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In vivo bio-efficacy of fungicide molecules against leaf spot, fruit rot and powdery mildew diseases of Chilli

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Abstract

Foliar diseases are causes major qualitative and quantitative yield loss in chilli at both field and storage condition. Management of these foliar diseases through fungicides is much needed effort. Hence, in present investigation different fungicide molecules were evaluated against leaf spot, fruit rot and powdery mildew diseases of chilli. Among fungicides evaluated, Carbendazim 12%+ Mancozeb 63% WP @ 750 g/ha, was found most effective with least leaf spot (9.16 PDI), powdery mildew (18.63 PDI) and fruit rot severity (13.45 PDI) compared to other fungicides and untreated control. Maximum fruit yield, 20.37 Q/ha was recorded in treatment Carbendazim 12%+ Mancozeb 63% WP @ 750 g /ha which was significantly superior over rest of the treatments. The cost benefit ratio analysis of different fungicides revealed that, Carbendazim 12%+ Mancozeb 63% WP with dosage 750 g /ha (1:15.1) found to be superior over rest of the treatments.

Keywords: Leaf spot, fruit rot, powdery mildew, fungicides and C:B ratio

Introduction

Chilli (*Capsicum annum* L) is an important spice cum vegetable crop. It is grown throughout the world for its green and red ripe fruits as it is a lucrative crop and form indispensable adjuvant almost in every house. Chilli fruit is used as fresh, cooked, pickled and canned in sauces and as powder for hot spices. Pungency in chilli, which is due to the presence of capsaicin, is a digestive stimulant and a cure for rheumatic troubles. Among the spices consumed in India dried chilli powder contribute the major share. Green chillies are rich source of vitamins especially vitamin A, C, B1, B2 and also rich in vitamin P (rutin), which is of immense pharmaceutical importance (Purseglow, 1977) [12]. India is the major producer, consumer and exporter of chilli in the world. In India, chilli is cultivated over an area of 775 thousand hectares with annual production of 1492 thousand metric tonnes (Anonymous, 2014)² which accounts for 25% of the world production.

Chilli suffers from many diseases caused by fungi, bacteria, viruses and nematodes. Among the fungal diseases, powdery mildew, leaf spot and anthracnose or fruit rot are the most prevalent (Khodke *et al.*, 2009) [11]. The powdery mildew caused by *Leveillula taurica* (Lev.) Arn. is a major constraint in chilli production in India causing heavy yield loss ranging from 14 to 30%, due to severe defoliation and reduction in photosynthesis, size and number of fruits per plant (Gohokar and Peshney, 1981) [9]. The anthracnose or ripe fruit rot caused by *Colletotrichum capsici* (Sydow.) Butler and Bisby, is a wide spread problem limiting the profitable cultivation and seed production throughout the major Chilli growing regions of India. By considering the seriousness of disease and the economic damage/exorbitant losses caused by the disease, the present investigation was carried out by using different fungicides for its efficacy against foliar diseases of chilli under field condition.

Materials and Methods

The field experiment was laid out in Randomized Block Design (RBD) with five treatments and four replications. The seeds of a local variety of Chilli (Pusa Jwala) were sown in small beds for raising nursery and 35 days old seedlings were transplanted into the field with 75 cm inter and 45 cm intra row spacing in plots measuring 5.0 m x 3.0 m. The treatments details are presented here under.

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Treatment Details

No.	Treatment Details	Dosage/ha	
		Active substance (g or ml)	Formulation (g or ml)
T1	Carbendazim 12%+ Mancozeb 63% WP	90 + 472.5	750
T2	Mancozeb 75% WP	1500	2000
T3	Carbendazim 50% WP	150	300
T4	Hexaconazole 2% SC	60	3000
T5	Control (water spray)	-	-

Observations on bio-efficacy of fungicides

Observations were recorded on disease incidence and fruit yield per plot and later converted into quintal per hectare basis. The data on disease incidence were recorded before spray application and 7 days after the last spray application. The first spray of fungicides was done after the first appearances of disease symptoms. The same concentrations were also followed during second and third spray applications with an interval of 15 days. Water sprayed plots served as control.

Assessment of PDI (Percent Disease Index)

To record incidence of *Cercospora* leaf spot and Powdery mildew diseases, 10 plants were selected randomly. Total 10 leaves per plant were examined at lower, middle and upper level for visual symptoms of diseases. To record incidence of *Colletotrichum* fruit rot, randomly selected three sets of fifty Chilli fruits from each plot and observed percent incidence of infected Chilli fruits. Percent disease index (PDI) was calculated by using the formula given by Wheeler (1969) [16].

Disease rating scale for Powdery mildew disease

Rating	% leaf area infected
0	No infection of powdery mildew
1	1-10% infection
2	11-15% infection
3	16-25% infection
4	26-50% infection
5	> 50% infection

Disease rating scale for leaf spot (*Cercospora*) and fruit rot (*Colletotrichum*) disease

Rating	% leaf /fruit area covered by disease
0	Healthy or no disease symptoms
1	Up to 5% infection
2	>5-10% infection
3	>10-25% infection
4	>25-50% infection
5	Above 50% infection

Yield assessment

The Fruit yields of Chilli were recorded after harvesting the crop at maturity and expressed in Q/ha. Cost benefit ratio was also calculated and compared with different treatments.

Statistical analysis

All the data of diseases incidence and yields were statistically analyzed by the following procedure of RBD. Calculations were made after applying the test of significance of the means. The per cent data of disease incidence was transformed to Arch sine value.

Results and Discussion

Effect of fungicides on leaf spot of Chilli caused by *Cercospora capsici*

Results revealed that, all the treatments were superior over control against the leaf spot disease. Plot treated with treatment, Carbendazim 12%+ Mancozeb 63% WP @ 750 g/ha, was found most effective treatment to reduce leaf spot disease incidence (9.16 PDI) which was also at par with Hexaconazole 2% SC @ 3000 ml/ha (9.74 PDI). Plots treated with Mancozeb 75% WP and Carbendazim 50% WP treatments were recorded 10.83 PDI and 11.20 PDI, respectively. Maximum PDI of 19.40 was recorded in Control plot (Table 1). The findings are agreement with Thejakumar and Devappa (2016) [15], they reported the fungicidal activity of carbendazim fungicide against cercospora leaf spot of chilli. Islam *et al.* (2015) [10] studied the management of *Cercospora* leafspot of chilli using bavistin fungicide. Bavistin-DF @ 1g/l sprayed 3 times at 12 days interval was effective prescription. The lowest incidence (33.5%) and severity (15.5%) were recorded at Chandina and Kushtia Sadar where Bavistin-DF was applied @ 1mg/l. Promising effect in reducing incidence and severity of *Cercospora* leaf spot of chilli was observed also in Marichar Char, Mymensingh where Bavistin-DF was applied @ 0.5 g/l.

Effect of fungicides on powdery mildew of Chilli caused by *Leveillula taurica*

All the fungicidal treated plots were significantly reduced disease incidence of powdery mildew. The minimum PDI (18.63 PDI) was recorded in plots treated with Carbendazim 12%+ Mancozeb 63% WP @ 750 g/ha and showed best among the all fungicidal treatments, which was at par with Hexaconazole 2% SC @ 3000 ml/ha (20.34 PDI). Followed by SAAF @ 1000 g/ha. Plots treated with Carbendazim 50% WP (31.80 PDI) and Mancozeb 75% WP (43.17 PDI) treatments were also reduced PDI compared to Control (58.71 PDI) (Table 1). The findings are supported by Raju *et al.* (2017) [13], they successfully managed the powdery mildew of chilli through foliar spray of carbendazim (0.1%) under protected cultivation. Audichay and Thakore (2000)³ concluded that, in order to safeguard the crop from the powdery mildew to obtain higher seed yield and lower infestation of the disease, single spray of carbendazim (0.1%) or triadimefon (0.1%) as protectant was recommended. Fugro *et al.* (2004) [8] reported that carbendazim 80% WDG at 250g a.i./ha was most effective in managing powdery mildew of chilli.

Effect of fungicides on Anthracnose or fruit rot of Chilli caused by *Colletotrichum capsici*

The experimental data revealed that, minimum PDI (13.45) was noticed in plot treated with foliar spray of Carbendazim 12%+ Mancozeb 63% WP @ 750 g/ha against the fruit rot of Chilli and which was significantly superior over all the treatments. Next in the order of superiority descending order was foliar spray of Mancozeb 75% WP (14.69 PDI), lower dose of SAAF (16.91 PDI), Carbendazim 50% WP (17.85 PDI) and Hexaconazole 2% SC (20.61). Maximum PDI of 41.59 was recorded in Control plot (Table 1). The results are agreement with Yadav *et al.* (2017) [17], they reported that, three fungicides *viz.*, tebuconazole (0.1%), carbendazim + mancozeb (0.1%) and propiconazole (0.1%) were effective in management of chilli fruit rot pathogen (*C. capsici*) in the field. These fungicides were applied as seed treatment and foliar spray. Ekbote (2005) [7] recorded that the less per cent

incidence of anthracnose and highest dry chilli pod yield in the treatment with emcop (0.20%) which was at par with carbendazim (0.1%) and copper oxychloride (0.25%). Chauhan *et al.*, (2014) [6] reported that the minimum anthracnose disease intensity with maximum fruit yield was found in carbendazim 0.05% which was statistically at par with 0.2% mancozeb, 0.2% carbendazim + mancozeb and 0.2% copper oxychloride.

Effect of fungicides on yield (Q/ha) of chilli

Results revealed that all the treatments increased the dry Chilli fruit yield (in quintal per ha) with respect to control. Maximum fruit yield, 20.37 Q/ha was recorded in treatment Carbendazim 12%+ Mancozeb 63% WP @ 750 g/ha which was significantly superior over rest of the treatments. Next treatment in order of superiority was treatment Hexaconazole 2% SC (17.88 Q/ha) followed by Mancozeb 75% WP (17.08

Q/ha) and Carbendazim 50% WP (15.83 Q/ha) as compared to control plot (14.88 Q/ha) (Table 2). Results are in comparison with results findings of Basha *et al.* (2017) [5], Gohokar and Peshney (1981) [9]; Sharmila (2001) [14]; Akhileshwari *et al.* (2012) [1] while working with various crops.

The incremental cost benefit ratio calculated for different fungicides revealed the superiority of treatment Carbendazim 12%+ Mancozeb 63% WP with dosage 750 g/ha (1:15.1) found to be superior over rest of the treatments (Table 3).

Experimental findings revealed that, Carbendazim 12%+ Mancozeb 63% WP at 750 g/ha effectively controlled the *Cercospora* leaf spot, Powdery mildew and Fruit rot diseases of Chilli crop. It showed superior result compared to its solo formulations, Mancozeb 75% WP and Carbendazim 50% WP. Fungicidal treatments recorded maximum fruit yield compared to control.

Table 1: Effect of foliar spray of fungicides against Leaf spot, Powdery mildew and Fruit rot disease of Chilli

Treatment details	Dosage g or ml /ha	Percent Disease Index									C:B
		Leaf spot			Powdery mildew			Fruit rot			
		Before application	After 3 rd spray	% Disease Control	Before application	After 3 rd spray	% Disease Control	Before application	After 3 rd spray	% Disease Control	
Carbendazim 12%+ Mancozeb 63% WP	750	4.70 (12.51)	9.16 (17.56)	52.78	7.43 (15.81)	18.63 (25.55)	68.26	2.32 (8.73)	13.45 (21.51)	67.66	1:15.1
Mancozeb 75% WP	2000	3.85 (11.29)	10.83 (19.19)	44.17	6.96 (15.29)	43.17 (41.03)	26.46	2.06 (8.25)	14.69 (22.53)	64.67	1:4.49
Carbendazim 50% WP	300	4.28 (11.92)	11.20 (19.55)	42.26	7.20 (15.56)	31.80 (34.33)	45.83	2.35 (8.78)	17.85 (24.99)	57.08	1:2.9
Hexaconazole 2% SC	3000	4.14 (11.74)	9.74 (18.15)	49.79	6.78 (15.08)	20.34 (26.78)	65.35	2.57 (9.19)	20.61 (26.99)	50.44	1:7.2
T7- Control	-	4.51 (12.24)	19.40 (26.13)	-	6.98 (15.30)	58.71 (50.01)	-	2.42 (8.90)	41.59 (40.15)	-	-
CD at 5%	-	NS	1.50	-	NS	1.96	-	NS	1.29	-	-
S.Em. ±	-	-	0.42	-	-	0.61	-	-	0.38	-	-

*Figures in parenthesis are arc sin transformed

Table 2: Effect of foliar spray of fungicides on yield of Chilli

Treatments	Formulation (ml or g/ha)	Dry Chilli yield Q/ha	% yield increase over control
Carbendazim 12%+ Mancozeb 63% WP	750	20.37	36.89
Mancozeb 75% WP	2000	17.08	14.78
Carbendazim 50% WP	300	15.83	6.38
Hexaconazole 2% SC	3000	17.88	20.16
Control	-	14.88	-
CD @5%		1.28	
S.Em. ±		0.39	

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