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Short communication

Management of early blight of tomato

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ABSTRACT

Field experiment was conducted for the management of early blight of tomato through a number of fungicides *viz.,* Mancozeb 75 WP (Indofil M-45, 75%), Difenoconazole 25 EC (Score, 25%), Copper Oxychloride 50 WP (Blue Copper, 50%), Ridomyl MZ 72 WP (Metalaxyl, 8% + Mancozeb, 64%), Chlorothalonil 75WP (Kavach, 75%) and biocontrol agent *viz. Trichoderma viride*. It was found that all the treatments were effective to reduce the severity of the disease. Among the treatments, seed treatment with Mancozeb followed by foliar spraying of the same fungicide was found most effective in both the years and was closely followed by foliar spraying with Difenoconazole. Percent disease control in two years pooled mean revealed that the maximum disease control was noticed in seed treatment with Mancozeb followed by foliar spraying of the same fungicide. A maximum increase of yield was also achieved with the same treatment.

Key words: *Solanum lycopersicum*, *Alternaria solani*, fungicides, bio-agent, *Trichoderma viride*.

Tomato (*Solanum lycopersicum*) is the second most important remunerable solanaceous vegetable crop after potato which is used as a fresh vegetable as well as in a variety of processed products. In India, tomato is one of the major horticultural crops, grown on 774,000 hectares, producing 18,732,000 MT during the year of 2015-16 (Anonymous, 1). The crop is vulnerable to infection by several diseases caused by fungal, bacterial, viral, nematode and abiotic factors (Balanchard, 3). Among the fungal diseases, early blight is the major disease of tomato caused by *Alternaria solani* (Ellis and Martin) Sorauer which causes severe losses of fruit yield both in quality and quantity (Muthukumar and Udhayakumar, 9). The causal organism is air borne and soil inhabiting and is responsible to cause disease on foliage (early blight), basal stems of seedlings (collar rot), lesions on stems of adult plants (stem lesions), and fruits (fruit rot) of tomato (Chaerani and Voorrips, 4). The disease appears on leaves, stems, petiole, twig and fruits under favourable conditions resulting in defoliation, drying off of twigs and premature fruit drop and causing serious damage in all stages of plant which ultimately reduce the yield (*Abada et al*., 2). In India, yield losses due to this disease have been reported to be 48 to 80 % (Datar and Mayee, 5). Present investigation was therefore undertaken to know the efficacy of different fungicides and biocontrol agents against early blight of tomato.

The field experiments were carried out during rabi seasons of 2011-12 and 2012-13 at the Research Farm of Regional Research and Technology Transfer Station, O.U.A.T, Chiplima, Sambalpur, Odisha. The station is situated at $20^0$21'N latitude and $80^0$55'E longitude in Dhankauda block of Sambalpur district at an altitude of 178.8 m above mean sea level. The experiment was laid out in a plot size 4 m X 2.5 m following randomized block design (RBD) with three replications. A number of commercially available fungicides *viz.* Indofil M-45 75 WP (Mancozeb, 75%), Difenoconazole 25 EC (Score, 25%), Copper Oxychloride 50 WP (Blue Copper, 50%), Ridomyl MZ 72 WP (Metalaxyl, 8% + Mancozeb, 64%), Chlorothalonil 75WP (Kavach, 75%) and biocontrol agent *viz., Trichoderma viride* with a suitable control constituted nine different treatments of the experiment. The treatment details were as follows *viz.,* T_1 =Seed treatment with Mancozeb @ 2.5 g/ kg seed, T_2 = T_1 + Spraying of Mancozeb @ 2.5g /l of water, T_3 =Seed treatment with *Trichoderma viride* @ 10g/kg of seed, T_4=T_3+Soil application of *Trichoderma viride* @ 2.5kg/ha, T_5=Spraying of Difenoconazole @ 1ml/l of water, T_6 =Spraying of Copper Oxychloride @ 4g/l of water, T_7= Spraying of Chlorothalonil 2.0g /l of water, T_8 =Spraying of Metalaxyl + Mancozeb @ 2.5g/l of water, T_9 =Control. The variety Pusa Rubi was sown with 75 cm X 60 cm spacing during the month of December in both the years. A recommended fertilizer dose was applied in all the plots and standard agronomic practices were followed as and when necessary to raise the crop. Fungicidal sprayings were started with the appearance of disease symptoms on the foliage and three sprayings of fungicides were done at 15 days interval. The disease severity on foliage was scored based on 0-5 scales (0= no symptom on the leaf, 1=0-5% leaf area infected, 2=6-20% area infected,

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3=21-40% area infected, 4=41-70% area infected, 5= >71% area infected) (Mayee and Datar, 6). Percent Disease Index (PDI) was calculated following standard formula given by Mckinny (7).

$$PDI = \frac{\text{Sum of all numerical ratings}}{\text{No. of observations} \times \text{Maximum rating}} \times 100$$

The data on percent disease index (PDI) of early blight are presented in Table 1. All the treatments were found effective against early blight disease in comparison to control plot in reducing the disease severity.

The disease severity data presented in Table 1 indicated that severity was more in second year than first year.

In the first year disease severity varied from 20.6 to 47.8% as compared to 71.1% in control. In the second year, seed treatment with Mancozeb + spraying of Mancozeb reduced the disease severity greatly. When the disease severity data were pooled over two years, minimum disease severity was recorded in seed treatment with Mancozeb + spraying of Mancozeb with 66.8% reduction over control followed by *at par* efficient spraying of Difenconazole with 62.9% reduction.

Sudharshana *et al*. (12) and Mishra (8) reported that Mancozeb is effective fungicides against early blight of tomato. Yadav and Dabbas (14) also reported that Mancozeb recorded least percent disease index as compared to all other tested fungicides in their studies. The effectiveness of Mancozeb for controlling the disease was also supported by a number of scientists (Naveenkumar *et al.,* 10; Sali *et al.*, 11).

Among the treatments, the bio-control treatments i.e., T_3 (Seed treatment with *Trichoderma viride* @ 10g/kg of seed) and T_4 (Seed treatment with *Trichoderma viride* @ 10g/kg of seed + Soil application of *Trichoderma viride* @ 2.5kg/ha) were not found significantly effective as they recorded 43.0 and 46.3% reduction of disease severity over control.

Verma *et al*. (13) reported that effective control of the disease was achieved with spray of Mancozeb, however disease severity could be significantly reduced with spray of *T. viride* followed by spray of Mancozeb.

The fruit rot incidence were recorded in both the years and presented in Table 2.

From the perusal of the Table 2, it was found that all the fungicides effectively suppressed fruit rot in both the years of studies. From the pooled data of two years, lowest fruit rot incidence was found in T_2 treatment (Seed treatment with Mancozeb + spraying of Mancozeb), which gave 68.2% reduction of fruit rot over control.

The pooled data on fruit yield (Table 3) showed that all the treatments were effective in increasing fruit yield from 15.7 to 58.6 % as compared to control (145.50q/ha).

Seed treatment with Mancozeb + spraying of Mancozeb recorded highest yield (230.70q/ha) with 58.6% yield increase over control. Among the treatments, the bio-control treatment i.e., Seed treatment with *Trichoderma viride* @ 10g/kg of seed

Table 1. Effect of different treatments on the severity of early blight disease of tomato.

Treatments	Per cent Disease Index (PDI)			% Reduction of disease severity over control
	2011-12	2012-13	Pooled	
Seed treatment with Mancozeb @ 2.5 g/kg seed (T_1)	42.2 (40.50)*	50.67 (45.38)	46.45 (42.95)	39.8
T_1 + Spraying of Mancozeb @ 2.5g/l of water (T_2)	20.6 (26.9)	30.67 (33.59)	25.62 (30.39)	66.8
Seed treatment with *Trichoderma viride* @10g/kg seed (T_3)	45.0 (34.5)	55.33 (48.07)	44.17 (41.64)	43.0
Seed treatment with *Trichoderma viride* @10g/kg seed + soil application of *T.viride* @2.5kg/ha (T_4)	38.9 (32.5)	44.00 (41.53)	41.43 (40.03)	46.3
Spraying of Difenoconazole @ 1ml/l of water (T_5)	23.3 (28.8)	34.0 (35.57)	28.67 (32.26)	62.9
Spraying of Copper oxychloride @ 4g/l of water (T_6)	33.8 (35.5)	42.0 (40.34)	37.93 (37.96)	50.9
Spraying of Chlorothalonil @ 2.0g/l of water (T_7)	29.5 (32.7)	39.33 (38.81)	34.40 (35.84)	55.5
Spraying of Metalaxyl+Mancozeb @ 2.5g/l of water (T_8)	47.8 (43.7)	58.00 (49.63)	52.9 (46.66)	31.5
Control (T_9)	71.1 (57.6)	83.33 (66.34)	77.22 (61.57)	-
SE(m)±	3.22	2.42	2.06	
CD(0.05)	9.65	7.27	6.18	

*Figure in the parenthesis is angular transformed value.

Table 2. Effect of different treatments on the incidence of fruit rot of tomato.

Treatments	Fruit rot (%)			% Reduction of fruit rot over control
	2011-12	2012-13	Pooled	
Seed treatment with Mancozeb @ 2.5 g/kg seed (T_1)	24.53 (29.47)*	30.83 (33.73)	27.68 (31.74)	29.9
T_1 + Spraying of Mancozeb @ 2.5g/l of water (T_2)	10.57 (18.92)	14.53 (22.27)	12.55 (20.68)	68.2
Seed treatment with *Trichoderma viride* @10g/kg seed (T_3)	26.17 (30.76)	32.03 (34.43)	29.10 (32.63)	26.3
Seed treatment with *Trichoderma viride* @10g/kg seed + soil application of *T.viride* @2.5kg/ha (T_4)	23.07 (28.69)	29.50 (32.84)	26.28 (30.83)	33.4
Spraying of Difenoconazole @ 1ml/l of water (T_5)	14.43 (22.29)	18.37 (25.35)	16.40 (23.88)	58.4
Spraying of Copper oxychloride @ 4g/l of water (T_6)	25.13 (30.07)	25.87 (30.55)	25.50 (20.04)	35.4
Spraying of Chlorothalonil@ 2g/l of water (T_7)	24.70 (29.78)	21.17 (27.36)	22.93 (28.61)	41.9
Spraying of Metalaxyl+Mancozeb @ 2.5g/l of water (T_8)	20.40 (26.84)	28.50 (32.24)	24.45 (29.62)	38.1
Control (T_9)	34.63 (36.03)	44.30 (41.71)	39.47 (38.92)	-
SE(m)±	0.85	1.36	3.47	
CD(0.05)	2.56	4.07	10.41	

*Figure in the parenthesis is angular transformed value.

Table 3. Effect of different treatments on the yield of tomato.

Treatments	Fruit yield (kg/ha)			Per cent increase in yield over control
	2011-12	2012-13	Pooled	
Seed treatment with Mancozeb @ 2.5 g/kg seed (T_1)	160.0	226.4	193.20	32.8
T_1 + Spraying of Mancozeb @ 2.5g/l of water (T_2)	203.0	258.4	230.70	58.6
Seed treatment with *Trichoderma viride* @10g/kg seed (T_3)	143.0	210.0	176.50	21.3
Seed treatment with *Trichoderma viride* @10g/kg seed + soil application of *T.viride* @2.5kg/ha (T_4)	150.0	214.5	182.25	25.3
Spraying of Difenoconazole @ 1ml/l of water (T_5)	196.0	251.7	223.85	53.8
Spraying of Copper oxychloride @ 4g/l of water (T_6)	170.0	230.3	200.15	37.6
Spraying of Chlorothalonil@ 2g/l of water (T_7)	176.0	235.0	205.50	41.2
Spraying of Metalaxyl+Mancozeb @ 2.5g/l of water (T_8)	136.0	200.8	168.40	15.7
Control (T_9)	113.0	178.0	145.50	-
SE(m)±	9.98	6.79	5.88	
CD(0.05)	29.92	20.36	17.63	

+ Soil application of *Trichoderma viride* @ 2.5kg/ha resulted in an increased yield of 25.3% followed by seed treatment with *Trichoderma viride* @ 10g/kg of seed (21.3%).

Mancozeb might have a role to restrict the germination of fungal spore and mycelial growth of the pathogen ultimately which may result in the inhibition of disease producing activity of fungal pathogen in plant and induced resistance in plant. This may be the reason for causing minimum disease in plant and producing maximum yield as compared to other treatments. So, it may be concluded that seed treatment with Mancozeb@2.5g/kg + three spraying of Mancozeb @ 2.5g/lit of water was found to the best and effective treatment in reduction of early blight disease severity, fruit rot incidence and increment in fruit yield.

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