www.ThePharmaJournal.com

The Pharma Innovation

ISSN (E): 2277- 7695
ISSN (P): 2349-8242
NAAS Rating: 5.23
TPI 2021; 10(1): 796-799

www.thepharmajournal.com
Received: 10-11-2020
Accepted: 20-12-2020

Preeti Chouhan
College of Agriculture, Ganjbasoda, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

OP Bharti
Krishi Vigyan Kendra, Harda, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India.

Corresponding Author:
Preeti Chouhan
College of Agriculture, Ganjbasoda, Jawaharlal Nehru Krishi Vishwa Vidyalaya, Jabalpur, Madhya Pradesh, India

Bio efficacy of fungicides against fruit rot in chilli incited by *Colletotrichum capsici*

Preeti Chouhan and OP Bharti

Abstract
The Chilli is a main constituent in all spices in India. Indian cuisine is renowned and celebrated throughout the world for its spicy treat to the tongue. The production of chilli is constrained mainly by fruit rot (anthracnose) caused by *Colletotrichum capsici* among other diseases, it is limiting factor in all chilli growing areas of India. An Experiment was laid out at farmer's field, Krishi Vigyan Kendra, Harda to evaluate the bio efficacy of new fungicides against fruit rot of chilli in rabi during 2018-19 in randomized block design and replicated thrice. The data revealed that all fungicidal treatments reduced the disease incidence as compared to untreated control with increased yield. The fungicide E1 (9.57%) was found most effective for the management of fruit rot of chilli followed by D2, B3, F4, H5, A6 and I7, while, the least effective was found C8 (17.80%) but more effective than control (19.13%). The treatment, E1statistically (P=0.05) significant superior over all the other treatments which compare with untreated (Control). The maximum (1364.33 q) yield ha^{-1} was harvested in E1 with highest Net return (1608930) and B:C ratio (4.68), while, minimum (1033.67 q) yield ha^{-1} was harvested in C8 which high compare to control (978 q) yield ha^{-1} in respect to Yield, net return with B:C ratio. The data was recorded excellent yield with higher cost - benefit ratio in E1 among all the treatments than control.

Keywords: Chilli, fruit rot, *Colletotrichum capsici*, DI%, and management

Introduction
Chilli (*Capsicum annum* L) belongs to the family *Solonaceae* is one of the major vegetables and spice crops grown in the country. Its cultivation became popular in 17th century being fit to chilli both tropical as well as sub tropical conditions. It's popular and highly remunerative, annual herbaceous vegetable crop. Chilli is an important spice cum vegetable crop, often referred to as Capsicum, hot pepper, sweet pepper or paparika. Chilli cultivation has existed for several hundred years as a sustainable form of agriculture in India and in many other countries. Green chilli provides vitamin-C while, the red chilli provides vitamin-A (Martin *et al.*, 2004) [8] in addition to iron, potassium and magnesium. The area and production of green chillies in India is 0.316 mha and 3.63 mt respectively during the year, 2018-19 (Anonymous, 2017) [3]. The sustainability of chilli-based agriculture is threatened by a number of biotic and abiotic factors. Although infected fruits are not toxic to humans or animals, severely affected fruits showing blemishes are generally considered unfit for human consumption. This is because the fruit rot causes an unpleasant colour and taste in its products. Studies conducted on resistance aspect of this disease show very little resistance in chilli germplasm which indicate the presence of diverse population within the fruit rot/dieback or anthracnose causing fungus. Management of the disease under the prevailing farming systems in India has, thus, become a recurrent problem to chilli growers. The disease can be kept under check with chemical spray programme (Rathore, 2004) [15] but the complete control is still intractable.
Fruit rot Colletotrichum genus, More than 40 fungal species known to affect the crop growth and fruit yield of chilli, more common species of Colletotrichum those cause the anthracnose are *C. capsici*, *C. gloeosporioides*, *C. acutatum*, *C. coccodes*, *C. dematium*, *C. siamense* added with *C. karstii* (Saini *et al*., 2016) [17]. Of these, mainly the *Colletotrichum capsici* is reported to be most virulent in causing higher fruit rot of chilli (Akhtar *et al.*, 2017) [2].
Symptoms of anthracnose pathogen perpetuate with seed, soil and air borne. The disease is prevalent in almost all major chilli growing areas of India (Rathore, 2006) [16]. On the leaves, initially small-circular spots appear and the severely infected leaves fall off leading to defoliation of plant. The infection starts from growing tips (necrosis of apical branch, dieback) followed by leaves and branches and then fruits. Among the plant parts, most susceptible stage is ripe fruit stage (Rahman *et al.*, 2011) [12].

Symptoms on matured fruit appear as sunken necrotic lesions with concentric rings which produce conidial masses in pink to orange colour. Under severe conditions, lesions fuse and conidial masses may form concentric rings on lesions (Gupta *et al.,* 2017) [6].

With the view, Yield losses due to anthracnose In India, pre and post-harvest losses of chilli are more than 50% (Pakdeevaraporn *et al.,* 2005) [9]. Fruit rot alone reduces the fruit yield by more than 50% in different parts of India (Ramachandran *et al.,* 2007) [13]. A wide range from 10% to 80% reduction in fruit yield has also been reported (Than *et al.,* 2008) [20].

The chilli crop suffers from more than 40 fungal species, of these *C. capsici* is one of the most destructive species (Rangaswami, 1979) [14] causing seedling rot or damping off at seedling stage/ nursery, leaf spot or die back at different stages of crop growth and fruit rot or anthracnose at fruiting stage leading to reduced fruit yield and marketability (Rahman *et al.,* 2011) [12]. To control this fungus, many contact and systemic fungicides have been recommended (Phansawan *et al.,* 2015) [10]. Traditionally, chemical control has been sought most effective. Among the several chemical fungicides, carbendazim is commonly used chemical to control the *C. capsici* of chilli (Priya Reddy, 2017a) [11]. The other fungicides advocated are copper containing compounds like, dithiocarbamates, benzimidazole and triazole compounds. Chemical control of mycoflora on chilli has been well established and the time of application is also very important for effective control of anthracnose (Shetty *et al.,* 1998) [18]. Therefore, efforts were made to compile complete and up to date information on different management practices for control of Colletotrichum capsici and management practices to reduce the fruit rot of chilli to achieve higher fruit yields. With view in approaches for anthracnose Management of fruit rot (anthracnose) is a major issue among chilli growing farmers. Generally, chemical fungicides are commonly used as control measures are available in market ready to use that farmers more prefers. However, combination of strategies like mechanical, chemical, biological and intrinsic resistance would be appropriate for management of anthracnose (Agrios, 2005) [1].

Materials and Methods

The field experiment on bio efficacy of Chilli fruit rot was conducted at Farmers field under monitoring Krishi Vigyan Kendra, Harda during the Rabi season of 2018-19. Chilli seedlings of variety Sunidhi were raised in a nursery bed and transplanted after 30 days old to the experimental field by following a spacing of 150 cm row spacing and plant spacing of 30 cm and with plot of size 22 X22 feet. The experiment was laid out in randomized block design (RBD) with three replications and nine treatments. The recommended agronomical package of practices such as nutriment, weed management, irrigation and pest management were followed. All the foliar sprays were given in treatment as per their doses. The first spray of fungicides was done after first appearance of disease with the help of motor operated knapsack sprayer. The same concentration was followed for second spray at 12 days interval and the unsprayed treatment served as control. In the spraying fluid was taken 300 liter spray volume was used per hectare. The disease incidence percent, fruits yield and other data were recorded at each harvesting. Statistical analysis with all the data related to diseases incidence and yield was statistically analyzed with randomized complete block design, Snedecor and Cochran, (1980) [19]. The critical difference at 5% level of significance for each character were work out for comparing the significance among the treatments means. The Disease incidence percent calculated formula with total numbers of infected fruits divided by total harvested fruit multiply by 100 at time each harvesting.

Results and Discussion

The data revealed that on the disease incidence percent of fruit rot of chilli were recorded periodically at each harvesting of crop. It is evident from Table 1 showed that all fungicides significantly reduced the disease incidence percent significantly as compared to the control. The lowest (9.57) disease incidence percent in E1 was recorded followed by treatment 10.20 and 12.23 in D2 and B3 while, Maximum (19.13%) disease incidence percent was recorded in G9 respectively, it is concerned with recently, mancozeb (0.2%) found to inhibit fruit rot by 73.47%, while carbendazim (0.05%) gave 64.12% control as compared to control (Linuand Jisha, 2017) [7]. According to Arvindkumar (2016) [5] reported that foliar spray of fungicide, propiconazole (0.1%) at pre-flowering, fruit set and fruit maturation resulted in fruit yield of 15.3 q ha^{-1} as against control (9.6 q ha^{-1}) and *Trichoderma harzianum* spray (10.7 q ha^{-1}). All the fungicides used as spray significantly managed the fruit rot (Table 1). All the chemical treatments D2 and B3 were found statistical significantly superior over rest of the treatments. Plant height was found in uniform compare to control treatment because due to plant suppressed by pathogen interaction as well as healthy plants recorded more branches which bears high fruits per plant during the crop season. According to Ali *et al.,* (2017) [4] also reported that foliar spray of mancozeb 50 EC (0.3%), COC 50 WP (0.1%), carbendazim 50 WP (0.1%), difenoconazole 25 EC (0.03%) or propinpconazole 25 EC (0.15%) thrice at pre- flowering, the fruit set and fruit maturity showed only 20.3% or less fruit rot incidence as compared to the control (48.9% fruit rot) and the fruit rot incidence could be further reduced with additional seed treatment.

With the view of economical analysis of crop, it is recorded that the cost of cultivation more or less in equal each treatment excluding to control which no significantly difference. The maximum Rs. 437935 in D2 treatment, while, the minimum Rs.436300 in A6 cost of cultivation were recorded. The maximum Rs. 1608930 gained with 4.68 benefit cost ratio in production the chilli crop.

The maximum green fruit yield (1364.33 q/ha) was observed in treatment E1 followed by treatment D2 with 1338 q/ha. Whereas the minimum green fruit yield (1056.33 q/ha) was observed in G9 (Untreated control). The maximum green fruit yield may be due to proper management of diseases and other yield reducing factors with also plant responses to the chemical sprayed. That spray of fungicide with suitable concentration controlled the diseases. Fruit rot caused by *C. capsici* reported to reduce the marketable yield from 2.5 to 11.6 depending on the variety (Rahman *et al.,* 2011) [12]. The disease incidence varies from 44 to 51% (Yadav and Singh, 2016) [22]. Recently, Yadav *et al.,* (2017) have shown a decreased fruit yield from 50.3 to 58.6% in untreated control as compared to the fungicide seed treatment (1%) + NSKE spray (5%). The yield losses extend even up to 100% (Amusa *et al.,* 2004) [23] and reduce the marketability. Hence, management of *C. capsici* is very important in chilli cultivation.

Table 1: Effect of fungicidal formulation foliar spray on powdery mildew of chilli

Treatment	Dosages	Plant Height (cm)	No. of Braches	Fruits/Plant (Kg)	No. of Fruits/Plant	Disease Incidence (%)	Yield q/ha	Cost of Cultivation	Gross Returned	Net Returned	B:C Ratio
A6	Tubuconazole 10% + S 65% wg @ 1250 g per ha	69	13.33	5.11	1609.33	14.33	1135.67	436300	1703500.00	1267200.00	3.90
B3	Tubuconazole 25.9 EC @ 625 ml @ 1250 g/ha	73.6667	14.67	5.98	1883.00	12.23	1329.67	437560	1994500.00	1556940.00	4.56
C8	Carbendazim 12% + Mencozeb 63% wp @ 1250 g/ha	68.6667	12.33	6.02	1896.67	17.80	1033.67	436480	1550500.00	1114020.00	3.55
D2	Metalaxyl 8% + Mencozeb 60% wp @ 1250 g/ha	74.6667	15.00	6.14	1934.00	10.20	1338.00	437935	2007000.00	1569065.00	4.58
E1	Thiophenate methyl 25% + mencozeb 50% wp @ 1250 g/ha	75.3333	15.33	5.84	1839.33	9.57	1364.33	437570	2046500.00	1608930.00	4.68
F4	Chlorothionil 75 wp @ 850 g/ha	71.3333	14.00	5.42	1707.33	13.40	1298.33	437830	1947500.00	1509670.00	4.45
G9	Hexacanozole 5% SC @ 400 ml/ha	68.3333	13.33	4.40	1386.00	16.77	1056.33	436560	1584500.00	1147940.00	3.63
H5	Mencozeb 800 wp @ 1500 g/ha	70.3333	14.33	4.40	1386.00	13.70	1203.67	437500	1467000.00	1029500.00	3.35
I7	control	68.3333	12.67	6.02	1896.67	19.13	978.00	436340	2007000.00	1570660.00	4.60
SEm +	-	0.84	0.52	0.33	1.61	0.54	10.72	-	-	-	-
CD at 5%	-	2.46	1.53	0.98	4.70	1.6	31.3	-	-	-	-

Conclusions

In the concern with high yield of green fruits per ha depends on proper management agronomical practices with also plant protection aspects. Here with the latest trends of chilli cultivation on raised bed with plastic mulching as well as drip system used for supply of nutrition and water in proper requirement of the plants that ultimately leads to increase crop production. In this, experiment E1 found best to management for fruit rot of diseases in chilli crop during rabi season.

References

1. Agrios GN. Plant Pathology, 5th Ed. Academic Press. San Diego; c2005. 922.
2. Akhtar J, Singh B, Kandan A, Pardeep Kumar, Dubey SC. Status of *Colletotrichum* species infecting chilli germplasm processed for pathogen-free conservation in national gene bank, India. Bangladesh Journal of Botany. 2017;46(2):631-637.
3. Anonymous.nhb.gov.in/Statistics/state_level/2017-18(1st%20Adv.%20Est).pdf; 2017.
4. Ali A, Bhat M, Masoodi L, Mughal N, Ambardar VK, Hassan MG. Integrated management of *Colletotrichum capsici* incitant of dieback and fruit rot of chilli under temperate conditions of Kashmir, India. Journal of Pharmacognosy and Phytochemistry. 2017;6(4):1509-1513.
5. Arvind Kumar. Variability and management of *Colletotrichum capsici* the causal organism of chilli anthracnose, M.Sc. thesis, Department of Plant Pathology, Sher-e-Kashmir University of Agricultural Sciences & Technology, Jammu; c2016.
6. Gupta V, Kaur A, Fatehpuria PK, Garg HS. Comparative studies on isolation, identification, and purification of *Colletotrichum capsici* causing anthracnose disease of chilli. International Journal of Chemical Studies. 2017;5(6):744-747.
7. Linu MS, Jisha MS. *In vitro* control of *Colletotrichum capsici* induced chilli anthracnose by fungicides and bio-control agent. International Journal of Applied and Pure Science and Agriculture. 2017;3(5):27-33.
8. Martin A, Ferreres F, Tomas BFA, Gil M. Characterization and quantization of antioxidant constituents of sweet pepper *Capsicum annum* L. Journal of Agricultural and Food Chemistry. 2004;52(12):3861-3869.
9. Pakdeevaraporn P, Wasee S, Taylor PWJ, Mongkolporn O. Inheritance of resistance to anthracnose caused by *Colletotrichum capsici* in *Capsicum*. Plant Breeding. 2005;124:206-208.
10. Phansawan B, Prapamontol T, Thavornyutikarn P, Chantara S, Mangklabruks A, Santasup C. A sensitive method for determination of carbendazim residue in vegetable samples using HPLC-UV and its application in health risk assessment. Chiang Mai Journal of Science. 2015;42(3):681-690.
11. Priya Reddy YN, Jakhar SS, Dahiya OS. Influence of plant oils and bio-fungicides on seed mycoflora of chilli (*Colletotrichum capsici*). International Journal of Pure and Applied Bioscience. 2017a;5(6):1544-1549.
12. Rahman MS, Akhter MS, Maya MA, Rahman AHMA, Akanda AM. Field resistance of chilli cultivars against anthracnose disease caused by *Colletotrichum capsici*. Thai Journal of Agricultural Science. 2011;44(4):243-250.
13. Ramachandran N, Madhavi RK, Rathnamma K. Current status of chilli anthracnose in India. The first International Symposium on chilli Anthracnose. 2007;25, Convention Centre, Seoul National University, Korea, 26.
14. Rangaswami G. Disease of Crop Plants in India. Printice-Hall of India Private Ltd. New Delhi, India; c1979, 570.
15. Rathore BS. Performance of some new fungicides in

controlling dieback and fruit rot of red pepper. Plant Disease Research. 2004;19(2):196-199.
16. Rathore BS. Evaluation of bio efficacy of myclobutanil (Systhane 10%WP) against disease of chilli. Journal of Mycology and Plant Pathology. 2006;36(1):74-76.
17. Saini TJ, Gupta SG, Char BR, Zehr UB, Anandalakshmi R. First report of chilli anthracnose caused by *Colletotrichum karstii* in India. New Disease Reports. 2016;34:6.
18. Shetty TAS, Uthaih BC, Rao KB, Indiresh KM. Chemical control of seed microflora on chilli. Plant Pathology Newsletter, University of Agricultural Sciences, Dharwad. 1988;6:22.
19. Snedecor GW, Cochran WG. Statistical Methods. Ames Iowa, Iowa State University press; c1980.
20. Than PP, Prihasturi H, Phoulivong S, Taylor PWJ, Hyde D. Chilli anthracnose disease caused by Colletotrichum species. Journal of Zhejiang University Sciences. 2008;9:764-778.
21. Yadav AL, Ghasolia RP, Choudhary S, Yadav VK. Exploitation of fungicides and plant extracts for eco-friendly management of chilli fruit rot disease. International Journal of Chemical Studies. 2017;5(4):1632-1634.
22. Yadav SS, Yadav ST, Mishra P, Mittal A, Kumar R, Singh J. An epidemiological study of malnutrition among under five children of rural and urban Haryana. Journal of clinical and diagnostic research: JCDR. 2016 Feb;10(2):LC07.
23. Amusa YB, Olabanji JK, Akinpelu VO, Olateju SO, Agbakwuru EA, Ndukwe N, Fatusi OA, Ojo OS. Pattern of head and neck malignant tumours in a Nigerian teaching hospital–A ten year review. West African journal of medicine. 2004;23(4):280-285.