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Comparative Efficacy of Bio-Agents with Fungicides, Antibiotics and Chemicals in Managing *Fusarial* Wilt Disease in Tomato

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ABSTRACT

Use of bio-agents in the management of plant diseases is eco-friendly and sustainable approach. The trials were in the variety BT-10 of tomato crop to study the efficacy of bio-agents in comparision with the use of fungicide, antibiotic and chemicals in controlling wilt disease caused by *Fusarium oxysporum* f.sp. *lycopersici* in two consecutive years. The result also revealed compatibility of bioagents with chemicals. The treatments were followed as such i.e. T_1 = Seedling root dip and soil treatment with *Trichoderma viride,* T_2 = Seedling root dip and soil treatment with *Pseudomonas fluorescens*, T_3 = Seedling root dip and soil treatment with *T. viride* + Seedling root dip and soil treatment with *P. fluorescens*, T_4 =Seedling root dip with carbendazim and streptocycline and soil drenching with streptocycline, carbendazim and plantomycin, T_5 = *T. viride* was applied as soil treatment and three times basal drenching with *T. viride* and *P. fluorescens* was practised, T_6=Control (neither seedling root dip nor soil application was adopted). The experimental trials resulted minimum wilt (2.89%) incidence and maximum yield (74.16 q/ha) was reported from the treatment where seedling root dip with carbendazim @ 0.15% and streptocycline 0.015% + Soil drench with carbendazim (0.2%), plantomycin (0.1%) and blitox (0.3%) were practised. It was followed by seedling root dip and soil treatment with only *P. fluorescens* which produced (70.35 q/h) was also higher than other three treatments. In control maximum wilt (12.35%) incidence and minimum yield (57.69 q/h) was recorded.

Keywords Seedling root dip, Soil treetment, *Fusarial* wilt, Tomato.

INTRODUCTION

Tomato (*Solanum lycopersicum*) is a popular vegetable crop in India. In our country this crop was grown under 879.6 (000) ha area and production was 18226.6 (000 MT) with 20.7 t/ha in 2013. The world wide tomato production was 170.8 million tons in the year, 2017. The major tomato growing countries are China, India, USA, Italy, Turkey and Egypt. China

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is the leading producer of tomatoes produces 31% of world production followed by India and United states. In Odisha tomato is grown in winter season in all districts and in *kharif* seasons in some pockets of Keonjhar, undivided Koraput and Phulbani Districts. According to Indian Horticulture Database, 2013-14 the area under cultivation is 96.55 (000) ha and production 1382.78 (000) ton and productivity 14.39 t/2013-14 ha. Odisha occupies 6th in position and shares 6.89% of total tomato production of the country in the year, 2016. The crop is infested by different fungal, bacterial viral diseases. Pre-dominant fungal diseases are damping off (*Pythium, Phytophthora, Fusarium, Phoma, Sclerotium*), septoria leaf spot (*Septoria lycopersici*) early blight (*Alternaria solani*). The bacterial pathogens cause stem and fruit canker (*Corynebacterium michiganense* pv. *michiganense*), wilting (*Ralstonia solanacearum*) while leaf curling (Tobacco leaf curl virus), mosaic (tomato mosaic virus), tomato spotted wilt are caused due to viral infections. Fusarial wilt (*Fusarium oxysporum* f.sp. *lycopersici*) is a major problem in tomato crop (Ahmed 2017, Venkatramana and Nayak 2016, Gholve et al. 2018, Hussein et al. 2016). This disease is devasting all over the world. In India there may be generally 30 to 40% yield loss and the loss may be goes upto 80% in favorable weather condition. Hence the trials were conducted in Central Farm, Orissa University of Agriculture and Technology, Bhubaneswar in the variety BT-10 of tomato crop to study the efficacy of bio-agents, antibiotic and chemicals in controlling wilt (Sahu et al. 2018, Shrwan et al. 2016). The use of bio-agents is gaining popularity day by day as the use of chemicals ar toxic and hazardous to environment (Bhattacharjee and Dey 2014, Indu et al. 2015). Two promising bio-agents with country wide adaptability were included in the test, i.e. *T. viride* and *P. fluorscens* (Enespa Dwivedi 2014).

MATERIALS AND METHODS

Field trials were conducted in *rabi* season in Central Farm, Orissa University of Agriculture & Technology, Bhubaneswar, Odisha in Randomized Block Design with six treatments and four replications in the year 2008-09 and 2009-10 in the variety BT-10 of tomato crop. In the plots the fertilizers (NPK) were added @ 120 : 75 : 100. The crop was grown under irrigated condition with 60 cm × 40 cm spacing and plot size was 5.5 m × 4.0 m. The treatments were used as follows : T_1 = Seedling root dip with *Trichoderma viride* + Soil treatment with *Trichoderma viride*. T_2 = Seedling root dip with *Pseudomonas fluorescens* + Soil treatment with *Pseudomonas fluorescens.* T_3= Seedling root dip with *Trichoderma viride* and *Pseudomonas fluorescens* + Soil treatment with *Trichoderma viride* and *Pseudomonas fluorescens.* T_4= Seedling root dip with carbendazim @ 0.15% and streptocycline 0.015% + Soil drench with carbendazim (0.2%), plantomycin (0.1%) and blitox (0.3%). T_5= Soil application of bleaching powder @ 15 kg / ha + Soil application of *Trichoderma viride* + 3 times drenching with *Trichoderma viride* + *Pseudomonas fluorescens.* T_6 = Control.

The following instructions were practised while conducting the experiments. In seedling root dip method 25 g of bio-agent of each type was mixed in 1 liter of water. Then the seedlings were dipped in that suspension for 20 minutes before transplanting in main field. Soil application of bio-agent was done at the time of hoeing and earthing up. Seedling root dip with antibiotic chemicals and fungicides were done simultaneously. Soil drenching with fungicides and antibiotic were done at the time of hoeing and earthing up. The bleaching powder was to be applied in furrow mixed in soil followed by light irrigation (after earthing up). The bio-agent was applied after application of chemical. In each treatment carbendazim 63% + mancozeb 12% was sprayed to control *Altermaria* blight @ 2 g/l. After establishments of seedlings in field the plots were monitored every day. Wilted plants were uprooted carefully and microscopically examined and identified. Wilting percentage was calculated as follows :

$$\text{Wilting percentage (\%)} = \frac{\text{Number of plants wilted}}{\text{Total number of plants}} \times 100$$

RESULTS AND DISCUSSION

In both the years wilt incidence and yield were recorded and mean was calculated . In the present study two potent bio-agents wider adaptability *T. viride* and *P. fluorescens* were used as seedling root dip and soil treatment individually and also in combined form.

The use of antibiotic and chemicals in controlling wilt had already been recorded (Singh et al. 2014). The use of bio-agents is gaining popularity day by day as the use of chemicals are toxic and hazardous to environment (Bhattacharjee and Dey 2014, Indu et al. 2015). Hence bioagents were used singly, in combined form and also with bleaching powder. From both the years result it was observed that minimum wilt (2.89%) incidence and maximum yield (74.16 q/ha) was recorded from the treatment where seeedling root dip with carbendazim @ 0.15% and streptocycline (0.015%) + Soil drench with carbendazim (0.2%), Plantomycin (0.1%) and blitox (0.3%) were applied (Table 1). It was followed by seedling root dip and soil treatment with only *P. fluorescens* which produced (70.35 q/ha). Wilting inhibition capacity was more in *P. fluorescens* than *T. viride* already reported (Singh et al. 2014). There was no significance difference in yield in T_1 and T_2. Maximum wilting 12.35 % was recorded in control with lowest yield 57.69 q/ha. The effectiveness of *T. viride* and *P. fluorescens* had been studied earlier. The potentiality of *T. viride* present in fungal consortium was already established in vegetated Western Himalayan agro ecosystem in reducing wilt and yield of tomato (Ahmed 2017). The individual application of *P. fluorescens* was better than individual application of *T. viride*. Fluorescent *Pseudomonas* is a plant growth promoting rhizobacteria and are known to protect from soil borne plant pathogenic organisms. These plant growth promoting activity (increase in shoot, root length as well as in volume) had already been recorded from pigeon pea (Sahu et al. 2018). The combine application of *T. viride* and *P. fluorescens* were less effective in suppressing the wilt than individual application. *P. fluorescens* was also compatible with some fungicides. Among different fungicides tested bavistin (0.1%) was fully suppressed the growth of 20 isolates of *Fusarium oxysporum* f.sp. *pisi in vitro* collected from different places of Uttar Pradesh followed by Copper oxychloride (0.1%) and Mancozeb (0.1%) (Shrwan et al. 2016). In different treatments reduction in wilting indicated increase in yield (Fig. 1) over control.

Table 1. Effect of different treatments on mean *Fusarial* wilt incidence and mean yield of tomato.

Treatments	*Fusarial* wilt (%)	Reduction (%)	Yield (q/ha)	Percent increase
T_1=Seedling root dip with *T. viride*+Soil treatment with *T. viride*	5.54 (13.04)	55.14	68.76	19.19
T_2= Seedling root dip with treatment with *P. fluorescens* and soil treatment *P. fluorescens*	6.04 (13.49)	51.09	70.41	22.05
T_3=Seedling root dip with *T. viride* and *P. fluorescens* + Soil treatment with *T.viride* and *P. fluorescens*	6.68 (14.64)	45.91	67.28	16.62
T_4=Seedling root dip with carbendazim @ 0.15% and streptocycline 0.015% + Soil drench with carbendazim (0.2%), plantomycin (0.1%) and blitox (0.3%)	2.89 (9.23)	76.60	79.16	37.22
T_5=Soil application of bleaching powder+ Soil applich *T. viride* + 3 times drenching with *T. viride*+*P. fluorescens*	6.96 (14.54)	43.64	68.68	19.05
T_6=Control	12.35 (19.87)	–	57.69	
SE (m)	1.59		1.45	
CD (5%)	4.77		4.26	

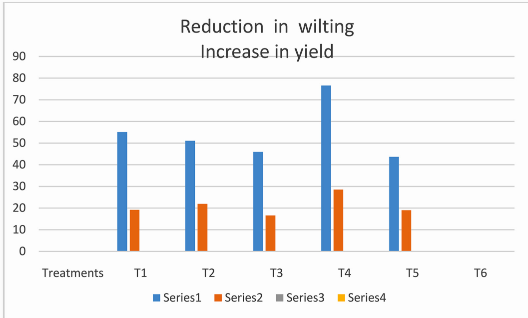

Fig. 1. Effect of treatments in reducing wilt (%) and increase in yield (qt).

In the treatment T_4 i. e. carbendazim @ 0.15% and streptocycline 0.015%+ Soil drench with carbendazim (0.2%), plantomycin (0.1%) and blitox (0.3%) (Table 1) recorded 76.6% decrease in wilting which ultimately increased 28.55%, increase in yield over control. It was followed by T_1, i.e. seedling root dip with *T. viride* + Soil treatment with *T. viride* then T_2 = Seedling root dip with *P. fluorescens*+ Soil treatment with *P. fluorescens* where reduction in wilting was 55.14% and 51.09% respectively. But increase in yield was more in *P. fluorescens* application than *T. viride* (Singh et al. 2014). It might be due to beneficial effect of *P. fluorescens* on growth of tomato plant. In T_3, i. e. seedling root dip with *T. viride* and *P. fluorescens* + Soil treatment with *T. viride* and *P. fluorescens* there was record of 45.91% decrease in wilting which was followed by T_5, i. e. soil application of bleaching powder @ 15 kg/ha + Soil application of *T. viride* + 3 times drenching with *T. viride* + *P. fluorescens* which revealed 43.64% decrease in wilting. Ultimately in both the treatments there were 16.62% (T_3) and 19.05% (T_5) increase over control was noticed. The effectiveness of both the bio-agents had been reported earlier (Singh et al. 2014).

REFERENCES

Ahmed M (2017) Studies on soil amendment with fungal consortium, chemical fungicide and wilt pathogen on growth and yield of tomato in vegetated Western Himalayan agro ecosystems. J Mycopathol Res 55 (2) : 195—199.

Bhattacharjee RR, Dey U (2014) An overview of fungal and bacterial biopesticides to control plant pathogens /diseases. Afr J Microl Res 8 : 1749—1762.

Enespa Dwivedi SK (2014) Effectiveness of some antagonistic fungi and botanicals against *Fusarium solani* and *Fusarium oxysporum* f. sp. *lycopersici* of brinjal and tomato plants. Asian J Pl Pathol 18 : 18—25.

Gholve VM, Sawade BR, Das Alpande IK (2018) Efficacy of new fungicides and bioagents against grain mold fungi. J Mycopathol Res 56 : 41—49.

Hussein Ali S, lmam Sahi S, Nasif J (2016) IPM approach for the management of wilt disease caused by *Fusarium oxysporum* f. sp. *lycopersici* on tomato. J Experim Biol Agric Sci 41 : 742—747.

Indu K, Chaudhary N, Sandhu P, Ahmed M Akhter (2015) Structural and mechanistic analysis of engineered trichodiene synthease enzymes from *Trichoderma harzianum* towards catalytic activities empowering sustainable agriculture. J Biomol Dyna 34 : 1—4.

Sahu S, Koshale K, Tiwari RKS, Khare N (2018) Evaluation of plant growth promotion activity of Fluorescent *Pseudomonas* on pigeon pea (*Cajanus cajan* (L.) Millsp). J Mycopathol Res 55 (4) : 347—352.

Shrwan K, Dabbas MR, Mishra O, Naresh P (2016) Variability of cultural, morphological, pathogenic and impact of different fungicides on *Fusarium oxysporum* f. sp. *pisi.* J Mycopathol Res 54 (3) : 355—360.

Singh BK, Srivastav S, Singh P, Shukla DN (2014) *In vitro* evaluation of biocontrol agents and botanicals against wilt incidence of water melon, tomato and marigold. J Mycopathol Res 52 (1) : 29—34.

Venkatramana NM, Nayak SC (2016) Molecular, phylogeny, pathogenicity and toxigenesis of *Fusarium oxysporum* f. sp. *lycopersici*. Sci Rep 6 : 21367, doi : 10.1038/srep 21367.