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SHORT COMMUNICATION

Effectiveness of some integrated disease management factors (IDM) on Fusarium wilt infected tomato

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Abstract

The study was conducted to investigate efficacy of Integrated disease management (IDM) viz., solarized soil, *Trichoderma harzianum*, spent mushroom compost and carbendazim on growth characteristics of infected tomato by Fusarial wilt (*Fusarium oxysporum* f.sp. lycopersici) under pots conditions in the Bio-net house during 2013-2014. Seven treatments and five replicates were taken up in completed randomized design. Maximum shoot length, fresh and dry shoot weight were noticed in T4 (solarized soil+ Spent mushroom compost+ *T. harzianum*) 118.10 cm, 67.25 and 42.20 g respectively as compared to *T. harzianum* or spent mushroom compost that alone treated plants. Maximum root length, fresh and dry root weight were also recorded in T4 (solarized soil+ spent mushroom compost+ *T. harzianum*) 28.35 cm, 4.65 and 2.55 g respectively. The yield of tomato plants was significantly increased in T6 (tomato plant alone without *Fusarium oxysporum*) 170.15 g/plant followed by T4 137.52 g/plant as compared with T0- *Fusarium oxysporum* alone and T1-Solarized soil + *Fusarium oxysporum* 0.0 g.

Key words: *Fusarium oxysporum*, *Trichoderma harzianum*, spent mushroom, carbendazim

Introduction

Tomato (*Lycopersicon esculentum* Mill.) is one among the most used vegetable in family solanaceae and is cultivated in many areas throughout the world (Villareal, 1979). There are many diseases for this plant, and Fusarium wilt is major among them causing 10-50 % yield loss (Larkin and Fravel, 1998; Borrero et al., 2004). It is of worldwide importance where at least 32 countries had reported the disease, which is particularly severe in countries with warm climate. Mui-Yun Wong, (2003). It is a devastating disease causing considerable economic losses ranging from 10-80% yield loss in many tomatoes producing area of the country (Kesavan and Chaudhary, 1977). Integrated disease management (IDM), is an important strategy to control this deadly disease (El Khoury and Makkouk, 2010).

The genus, *Trichoderma* (Deutromycota, Dematiaceae), is a common saprophytic fungus in the rhizosphere soil. This has some mycoparasite ability against plant pathogens (Papavizas, 1985; Elad et al., 1993; Elad, 2000; Freeman et al., 2004; Dubey et al., 2007) and

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nematodes (Windham et al., 1989; Sharon et al., 2001). This fungus can be used as a biocontrol measure for many diseases (Sivan and Chet, 1986; Calvet et al., 1990).

Similarly, mushroom compost (spent mushroom substrate (SMS), mushroom soil) also has some antimicrobial effects and can be used against plant diseases caused by fungi (Davis et al. 2005). This study was conducted to evaluate some IDM elements: Solarized soil, *Trichoderma harzianum*, spent mushroom compost and carbendazim on some growth parameters of infected tomato by Fusarium wilt.

Materials and Methods

Study area

The present study was carried out under pots conditions in the Bio-net house, Department of Plant Pathology, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Naini, Allahabad during 2013-2014 with seven treatments *Fusarium oxysporum* alone, Solarized soil + *F. oxysporum*, Solarized soil + spent mushroom compost + *F. oxysporum*, Solarized soil + *Trichoderma harzianum* + *F. oxysporum*, Solarized soil+ spent mushroom compost + *Trichoderma harzianum* + *F. oxysporum*, Carbendazim + *F. oxysporum* and Tomato plant alone (without *F. oxysporum*) with five replicates. Tomato cultivar seeds CO - 3 were obtained from IIVR (Indian Institute of Vegetable Research), Varanasi, Uttar Pradesh, India. *Trichoderma harzianum* were obtained as biocont from Yash Trichoguard, DBT Referral Lab, SHIATS, Allahabad, Uttar Pradesh, India. Spent mushroom compost acquired from Department of Plant Pathology, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Uttar Pradesh, India. *Fusarium oxysporum* f.sp. *lycopersici* was isolated from infected roots of tomato by tissue segment method. The infected roots of tomato were cut separately into small pieces into the wash glass with the help of sterile blade and surface sterilized with mercuric chloride (0.1%) for 20-30 seconds followed by three times rinsing with sterilized distilled water. The diseased pieces were then placed on pre-sterilized blotting paper to remove excess moisture. The surface sterilized diseased pieces were then aseptically, transferred on PDA medium and incubated at 28±2°C for five days. After incubation, colonies were observed and identified on the basis of morphological and reproductive characters.

Pathogenicity of *Fusarium oxysporum* f.sp. *lycopersici* was tested on healthy tomato seedling at the three-true-leaf stage according to Koch's postulate, their roots were cut and dipped into conidial suspension (10^6 spores/ml) of tested isolate for 30 minute, and then the seedlings were transplanted into sterilized soils in pots (10 cm in diameter) and kept in Bio-net. After symptoms appeared the pathogen was re-isolated from infected portion of tomato seedling and again identified through microscopic method in the laboratory.

Farm yard manure (FYM) @ 100 g / pot was mixed with solarized and unsolarized soil and was filled in thirty-five pots with capacity 10 kg soil / pot. The bioagent *Trichoderma harzianum* was applied @ 2 g / pot, four days before sowing the seeds of tomato variety (CO-3), carbendazim 50 % W.P was applied @ 2 kg a.i / ha, whereas spent mushroom compost was unsterile and mixed with soil in the pots @ 20 g / kg of soil. Seven days after germination, four seedlings per pot were maintained in each treatment. Observations were recorded on shoot length (cm), fresh and dry shoot weight (g), root length (cm), fresh and dry root weight (g) and yield / plant (g). In the experiment Complete Randomized Design (CRD) was adopted. Soil solarization was conducted for 2 months from 15th April to 15th June 2013 at research field of SHIATS, Allahabad, The soil was tilled, leveled and Irrigation was given prior to laying of the polythene sheet which was transparent and thick.

The analysis of variance (ANOVA) technique was applied for drawing conclusion from data. The calculated values were compared the tabulated values at 5% level of probability (Fisher and Yates, 1968).

Results and discussion

Shoot length (cm)

The results presented in Table 1 revealed that significant increase of shoot length was found in T_6 (Tomato plant alone) and T_4 (solarized soil + Spent mushroom compost + *Trichoderma harzianum*+ *F.o*) (124.81 and 118.10 cm respectively) as compared with other treatments, However, (T_6, T_4), (T_3, T_4), (T_3, T_5) and (T_1, T_o), were found non-significant from each other.

Table 1. Effect of solarized soil with spent mushroom compost, *Trichoderma harzianum* and carbendazim on plant growth parameters of tomato.

Treatment	Shoot length (cm)	Fresh Shoot Weight (g)	Dry Shoot Weight (g)	Root Length (cm.)	Fresh Root Weight (g)	Dry Root Weight (g)	Yield / plant (g)
T0	50.65	7.50	5.05	10.35	0.60	0.39	0.00
T1	55.10	8.65	5.60	11.55	0.79	0.52	0.00
T2	81.25	40.70	21.95	23.85	4.35	1.90	128.25
T3	103.45	53.45	32.80	28.25	4.50	1.60	107.12
T4	118.10	67.25	42.20	28.35	4.65	2.55	137.52
T5	100.55	50.40	30.45	20.00	4.40	1.85	115.77
T6	124.81	91.35	61.60	28.65	6.20	3.30	170.15
C. D. 0.05	16.105	23.326	15.308	5.724	1.422	0.865	17.546

T_0- *Fusarium oxysporum* alone
T_1- Solarized soil + *F. oxysporum*
T_2 - Solarized soil + spent mushroom compost + *F. oxysporum*
T_3- Solarized soil + *Trichoderma harzianum* + *F. oxysporum*
T_4-Solarized soil+ spent mushroom compost + *Trichoderma harzianum* + *F. oxysporum*
T_5- Carbendazim + *F. oxysporum*
T_6- Tomato plant alone (without *F. oxysporum*)

Root length (cm)

The results presented in Table 1 revealed that T_6 (Tomato plant alone,28.65 cm), T_4 (solarized soil + Spent mushroom compost + *Trichoderma harzianum*+ F.o, 28.35 cm), T_3 (solarized soil + *Trichoderma harzianum*+ *F.o* ,28.25 cm) and T_2 (solarized soil + Spent mushroom compost+ *F.o*, 23.85 g) significantly increased in root length from T5 (carbendazim+ *F.o*, 20.00 cm), T1 (solarized soil + *F.o* ,11.55 cm) and T0 (*F.o* alone,10.35 cm). Among the treatments (T_0, T1), (T6, T_4, T_3, T2), (T_5, T_2) were not significant from each other.

Fresh and dry shoot weight (g)

The results presented in Table 1 revealed that treatments T6, T_4, T_3, T_5 and T_2 significantly increased in fresh and dry shoot weight from (T_1, T_0), However (T_4, T_3, T_5), (T_4, T_5, T_2) and (T_1, T_0), were found non-significant from each other.

Root fresh weight (g)

The results presented in Table 1 revealed that significantly increased the fresh root weight in treatments T_6 (6.20 g), T_4 (4.65 g), T_3 (4.50 g), T_5 (4.40 g) and T_2 (4.35 g) from T1 (0.79 g) and T0 (0.60 g).

Root dry weight (g)

The results presented in Table 1 revealed that significantly increased the dry root weight in the treatments T_6, T_4, T_2, T_5 and T_3 as compared with T1 and T0. However, the treatments (T_6, T_4), (T_4, T2, T5), (T_2, T_5, T_3) and (T_1, T_0) were found non-significant from among themselves.

Yield / plant (g)

Fruit yield (g) per plant of tomato were taken after 150 days of germination in the Table 1 revealed that significantly increased the yield (g) of tomato plants was found in T_6 (170.15 g, plant without fusarium and treatments), T_4 (137.52 g ,S.S + S.m.c + *T.h* +*F.o*) , T_2(128.25 g, S.S + S.m.c + *F.o*), T_5 (115.70 g ,C +*F.o*) and T_3(107.12 g, S.S + *T.h* +*F.o*), as compared with the treatments T_1(0.0 g, S.S + *F.o*) and T_0 (0.0 g, *F.o* alone), however the treatments (T_4, T_2) and (T_2,T_3,T_5) and (T_1,T_0) were found non-significant among themselves.

Najat and Kahkashan (2012) reported that under pots culture 117.5 % increase in plant height can be achieved for tomato plants treated with *T. harzianum*. Similar results were reported by Sundaramoorthy and Balabaskar (2013). Rasool et al. (2011) reported that *Trichoderma* species can be used as biocontrol agents against phytopathogenic fungi and increase fresh shoot and root weight in tomato seedlings. Increases in dry root weight in tomato seedlings were observed in treated soil with *T. harzianum* T969 as compared with the control, dry root weight also increased in seed that inoculated by *Trichoderma* isolates. Ebtsam et al. (2009) observed that control treatment was recorded low values of dry weight of plants in comparison with other treatments. Ebtsam et al. (2009); Niknejad et al. (2000) and Zaghloul et al. (2007) showed the treatment of *B. subtilis*, *T. harzianum* enhanced the number, weight and yield of fruits of tomato. The probable reasons for such findings may be that *Trichoderma harzianum* have many positive effects on plant and systemic resistance to plant diseases (Harman et al., 2004; Harman, 2006). The growth enhancement might be due to secretion of auxins, gibberellins and cytokinins (Sundaramoorthy and Balabaskar, 2013).

Conclusion

From the findings, it's concluded that effectiveness of some integrated disease management factors (IDM) on some characteristics of growth of infected tomato by fusarium wilt using *T. harzianum*, spent mushroom compost, chemical method (Carbendazim) and physical method (Soil solarization). Plants treated with a combination of *T. harzianum* and spent mushroom compost with solarized soil showed significant increasing in shoot length (cm), fresh and dry shoot weight (g), root length (cm), fresh and dry root weight (g) and yield / plant (g).

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Authors' contributions

SS and AAL planed and coordinated the research, HAS participated in, set up and carried out the field experiment, collected data, analysis and data interpretation, and wrote the article. ALA reviewed and submitted article to Journal of Scientific Agriculture. All the authors revised manuscript.

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