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**Apurv Kumar M Patel**  
Department of Plant Pathology,  
Navsari Agricultural University,  
Navsari, Gujarat, India

**KB Rakholiya**  
Department of Plant Pathology,  
Navsari Agricultural University,  
Navsari, Gujarat, India

**KN Panara**  
Department of Plant Pathology,  
Navsari Agricultural University,  
Navsari, Gujarat, India

**SH Paladiya**  
Department of Plant Pathology,  
Navsari Agricultural University,  
Navsari, Gujarat, India

**Corresponding Author**  
**Apurv Kumar M Patel**  
Department of Plant Pathology,  
Navsari Agricultural University,  
Navsari, Gujarat, India

## ***In vitro* evaluation of fungicides against *Colletotrichum capsici* (Sydow) Butler and Bisby causing anthracnose disease of chilli**

**Apurv Kumar M Patel, KB Rakholiya, KN Panara and SH Paladiya**

### **Abstract**

The Research was conducted on evaluation of fungicides against *Colletotrichum capsici* at Department of Plant Pathology, N. A. U., Navsari. Three non-systemic fungicides, four systemic fungicides and four combination fungicides at four different concentration were screened *in vitro* for evaluating their efficacy against *C. capsici*. Among non-systemic fungicides, 95.83 per cent growth inhibition over control was recorded in copper oxychloride at four different concentrations (1000, 1500, 2000 and 2500 ppm). Among systemic fungicides, at 500 and 1000 ppm concentration significantly highest per cent growth inhibition over control was recorded in propiconazole 96.21 per cent and 96.59 per cent, respectively. Among combination fungicides carbendazim (12%) + mancozeb (63%) and captan (70%) + hexaconazole (5%) recorded significantly highest 97.35 per cent growth inhibition over control at 1000 ppm concentration.

**Keywords:** *In vitro*, *Colletotrichum capsici*, non-systemic fungicides, systemic fungicides, combination fungicides

### **1. Introduction**

Chilli is one of the important vegetable crop of India and world. Among the fungal diseases infecting chilli crop, anthracnose caused by *Colletotrichum capsici* was one of the most destructive diseases causing accountable qualitative and quantitative losses. Anthracnose symptoms on chilli appeared in the form of small circular spots appear on the leaves. On fruit typical symptoms were found as circular or angular sunken lesions with a slightly raised rim. These spots were brown to dark brown surrounded by a dark margin. The spots at first were small and dark or water soaked. As they enlarge, they become irregular in shape, variable in size and give a scorched appearance. Severely infected leaves and fruits fall off leading to defoliation. The infection of growing tips leads to necrosis of branches which progress backward on the diseased branches, the die back symptom was severe and it may kill the whole plant. Now-a-day's new molecules of chemicals are available in market with less toxicity remained to be tried for management of disease. Hence, evaluation of fungicides to manage the chilli anthracnose were very much informative as well as practically useful with acceptability of good quality product of chilli fruits. Therefore, *in vitro* evaluation of fungicides against *C. capsici* is crucial for the effective disease management.

### **2. Materials and Methods**

#### **2.1 Isolation of Pathogen**

Disease sample of chilli anthracnose were collected during survey. Pathogen was isolated from anthracnose lesions of disease affected plant parts or fruits and cultured on PDA.

#### **2.2 *In vitro* evaluation of different fungicides for the management of the chilli anthracnose**

The effect of fungicides on mycelial growth of *C. capsici* was tested by poisoned food technique. Systemic, non-systemic and combined fungicides were tested against chilli anthracnose by Poison Food Technique and using PDA as a medium. Systemic, non-systemic and combined fungicides were tested at different concentrations. The required quantity of each test fungicide was added in conical flask containing 100 ml molten PDA medium so as to get required concentration in ppm. The flask containing poisoned medium was well shaken to facilitate uniform mixture of fungicide and 20 ml was poured in sterilised Petri plates.

On solidification of the medium, the plates were inoculated with five mm disc of mycelial bit taken from the periphery of seven days old culture with the help of cork borer. The inoculated Petri plates were incubated at  $28^{\circ}\text{C} \pm 2^{\circ}\text{C}$ . Three Petri plates were used for each treatment. Petri plates without fungicide were served as control. Suitable check was maintained without fungicide and inoculated with *C. capsici*. The experiment was conducted in Completely Randomized Design (CRD). Colony diameter was measured along the two diagonals passing through the colony by excluding the initial diameter (5 mm) of bit. Colony diameter was measured when the control treatment with pathogen reached full growth. The per cent growth inhibition (PGI) of fungus over control was calculated by using the following formula (Vincent, 1927) [4].

$$\text{PGI} = 100 (\text{DC} - \text{DT}) / \text{DC}$$

Where,

PGI = Per cent growth inhibition

DC = Average diameter (mm) of mycelial colony of control plate

DT = Average diameter (mm) of mycelial colony of treated plate

### 3. Result and Discussion

#### 3.1 Effect of different non-systemic fungicides on growth inhibition of *C. capsici*

The relative efficacy of non-systemic fungicides viz., mancozeb 75 WP, chlorothalonil 75 WP, and copper oxychloride 50 WP were evaluated at 1000, 1500, 2000, and 2500 ppm concentration by poison food technique. The observation regarding per cent growth inhibition are presented in (Table-1).

**Table 1:** *In vitro* effect of non-systemic fungicides on growth inhibition of *C. capsici*

Sr. No.	Fungicides	Concentrations (ppm)				
		Per cent Growth Inhibition <sup>#</sup>				
		1000	1500	2000	2500	Mean
1	Mancozeb 75 WP	(76.89)* 61.27**	(82.19) 65.04	(87.87) 69.63	(91.28) 72.84	(84.56) 67.19
2	Chlorothalonil 75 WP	(18.18) 25.18	(21.59) 27.68	(26.13) 30.74	(29.54) 32.92	(23.86) 29.13
3	Copper oxychloride 50WP	(95.83) 78.31	(95.83) 78.31	(95.83) 78.31	(95.83) 78.31	(95.83) 78.31
	S.Em.±	0.79				
	C.D. at 5%	2.31				
	C.V. %	2.35				

\*Figures in parenthesis are original values, \*\*Figures in outside parenthesis are Arc sine transformed values, # Average of three replication

The results presented in Table 1 revealed that all the three non-systemic fungicides at different concentrations (1000, 1500, 2000 and 2500 ppm) found promising against *C. capsici*. The copper oxychloride fungicide found significantly highest per cent growth inhibition over control was recorded same result (95.83%) at four different concentrations (1000, 1500, 2000 and 2500 ppm). Next best in order of merit was mancozeb fungicide found (87.87%), and (91.28%) growth inhibition over control at 2000 and 2500 ppm concentration, respectively.

Three fungicides greatly varied in their efficacy to inhibit the growth of fungus under study. It is inferred from results that there was very less mycelial growth of the pathogen in copper oxychloride fungicide at all at four different concentrations.

So, copper oxychloride proved the most effective fungicide for *C. capsici*. Next best fungicide in order of merit was mancozeb.

The fungicide chlorothalonil was found least effective at all concentration as compared to other fungicides.

#### 3.2 Effect of different systemic fungicides on growth inhibition of *C. capsici*

The relative efficacy of systemic fungicides viz., azoxystrobin 23 SC, carbendazim 50 WP, propiconazole 25 EC and difenconazole 25 EC were evaluated at 100, 250, 500, and 1000 ppm concentration by Poison Food Technique. The observation regarding per cent growth inhibition are presented in (Table- 2).

**Table 2:** *In vitro* effect of systemic fungicides on growth inhibition of *C. capsici*

Sr. No.	Fungicides	Concentrations (ppm)				
		Per cent Growth Inhibition <sup>#</sup>				
		100	250	500	1000	Mean
1	Azoxystrobin 23 SC	(59.09)* 50.24**	(65.15) 53.82	(69.31) 56.37	(78.40) 62.32	(67.99) 55.68
2	Carbendazim 50 WP	(76.13) 60.76	(78.78) 62.59	(79.54) 63.11	(80.68) 64.00	(78.78) 62.61
3	Difenconazole 25 EC	(79.54) 63.11	(84.09) 66.50	(96.21) 78.80	(96.21) 78.96	(89.01) 71.84
4	Propiconazole 25 EC	(79.92) 63.40	(92.04) 73.72	(96.21) 78.80	(96.59) 79.46	(91.19) 73.84
	S.Em.±	0.86				
	C.D. at 5%	2.49				
	C.V. %	2.27				

\*Figures in parenthesis are original values, \*\*Figures in outside parenthesis are Arc sine transformed values, # Average of three replication

The results presented in Table 2 revealed that all the four systemic fungicides at different concentrations (100, 250, 500 and 1000 ppm) found promising against *C. capsici*. At 500 and 1000 ppm concentration significantly highest per cent growth inhibition over control was recorded in propiconazole 96.21 per cent and 96.59 per cent respectively. Next best in order of merit was difenconazole found same result 96.21 per cent and 96.21 per cent at 500 and 1000 ppm concentration

respectively. The next best systemic fungicide was carbendazim at 1000 ppm concentration inhibited 80.68 per cent mycelial growth inhibition over control. The inhibitory effect of all the systemic fungicides increased with the increasing concentrations of the fungicides.

There was very less growth of the pathogen in propiconazole 25 EC and difenconazole 25 EC at 500 and 1000 ppm. Thus, both the fungicides proved the most effective for *C. capsici*.

Next best fungicide in order of merit was carbendazim 50 WP. The fungicide azoxystrobin 23 SC was found least effective at all concentration as compared to other fungicides.

### 3.3 Effect of different combined fungicides on growth inhibition of *C. capsici*

The relative efficacy of combination fungicides viz.,

pyraclostrobin (13.3%) + epoxiconazole (5%), carbendazim (12%) + mancozeb (63%), captan (70%) + hexaconazole (5%) and zineb (68%) + hexaconazole (4%) were evaluated at 100, 250, 500, and 1000 ppm concentration by poison food technique. The observation regarding per cent growth inhibition are presented in (Table- 3).

**Table 3:** *In vitro* effect of combined fungicides on growth inhibition of *C. capsici*

Sr. No.	Fungicides	Concentrations (ppm)				
		Per cent Growth Inhibition <sup>#</sup>				
		100	250	500	1000	Mean
1	Pyraclostrobin 13.3% + Epoxiconazole 5% SE	(87.5)*	(90.15)	(89.77)	(90.91)	(89.58)
		69.31**	71.76	71.37	72.47	71.23
2	Carbendazim 12% + Mancozeb 63% WP	(94.32)	(96.59)	(96.97)	(97.35)	(96.31)
		76.25	79.46	80.02	80.87	79.15
3	Captan 70% + Hexaconazole 5% WP	(93.18)	(94.32)	(96.59)	(97.35)	(95.36)
		74.90	76.25	79.36	80.87	77.84
4	Zineb 68% + Hexaconazole 4% WP	(67.04)	(68.18)	(92.04)	(93.56)	(80.21)
		54.97	55.66	73.64	75.39	64.91
S.Em.±		0.87				
C.D. at 5%		2.52				
C.V. %		2.07				

\*Figures in parenthesis are original values, \*\*Figures in outside parenthesis are Arc sine transformed values, # Average of three replication

The results presented in Table 3 revealed that all the four combined fungicides at different concentrations (100, 250, 500 and 1000 ppm) found promising against *C. capsici*. Carbendazim (12%) + mancozeb (63%) and captan (70%) + hexaconazole (5%) recorded significantly highest 97.35 per cent growth inhibition over control at 1000 ppm concentration. At 500 ppm concentration, carbendazim (12%) + mancozeb (64%) and captan (70%) + hexaconazole (5%) were recorded 96.97 per cent and 96.59 per cent growth inhibition over control respectively.

While fungicide pyraclostrobin (13.3%) + epoxiconazole (5%) and zineb (68%) + hexaconazole (4%) were recorded 89.77 per cent and 92.04 per cent growth inhibition at 500ppm concentration and at 1000 ppm concentration recorded 90.91 per cent and 93.56 per cent growth inhibition over control, respectively. The inhibitory effect of all the combined fungicides increased with the increasing concentrations of the fungicides found significantly highest per cent growth inhibition over control.

Different fungicides greatly varied in their efficacy to inhibit the growth of fungus under study. The growth inhibition per cent positively correlated with increase in concentration for all the fungicides tested. It is inferred from results that there was no mycelial growth of the pathogen in carbendazim (12%) + mancozeb (63%) and captan (70%) + hexaconazole (5%) fungicides at 1000ppm concentrations and also significantly lesser growth at 500 ppm concentrations compared to other fungicides. Thus, both fungicides proved the most effective fungicide for *C. capsici*. Next best fungicide in order of merit was pyraclostrobin (13.3%) + epoxiconazole (5%). The fungicide zineb (68%) + hexaconazole (4%) was found medium effective as compared to other fungicides.

Similar results have also been presented by Chauhan (2010)<sup>[1]</sup>, Vani and Somashekhar (2018)<sup>[3]</sup>, Katediya *et al.* (2019)<sup>[2]</sup>.

### 4. Conclusion

The studies of *in vitro* evaluation of fungicides against *C. capsici*, ready mix fungicides (Combination) carbendazim

(12%) + mancozeb (63%) recorded significantly highest 96.31 per cent mean growth inhibition over control at four different concentration, non-systemic fungicides copper oxychloride found significantly highest 95.83 per cent mean growth inhibition over control at four different concentration and systemic fungicide propiconazole recorded significantly highest 91.19 per cent mean growth inhibition over control at four different concentration.

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