EFFICACY OF FUNGICIDES AND BIOCONTROL AGENTS IN THE MANAGEMENT OF CERCOSPORA LEAF SPOT OF CHILLI

Pun M, Kumar V, Bisht S S and Upadhyay S

Department of Plant Pathology, College of Horticulture VCSG UUHF Bharsar

ABSTRACT

Chilli is an important vegetable as well as important spice in India. It is known to suffer from many types of diseases. Frog eye leaf spot caused by *Cercospora capsici* has been destructive disease of chilli. An investigation carried out under laboratory condition at Department of Plant Pathology, College of Horticulture VCSG UUHF Bharsar, Pauri Garhwal to evaluate the efficacy of six fungicides and five biocontrol agents against the pathogen. Among the tested treatments, *in vitro* experiment Hexaconazole and Carbendazim showed 100% inhibition of mycelial growth of the fungus whereas *Trichoderma harzianum* showed 72% inhibition. Field experiment was conducted to find out effective management against one most common Cercospora leaf spot disease of chilli. The results revealed that spraying of Hexaconazole 5% SC @0.1 mL recorded the lowest per cent disease index (5.72) whereas, among biocontrol agents, *Trichoderma viride* with minimum PDI (15.58).

Keywords: N.A

No: of Tables: 4 **No: of References: 20**

INTRODUCTION

Chilli (*Capsicum annum* L.) is one of the important cash earning crop, widely used as universal spice of India mainly cultivated for its vegetable green chilli and dry chilli especially in tropical and subtropical regions throughout the world. It is member of the family Solanaceae. The centre of origin of chilli is said to be Mexico, Guatemala and Bulgaria. Chilli was known to Indians about 400 years ago since from the crop was introduced by Portuguese during the 16th century. Its cultivation become popular in the 17th century (Selvakumar, 2014). Chilli is a warm season crop. It is a perennial crop and can be grown throughout the year. However, the major harvest season is between December to March. The planting is mainly done during August to October (Bosland and Votava, 2000).

India is the largest producer and consumer of chilli among others major producers in the world. The area under chili cultivation is 287.05 ha with production 3406.03 MT (Horticulture Statistics at a Glance, 2017). Andhra Pradesh is the largest producer of Chilli in India and contributes about 35 per cent to the total area under chilli. Karnataka is the second largest producer contributing 8 per cent to the total production followed by West Bengal (7%), Orissa (6%), Maharashtra (5%), Madhya Pradesh (5%) and others about 10% during 2013-14 (NBHC, 2015). Chilli is commonly affected by fungal diseases like Cercospora leaf spot, damping off, wilt, anthracnose (dieback/fruit rot), leaf spots, powdery mildew, bacterial diseases (soft rot and bacterial wilt). Among the fungal diseases, Cercospora leaf spot of chilli is one of the major problems of chilli cultivation in Bangladesh (Meah and Khan, 1987).Cercospora leaf spot disease, also known as frogeye leaf spot disease, was first reported by Saccardo in 1876. This disease is caused by a fungus referred to as *Cercospora*. The genus *Cercospora*, a Greek word (Kerkos- a tail and spora- a spore) name was first proposed by Fresenius (1863). It is one of the largest genera of dematiaceous hyphomycetes producing filiform conidia and has around 3000 species and distributed globally (Kamal, 2010). The asexual spores (conidia) of *Cercospora* infect the leaves by penetrating directly or through stomata. Fungal mycelium develops in leaves and, damages the tissues, which become visible in the form of circular or irregularly-shaped brownish spots with light whitish centre resembling 'frogeye. In Karnataka, crop losses due to *Cercospora* have been reported up to 45% in groundnut (Siddaramaiah *et al.,*1983). Loss due to this disease has been estimated to 21% in bidi tobacco field under normal monsoon conditions in Gujarat (Kumar *et al.,* 2016). Sharma (1998) recorded Maximum of 49% severity of frogeye leaf spot of Bell pepper in Himachal Pradesh, India. The perfect stage was identified as *Mycosphaerella capsici*. The pathogen has been first isolated and named from bell pepper by Heald and Wolf (1911) and later studied by several researchers (Chupp, 1953; Vasudeva,1963; Meon, 1990; Lim and Kim, 2003 and Bhat *et al.,* 2008).

The objectives of the present studies were to simulate model for diagnosis of

Cercospora leaf spot of chilli and to formulate model prescription for the disease based on proper diagnosis and management options.

MATERIALS AND METHODS

In vitro evaluation of fungicides and biocontrol agents against *Cercospora capsici*

In vitro experiment was carried out in the Department of Plant Pathology, College of Horticulture VCSG UUHF, Bharsar, Pauri Garhwal. Three replications were maintained for six different fungicides namely Hexaconazole, Carbendzim, Copper oxychloride, Captan, Mancozeb and Chlorothalonil with a control were tested on different concentrations like 500, 1000, 1500, 2000 and 2500 ppm by use of food poison technique (Nene and Thapliyal, 1993). Then it were incubated at 25 ± 1°C and mycelial growth of test fungus will be observed after 15 days.The efficacy of fungicides was expressed as per cent inhibition of mycelial growth over control, calculated by using following formula suggested by (Vincent, 1947).

$$PGI = \frac{C-T}{C} \times 100$$

Where; PGI = Per cent growth inhibition

C = Radial growth of fungus in control

T = Radial growth of fungus in treatment

Five different biocontrol agents namely *Bacillus ceresus, Pseudomonas fluorescens, Trichoderma viride, Bacillus subtilis, Trichoderma harzianum* and with a control were evaluated against *Cercospora capsici* through dual culture technique (Faheem *et al*., 2010). In this method, the bioagents and the test fungus were inoculated both side on a single petri plate containing solidified PDA medium. Four replications were maintained for each treatment with one control by maintaining only pathogen and bio agent separately. Inoculated plates were incubated at 25 ± 1°C for 15 days. The diameter of the colony of bio agents and the pathogen measured in two directions and average were recorded.

In vivo evaluation of fungicides and biocontrol agents against *Cercospora capsici*

A field experiment was conducted during *kharif* season 2018 at Vegetable Research and Demonstration Block, College of Horticulture VCSG UUHF Bharsar in Randomized Complete Block Design with cv. Pant C1. Plot size of 1.8m ×1.35m was maintained per treatment. Seven fungicides treatments *viz.*,T_1 Control, T_2 Hexaconazole 5%SC @1.0ml/L, T_3 Carbendazim 50% WP @2.0gm/L, T_4 Copper oxychloride 50% WP @2.0gm/L, T_5 Captan 50% WP @2.0gm/L, T_6 Mancozeb 75%WP @2.0gm/L and T_7 Chlorothalonil 75% WP @2.0gm/L with three replications and six biocontrol agents treatments T_1 Control, T_2 *Bacillus ceresus*, T_3 *Pseudomonas fluorescens,* T_4 *Trichoderma viride,* T_5 *Bacillus subtilis* and T_6 *Trichoderma harzianum* each with 5gm/L against *Cercospora capsici*. The treatments/spray schedule as initiated at the disease appearance stage and totally three sprays were taken at 15 days interval. The

observation were recorded taken five randomly selected plants. Disease severity were recorded using a disease scale 0 to 9 rating scale given by Mayee and Datar (1986).Now, Per cent disease index were calculated with the help of formula given by Wheeler (1969).

$$PDI = \frac{\text{Summation of all numerical ratings}}{\text{No. of plant observed} \times \text{Maximum grade value (9)}} \times 100$$

RESULTS AND DISCUSSION

The result of *in vitro* presented in Table 1 and 2. Among fungicides tested on this experiment T_2 (Hexaconazole) was found most effective which inhibited 100 % growth of fungus at each concentration which was statistically at par with T_3 (Carbendazim) inhibited 100 % radial growth. All fungicides differ significantly over T_1 (control). And the effect of bioagents on the fungal mycelial growth showed that T_6 (*Trichoderma harzianum*) was effective on percent mycelium growth inhibition of *C.capsici* (*in vitro*) showed maximum inhibition (72.02%) on the pathogen followed by T_4 (*T. viride*) (65.56%) which was found statistically at par with T_3 (*P. fluorescens*) (63.46%).

Table 1. *In vitro* evaluation of fungicides on Per cent mycelium inhibition of *C. capsici*

T. No	Treatments	500ppm ± S.E.(m)	1000ppm ± S.E.(m)	1500ppm ± S.E.(m)	2000ppm ± S.E.(m)	2500ppm ± S.E.(m)
T_1	Control	0.00 ± 0.00 (0.00)	0.00±0.00 (0.00)	0.00±0.00 (0.00)	0.00±0.00 (0.00)	0.00±0.00 (0.00)
T_2	Hexaconazole 5%SC	100.00±0.00 (90.00)	100.00±0.00 (90.00)	100.00±0.00 (90.00)	100.00±0.00 (90.00)	100.00±0.00 (90.00)
T_3	Carbendazim 50% WP	35.77 ±2.05 (36.70)	54.55±3.32 (47.60)	66.64±1.88 (54.71)	100.00±0.00 (90.00)	100.00±0.00 (90.00)
T_4	Copper oxychloride 50% WP	77.63 ±1.84 (61.78)	79.06±3.08 (62.85)	82.32±0.89 (65.12)	84.84±1.23 (67.09)	85.92±0.04 (67.93)
T_5	Captan 50 % WP	54.51 ±3.83 (47.58)	60.30±0.48 (50.92)	62.46±1.07 (52.20)	66.22±1.84 (54.46)	72.20±1.38 (58.17)
T_6	Mancozeb 75%WP	42.99 ±3.95 (40.93)	50.86±3.96 (45.48)	59.60±3.71 (50.54)	65.36±3.31 (53.97)	77.18±1.29 (61.46)
T_7	Chlorothalonil 75% WP	22.78 ±1.28 (28.47)	26.74±0.27 (31.12)	29.49±0.15 (32.87)	36.48±1.49 (37.13)	44.58±1.13 (41.87)

TABLE 2. *In vitro* evaluation of biocontrol agents on mycelial growth and per cent mycelium growth inhibition of pathogen

T.No.	Treatments	Mycelial growth (mm) ± S.E.(m)	Per cent mycelium growth inhibition± S.E.(m)
T_1	Control	46.59±0.21	0.00±0.00(0.00)
T_2	*Bacillus ceresus*	30.07*±0.57	35.53±1.36(36.56)
T_3	*Pseudomonas fluorescens*	17.01*±0.49	63.46±1.18(52.79)
T_4	*Trichoderma viride*	16.04*±0.46	65.56±0.98(54.05)
T_5	*Bacillus subtilis*	36.14*±0.46	22.41±1.14(28.22)
T_6	*Trichoderma harzianum*	13.03*±0.81	72.02±1.66(58.07)

In vivo results of investigation are presented in table 3 and 4. All the tested fungicides are significant over control. The minimum per cent disease severity was observed in T_2 Hexaconazole (5.72%) whereas, maximum was observed in T_1 Control (28.93%). Among the biocontrol agents, minimum per cent of disease intensity was observed in T_6 (*Trichoderma harzianum)* 14.16%, whereas maximum disease intensity was observed in control (28.78%).

Table 3. Effect of different fungicides on per cent disease index (PDI) 65, 80 and 95 days after transplanting (DAT)

T.No.	Treatments	Dose	Per cent Disease Index (PDI)		
			65 DAT± S.E. (m)	80 DAT± S.E.(m)	95 DAT± S.E.(m)
T_1	Control	-	18.54±1.04(25.48)	23.66±1.87(29.06)	28.93±1.11(32.51)
T_2	Hexaconazole 5%SC	1.0 ml/L	4.91*±0.96(12.68)	5.14*±0.78(13.03)	5.72*±1.20(13.68)
T_3	Carbendazim 50% WP	2.0 gm/L	6.67*±1.29(14.82)	6.94*±1.15(15.17)	8.22*±1.24(16.55)
T_4	Copper oxychloride 50% WP	2.0 gm/L	7.87*±0.59(16.26)	8.56*±1.17(16.93)	9.56*±0.44(17.99)
T_5	Captan 50 % WP	2.0 gm/L	9.14*±0.77(17.56)	11.22*±1.69(19.45)	13.54*±0.83(21.56)
T_6	Mancozeb 75%WP	2.0 gm/L	8.47*±0.88(16.87)	10.67*±1.14(19.00)	12.25*±0.93(20.45)
T_7	Chlorothalonil 75% WP	2.0 gm/L	11.06*±0.87(19.39)	13.54*±0.46(21.57)	16.55*±0.69(23.98)

Table 4. Effect of different biocontrol agents on per cent disease index (PDI) 65, 80 and 95 days after transplanting (DAT)

T.No.	Treatments	Dose	Per cent Disease Index (PDI)		
			65 DAT± S.E. (m)	80 DAT± S.E. (m)	95 DAT± S.E. (m)
T_1	Control	-	18.46±1.07 (25.40)	23.49±1.33 (28.95)	28.78±0.80 (32.42)
T_2	*Bacillus ceresus*	5gm/L	15.33*±0.81 (23.02)	19.06*±0.73 (25.86)	23.72*±0.45 (29.13)
T_3	*Pseudomonas fluorescens*	5gm/L	12.35*±0.79 (20.53)	14.38*±0.25 (22.27)	17.06*±0.84 (24.37)
T_4	*Trichoderma viride*	5gm/L	11.76*±0.62 (20.02)	13.13*±0.64 (21.22)	15.58*±0.51 (23.23)
T_5	*Bacillus subtilis*	5gm/L	14.55*±0.96(22.38)	17.19*±0.95 (24.46)	20.16*±0.39 (26.66)
T_6	*Trichoderma harzianum*	5gm/L	10.60*±0.94 (18.93)	12.75*±0.71 (20.89)	14.16*±0.42 (22.08)

REFERENCES

Anonymous. 2017. Area and production of crops. Horticulture Statistics at a Glance.

Bhat F A, Dar D M, Teli M A and Ahmad M F. 2008. Frogeye leaf spot of bell pepper in Kashmir: prevalence and cause. *Karnataka Journal Agricultural Science*.21(**3**): 460-461.

Bosland P W and Votava E J. 2000. Peppers: Vegetables and Spices *Capsicums*. CABI, New York. pp.14.

Chupp C. 1953. *A monograph of fungus Genus Cercospora,* Ithaca. New York. pp. 667.

Faheem A, Razdan V K, Mohiddin F A, Bhat K A and Sheikh P A. 2010. Effect of volatile metabolites of *Trichoderma* species against seven fungal plant pathogen in *vitro*. *Journal of Phytopathology*. 2: 34-37.

Fresenius J B. 1863. Cercospora Fresenius *Beitr. Mykol.* 3:91-93.

Heald F D and Wolf F A. 1911. New species of texas: Fungi. *Mycologia.* 3: 5-22.

Kamal. 2010. Cercosporoid fungi of India. Bishen Singh Mahendra Pal Singh, Dehradun India. pp: 351.

Kumar N D, Karegowda C, Murali R, Sayiprathap B R, Mahesh M, Nagaraj H, Raju J, Jayalakshmi, Rudrappa K B, Manu T G, Kavitha T H and Mahantesh S B. 2016. Frog Eye Leaf Spot disease of FCV Tobacco caused by *Cercospora nicotianae* in Southern Districts of Karnataka. *Journal of Pune and Apllied Microbiology*. 10(**1**): 401-406.

Lim Y S and Kim B S. 2003. Sporulation of *Cercospora capsici* causing Cercospora leaf spot of pepper. *Research in Plant Diseases.* 9(**3**): 162-165.

Mayee C D and Datar V V. 1986. Phytopathometry. Technical Bulletin-I, Marathawada Agricultural University, India. pp. 146.

Meah M B and Khan A A. 1987. Check list of fruit and vegetable disease in Bangladesh. 1st ed. Department of Plant Pathology, Bangladesh Agricultural University, Mymen Singh, Bangladesh. pp.13.

NBHC. 2015. Area and production of chilli. *Seasonal Commodity Insight.*

Nene Y L and Thapliyal P N. 1973. Fungicides in plant disease control. Oxford and IBH publishing Co. Pvt. Ltd. New Delhi. 325.

Saccardo P A. 1876. Fungi veneti novi vel criti. Series V. *Nuovo Giornale Botanico Italiano.* 8: 161-211.

Selvakumar R. 2014. A textbook of Glaustas Olericulture. New Vishal Publications. New Delhi. pp. 255-256.

Sharma S K. 1998. Efficacy of different fungi toxicants against frogeye leaf spot of bell pepper. *Plant Disease Research.* 13: 62-63.

Vasudeva R S. 1963. Indian *Cercosporae*. IARI, New Delhi. pp. 254.

Vincent J M. 1947. Distortion of fungal hyphae in presence of certain inhibitors. *Nature*. 159: 850.

Wheeler B E. 1969. An introduction to plant diseases. *John Willey and Sons Ltd., London.*