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Effect of trichocompost on the incidence of late blight and leaf curl of tomato

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Abstract
This experiment was carried out to investigate the effect of Trichocompost which was formulated by exploiting *Trichoderma harizinum* as decomposing agent in municipality waste. The treatments were (1) Trichocompost 500g/m^2, (2) Trichocompost 750g/m^2, (3) Trichocompost 1000g/m^2 and (4) control. It has been observed that application of Trichocompost prepared from *Trichoderma* decreased the Late blight and Leaf curl diseases of Tomato. All the treatments including control treatment showed significant control on the incidence of late blight and leaf curl of tomato. The lowest incidence 3.59% was recorded in Trichocompost @ 1000g/m^2 on late blight and incidence 1.79% was recorded on leaf curl of tomato by the same treatment. Whereas control plots showed 7.16% and 7.28% on the respective diseases of tomato.

Keywords: Trichocompost, *Trichoderma*, late blight of tomato, leaf curl of tomato, incidence of late blight of tomato, incidence of leaf curl of tomato

1. Introduction
Tomato (*Lycopersicum esculentum Mill*; family Solanaceae) is a very popular vegetable in the world. It is a key component in the so-called "Mediterranean diet", which is strongly associated with a reduced risk of chronic degenerative diseases (Agarwa and Rao, 2000) [1]. Tomato is one of the most potent antioxidants among dietary carotenoids. Dietary intake of tomatoes and tomato products containing lycopene has been shown to be associated with a decreased risk of chronic diseases, such as cancer and cardiovascular disease (Sanjiv and Akkinappally, 2000) [2]. Tomato, has long been appreciated for its organoleptic and culinary properties, in recent times, it has been valued for it's nutritional, dietetic and health traits. From several recent medical researches, the key-role of tomato fruit has emerged as a supplier of antioxidant compounds essential in human metabolism for people in western countries. Starting from the economic significance of the tomato, in this review its health benefits are underlined especially those referred to antioxidant properties (Serio *et. al.*, 2006) [3]. Epidemiological studies have shown that consumption of raw tomato and its tomatobased products is associated with a reduced risk of cancer and cardiovascular diseases (Giovannucci *et. al.*, 2002) [4].

Diseases of tomato act as the limiting factors to its economic production. Watterson (1986) [5] reported that there have been about 200 diseases to affect the tomato plants in the world. Late blight caused by fungus like organism *Phytophthora infestans* is one of the most dreaded diseases of potato worldwide and cause significant loss in production (Arora et. al. 2014) [6]. Late blight disease is the most limiting component among pest and diseases for potato production in India. It not only adversely affects tuber yield and economy of potato growers, but also reduces produce quality (Lal et. al. 2016) [7]. Tomato leaf curl virus (TLCV) is the major disease of tomato crop all over the world. TLCV spreads by *Bemisia tabaci* under natural conditions in persistant-circulative manner. The environmental factors and the population of *Bemisia tabaci* considerably increased the spread of disease (Yasin, et. al., 2017) [8].

The use of chemicals to control diseases of crops results environmental pollution, health hazards etc. Living microorganisms such as bacteria, viruses or fungi are employed in biological control can be either as antagonists, parasites or predator (Kwok *et al*. 1997) [9]. The IPM Lab (Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh) produce *Trichoderma* spp as Biopesticide has been demonstrated to controls a wide range of soil borne plant diseases. Moreover, BAU-Biofungicide, *Trichoderina* based formulation of Eco-friendly Plant Disease Management Lab., Department of Plant Pathology, Bangladesh Agriculture University, Mymensingh has been reported for controlling seed borne, soil borne and air borne diseases of different crop plants (Hossain, 2011) [10].

Until recently, no endeavor has been reported to control late blight of tomato and tomato leaf curl disease by bio fungicide in Bangladesh. Therefore, the present study was under taken to achieve the following objectives:

1. To study the incidence of late blight and leaf curl of tomato under Trichocompost effect
2. To evaluate the effect of Trichocompost on the severity of late blight and leaf curl of tomato

2. Materials and Methods
The experiment was conducted at the Field laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. The experiment was laid out in the Randomized Complete Block Design (RCBD) with four replications. Distance between the blocks was 1m and between the plots was 0.5m. The size of unit plot was 5m X 1m.

Treatments of the experiments
A total of 4 treatments were used designated as T_1, T_2, T_3, and T_4 which were as follows:

T_1 =Trichocompost@500g /m^2
T_2 = Trichocompost@750g/ m^2
T_3 = Trichocompost@1000g /m^2
T_4 = Control

Source of Trichoderma: Eco-Friendly Plant Disease Management Laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh, Bangladesh.
Four soil samples were collected from tomato field (randomly), Department of Plant Pathology Field laboratory, Bangladesh Agricultural University, Mymensingh.

Preparation of culture media
Potato dextrose agar (PDA) medium was formulated by Potato (peeled and sliced)- 200g, Dextrose-20g, Agar-17g & Water-1000ml (Aryal, 2015) [11]. The prepared PDA was poured in 500ml screw-cap glass bottles and sterilized (121ºC, 15 psi for 15 min). The media was acidified with 30 drops of 50% lactic acid per 250ml medium.

Isolation of soil fungi
Dilution plate technique (Warcup, 1955) [12] for isolation of *Trichoderma* was followed:
The surface of the working area, hand and the glass wares were disinfected with cotton soaked in methylated spirit (70%). The procedure of dilution plate technique was as follows:

a. One gram of the soil was placed in test tube containing 9 ml of sterile water and stirred thoroughly for few minutes in order to obtain an uniform 1:10 dilute soil suspension. This was used as stock suspension.
b. One milliliter of that 1:10 stock suspension was transferred with the help of sterile pipette into the 2nd test tube containing 9 ml sterile water and shaken thoroughly thus resulting 10^{-1} dilution.
c. One milliliter of the dilution is transferred to 3rd test tube containing 9 ml sterile water by sterile pipette thus making 10^{-2} dilution. In this way dilution was made up to 10^{-4}(Fig. 1).

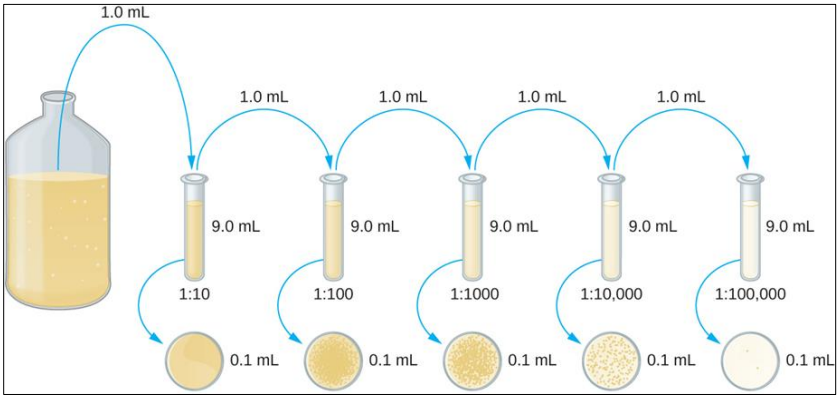

Fig 1: Preparation of dilution series (Soil dilution)

d. Twenty milliliter of warm melted PDA medium was (approx. 45ºC) poured in each sterile Petri-plate.
e. One milliliter of diluted soil sample was placed at the center of PDA and spread. Four Petri-dishes each were inoculated with 1 ml of diluted sample. This was repeated with every soil sample.
f. The inoculated PDA plates were incubated for 7-10 days at room temperature (25±1ºC).
g. The colonies grow out on PDA were recorded after 3-5 days. Sub cultures were made by transferring a small colony to a new Petri-dish on the basis of color and morphology of the colony. Further transfers were made for purification. The contaminated plates were discarded.

Estimation of soil fungi
The number of colonies developed in each PDA plates was counted and average values were calculated for each sample. Number of colonies per ml of soil suspension was calculated by its colony forming units (CFU). The number of CFU/g sample was calculated by using following formula (McDonald, 1997):
Population of fungi = Average number of total colonies/ml in 4 Petri-dishes × Dilution factor (10^2 and 10^3).

Application of trichocompost
The Trichocompost has been sprayed five times in the experimental plot from 2nd week to 6th week after transplanting. Data collected for five times plot from 3rd week to 7th week after transplanting.

Analysis of data
Data collected during experimental period were tabulated and analyzed through a standard computer package statistical procedure MSTAT-C. The mean values of individual treatments were compared by Least Significant Difference (LSD) test.

3. Result

3.1 Population of *Trichoderma* in the soils of different treatments

The population of *Trichoderma* was higher just after treatment of Trichocompost. A decreasing tendency was seen with times. The highest soil population was observed in T_3 (@ 1000g/m^2) while the lowest population was observed in control T_4 (without Trichocompost). (Table 1)

Table 1: Population of *Trichoderma* in soils of different treatments at different week

Treatments	Trichoderma in soil (CFU×10²/g soil)								
	1st week	2nd week	3rd week	4th week	5th week	6th week	7th week	8th week	9th week
T_1	5.00 b	2.00 a	2.50 a	2.75a	2.25 a	1.75 b	1.75b	1.75 a	1.75 a
T_2	5.00 b	1.75 b	2.50 a	1.75c	2.00 b	2.50 a	1.75b	1.75 a	1.00 b
T_3	5.750 a	1.75 b	1.75 b	2.25b	2.25 a	1.25 c	2.25a	1.50 b	1.75 a
Control (T_4)	00 c	00 c	00 c	00 d	00 c	00 d	00 c	00 c	00 c
$LSD_{0.05}$	0.143	0.143	0.143	0.087	0.087	0.113	0.189	0.215	0.087
CV%	5.17	6.03	5.04	3.04	3.22	4.46	6.64	9.66	4.47

Means followed by the same letter (s) in a column did not differ significantly at 5% level by DMRT
T_1 = Trichocompost @ 500 g/m², T_2 = Trichocompost @ 750 g/m², T_3 = Trichocompost @ 1000 g/m², T_4 = Without Trichocompost

3.2 Effect of Trichocompost on the incidence of late blight of tomato

Incidence of late blight of tomato was monitored for 5 weeks. The treatments showed significant variation in the incidence at every week interval. In 3rd week the highest incidence was recorded in control (T_4) plot and it was 9.06%. The plants did not show any visible symptoms in T_3. The incidence of the disease gradually increases with the advancement of time. At 5th week, the highest incidence was recorded in T_4 and the lowest in T_1 (Table 2). This result is similar to Yao (2015) [14].

Table 2: Incidence of late blight of tomato as influenced by supplementation with Trichocompost

Treatments	Incidence of late blight of tomato				
	3rd week	4th week	5th week	6th week	7th week
T_1	3.72 c	5.49 c	5.36 c	6.14 a	7.08 b
T_2	4.20 b	8.25 b	6.33 b	6.98 b	7.07 b
T_3	3.00 d	3.57 d	5.49 c	6.59 ab	7.82 c
Control (T_4)	9.06 a	10.7 a	10.8 a	8.28 a	8.23 a
$LSD_{0.05}$	0.33	0.34	0.41	0.29	0.37
CV%	4.94	3.05	3.65	3.10	3.70

Means followed by the same letter (s) in a column did not differ significantly at 5% level by DMRT
T_1 = Trichocompost @ 500 g/m², T_2 = Trichocompost @ 750 g/m², T_3 = Trichocompost @ 1000 g/m², T_4 = Without Trichocompost

3.3 Effect of Trichocompost on the severity percentage of late blight of tomato

The severity of late blight of tomato varied significantly among the different treatments at different time intervals (Table 3). Initially the severity was highest in control treatments (28.21%) while it was nil in T_3. The severity gradually increases until 5th week and afterwards started decline. At 5th week the severity was maximum in T_2 (8.58%) and minimum was in T_3 (3.31%).

Table 3: Severity of late blight disease as influence by supplementation with Trichocompost

Treatments	Severity % of late blight of tomato				
	3rd week	4th week	5th week	6th week	7th week
T_1	3.57 c	6.47 b	7.12 b	7.63 b	8.56 a
T_2	9.29 b	7.15 b	5.54 c	4.94 c	8.58 a
T_3	1.04 d	2.75 c	2.74 d	2.86 d	3.31 c
Control (T_4)	28.2 a	22.8 a	26.8 a	11.7 a	9.28 b
$LSD_{0.05}$	0.508	0.793	1.07	0.563	0.447
CV%	3.02	5.04	6.31	5.18	4.03

Means followed by the same letter (s) in a column did not differ significantly at 5% level by DMRT
T_1 = Trichocompost @ 500 g/m², T_2 = Trichocompost @ 750 g/m², T_3 = Trichocompost @ 1000 g/m², T_4 = Without Trichocompost

3.4 Effect of Trichocompost on the incidence of leaf curl of tomato

Incidence of leaf curl of tomato was monitored for 5 weeks. The treatments showed significant variation in the incidence at every week interval. In 3rd week the lowest incidence was recorded in T_3 (@ 1000g/m²) plot and it was 0.00%. The plants did not show any visible symptoms in T_3. The incidence of the disease gradually increases with the advancement of time. At 7th week, the highest incidence was recorded in T_4 (7.25%) and the lowest in T_3 was 1.77%. (Table 4).

Table 4: Incidence of leaf curl of tomato as influenced by supplementation with Trichocompost

Treatments	Leaf curl diseases incidence (DI)				
	3rd week	4th week	5th week	6th week	7th week
T_1	1.79 b	3.72 b	3.45 c	5.37 a	5.54 b
T_2	4.06 a	5.98 a	5.84 a	5.49 a	4.07 c
T_3	1.00 c	1.79 c	3.45 c	1.79 c	1.77 d
Control (T_4)	1.92 b	3.71 b	5.37 b	3.71 b	7.25 a
$LSD_{0.05}$	0.18	0.21	0.24	0.31	0.24
CV%	6.00	3.58	3.41	4.78	3.33

Means followed by the same letter (s) in a column did not differ significantly at 5% level by DMRT
T_1 = Trichocompost @ 500 g/m², T_2 = Trichocompost @ 750 g/m², T_3 = Trichocompost @ 1000 g/m², T_4 = Without Trichocompost

4.5 Effect of Trichocompost on the severity percentage of leaf curl of tomato

The severity of leaf curl of tomato varied significantly in different treatments at different time intervals (Table 5). At the time of first disease appearance at 3rd week after transplanting T_1 showed the minimum leaf curl severity 1.14% while Control plot showed the maximum leaf curl severity (5.88%). At 4th week T_3 treatment showed the lowest severity (1.85%), Control plot showed the

maximum 6.82%. From 3rd week to 7th week of data collection, T_3 showed the lowest severity at 6th week (0.56%), while Control (T_4) plot showed the highest 9.99% leaf curl disease severity at 5th week.

Table 5: Severity of leaf curl disease of tomato as influence by supplementation with Trichocompost

Treatments	Severity % of leaf curl of tomato				
	3rd week	4th week	5th week	6th week	7th week
T_1	1.14 d	3.26 c	1.41c	1.16 c	0.892 c
T_2	6.58 a	9.10 a	10.48 a	6.78 b	4.89 a
T_3	2.13 c	1.85 d	1.33 c	0.56 d	0.94 c
Control (T_4)	5.88 b	6.82 b	9.99 b	9.95 a	2.75 b
$LSD_{0.05}$	0.27	0.30	0.32	0.365	0.42
CV%	4.33	3.02	3.44	4.96	11.09

Means followed by the same letter (s) in a column did not differ significantly at 5% level by DMRT T_1 = Trichocompost @ 500 g/m^2, T_2 = Trichocompost @ 750 g/m^2, T_3 = Trichocompost @ 1000 g/m^2, T_4 = Without Trichocompost

4. Discussion

This experiment was conducted at the Field laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. The treatments used in this experiment were (1) Trichocompost 500g/m^2, (2) Trichocompost 750g/m^2, (3) Trichocompost 1000g/m^2 and (4) control. For this experiment four (4) soil samples were collected from tomato field (randomly). For isolation of *Trichoderma*, dilution plate technique (Warcup, 1955) [12] was followed. The Trichocompost has been sprayed five times in the experimental plot from 2nd week to 6th week after transplanting. Collection of data was done for five times from 3rd week to 7th week after transplanting. In case of the population of *Trichoderma* in the soils of different treatments, the highest population were found at the time of inoculation (T_1=5.00, T_2=5.00, T_3=5.75). But the control treatment (T_4) had no *Trichoderml* population as they are not being inoculated by *Trichoderma*. The incidence of the Late blight of tomato were calculated in this experiment. The highest incident was found in Control plot 10.8 at 5th week compare to the treatments. At all the treatments the incidence rate gradually increase as the plants age increases. But here after 5th week at control plot the incidence rate decreased. This situation is similar as Mukhopodhyay *et al*. (1989) [15]. In case of the severity, the percentage gradually increases until 5th week and afterwards started decline. At 3rdth week the severity was maximum in T_4 (28.2%) and minimum was in T_3 (1.04%). At 7th week the severity was maximum at control plot (9.28%) and minimum percentage of severity was showed by T_3 treatment (3.31%). At the time of leaf curl disease incidence of tomato, the highest severity was found at 7th week at control plot 7.25 and the lowest at this week was 1.77 at T_3 treatment. This result is similar to Ozbay *et al*. (2004) [16]. The severity of leaf curl of tomato varied significantly in different treatments at different time intervals. From 3rd week to 7th week of data collection, T_3 showed the lowest severity at 6th week (0.56%), while Control (T_4) plot showed the highest 9.99% leaf curl disease severity at 5th week.

5. Conclusion

This experiment was conducted at the Field laboratory, Department of Plant Pathology, Bangladesh Agricultural University, Mymensingh. The treatments used in this experiment were (1) Trichocompost 500g/m^2, (2) Trichocompost 750g/m^2, (3) Trichocompost 1000g/m^2 and (4) control. Soil population of *Trichoderma* is very low which can be improved by supplementation with Trichocompost. *Trichoderma* spp. was found to be effective against *Phytophthora infestans* and beneficial against leaf curl disease. As the age of the plants age increase the incidence and severity of Late blight and Leaf curl diseases of tomato generally increased. After all different treatments showed significant result including control (T_4) in this experiment. According to the analysis Trichocompost (@ 1000g/m^2) gave the highest result.

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