the efficacy of two formulations (talc formulation and vermi formulation) of four bacterial nematode biocontrol agents *viz.*, *Bacillus subtilis*, *Bacillus pumilus*, *Bacillus megaterium* and *Pseudomonas flourescens* as seed treatment against root knot nematode, *Meloidogyne incognita* on tomato. All the bioagents were tried at 10 and 20g / kg of seed. The experiment was terminated at 60 days after sowing the seed. The results revealed that all the treatments significantly increased the plant growth parameters and reduced the nematode multiplication over untreated control. However, maximum plant growth parameters and minimum galls per root system, eggmasses per root system, eggs per egg masses and final nematode population was recorded when seeds of tomato (var. Pusa Ruby) was treated with talc formulation of *Pseudomonas flourescens* @20g/kg followed by seed treatment with vermi formulation of *Bacillus subtilis* @ 20g/kg of seed.

**Keywords**

Bacterial biocontrol agents, Seed treatment, Root knot nematode

**Article Info**

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**Introduction**

In recent years, management of plant parasitic nematodes using biocontrol agents (fungal as well as bacterial) is gaining importance in the light of increased awareness of environmental and human health hazards associated with nematicidal chemicals application. Biological control promises to be one of these alternatives. Biological agents are environment-friendly, hence cause no side effect, they are affordable compared to agrochemicals (pesticides, insecticides, nematicides) and easy to use. Among the biological control agents that have been assessed against nematodes are antagonistic bacteria, nematophagous fungi and yeasts (Das and Borgohain, 2018; Jayakumar, 2019). A good number of bacterial biocontrol agents have been identified for their nematicidal action on root knot nematodes and becomes promising source of biopesticides. The present investigation aims to evaluate the efficacy of few bacterial biocontrol agents as
seed treatment against root knot nematode, which is responsible for 27.21 per cent annual yield loss of tomato.

**Materials and Methods**

Pot experiment was laid out at 4CRD in the Net House of Department of Nematology, Assam Agricultural University, Jorhat with thirteen treatments, viz., T1: Seed treatment with *Bacillus subtilis* (1×10⁹ cfu/gm of talc formulation) @10gm/kg of seed; T2: Seed treatment with *B. subtilis* (1×10⁹ cfu/gm of talc formulation) @20gm/kg of seed; T3: Seed treatment with *B. subtilis* (1×10⁹ cfu/gm of vermi formulation) @ 10 gm/kg of seed; T4: Seed treatment with *B. subtilis* (1×10⁹ cfu/gm of vermi formulation) @ 20 gm/kg of seed; T5: Seed treatment with *B. pumilus* (1×10⁹ cfu/gm of talc formulation) @10gm/kg of seed; T6: Seed treatment with *B. pumilus* (1×10⁹ cfu/gm of talc formulation) @20gm/kg of seed; T7: Seed treatment with *B. megaterium* (1×10⁹ cfu/gm of talc formulation) @ 10gm/kg of seed; T8: Seed treatment with *B. megaterium* (1×10⁹ cfu/gm of talc formulation) @ 20gm/kg of seed; T9: Seed treatment with *B. megaterium* (1×10⁹ cfu/gm of vermi formulation) @ 10gm/kg of seed; T10: Seed treatment with *B. megaterium* (1×10⁹ cfu/gm of vermi formulation) @20gm/kg of seed; T11: Seed treatment with *Pseudomonas fluorescens* (1×10⁹ cfu/gm of talc formulation) @ 10gm/kg of seed; T12: Seed treatment with *P. fluorescens* (1×10⁹ cfu/gm of talc formulation) @20gm/kg of seed and T13: Untreated control. Seeds of susceptible tomato variety (Pusa Ruby) were pre soaked in water for 12 hours, treated with biocontrol agents with calculated amount and then incubated at 25-30°C for 48 hours. Treated seeds were raised in sterilized pot mixture of sand, field soil and cowdung at 1:2:1 in 1kg earthen pots. Seedlings were thinned to keep one healthy seedling per pot at 3 leaf stage. Second stage juveniles of root knot nematode *Meloidogyne incognita* were inoculated around the root zone of tomato seedlings at 1J₂/1g of soil. Seedlings were maintained following package of practices. The experiment was terminated at 60 days after sowing the seeds and observations on plant height, root length, fresh and dry shoot weight, fresh and dry root weight, number of galls per root system; numbers of egg masses per root system and final soil nematode population were recorded.

**Results and Discussion**

Results revealed that all the treatments significantly increased the plant growth parameters and reduced the infestation of root knot nematodes in tomato. However, maximum plant growth parameters and minimum number of galls, eggmass per root system, final soil nematode population were recorded when tomato seeds (var. Pusa Ruby) were treated with *Pseudomonas fluorescens* @20g/kg seed (T12), followed by seed treatment with *Bacillus subtilis* (vermi formulation) @20g/kg seed (T4); whereas, minimum was recorded in untreated control (T13) (Table 1).

Maximum plant height (39.23 cm), root length (16.29cm), fresh shoot and root weight (15.59g and 9.70g), dry shoot and root weight (5.88g and 4.81g) were recorded when seeds were treated with *Pseudomonas fluorescens* @20g/kg seed (T12), followed by seed treatment with *Bacillus subtilis* (vermi formulation) @20g/kg seed (T4); whereas, minimum was recorded in untreated control (T13) (Table 2). The result of the present

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investigation clearly showed that bacterial bio-agents can effectively manage the infestation of root knot nematode, *M. incognita* in tomato.

**Table.1** Effectiveness of bacterial bioagents as seed treatment on plant growth parameters of tomato (var.- Pusa Ruby)

| Treatment | Plant Height | Fresh Shoot weight | Dry shoot weight | Root Length | Fresh Root weight | Dry root weight |
|-----------|--------------|--------------------|------------------|-------------|------------------|-----------------|
| T1        | 31.40        | 10.90              | 3.96             | 11.55       | 5.29             | 2.33            |
| T2        | 31.78        | 10.95              | 3.73             | 13.29       | 6.17             | 2.94            |
| T3        | 32.48        | 12.93              | 3.74             | 12.57       | 6.01             | 2.65            |
| T4        | 37.13        | 14.69              | 4.23             | 14.51       | 7.90             | 3.83            |
| T5        | 29.90        | 9.54               | 2.67             | 10.77       | 5.15             | 1.99            |
| T6        | 33.33        | 11.38              | 3.27             | 11.99       | 5.62             | 2.42            |
| T7        | 29.98        | 9.03               | 2.59             | 10.96       | 5.17             | 1.79            |
| T8        | 29.10        | 8.47               | 2.53             | 11.30       | 6.90             | 3.32            |
| T9        | 31.20        | 9.085              | 2.41             | 11.56       | 5.80             | 1.16            |
| T10       | 31.73        | 10.44              | 2.92             | 11.63       | 5.61             | 1.34            |
| T11       | 33.18        | 12.36              | 3.24             | 12.25       | 6.62             | 1.88            |
| T12       | 39.23        | 15.59              | 5.88             | 16.29       | 9.70             | 4.81            |
| T13       | 21.63        | 7.11               | 1.49             | 9.22        | 4.65             | 1.13            |
| SEd       | 3.37         | 1.32               | 0.7              | 0.88        | 0.89             | 0.56            |
| CD(0.05)  | 5.65         | 2.21               | 1.18             | 1.48        | 1.49             | 0.93            |

**Table.2** Effectiveness of bacterial bioagents as seed treatment on infestation of root knot nematode, *Meloidogyne incognita* on tomato

| Treatment | Gall/root system | Egg mass/root system | Final nematode population (200 cc of soil) |
|-----------|------------------|----------------------|------------------------------------------|
| T1        | 34.0             | 36.50                | 145.25                                   |
| T2        | 20.50            | 26.00                | 138.25                                   |
| T3        | 33.00            | 31.50                | 149.00                                   |
| T4        | 19.00            | 21.00                | 131.00                                   |
| T5        | 34.50            | 34.50                | 162.25                                   |
| T6        | 29.25            | 27.50                | 155.50                                   |
| T7        | 36.50            | 36.50                | 168.25                                   |
| T8        | 35.00            | 30.00                | 143.00                                   |
| T9        | 39.00            | 31.50                | 164.50                                   |
| T10       | 32.50            | 25.00                | 147.00                                   |
| T11       | 29.50            | 20.50                | 130.50                                   |
| T12       | 12.00            | 16.25                | 110.25                                   |
| T13       | 50.50            | 41.00                | 231.25                                   |
| SEd       | 3.16             | 2.89                 | 10.65                                     |
| CD(0.05)  | 5.29             | 3.84                 | 17.84                                     |
The present findings are in the line of findings reported by Verma et al., (1998), Ali et al., (2002), Hashem and Abo-Elyoury (2011) and Roy et al., (2015). Verma et al., (1998) reported that application of Pseudomonas fluorescens @ 10g/kg seed was effective in reducing the menace of root-knot nematode, Meloidogyne incognita in tomato. Hashem and Abo-Elyoury (2011) conducted an experiment to evaluate the nematicidal activity of Pseudomonas fluorescens, Paecilomyces lilacinus, Pichia guilliermondii and Calothrix parietina against root-knot nematode (Meloidogyne incognita) on tomato. Tomato seeds were immersed in the biocontrol agent suspensions, which contained separately $10^8$ cell ml$^{-1}$ of P. fluorescens, $10^5$ CFU ml$^{-1}$ of P. lilacinus, $10^8$ CFU ml$^{-1}$ of P. guilliermondii and $10^9$ cell ml$^{-1}$ of C. parietina. Sterile distilled water (DW) was used as control. Results revealed that all treatments significantly reduced the population of M. incognita and root galling on tomato along with increased percentage of germination and vigor index (VI) except, C. parietina, which has no significant difference from the control. Among all the treatments the most vigorous root system was obtained in the treatment with P. fluorescens. Sonkar et al., (2018) observed that P. fluorescens was able to reduce nematode parameters at different concentration when applied either as seedling root dip treatment or soil drench around tomato. Siddiqui and Shaukat (2002) revealed that these rhizobacteria have the ability to induce systemic resistance against root knot nematode, which may play a role in the present study.

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