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Bio-efficacy and dose standardization of Proclaim Fit 45 WG against *Meridarchis scyroides* in ber and toxicity to natural enemies

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Abstract

We evaluated the bio-efficacy and dose standardization of Proclaim Fit 45 WG against *Meridarchis scyroides* Meyrick in ber, *Ziziphus mauritiana* under field conditions. The treatment Emamectin benzoate 5% + Lufenuron 40% WG @ 31.5g and Emamectin benzoate 5% + Lufenuron 40% WG @ 27g a.i. ha⁻¹ proved most effective in term of per cent reduction of fruit infestation with 82.86 and 86.62 % reduction in fruit infestation with higher yield during 2017-18 and 2018-19, respectively. The treatment chlorpyrifos 20% EC @ 600g a.i. ha⁻¹ found to be a least effective by giving 63.95 and 68.40 % reduction in fruit infestation during the 2017-18 and 2018-19, respectively. All the three doses of Emamectin benzoate 5% + Lufenuron 40% WG and other treatments found to be safe to the natural enemies viz., spider and coccinellids.

Keywords: Emamectin benzoate 5%, Lufenuron 40% WG, *Meridarchis scyroides*, *Ziziphus mauritiana*.

Introduction

The ber (*Ziziphus mauritiana* Lamark) also called as desert apple, jujube, Chinese apple, Ber (Hindi), Indian plum and Permseret (Anguilla) is a tropical fruit tree species, belonging to the family Rhamnaceae [1, 2, 3]. In India, it is popular fruit crop for arid and semi-arid region of India and most of the cultivated areas are confined to Rajasthan, Haryana, Punjab, Gujarat, Maharashtra and Uttar Pradesh. The crop is gaining popularity among the growers because it thrives well under adverse climatic condition and gives good returns. The fruits are quite nutritious contain higher quality of vitamin "C", second only to aonla and guava and much higher than citrus and apple [4]. The crop is grown in 50 thousand ha area with 633 thousand tons production. Balikai [1] reported a total of 22 insect and non-insect species in Karnataka. Likewise, Kavitha and Savithri [5] documented about 23 insect species on ber from Andhra Pradesh. The fruit borer, *Meridarchis scyroides* (Lepidoptera: Carposinidae) is a serious pest in Southern and western India [6, 7]. The borer causes up to 70% yield loss under severe infestation [8]. The moths lay eggs on fruits at pea stage and upon hatching the newly emerged caterpillars bore into fruits and feed on the pulp near seed and accumulate fecal. The first and second instar larvae feeds on the fruit superficially but third to fifth instar larvae feeds internally and damages the pulp around the seed. At initial stages of fruit development, the full grown larvae found to feed on soft immature seed. The occurrence of fruit borer found to be positively correlated with the temperature and negatively correlated with the relative humidity and wind speed [9]. The infestation starts during month of November and the peak incidence occurs during end of December [10, 11]. Dimethoate (30 EC) was found most effective followed by imidacloprid (17.8 SL), thiamethoxam (25 WG) and monocrotophos (36 EC), however, they were at par with each other [12]. The present investigation was undertaken to evaluate the bio-efficacy and dose standardization of Proclaim Fit 45 WG against *Meridarchis scyroides* Meyrick and natural enemies in ber, *Ziziphus mauritiana* under field conditions.

Materials and methods

The field experiments were conducted to study the evaluate the bio-efficacy of Emamectin benzoate 5% + Lufenuron 40% WG at three doses viz., 22.5g a.i. ha⁻¹, 27g a.i. ha⁻¹ and 31.5g a.i. ha⁻¹ along with emamectin 5% W.G. @ 4g a.i. ha⁻¹, Lufenuron 5.4 % EC @30 a.i. ha⁻¹, Chlorpyrifos 20% EC @ 600g a.i. ha⁻¹ and Pyriproxyfen 5%+Fenpropathrin 15% EC @ 150g (37.5+112.5g) a.i. ha⁻¹ with four replications at Instructional and Research Farm, College of

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Horticulture, Mandasaur, RVSKVV, Gwalior (M.P.) during 2017-18 and 2018-19. The first spray was given at the peanut stage of the fruit and the second spray was given at 10 days after the first spray. The observations on fruit damage were recorded on per plant basis at the time of 10 days after each spray by counting the total number of healthy and infested fruits. From this, per cent fruit infested was calculated and the percentages were further transformed to arcsine values. Similarly, fruit yield harvested from each treated plant (kg/plant) was recorded separately. The values were then transformed to square root transformation for number and arcsine values for per cent damage. The data were subjected to statistical analysis using square root transformed values and arc sin transformed values in Randomized block design.

Results

The different dose and insecticides were taken for bio-efficacy against *M. scyrodus* and significant differences were found in percentage fruit infestation at experimental farm of College of Horticulture, Mandasaur, RVSKVV, Gwalior (M.P.) during 2017-18 and 2018-19. The mean data recorded at 10 days after first and second spray (Table 1) showed that Emamectin benzoate 5% + Lufenuron 40% WG @ 31.5g a.i. ha⁻¹ was found to be the best and most effective treatment with a 83.80 % and 87.49 reduction in fruit infestation during 2017-18 and 2018-19, respectively, but it was at par with Emamectin benzoate 5% + Lufenuron 40% WG @ 27g a.i. ha⁻¹ having 82.86 and 86.62 % reduction in fruit infestation during 2017-18 and 2018-19, respectively over control. It was followed by the treatment Emamectin benzoate 5% + Lufenuron 40% WG @ 22.5g a.i. ha⁻¹ also gave 73.46 and 76.60 % reduction in fruit infestation and was at par with Emamectin benzoate 5% WG @ 4g a.i. ha⁻¹ during 2017-18 and 2018-19, respectively. The treatment chlorpyrifos 20% EC @ 600g a.i. ha⁻¹ found to be a least effective by giving 63.95 and 68.40 % reduction in fruit infestation during the 2017-18 and 2018-19, respectively. Singh *et al.* [13] reported that the Malathion 0.05 percent resulted in the lowest percentage of fruit infestation at 15 days after the 1st, 2nd and 3rd sprayings 9.30%, 7.30% and 4.60%, respectively. At fruit harvest, the similar trend was also found in treatment Emamectin benzoate 5% + Lufenuron 40% WG @ 31.5g a.i. ha⁻¹ with 80.73 % and 83.52 % reduction in fruit infestation (Table 2) during 2017-18 and 2018-19 it was at par with

Emamectin benzoate 5% + Lufenuron 40% WG @ 27g a.i./ha by giving 80.32 and 82.96 % reduction in fruit infestation during 2017-18 and 2018-19, respectively. Whereas, lowest per cent reduction 72.29 and 72.23 of fruit damage was recorded at harvest in treatment lufenuron 5.4% EC @ 30g a.i. ha⁻¹ during 2017-18 and 2018-19, respectively. The treatments with Emamectin benzoate 5% + Lufenuron 40% WG @ 31.5g a.i. ha⁻¹ was found significantly superior by recording fruit yield 53.87 and 55.89 kg plant⁻¹, which was at par with Emamectin benzoate 5% + Lufenuron 40% WG @ 27g a.i. ha⁻¹ by recording fruit yield 51.84 and 53.82 kg plant⁻¹ during 2017-18 and 2018-19, respectively. This was followed by the treatment with Emamectin 5% WG @ 4g a.i. ha⁻¹ by recording 42.44 and 44.53 kg fruits plant⁻¹ during 2017-18 and 2018-19, respectively. While, the lowest yield was recorded in treatment 39.72 and 41.65 kg fruits plant⁻¹ during both consecutive years (Table 2). The similar result was also reported that Lufenuron 5 EC @ 25 g ai/ha and 30 g ai/ha resulted in higher yields by effectively checking the damage due to thrips and pod borer in chillies [14]. While Patra *et al.* [15] reported that the Emamectin benzoate @ 15 g a.i. ha⁻¹ gave highest okra fruit yield was of 97.25 q/ha which was on a par with spinosad @ 50 g a.i. ha⁻¹ was of 96.1 q/ha. The effect of all the treatments on natural enemies was studied and presented in table 3. The table reveals that the highest population of spider was found in plot of untreated check as well as Emamectin benzoate 5% + Lufenuron 40% WG (Proclaim Fit 45 WG) @ 22.5g a.i. ha⁻¹ i.e. 2.36 and 2.29 during 2017-18 and 2018-19, respectively at 10 days after spray. While, the population of coccinellids was recorded highest in the treatment Emamectin benzoate 5% + Lufenuron 40% WG (Proclaim Fit 45 WG) @ 22.5g a.i. ha⁻¹ i.e. 2.52 and 2.65 during 2017-18 and 2018-19, respectively at 10 days after spray. The lowest population of spider was recorded in treatment of pyriproxyfen 5%+Fenpropathrin 15% EC @ 150g a.i. ha⁻¹ was of 2.05 and 1.97 for 2017-18 and 2018-19, respectively and coccinellids (2.24 and 2.71) for 2017-18 and 2018-19, respectively in the treatment chlorpyrifos 20% EC @ 600g a.i. ha⁻¹. However, there were no significant differences all among treatments during both the study years. The similar results were also reported by Muthukumar *et al.* [16] that the Spinosad, Biolep, emamectin benzoate and neem oil proved safer to natural enemies in the cauliflower ecosystem.

Table 1: Effect of different insecticides on per cent fruit damage in ber before and after spray during 2017-18 and 2018-19

S. No.	Treatments	Dosage g a.i./ha	Dose g or ml/ha	Pre count		Per cent fruit damage over untreated check							
						10 days after first application		10 days after second application		Mean of two applications/ spray		% reduction of fruit over mean	
				2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19
1.	Untreated control	--	--	2.42* (8.95)	1.12 (6.07)	19.89 (26.49)	23.01 (28.66)	50.99 (45.57)	53.50 (47.01)	35.44 (36.54)	38.26 (38.21)	--	--
2.	Emamectin benzoate 5% + Lufenuron 40% WG	22.5 (2.5+20)	50	2.76 (9.56)	1.46 (6.94)	5.55 (13.63)	5.17 (13.14)	13.26 (21.35)	12.73 (20.90)	9.41 (17.86)	8.95 (17.41)	73.46	76.60
3.	Emamectin benzoate 5%+ Lufenuron 40% WG	27 (3+24)	60	2.76 (9.56)	1.46 (6.94)	3.89 (11.38)	2.91 (9.82)	8.26 (16.70)	7.33 (15.71)	6.08 (14.27)	5.12 (13.08)	82.86	86.62
4.	Emamectin benzoate 5%+ Lufenuron 40% WG	31.5 (3.5+28)	70	2.09 (8.31)	0.79 (5.10)	3.55 (10.86)	2.57 (9.23)	7.93 (16.36)	7.00 (15.34)	5.74 (13.86)	4.79 (12.64)	83.80	87.49
5.	Emamectin 5% WG	4	80	3.09 (10.12)	1.79 (7.69)	6.22 (14.44)	5.34 (13.36)	12.99 (21.13)	12.50 (20.70)	9.61 (18.05)	8.92 (17.38)	72.90	76.68
6.	Lufenuron 5.4 % EC	30	600	2.09 (8.31)	0.79 (5.10)	6.55 (14.83)	5.67 (13.78)	13.99 (21.96)	13.50 (21.56)	10.27 (18.69)	9.59 (18.03)	71.02	74.94
7.	Chlorpyrifos 20% EC	600	3000	2.42 (8.95)	1.12 (6.07)	7.89 (16.31)	7.01 (15.35)	17.66 (24.85)	17.17 (24.48)	12.78 (20.94)	12.09 (20.35)	63.95	68.40
8.	Pyriproxyfen 5% + Fenpropathrin 15% EC	37.5 + 112.5	750	2.42 (8.95)	1.12 (6.07)	6.22 (14.44)	5.34 (13.36)	13.09 (21.21)	12.50 (20.70)	9.66 (18.10)	8.92 (17.38)	72.76	76.68
	SEm ±	--	--	NS	--	0.48	0.45	1.13	1.04	0.66	0.51	--	--
	CD at (0.05)	--	--	--	--	1.47	1.39	3.46	3.18	2.03	1.56	--	--

*Mean of three replications. Figures in parenthesis are retransformed value of Arc sin transformed values.

Table 2: Effect of different insecticides on per cent fruit damage at harvesting time and yield of ber

S. No.	Treatments	Dosage g a.i./ha	Dose : Product g or ml/ha	Per cent fruit damage over control				Yield (kg/plant)	
				At harvest		% control		2017-18	2018-19
				2017-18	2018-19	2017-18	2018-19		
1.	Untreated control	--	--	58.93* (50.14)	59.39 (50.41)	--	--	27.23 (31.45)	30.56 (33.56)
2.	Emamectin benzoate 5% +Lufenuron 40% WG	22.5 (2.5+20)	50	15.60 (23.26)	15.72 (23.36)	73.53	73.53	44.23 (41.69)	47.56 (43.60)
3.	Emamectin benzoate 5% +Lufenuron 40% WG	27 (3+24)	60	11.60 (19.91)	10.12 (18.55)	80.32	82.96	61.83 (51.84)	65.16 (53.82)
4.	Emamectin benzoate 5% +Lufenuron 40% WG	31.5 (3.5+28)	70	11.37 (19.71)	9.79 (18.23)	80.71	83.52	65.23 (53.87)	68.56 (55.89)
5.	Emamectin 5% WG	4	80	15.33 (23.05)	15.49 (23.18)	73.99	73.92	45.53 (42.44)	48.86 (44.35)
6.	Lufenuron 5.4 % EC	30	600	16.33 (23.83)	16.49 (23.96)	72.29	72.23	43.53 (41.28)	46.86 (43.20)
7.	Chlorpyrifos 20% EC	600	3000	20.00 (26.57)	20.16 (26.68)	66.06	66.05	40.83 (39.72)	44.16 (41.65)
8.	Pyriproxyfen 5% + Fenprothrin 15% EC	37.5 + 112.5	750	15.43 (23.13)	15.49 (23.18)	73.82	73.92	44.83 (42.03)	48.16 (43.95)
	SEm±	--	--	0.93	1.28	--	--	1.72	1.66
	CD at (0.05)	--	--	2.84	3.92	--	--	5.25	5.08

*Mean of three replications. Figures in parenthesis are retransformed value of Arc sin transformed values.

Table 3: Effect of different insecticides on survival of natural enemies in ber during 2017-18 and 2018-19

S. No.	Treatments	Dosage g a.i./ha	Dose g or ml/ha	Average survival of natural enemies per plant							
				Spiders				Coccinellids			
				Before spray		10 DAA		Before spray		10 DAA	
2017-18	2018-19	2017-18	2018-19	2017-18	2018-19	2017-18	2018-19				
1.	Untreated control	--	--	2.08* (1.44)	1.85 (1.36)	5.57 (2.36)	5.24 (2.29)	1.96 (1.40)	1.99 (1.41)	6.35 (2.52)	7.00 (2.65)
2.	Emamectin benzoate 5% + Lufenuron 40% WG	22.5 (2.5+20)	50	1.95 (1.40)	1.72 (1.31)	5.56 (2.36)	5.23 (2.29)	1.94 (1.39)	1.99 (1.41)	5.35 (2.31)	7.00 (2.65)
3.	Emamectin benzoate 5% +Lufenuron 40% WG	27 (3+24)	60	2.08 (1.44)	1.85 (1.36)	5.22 (2.28)	4.89 (2.21)	1.60 (1.26)	1.65 (1.28)	6.02 (2.45)	6.66 (2.58)
4.	Emamectin benzoate 5% +Lufenuron 40% WG	31.5 (3.5+28)	70	1.84 (1.36)	1.61 (1.27)	4.89 (2.21)	4.56 (2.14)	2.10 (1.45)	2.15 (1.47)	6.02 (2.45)	6.67 (2.58)
5.	Emamectin 5% WG	4	80	1.83 (1.35)	1.60 (1.26)	4.90 (2.21)	4.57 (2.14)	2.04 (1.43)	2.19 (1.48)	5.35 (2.31)	8.00 (2.83)
6.	Lufenuron 5.4 % EC	30	600	2.08 (1.44)	1.85 (1.36)	4.56 (2.14)	4.23 (2.06)	1.60 (1.26)	1.65 (1.28)	5.02 (2.24)	6.66 (2.58)
7.	Chlorpyrifos 20% EC	600	3000	1.91 (1.38)	1.68 (1.30)	4.58 (2.14)	4.25 (2.06)	2.27 (1.51)	2.32 (1.52)	5.02 (2.24)	7.33 (2.71)
8.	Pyriproxyfen 5% + Fenprothrin 15% EC	37.5 + 112.5	750	1.84 (1.36)	1.61 (1.27)	4.22 (2.05)	3.89 (1.97)	1.60 (1.26)	1.65 (1.28)	5.68 (2.38)	6.66 (2.58)
	SEm±	--	--	0.03	0.04	0.06	0.05	0.04	0.04	0.07	0.06
	CD at (0.05)	--	--	NS	NS	NS	NS	NS	NS	NS	NS

*Mean of three replications. Figures in parenthesis are retransformed values of square root transformed values

Conclusion

It may conclude that treatment Emamectin benzoate 5% + Lufenuron 40% WG @ 31.5g and Emamectin benzoate 5% + Lufenuron 40% WG @ 27g a.i. ha⁻¹ proved most effective in term of per cent reduction of fruit infestation with 82.86 and 86.62 % reduction in fruit infestation with higher yield during 2017-18 and 2018-19, respectively. The treatment chlorpyrifos 20% EC @ 600g a.i. ha⁻¹ found to be a least effective by giving 63.95 and 68.40 % reduction in fruit infestation during the 2017-18 and 2018-19, respectively. Further, all the three doses of Emamectin benzoate 5% + Lufenuron 40% WG and other treatments found to be safe to the natural enemies viz., spider and coccinellids.

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