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Eco-friendly management of disease complex of tomato caused by root knot nematode and wilt causing fungus

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Abstract

With the mission attempting eco-friendly management of pathogenic fungus *Fusarium oxysporum* f. sp. *lycopersici* and root knot nematode *Melidogyne incognita* causing disease complex on tomato. The development of disease management package through non chemical natural resources particularly using antagonist fungal bioagent *T. viride* and *P. lilacinus* with Karanj oil seed cake was found most effective and by this integrated treatment we get maximum yield with minimum disease complex incidence. In this treatment minimum number of gall/plant, number of egg masses/plant, number of eggs/ egg masses and nematode population with high egg parasitization of egg masses through fungal bioagent were recorded. By this integrated treatment we get maximum yield with minimum disease complex incidence.

Keywords: Antagonist, endoparasitic, pathogenic, phyllogenetic

Introduction

Tomato crop is highly susceptible to root pests especially nematodes and shoot and fruit pests. Secondary the wilt fungus *Fusarium oxysporum* f. sp. *lycopersici* is another most devastating energy of vegetables in vascular wilt caused by fungus which causes constraints in production of tomato. In present paper an attempt has been made to check the nematode population and wilt fungus incidences with above ecofriendly management component for achieving healthier crops and soil. (Butler 1918, Chahal 2007, Devi & Sharma 2008)

Materials and Methods:

Extensive survey conducted successively for two cropping season during February to May and July to October in vegetable growing field confining mainly to tomato crop. The highly infested tomato field referred as ‘hot spot’ exhibited mostly 3types of plant viz (a)highly wilted ones (b)Non wilted plants with heavily galled roots and (c) the highly stunted with heavy galling. On uprooting the diseased plants, heavy galling was observed due to root knot nematode, each of which on closer examination also show wilt symptoms. The galled roots were observed to be the population density of *Meloidogyne incognita* was between 4 and 8 larvae /g soil. From the above survey of many tomato crops in vegetable growing area are showed severe wilt symptoms by vascular wilt causing fungus with colony forming unit (CFU) showing spore load 2 x 10^8/g soil. The integrated management of root knot wilt complex is carried out in two phases i.e.

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a) Nursery stage

Conducted in randomized block design with three replications with 1xl m^2 micro plot size. The initial soil status of nematode and wilt population were 2 larvae/g soil and spore load 3x10^8/g soil respectively. For soil treatment with talc based formulation of potential antagonists, *T. viride* (TV_4) and *lilacinus* (PL_4) was applied in soil @200g/m^2 with spore load2 x 10^8 at sowing in integration with karanj oilseed cake @ 500 g/m^2 two week prior to sowing of the seed. The treatments for this experiment were as follows:

i. *T. viride* alone @ 10 g w/w + N
ii. *P. lilacinus* @ 10 g w/w + N
iii. KC alone @ 2% w/w + N
iv. *T. viride* + KC + N
v. *P. lilacinus* KC + N
vi. *T. viride* + *P. lilacinus* + N
vii. *T. viride* + *P. lilacinus* + KC + N
viii. Nematode alone (N @ 2 g/gm soil) + fungus alone (F @ 2 g mycelial mat 1500 gm soil)

b) Followed by 2 bare root dip treatment prior to transplantation on hot spot at infested microplot with.

Population of 3 second stage larvae per gram soil and root wilt, *F. oxysporum* f. sp. *lycopersici* (with initial spore load $3x10^{\mathbf{8}}$ /gram soil). The micro-plot experiment at hot spot was conducted randomized block design with three replications with 4x2.5 plot size. Prior to transplantation of 4 weeks old about 25 healthy seedlings from each of the above nursery bed treatments, bare root treatments were done with each of the respective treatments separately for 30 minutes. Thereafter each of the above seedlings was transplanted singly to the main infested field after deep ploughing. The treatments from the nursery beds through bare root in a lurry containing same components were maintained separately till transplantation to the main infested field. Till harvest i.e. days after transplantation the corresponding treatments were maintained for proper observation at harvest. Plant growth, yield and disease incidence including root wilt, root galls were recorded at 15 days interval upto maturity of crop after 60 days transplanting of seedlings.

The treatments for experiment were as follows:

1.*T. viride* alone @ 10 g w/w + N

2. *P. lilacinus* @ 10 g w/w + N

3.K.C. @ 2% w/w + N

4. *T. viride* + K.C. + N

5. *P. lilacinus* + K.C. + N

6. *T. viride* + *P. lilacinus* + N

7. *T. viride* + *P. lilacinus* + KC + N

8. Fungus (with initial spore load $3x10^8$/gm soil)

Selecting best treatment through in-vitro, pot and above microplot trials with sustainable management components to combat disease complex caused by soil borne root knot nematode and root wilt fungus, it is expected to evolve a package which would be economical and safe for the farmers.

Results and Discussion

For the management of disease complex caused by root knot nematode, *M. incognita* and root wilt causing fungus *F. oxysporum* f. sp. *lycopersici* on tomato plants, pot experiment was conducted both alone and completely randomized block design with five replications using based bioformulation of potention antagonists, *T. viride*-Lucknow *P. lilacinus*- Allahabad in integrating with karanj oil seed cake was found most effective in improving the plant biomass (117.20 g) with significantly reduced root galls (4.64), no. of eggs/egg mass (0.68), no. of egg masses/plant (12.81), root know nematode population (215.0/500g soil) as compared to all other treatments. Maximum per cent of egg infection and penetration of egg masses of *M. incognita* was also recorded in this treatment as observed through microscope. A remarkable fungal colonization on eggs was also found more profusely in the gelatinous matrix and egg section occurred after few days of incubation (Table-1). Integrated management of disease complex caused by *M. incognita* and *F. oxysporum f. sp. Lycopersici* on tomato by *T. viride, P. lilacinus* and karanj oilseed cake under micro plot. To confirm the findings of integrated approach of using fungal bioagents of karanj oilseed cake for the management of disease complex caused by root know nematode and wilt causing fungus on tomato under micro plot conditions a field heavily infested with root know nematode about 3 juveniles/g soil and wilt causing fungus with CFU 2 x 10^6 conidia was identified. The microplot experiment was conducted in a sequence of treatments viz.: nursery bed, bare root dip treatment followed by transplantation to the main infested microplot. At nursery bed the treatments were monitored for 4 weeks following which they were harvested and the results presented in Table-2. Among all the treatments under study evaluated against disease complex caused by *M. incognita* and *F. oxysporum* f. sp. *lycopsersici*, the most outstanding performance was encountered in the treatment where *T. viride* (Tv_4) and *P. lilacinus* (PL_4) in integration with karanj oilseed cake were applied together. This showed maximum seed germination percentage (81.0) followed by *viride*+oilseed cake (72.01), *T. viride* + *P. lilacinus* (69.68), *lilacinus* +oilseed cake (66.01), *T. viride* (63.68), oilseed cake (9.68) and *P. lalicinus* (58.34) while in control (41.0) under microplot experiment (Table-2).Regarding the response of the health of tomato seedlings as influenced by different management components on disease complex alone and in combination which is represented by the biomass of ten seedlings as above the treatment constituting talc based *T. viride* and *P. lilacinus* together with karanj oilseed cake was most promising (67.50) followed by *T. viride* + oilseed cake (65.81), *T. viride* + *P. lilacinus* (60.40), P.

Table-1: Effect of plant grown parameters and disease complex incidences caused by *M. incognita* and *F. oxysporum* f. sp. *lycopersici* on tomato under pot experiment by talc based *P. lilacinus* and *T. viride* in integrated with karanj oilseed cake.

S. No.	Treatments	Biomass (g)	Root wilt incidence	No. of galls / plant	Egg masses / plant	Eggs / egg mass	Egg infection percent	Nematode population
1.	T_1 (*T. viride*)	101.17	23.61	16.44	26.56	78.51	53.51	1650.61
2.	T_2 (*P. lilacinus*)	94.26	28.74	18.68	27.81	89.88	79.88	1860.51
3.	T_3 (Karanj oil seed cake)	102.56	24.17	14.38	22.81	70.59	0.00	1475.59
4.	T_4 (T. viride + karanj oil seed cake)	116.29	16.31	6.51	14.71	52.17	56.17	325.76
5.	T_5 (P. lilacinus + karanj oil seed cake)	113.70	21.36	8.91	16.75	58.70	81.36	675.01
6.	T_6 (*T. viride+ P. lilacinus*)	112.21	17.46	10.18	18.27	63.16	86.71	330.76
7.	T_7 (*T. viride+ P. lilacinus* + karanj oil seed cake)	117.21	12.90	4.66	12.83	48.78	92.68	215.01
8.	T_8 (Control)	72.69	43.68	158.53	247.49	296.41	0.00	5573.61
9.	T_9 (Un-inoculated)	92.66	0.00	0.00	0.00	0.00	0.00	0.00
SEm±		1.11	1.09	2.62	1.62	2.68	1.59	6.79
C.D. (P=0.001)		1.13	1.63	3.47	5.90	8.53	4.59	34.79
Mean of three replications								

Table-2: Effect of germination of seeds, mortality of seedling and disease complex incidence caused by *M. incognita* and *F. oxysporum* f. sp. *lycopersici* on tomato under nursery bed by talc based *P. lilacinus* and *T. viride* in integrated with karanj oilseed cake.

S. No.	Treatments	Germination percent	Percent mortality of seedlings	Biomass* (g)	Gall/ plant	Egg masses/ plant*	Soil population/ 500 g soil
1.	T_1 (*T. viride*)	63.67 (52.94)	23.67(29.11)	48.60	4.60	8.90	580.78
2.	T_2 (*P. lilacinus*)	58.33 (49.81)	28.67(32.38)	46.50	6.20	10.40	760.50
3.	T_3 (Karanj oil seed cake)	59.67 (53.58)	27.67(31.75)	47.85	7.90	12.65	850.60
4.	T_4 (T. viride + karanj oil seed cake)	70.00 (58.06)	15.33(23.06)	65.80	2.50	3.80	189.30
5.	T_5 (P. lilacinus + karanj oil seed cake)	66.00 (54.34)	19.33(26.09)	52.90	3.80	4.89	228.13
6.	T_6 (*T. viride+ P. lilacinus*)	69.67 (56.59)	17.33(24.58)	60.40	1.60	1.00	178.56
7.	T_7 (*T. viride+ P. lilacinus+* karanj oil seed cake)	81.00 (54.59)	7.00(15.33)	67.50	0.00	0.00	158.47
8.	T_8 (Control)	41.00 (39.83)	41.67(40.22)	18.50	13.80	23.70	2290.40
9.	T_9 (Un-inoculated)	62.67 (52.35)	3.33(10.50)	57.75	0.00	0.00	194.60
SEm±		1.83	1.16	2.95	1.20	1.17	8.74
C.D. (P=0.001)		4.87	5.89	4.78	1.60	1.96	12.68
Mean of three replications, * Average of ten seedlings plants							

lilacinus + oilseed cake (52.90), T. *viride (*48.60), oilseed cake (47.85) and *P. lilacinus* (46.50) while in control experiment (Table-2). Besides the results on parameter of seedlings of tomato and on germination of seeds, the data on multiplication of *M. incognita* both in roots and in soil clearly showed minimum number of galls/plant in treatment. *T. viride* and P. *lilacinus* when treated with karanj oilseed cake (0.0) followed by T. *viride* + *lilacinus* (1.6), T. *viride* + oilseed cake (2.51), *P. lilacinus* + oilseed cake (3.8), T. viride (4.61), P. lilacinus (6.21) and oilseed (7.91). In control plants under microplot experiment maximum number of galls (13.81) was recorded. nematode population and wilt incidence, when the same treatment was compared with karanj oil seed cake the latter showed better results on plant biomass. (Barber, 1901, Bhagawati & Goswami 2000, Ahmad *et al* 1988).

Conclusion

Through the above survey of vegetables crop particularly tomato on farmer's field showing heavy infestation several beneficial fungi were also isolated and identified out of which fungal bioagent viz *Paecilomyces lilacinus, Tricoderma Viride and G. fasciculatum* after isolation and identification from rizosphere and rhizoplane of root knot affected plants were maintained as management component of present study. These isolated of each of the above fungal bioagents collected from fields along with other two isolates from already existing once procured from IARI Delhi were subjected to in vitro tests for selecting the most potential isolates of each. For achieving the target of minimize the incidence of disease complex caused *by M. incognita and F. oxysporum f. sp lycospersici* most potential isolates of each fungal bio agent viz. P. *lilacinus and T. viride* were proved to be very important management component for the present integrated package.

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