

MANAGEMENT OF FUSARIUM WILT OF TOMATO BY BOTANICALS AND BIOCONTROL AGENTS AND THEIR EFFECT ON YIELD

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Abstract

Investigation was undertaken to screen out the extract of botanicals viz., neem leaf, neem oil, garlic, marsh paper plant, allamanda leaf, wood apple leaf, betel leaf and biological antagonists viz., *Trichoderma viride* and *T. harzianum*. Positive control was soil amendment with Provax and negative control with untreated soil. Soil drenching with Provax and untreated soil showed 7.65 and 37.5% wilt of tomato. Wilt incidence varied from 8.5 - 30.81%. Botanicals and biocontrol agents had significant effect on yield of tomato. Provax gave the highest (30.55 t/ha) yield which was statistically identical to garlic extract (29.66 t/ha) and untreated control showed the lowest (20.19 t/ha) yield which was followed by soil drenching with neem leaf extract. Both the biocontrol agents viz., *T. harzianum* and *T. viride* as broth and compost significantly reduced wilt incidence of tomato in the field over control.

Introduction

Fusarium oxysporum f. sp. *lycopersici* is a highly destructive pathogen both in greenhouse and field conditions (Jaiswal *et al.* 2015). World-wide wilt is considered as one of the most economically important disease (Cal *et al.* 2004). Use of fungicides leads to severe environmental pollutions and reduction of beneficial microbes (Jaiswal *et al.* 2015). Non-chemical and ecofriendly botanicals and biocontrol agents as broad spectrum fungicides have been found to provide an answer to the non-discriminatory broad spectrum fungicides.

The antifungal and antimicrobial properties of several plant extracts and essential oils are investigated by many workers (Boulenouar *et al.* 2009, Pizana *et al.* 2010). It is generally assumed that the active constituents responsible for antifungal properties of the extracts are phytochemicals (Okwu 2004). Reduction in the population of *Fusarium oxysporum* with plant parts extract were reported by many workers (Bowers and Locke 2000, Pattanaik *et al.* 2002, Khayungarnawee *et al.* 2004, Agbenin and Marley 2006). The antifungal activity of ethanol and acetone extract of leaves of nine medicinal plants against the causal agent of Fusarium wilt in tomato was assessed by Neela *et al.* (2014).

The antagonistic fungi *Trichoderma* spp. have been widely used against *Fusarium* spp. (El-Rafai *et al.* 2003, Ahmed 2011, Hend and Perveen 2012). However, it is also reported that all of the isolates of *Trichoderma* spp. are not equally effective to control the pathogen *in vitro* and *in vivo* (Ramezani 2008). Therefore, the present investigation was to evaluate the management of Fusarium wilt of tomato by botanicals and biocontrol agents and to assess their effect on the yield of tomato *in vivo* condition.

Materials and Methods

The field experiment was conducted at Regional Agricultural Research Station, Ishurdi, Pabna, Bangladesh during 2011 - 2012. The experimental land was well ploughed and properly

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leveled before bed preparation. Weeds and stubbles were removed from the field. Cow-dung @ 10 t/ha, urea @ 550 kg/ha, TSP @ 450 kg/ha and MP @ 250 kg/ha were applied. BARI Tomato 14 was used in this experiment. The experiment was carried out following RCBD with three replications. Size of the plots was 3 × 2 m and plant spacing was 60×40 cm. *Fusarium oxysporum* f. sp. *lycopersici* inoculum was mixed with soil before 2 weeks of plantation of tomato for establishment of fungi. Preparation of plant extracts was made according to Neela *et al.* (2014). One ml of prepared extract was mixed with 5 ml of water which gave 1 : 5. Thirteen treatments of soil amendment with extract (1 : 5) is presented in Table 1. The inoculum of *Fusarium oxysporum* was applied only up to a depth of 6 cm in the soils i.e. 5 g of oat culture was mixed with soil of pit before two weeks of tomato plantation. The treatments were applied in pits during crop plantation. Intercultural operations were done as and when needed and to maintain the normal hygienic condition of crop in the field. Wilt incidence, number of fruit branches/plant, number of fruits/plant, weight of fruits/plant and yield (t/ha) were recorded. The percentage of wilt of tomato was recorded by adopting the formula of Siddaramaiah *et al.* (1978).

Data were analyzed statistically to find out the level of significance and the variations among the respective data were compared following DMRT according to Gomez and Gomez (1984).

Results and Discussion

Effect of botanicals and biocontrol agents on yield contributing characters, yield and per cent wilt of tomato are presented in Table 1. Wilt incidence of tomato was significantly influenced by the botanicals and biocontrol agents (Table 1). Wilt incidence varied from 7.65 - 37.50%, where the lowest incidence was observed in soil amendment with Provax which was statistically similar to soil drenching with garlic extract and allamanda leaf extract. The highest incidence was observed in untreated soil which was not statistically similar to all other treatments. The highest number (12.00) of fruit branches per plant was recorded in soil drenching with Provax (2 g/l water) which was not statistically similar to all other treatments, and the lowest (7.56) number of fruit branches per plant was recorded in control which was statistically similar to soil drenching with *Trichoderma harzianum* broth. Soil drenching with Provax resulted the highest (19.26) number of fruits per plant which was followed by soil drenching with garlic extract, marsh pepper plant extract and allamanda leaf extract. Control resulted the lowest (11.90) number of fruits per plant which was also followed by soil drenching with neem leaf extract and betel leaf extract. The maximum weight (365.94 g) of fruits per plant was obtained from soil drenching with Provax which was statistically similar to garlic extract (350.92 g), and the lowest weight (226.10 g) of fruits per plant was obtained from control treatment which was statistically similar to soil drenching with neem leaf extract. Botanicals and biocontrol agents had significant effect on yield of tomato. Provax showed the highest yield (30.55 t/ha) which was statistically identical to garlic extract (29.66 t/ha) and control gave the lowest (20.19 t/ha) yield which was followed by soil drenching with neem leaf extract (Table 1).

Hassanein *et al.* (2010) conducted an experiment on the effect of neem (*Azadiracta indica*) leaf extract against *Alternaria solani* and *Fusarium oxysporum*, the causal agents of early blight and wilt of tomato plants, respectively. There was significant gradual increase in growth parameters when the plants were sprayed and irrigated with aqueous neem extract. In this study, neem leaf extract also showed satisfactory result against *Fusarium oxysporum*. Islam and Faruq (2012) studied the effects of some plant extracts against damping-off disease of some winter vegetable in the net house. The most effective treatment was with the neem leaf extract followed by garlic, clove and allamanda leaf extracts in terms of suppressing damping-off disease incidence with increasing plant growth characters. In the present study garlic extract gave the highest yield

(29.66 t/ha) which was statistically identical to positive control (30.55 t/ha) followed by allamanda leaf extract. Other treatments also showed better performance in increasing yield and suppressing fusarium wilt disease of tomato. This result indicated that plant extract can be an excellent alternative of chemicals for wilt treatment. Present findings were correlated with Islam *et al.* (2006).

Table 1. Effect of botanicals and biocontrol agents on yield contributing characters, yield and percent wilt of tomato.

Treatments with concentration	Wilted plant (%)	No. of fruits branches/ plant	No. of fruits/ plant	Wt. of fruits/ plant (g)	Yield (t/ha)
Soil drenching with neem leaf extract (1 : 5)	30.50 b	9.33 fg	12.93 ef	245.68 gh	21.48 gh
" neem oil (0.5%)	25.00 d	10.00 de	14.78 cde	274.94 ef	22.39 fg
" garlic extract (1:5)	8.63 g	11.27 b	18.89 a	350.92 a	29.66 ab
" marsh pepper plant extract (1 : 5)	12.50 f	10.89 bc	17.11 ab	325.10 bc	27.48 cd
" allamanda leaf extract (1 : 5)	8.50 g	9.44 fg	17.45 ab	331.56 b	28.33 bc
" wood apple leaf extract (1 : 5)	20.33 e	10.30 d	16.56 bc	314.64 bcd	26.85 cd
" betel leaf extract (1 : 5)	25.00 d	9.00 g	14.00 def	266.00 fg	23.22 fg
" <i>Trichoderma viride</i> broth (1 : 5)	20.53 e	9.67 ef	16.55 bc	314.46 bcd	27.00 cd
" <i>T. harzianum</i> broth (1 : 5)	29.16 c	7.67 h	16.11 bcd	306.10 cd	26.95 cd
" <i>T. viride</i> compost (1 t/ha)	20.63 e	10.45 cd	16.00 bcd	304.00 cd	25.81 de
" <i>T. harzianum</i> compost (1 t/ha)	30.81 e	9.67 ef	15.89 bcd	301.92 de	24.01 ef
" Provax (2 g/l water) (Positive control)	7.65 g	12.00 a	19.26 a	365.94 a	30.55 a
Untreated soil (negative control)	37.50 a	7.56 h	11.90 f	226.10 h	20.19 h
LSD ($p \geq 0.05$)	0.983	0.46	2.12	23.90	1.99
CV (%)	3.99	2.14	5.83	3.26	3.39

In a column, similar letter(s) do not differ significantly at 1% level of probability.

The potential of *Trichoderma* spp. as biocontrol agent against various plant pathogenic fungi has been well reported by many researchers. In the present investigation, soil drenching with two species of *Trichoderma* broth showed better yield than *Trichoderma* compost. Broth is a liquid formulation so it can easily mix with soil particles compared to compost. The inhibitory effect of these bioagents against the tested pathogen was probably due to competition and or antibiosis. Sundaramoorthy and Balabaskar (2013) reported that the application of *Trichoderma harzianum* (ANR-1) under greenhouse conditions exhibited the least disease incidence (15.33%). In the present study, the lowest wilt incidence was reported by *T. viridae* broth which was 20.53%. This difference might be due to the different strains of *Trichoderma* spp.

From the above study, it may be concluded that *Allium sativum* garlic extract and *Allamanda schottii* allamanda leaf extract may be incorporated in biofungicides formulation which may be used in integrated management approach in controlling Fusarium wilt and increasing yield of tomato under field condition.

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