



Research Article

BIO-MANAGEMENT OF *Meloidogyne incognita* IN ORGANIC TOMATO

THENGAL PALASH*¹, HAZARIKA K.², KONWAR M.J.³, SUTRADHAR P.⁴, RAHMAN SYED WASIFUR⁵ AND PHUKAN S.K.⁶

^{1,2}Department of Nematology, Assam Agricultural University, Jorhat, 785013, Assam, India

^{3,4}Department of Agronomy, Assam Agricultural University, Jorhat, 785013, Assam, India

⁵Department of Biotechnology, Assam Agricultural University, Jorhat, 785013, Assam, India

⁶Department of Tea Husbandry and Technology, Assam Agricultural University, Jorhat, 785013, Assam, India

*Corresponding Author: Email-polu.thengal@gmail.com

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Abstract- A field experiment was conducted in rabi season, 2015-2016 in the organic block of Instructional-cum-Research Farm, Assam Agricultural University, Jorhat-13, to study the efficacy of bio-agents, organic amendment and clear plastic mulching in management of *M. incognita* in organic tomato. All treatments viz., clear plastic mulch of 0.75 mm density, vermin-compost, *Trichoderma viride*, mustard oil cake alone or in combination significantly increased plant growth parameters and yield of tomato over control. However maximum reduction of galls, egg masses per root system and final nematode population in soil was observed in the treatment with clear plastic mulch of 0.75 mm density + mustard oil cake @ 750 kg/ha over control.

Keywords- Clear plastic mulch, Vermi-compost, Mustard oilcake, *Trichoderma viride*, *Meloidogyne incognita*, Tomato

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Introduction

Tomato (*Solanum lycopersicu* L) belongs to the family *Solanaceae* is one of the most popular and widely grown vegetables in the world second to potato. China is the leading producer of tomato in the world with a production of 418.8 lakh MT in an area of 8.7 lakh ha with a productivity of 48.1 MT/ha during 2010-11 [1]. India stands second in the production of tomato with a production of 168.3 lakh MT in an area of 8.6 lakh ha and with a productivity of 19.5 MT/ha [1]. The productivity in India as compared to China is very low. So, improvement in yield of tomato is necessary. In Assam, its production account for 3.87 lakh tonnes sharing 2.30 per cent of India's tomato production during 2010- 11 [1]. There is considerable loss in tomato due to different diseases caused by fungi, bacteria, viruses, and nematodes. Root-knot nematodes have been reported to causes about 40% yield loss of tomato in Bangladesh and about 46.2% yield reduction in India [2, 3]. Among the nematodes *Meloidogyne incognita* is most dominant and widely prevalent species inflicting serious loss in tomato [4]. A yield loss of 35 - 39.7 per cent has been reported due to root knot nematode infestation (Reddy, 1985). In Assam condition, also *M. incognita* (root-knot nematode) is recognized as a serious pest of this crop. Roy (1977) reported that this nematode to be most prevalent in Assam causing root-knot diseases in many crops.

Under the above circumstances, the present piece of research was undertaken to find out efficacy of clear plastic mulch, vermicompost, mustard oilcake, and *Trichoderma viride* to manage *M. incognita* of tomato and to increase plant growth and yield of tomato. Further, increasing the emphasised on organic cultivation demands a suitable organic management practice for the crop in root-knot nematode infested soil.

Materials and Methods

The experiment was carried out during the rabi season of 2015-16 in the organic

block of Instructional Cum-Research Farm, Assam Agricultural University, Jorhat to evaluate the efficacy of clear plastic mulch, Vermicompost, *Trichoderma viride* and mustard oil cake alone or in combination for the management of *M. incognita* on tomato. Treatments are used as follows T₁ : Clear plastic mulch of 0.75 mm density 15 days prior to transplanting, T₂ : Vermicompost @ 2 t/ha applied 15 days prior to transplanting, T₃ : *Trichoderma viride* @ 20 kg/ha at time of transplanting, T₄ : Mustard oil cake @ 750 kg/ha applied 15 days before transplanting, T₅ : Clear plastic mulch of 0.75 mm density + Vermicompost @ 2 t/ha applied, T₆ : Clear plastic mulch of 0.75 mm density + Mustard oil cake @ 750 kg/ha applied, T₇ : Vermicompost @ 1 t/ha applied + Mustard oil cake @ 375 kg/ha applied, T₈ : Control. The surface soil of the experimental site was sandy loam in texture (sand 64.08%, silt 18.66%, clay 17.26%), acidic in reaction (pH 5.5), medium organic carbon (0.58 %), medium available nitrogen (N 292.87 kg/ha) but low in available phosphorus (P₂O₅ 20.28 kg/ha) and potassium (K₂O 107.71 kg/ha). Initial population of root-knot juveniles (J₂s) recorded from the experimental field was 350/250 cc of soil. The experiment was conducted in Randomised Block Design with an area of 144 m², divided in to 24 plots measuring 3 m x 2 m (6 m²) in each plot with three rows (Replication 3). A gap of 75 cm was maintained between two plots. Tomato seeds of 'Pusa Ruby' variety were sown in already prepared 1 x 3 m² sized nursery bed near the experiment conducted field. Watering regularly maintained seedlings. Three-week-old healthy seedlings were transplanted in plots keeping the spacing of 75 cm x 30 cm between rows and plants respectively according to package of practices for horticultural crops of Assam. Irrigation, weeding, earthing up and staking of the plants were done whenever felt required. After full maturity (75 days) the plants were harvested. Ten plants from each plot were uprooted randomly and the roots were washed carefully in slow tap water to remove adhering soil particles. Plant growth parameters (shoot and root lengths,

fresh weight of shoot and root, dry weight of shoot and root), nematode infestation (number of galls per root system) and nematode reproductive characters (number of egg masses per root system) were determined and recorded.

Results and Discussion

Results presented in [Table-1] and [Table-2] revealed that all the seven treatments significantly increased the plant growth parameters of tomato and decreased multiplication of

M. incognita. The shoot length, fresh and dry weight of shoot was found to be maximum with the application of Clear plastic mulch of 0.75 mm density + Mustard oil cake @ 750 kg/ha (T_6) followed by the treatment combination of clear plastic mulch of 0.75 mm density and vermicompost @ 2 t/ha (T_5). This result is conformity with that of Galip (2007), who reported combination treatment of plastic mulch and organic amendment improve plant growth parameters and yield of tomato. The improve plant growth and yield of tomato in above mentioned two treatment combinations may be due to enhancement of rhizosphere soil temperature which may facilitate to proper degradation of applied organic matters leading to increase the available of macro and micro nutrients inside the soil rhizosphere zone favourable to the crop. In support of this discussion we can site report of Gamliel and Stapleton (1993), where they mentioned that soil solarisation and its combination with organic amendment cause a chain reaction of chemicals and microbial degradation increase plant growth regulators. Gamliel and Stapleton (1993) also reported excellent control of root-knot nematode (*Meloidogyne incognita*) in the San Joaquin Valley by combining solarisation with the application of organic manure. Galip (2007) also reported that combination treatment of plastic mulch and organic amendments was an effective soil disinfestations method which reduced the number of galls and egg masses to a minimum level. Decrease of nematode population was observed in (T_6) and (T_5), [Table-2] may be for the chain reactions brought about to the organic matters by the increased temperature and moisture due to plastic mulch. Gamliel *et al.* (1999) reported that solarisation of plastic mulch with organic manure increases chemical and microbial degradation, leading to the generation of toxic compounds in the vapour or solid phase and accumulate under plastic mulch, which enhanced toxic activity against

soil flora and fauna.

All treatments were found to be effective in increasing plant growth parameters and decreasing nematode reproductive parameters over untreated control. Application of vermicompost, mustard oil cake and *T. viride* alone successfully improved the plant growth parameters of tomato. This result is in conformity with that of Gowda and Shetty (1973) who reported that application of different oil cakes and farmyard manure improve plant growth parameters in phytonematode infested soils. Similarly, Sidique *et al.* (1976) and Trivedi *et al.* (1978) also reported increase plant growth parameters and decrease nematode population in nematode infested soils treated with organic matters including mustard oil cake.

Among the treatments with different components applied alone, maximum plant growth parameters and yield was recorded in the treatment with mustard oil cake @ 750 kg/ha (T_4). Same trend of results was also reported by Patel *et al.* (1985) when mustard oil cake was used against *M. incognita* on okra. Bora and Phukan (1983) used three organic amendment viz., poultry manure, mustard oil cake and neem oil cake and reported increased yield of green gram under field condition. Further, the reproductive parameters of *M. incognita* recorded in the (T_4) also revealed that the treatment with mustard oil cake @ 750 kg/ha alone and *T. viride* @ 20 kg/ha alone found to be statistically at par. Momotaz *et al.* (2012) reported similar results when mustard oil cake alone and bio agent *Trichoderma hurzianum* alone were applied against *M. incognita* on cucumber. Same trend of findings were also reported by Tripathi and Singh (2016) when tomato plant treated with mustard oil cake alone and *T. viride* alone.

However, all plant growth parameters and nematode reproductive factors were found to be failed to reach the desired level in the treatment with clear plastic mulch 0.75 mm density alone. It may be because of low available nutrients in the experimental field [Table-1] that are essential for growth and developments of plants. Further, the lethal temperature for control of plant parasitic nematode is around 45°C. To attain this temperature it needs higher levels of solar radiation for long periods of time. Hartman (2002) also reported that soil solarisation with plastic mulch needed long, hot and sunny days to reach the desired soil temperatures which may able to kill soil borne pests.

Table-1 Effect of different treatments in plant growth parameters on tomato (Mean of 3 replications)

Treatments	Shoot length (cm)	Fresh weight of shoot (g)	Dry weight of shoot (g)	Root length (cm)	Fresh weight of root (g)	Dry weight of root (g)
T_1 = Clear plastic mulch of 0.75 mm	53.30 ^d	301.57 ^d	40.18 ^f	23.70 ^e	38.43 ^d	6.51 ^d
T_2 = Vermicompost @ 2.00 t/ha	56.17 ^{cd}	304.10 ^d	42.80 ^e	24.33 ^e	39.93 ^d	6.68 ^d
T_3 = <i>Trichoderma viride</i> @ 20 kg/ha	57.80 ^c	310.04 ^c	45.33 ^d	27.37 ^d	41.73 ^c	6.80 ^{cd}
T_4 = Mustard oil cake @ 750 kg/ha	59.67 ^c	312.83 ^c	46.40 ^d	28.30 ^d	43.23 ^c	7.18 ^c
T_5 = Clear plastic mulch of 0.75 mm density + Vermicompost @ 2.00 t/ha	66.70 ^a	337.53 ^a	54.03 ^b	35.23 ^b	47.47 ^b	8.71 ^b
T_6 = Clear plastic mulch of 0.75 mm density + Mustard oil cake @ 750 kg/ha	68.93 ^a	342.33 ^a	56.40 ^a	39.93 ^a	50.60 ^a	9.79 ^a
T_7 = Vermicompost @ 1.00 t/ha + Mustard oil cake @ 375 kg/ha	63.83 ^b	318.97 ^b	49.27 ^c	30.33 ^c	45.83 ^b	7.90 ^c
T_8 = Control						
	44.77 ^f	277.58 ^e	34.90 ^g	18.80 ^f	40.60 ^f	6.20
S.Ed(±)	1.28	2.54	0.56	0.87	1.21	0.22
CD _{5%}	2.76	5.45	1.21	1.87	2.60	0.49

Mean followed by the same letter in the superscript(s) are not significantly different

Table-2 Effect of Clear plastic mulch, Vermicompost, *Trichoderma viride*, and Mustard oil cake on reproductive parameters of *Meloidogyne incognita* on tomato (Mean of 3 replications)

Treatments	No. of galls	No. of egg masses	Final nematode population / 250 cc soil	% decrease over control	% increase/ decreased over INP
T ₁ = Clear plastic mulch of 0.75 mm	83.67 ^a	60.33 ^a	322.43 ^a	34.54	-7.87
T ₂ = Vermicompost @ 2.00 t/ha	82.30 ^a	57.33 ^a	320.93 ^a	34.84	-8.30
T ₃ = <i>Trichoderma viride</i> @ 20 kg/ha	73.67 ^{cd}	45.67 ^d	301.70 ^d	38.74	-13.8
T ₄ = Mustard oil cake @ 750 kg/ha	76.00 ^d	48.00 ^d	306.57 ^d	37.76	-12.40
T ₅ = Clear plastic mulch of 0.75 mm density + Vermicompost @ 2.00 t/ha	65.33 ^b	29.33 ^b	278.47 ^d	43.46	-20.43
T ₆ = Clear plastic mulch of 0.75 mm density + Mustard oil cake @ 375 kg/ha	57.67 ^a	23.33 ^a	260.50 ^a	47.11	-25.57
T ₇ = Vermicompost @ 1.00 t/ha + Mustard oil cake @ 375 kg/ha	70.33 ^c	39.33 ^c	295.93 ^c	39.92	-15.44
T ₈ = Control	118.33 ^f	82.67 ^f	492.57 ^f		+28.94
S.Ed±	2.28	1.7	2.34		
CD0.05	4.90	3.67	5.03		

(-) = Decrease; (+) = Increase; INP = Initial Nematode Population Initial nematode population is 350/250 cc of soil Mean followed by the same letter in the superscript(s) are not significantly different

Conclusion

The present study revealed that all seven tested treatments brought about a significant reduction in number of galls, egg masses, and final nematode population in soil over control. The treatment with clear plastic mulch of 0.75 mm density + mustard oil cake @ 750 kg/ha (T₆) was found to be most effective in increasing plant growth parameters, decreasing the nematode the nematode reproductive parameters under nematode infested condition.

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Author Contributions

- [1]-Execution of the research work and all necessary lab and statistical analysis with the technical guidance of the advisors.
 [2]-Helps in planning, designing, executing the research work and other technical writing parts.
 [3], [4], [5],[6]-Helping in preparing the manuscript and conduction of research in the field.

Abbreviations

MT: Million Tonnes, INP = Initial Nematode Population

Conflict of Interest: None declared

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