International Journal of Chemical Studies

P-ISSN: 2349–8528
E-ISSN: 2321–4902
IJCS 2019; 7(4): 2444-2446

Received: 19-05-2019
Accepted: 21-06-2019

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Studies on bio-efficacy and phytotoxicity of mandipropamid 23.4% w/w SC (Revus 25 SC) on watermelon against downy mildew disease

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Abstract
Watermelon (*Citrullus lanatus*) belonging to the family Cucurbitaceae is one of the most widely cultivated crops in the world. Foliar diseases of watermelon have become a major constraint in watermelon growing areas causing qualitative as well as quantitative losses. Therefore, a field experiment was carried out on the effect of Mandipropamid 23.4% w/w SC (Revus 25 SC) against downy mildew of watermelon 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 seasons significantly least disease severity of downy mildew (4.66 and 8.66 %, respectively) was recorded with foliar sprays of Mandipropamid 23.4% w/w SC (Revus 25 SC) at 1 ml/lit and highest yield of 24.62 and 18.36 t/ha, respectively followed by Mandipropamid 23.4% w/w SC (Revus 25 SC) at 0.8 ml/lit.

Keywords: Water melon, downy mildew and mandipropamid

Introduction
Watermelon (*Citrullus lanatus*) belonging to the family Cucurbitaceae is one of the most widely cultivated crops in the world. According to (Anon, 2016) [2]. statistics, the world's largest producers of watermelon are China, Iran, Turkey, Brazil, and the United States, respectively. In India area under watermelon was 91.00 thousand ha with the production of 2182.00 thousand tonnes in the year 2016-17. (Anon., 2017) [1]. The global consumption of the crop is greater than that of any other cucurbit. Watermelon is also known as tarbuj, tarmuj, kalingad and kalindi in different parts of India. Though it is grown in the garden land, it is a major river-bed crop of Maharashtra, Uttar Pradesh, Rajasthan, Gujrat and Andhra Pradesh, Punjab, Haryana, Karnataka, Assam, West Bengal, Orissa, Himachal Pradesh, Tamil Nadu are major watermelon growing states. The watermelon fruit has a 78 per cent edible portion. The edible portion in watermelon fruits contains moisture (95.8 per cent), protein (0.2 per cent), minerals (0.3 per cent), carbohydrates (3.3 per cent) and energy (16 k. cal). It also contains 11 mg. of calcium, 0.02 mg. of thiamine, 0.04 mg. of riboflavin and 1 mg. of ascorbic acid per 100 grams of edible portion (Gopalan *et al*., 1984) [5]. It is also an excellent source of vitamins. Watermelon is rich in antioxidants like lycopene which reduce the risk of diseases like asthma, atherosclerosis, diabetes, colon cancer and arthritis. It is highly nutritious and thirst-quenching and also contains vitamins C and A in the form of diseases-fighting beta-carotene. It is affected by several biotic and abiotic stresses, among the biotic factor's fungal diseases like leaf spot and downy mildew are most destructive in nature. Leaf spot caused by *Cercospora* sp. produces a dark brown center and a yellow halo. Infected leaves are first observed at the crown of the plant. When the disease is severe, foliage loss will restrict fruit development and result in sunburn of fruit. Downy mildew (*Pseudopernospora cubensis)* the causes, irregular yellowish to brown spots, often vague in outline, appear on upper leaf surface near the crown. Brown spots later become more distinct on both sides of the leaves. The disease appears annually during the cropping seasons (from December to April) in different parts of India and causes enormous loss to grower's up to 14 to 76 per cent. Therefore, keeping in view of economic losses caused by diseases, the present study was aimed at bottleneck for the management of downy mildew diseases.

Material and methods

A field experiment on bio-efficacy of Mandipropamid 23.4 % w/w SC (Revus 25 SC) against downy mildew of watermelon were conducted at College of Horticulture, Hiriyur during 2017-18 and 2018-19. The experiments consisted of eight treatments *viz.*, untreated check, Mandipropamid 23.4 % w/w SC (Revus 25 SC) at 0.6, 0.8 and 1ml/lt. Chlorothalonil 75 WP (Kavach 75 WP) (1 g/lt), Cymoxanil 8% + Mancozeb 64% WP (3 g/lt) and Mancozeb 75% WP (4 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 were 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).

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/ lt of water	Formulation (g or ml/lt of water)
1	Untreated check	--	---
4	Mandipropamid 23.4% w/w SC	0.25	1
5	Mandipropamid 23.4% w/w SC	0.5	2

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 watermelon 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), 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) other comparing fungicides on downy mildew of watermelon 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 watermelon 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 5.33 and 4.66 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 83.06 and 85.19 reduction in downy mildew, respectively compared to control (31.48 % disease severity) and significantly superior over other molecules. The downy mildew severity in Cymoxanil 8% + Mancozeb 64% WP and Chlorothalonil 75 WP were 10.33 and12.52 and 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 9.76 and 8.66 in Mandipropamid 23.4 % w/w 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. The per cent disease reduction by those treatments compared to untreated check were 79.80 % and 82.08 % respectively. The next best treatment was Mandipropamid 23.4 % w/w SC @ 0.6 ml/lt, Cymoxanil 8% + Mancozeb 64% WP @ 3 g/lt, Chlorothalonil 75% WP@ 2 g/lt but it was inferior over the Mandipropamid 23.4% w/w SC @ 0.8 and 1 ml/lt of water. (Table. 1)

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.,* 23.73 and 24.62 t/ ha respectively which were significantly higher than the other molecules tested. The untreated check recorded yield of 16.17 t/ha. Cymoxanil 8% + Mancozeb 64% WP exhibited fruit yield of 20.46 t/ha and Chlorothalonil 75 WP gave the fruit yield of 19.51 t/ha (Table 2). Which were significantly inferior to Mandipropamid 23.4% w/w SC (Revus 25 SC) at the rate 0.8 ml/lt and 1 ml/lt during 2017-18. The treatments, Mandipropamid 23.4% w/w SC (Revus 25 SC) @ 0.8 ml/lt and 1 ml/lt gave fruit yield *i.e.,* 17.90 and 18.36 t/ha respectively which were significantly higher than the other molecules tested during the year 2018-19. The untreated check resulted in 12.32 t/ha. Cymoxanil 8% + Mancozeb 64% WP exhibited fruit yield of 14.84 t/ha and Chlorothalonil 75 WP gave the fruit yield of 13.95 t/ha. Which were significantly inferior to Mandipropamid 23.4% w/w SC (Revus 25 SC) at the rate 400 ml/ha and 500 ml/ha in both the season. The results obtained concur with the results obtained by many workers Cohen *et al*. (2007) [4]. and Lal *et al*. (2018) [6]. 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.

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 of water (Table 3).

Table 1: Bio efficacy of Mandipropamid 23.4% w/w SC against downy mildew of Watermelon 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	-	0.48	0.48	15.66	20.66	31.48	48.33	-	-
2	Mandipropamid 23.4% w/w SC	0.6	0.52	0.36	4.66	8.33	8.40	15.66	73.31	67.59
3	Mandipropamid 23.4% w/w SC	0.8	0.28	0.40	1.88	5.66	5.33	9.76	83.06	79.80
4	Mandipropamid 23.4% w/w SC	1	0.24	0.52	1.33	4.33	4.66	8.66	85.19	82.80
5	Chlorothalonil 75 WP (Kavach 75 WP)	1	0.32	0.36	5.92	8.33	12.52	18.33	60.22	62.07
6	Cymoxanil 8% + Mancozeb 64% WP	3	0.60	0.88	5.33	7.33	10.33	16.82	67.18	65.19
7	Mancozeb 75% WP	4	0.44	0.60	8.24	12.66	18.33	23.50	41.77	51.75
	SEm+		NS	NS	0.61	0.61	0.62	0.51		
	CD (0.05%)		NS	NS	1.90	1.90	1.91	1.61		
	CV		NS	NS	17.39	11.11	8.21	5.30		

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

Sl. No	Treatments	Dosage g or ml/lt	Yield (t/ha)	
			2017-18	2018-19
1	Untreated check	-	16.17	12.32
2	Mandipropamid 23.4% w/w SC	0.6	21.24	16.04
3	Mandipropamid 23.4% w/w SC	0.8	23.73	17.90
4	Mandipropamid 23.4% w/w SC	1	24.62	18.36
5	Chlorothalonil 75 WP (Kavach 75 WP)	1	19.51	13.95
6	Cymoxanil 8% + Mancozeb 64% WP	3	20.46	14.84
7	Mancozeb 75% WP	4	18.16	13.12
	SEm+		0.60	0.59
	CD (0.05%)		1.87	1.82
	CV		5.14	6.77

Table 3: Impact of Mandipropamid 23.4% w/w SC on Watermelon 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	500	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	1000	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.

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 cucumber, 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

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