International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(5): 2493-2495

Received: 16-07-2019
Accepted: 18-08-2019

Suresh D Ekabote
Professor and Head, Department of Horticulture Crop Protection, College of Horticulture, Hiriyur, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Pruthviraj
Senior Research Fellow, Department of Horticulture Crop Protection, College of Horticulture, Hiriyur, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Ravindra H
University Librarian, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Narayanaswamy P
Registrar, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Corresponding Author:
Suresh D Ekabote
Professor and Head, Department of Horticulture Crop Protection, College of Horticulture, Hiriyur, University of Agricultural and Horticultural Sciences, Shivamogga, Karnataka, India

Evaluation of Mandipropamid 23.4% w/w SC (Revus 25 SC) on bitter gourd against downy mildew disease under field condition

Suresh D Ekabote, Pruthviraj, Ravindra H and Narayanaswamy P

Abstract
Momordica charantia is a tropical and subtropical vine of the family Cucurbitaceae, widely grown in Asia, Africa, and the Caribbean for its edible fruit. Its many varieties differ substantially in the shape and bitterness of the fruit. Bitter melon originated from the South Indian state of Kerala and was introduced into China in the 14th century. It is widely used in the cuisines of East Asia, South Asia, and Southeast Asia. Downy mildew caused by *Pseudoperonospora cubensis* (Berk. and Curt.) Rostow has become a serious problem for successful cultivation of bittergourd. Therefore, a field experiment was carried out on the effect of Mandipropamid 23.4% w/w SC (Revus 25 SC) against downy mildew during 2017-18 and 2018-19, at College of Horticulture, Hiriyur. Experimental results revealed that all the treatments significantly reduced the downy mildew disease severity over untreated control. Amongst all the treatments in both season significantly least disease severity of downy mildew (4.88 and 3.90%) was recorded with foliar application of Mandipropamid 23.4% w/w SC (Revus 25 SC) at 1ml/lt with highest yield of 23.16 and 21.32 t/ha respectively followed by Mandipropamid 23.4% w/w SC (Revus 25 SC) at 0.8ml/lt.

Keywords: Bitter gourd, downy mildew and Mandipropamid

Introduction
Bittergourd is one of the most popular vegetable cultivated throughout India and extensively grown in Karnataka. This vegetable is also known as bittermelon in other parts of the world. In India this vegetable is called as "Karela". The fruits are used in a variety of culinary preparations and possess high nutritive and medicinal value. The fruits are rich in vitamin C and contain alkaloids like momordicine, saponine and albuminoides which are medicinally important. The commercial cultivation of bittergourd is very successful because of its high demand and market value. The major constraint faced in the cultivation of bittergourd is the incidence of diseases. Among the various diseases inflicting bittergourd, downy mildew is one of the most serious diseases in the state during the monsoon period leading to heavy economic losses. It is caused by the oomycete *Pseudoperonospora cubensis* (Berk. and Curt.) Rostow. which is one of the most destructive pathogens of all cucurbits that affects the crop both in the field and those grown in passive or traditional greenhouses. It is seen especially damaging in warm, humid climates where the pathogen thrives. The disease affects plants of all ages. Although the disease only infects foliage, a reduction in photosynthetic activity early in plant development results in stunted plants and yield reduction. The disease is characterized by yellow to white patches on the upper surfaces of older leaves. On the underside, these areas are covered with white to greyish, cotton-like fungi. These "downy" masses are most often noticed after rain or heavy dew and disappear soon after sunny weather resumes. As the disease progresses leaves may eventually turn crisp and brown and fall off. The pathogen produces large lemon-shaped sporangia with a conspicuous papilla where the sporangia are borne singly on pointed tips of sporangiophores that branch at acute angles. This disease overwinters on plant debris and in the soil. A reduction of production costs by eliminating these diseases would make bittergourd cultivation more competitive in the market. However, currently the most effective means to control downy mildew is the use of fungicides. These fungicides either inhibit germination, growth or multiplication of the pathogen (Agrios, 1997) [1]. Under the above circumstances, an attempt was made to manage downy mildew disease of bittergourd using fungicide Mandipropamid 23.4% w/w SC (Revus 25 SC) at different concentrations on the other fungicides.

Material and Methods

A field experiment on bio-efficacy of Mandipropamid 23.4% w/w SC (Revus 25 SC) against downy mildew of bittergourd were conducted at College of Horticulture, Hiriyur during 2017-18 and 2018-19. The experiments consisted of seven treatments *viz.*, untreated check, Mandipropamid 23.4% w/w SC (Revus 25 SC) at 0.6, 0.8 and 1ml/lt. Cymoxanil 8% + Mancozeb 64% WP (3 g/lt), Mancozeb 75 WP (4 g/lt) and Thiophanate Methyl 70% WP (2.86 g/lt) and was laid-out in Randomized Block Design with three replication. A susceptible variety was used for the present investigations. The variety was grown as per packages of practices for higher yields. Treatments were imposed at the beginning of the disease appearance. Spray schedule was repeated at ten days intervals. The observation of downy mildew was recorded using a 0-5 scale. The Per cent disease index (PDI) was computed by selecting five plants at random and recording severity as per 0–5 scale (Verma and Saharan, 1994) where 0- no disease; 1, 1–10%; 2, 11–25%; 3, 26– 50%; 4, 51–75%; 5, 76–100% at before and after each spray. Average of all spray has been given in this and the data was statistically analyzed after suitable transformations. The recorded grade values were converted into Percent Disease Index (PDI) by using following formula proposed by Wheeler (1969) [7].

The per cent disease severity was calculated by the formula:

$$\text{Percent disease severity} = \frac{\text{Number of leaves infected}}{\text{Total number of leaves observed}} \times 100$$

The observation on fruit yield expressed in terms of t/ha was also recorded.

For Phytotoxicity studies

Sl. No	Treatment	g. a.i/ lit of water	Formulation (g or ml/lit of water)
1	Untreated check	--	---
2	Mandipropamid 23.4% w/w SC	0.25	0.5
3	Mandipropamid 23.4% w/w SC	0.5	1.0

Results and Discussion

A field experiment was conducted at College of Horticulture, Hiriyur as explained in 'material methods' to find out the effect of chemical for management of downy mildew of bitter gourd during the *kharif* 2017-18 and 2018-19. Totally three sprays were given at fifteen days intervals starting from initiation of disease. The Observations were recorded at fifteen days after spray (DAS) by using a 0-5 scale and converted into per cent disease index (PDI) using the formula given by Wheeler (1969) [7], and calculated yield was statistically analyzed, data were presented in Table 1 and 2.

Per cent disease index

Downy mildew during first year experiments (2017-18) the effect of test fungicides Mandipropamid 23.4% w/w SC (Revus 25 SC) comparing with other fungicides on downy mildew of bitter gourd revealed that the disease severity before the treatment imposition was non-significant, and all the treatments remained on par or almost uniform with each other. The first season experiment on effect of test fungicide Mandipropamid 23.4% w/w SC (Revus 25 SC) and other comparing fungicide on downy mildew of bitter gourd revealed that the treatments differed significantly over the study period (Table 1). Downy mildew severity was significantly low in Mandipropamid 23.4% w/w SC treated plots. At the terminal stage of disease record 4.96 and 4.88 disease severity was measured when treated with Mandipropamid 23.4% w/w SC at the rate of 0.8 ml/lt and 1 ml/lt respectively, which indicated 84.61 and 84.86 reduction in downy mildew, respectively compared to control (32.24% disease severity) and significantly superior over other fungicides tried. The downy mildew severity in Cymoxanil 8% + Mancozeb 64% WP and Thiophanate Methyl 70% WP were 8.12 and 10.60 and these treatments were found inferior to the various doses of Mandipropamid 23.4% w/w SC.

The 2nd season experiment exhibited that at terminal stage of disease record downy mildew severity were 4.12 and 3.90 in Mandipropamid 23.4% w/w SC (Revus 25 SC) treated plots applied through foliar application @ 0.8 ml/lt and 1 ml/lt, respectively and these treatments were significantly comparable with the other treatments (Table 1). The per cent disease reduction by these treatments compared to untreated check were 85.64% and 86.41% respectively. The next best treatment was Mandipropamid 23.4% w/w SC (Revus 25 SC) applied @ 0.6 ml/lt. Cymoxanil 8% + Mancozeb 64% WP @ 3 gm/lt and Thiophanate Methyl 70% WP @ 2.86 g/lt were inferior to the various doses of Mandipropamid 23.4% w/w SC (Revus 25 SC).

Yield

The treatments, Mandipropamid 23.4% w/w SC (Revus 25 SC) @ 0.8 ml/lt and 1 ml/lt gave fruit yield *i.e.*, 22.62 and 23.16 respectively which were significantly higher than the other molecules tested in the year 2017-18. The untreated check resulted in 11.36 ton per hectare. Cymoxanil 8% + Mancozeb 64% WP exhibited fruit yield of 17.82 t/ha and Thiophanate Methyl 70% WP gave the fruit yield of 16.18 t/ha which were significantly inferior to all the doses of Mandipropamid 23.4% w/w SC (Revus 25 SC) (Table 2). In the year 2018-19 the treatments, Mandipropamid 23.4% w/w SC (Revus 25 SC) @ 0.8ml/lt and 1 ml/lt gave fruit yield *i.e.*, 20.18 t/ha and 21.32 t/ha respectively which were significantly higher than the other molecules tested. The untreated check resulted in10.56 t/ha. Cymoxanil 8% + Mancozeb 64% WP exhibited fruit yield of 16.72 t/ha and Thiophanate Methyl 70% WP gave the fruit yield of 15.25 t/ha which were significantly inferior to all the doses of Mandipropamid 23.4% w/w SC (Revus 25 SC) in both the seasons. Results of the present study showed that all fungicide treatments significantly controlled downy mildew infection on cucmber as compared to untreated control. Among the different fungicides Mandipropamid 23.4% w/w SC (Revus 25 SC) at all concentration recorded least disease severity. The results obtained concur with the results obtained by many workers Cohen *et al*. (2007) [4] and Lal *et al*. (2018) [5] found that carboxylic acid amide (CAA) fungicide mandipropamid was effective in managing late blight of with no phytotoxic effect on the crop even on increasing the recommended dose. Bhat *et al*. (2018) [3] who found that Mandipropamid was found effective in managing downy mildew of cucumber. According to Raziq (2008) [6] and Beckerman (2009) [2], prophylactic spraying of fungicides like azoxystrobin, pyraclostrobin, kresoxim methyl, Trifloxystrobin and Thiophanate Methyl at seven to ten days interval is found to be effective in reducing the disease incidence. These fungicides are known to stimulate defense reactions and the synthesis of phytoalexin which, in turn, suppressed the

activities of the pathogen, and thereby reduced disease severity.

Phytotoxicity

There were no phytotoxicity symptoms like epinasty, hyponasty, vein clearing, yellowing, necrosis, leaf margin burning, rossetting and wilting were observed in the treatments of Mandipropamid 23.4% w/w SC (Revus 25 SC) @ 1 ml/lt and 2 ml/lt (Table 3).

Conclusion

Based on the two-year experimentation it has been found that, Mandipropamid 23.4% w/w SC (Revus 25 SC) at 1ml/lit is most effective in management of downy mildew of bittergourd, which was on par with the same fungicides at 0.8 ml/lit.

Acknowledgement

The senior author is grateful to M/s Syngenta, India Ltd, Pune for providing financial assistance to conduct the study.

Table 1: Bio efficacy of Mandipropamid 23.4% w/w SC against downy mildew of Bitter gourd during 2017-18 and 2018-19

Sl. No	Treatments	Dosage g or ml/lt	Disease severity of days after spray (DAS)						Percent disease reduction	
			1 DBA		15 days 1st spray		15 days 2nd spray		2017-18	2018-19
			2017-18	2018-19	2017-18	2018-19	2017-18	2018-19		
1	Untreated check	-	2.68	1.46	9.48	11.54	32.24	28.70	-	-
2	Mandipropamid 23.4% w/w SC	0.6	1.96	1.24	3.24	4.88	7.88	6.36	75.55	77.83
3	Mandipropamid 23.4% w/w SC	0.8	2.24	1.12	2.68	3.20	4.96	4.12	84.61	85.64
4	Mandipropamid 23.4% w/w SC	1	2.72	1.10	2.44	3.00	4.88	3.90	84.86	86.41
5	Cymoxanil 8% + Mancozeb 64% WP	3	1.12	1.56	3.36	4.12	8.12	8.16	74.81	71.56
6	Thiophanate Methyl 70% WP	2.86	1.60	1.36	5.12	5.80	10.60	9.90	67.12	65.50
7	Mancozeb 75 WP	4	1.48	1.48	6.80	6.36	12.72	11.88	60.54	58.60
	SEm±		NS	NS	0.61	0.17	0.72	0.42		
	CD (0.05%)		NS	NS	1.90	1.18	1.18	1.28		
	CV		NS	NS	22.59	9.24	9.19	10.15		

* DBA- day before application

Table 2: Effect of Mandipropamid 23.4% w/w SC on yield of Bitter gourd during 2017-18 and 2018-19

Sl. No	Treatments	Dosage g or ml/lt	Yield (t/ha)	
			2017-18	2018-19
1	Untreated check	-	11.36	10.56
2	Mandipropamid 23.4% w/w SC	0.6	18.24	17.46
3	Mandipropamid 23.4% w/w SC	0.8	22.62	20.18
4	Mandipropamid 23.4% w/w SC	1	23.16	21.32
5	Cymoxanil 8% + Mancozeb 64% WP	3	17.82	16.72
6	Thiophanate Methyl 70% WP	2.86	16.18	15.25
7	Mancozeb 75 WP	4	15.86	14.71
	SEm±		0.87	0.62
	CD (0.05%)		2.70	1.83
	CV		10.25	10.50

Table 3: Impact of Mandipropamid 23.4% w/w SC on Bitter gourd during 2017-18 and 2018-19

Treatments	Dose (ml/lt)	Score values on																												
		1 DAA						3 DAA						5 DAA						7 DAA						10 DAA				
		A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F	A	B	C	D	E	F
Mandipropamid 23.4% w/w SC	1	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Mandipropamid 23.4% w/w SC	2	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Untreated check	--	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

A: Leaf injury on tips and leaf surface; B: Wilting; C: Leaf vein clearing; D: Necrosis; E: Epinasty; F: Hyponasty; DAA: Days after Application.

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