Pest Management in Horticultural Ecosystems
Vol. 28, No.2 pp 203 -206 (2022)

DOI Number: 10.5958/0974-4541.2022.00064.9

RESEARCH NOTE

Efficacy of a new fungicidal molecule for the management of *Phytophthora capsici* in Capsicum

K. AJITHKUMAR, [1*], A. S[2] SAVITHA, G. RAMESH, [3], M. RENUKA, [1] and M. Y. AJAYAKUMAR[1]

[1]Main Agricultural Research Station, [2]Department of Plant Pathology, College of Agriculture
University of Agricultural Sciences, Raichur – 584 104, Karnataka, India.

[3]Department of Horticulture, College of Agricultural Engineering, University of Agricultural Sciences, Raichur – 584 104, Karnataka, India

***E-mail**: ajithk.path@gmail.com

ABSTRACT: Capsicum, *Capsicum annuum* var. *grossum* Sendt is an important spice and annual herbaceous vegetable crop in India. Phytophthora blight is a devastating disease that virtually infects every plant part resulting in root and crown rot, leaf blight, stem blight, and fruit rot. Hence the present investigation is carried out to test the bio-efficacy of novel fungicide molecules against leaf blight, stem blight, and fruit rot of capsicum. The results revealed that among the implemented treatments, valifenalate 6 % + mancozeb 60 % WG at 3000 g/ha was very effective in reducing leaf blight, stem blight, and fruit rot diseases of capsicum with a maximum fruit yield of 31.20 t/ha with B: C ratio of 3.84. Further phytotoxicity was tested, which revealed that there were no visual phytotoxic symptoms observed during the experimentation.

Keywords: Capsicum, fungicide, fruit rot, leaf blight, phytotoxicity and stem blight.

Capsicum (*Capsicum annuum* var. *grossum* Sendt), popularly known as bell pepper or sweet pepper, is an important spice and annual herbaceous vegetable crop grown across India (Herath *et al*., 2020). Capsicum production is very low in India, mainly due to the infectious diseases caused by fungi, bacteria, viruses, and mycoplasmas, which drastically decline yield (Chadha, 2003). Among the fungal infections, the *Phytophthora* blight is a devastating disease of bell pepper caused by the oomycete pathogen, *Phytophthora capsica*. It infects every part resulting in root and crown rot, on aerial parts, it causes leaf blight, stem blight and fruit rot (Madhura et al., 2015; Weber, 1932).

Effective management strategies are required to mitigate the *Phytophthora* leaf blight, which includes cultural measures such as proper drainage facility, raised beds used for transplanting, drip irrigation, straw mulching, crop rotation for at least three years with non-host plants, soil solarization, use of resistant varieties, botanicals and bio-control agents (Ristaino and Johnston, 1999; Savitha and Sriram, 2015). Nevertheless, these cultural measures could have managed the disease to the maximum extent. The utility of fungicides at optimum concentration with timely application marks the ultimate remedy for controlling *Phytophthora*. The present investigation tests the bio-efficacy of one novel combi-fungicide valifenalate 6 % + mancozeb 60 % WG against leaf blight, stem blight, and fruit rot of capsicum.

The field experiment was conducted during 2020-21 and 2021-2022 in a randomized complete block design with nine treatments replicated thrice using the popular hybrid Green Indra with a spacing of 60 × 45 cm. The details of the treatments and the dosage of the chemicals were followed as per the protocol. The first foliar spray of recommended fungicide was given as per the respective treatments before the disease infection period when conditions were favorable for the disease infection. The observations on disease incidence and severity of *Phytophthora capsici* are to be recorded before application and 10 days after each spray. The disease severity to be recorded on leaves, stem, and disease incidence to be recorded on fruit using the 0 to 5 scale adopted by Inglis *et al*. (1988) given below (Table 1).

To know the crop tolerance/safety, the plants were observed at 1, 3, 5, 7, and 10 days after each application for phytotoxic symptoms like leaf injury, wilting, vein clearing, necrosis, yellowing, stunting, epinasty, and hyponasty. The first picking of matured capsicum fruits was started approximately 50-55 days after transplanting. The capsicum harvested throughout the cropping period was noted, and the plot yield was computed later for hectare.

Table 1. Disease scale followed for rating of disease intensity of *Phytophthora* leaf blight, stem blight and fruit rot in capsicum

Disease Scale	Plant parts affected
0	No disease
1	1-10 per cent area with lesions
2	11-25 per cent area with lesions
3	26-50 per cent area with lesions and limited chlorosis
4	50-75 per cent area with lesions and extensive necrosis
5	>75 per cent area with lesions and extensive necrosis

The data were computed to per cent disease index (PDI) using following formula given by Wheeler (1969):

$$PDI = \frac{\text{Sum of numerical ratings}}{\text{Number of leaves observed}} \times \frac{100}{\text{Maximum disease rating value}}$$

The combi-fungicide molecule at the different concentrations tested against leaf blight, stem blight, and fruit rot disease of capsicum during 2020-21 and 2021-22, and the pooled results revealed that the treatment plots sprayed with three applications of valifenalate 6 % + mancozeb 60 % WG at 3000 g/ha (T5) with 10 days interval has recorded minimum severity of leaf blight (5.50 %), stem blight (2.67 %) and fruit rot (1.84 %) at 10 days after third spray which was followed by valifenalate 6 % + mancozeb 60 % WG at 2500 g/ha (T4) and 2000 g/ha (T3) with 6.50, 3.17 and 2.34 per cent leaf blight, stem blight and fruit rot, respectively and 8.67, 5.00 and 4.17 per cent leaf blight, stem blight and fruit rot disease, respectively which are on par with each other and are significantly superior over remaining treatments including untreated control (39.33 % leaf blight, 21.34 % stem blight and 17.67 % fruit rot) (Table 2).

Among all the tested combinations, the maximum percentage of reduction over untreated control of leaf blight, stem blight, and fruit rot diseases at 10 days after the third spray was recorded with valifenalate 6 % + mancozeb 60 % WG at 3000 g/ha (T5) (86.00 %, 87.56 %, and 89.52 %) which was found comparable with valifenalate 6 % + mancozeb 60 % WG at 2500 g/ha (T4) (83.50 %, 85.16 %, and 86.77 %) and 2000 g/ha (T3) (78.16 %, 76.87 %, and 77.48 %) (Table 2). The results of the experiment revealed that among the implemented treatments, valifenalate 6 % + mancozeb 60 % WG at 3000 g/ha (T5) recorded a maximum fruit yield of 31.20 t/ha, which was followed by valifenalate 6 % + mancozeb 60 % WG at 2500 g/ha (T4) and 2000 g/ha (T3) with 31.03 t/ha and 30.59 t/ha respectively, which are on par with each other and are significantly superior over remaining treatments including the untreated control (T1 -15.99 t/ha) (Table 2).

The cost-benefit analysis of different treatments revealed that the maximum BC ratio was recorded by valifenalate 6 % + mancozeb 60 % WG at 2500 g/ha (T4) with 3.85 followed by valifenalate 6 % + mancozeb 60 % WG at 3000 g/ha (T5) and 2500 g/ha (T3) with 3.84 and 3.79, respectively. However, the minimum BC ratio (1.20) was recorded by valifenalate 10 % WG at 1500 g/ha (T6). The phytotoxicity of combi-fungicide was tested at X (at 2000 and 2500 g/ha) and 2X (at 4000 and 5000 g/ha) doses on capsicum crop, and the observations revealed that there were no visual phytotoxic symptoms such as leaf injury, wilting, vein clearing, necrosis, epinasty, hyponasty, yellowing, and stunting observed during the experimentation period.

The obtained results agree with Matheron and Porchas (2000), who found that among five fungicides tested against the root, crown, and fruit rot of chile pepper, mefenoxam was the most effective compound for inhibiting the lesion development on stem and fruits at 1200 µg/ml. Verma *et al*. (2006) observed that among various fungicides spray applied on the fruit surface of capsicum, ridomil-MZ effectively managed the fruit rot by up to 86 per cent compared with untreated control. Keinath (2007) conducted a study to determine whether the isolates of *P. capsici* in South Carolina were sensitive to mefenoxam. Out of 120 *P. capsici* collected, 60 isolates were susceptible to mefenoxam at 100 mg/l under *in vitro* conditions. Sumbula and Mathew (2015) observed that foliar spray with cymoxanil + mancozeb at 2 g/l has resulted in 23.33 per cent *Phytophthora* leaf fall disease severity in nutmeg. Ghatak *et al*. (2015) found that combining mancozeb with cymoxanil and mancozeb with phenamidone rendered the fruit rot incidence between 8 and 9.33 per cent, respectively. Mohammad and Jose (2018) recorded that the incidence of fruit rot caused by *P. capsici* was 48 per cent in the control plot, whereas 7, 27, and 13 per cent were obtained in the plots sprayed with cyazofamid, dimethomorph, and mandipropamid, respectively. A field experiment was conducted to manage the foliar blight of bell pepper

Table 2. Bioefficacy of new fungicidal molecule against leaf blight, stem blight and fruit rot of capsicum.

Tr. No.	Treatment Details	g. *a.i.*/ ha	Formulated product (ml or g/ha)	Disease intensity at Pre-application (%)			Disease intensity 10 days after second spray (%)			ROC at 10 days after third spray (%)			Yield (t/ha)	Benefit cost ratio
				Leaf blight	Stem blight	Fruit rot	Leaf blight	Stem blight	Fruit rot	Leaf blight	Stem blight	Fruit rot		
T_1	Untreated control	-	-	6.00 (14.96)	2.67 (9.41)	0	39.33 (38.86)	21.34 (27.52)	17.67 (24.87)	-	-	-	15.99	-
T_2	Valifenalate 6% + Mancozeb 60% WG	990	1500	5.34 (13.36)	1.33 (6.63)	0	22.67 (28.45)	13.00 (21.15)	10.67 (19.08)	42.21	38.63	39.07	23.31	1.93
T_3	Valifenalate 6% + Mancozeb 60% WG	1320	2000	4.67 (12.48)	1.33 (6.63)	0	8.67 (17.13)	5.00 (12.93)	4.17 (11.78)	78.16	76.87	77.48	30.59	3.79
T_4	Valifenalate 6% + Mancozeb 60% WG	1650	2500	5.17 (13.14)	2.67 (9.41)	0	6.50 (14.78)	3.17 (10.25)	2.34 (8.79)	83.50	85.16	86.77	31.03	3.85
T_5	Valifenalate 6% + Mancozeb 60% WG	1980	3000	5.17 (13.14)	2.67 (9.41)	0	5.50 (13.57)	2.67 (9.40)	1.84 (7.79)	86.00	87.56	89.52	31.20	3.84
T_6	Valifenalate 10% WG	150	1500	5.50 (13.57)	3.17 (10.25)	0	22.84 (28.56)	13.50 (21.57)	11.67 (19.98)	42.07	36.82	33.88	20.37	1.20
T_7	Mancozeb 75% WP	1500	2000	5.17 (13.14)	1.67 (7.42)	0	20.67 (27.05)	11.84 (20.13)	11.50 (19.83)	47.67	44.56	35.28	24.26	2.25
T_8	Azoxystrobin 11% + Tebuconazole 18.3% w/w SC	192	600	5.00 (12.93)	2.50 (9.10)	0	9.67 (18.12)	10.50 (18.92)	9.33 (17.79)	63.05	51.62	47.70	26.67	2.84
T_9	Carbendazim 12% + Mancozeb 63% WP	563	750	5.17 (13.14)	2.17 (8.48)	0	22.50 (28.33)	12.50 (20.72)	10.50 (18.92)	43.40	41.92	41.08	20.69	1.28
S. Em.				1.42	1.21		2.08	1.73	1.76	-	-	-	0.87	
C. D. at 5%				NS	NS		6.24	5.28	5.26	-	-	-	2.62	

*Figures in the parenthesis are arc sine transformed values; NS- Non significant; ROC-Reduction Over untreated control

(*Phytophthora* spp). Among different fungicides tested, foliar spray of moximate (cymoxanil 8 % + mancozeb 64 %) at 2 g/l scored minimum disease severity (2.67 %) and maximum fruit yield/plant (520.50 g) (Chaudhary *et al*., 2021).

The results of the evaluation of the bio-efficacy of a new advanced fungicidal molecule revealed that among the treatments, valifenalate 6 % + mancozeb 60 % WG at 3000 g/ha (T5) was very effective in reducing leaf blight, stem blight, and fruit rot diseases of capsicum with maximum fruit yield of 31.20 t/ha. However, the maximum BC ratio (3.85) was recorded by valifenalate 6 % + mancozeb 60 % WG at 2500 g/ha (T4). Hence, considering the economic point of view, valifenalate 6 % + mancozeb 60 % WG at 2500 g/ha (3300 g. a.i. /ha) can be recommended for the management of capsicum diseases like leaf blight, stem blight, and fruit rot.

ACKNOWLEDGEMENT

The authors are highly grateful to the Professor and Head, Department of Plant Pathology, College of Agriculture and the Director of Research, University of Agricultural Sciences, Raichur for their technical support and for providing all the facilities required for conducting the field experiment.

REFERENCES

Chadha, K. L. 2003. Capsicum. *Hand Book of Horticulture*. Indian Council of Agricultural Research, New Delhi, **3**: 368-371.

Chaudhary, S., Ghimire, M., Adhikari, N., Sah, A., Yadav, S. K. and Swar, P. 2021. Effect of fungicides on foliar blight of bell pepper (*Capsicum annum* L.) in Morang, Nepal. *International Journal of Agriculture and Environmental Research*, **7**(4): 701-711.

Ghatak, A., Ansar, M., Ghatak, L. V. and Balodi, R. 2015. Elucidation of relationship between *Phytophthora* leaf blight and fruit rot in tomato. *Journal of Postharvest Technology*, **3**(2): 50-57.

Herath, H. M. S. N., Rafil, M. Y., Ismail, S. I., Nakasha, J. J. and Ramlee, S. I. 2020. Improvement of important eoconomic traits in chilli through heterosis breeding: A review. *Journal of Horticultural Sciences and Biotechnology*, **96**(1): 14-23.

Inglis, D. A., Hagedorn, D. J. and Rand, R. E. 1988. Use of dry inoculum to evaluate beans for resistance to anthracnose and angular leaf spot. *Plant Disease*, **72**: 771-774.

Keinath, A. P. 2007. Sensitivity of populations of *Phytophthora capsici* from South Carolina to mefenoxam, dimethomorph, zoxamide and cyamoxanil. *Plant Disease*, **91**: 743-748.

Madhura, S., Chowdappa, P. and Pavani, K.V., 2015. Aggressiveness of Phytophthora boehmeriae and P. capsici isolates from India on hot pepper (*Capsicum annum* L.). *Pest Management in Horticultural Ecosystems*, **21**(2): 203-209.

Matheron, M. E. and Porchas, M. 2000. Camparison of five fungicides on the development of root, crown and fruit rot of chile pepper and recovery of *Phytophthora capsici* from soil. *Plant Disease*, **84**: 1038-1043.

Mc Kinney, H. H. 1923. Influence of soil temperature and moisture on infection of wheat seedlings by *Helminthosporium sativum*. *Journal of Agricultural Research*, **26**: 195-217.

Mohammad, B. and Jose, R. D. S. 2018. Chemical management of *Phytophthora capsici* in pumpkin in Illinois. *Modern Concepts and Developments in Agronomy*, **1**(4): 78-82.

Ristaino, J. B. and Johnston, S. A. 1999. Ecologically based approaches to management of *Phytophthora* blight on bell pepper. *Plant Disease*, **83**(12): 1080-1089.

Savitha, M.J. and Sriram, S., 2015. Morphological and molecular identification of Trichoderma isolates with biocontrol potential against Phytophthora blight in red pepper. *Pest Management in Horticultural Ecosystems*, **21**(2): 194-202.

Sumbula, V. and Mathew, S. K. 2015. Management of *Phytophthora* leaf fall disease of nutmeg (*Myristica fragrans* Houtt). *Journal of Tropical Agriculture*, **53**(2): 180-186.

Verma, A., Shyam, K. R. and Gupta, A. K. 2006. Fungicidal management of *Phytophthora* leaf blight and fruit rot of bell pepper (*Capsicum annuum* L.). *Plant Disease Research*, **21**(2): 128-131.

Weber, G. F. 1932. Blight of peppers in Florida caused by *Phytophthora capsici*. *Phytopathology*, **22**: 775-780.

Wheeler, B. E. J. 1969. An introduction to plant diseases, John Wiley Publications, London, p. 301.

MS Received: 18 October 2022
MS Accepted : 27 November 2022