



Emamectin Benzoate 5 SG: A Safer Insecticide to Predatory Spiders in Cotton Ecosystem

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Studies were conducted in the field to evaluate the emamectin benzoate 5 SG for safety to predatory spiders in cotton ecosystem. The results showed that emamectin benzoate 5 SG was found be safer to spiders at all concentrations (Emamectin benzoate 5 SG at 7, 11 and 15 g a.i. / ha) tested compared to standard endosulfan35 EC. The highest spider population was recorded in plots treated with emamectin benzoate 5 SG at 7 g a.i. / ha followed by emamectin benzoate 5 SG at 11 g a.i. / ha, respectively.

Key words: Safety, Emamectin benzoate 5 SG, Predatory spiders, Cotton ecosystem

Cotton (*Gossypium* spp. L.) is the most important natural textile fibre of the world. It occupies a prominent place in the Indian economy (Rohini *et al.*, 2012). India ranks second in cotton production after China, with a productivity of 526 kg / ha. In India, cotton is cultivated over an area of 93.73 lakh hectares with a production of 290 lakh bales and in Tamil Nadu, the average area, production and productivity are 1.19 lakh ha, 5.00 lakh bales and 714 kg / ha, respectively (Kranthi *et al.*, 2011). The cotton ecosystem normally contains predators and parasitoids that frequently provide partial to satisfactory pest control. Spiders are the abundant natural enemies in any agroecosystem and are found in most terrestrial habitats and often present in high numbers. About 36,000 spider species belonging to 3,050 genera and 106 families have been described and up to 170,000 species could exist. They are generalist predators, that can kill a large number of insects per unit time and hence of great importance in reducing and even in preventing outbreaks of insect pests in agriculture. In cotton ecosystem six predominant spider species *viz.*, *Oxyopes javanus*, *Peucetia viridana*, *Clubiona drassodes*, *Argiope pulchella*, *Leucauge decorata* and *Salticus* sp feed on leafhoppers, aphids and whiteflies (Vanitha *et al.*, 2009). Spiders have been reported to feed on lepidopteran eggs in cotton (Pfannenstiel, 2005). It was observed that immediately after the application of insecticides the spider population was reduced. The indiscriminate use of insecticides has affected the population of bio control agents as all the recommended insecticides are highly toxic to predators and parasitoids (Dhawan *et al.*, 1994). The population of predators declined to a great extent during the last decades and many parasitoids have been eliminated from cotton ecosystem (Dhawan and

Simwat, 1996). In cotton ecosystem sap sucking pests, neonate and eggs of lepidopteran pests were effectively controlled by predatory spiders. Emamectin benzoate, one of the newer compounds is synthesized from the naturally occurring insecticide/acaricide of avermectin family. This was discovered in 1984 as a broad spectrum lepidoptericide. Emamectin benzoate is a mixture of emamectin benzoate B1a and emamectin benzoate B1b that are extracted from *Streptomyces avermitilis* Burg. It has been reported to perform well against pests of cotton (Govindan *et al.*, 2010) and vegetables (Govindan *et al.*, 2011) and can serve as an alternative to existing insecticide formulations. Emamectin benzoate 5 SG with is effective even at lower doses and are safer to the predatory spiders. Hence the present study was undertaken to study the safety of emamectin benzoate 5 SG on predatory spiders in cotton ecosystem.

Materials and Methods

Safety of emamectin benzoate 5 SG was tested at different doses against predatory spiders in cotton ecosystem at two locations *viz.*, one at Vellan Koil Erode District, Tamil Nadu on winter season (Cultivar - MCU 5) during January – April 2008 and another at Erangkattur Erode District, Tamil Nadu on summer season (Cultivar -Surabhi) during May - September 2008. The new formulation emamectin benzoate 5 SG was evaluated at different doses (emamectin benzoate 5 SG at 7, 11, 15 g a.i. / ha) along with standard check, endosulfan 35 EC at 350 g a.i. / ha, Proclaim® at 11 g a.i. ha, registered product of emamectin benzoate 5 SG) and spinosad 45 SC at 75 g a.i. / ha for safety to predatory spiders in cotton ecosystem. The field experiments were carried out in plots of 5 m ´ 5 m size in a randomized

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block design (RBD) with seven treatments replicated thrice. The treatment sprays were imposed two (Vellan Koil) or three (Erangkattur) times during January – August 2008, at 10 days interval commencing from 60th day after sowing and the spraying was given with pneumatic knapsack sprayer (Aspee sprayer) using 1000 litres of spray fluid per hectare. In both the field trials, population of spiders was recorded from ten randomly selected plants per plot at 3, 5, 7 and 10 days after treatment. The data were transformed in square root values $x + 0.5$ before statistical analysis (Gomez and Gomez, 1984). The mean values were separated using Duncan's Multiple Range Test (DMRT) (Duncan, 1951).

Results and Discussion

The population of spiders ranged from 4.67 to 7.67 spiders per ten plants before imposing treatments in the first field experiment (Table. 1). At three days after first application, the predatory spiders population was the highest (4.33 spiders / 10 plants) in the plots treated with emamectin benzoate 5 SG at 7 g a.i. / ha, which was on par with emamectin benzoate 5 SG at 11 g a.i. / ha and emamectin benzoate 5 SG (Proclaim®) at 11 g a.i. / ha (4.00 spiders / 10 plants). The highest predatory spiders observed in untreated plots (8.00 spiders / 10 plants). These findings are in conformity with the results of Tilman and Mulrooney (2000) who

reported that emamectin benzoate with novel mode of action is generally more selective and has low moderate impact on beneficial insects. At 10 DAT, the population gradually increased in the lower dose of emamectin benzoate 5 SG at 7 g a.i. / ha which recorded 6.66 per ten plants, emamectin benzoate 5 SG at 11 g a.i. / ha (6.00 spiders / 10 plants), emamectin benzoate 5 SG at 15g a.i. / ha (4.33 spiders /10 plants), standard chemicals, emamectin benzoate 5 SG (Proclaim®) at 11g a.i. / ha (4.66 spiders / 10 plants), spinosad 45 SC at 75 g a.i. / ha (4.00 spiders / 10 plants). Emamectin benzoate 5 SG at lowest dose recorded the higher mean spiders number of 5.16 per 10 plants next untreated check (8.91 spiders / 10 plants), while emamectin benzoate 5 SG at 11 and 15 g a.i. / ha recorded 4.50 and 3.50 spiders per ten plants. The standard chemicals, Proclaim® (4.25 spiders / 10 plants) and spinosad (3.69 spiders / 10 plants) recorded lower spider population. This observation is similar to that of Schoonover and Larson (1995) reported that spinosad was found to have short-term toxicity to predatory spider mite, *Phytoseiulus persimilis*. Endosulfan 35 EC recorded a mean of 3.00 spiders per 10 plants.

After second spray data (Table. 1) emamectin benzoate 5 SG at 7 g a.i. / ha recorded higher mean spiders of 5.08 per 10 plants next to untreated check (8.33 spiders / 10 plants). The emamectin benzoate

Table 1. Effect of emamectin benzoate 5 SG on spiders in cotton eco system

Treatment Dose (g a.i.ha ⁻¹)	Number of spiders per ten plants*											
	First application						Second application					
	PTC	3DAT	5DAT	7DAT	10DAT	Mean	PTC	3DAT	5DAT	7DAT	10DAT	Mean
Emamectin benzoate 5 SG @ 7.0 g	6.33	4.33	4.00	5.66	6.66	5.16	5.67	5.00	4.66	5.00	5.66	5.08
		(2.19)b	(2.11)b	(2.48)b	(2.67)b			(2.33)b	(2.27)b	(2.33)b	(2.47)b	
Emamectin benzoate 5 SG @ 11.0g	6.00	4.00	3.00	5.00	6.00	4.50	5.00	4.33	4.00	4.33	5.33	4.50
		(2.11)b	(1.85)bc	(2.33)bc	(2.54)bc			(2.19)bc	(2.11)bc	(2.19)bc	(2.40)b	
Emamectin benzoate 5 SG @ 15.0g	5.00	3.00	2.33	4.33	4.33	3.50	5.00	3.66	3.66	3.66	4.66	3.91
		(1.85)bc	(1.67)c	(2.19)bc	(2.19)cd			(2.03)bc	(2.03)bc	(2.03)bc	(2.27)bc	
Endosulfan 35 EC @350 g	4.67	2.33	2.33	3.66	3.66	3.00	6.33	3.33	2.66	3.33	3.66	3.25
		(1.67)c	(1.67)c	(2.03)c	(2.01)d			(1.95)c	(1.76)c	(1.95)c	(2.03)c	
Emamectin benzoate 5 SG (Proclaim®) @ 11.0g	5.67	4.00	3.33	5.00	4.66	4.25	4.67	4.00	4.00	3.66	5.66	4.33
		(2.11)b	(1.95)bc	(2.33)bc	(2.28)bcd			(2.11)bc	(2.11)bc	(2.03)bc	(2.48)b	
Spinosad 45 SC @ 75 g	4.67	3.00	2.77	5.00	4.00	3.69	5.00	3.66	3.33	4.00	5.33	4.08
		(1.85)bc	(1.77)c	(2.33)bc	(2.11)cd			(2.03)bc	(1.95)bc	(2.00)bc	(2.14)b	
Untreated check	7.67	8.00	8.30	9.33	10.00	8.91	6.33	7.66	8.33	8.66	8.66	8.33
		(2.91)a	(2.97)a	(3.13)a	(3.23)a			(2.85)a	(2.97)a	(3.02)a	(3.02)a	

PTC- Pretreatment count ; DAT- Days after treatments. * Mean of three replications

Figures in parentheses are values $x + 0.5$ transformed values; In a column, means followed by a common letter(s) are not significantly different by DMRT(P=0.05). Location : Vellankoil I Season, January - April 2008

5 SG at 11g a.i. / ha (4.50 spiders / 10 plants) which was higher than the standard Proclaim® at 11g a.i. / ha (4.33 spiders /10 plants). Among the insecticidal treatments, emamectin benzoate 5 SG at 15 g a.i. / ha (3.91 spiders / 10 plants) and endosulfan 35 EC at 350 g a.i. / ha (3.25 spiders / 10 plants) recorded minimum spider population which is in agreement with the report of Aiswariya, (2010) who stated that plots treated with emamectin benzoate 5 WSG at 7 and 9 g a.i. / ha showed less toxicity to predatory spiders in cotton ecosystem. Dunbar *et al.* (1998)

observed that emamectin benzoate is a safe chemical to natural enemies due to rapid degradation on the surface of foliage, limiting contact of phytophagous insects as its mode of action is mainly by ingestion, ecologically selective to wide range of beneficial species 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.

In the second field experiment, the pretreatment population of spiders ranged from 3.57 to 4.60

Table 2. Effect of emamectin benzoate 5 SG on spiders in cotton eco system

Treatment Dose (g a.i.ha ⁻¹)	Number of spiders per ten plants*																	
	First application								Second application									
	PTC	3DAT	5DAT	7DAT	10DAT	Mean	PTC	3DAT	5DAT	7DAT	10DAT	Mean	PTC	3DAT	5DAT	7DAT	10DAT	Mean
Emamectin benzoate 5 SG @ 7.0 g	3.67	3.47	2.83	3.27	3.27	3.19	3.27	2.90	2.50	2.93	3.10	2.86	3.10	2.80	2.47	2.77	3.20	2.81
		(1.99) _b	(1.83) _b	(1.94) _b	(1.94) _b			(1.84) _b	(1.73) _b	(1.85) _b	(1.90) _b			(1.82) _b	(1.72) _b	(1.81) _b	(1.92) _b	
Emamectin benzoate @ 11.0g	3.87	3.43	2.83	3.10	3.10	3.12	3.10	2.87	2.27	2.73	3.00	2.72	3.00	2.77	2.27	2.60	3.10	2.69
		(1.98) _b	(1.83) _b	(1.90) _b	(1.90) _b			(1.83) _b	(1.66) _{bc}	(1.80) _{bc}	(1.87) _b			(1.81) _b	(1.66) _b	(1.76) _b	(1.90) _b	
Emamectin benzoate @15.0g	4.03	3.00	2.63	2.87	2.87	2.84	2.87	2.73	2.10	2.63	2.80	2.57	2.80	2.63	2.07	2.73	2.90	2.58
		(1.86) _b	(1.77) _b	(1.83) _{bcd}	(1.83) _{bcd}			(1.80) _b	(1.61) _{bc}	(1.77) _{bc}	(1.82) _b			(1.77) _b	(1.60) _b	(1.80) _b	(1.84) _b	
Endosulfan 35 EC @350 g	3.57	2.10	1.97	2.43	2.43	2.23	2.43	1.83	1.40	1.53	1.83	1.65	1.83	1.40	1.13	1.87	2.30	1.68
		(1.61) _c	(1.57) _c	(1.71) _d	(1.71) _d			(1.53) _d	(1.38) _d	(1.43) _d	(1.53) _c			(1.38) _c	(1.28) _c	(1.52) _c	(1.67) _c	
Emamectin benzoate SG(Proclaim®) @ 11.0g	3.93	3.00	2.77	3.00	3.00	2.94	3.00	2.77	2.10	2.63	3.03	2.63	3.03	2.63	2.27	2.73	3.00	2.66
		(1.87) _b	(1.81) _b	(1.87) _{bc}	(1.87) _{bc}			(1.81) _b	(1.61) _{bc}	(1.77) _{bc}	(1.88) _b			(1.77) _b	(1.66) _b	(1.80) _b	(1.87) _b	
Spinosad 45 SC @ 75 g	4.30	3.17	2.63	2.57	2.57	2.74	2.57	2.13	1.90	2.50	3.00	2.38	3.00	2.37	2.03	2.70	2.93	2.51
		(1.91) _b	(1.77) _b	(1.75) _{cd}	(1.75) _{cd}			(1.62) _c	(1.55) _c	(1.73) _c	(1.87) _b			(1.69) _b	(1.59) _b	(1.79) _b	(1.85) _b	
Untreated check	4.60	5.00	4.70	4.73	4.73	4.79	4.73	5.30	5.90	6.03	6.20	5.86	6.20	6.50	6.87	7.00	7.33	6.93
		(2.34) _a	(2.28) _a	(2.29) _a	(2.29) _a			(2.41) _a	(2.53) _a	(2.55) _a	(2.59) _a			(2.64) _a	(2.71) _a	(2.74) _a	(2.80) _a	

PTC- Pretreatment count; DAT- Days after treatments, * Mean of three replications

Figures in parentheses are values $\times + 0.5$ transformed values; In a column, means followed by a common letter(s) are not significantly different by DMRT(P=0.05). Location:

Erangattur - II Season, May -September, 2008

spiders per ten plants (Table. 2). At 3 DAT, the plots treated with emamectin benzoate 5 SG at 7 g a.i./ ha recorded 3.47 spiders per ten plants, which was on par with emamectin benzoate 5 SG at 11 g a.i./ ha (3.43 spiders / 10 plants), emamectin benzoate 5 SG at 15 g a.i./ ha (3.00 / 10 plants), spinosad (3.17 spiders / 10 plants) and proclaim® (3.00 spiders / 10 plants). Whereas endosulfan harbored 2.10 spiders per ten plants as against 5.00 spiders per ten plants in untreated check. Balikai and Patil (2007) who reported that emamectin benzoate 5 SG (Proclaim®) at 8g a.i ha⁻¹ recorded highest population of spiders then untreated check in grape vine. Emamectin benzoate 5 SG at 7 and 11 g a.i. / ha recorded a mean spiders population of 3.19 and 3.12 spiders per ten plants, respectively and untreated plots recorded 4.79 per ten plants. The higher dose of emamectin benzoate 5 SG at 15 g a.i. / ha recorded 2.84 spiders per ten plants, whereas proclaim®, spinosad and endosulfan treated plots recorded 2.94, 2.91 and 2.38 spiders per ten plants, respectively. This observations is similar to that of Ruly, (2008) stated that emamectin benzoate 5 SG treated plots showed that population of natural enemies higher then untreated plots in cotton.

After second spray maximum mean population per 10 plants was observed in untreated check (5.86 spiders / 10 plants) followed by emamectin benzoate 5 SG at 7 and 11 g a.i./ ha (2.86 spiders / 10 plants and 2.72spiders / 10 plants, respectively) (Table. 2). This is in parallel to the report of Chakraborti and Sarkar, (2011) who reported that *foliar application* emamectin benzoate 5 SG at 7 g a.i./ ha treated plots showed 4.6 spiders / plant in brinjal ecosystem at 30 DAT. The spider population in proclaim® and spinosad was more or less similar. This result is in concordance with that of Nair *et al.* (2008) who noticed that spinosad 45 SC at 75 g a.i. ha⁻¹ treated plot showed no reduction of spiders.

After third round of application, emamectin benzoate 5 SG at 7 and 11 g a.i. / ha was found to be the least toxic recording a mean population of 2.81 and 2.69 spiders per ten plants, respectively (Table. 2). This result is in correspondence with that of Sultana and Horowitz (2005) proved that emamectin benzoate a macrocyclic lactone insecticide had low toxicity to beneficial insects and also results reported by Dunbar *et al.* (1998) observed that emamectin benzoate had no adverse effects on beneficial arthropod species. The order of safety of different insecticidal treatments to predatory spiders was: emamectin benzoate 5 SG at 7 g a.i. / ha > emamectin benzoate 5 SG at 11 g a.i. / ha > proclaim® > emamectin benzoate 5 SG at 15 g a.i. / ha > spinosad > endosulfan. The activity of natural enemies population in emamectin benzoate 5 SG treated plots was found to be on par with untreated check indicating safety to these predominant natural enemies in cotton ecosystem (Udikeri *et al.*, 2004). Among the emamectin benzoate doses, at 15 g a.i. / ha recorded lowest mean of 2.63 spiders per ten plants. All the emamectin benzoate treatments were found to have only a little impact on predatory spiders. Fitt *et al.* (2004) who reported that bio-rational insecticides are less disruptive to beneficial populations. Population of spiders declined immediately after the spray and started increasing gradually. Untreated plots showed highest spiders population through out the period of studies. Emamectin benzoate had minimum negative impact on the predator population and may be considered as an ideal chemical for use in integrated pest management programmes. Although emamectin reservoir with the mesophyll layer of leaf tissue is accessible to phytophagous insects, the parasitic and predatory arthropods continue to proliferate because of the short lived surface residues. Therefore, the application of emamectin benzoate is less harmful to the important natural enemies in cotton ecosystem.

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