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Bio efficacy of dithiocarbamate group of fungicide (Zineb 75% WP) against major foliar fungal diseases of chilli in Kalyana Karnataka region

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Abstract
Chilli (*Capsicum annuum* L) is an important spice and also vegetable crop being predominently grown across world and it is well known for its hot, pungent flavor due to the presence of bio-active compound called "Capsaicin". In India, Chilli being cultivated both tropical and sub-tropical zones accounting for 40 percent of the world's area. Realizing its economic importance there has bee increase in its area of production which lead to monopoly over its cultivation which resulted in outbreak of several fungal, bacterial and viral diseases tumbled the quality and quantity. Among them, fungal diseases *viz.*, leaf spots and fruit rot are major both in field and storage conditios. Management of these foliar diseases through fungicides is much needed effort. In this context, investigations of different fungicide molecules were evaluated against leaf spot and fruit rot diseases of chilli in two growing seasons of *Kharif* 2020-21 and 2021-22. The study revealed that during *Kharif* 2020-21, the three successive sprays of Zineb 75% W.P @ 2250 g/ha was found most effective with least leaf spot (24.66 PDI) and fruit rot severity (19.38 PDI) when compared to other fungicides and untreated control with highest significant yield of 22.04 q/ha. Similar outcome in the efficacy was seen during *Kharif* 2021-22, after sequential sprays of Zineb 75% W.P @ 2250 g/ha there was maximum yield of 17.36 q/ha with significant reduction in both leaf spot and fruit rot with least disease incidence of 17.33 and 20.85 respectively.

Keywords: Bio efficacy, leaf spot, fruit rot, Zineb 75% WP

Introduction
Vegetables constitute an essential part of human diet. Not only, they are rich in vitamins and minerals but also forms an integral part for healthy living. Among the different vegetables, chilli (*Capsicum annum.* L.) is an important remunerative, widely grown indispensable spice and vegetable crop grown across the globe. It is a cash crop to the world's food industry.

India being the world's largest producer, consumer and exporter of chillies comprising an area of 7.43 lakh hectares (2020-21) accounting for 40 percent of the world's area with a production of 19.14 lakh tonnes followed by Thailand (3.50 lakh tonnes), China (3.30 lakh tonnes), Ethiopia (3.10 lakh tonnes) contributing 42.60 percent of total world's chilli production. Average productivity per hectare in India is 2576 Kg.

Major states growing chilli in India are Andhra Pradesh, Telangana, Madhya Pradesh, Karnataka and West Bengal. In Karnataka, the crop is being cultivated in an area of 95.45 thousand hectares sharing 20% of the total area of the country with total dry chilli production around 118.49 thousand tonnes. Average productivity per hectare is 2053 Kg. In Karnataka, although the crop occupied an area both in irrigated and rained situation, major production comes from irrigated belt owing to Tungabhadra project covering Koppal, Ballari and Raichur districts.

Chilli not only being an important economic commodity of the country, it has uncountable benefits to human health as well. Fresh green chilli fruits contain more of Vitamin C than found in citrus fruits. While, red chilli fruits have more of Vitamin A content than as found in carrots (Osuna-García *et al.* 1998; Marin *et al.* 2004, Than *et al.* 2008) [5, 3, 7]. The active ingredient of the spice, capsaicin is a complex of capsaicinoid alkaloids found in variable concentrations in different chilli varieties. Capsaicin possesses antioxidant, anti-mutagenic and anti-carcinogenic activities with an ability to inhibit bacterial growth and platelet aggregation. It is also used as an anti-arthritic and anti-inflammatory agent. Regular consumption of chilli fruit is helpful against haemorrhoids, varicose veins, anorexia and liver congestion.

The chilli crop is known to suffer from various fungal, bacterial and viral diseases. Among which, the foliar diseases *viz.*, Leaf spots (*Alterneria* sp. and *Cercospora* sp.), fruit rot,

muruda complex and soil borne diseases like damping off and wilt were regarded as the most devastating diseases causing enormous yield losses. Research on the control of these diseases is intensified towards the development of resistant varieties through breeding programmes, next alternative being adoption of need based chemical protection methods.

It is felt essential to intensify the programme on plant protection through the use of chemicals especially fungicides to save the crop against the damage caused by different fungal diseases. Furthur, it is to emphasize that the chemical plant protection measures are most effective and promising. However, recent survey on use of chemicals revealed that the chemicals are being used indiscriminately by the chilli growers especially in the irrigated areas without any knowledge about the chemical, its efficacy and mode of action which lead to increase the cost of cultivation besides creating environmental pollution. Looking into the growing disease scenario and chemicals being used on the crop indiscriminately, it is felt essential to evaluate the cost effective new fungicidal molecules for their efficacy and phtotoxicity so as to come out with cost effective broad spectrum fungicide for recommendation against fungal foliar diseases of chilli crop. Keeping the fact inview, investigations were taken up to study the bioefficacy of Zineb 75% W.P (Indofil Z-78) which is provided by Indofil Industries Pvt.Ltd., Mumbai for its efficacy against major fungal disease complex of chilli in Kalyana Karnataka region of India.

Materials and Methods

Field evaluation was conducted during two growing seasons, *Kharif* 2020-21 and *Kharif* 2021-22 at Main Agricultural Research Station (MARS), University of Agricultural Sciences, Raichur. The experiment was laid out in randomized block design with eight treatments and three replications. The seeds of popular variety of Chilli (Indam 5) 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 soil of the experimental plot was red sandy loam in texture. The crop was raised as per the agronomic practices recommended by University of Agricultural Sciences, Raichur, Karnataka (India).

The treatment details are mentioned as follows

Treatment No.	Treatments	Dosage/ha Formulation (g/ha)
T1	Zineb 75% WP	1250
T2	Zineb 75% WP	1500
T3	Zineb 75% WP	1750
T4	Zineb 75% WP	2000
T5	Zineb 75% WP	2250
T6	Mancozeb 75% WP	2000
T7	Copper Oxychloride 50% WP	2500
T8	Untreated Check	----

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 10 days after each 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 10 days. Unsprayed plots served as control.

Assessment of PDI (Percent Disease Index)

To record incidence of leaf spot, 10 plants were selected randomly. Total 10 leaves per plant were examined at lower, middle and upper level for visual symptoms and disease severity was recorded by using 0-5 scale (Datar and Mayee, 1986) [4] which is described below. Similarly, for the incidence of *Colletotrichum* fruit rot, randomly selected two 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) [9].

Disease rating scale for leaf spots 0-5 scale (Datar and Mayee, 1986) [4]

Rating	Percentage infection
0	No infection on leaves
1	1-5% leaf area is infected and covered by spot, no spot on petiole and branches;
2	6-20% leaf area is infected and covered by spot, some spots on petiole
3	21-40% leaf area is infected and covered by spot, spots also seen on petiole, branches
4	41-70% leaf area is infected and covered by spot, spots also seen on petiole, braches, stem
5	>71 percent leaf area is infected and covered by spot, spots also seen on petiole, branch, stem and fruits.

Disease rating scale for fruit rot (*Colletotrichum* sp.) 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

Percent disease index (PDI) was calculated by using the formula proposed by Wheeler (1969) [9].

$$\text{Percent disease index (PDI)} = \frac{\text{Sum of numerical ratings}}{\text{Number of plants assessed x Maximum rating}} \times 100$$

Yield assessment

The fruit yields of Chilli were recorded after harvesting the crop at maturity and expressed in Q/ha. 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 percent data of disease incidence was transformed to arch sine value.

Results

Efficacy on leaf spots

The fungicides tested against leaf spot disease in chilli during *Kharif* 2020 revealed that, the percent disease index (PDI) before the treatment imposition and 10 days after the first spray of different formuations was non-significant and all the treatments remained on par one another. The efficacy of chemical at different formulations was observed 10 days after the second spray that the chemical Zineb 75% WP @ 2250 g/ha recorded as significantly effective with the lowest disease index of 21.33 PDI (Table 1) and the treatment is significantly superior in efficacy over other treatments of the trial. However, the efficacy of Zineb 75% WP @ 1500 g/ha

(26.00 PDI) was found to be on par with its next higher dosages of Zineb 75% WP @ 1750 g/ha (25.33 PDI) and Zineb 75% WP @ 2000 g/ha (24.90 PDI). Significantly highest leaf spot intensity was observed in untreated check plot (44.66 PDI).

Similar outcome in the efficacy was obtained at 20 days after the second spray that Zineb 75% WP @ 2250 g/ha recorded as significantly effective with lowest leaf spot intensity of 24..66 PDI than all other treatments of the trial. This is followed by its next lower dosages *viz;* Zineb 75% WP @ 2000 g/ha (@ (29.32 PDI), Zineb 75% WP @ 1750 g/ha (30.05 PDI) and Zineb 75% WP @ 1500 g/ha (30.66 PDI). All these three treatments exhibited on par efficacy one another. Significantly highest disease intensity was observed in untreated check plot (46.66 PDI).

The fungicides tested against leaf spot disease in chilli during *Kharif*, 2021 revealed that, the percent disease index before the treatment imposition was non-significant and all the treatments remained on par each another. The efficacy of chemical at different formulations was observed 10 days after the second spray that, Zineb 75% WP @ 2250 g/ha recorded as significantly effective with the lowest disease index of 19.33 PDI (Table 2) and the treatment is significantly superior in efficacy over other treatments of the trial. However, the efficacy of Zineb 75% WP @ 2000 g/ha (21.15 PDI) was found to be on par with its next lower dosages of Zineb 75% WP @ 1750 g/ha (21.50 PDI) and Zineb 75% WP @ 1500 g/ha (22.00 PDI). Significantly, highest leaf spot intensity was observed in untreated check plot (34.00 PDI).

Similar tendency in efficacy was obtained at 20 days after the second spray that Zineb 75% WP @ 2250 g/ha recorded as significantly effective with lowest disease intensity of 17.33 PDI. This is followed by its next lower dosages viz; Zineb 75% WP @ 2000 g/ha (18.00 PDI), Zineb 75% WP @ 1750 g/ha (19.33 PDI) and Zineb 75% WP @ 1500 g/ha (20.66 PDI). All these three treatments exhibited on par efficacy one another. Significantly, highest disease intensity of 37.33 PDI was observed in untreated check plot.

Efficacy on fruit rot

During *Kharif* 2020, efficacy of Zineb 75% WP on fruit rot incidence of chilli at 10 days after second spray revealed that, the chemical at different formulations were found to be on par each other with least fruit rot incidence of 18.01% (Table 3) at the concentration of Zineb 75% WP @2250 g/ha, the performance of which was little bit numerically superior but non- significant with the above mentioned lower dosages. Significantly, highest fruit rot incidence of 46.19 percent was recorded in untreated check plot.

Efficacy was observed at 20 days after second spray that, the chemical exhibited on par efficacy at the dosages of 1500 g/ha, 1750 g/ha, 2000 g/ha and 2250 g/ha with the record of lower fruit rot incidence of 22.26%, 20.78%, 19.81%,and 19.38% respectively. Significantly highest fruit rot incidence of 48.90% was recorded in the untreated check plot.

During *Kharif* 2021, efficacy of Zineb 75% WP on fruit rot incidence of chilli at 10 days after second spray revealed that the chemical at different tested formulations viz; 1500 g/ha, 1750 g/ha, 2000 g/ha and 2250 g/ha were found to be on par each other with least fruit rot incidence of 19.46% (Table 4) at the concentration of Zineb 75% WP @ 2250 g/ha, the performance of which was little bit numerically superior but non- significant with the next lower dosages. However, the chemical @ 1250 g/ha significantly recorded the higher fruit rot incidence of 25.57%. Significantly, the highest fruit rot incidence of 32.70 percent was recorded in untreated check plot.

Similar trend in the efficacy was observed at 20 days after second spray that the chemical exhibited on par efficacy at the dosages of 1500 g/ha, 1750 g/ha, 2000 g/ha and 2250 g/ha with the record of lower fruit rot incidence of 23.65%, 21.84%, 20.61%, and 20.85% respectively. Significantly highest fruit rot incidence of 36.65% was recorded in untreated check plot.

Yield

The difference in the yield level between treated and untreated plots was very much significant during both *Kharif*, 2020 and 2021 season (Table 5). During Kharif 2020, Yield levels obtained in treated plots also corresponds to the efficacy as the highest significant yield of 22.04 q/ha (Table 3) was obtained in the plot treated with Zineb 75% WP @ 2250 g/ha followed by the next best on par treatments in respect of yield *viz*; Zineb 75% WP @ 2000 g/ha (20.15 q/ha), Significantly lowest yield of 12.80 q/ha was harvested in untreated check plot.

Similarly during Kharif, 2021, highest yield (17.36 q/ha) was recorded in the plot treated with the Zineb 75% WP @ 2250 g/ha followed by the next best on par treatments in respect of yield *viz*; Zineb 75% WP @ 2000 g/ha (15.88 q/ha), Zineb 75% WP @ 1750 g/ha (15.82 q/ha) and Zineb 75% WP @ 1500 g/ha (14.99 q/ha). Significantly lowest yield of 9.59 q/ha was obtained in untreated check plot (Table 6).

Table 1: Bio-efficacy of Zineb 75% WP against leaf spot of chilli during 2020-21

Tr. No	Treatments	Formulation g/ha	Percent disease index (PDI)					
			Before spray	10 days after I spray	20 Days after I spray	10 days after II spray	20 Days after II spray	Percent reduction over control
T1	Zineb 75% WP	1250	22.66 (28.35)	22.00 (27.92)	35.33 (36.45)	39.33 (38.83)	40.00 (39.22)	14.27
T2	Zineb 75% WP	1500	25.33 (30.20)	23.33 (28.87)	34.00 (35.65)	26.00 (30.64)	30.66 (33.60)	34.29
T3	Zineb 75% WP	1750	25.33 (30.20)	22.66 (28.42)	30.66 (33.61)	25.33 (30.20)	30.05 (33.23)	35.59
T4	Zineb 75% WP	2000	22.66 (28.35)	20.00 (26.54)	28.66 (32.34)	24.90 (29.92)	29.32 (33.77)	37.16
T5	Zineb 75% WP	2250	21.33 (27.48)	20.00 (26.54)	26.00 (30.64)	21.33 (27.48)	24.66 (29.77)	47.14
T6	Mancozeb 75% WP	2000	25.33 (30.11)	22.00 (27.90)	32.00 (34.44)	24.00 (29.27)	28.66 (32.34)	38.57
T7	Copper Oxychloride 50% WP	2500	25.33 (30.11)	22.66 (28.36)	33.33 (35.24)	28.66 (32.34)	32.00 (34.41)	31.41
T8	Untreated check		24.00 (29.33)	27.33 (31.51)	42.00 (40.38)	44.66 (41.93)	46.66 (43.08)	-
		S.Em. ±	-	-	0.38	0.57	0.42	
		C.D. @ 5%	NS	NS	1.18	1.73	1.27	
		CV %	7.68	5.80	3.02	3.04	2.09	

Table 2: Bio-efficacy of Zineb 75% WP against leaf spots of chilli during 2021-22

Tr. No	Treatments	Formulation g/ha	Percent disease index (PDI)					
			Before spray	10 days after I spray	20 Days after I spray	10 days after II spray	20 Days after II spray	Percent reduction over control
T1	Zineb 75% WP	1250	22.66 (28.42)*	24.00 (29.31)	25.33 (30.20)	25.92 (30.59)	26.66 (31.08)	28.58291
T2	Zineb 75% WP	1500	22.00 (27.95)	23.33 (28.87)	24.66 (29.77)	22.00 (27.96)	20.66 (27.03)	44.65577
T3	Zineb 75% WP	1750	23.00 (28.65)	22.00 (27.95)	25.33 (30.21)	21.50 (27.62)	19.33 (26.07)	48.21859
T4	Zineb 75% WP	2000	24.00 (29.32)	21.00 (27.26)	24.00 (29.31)	21.15 (27.38)	18.00 (25.07)	51.78141
T5	Zineb 75% WP	2250	22.66 (28.39)	20.66 (26.99)	25.33 (30.21)	19.33 (26.07)	17.33 (24.57)	53.57621
T6	Mancozeb 75% WP	2000	23.33 (28.84)	22.66 (28.40)	25.33 (30.18)	22.00 (27.95)	20.00 (26.54)	46.42379
T7	Copper Oxychloride 50% WP	2500	24.00 (29.27)	25.33 (30.20)	28.00 (31.93)	27.33 (31.51)	26.66 (31.08)	28.58291
T8	Untreated check		23.33 (28.86)	25.33 (30.20)	30.00 (33.19)	34.00 (35.65)	37.33 (37.65)	-
		S.Em. ±	-	0.70	0.62	0.43	0.65	
		C.D. @ 5%	NS	2.10	1.86	1.30	2.02	
		CV %	4.97	4.19	3.47	2.53	4.04	

Table 3: Bio-efficacy of Zineb 75% WP against fruit rot of chilli during 2020-21

Tr. No	Treatments	Formulation g/ha	Fruit rot incidence (%)					
			Before spray	10 days after I spray	20 Days after I spray	10 days after II spray	20 Days after II spray	Percent reduction over control
T1	Zineb 75% WP	1250	31.18 (33.92)	33.74 (35.49)	36.31 (37.04)	33.59 (35.40)	35.73 (36.69)	26.93252
T2	Zineb 75% WP	1500	31.05 (33.85)	22.51 (28.31)	24.13 (29.40)	20.42 (26.84)	22.26 (28.14)	54.47853
T3	Zineb 75% WP	1750	32.09 (34.48)	22.33 (28.17)	22.17 (28.06)	19.30 (26.05)	20.78 (27.11)	57.50511
T4	Zineb 75% WP	2000	29.61 (32.95)	20.01 (26.56)	20.92 (27.21)	18.71 (25.61)	19.81 (26.42)	59.48875
T5	Zineb 75% WP	2250	30.81 (33.70)	20.57 (26.96)	20.17 (26.67)	18.01 (25.09)	19.38 (26.11)	60.3681
T6	Mancozeb 75% WP	2000	31.48 (34.12)	20.49 (26.89)	21.73 (27.77)	19.76 (26.37)	21.14 (27.36)	56.76892
T7	Copper Oxychloride 50% WP	2500	32.91 (34.99)	27.93 (31.87)	28.72 (32.38)	26.65 (31.05)	29.54 (32.88)	39.591
T8	Untreated check		31.31 (34.00)	38.44 (38.31)	41.61 (40.16)	46.19 (42.81)	48.90 (44.36)	-
		S.Em. ±	-	0.82	0.76	0.78	0.81	
		C.D. @ 5%	NS	2.48	2.29	2.42	2.45	
		CV %	3.89	4.68	4.21	4.62	4.50	

Table 4: Bio-efficacy of Zineb 75% WP against fruit rot of chilli during 2021-22

Tr. No	Treatments	Formulation g/ha	Fruit rot incidence (%)					
			Before spray	10 days after I spray	20 Days after I spray	10 days after II spray	20 Days after II spray	Percent reduction over control
T1	Zineb 75% WP	1250	20.57 (26.95)	23.97 (29.30)	27.93 (31.90)	25.57 (30.37)	27.36 (31.53)	25.34789
T2	Zineb 75% WP	1500	21.77 (27.77)	23.96 (29.30)	25.86 (30.55)	22.51 (28.30)	23.65 (29.09)	35.47067
T3	Zineb 75% WP	1750	20.86 (27.14)	23.40 (28.90)	24.65 (29.75)	20.79 (27.10)	21.84 (27.84)	40.40928
T4	Zineb 75% WP	2000	24.49 (29.64)	21.50 (27.61)	23.80 (29.19)	20.55 (26.94)	20.61 (26.97)	43.76535
T5	Zineb 75% WP	2250	21.36 (27.49)	20.57 (26.95)	22.96 (28.61)	19.46 (26.16)	20.85 (27.16)	43.1105
T6	Mancozeb 75% WP	2000	23.21 (28.77)	23.64 (29.08)	24.70 (29.78)	22.41 (28.23)	23.12 (28.71)	36.91678
T7	Copper Oxychloride 50% WP	2500	22.05 (27.94)	25.37 (30.21)	28.00 (31.92)	25.82 (30.51)	27.86 (31.83)	23.98363
T8	Untreated check		20.81 (27.12)	24.86 (29.89)	28.63 (32.33)	32.70 (34.86)	36.65 (37.24)	
		S.Em. ±	-	-	0.79	0.82	0.74	
		C.D. @ 5%	NS	NS	2.39	2.46	2.30	
		CV %	6.92	4.71	4.47	4.84	4.37	

Table 5: Yield levels obtained in different treatments of Zineb 75% WP against chilli diseases during 2020-21

Tr. No	Treatments	Formulation g/ha		
			Kg/plot	Q/ha
T1	Zineb 75% WP	1250	4.92	16.21
T2	Zineb 75% WP	1500	5.73	18.88
T3	Zineb 75% WP	1750	5.97	19.66
T4	Zineb 75% WP	2000	6.12	20.15
T5	Zineb 75% WP	2250	6.69	22.04
T6	Mancozeb 75% WP	2000	6.27	20.63
T7	Copper Oxychloride 50% WP	2500	4.66	15.34
T8	Untreated check		3.89	12.80
		S.Em. ±	0.25	0.84
		C.D. @ 5%	0.76	2.53
		CV %	7.67	7.93

Table 6: Yield levels obtained in various treatments of Zineb 75% WP against chilli diseases during 2021-22

Tr. No	Treatments	Formulation g/ha		
			Kg/plot	Q/ha
T1	Zineb 75% WP	1250	3.68	12.13
T2	Zineb 75% WP	1500	4.55	14.99
T3	Zineb 75% WP	1750	4.80	15.82
T4	Zineb 75% WP	2000	4.82	15.88
T5	Zineb 75% WP	2250	5.27	17.36
T6	Mancozeb 75% WP	2000	5.15	16.96
T7	Copper Oxychloride 50% WP	2500	3.89	12.82
T8	Untreated check		2.91	9.59
		S.Em. ±	0.18	0.60
		C.D. @ 5%	0.55	1.81
		CV %	7.16	7.15

Discussion

In order to find out the effective fungicide for the management of major fungal disease complex of chilli, we have evaluated the Zineb 75% W.P (Indofil Z-78) in different concentration along with the commonly used fungicides such as Mancozeb 75% WP and Copper Oxychloride 50% WP. In both the seasons, we have noticed that the spray of Zineb 75% W.P at 2250 ml/ha was found superior to other fungicides. Similar results were reported by the various authors where they reported the effectiveness of dithiocarbamate group of fungicides in controlling leaf spots in other Solanaceous crops. Under invitro studies among tested fungicides against *Alterneria* leaf spot of tomato (*Lycopersicon esculentum*) Mancozeb 75% WP exhibited 100% inhibition in mycelium growth at 0.2% concentration (Dheshmukh *et al*., 2020) [2].

These findings were in agreement with results of previous experiments where in fungicides used to control leaf spot, powdery mildew and fruit rot. Among the tested fungicides, 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) when compared to other fungicides and untreated control with maximum fruit yield of 20.37 q/ha which was significantly superior over rest of the treatments (Palaiah *et al*., 2019) [6].

Several reports showed that the derivatives of dithiocarbamic acid H_2N, CSH had insecticidal and fungicidal properties. According to the mode of action of dithiocarbamate complexes, the dithiocarbamate ligand and metal ions present within the molecules of the complexes act synergistically. The antimicrobial properties of dithiocarbamate compounds have been attributed to their properties as they interfere with the cell wall by changing the cell permeability (Jerry *et al*., 2019) [1], or interfere with various cellular enzymes by cellular weakening as a result of the denaturing of proteins (Yilmaz, 2003) [8].

Conclusion

As a result, it can be concluded that, *Alterneria* sp., *Cercospora* sp. and *Colletotrichum sp.* are notorious pathogens, having a wide range of host and causing significant economic losses in Chilli. As a result, a comprehensive and effective approach was needed to combat its harmful effects. The present investigations confirms that, application of Zineb 75% WP at the dosages of 2500 g/ha was found to be optimum as its efficacy against leaf spot and fruit rots of chilli is on par with other dosages of the product up to 2000 g/ha.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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Conflict of Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper

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