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Effect of Biocontrol, Physical Control and Compost on Tomato Plants that Infected with Fusarium wilt under Greenhouse Conditions

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Abstract The objective of this paper was to evaluate the efficacy of *Trichoderma harzianum*, Spent mushroom compost and carbendazim 50 % W.P with solarized and unsolarized soil to promote some of plant growth parameters of tomato plants infested with Fusarium wilt disease under *in vivo* conditions. The application of *T. harzianum* with spent mushroom compost exhibited the maximum number of fruits per plant after 150 days. Also tomato plants treated with carbendazim showed a significant stimulatory effect on weight of five fruits per replicate (g) of tomato plants by 132.50 g and increased the cost benefit ratio by 2.57 followed by treatment of *T. harzianum* by 2.31 in comparison with treatment of *F. oxysorum* alone.

Keywords: *Trichoderma harzianum, Carbendazim, spent mushroom compost, solarized soil*

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1. Introduction

Tomato is the most important vegetable crop in the tropics [3]. *F. oxysporum* causes foot and root rot in tomato plants and is a serious problem for both field and greenhouse crops [8]. Successful biological control systems commonly employ and naturally occurring, antagonistic microorganisms that are able to reduce the activities of plant pathogens. Such antagonists can compete with pathogens for nutrients, inhibit pathogen growth by secreting antibiotics, or reduce pathogen populations through parasitism. In addition, some of these microorganisms induce resistance in host plants, which enhances the plant's ability to defend itself from pathogen attack [4]. *T.* spp have evolved numerous mechanisms that are involved in attacking other fungi such as competition for space and nutrients, mycoparasitism, production of inhibitory compounds, inactivation of the pathogen's enzymes and induced plant resistance [2,5,9,15,13,18]. Soil solarization is a hydrothermal process of disinfesting soil of plant pathogens that is accomplished through passive solar heating [16]. The composts, in general, enhanced microbial activity (total fungi and bacteria) in amended soils resulting in reduction in inoculums density and capacity as well as better plant growth (in terms of shoot and root lengths) and disease control. Mushroom composts were most effective in reducing the mean inoculum load of *Fusarium oxysporum* f. sp. *Iycopersici* [12]. This study was therefore carried out to evaluate Cost benefit ratio of tomato yield by using *T. harzianum*, spent mushroom compost and carbendazim 50 % W.P with solarized and unsolarized soil against *F. oxysporum.*

2. Materials and Methods

2.1. Source of Fungi, Spent Mushroom Compost and Tomato Seeds

Pathogenic fungal isolate, *F. oxysporum* f. sp. *lycopersici* and antagonistic fungal biocontrol, *T. harzianum* and Spent mushroom compost were obtained from Department of Plant Pathology, Sam Higginbottom Institute of Agriculture, Technology & Sciences, Naini, Allahabad, Tomato cultivar seeds CO - 3 were collected from IIVR (Indian Institute of Vegetable Research), Varanasi, Uttar Pradesh, India.

2.2. Inoculants of Pathogenic and Trichoderma Fungi, Carbendazim and Spent Mushroom Compost

F. oxyspoum f.sp. *lycopersici* was subcultured on potato dextrose agar at 27±1°C. *Fusarium* culture suspension (3×10^5cfu/ ml) was added as soil treatment for each pot. Carbendazim 50 % W.P was applied @ 2 kg a.i/ha, whereas *T. harzianum* @ 2 g / pot and spent mushroom compost was mixed with soil in the pots @ 20 g / kg of soil [14].

2.3. Greenhouse Experiment

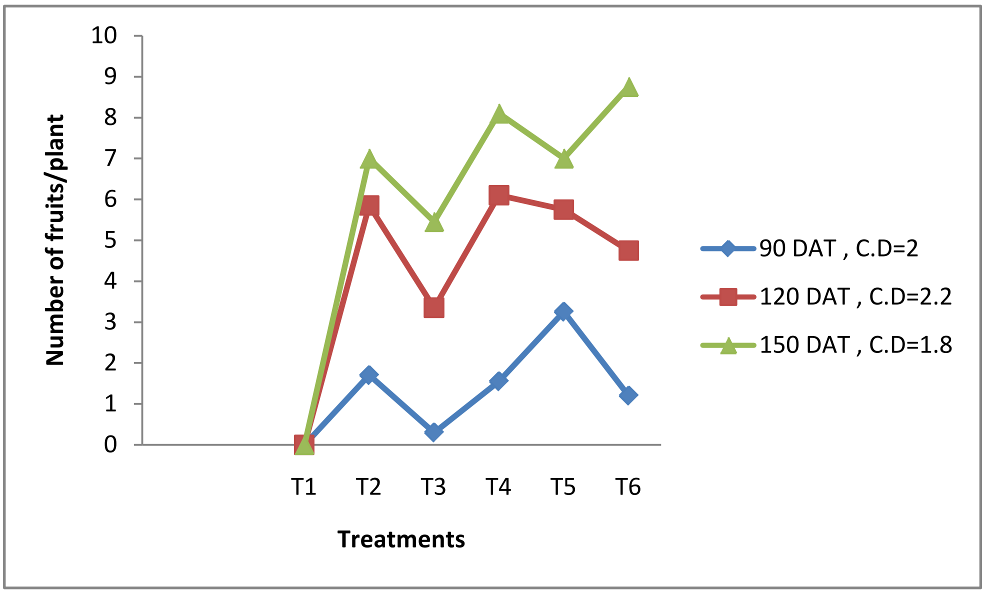
Tomato seeds transplanted in pots (15 cm diameter) containing a sandy clay soil under greenhouse conditions, Four plants / pot and five pots for each treatment were used. Also, the solarized and unsolarized soils was mixed with FYM @ 100 g / pot and were filled in thirty pots. The experiment was laid out in CRD.

3. Results and Discussion

A pots experiment was carried out to examine the *in vivo* efficiency of *T. harzianum*, spent mushroom compost and Carbendazim to antagonize *F. oxyspoum* under greenhouse conditions. The maximum number of fruits per plant was recorded in T_5 (non S.S + C +*F.o*) 3.25 at 90 days and T_4 (S.S + S.m.c + *T.h* +*F.o*) 6.10, 8.10 at 120 and 150 days respectively as compared with other treatments (Figure 1), similar finding by [11,19] reported that application of selected antagonist *T. harzianum* has significantly increased the number of fruits / tomato plant.

Trichoderma can parasitize fungal pathogens and produce antibiotics, in addition, the fungus have many positive effects on plant growth, yield, nutrient uptake, fertilizer utilization efficiency, rate of seed germination and systemic resistance to plant diseases [6,7,10].

The result of Figure 2 revealed that significantly increased in the weight of five fruits per replicate of tomato plants in treatments T_6 (S.S + tomato plant) 158.60 g, T_5 (non S.S + C +*F.o*) 132.50 g, T_2 (S.S + S.m.c + *F.o*) 131.60, T_4 (S.S + S.m.c + *T.h* +*F.o*) 114.70 g, and T_3 (S.S + *T.h* +*F.o*) 102.50 g as compared with T_1 (non S.S +*F.o*) 0.00 g. [1] reported that significant increase was noticed with the fungicide treatment in the yield of tomato plants as compared with control treatment. [17] reported that the fruit yield were increased when tomato plants were treated with *T. harzianum*.



Solarized soil = S.S, *F. oxysporum* = *F.o*, Spent mashroom compost = S.m.c, Carbendazim = C, *T. harzianum* =*T.h*

Figure 1. Effect of S.m.c, *T. harzianum* and carbendazim using solarized and unsolarized soil on the Number of fruits per tomato plant at 90, 120, 150 days

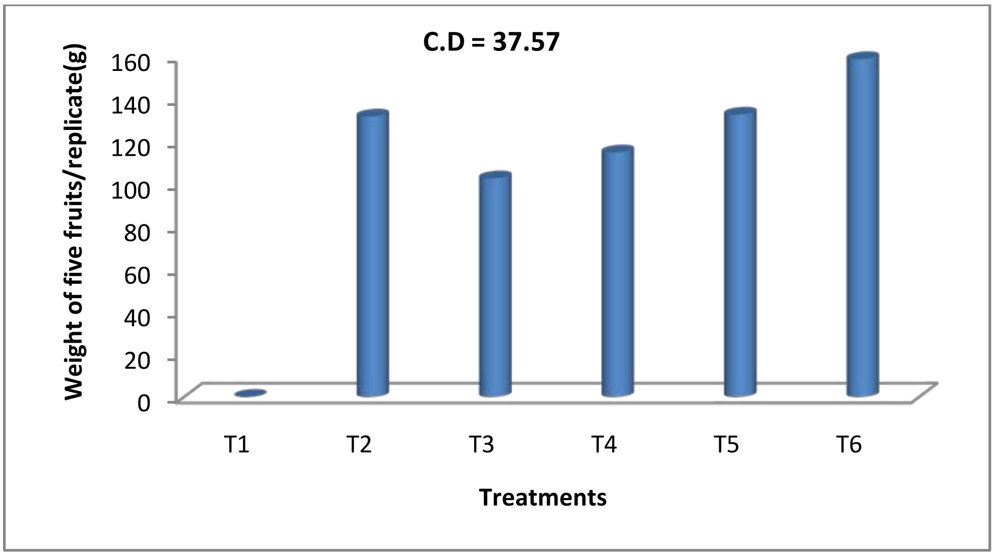


Figure 2. Effect of S.m.c, *T. harzianum* and carbendazim using solarized and unsolarized soil on the weight of five fruits per replicate (g) at 125 days

3.1. Cost Benefit Ratio

The data with respect to cost benefit ratio as influenced by various treatments is presented in Table 3 which revealed that the higher amount of monetary return was obtained with T_6 (S.S + tomato plant) with 4.50, followed by T_5 (non S.S + C +*F.o*) 0.5kg/ha with 2.57, T_3 (S.S + *T.h* +*F.o*) 2.5 kg/ha with 2.31,T_4 (S.S +S.m.c+ *T.h* +*F.o*) 4000+ 2.5Kg/ha with 1.41,T_2 (S.S + M.C + *F.o*) 4000 Kg/ha with 1.26.The minimum cost benefit ratio in T_1 (Non S.S + *F.o*) obtained (0).

Notice: Cost benefit ratio without units

Table 1. Cost of agronomical practices of cultivation per hectare

Sr. No.	Particular	Requirement	Rate/unit (Rs)	Cost (Rs)
(A)	**Land preparation**			
I.	Ploughing	3 hours	500 Rs/hours	1500
II.	Harrow	3 hours	500 Rs/hours	1500
III.	Layout of field	10 labours	150 Rs/labour	1500
(B)	**Manures and fertilizer**			
I.	FYM	20 tons	100 Rs /qu.	20000
II.	Urea	193 Kg	7 Rs/Kg	1351
III.	DAP	174 Kg	15 Rs/Kg	2610
IV.	Labour	6 labours	150	900
(C)	**Seed sowing**			
I.	Seed material	0.5 kg	1500 Rs/Kg	750
II.	transplanting and leveling	12 labours	150	1800
(D)	**Weed Management**	15 labour X3 time	150 Rs/labour	6750
(E)	**Harvesting**	30 labours	150 Rs/labour	4500
(F)	**Total cost of cultivation**			**25161**

Table 2. Economics of treatments

Sr. No.	**Treatment**	**Use of S.m.c, *T. harzianum* and carbendazim**	**Cost of S.m.c, *T. harzianum* and carbendazim**	**Total Cost S.m.c, *T. harzianum* and carbendazim**	**Use of 3 labours 2 time spray**	**Total labours cost (Rs)**	**Total cost of Treatment (Rs)**
T_1	Non S.S + *F.o*	0	0	0	0	0	0
T_2	S.S + S.m.c + *F.o*	4000Kg/ha	5 Rs/ kg	20000	150 Rs/labour	900	20900
T_3	S.S + *T.h* + *F.o*	2.5kg/ha	80Rs/kg	200	150 Rs/labour	900	1100
T_4	S.S + S.m.c + *T.h* + *F.o*	4000+ 2.5Kg/ha	5+ 80 Rs/ kg	20200	150 Rs/labour	900	21100
T_5	Non S.S + C + *F.o*	0.5kg/ha	560Rs/kg	280	150 Rs/labour	900	1180
T_6	S.S + tomato plant	0	0	0	0	0	0

Table 3: Cost benefit ratio

Treatments				**M**	**N**	**A**	**D**	**F**	**G**	**H**	**O**
		Quantity of S.m.c , *T.h* and carbendazim /ha.	**Price rate of S.m.c , *T.h* and carbendazim Rs/kg**	**Treatment cost RS /ha. (M)**	**Agronomical Practices cost Rs/ha (N)**	**Total cost Rs /ha. (A)=M+N**	**Yield Ton /ha.(D)=no of plants /ha (37000) × yield / plant**	**Price of yield Rs/ton (F)**	**Total value of yield Rs/ha (G)=D ×F**	**Net return Rs/ha (H)= G - A**	**Cost benefit Net return/total cost (O)=H/A**
T_1	**Non S.S + *F.o***	0	0	0	25161	25161	0	22000	0	0	0
T_2	**S.S + S.m.c + *F.o***	**4000Kg/ha**	**5 Rs/ kg**	**20900**	25161	46061	4.745	22000	104390	58329	1.26
T_3	**S.S + *T.h* + *F.o***	**2.5kg/ha**	**80Rs/kg**	**1100**	25161	26261	3.963	22000	87186	60925	2.31
T_4	**S.S + S.m.c + *T.h* + *F.o***	**4000+ 2.5Kg/ha**	**5+ 80 Rs/ kg**	**21100**	25161	46261	5.088	22000	111936	65675	1.41
T_5	non S.S + C + *F.o*	0.5kg/ha	560Rs/kg	1180	25161	26341	4.280	22000	94160	67819	2.57
T_6	**S.S + tomato plant**	0	0	0	25161	25161	6.295	22000	138490	113329	4.50

Solarized soil = S.S
Fusarium oxysporum = *F.o*
Spent mashroom compost = S.m.c
Carbendazim = C
Trichoderma harzianum = *T.h.*

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