Biological Forum – An International Journal 15(12): 154-158(2023)

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

In-vitro Effect of Different Fungicides on Management of Anthracnose (*Colletotrichum capsici*) Disease of Chilli

***Preeti Thakur*[1]*, Anupam Kumar*[1*]*, Vinod Kumar*[2]*, Rajan Kamboj*[3]*, Ravinder*[4]*, Shivani Kaundal*[5]*, Prabhat Kumar*[1]*, Sahil Chaudhary*[1]*, Neeraj Bhardwaj*[1]*, Ashish*[1] *and Ashwani Kumar*[1]**

[1]*Department of Plant Pathology, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.*
[2]*Department of Seed Science and Technology ANDUA&T, Kumarganj Ayodhya (Uttar Pradesh), India.*
[3]*Department of Entomology, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.*
[4]*Department of Soil Science, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.*
[5]*Department of Crop Physiology, School of Agriculture, Abhilashi University, Mandi (Himachal Pradesh), India.*

(Corresponding author: Anupam Kumar)*
(Received: 10 October 2023; Revised: 05 November 2023; Accepted: 19 November 2023; Published: 15 December 2023)
(Published by Research Trend)

ABSTRACT: Anthracnose disease is a major problem in chilli production worldwide, especially in tropical and subtropical regions. Chilli is an important spice and condiment crop globally, and in the Colletotrichum pathosystem, different *Colletotrichum* spp. can be associated with anthracnose of the same host. Most of the fungicides have fungistatic and fungicidal activities. Hence, it is essential to recommend the appropriate fungicide and its concentration to reduce the yield loss caused by them. An experiment was conducted with eight treatments of different concentrations (100, 200, and 300 ppm) of fungicides. All the tested fungicides proved to be efficient and statistically significant to reduce the radial mycelial growth. The plates showed that fungicides were significantly more effective than the control at preventing *Colletotrichum capsici* from growing radially. Among the 3 fungicides, at 24, 48, and 72 hours, the treatments T4 (propiconazole 100 ppm), T5 (propiconazole 200 ppm), and T6 (propiconazole 300 ppm) showed the highest percentage of growth inhibition (100%), whereas T1 (copper oxide at 100 ppm), T2 (copper oxide at 200 ppm), and T3 (copper oxide at 300 ppm) showed a minimum percentage of growth inhibition of *Colletotrichum capsici.* There are various types of fungicides and chemicals available in the market that can be used to control anthracnose disease. However, some of these fungicides are highly effective against the pathogen and the disease, while others may not work as well for controlling anthracnose disease in chilli crops. Therefore, this investigation will be helpful for farmers to choose suitable fungicides for controlling anthracnose disease in an integrated way, saving their crops from the disease and obtaining better yields.

Keywords: Chilli, *Colletotrichum,* fungicides, inhibition and Anthracnose.

INTRODUCTION

Chilli (*Capsicum annuum* L.) is a hot-testing tropical berry belonging to the *Solanaceae* family. Due to its wide spread usage, chillies are a highly significant vegetable found to have many medicinal properties. In addition, chilli can reduce the risk of cancer by preventing carcinogens from binding to DNA and reduce calorie intake by increasing the remoteness on perceived scientific and economic. Numerous studies have revealed that *Colletotrichum* infects a variety of tropical, subtropical, and temperate fruits, crops, and ornamental plants with anthracnose disease and postharvest decay (Lima *et al*., 2011; Damm *et al*. 2012). 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. In India this disease causes severe damage to fruits in the field as well as in storage up to 84 per cent (Saxena *et al.*, 2014). This is because the anthracnose causes an unpleasant color and taste in chilli products. The disease is seed borne and cause yield losses up to 30—60% (Thippeswamy et al. 2007). One of these hosts, the chilli pepper (*Capsicum* spp.), is severely impacted by chilli anthracnose, which can cause yield losses of up to 50% (Poulos, 1992, Pakdeevaraporn *et al*., 2005). The quality and yield of chilli fruits are significantly decreased by the chilli anthracnose disease, which is brought on by *Colletotrichum* species, leaving farmers with low returns. It causes a loss of around 13% of marketable yield in Korea (Yoon *et al.*, 2004; Kim *et al.*, 2008).

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. Plant disease known as anthracnose is characterized by very dark, sunken lesions that contain spores (Isaac, 1992). As they enlarge, they become irregular in shape, variable in size and give a scorched appearance. According to Pakdeevaraporn *et al.* (2005), up to 50% yield losses may occur due to small-circular lesions that form on mature fruits. 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. Severely infected fruits appear straw-colored and bear concentric rings of numerous acervuli. Capsicum fruit rot reduces the dry weight, quality, quantity of capsaicin, and oleoresin of fruit (Mistry *et al.,* 2008).

The disease causes pre- and post-harvest damage to chilli causing lesions on fruits and reduces the market value. Anthracnose of chilli is one of the major devastating diseases of chilli causes severe losses up to 10-60 % in yield and quality parameters (Bansal and Grover 1969). In later stage black dots (acervuli) are formed on necrotic surface which bear concentric rings containing conidial masses. Due to the limited availability of the chilli cultivars resistant to the disease, farmers mostly rely on fungicides to control disease. But the indiscriminate use of the chemicals for crop protection is leading to their accumulation of residues in soil, water and plants, and also causing the ecological imbalance by killing the beneficial microorganisms (Rajathilagam and Kannabiran 2001). Chilli anthracnose is a significant disease that is now considered a major obstacle in the production of chilli for both profitable cultivation and seed production. Typically, chemical fungicides were recommended for managing this disease. Chemical protection is the primary strategy for plant disease control, especially in the absence of a resistant source. The most common way to shield plants from diseases is to use fungicides.

Anthracnose is a disease that affects plants in India, primarily caused by three species of Colletotrichum: *Colletotrichum capsici, Colletotrichum acutatum,* and *Colletotrichum gleosporoides*. Among these, *Colletotrichum capsici* Syd. Butler and Bisby are responsible for significant fruit losses during the plant's mature stage, resulting in substantial economic losses. This disease can be devastating for farmers and requires timely intervention to prevent the loss of crops (Saxena *et al.,* 2016). Although, earlier several studies have been conducted to manage chilli anthracnose, Different fungicides have been used against *Colletotrichum capsici,* and few are found to be highly effective. Generally, Colletotrichum diseases can be controlled by a wide range of chemicals such as copper compounds, dithiocarbamates, benzimidazole and trizole compounds; other fungicides such as chlorothalonil, imazalil and prochloraz are also effective against *Colletotrichum* (Waller, 1992). Saha *et al.* (2017) reported the superiority of a ready-mix fungicide, Tricyclazole 18% + Mancozeb 62% WP in controlling the disease Anthracnose of Chilli, caused by *Colletotrichum capsici,* as compared to untreated control as well as their solo components. So, copper oxychloride proved the most effective fungicide for *C. capsici*. Next best fungicide in order of merit was mancozeb. Chauhan & Yadav (2022) reported that Propiconazole 25% EC was the most effective fungicide, completely inhibiting the mycelia growth of *C. capsici* among the eight selected. Keeping in view the present investigation was undertaken for *In-vitro* effect of different fungicides on management of Anthracnose (*Colletotrichum capsici*) disease of chilli.

MATERIALS AND METHODS

The following resources and techniques were employed to investigate the treatment of chili anthracnose (*Colletotrichum capsici*) disease. Experiment was conducted at laboratory of Plant Pathology, School of Agriculture, Abhilashi University campus in Chail Chowk, Mandi, Himachal Pradesh–175045 between 2022-2023. Below is a description of the specific materials and methodology that were employed.

Instruments used. Electronic digital weighing Balance, Autoclave, Magnetic Stirrer, Hot air oven, Forceps, scissors, cork borer & needles for inoculation, Spirit lamp, Laminar Air Flow, BOD incubator, Micro pipette, Compound microscope etc are the instruments used in experiment. The glassware utilized in the studies washed by soaking it in water for an entire night, followed by a detergent wash under running water and drying. The glassware that had been air dried was sterilized for two hours at 180 degrees Celsius in a hot air oven. During inoculation and purification, the forceps and other metallic equipment were disinfected by dipping them in ethanol and heating them over a spirit lamp flame.

Media used

Potato dextrose agar (P.D.A.) medium

Composition

Peeled potato	200g
Dextrose	20g
Agar-agar	20g
Distilled water	1000 ml

PDA Preparation procedure

The required quantity of peeled potatoes was cut into small pieces and boiled in 500ml of distilled water till the pieces become soft. The potato extract was filtered through muslin cloth and the filtrate was collected in the 500ml beaker. Rest of the 500ml water was made warm and 20gm agar and 20 gm dextrose was added property by shaking through glass rod. Both Solutions wares mixed together in a 1000 ml beaker and volume was maintained up to 1000 ml by adding required amount of distilled water. And 1/3ml PDA was dispended in each conical flask of 250 ml capacity. Flask’s ware plugged with non-absorbent cotton plugs and wrapped with silver foil. Flasks containing medium sterilized at 121ºC at 15 lbs pressure/inch^2 for 15 minutes in an autoclave.

***In-vitro* effect of different fungicides on the management of Anthracnose of chilli.** Efficacy of fungicides belonging form different groups was tested at 100, 200 and 300 ppm concentration *in-vitro* for their efficacy to inhibit the growth of the pathogen to a maximum extent. Effect on the growth of Anthracnose was studied using poisoned food technique. Potato dextrose agar (PDA) was prepared and 100 ml of the medium was taken in 250 ml of flasks and sterilized them. To the molten, cooled, sterile medium required quantity of fungicides ware added separately and mixed thoroughly so to get the required concentrations for each fungicide. Fifteen to twenty ml of poisoned medium poured into each of 90 mm sterilized petri plate. After that 5mm bit of mycelium of the pathogen was inoculated at the centre of the plates. One checked control treatment is maintained by without fungicide in PDA medium. There replications ware maintained for each treatment, and plates ware incubated at 26±2º till the growth of the colony.

Observations were recorded:

The per cent inhibition of fungal pathogen was calculation after growth of pathogen in control plate by using formula (Vincent *et al.*, 1947).

$$\text{Per cent of Inhibition, } I = \frac{C - T}{C} \times 100$$

Where, I = Per cent inhibition of mycelium
C = Radial growth (mm) in control
T = Radial growth (mm) in treatment

RESULT AND DISCUSSION

The present study on the management of Anthracnose disease (*Colletotrichum capsici)* in chilli was conducted during the period 2022-2023. Experiment was conducted at Plant Pathology laboratory, School of Agriculture situated in the campus of Abhilashi University, Chail-Chowk, Mandi, and Himachal Pradesh. The result present in Table 1 that fungicides were effective than control.

The effectiveness of three different chemical fungicides, namely Copper Oxychloride (50%WP), Propiconazole (25% EC), Carbendazim (50%WP) + Mancozeb (75%WP), was tested at a concentration of 100, 200and 300 ppm against Anthracnose disease of chili caused by *Colletotrichum capsici*. All the test fungicides efficiently reduced the intensity of the disease, thereby significantly increasing the yield of chili. At 100 ppm concentration of fungicides maximum per cent growth inhibition of 100 per cent was obtained in Propiconazole (25% EC) where no mycelia growth was observed, it was followed by Carbendazim (50%WP) + Mancozeb (75%WP) with growth inhibition of 77.83 per cent and radial growth 1.33 mm. The minimum per cent growth inhibition at 100 ppm concentration of fungicides was observed in treatment with Copper Oxychloride (50% WP) 11.16 per cent and radial growth of 5.33 mm was recorded. At 200 ppm concentration of fungicides maximum per cent growth inhibition of 100 per cent was obtained in Propiconazole (25% EC) where no mycelia growth was observed. The minimum per cent growth inhibition at 200 ppm concentration of fungicides was observed in treatment with Copper Oxychloride (50%WP) 50 per cent and radial growth of 3 mm was recorded. Similar trends were also observed at a concentration of 300 ppm of fungicides. The maximum percentage of growth inhibition of 100% was observed in Propiconazole (25% EC), where no mycelial growth was recorded. On the other hand, the minimum percentage of growth inhibition at 300 ppm concentration of fungicides was observed in the treatment with Copper Oxychloride (50%WP), which was 42.61 %, and the radial growth of 10.33 mm was recorded.

The radial mycelial growth of *Colletotrichum capsici* varied significantly at different concentrations of chemical fungicides (Table 1) at 24, 48 and 72 hrs. Radial growth of mycelia was reduced with the increase of concentration of chemical fungicides. Significantly highest colony diameter of 6.00, 14.0 and 18.0 mm was found in untreated control plate and the lowest colony diameter of 0.00 mm was recorded in plate treated with Propiconazole (25%EC) at 100, 200 and 300 ppm at 24, 48 and 72 hrs. All the chemical fungicides treated plate showed reduced colony diameter as compared to control. Among the chemical fungicides Carbendazim (50%WP) +Mancozeb (75%WP) at 100 ppm observed the second lowest colony diameter of 1.33, 2.33 and 3.33 mm and the highest colony diameter of 5.33, 8.33 and 15.66 ppm was recorded in treatment T_1 Copper Oxychloride (50%WP) at 100 ppm. Katediya *et al.* (2019) reported that the Copper oxychloride (0.2%) found second better fungicide for controlling the disease with 26.80 per cent disease intensity, which was at par with propiconazole (0.025%) and carbendazim + mancozeb (0.2%) in controlling the disease with 28.32 and 29.88 per cent disease intensity.

Table 1: *In vitro* efficacy of fungicides at different concentrations against *Colletotrichum capsici.*

Sr. No.	Treatments	Conc. (ppm)	24 Hours		48 Hours		72 Hours	
			Average Radial Growth (mm)	Inhibition%	Average Radial Growth (mm)	Inhibition%	Average Radial Growth (mm)	Inhibition%
1.	Copper Oxychloride (50%WP)	100	5.33	11.16	8.33	40.50	15.66	13.00
2.	Copper Oxychloride (50%WP)	200	3	50	5	64.28	10.66	40.77
3.	Copper Oxychloride (50%WP)	300	1.66	72.33	4	71.42	10.33	42.61
4.	Propiconazole (25%EC)	100	0.0	100	0.0	100	0.0	100
5.	Propiconazole (25%EC)	200	0.0	100	0.0	100	0.0	100
6.	Propiconazole (25%EC)	300	0.0	100	0.0	100	0.0	100
7.	Carbendazim(50%WP) +Mancozeb(75%WP)	100	1.33	77.83	2.33	81.5	3.33	81.5
8.	Control		6		14		18	
	CD (At 5% level)		3.326		3.536		2.330	
	SE(m)		1.100		1.170		0.771	

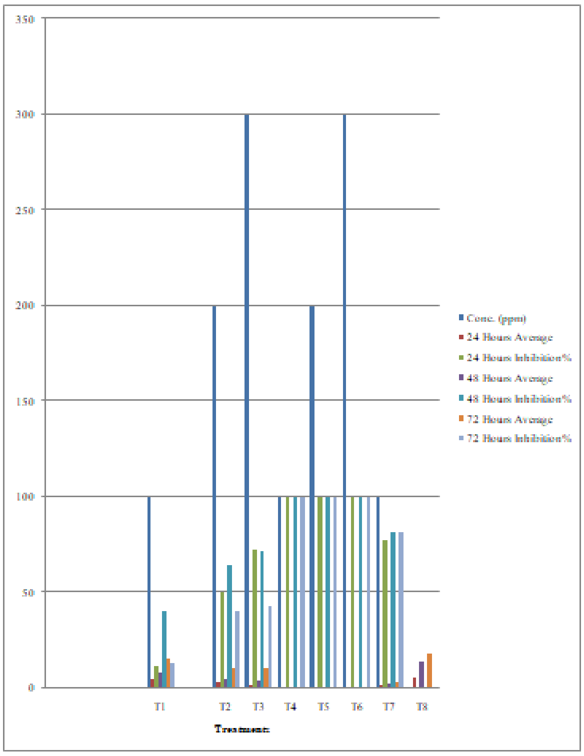
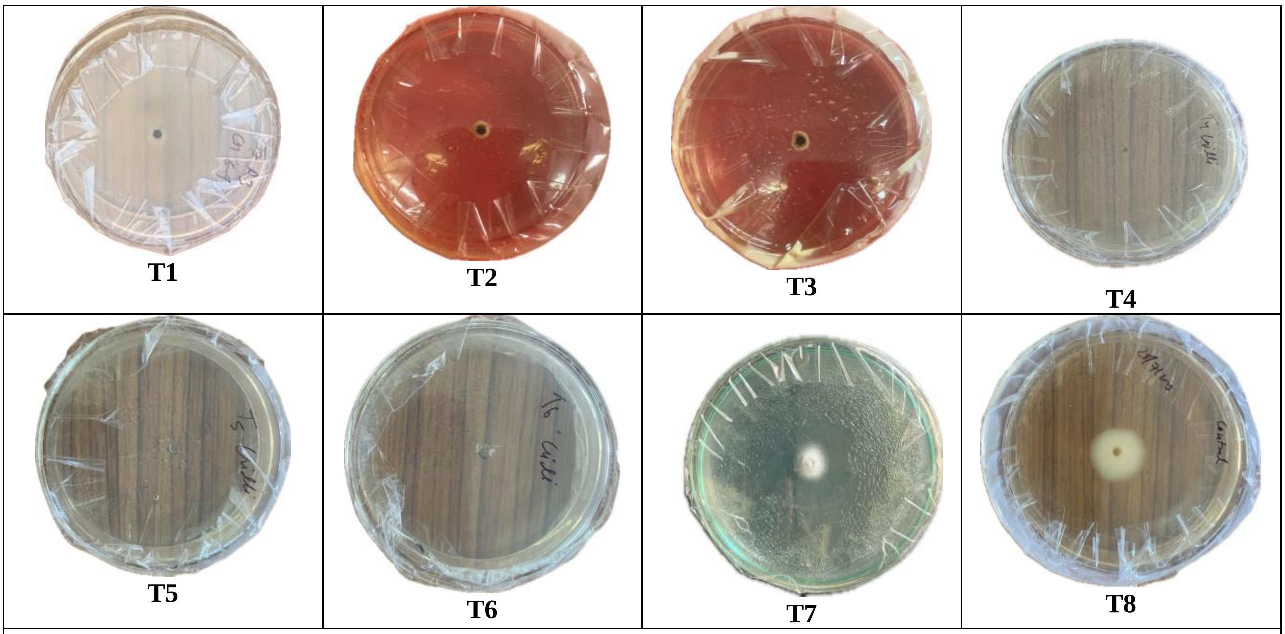


Fig. 1. *In vitro* efficacy of fungicides at different concentration against *Colletotrichum capsici*.



T1-Copper Oxychloride(50%WP); **T2**-Copper Oxychloride(50%WP); **T3**-Copper Oxychloride(50%WP); **T4**-Propiconazole(25%EC); **T5**-Propiconazole(25%EC); **T6**-Propiconazole(25%EC); **T7**-Carbendazim(50%WP) +Mancozeb(75%WP); **T8**-Control

Plate 1: *In-vitro* evaluation of fungicides against *C. capsici* after 24 hr,48hr and 72hr of inoculation.

Aman & Yadav (2022) revealed with the results of in vitro application of fungicides showed that with increase in the concentration of the fungicide there is increase in the inhibition of mycelial growth of *C. capsici*. Similar result was found by Jagtap *et al.* (2012); Akhtar *et al.* (2018); Padghan *et al.* (2023).

CONCLUSIONS

On the basis of present investigations, it was concluded that concentration among the selected fungicides Propiconazole 25% EC was found to be the most effective showing complete inhibition in the radial growth of *Colletotrichum capsici*.

Acknowledgement. The authors wish to thanks HOD, Department of Plant Pathology, School of Agriculture, Abhilashi University Mandi H.P. 175028, for providing need-based facilities conducting this research work.

REFERENCES

Akhtar, N., Chandra, R., & Mazhar, Z. (2018). Efficacy of Different Fungicides against *Colletotrichum capsici* under Field Condition and their Impact on Yield. *Trends in Biosciences, 11*(32), 3687-3691.

Bansal, R. D., and Grover, R. K. (1969). Reaction of chilli (*Capsicium frutescens*) varieties to *Colletotrichum capsici*. *J. Res., Punjab Agric. Univ*., *6*, 345-348.

Chauhan, A., & Yadav, V. K. (2022). *In vitro* Evaluation of Plant Extracts and Fungicides against *Colletotrichum capsici* causing Anthracnose Disease of Chilli. *Biological Forum – An International Journal, 14*(4), 720-725.

Damm, U., Cannon, P. F., Woundenberg, J. H. C., Johnston, P. R., Weir, B. S., Tan, Y. P., Shivas, R. G., Crous, P. W. (2012). The *Colletotrichum boninense* species complex. *Studies in Mycology, 73*, 1-36.

Isaac, S. (1992). Fungal Plant Interaction. London: *Chapman and Hall Press*. pp. 115.

Jagtap, G. P., Gavate, D. S. and Dey, U. (2012). Control of *Colletotrichum truncatum* causing anthracnose/pod blight of soybean by aqueous leaf extracts, biocontrol agents and fungicides. *Sci. J. Agril., 1*(2), 39 -52.

Katediya, M. A., Jaiman, R. K., & Acharya, S. K. (2019). Management of chilli anthracnose caused by *Colletotrichum capasici*. *Journal of Pharmacognosy and Phytochemistry*, *8*(3), 2697-2701.

Kim, J. T., Park, S. Y., Choi, W., Lee, Y. H. & Kim, H. T. (2008). Characterization of *Colletotrichum* isolates causing anthracnose of pepper in Korea. *Plant Pathology Journal, 24,* 17-23.

Lima, W. G., Spósito, M. B., Amorim, L., Gonçalves, F. P. & de Filho, P. A. M. (2011). *Colletotrichum gloeosporioides*, a new causal agent of citrus post-bloom fruit drop. *European Journal of Plant Pathology*, *131*, 157-165.

Mistry, D. S., Sharma, I. P. and Patel, S. T. (2008). Biochemical parameters of chilli fruits as influenced by *Colletotrichum capsici* (Sydow) Butler and Bisby infection. *Karnataka Journal of agricultural Science*, *21*, 586-587.

Padghan, P. R., Mondal, B., & Gade, R. M. (2023). In vitro efficacy of different fungicides against *Colletotrichum capsici* causing anthracnose of chilli. *Plant Archives*, *23*(2), 403-406.

Pakdeevaraporn, P., Wasee, S., Taylor, P. W.J., & Mongkolporn, O. (2005). Inheritance of resistance to anthracnose caused by *Colletotrichum capsici* in Capsicum. *Plant Breeding*, *124*(2), 206-208.

Poulos, J. M. (1992). Problems and progress of chilli pepper production in the tropics. In Proceedings of the Conference on Chilli Pepper Production in the Tropics. Kuala Lumpur, Malaysia (pp. 98-129).

Saha, S., Loganathan M., Garg R., Rai, A. B. (2017). Sensitivity of chilli plants to tricyclazole 18% + mancozeb 62% WP against anthracnose disease. *Journal of Mycopathological Research*, *55*(3), 295-297.

Sahitya, U. L., Sri Deepthi, R. & Krishna, M. (2014) Anthracnose, a prevalent disease in capsicum. *Research Journal of Pharmaceutical, Biological and Chemical Sciences*, *5*(3), 1583-1604.

Saxena, A., Raghuwanshi, R. and Singh, H. B. (2016). Elevation of defence network in Chilli against *Colletotrichum capsici* by Phyllospheric Trichoderma Strain. *Journal of Plant Growth Regulator, 35*, 377-389.

Sexena, A., Reghuwanshi, R. & Singh, H. B. (2014). Molecular phenotypic and pathogenic variability in Colletotrichum isolates of subtropical region in North Eastern India, causing fruit rot of chillies. *Journal of Applied Microbiology*, *117,* 1422-1434.

Thippeswamy, B., Krishnappa, M., Chakravarthy, C. N., Sathisha, A. M., Jyothi, S. U. and Kumar, K. V. (2007). Pathogenicity and management of anthracnose and alternaria leaf spot of chilli. *Int J Pl Sci., 2*, 39—43.

Waller, J. M. (1992) Colletotrichum diseases of perennial and other cash crops. Bailey, JA, Jeger MJ (eds). In: Colletotrichum: Biology, pathology and control. CAB Int, Wallingford, UK, pp 167-186.

Yoon, J. B., Yang, D. C., Lee, W. P., Ahn, S. Y., & Park, H. G. (2004). Genetic resources resistant to anthracnose in the genus Capsicum. *Horticulture Environment and Biotechnology*, *45*(6), 318-323.

How to cite this article: Preeti Thakur, Anupam Kumar, Vinod Kumar, Rajan Kamboj, Ravinder, Shivani Kaundal, Prabhat Kumar, Sahil Chaudhary, Neeraj Bhardwaj, Ashish and Ashwani Kumar (2023). *In-vitro* Effect of Different Fungicides on Management of Anthracnose (*Colletotrichum capsici*) Disease of Chilli. *Biological Forum – An International Journal, 15*(12): 154-158.