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Fungicidal management of Early Blight disease in tomato

A. DHAL[1], S.K. BEURA[2], S.K. DASH[3] AND L. TRIPATHY[4]
[1]KVK, Jagatsinghpur 754160, Odisha
[2]Department of Plant Pathology, OUAT, Bhubaneswar 751003, Odisha
[3]College of Horticulture, OUAT, Chiplima, Odisha
[4]AICRP on Floriculture, College of Horticulture, OUAT, Chiplima,Odisha

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The efficacy of nine fungicides such as Difenconazole, Metalaxyl + Mancozeb, Propiconazole, Penconazole, Hexaconazole, Thiophanate methyl, Propineb, Chlorothalonil and Carbendazim + Mancozeb were studied for the management of Alternaria leaf blight disease of tomato (*Lycopersicon esculentum* Mill.). Field trials were conducted for three consecutive *rabi* seasons 2010-11 to 2012-13 in the farmers field at Tirtol (Jagatsinghpur) of Odisha with the variety Utkal Kumari (BT-10). The trial was laid out in Randomized Block Design with three replications. The row to row spacing of 60 cm and plant to plant spacing of 40 cm was adopted in plot size of 8.1 sq.m. (3.0 x 2.7m) with a fertilizer dose of N:P_2O_5 :K_20 @125:60:100 Kg/ha. Spraying with Difenconazole, Carbendazim, Chlorothalonil and Thiophanate methyl in their respective concentrations proved effective by recording minimum disease incidence i.e PDI of 3.3, 6.3, 6.9 and 10.4 respectively. Spraying with Difenconazole (0.15%) recorded maximum marketable fruit yield of 381.7 q/ha and minimum rotted fruits (7.4 q/ha). However, the plots sprayed with Carbendazim (0.15%) twice at 10 days interval after the initiation of disease recorded highest cost benefit ratio of 1:5.3 followed by Difenconazole (1:5.0), Chlorothalonil (1:3.6) and Thiophanate methyl (1:3.1).

Key words: Tomato, Early Blight, fungicides

INTRODUCTION

Tomato (*Lycopersicon esculentum* Mill.), a native of tropical America, is an important vegetable crop grown throughout the world. Tomato belongs to family Solanaceae and is the second most important vegetable crop next to potato. Tomato is highly sensitive to environmental stresses and several diseases cause remarkable loss in yield. Among the fungal diseases, Early Blight and Fruit Rot disease caused by *Alternaria solani* (Ellis and Martin) Jones and Grout is most destructive in tropical and subtropical regions. It is one of the most catastrophic diseases incurring loss both at pre-and post-harvest stages causing 35 to 78 per cent reduction in yield (Jones *et al.*, 1993). Every one per cent increase in intensity can reduce yield by 1.36 per cent and complete crop failure can occur when the disease is most severe. (Ngoc *et al.*, 2013).

This disease is severe in almost all tomato growing areas of Odisha. But not much more information is available for suitable management of this disease. Considering the economic importance and serious nature of the disease and in absence of suitable resistant genotypes of the crop, attempts

have been made to manage the disease by foliar spray of fungicides, by seed treatment or by adopting combination of practices. In the present investigation, it is thought worthwhile to test the efficacy of more promising and new generation fungicides against the Early Blight fungus.

MATERIALS AND METHODS

In order to study the efficacy of nine chemicals on the management of Early Blight of tomato, the field trials were conducted for three consecutive *rabi* seasons of 2010-11, 2011-12 and 2012-13 in the farmers field at Tirtol (Jagatsinghpur) of Odisha with the variety Utkal Kumari (BT-10).

The trial was laid out in Randomized Block Design with three replications. The chemicals included under study eg. T_1 – Difenconazole (0.05%), T_2 – Metalaxyl + Mancozeb (0.2%), T_3 – Propiconazole (0.05%), T_4 – Penconazole (0.05%), T_5 – Hexaconazole (0.05%), T_6 – Thiophanate methyl (0.15%), T_7 – Propineb (0.05%), T_8 – Chlorothalonil (0.2%), T_9 – Carbendazim + Mancozeb (0.2%) and T_{10} – Control (without any chemicals).

The crop was planted with a row to row spacing of 60 cm and plant to plant spacing of 40 cm, being adopted in a plot size of 8.1 sq.mt. (3.0m x 2.7m). All the agronomical practices as generally recommended were followed with the fertilizer dose of N_2:P_2O_5:K_2O::125:60:100 kg /ha. In all the treatments except control, seed treatment was done alone with Metalaxyl (4%) + Mancozeb (64%) @ 2 g / kg of seed. Two foliar sprayings were given at an interval of 10 days after appearance of disease in the field. The per cent disease incidence (PDI) and per cent disease control (PDC) were calculated. The observations were taken to find the marketable as well as rotted fruit yield. Economics of chemical management was worked out on the basis of prevailing market price of tomato fruits @ Rs. 800/- per quintal, labour wage @ Rs. 200/- per day per person and cost of chemical taking into account.

Table 1 : Effect of foliar application of fungicides on *Alternaria* blight incidence in tomato

Treatments	Mean percentage leaf blight incidence			Mean	% disease reduction
	2010-11	2011-12	2012-13		
T1 – Difenconazole	2.4 (8.88)	4.5 (12.17)	3.0 (9.89)	3.3 (10.31)	93.9
T2 – Metalaxyl + Mancozeb	11.4 (19.67)	12.6 (20.74)	9.8 (18.15)	11.3 (19.52)	79.2
T3 – Propiconazole	28.2 (32.06)	26.4 (30.84)	25.3 (30.12)	26.7 (31.01)	50.9
T4 – Penconazole	17.8 (24.92)	20.3 (26.75)	19.4 (26.12)	19.2 (25.01)	64.7
T5 – Hexaconazole	15.1 (22.83)	17.2 (24.47)	16.6 (24.02)	16.3 (23.77)	70.0
T6 – Thiophanate Methyl	10.0 (18.26)	12.5 (20.64)	8.6 (16.99)	10.4 (18.63)	80.9
T7 – Propineb	23.4 (28.89)	25.2 (30.11)	23.6 (29.04)	24.1 (29.35)	55.7
T8 – Chlorothalonil	7.1 (15.33)	8.3 (16.67)	5.2 (13.13)	6.9 (15.04)	87.3
T9 – Carbendazim	5.6 (13.60)	7.1 (15.34)	6.2 (14.27)	6.3 (15.97)	88.6
T10 – Control	52.4 (46.38)	56.8 (48.92)	54.0 (47.30)	54.4 (47.53)	
SE(m)±	(1.36)	(0.85)	(0.83)	(0.51)	
CD (0.05)	(4.03)	(2.52)	(2.47)	(1.51)	
CV%	(10.19)	(5.96)	(6.29)	(3.75)	

Figures in parenthesis indicate angular transformed values and statistics applied to them

Table 2 : Effect of foliar application of fungicides on fruit yield of tomato

Treatment	Marketable yield				Yield increase over control (%)	Rotted fruit yield				Total fruit yield (Mean)
	2010-11	2011-12	2012-13	Mean		2010-11	2011-12	2012-13	Mean	
T1–Difenconazole	385.4	378.6	381.0	381.7	26.6	8.4	7.0	6.8	7.4	389.1
T2–Metalaxyl + Mancozeb	345.8	348.6	342.4	345.6	14.6	16.3	18.4	17.6	17.4	363.0
T3–Propiconazole	338.2	334.3	335.1	335.9	11.4	18.2	19.4	20.0	19.2	355.1
T4–Penconazole	320.6	325.4	323.8	323.3	7.2	20.4	22.3	24.0	22.2	345.5
T5–Hexaconazole	348.4	342.6	345.7	345.6	14.6	14.2	15.6	16.1	15.3	360.9
T6–Thiophanate Methyl	351.4	354.8	349.6	351.9	16.7	13.1	15.0	14.6	14.2	366.1
T7–Propineb	341.6	338.2	339.4	339.7	12.6	16.8	20.0	18.6	18.5	358.2
T8–Chlorothalonil	354.4	355.8	352.6	354.3	17.5	12.4	14.1	13.8	13.4	367.7
T9–Carbendazim	371.5	365.8	368.2	368.5	22.2	11.2	10.5	12.0	11.2	379.7
T10– Control	298.8	304.6	301.3	301.6	-	26.5	28.4	30.3	28.4	330.0
SE(m) ±	2.09	0.85	1.66	1.52		1.17	0.80	0.89	0.54	
CD(0.05)	6.20	2.54	4.95	4.50		3.46	2.37	2.65	1.62	
CV%	1.05	0.43	0.84	0.76		12.82	8.1	8.9	5.64	

RESULTS AND DISCUSSION

It was evident from Tables 1, 2, 3, and Fig 1 that, all the nine fungicides included under study were found efficaceous in reducing the disease incidence and increasing the marketable yield. However, among the fungicides, spraying with Difenconazole, Carbendazim, Chlorothalonil and Thiophanate methyl recorded mean per cent leaf blight incidence of 3.3, 6.3, 6.9 and 10.4% respectively where as the check plot recorded as high as 54.4% disease incidence. But the percentage disease reduction was found to be the maximum in Difenconazole (93.9%) followed by Carbendazim (88.6%), Chlorothalonil (87.3%) and Thiophanate methyl (80.9%) and Metalaxyl + Mancozeb (79.2%) which recorded yield increase over control by 26.6%, 22.2%, 17.5% and 16.7% respectively. Maximum fruit yield (marketable) 381.7q/ha was harvested from spraying with Difenconazole followed by Carbendazim (368.5 q/ha), Chlorothalonil (354.3q/ha) and Thiophanate methyl (351.9 q/ha). The production of rotted fruits was also found to be minimum 7.4 q/ha in Difenconazole treatment followed by 11.2 q/ha in Carbendazim treatment, where as in control plots as high as 28.4 q/ha of rotted fruits were recorded.

So far as cost: benefit (CB) ratio analysis was concerned, maximum C:B ratio 1:5.3 was recorded from Carbendazim spray followed by 1:5.0 from Difenconazole, 1:3.6 from Chlorothalonil and 1:3.1 from Thiophanate methyl. The cost: benefit ratio was directly related to low disease incidence and higher fruit yield, but C:B ratio obtained was a bit higher from Carbendazim than Difenconazole because of higher cost of Difenconazole as compared to Carbendazim.

The effectiveness of Difenconazole in controlling Early Blight in tomato has been reported by Meena *et al.* (2010), Saha *et al.* (2013) and Ngoc *et al.* (2013) which supports our findings. Carbendazim, a systemic chemical effective against Early Blight of tomato as reported by Prasad and Naik (2003) is also in agreement with the present study.

It is evident from the earlier reports that Mancozeb, no doubt was the most efficacious chemical against *A. solani,* but in the present investigation an at-

Table 3 : Economics of fungicidal spray on *Alternaria* blight of tomato

Treatment	Excess produce over control (Qtl)	Gross expenditure over control (Rs)	Gross return over control (Rs)	Net return over control (Rs)	BC ratio
T1 – Spraying Difenconazole	80.1	10,650	64,080	53,430	5.0
T2 – Spraying Metaloxyl + Mancozeb	44.0	12,350	35,200	22,850	1.9
T3 – Spraying Propiconazole	34.3	9,570	27,440	17,870	1.9
T4 – Spraying Penconazole	21.7	9,840	17,360	7,790	0.8
T5 – Spraying Hexaconazole	44.0	10,515	35,200	24,685	2.3
T6 – Spraying Thiophanate Methyl	50.3	9,745	40,240	30,495	3.1
T7 – Spraying Propineb	38.1	9,560	30,480	20,920	2.2
T8 – Spraying Chlorothalonil	52.7	9,180	42,160	32,980	3.6
T9 – Spraying Carbendazim	66.9	8,540	53,520	44,980	5.3
T10 – Control	-	-	-	-	-

tempt has been made to include mancozeb along with systemic Metalaxyl, and some new molecules such as Propiconazole, Penconazole and Hexaconazole for the control of *A. solani.* Metalaxyl + Mancozeb proved effective against the disease as reported earlier by Jovancev (1998) and Patel and Choudhury (2010) which is in agreement with the present investigation. The nonsystemic fungicides are reported to be effective against *Alternaria* than the systemic ones. The effectiveness may be attributed to their greater ability to inhibit the inoculums persistence on the crops which in term

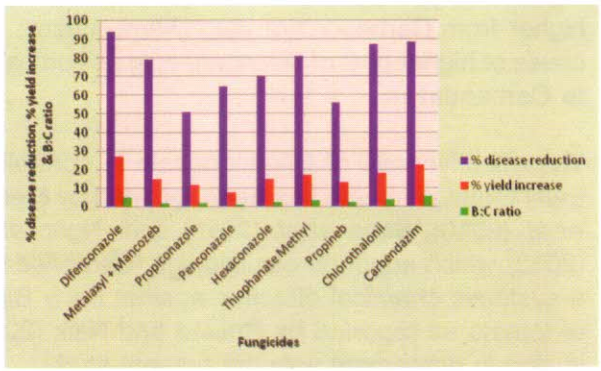

Fig. 1 : Effect of foliar application of fungicides on disease reduction, increase in fruit yield & B:C ratio

affects the metabolic activity of the organism. Therefore, alternate spraying of nonsystemic (Mancozeb) and systemic (Difenconazole / Carbendazim) is suggested for overall control of Early Blight of tomato to minimise the risk of development of resistant strains and effective management of the disease.

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