Journal of Entomology and Zoology Studies

Available online at www.entomoljournal.com

E-ISSN: 2320-7078
P-ISSN: 2349-6800
JEZS 2017; 5(6): 2494-2497

Received: 20-09-2017
Accepted: 23-10-2017

Karthikeyan R
Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Ayysamy R
Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Correspondence
Karthikeyan R
Department of Entomology, Faculty of Agriculture, Annamalai University, Chidambaram, Tamil Nadu, India

Safety evaluation of Emamectin benzoate 1.9 EC against predatory coccinellid in okra eco-system

Karthikeyan R and Ayysamy R

Abstract
Biosafety of insecticides on natural enemies, coccinellids was evaluated in okra at two season in vilacherri, Madurai (I Season: August 2015 to December 2015 and II Season: August 2016 to December 2016) of Tamil Nadu. 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 coccinellid predators in okra eco-system were studied. The coccinellid 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 coccinellids 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: Coccinellid, Emamectin benzoate 1.9 EC, Okra, Safety

1. Introduction
India is the second largest producer of vegetables in the world accounting for about 10 percent of the world production [8]. Of the various reasons for low productivity, heavy damage inflicted by insect pests is a key limiting factor. Okra is infested by more than 72 species of insects [15], The major pests are leafhopper, *Amrasca biguttula biguttula* (Ishida), whiteflies, *Bemisia tabaci* (Gennadias), aphid, *Aphis gossypii*(Glover), mite, *Tetranychus cinnabarinus* (Boisduval), fruit borer, *Earia svittella* (Fabricius) and *Helicoverpa armigera* (Hubner). Among them, fruit borers are the most destructive pests [13]. 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. 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 [10]. Coccinellids popularly known as lady bird beetles are the most successful group of beneficial insects, which plays an essential role in checking the aphids and other soft bodied insects [17] 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 [7]. Hence the present investigation was under taken to evaluate the safety of emamectin benzoate 1.9 EC on coccinellids 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 coccinellid 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 coccinellid predators (number of coccinellid/ 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 factorial RBD analysis and the means obtained were separated by Duncan's Multiple Range Test [6].

4. Results and Discussion

The safety of emamectin benzoate 1.9 EC in comparison with standard check evaluated against coccinellid 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 8.33 to 9.33 per ten plants (Table 1). At three days after first application, the predatory coccinellid population was the highest (7.00/10 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 (6.67 5.33 and 5.00 / 10 plants). The highest population of coccinellids was observed in untreated plots (8.67 / 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 coccinellids in okra eco system [11]

Similar trend was observed after 5 and 7 days of treatment (DAT). At 10 DAT, coccinellid population gradually increased in the lower dose of emamectin benzoate 1.9 EC (5.00 g a.i. / ha) recorded mean population of 8.67 coccinellids per 10 plants followed by untreated check (10.33/10 plants) while emamectin benzoate 1.9 EC at 6.75 8.50 and 11.00 a.i. / ha recorded 7.33 7.00 and 6.67 coccinellids 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* [18].

After second application, at 3 DAT, emamectin benzoate 1.9 EC at 5.00 g a.i. / ha recorded 7.67 coccinellids which was on par with emamectin benzoate 1.9 EC at 6.75 g a.i. / ha (7.00 coccinellids / 10 plants) and emamectin benzoate 1.9 EC at 8.50 and 11.00 g a.i. / ha (6.00 coccinellids / 10 plants (Table 1). Present findings were observed that emamectin benzoate is safe to *Coccinellids* 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 coccinellids population was low in lamda cyhalothrin treated plots. and confirmed that abamectin was safer to lady bird beetles [1]. Mean population coccinellids, emamectin benzoate 1.9 EC at 5.00 g a.i./ ha recorded 9.17 coccinellids per ten plants followed by emamectin benzoate 1.9 EC at 6.75, 8.50 and 11.00 g a.i./ ha (8.67, 7.83 and 7.50 / 10 plants), as compared to standard insecticide *viz.*, pyridalyl 10 EC (6.92 / 10 plants). All the emamectin benzoate irrespective of the doses were found to have only a little impact on coccinellids. Population of coccinellids declined immediately after the spray and started increasing gradually.

The results of the second season field experiment on the toxicity of emamectin benzoate to coccinellids in okra ecosystem are presented in Table 2. The pre trea tment population of coccinellids ranged from 8.00 to 8.67 per ten plants. Significant differences among coccinellids 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 6.67 coccinellids per ten plants, which was on par with emamectin benzoate 1.9 EC at 6.75 g a.i./ ha (6.67 / 10 plants) whereas higher dose of emamectin benzoate 1.9 EC at 11.00 g a.i. / ha harboured 5.33 as against 9.00 coccinellids per ten plants in untreated check. Similar trend of coccinellids population was observed at 7 DAT (6.00 to 7.33 / 10 plants), 10 DAT (6.67 to 9.33 / 10 plants) and 14 DAT (7.67 to 9.67 / 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* [4].

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 coccinellids population of 8.00 per ten plants which was on par with emamectin benzoate 1.9EC at 6.75 g a.i./ ha (7.00 / 10 plants) followed by emamectin benzoate 1.9 EC at 8.50 and 11.00 g a.i./ ha (6.33 / 10 plants).Among the insecticidal treatments lowest coccinellids population was registered in lamdacyhalothrin 5 CS treated plots (3.00 / 10 plants), untreated plots recorded the highest coccinellids population of 11.33 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 coccinellid predator species [14]. 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 coccinellids population were 10.33, 10.00, 9.00 and 8.33 per 10 plants. Sultana and Horowitz reported that emamectin benzoate a macrocyclic lactone insecticide had low toxicity to beneficial insects [16]. The population of predatory coccinellids was the highest in untreated check during the period of study (12.00 / 10 plants). The mean minimum population of 4.50 coccinellids 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 coccinellids [5]. And the bio-rational insecticides are less disruptive to beneficial populations [8]. Population of coccinellids declined immediately after the spray and started increasing gradually. Untreated plots showed highest cocceinellids population throughout the period of studies. Ishaaya and ohsawa indicated that the emamectin benzoate 5 SG was less toxic to beneficial insects [11] 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.

Table 1: Effect of Emamectin benzoate 1.9% EC on coccinellid population on okra eco system (Location: Vilacherri Season 1

Treatments	Dose (g a.i. ha^{-1})	Number of coccinellids per 10 plants (grubs and Adults)										
		First Application Second application										
		PTC	3 DAT	7 DAT	10 DAT	14DAT	Mean	3 DAT	7 DAT	10 DAT	14DAT	Mean
Emamectin benzoate 1.9 EC	5.00	9.33	7.00 (2.73)	8.00 (2.91)	8.67 (3.03)	9.00 (3.08)	8.17	7.67 (2.85)	8.67 (3.02)	9.33 (3.13)	11.00 (3.39)	9.17
Emamectin benzoate 1.9 EC	6.75	8.33	6.67 (2.67)	7.00 (2.73)	7.33 (2.79)	8.00 (2.91)	7.25	7.00 (2.73)	8.33 (2.97)	9.33 (3.13)	10.00 (3.24)	8.67
Emamectin benzoate 1.9 EC	8.50	9.33	5.33 (2.34)	6.00 (2.54)	7.00 (2.73)	7.67 (2.85)	6.42	6.00 (2.54)	7.00 (2.73)	9.00 (3.08)	9.33 (3.13)	7.83
Emamectin benzoate 1.9 EC	11.00	8.67	5.00 (2.34)	5.63 (2.47)	6.67 (2.67)	7.67 (2.85)	6.33	6.00 (2.53)	7.00 (2.73)	8.33 (2.96)	8.67 (3.03)	7.50
Pyridalyl 10 EC	50	9.00	4.00 (2.12)	4.33 (2.19)	5.00 (2.34)	6.33 (2.61)	4.92	5.33 (2.41)	6.67 (2.67)	7.33 (2.79)	8.33 (2.97)	6.92
Lamda cyhalothrin 5 CS	15	8.67	2.33 (1.68)	3.67 (2.04)	5.00 (2.34)	6.00 (2.54)	4.25	2.00 (1.58)	2.33 (1.68)	2.67 (1.78)	4.67 (2.27)	2.92
Untreated check		8.33	8.67 (3.02)	9.33 (3.13)	10.33 (3.29)	10.00 (3.24)	9.58	11.00 (3.39)	12.67 (3.62)	13.00 (3.67)	13.67 (3.76)	12.59
SEd			0.17	0.11	0.19	0.13		0.20	0.21	0.29	0.26	
CD(P=0.05)		**NS**	0.37	0.24	0.42	0.30		0.45	0.46	0.53	0.57	

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 notsignificantly different by DMRT (P=0.05)

Table 2: Effect of Emamectin benzoate 1.9% EC on Coccinellid population on okra eco system (Location: Vilacherri Season 1

Treatments	Dose (g a.i. ha^{-1})	Number of coccinellids per 10 plants (grubs and Adults										
		First Application Second application										
		PTC	3 DAT	7 DAT	10 DAT	14DAT	Mean	3 DAT	7 DAT	10 DAT	14DAT	Mean
Emamectin benzoate 1.9 EC	5.00	8.00	6.67 (2.68)	7.33 (2.80)	9.33 (3.13)	9.67 (3.19)	8.25	8.00 (2.91)	9.00 (3.08)	10.33 (3.29)	11.67 (3.48)	9.75
Emamectin benzoate 1.9 EC	6.75	8.33	6.67 (2.68)	7.00 (2.73)	9.00 (3.08)	9.33 (3.13)	8.00	7.00 (2.73)	8.33 (2.96)	10.00 (3.22)	11.33 (3.43)	9.17
Emamectin benzoate 1.9 EC	8.50	8.67	5.00 (2.34)	6.67 (2.67)	8.67 (3.01)	9.00 (3.08)	7.34	6.33 (2.60)	7.33 (2.80)	9.00 (3.08)	11.00 (3.38)	8.42
Emamectin benzoate 1.9 EC	11.00	8.33	5.33 (2.41)	6.00 (2.55)	6.67 (2.67)	7.67 (2.85)	6.42	6.33 (2.59)	7.67 (2.83)	8.33 (2.96)	8.67 (3.03)	7.75
Pyridalyl 10 EC	50	8.67	4.00 (2.12)	4.33 (2.20)	7.00 (2.73)	8.67 (3.02)	6.00	5.67 (2.48)	6.67 (2.67)	8.67 (3.02)	9.00 (3.08)	7.50
Lamda cyhalothrin 5 CS	15	8.00	3.00 (1.86)	3.67 (2.04)	6.33 (2.59)	7.00 (2.73)	5.00	3.00 (1.86)	3.67 (2.02)	4.67 (2.23)	6.67 (2.67)	4.50
Untreated check		8.67	9.00 (3.08)	9.33 (3.13)	10.00 (3.24)	10.33 (3.29)	9.67	11.33 (3.44)	11.67 (3.49)	12.00 (3.52)	12.33 (3.58)	11.83
SEd			0.13	0.11	0.24	0.14		0.20	0.22	0.30	0.17	
CD(P=0.05)		**NS**	0.29	0.25	0.52	0.31		0.45	0.49	0.65	0.39	

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)

5. Conclusion

The present study results concluded that emamectin benzoate 1.9 EC was found safer to coccinellids 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

6. References

1. Acharya S, Mishra HP, Dash D. Efficacy of insecticides against okra jassid, *Amrasca biguttula biguttula* Ishida. Annual Review of Entomology. 2002; 36-10(2):230-232.
2. Balikai RA, Patil DR. Bio efficacy of emamectin benzoate 5 SG (Proclaim®) against grapevine pests and its effect on natural enemies and plants. Pestology. 2007; 31(5):13-20.
3. Chaudhary HR, Dadeech LN. Incidence of insect attacking okra and losses caused by them. Annuals of Arid Zone. 1989; 2(3/4):305-307
4. Dunbar DM, Lawson DS, White S, Ngo N. Emamectin benzoate: control of the *Heliothis* complex and impact on beneficial arthropods. In: Proceedings. Beltwide Cotton Conference., P.Dugger and D. Richter (eds.), San Diego, California, USA, 5-9 January, 1998, 1116-1118.
5. Fitt GP, Wilson L, Mensah R, Daly J. Advances with Integrated Pest Management as a component of sustainable agriculture: the case of the Australian cotton industry. In: Proceedings of the 4th International Crop Science Congress, 2004, Brisbane, Australia. Published on CD-ROM. Available from: www.cropscience.org.au.
6. Gomez KA, Gomez AA. Statistical procedures for Agricultural Research. Second edition. John Wiley and sons. New York 1984, 582
7. Horowitz AR, Ishaaya I. Biorational insecticides: mechanisms, selectivity, and importance in pest

management. In: Horowitz, AR., Ishaaya, I. (Eds.), *Insect Pest Management.* Springer-Verlag, Berlin Heidelberg New York, 2004, 1-28.
8. ICAR. Hand book of Agriculture, Indian council of Agricultural Research, New Delhi. 1997; 1088-1102
9. Lal OP. Biodiversity in relation to insect pest management In: Abstract of National Conference: Plant Protection New Horizons in a Millenium held at Udaipur during February, 2001; 23-25:2001
10. Ishayaa I, Ohsawa K Emamectin a novel insecticide for controlling field crops pests. Pest Management science. 2002; 58(11)1091-1095
11. Jasmine RS, Kuttalam S. Emamectin benzoate 5 SG and 1.9 EC; A safer insecticide to coccinellids of bhendi eco system. Madras Agricultural journal. 2011; 98(1-3):92-94
12. Lasota JA, Dybas RA. Avermectins: A novel class of compounds: Implications for use in arthropod pest control. Annual Review of Entomology. 1991; 36:91-117.
13. Mani MA. Krishnamoorthy, Gopalakrishnan C. Biological control of lepidopterous pests of Horticultural crops in India. Annual Review of Agricultural Research, 2005; 26(1):39-49.
14. Sechser B, Ayoub, Monuir SN. Selectivity of emamectin benzoate to predators of sucking pests on cotton, Journal of Plant Protection. 2003; 110(2):184-194.
15. Srinivasa Rao, Rajendran R. Joint action potential of neem with other plant extracts against the leaf hopper *Amrasca devastan* (Distant) on Okra. Pest Management and Zoology. 2003; 10:131-136.
16. Sultana K, Horowitz R. Emamectin benzoate 5 SG as novel insecticides. Pest Management. Science. 2005; 58:1091-1095.
17. Swaminatha R, Jai H, Hussain T. Side effects of a few botanicalson the apidophagous coccinellids. Journal of Bio Pesticides. 2010; 3(1):081-084
18. Tilman PG, Mulrooney JE. Effect of selected insecticides on the natural enemies *Coleomegilla maculata* and Hippodamia convergens (Coleoptera: Coccinellidae), Geocoris punctipes (Hemiptera: Lygaeidae), and Bracon mellitor, Cardiochiles nigriceps, and Cotesia marginiventris (Hymenoptera: Braconidae) in cotton. Journal of. Economic. Entomology. 2000; 93:1638-1643.