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Research Article

FIELD EVALUATION OF CHEMICAL FUNGICIDES AGAINST CHILLI ANTHRACNOSE CAUSED BY *Colletotrichum capsici* IN WEST BENGAL

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Abstract- Chilli anthracnose, caused by *Colletotrichum capsici*, is one of the most destructive diseases that causes considerable loss in chilli production. In the absence of resistant cultivars, the management of chilli anthracnose disease has relied principally on the application of chemical fungicides. The present study evaluated the effects of chemical fungicides on chilli anthracnose disease and investigated the effect of the yield of chilli plants. The experiment was conducted during the *Kharif* season of 2017 and 2018 under natural epiphytotic conditions. The susceptible variety Bullet was used for the experiment. The pathogenicity test was conducted in the laboratory. Two sprays at 15-day intervals of Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha was the most effective, followed by Azoxystrobin 18.2% + Difenoconazole 11.4% SC @ 1000 ml/ha and Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha. The results of the present study demonstrated a promising approach to chemical management against anthracnose disease of chilli.

Keywords- *Anthracnose, Chilli, Chemical fungicides, Colletotrichum capasici*

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Introduction

India is known as The Home of Spices and Indian spices are famous all over the world for their gastronic value, possessing high medicinal values. Chilli (*Capsicum annum* L.), which belongs to the family Solanaceae, is one of the most important vegetables, primarily grown for its pungency, colour, and spicy taste. It is a valuable source of vitamins A and C [1] and is used in beverages, cosmetics, and medicines. Presently, India leads the world in production, consumption, and export of chilli, contributing nearly 25% of the total chilli exports. It produces 1.49 million tonnes of chillies from 0.77 million hectares of land with a productivity of 1.92 MT/ha [2]. Chilli was grown on an area of 63.6 thousand hectares (8.21%) in West Bengal, with a total production of 100 thousand tonnes (6.70%) and a productivity of 1.57 tonnes per hectare [3]. Chilli production is minimised due to numerous restraints like continuous monoculture, improper cultivation methods adopted by the farmers, unavailability of healthy seeds, adverse climate, poor soil conditions, pests and various fungal, bacterial and viral diseases [4].

Chilli was grown on an area of 63.6 thousand hectares (8.21%) in West Bengal, with a total production of 100 thousand tonnes (6.70%) and a productivity of 1.57 tonnes per hectare [5], but here *C. capsici* (Syd.) Butler and Bisby is the cause of major damage at the ripe fruit stage of the plant [6,7]. Small, black, round spots emerge on the fruit skin, indicating the presence of the disease. Fruits that have been infected with a fungus turn straw-colored or pale white and lose their flavor. The fungus produces an acervulus that grows on the surface of infected parts and contains conidia that are responsible for the secondary spread of the pathogen. Both mature and immature fruits are severely affected by the disease in the field as well as during storage under favourable conditions, i.e., high humidity (when rain occurs after the fruits start to ripen), and losses of up to 84 percent have been reported by Thind and Jhooty, (1985) [8], as well as an estimated overall annual productivity loss of around 29.5 percent [9]. Chemicals, which are the most widely used technique of disease management due to their quick results compared to the time required to establish a resistant cultivar, have further popularised the use of fungicides for disease control, particularly anthracnose [10].

In the absence of resistant cultivars, the management of chilli anthracnose disease has relied principally on the application of synthetic fungicides. The present study evaluated the effects of chemical fungicides on chilli anthracnose disease and yield of chilli plants. The results of this work could be used as an effective strategy for the management of chilli anthracnose disease.

Materials and Methods

The trial was taken up to evaluate the effectiveness of some chemical fungicides in managing *Colletotrichum capsici* (Syd.) Butl. and Bisby. causing anthracnose in chilli crops. The field experiment was set up in the subtropical climatic conditions of West Bengal at the Regional Research Sub-Station (R & L Zone), Bidhan Chandra Krishi Viswavidyalaya, Sekhampur, Birbhum, West Bengal, India during *Kharif* 2017 and *Kharif* 2018. There were three replications laid out in a randomised block design, having a block size of 5 m x 3 m and a spacing of 70 cm x 40 cm, and the local chilli Bullet variety was taken. The crop was maintained with judicious agronomic practises. The disease is most severe at the fruiting stage of the crop. Diseased parts were collected from the field and examined microscopically, and the isolation procedure was done as per pathological technique to confirm the presence of the fungus. After the first appearance of the symptoms, the fungicides were sprayed, *i.e.*, 105 days after planting. Two sprays at a 15-day interval were done. The disease was scored using the following 0–9 scale as described by Mayee and Datar (1986) [11], where: 0 = No incidence; 1 = Less than 1% area infected; 3 = 1–5% leaf/fruit area affected; 5 = 6-25% leaf/fruit area affected; 7 = 26–50% leaf/fruit area affected, and 9 = 61–100% leaf/fruit area affected. The Percentage Disease Index was worked out using the formula, PDI = [Sum of all numerical ratings/total number of observations taken x maximum disease score] x 100 [12].

Results and Discussion

Results presented in from of the experimental trials revealed that all the treatments reduced the disease severity of chilli anthracnose over (T_7) control.

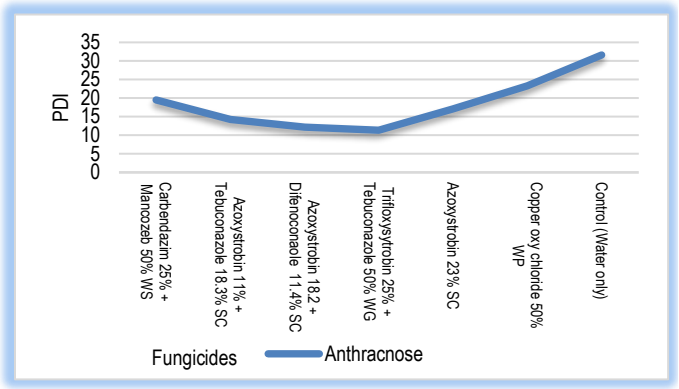

Fig-1 Percent disease index (PDI) in different fungicides against chilli anthracnose

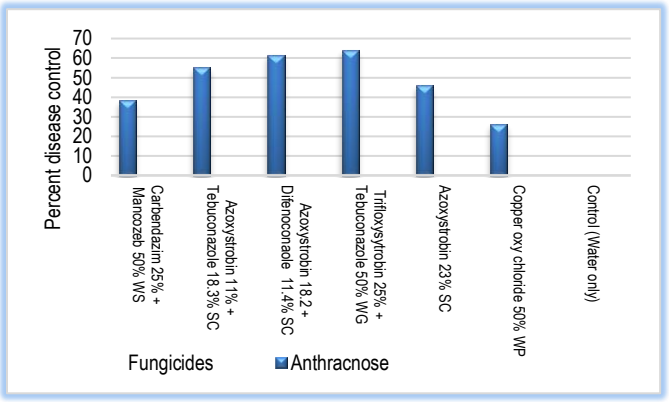

Fig-2 Effect of fungicides on disease reduction of chilli anthracnose

Table-1 *Treatments details of fungicides*

Treatments	Fungicides	Dosage (ml/g per ha)
T_1	Carbendazim 25% + Mancozeb 50% WS	700
T_2	Azoxystrobin 11% + Tebuconazole 18.3% SC	1000
T_3	Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC	1000
T_4	Trifloxysytrobin 25% + Tebuconazole 50% WG	350
T_5	Azoxystrobin 23% SC	500
T_6	Copper oxy chloride 50% WP	2500
T_7	Control (Water only)	--

Depending on the prevailing weather conditions, the maximum PDI, or percent disease index, was recorded in control (31.61%). At 15 days after the second spray, T_4: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (11.36%), T_3: Azoxystrobin 18.2%+ Difenoconaole 11.4% SC @ 1000 ml/ha (12.15%), T_2: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (14.21%), and T_1: Carbendazim 25%Results among these three treatments (T_2, T_3 & T_4) were found to have good efficacy against the disease over control [Table-2] and [Fig-1].

The percent reduction in PDI was also calculated over control [Table-2] and [Fig-2]. The data revealed that the highest disease reduction was in T_4: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (61.56%), followed by T_3: Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC @ 1000 ml/ha (61.56%), T_2: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (55.05%), and T_1: Carbendazim 25% + Mancozeb 50% WS @ 700 g/ha (38.41%) at 15 days after the 2nd spray. All treatments effectively control the anthracnose disease in chillies. The yield data has been presented in [Table-3] and [Fig-3]. The results showed that T_4: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (96.42 qn/ha) produced the highest yield, followed by T_3: Azoxystrobin 18.2%+ Difenoconaole 11.4% SC @ 1000 ml/ha (95.86 qn/ha), and T_2: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha. The lowest yield was recorded in T_7: Control (58.47 qn/ha). The highest incremental yield was calculated from T_4: Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha (64.91%), followed by T_3: Azoxystrobin 18.2%+ Difenoconazole 11.4% SC @ 1000 ml/ha (63.95%), T_2: Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha (61.16%), and T_1: Carbendazim 25% + Mancozeb 50% WS @ 700 g/ha (49.92%).

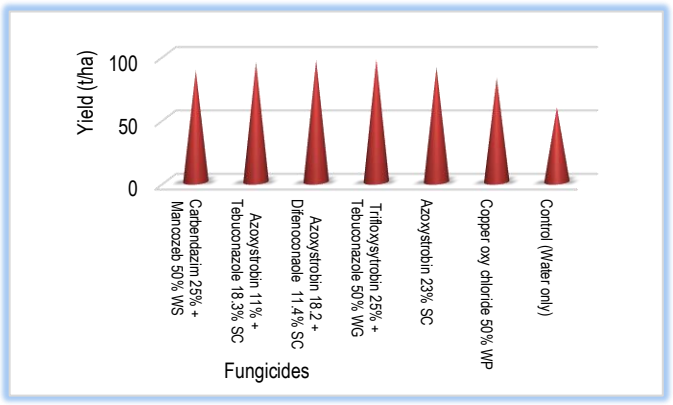

Fig-3 Effect of fungicides on yield of chilli anthracnose

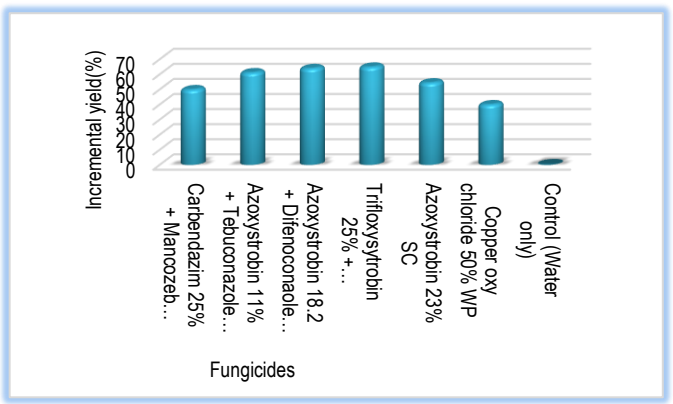

Fig-4 Effect of fungicides on incremental yield in chilli anthracnose

The combination of Azoxystobin and Tryfloxystrobin in combination with Tebuconazole proved to be in synergy as the individual components have different modes of action. Azoxystrobin inhibits fungi respiration by disrupting the electron transport chain, thereby preventing ATP synthesis, by binding to the Complex III Qo site within the mitochondrion. Tebuconazole is a triazole that acts as a demethylation inhibitor (DMI) in fungal sterol biosynthesis and is highly susceptible to cross-resistance, but it has excellent broad spectrum activity for disease control. The risk of cross resistance is regulated by using a component having a different mode of action. Trifloxystrobin, a Quinone outside Inhibitor (QoI), affects the mitochondrial respiration of the fungi [13,14]. As trifloxystrobin decreased the transpiration rate, it was endowed with chemical science. Smith (2000) [15] experimented with manganese ethylene bis dithiocarbamate (Maneb) as the best way to control the infection of anthracnose caused by chilli. Than *et al.* (2008) [16] reviewed that chilli anthracnose can be controlled with the strobilurin fungicides azoxytrobin, trifloxystrobin, and pyraclostrobin. When only one chemical is used, fungicide resistance develops more quickly [17]. According to Santoshreddy and Nargund (2015) [18], among the five combi fungicides tested alongside systemic one tricyclazole, 18% + mancozeb, 62.0% WP and pyraclostrobin 5% + metiram, 55.0% @ 0.25 concentration were effective against the disease, and the highest dry chilli yield was observed with difenconazole 25% EC (8.86 q ha^{-1}) which was on par with pyraclostroIn an experiment on the evaluation of fungicides for the control of fruit rot and dieback disease of chilli, Azad *et al.* (2017) [19] used Metiram 55 + Pyraclostrobin 5 WG, which resulted in a percent preventable yield loss of 41.41 % due to the application of the same.

Conclusion

The result of the investigation was comparable with the findings of the previous researchers. Based on the findings of the study, it may be concluded that two foliar sprays at a 15-day interval with Trifloxysytrobin 25% + Tebuconazole 50% WG @ 350 g/ha was the best, followed by Azoxystrobin 18.2% + Difenoconaole 11.4% SC @ 1000 ml/ha and Azoxystrobin 11% + Tebuconazole 18.3% SC @ 1000 ml/ha. There was no significant difference among the three fungicides, and these may be recommended to control the anthracnose disease of chilli in West Bengal.

Table-2 *Effect of chemical fungicides against anthracnose disease of chilli (Pooled data for two years)*

Treatments	Fungicides	Dose (ml/g per ha)	PDI on fruit	
			15 days after 2nd spray	Per cent reduction over control
T_1	Carbendazim 25% + Mancozeb 50% WS	700	19.47(26.18)	38.41
T_2	Azoxystrobin 11% + Tebuconazole 18.3% SC	1000	14.21(22.15)	55.05
T_3	Azoxystrobin 18.2% + Difenoconaole 11.4% SC	1000	12.15(20.40)	61.56
T_4	Trifloxysytrobin 25% + Tebuconazole 50% WG	350	11.36(19.70)	64.06
T_5	Azoxystrobin 23% SC	500	17.12(24.44)	45.84
T_6	Copper oxy chloride 50% WP	2500	23.30(28.86)	26.29
T_7	Control (Water only)	--	31.61(34.21)	0.00
	SEm (±)		0.956	
	CD 5%		2.95	

Values in parentheses are arcsine-transformed values

Table-3 *Effect of fungicidal management on yield of chilli (Pooled data for two years)*

Treatments	Fungicides	Dose (ml/g per ha)	Fruit Yield (qn/ ha)	Incremental yield (%)
T_1	Carbendazim 25% + Mancozeb 50% WS	700	87.66	49.92
T_2	Azoxystrobin 11% + Tebuconazole 18.3% SC	1000	94.23	61.16
T_3	Azoxystrobin 18.2 %+ Difenoconaole 11.4% SC	1000	95.86	63.95
T_4	Trifloxysytrobin 25% + Tebuconazole 50% WG	350	96.42	64.91
T_5	Azoxystrobin 23% SC	500	90.29	54.42
T_6	Copper oxy chloride 50% WP	2500	81.84	39.97
T_7	Control (Water only)	--	58.47	0.00
	SEm (±)		0.90	
	CD 5%		2.78	

Application of research: Using the Strobilurin group of fungicides (Azoxystobin and Tryfloxystrobin) in combination with Tebuconazole, a trizole fungicide, had better control of anthracnose disease of chilli.

Research Category: Plant disease management by chemical fungicide

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Research project name or number: Research station study

Author Contributions: Sole author

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Study area / Sample Collection: Regional Research Sub-Station (Red & Laterite Zone), Sekhampur, Birbhum, 731129

Cultivar / Variety / Breed name: *Colletotrichum capsici*

Conflict of Interest: None declared

Ethical approval: This article does not contain any studies with human participants or animals performed by any of the authors.
Ethical Committee Approval Number: Nil

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