

Emamectin benzoate 1.9 EC: A safer insecticide to spider predators in okra ecosystem

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Abstract: Biosafety of insecticide, emamectin benzoate 1.9 EC against spider predator in okra in vilacherri, Madurai of Tamil Nadu during 2015 and 2016. The new formulation of Emamectin benzoate 1.9 EC at different doses (5.00, 6.75, 8.50 and 11.00 g.ai ha⁻¹) against the standard check, Pyridalyl 10 EC (50 g a. i. ha⁻¹) and Lamda cyhalothrin 5 CS (15 g a.i. ha⁻¹) for their safety to spider predators in okra eco-system were studied. The spider population were recorded prior to spraying and at 3, 7, 10 and 14 days of each spraying from ten randomly selected plants in each all the treatments. Emamectin benzoate 1.9 EC was found to be safer to spiders at all concentrations tested and the highest population was recorded in plots treated with emamectin benzoate 1.9 EC at 5.00 g a.i. ha⁻¹ followed by emamectin benzoate 1.9 EC at 6.75,8.50 and 11.00 g a.i. ha⁻¹ respectively.

Keywords: Spider, Emamectin benzoate 1.9 EC, Okra, Safety.

1. INTRODUCTION

Okra (*Abelmoschus esculantus* (L.) Moench) is important vegetable occupies major component of our food. India is the second largest producer of vegetables in the world accounting for about 10 percent of the world production [7]. The major pests are leaf hopper, *Amrasca biguttula biguttula*, Whiteflies, *Bemisia tabaci*, aphid, *Aphis gossyphi*, fruit borer *Earias vitella* (Fab.), *Earias insulana* (Boisd.) and *Helicoverpa armigera* (Hub.) [12]. In which, the fruit borers viz., *Earias vitella* (Fab.), *Earias insulana* (Boisd.) and *Helicoverpa armigera* (Hub.) are known to cause severe damage (88-100% fruit damage) to crop [1]. Since high cost is incurred in the cultivation of high yielding okra, the farmers have to rely upon pesticides to get a high net income [17]. The indiscriminate use of pesticides has led to many problems like adverse effect on parasites, predators and pollinators: toxic residue causing health hazards, resurgence of pests: development of resistance in insects to insecticides and environmental pollution [9]. As many of the recommended insecticides are reported highly toxic to predatore and parasitoids and the population of predators declined by 68.4% during last decades [5]. Spiders are the most successful group of beneficial insects, which plays an essential role in checking the soft bodied insects [13]. It is important to adopt or use some newer insecticide molecule with high toxicity even at lower doses and should also be safer to the natural enemies present in the agro eco-system[3]. One such insecticide is Emamectin benzoate which is a semi synthetic derivative of avermectin produced as fermentation metabolites of soil actinomycetes, *Streptomyces avermitilis* Burg.[6] Hence the present investigation was under taken to evaluate the safety of emamectin benzoate 1.9 EC on spiders predators in okra ecosystem

2. MATERIALS AND METHODS

Field experiments on okra were conducted at Vilacherri, Madurai (I season: August 2015 to December 2015) and Vilacherri (II season: August 2016 to December 2016) of Tamil Nadu to evaluate the safety of new formulation emamectin benzoate 1.9 EC at different doses (5.00, 6.75, 8.50 and 11.00 g. ai ha⁻¹) against spider predators of okra.

The experiments were conducted using Randomized Block Design (RBD) with seven treatments replicated thrice with a plot size of 4 m × 5 m using the variety NOKH-1013 hybrid from Nuziveedu seeds. During both the seasons two rounds of spraying were given at 14 days interval starting from 45 days after sowing. Pneumatic knapsack sprayer (Aspee sprayer) using 500 litres of spray fluid per hectare was used to spray various doses of test insecticide. Population of spider predators (number of spider/ 10 plants) was recorded in all the treatments prior to spraying and at 3, 7, 10 and 14 days after each spraying from 10 randomly selected

3. STATISTICAL ANALYSIS

Data were subjected to analysis of variance (ANOVA). Before analysis, data on population were transferred by square root transformation. In order to know the interaction among treatments, data from field experiment were subjected to RBD analysis and the means obtained were separated by Duncan's Multiple Range Test [8].

4. RESULTS AND DISCUSSION

The safety of emamectin benzoate 1.9 EC in comparison with standard check evaluated against spider predators based on two rounds of spray are presented in Tables 1 and 2. In the first season, the grubs and adult populations prior to first spraying were 5.00 to 5.67 per ten plants (Table 1). At seven days after first application, the predatory spider population was the highest (5.33 / 10 plants) in the plots treated with emamectin benzoate 1.9 EC at 5.00 g a.i. / ha followed by emamectin benzoate 1.9 EC at 6.75, 8.50 and 11.00 g a. i. / ha (5.17, 5.00 and 4.67 / 10 plants). The highest population of spiders was observed in untreated plots (7.33 / 10 plants). Similar result were reported by Jasmine and Kuttalam who observed that plots treated with emamectin benzoate 5 SG at 7 g ai/ha recorded highest population of spiders in okra eco system[11]

At 14 DAT, spider population gradually increased in the lower dose of emamectin benzoate 1.9 EC (5.00 g a.i. / ha) recorded mean population of 5.83 spiders per 10 plants followed by untreated check (7.24/10 plants) while emamectin benzoate 1.9 EC at 6.75 8.50 and 11.00 a.i. / ha recorded 5.79, 5.50 and 5.16 spiders per ten plants. These present findings are in conformity with the results of Tilman and Mulrooney who reported that emamectin benzoate with novel mode of action is generally more selective and require lower rates than conventional insecticides and has low moderate impact on beneficial insects' And stated that avermectins were safe to *Coccinella septempunctata* [15].

After second application, at 3 DAT, emamectin benzoate 1.9 EC at 5.00 g a.i. / ha recorded 6.00 spiders which was on par with emamectin benzoate 1.9 EC at 6.75 g a.i. / ha (5.03 spiders / 10 plants) and emamectin benzoate 1.9 EC at 8.50 and 11.00 g a.i. / ha (4.67 and 4.33 spiders / 10 plants (Table 1). Present findings were observed that emamectin benzoate is safe to *Spiders* and *Chrysoperla carnea* due to rapid breakdown of the active ingredient by photo-oxidation to non-toxic level on the leaf surface, limiting contact activity to a very short period' [4].

Comparatively at all the days after treatment spiders population was low in lamda cyhalothrin treated plots. and confirmed that abamectin was safer to lady bird beetles. Mean population spiders, emamectin benzoate 1.9 EC at 5.00 g a.i./ ha recorded 7.41 spiders per ten plants followed by emamectin benzoate 1.9 EC at 6.75, 8.50 and 11.00 g a.i./ ha (6.75, 6.41 and 5.95 / 10 plants), as compared to standard insecticide viz., pyridalyl 10 EC (5.83 / 10 plants). All the emamectin benzoate irrespective of the doses were found to have only a little impact on spiders. Population of spiders declined immediately after the spray and started increasing gradually.

The results of the second season field experiment on the toxicity of emamectin benzoate to spiders in okra ecosystem are presented in Table 2. The pre treatment population of spiders ranged from 3.67 to 4.67 per ten plants. Significant differences among spiders population were observed among different treatments after spray. After the first round of spraying, At 3 DAT, the plots treated with emamectin benzoate 1.9 EC at 5.00g a.i./ ha recorded 3.00 spiders per ten plants, which was on par with emamectin benzoate 1.9 EC at 6.75 g a.i./ ha (2.67 / 10 plants) whereas higher dose of emamectin benzoate 1.9 EC at 11.00 g a.i. / ha harboured 2.00 as against 4.67 spiders per ten plants in untreated check. Similar trend of spiders population was observed at 7 DAT (2.33 to 5.00 / 10 plants), 10 DAT (2.67 to 5.00 / 10 plants) and 14 DAT (3.00 to 5.33 / 10 plants) in emamectin benzoate treatments. The similar results were observed in grapes i.e emamectin benzoate 5 SG at 8 g a.i / ha safe to coccenellids [2] and emamectin benzoate had no effects on the ladybeetles *Hippodamia convergens* [6].

Second spray data revealed that (Table 2) plots treated with lower dose of emamectin benzoate 1.9 EC at 5.00 g a.i./ ha recorded a spiders population of 3.67 per ten plants which was on par with emamectin benzoate 1.9EC at 6.75 g a.i./ ha (3.33 / 10 plants) followed by emamectin benzoate 1.9 EC at 8.50 and 11.00 g a.i./ ha (3.33 and 3.00 / 10 plants). Among the insecticidal treatments lowest spiders population was registered in lamdacyhalothrin 5 CS treated plots (2.00 / 10 plants), untreated plots recorded the highest spiders population of 5.67 per ten plants at 3 DAT. These results are in line with Sechser et al. where they observed that foliar application of emamectin benzoate was relatively safe to all stages of the spider predator species [13]. At 10 DAT, emamectin benzoate 1.9 EC at 5.00, 6.75, 8.50 and 11.00 g a.i./ ha treated plots, the predatory spiders population were 4.67, 4.33, 4.00 and 3.67 per 10 plants. Sultana and Horowitz reported that

emamectin benzoate a macrocyclic lactone insecticide had low toxicity to beneficial insects [14]. The population of predatory spiders was the highest in untreated check during the period of study (6.33 / 10 plants). The mean minimum population of 3.00 spiders per ten plants was observed in lamdacyhalothrin treated plots.

The emamectin benzoate had no adverse effects on beneficial arthropod species[4]. All the emamectin benzoate treatments were found to have only a little impact on spiders [5]. Udikeri agreed that the avermectins were generally safe to coccinellids And the bio-rational insecticides are less disruptive to beneficial populations[16]. Population of spiders declined immediately after the spray and started increasing gradually. Untreated plots showed highest spider population throughout the period of studies. Ishaaya and ohsawa indicated that the emamectin benzoate 5 SG was less toxic to beneficial insects [10] Although emamectin reservoir with mesophyll layer of leaf tissues is accessible to phtophagous insects, the parasitic and predatory arthropods continue to proliferate because of their short lived surface residues. Emamectin benzoate had minimum negative impact on the predator population and may be considered as ideal chemical for use in integrated pest management programmes. Therefore, the application of emamectin benzoate is less harmful to the important natural enemies in okra ecosystem.

5. CONCLUSION

The present study results concluded that emamectin benzoate 1.9 EC was found safer to spiders at all the tested concentrations. The highest population was recorded in plots treated with emamectin benzoate 1.9 EC at 5.00 g a.i. / ha followed by emamectin benzoate 1.9 EC at 6.75 8.50 and 11.00 g a.i. / ha. More studies on other natural enemies need to be investigated

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APPENDIX – A

LIST OF TABLES:

Table1. Effect of Emamectin benzoate 1.9 % EC on spider population on okra eco system (Location: Vilacherri) Season 1

Treatments	Dose (g a.i. ha ⁻¹)	Number of spiders per 10 plants (grubs and Adults)										
		First Application					Second application					
		PTC	3 DAT	7 DAT	10 DAT	14 DAT	Mean	3 DAT	7 DAT	10 DAT	14 DAT	Mean
Emamectin benzoate 1.9 EC	5.00	5.33 (2.41)	3.67 (2.04)	5.33 (2.41)	7.00 (2.73)	7.33 (2.79)	5.83	6.00 (2.54)	6.33 (2.61)	8.00 (2.91)	9.33 (3.13)	7.41
Emamectin benzoate 1.9 EC	6.75	5.00 (2.34)	4.00 (2.12)	5.17 (2.38)	6.67 (2.67)	7.33 (2.79))	5.79	5.03 (2.35)	6.00 (2.54)	7.33 (2.79)	8.67 (3.02)	6.75
Emamectin benzoate 1.9 EC	8.50	5.67 (2.48)	3.33 (1.95)	5.00 (2.34)	6.67 (2.67)	7.00 (2.73)	5.50	4.67 (2.27)	5.67 (2.48)	7.00 (2.73)	8.33 (2.97)	6.41
Emamectin benzoate 1.9 EC	11.00	5.33 (2.41)	3.00 (1.87)	4.67 (2.27)	6.33 (2.61)	6.67 (2.67)	5.16	4.33 (2.19)	5.33 (2.41)	6.33 (2.61)	7.67 (2.85)	5.95
Pyridalyl 10 EC	50	5.67 (2.48)	3.00 (1.87)	4.33 (2.19)	5.67 (2.48)	6.00 (2.54)	4.75	4.33 (2.19)	5.00 (2.34)	6.33 (2.61)	7.67 (2.85)	5.83
Lamda cyhalothrin 5 CS	15	5.67 (2.48)	1.33 (1.35)	2.67 (1.78)	4.33 (2.19)	5.00 (2.34)	3.33	2.67 (1.78)	2.67 (1.78)	4.33 (2.19)	7.33 (2.80)	4.25
Untreated check		5.33 (2.41)	6.33 (2.60)	7.33 (2.76)	7.33 (2.86)	7.67 (2.88)	7.24	8.67 (3.02)	9.33 (3.13)	10.00 (3.24)	10.33 (3.29)	9.58
SEd			0.18	0.10	0.09	0.14		0.23	0.18	0.19	0.18	
CD(P=0.05)		NS	0.37	0.22	0.20	0.30		0.47	0.36	0.39	0.38	

PTC- Pretreatment count, DAT- Days after treatment Values in parentheses are $\sqrt{x + 0.5}$ transformed values in a column means followed by a common letter are not significantly different by DMRT (P=0.05).

Table2. Effect of Emamectin benzoate 1.9 % EC on Spider population on okra eco system (Location: Vilacherri) Season 1

Treatments	Dose (g a.i. ha ⁻¹)	Number of spiders per 10 plants (grubs and Adults)										
		First Application						Second application				
		PTC	3 DAT	7 DAT	10 DAT	14 DAT	Mean	3 DAT	7 DAT	10 DAT	14 DAT	Mean
Emamectin benzoate 1.9 EC	5.00	4.00	3.00 (1.86)	4.00 (2.12)	4.33 (2.20)	5.00 (2.34)	4.08	3.67 (2.03)	4.33 (2.20)	4.67 (2.27)	5.33 (2.41)	4.50
Emamectin benzoate 1.9 EC	6.75	4.33	2.67 (1.76)	3.67 (2.03)	4.00 (2.11)	5.00 (2.35)	3.84	3.33 (1.95)	4.00 (2.12)	4.33 (2.18)	5.00 (2.34)	4.17
Emamectin benzoate 1.9 EC	8.50	4.67	2.33 (1.64)	3.33 (1.95)	4.00 (2.11)	4.33 (2.20)	3.50	3.33 (1.95)	3.67 (2.03)	4.00 (2.10)	4.67 (2.26)	3.92
Emamectin benzoate 1.9 EC	11.00	3.67	2.00 (1.56)	3.33 (1.95)	3.67 (2.03)	4.33 (2.20)	3.33	3.00 (1.86)	3.67 (2.03)	3.67 (2.03)	4.67 (2.26)	3.75
Pyridalyl 10 EC	50	3.67	1.67 (1.46)	2.67 (1.77)	3.33 (1.95)	3.67 (2.03)	2.84	2.67 (1.76)	3.00 (1.86)	3.33 (1.95)	3.67 (2.03)	3.17
Lamda cyhalothrin 5 CS	15	4.00	1.67 (1.46)	2.33 (1.66)	2.67 (1.76)	3.00 (1.87)	2.42	2.00 (1.56)	2.67 (1.76)	2.67 (1.76)	3.00 (1.86)	2.59
Untreated check		4.33	4.67 (2.27)	5.00 (2.34)	5.00 (2.35)	5.33 (2.41)	5.00	5.67 (2.47)	5.67 (2.45)	6.33 (2.59)	6.67 (2.67)	6.09
SEd			0.29	0.18	0.15	0.13		0.13	0.23	0.26	0.21	
CD(P=0.05)		NS	0.54	0.40	0.33	0.27		0.28	0.49	0.57	0.47	

PTC- Pretreatment count, DAT- Days after treatment Values in parentheses are $\sqrt{x + 0.5}$ transformed values in a column means followed by a common letter are not significantly different by DMRT (P=0.05).