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Emamectin Benzoate 5 SG and 1.9 EC: A Safer Insecticide to Coccinellids of Bhendi Ecosystem

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Two field experiments were conducted to study the impact of emamectin benzoate on coccinellids of bhendi. Emamectin benzoate 5 SG and 1.9 EC @ 7,11 15 and 20 g a.i. ha^{-1} were tested in comparison with Proclaim 5 SG @ 11 g a.i. ha^{-1} and endosulfan 35 EC @ 350 g a.i. ha^{-1} Observations on the population of coccinellids were made prior to spraying and on 3, 7, 10 and 14 days after spraying from 10 randomly tagged plants per plot and the mean worked out. Results showed that emamectin benzoate 5 SG and 1.9 EC was found to be safer to coccinellids at all concentrations tested. The highest population was recorded in plots treated with Emamectin benzoate @ 7 g a.i. ha^{-1} followed by emamectin benzoate @ 11 g a.i. ha^{-1}, respectively.

Key words: Emamectin benzoate, safety, coccinellids, bhendi

Bhendi (*Abelmoschus esculentus* L) is grown for its tender fruits as valuable vegetable. The stem of the crop is used in paper industry and also for the extraction of fibre. The productivity of crop is low because of insect pest damage at all the stages of crop growth. Among the pests, borers such as *Helicoverpa armigera* (Hubner), and *Earias vittella* F, cause heavy losses in yield. Chemical insecticides are used as the frontline defense sources against pests, in spite of their drawbacks in India. 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.*, 1992, 1994; Singh, 1994). The population of predators has declined by 68.4 % during the last two decades and many parasitoids have been eliminated from cotton ecosystem (Dhawan and Simwat, 1996).To a large extent, problems of environmental and human risk have been overcome through the development of newer compounds that can be handled safely and that do not persist as environmental contaminants. Emamectin benzoate is one of the broad spectrum microbial insecticides derived from the soil actinomycetes, *Streptomyces avermitilis*. It has been reported to possess excellent performance against pests of cotton and vegetables (Sinha *et al.,* 2007; Harish and Patil, 2008, Sharma and Kausik, 2010) alternate to existing formulation and also ecologically sound for the effective management of bhendi borers. Keeping in view, the present study was taken up to study the impact of emamectin benzoate to coccinellids in bhendi ecosystem.

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Materials and Methods

Two field experiments were conducted one each at Allapalayam, Annur and Maampalli, Kinathu kadavu during 2006 to study the impact of emamectin benzoate 5 SG and 1.9 EC against coccinellids on bhendi. The experiments were carried out in a randomized block design with eleven treatments, each replicated three times. The treatments imposed were emamectin benzoate 5 SG and 1.9 EC @ 7,11 15 and 20 g a.i. ha^{-1}, emamectin benzoate (Proclaim®) 5 SG @ 11 g a.i. ha^{-1}, endosulfan 35 EC @ 350 g a.i. ha^{-1} and untreated check. The treatments were imposed three times at 14 days interval commencing from 30th day after sowing with pneumatic knapsack sprayer using 750 litres of spray fluid per hectare. Observations on the population of coccinellids (grubs and adults), a day before each spraying and on 3, 7, 10 and 14 days after each spraying from 10 randomly tagged plants per plot were made and the mean worked out. Statistical analysis was carried out using IRRISTAT ver 3.1. ANOVA. The data were transformed into $\sqrt{x}$ +0.5. The mean values of treatments were separated using Duncan's Multiple Range Test (DMRT) (Gomez and Gomez, 1994).

Results and Discussion

The population of coccinellids ranged from 8.3 to 9.3 per 10 plants before imposing treatments in the first field experiment (Table 1). Emamectin benzoate 5 SG at the lowest dose recorded the higher mean coccinellid number of 9.73 per 10 plants next to untreated check (11.0 per 10 plants).

Emamectin benzoate 1.9 EC at 7 g a.i.ha^{-1} recorded 9. 65 coccinellids per 10 plants followed by emamectin benzoate 5 SG and 1.9 EC at 11 g a.i.ha-1 (9.50 per 10 plants) which was on par with Proclaim® at 11 g a.i.ha^{-1}. Endosulfan 35 EC recorded a mean of 7.25 coccinellids per 10 plants. Coccinellid numbers increased significantly three days after each spraying in all treatments.

After the second round of spray, emamectin benzoate 5 SG and 1.9 EC @ 7 g a.i.ha^{-1} recorded a mean of 12.00 coccinellids per 10 plants and emamectin benzoate 1.9 EC at 11g a.i.ha^{-1} (11.35 per10 plants). All the emamectin benzoate treat ments had little effect on coccinellids compared to endosulfan 35 EC (7.83 per 10 plants) throughout the investigation period. The same trend was noticed in the third round also. (Table 1)

Table 1. Effect of emamectin benzoate 5 SG and 1.9 EC on coccinellids on bhendi eco system (Location-Allapalayam)

Treatment	PTC	Number of coccinellids / 10 plants													
		Days after first treatment					Days after second treatment					Days after third treatment				
Emamectin benzoate 1.9 EC 7.0 g a.i.ha^{-1}	9.0	8.3^{ab} (2.97)	9.0^{ab} (3.08)	10.0^{abc} (3.24)	11.3 ^{b} (3.44)	9.65	10.3^{b} (3.29)	11.7^{b} (3.49)	12.3^{b} (3.58)	13.7^{b} (3.77)	12.00	12.7^{b} (3.63)	13.7^{b} (3.77)	15.0 ^{b} (3.94)	16.3 ^{b} (4.10)	14.43
Emamectin benzoate 1.9 EC 11.0 g a.i.ha^{-1}	9.3	8.3^{ab} (2.97)	9.0^{ab} (3.08)	9.7^{bc} (3.19)	11.0^{b} (3.39)	9.50	10.0^{b} (3.24)	11.0^{bc} (3.39)	11.7 ^{bc} (3.49)	12.7 ^{bc} (3.63)	11.35	11.7^{bc} (3.49)	12.7^{bc} (3.63)	14.0^{bc} (3.81)	15.7^{b} (4.02)	13.53
Emamectin benzoate 1.9 EC 15.0 g a.i.ha^{-1}	9.0	8.0^{b} (2.92)	8.7^{b} (3.03)	9.3^{bc} (3.13)	10.7^{b} (3.35)	9.18	9.3^{b} (3.13)	10.3^{c} (3.29)	11.0^{c} (3.39)	12.3^{c} (3.58)	10.73	11.0^{c} (3.39)	12.0^{c} (3.54)	13.0^{cd} (3.67)	14.3^{c} (3.85)	12.58
Emamectin benzoate 1.9 EC 20.0 g a.i.ha^{-1}	9.0	7.7^{b} (2.86)	8.3^{b} (2.97)	9.0^{c} (3.08)	10.3^{b} (3.29)	8.83	9.0^{b} (3.08)	10.0^{c} (3.24)	11.0^{c} (3.39)	12.3^{c} (3.58)	10.58	10.7^{c} (3.35)	11.7^{c} (3.49)	12.7^{d} (3.63)	14.0^{c} (3.81)	12.28
Emamectin benzoate 5 SG 7.0 g a.i.ha^{-1}	8.7	8.3^{ab} (2.97)	9.0^{ab} (3.08)	10.3^{ab} (3.29)	11.3^{b} (3.44)	9.73	10.3^{b} (3.29)	11.7^{b} (3.49)	12.3^{b} (3.58)	13.7^{b} (3.77)	12.00	12.7^{b} (3.63)	13.7^{b} (3.77)	15.0^{b} (3.94)	16.3^{b} (4.10)	14.43
Emamectin benzoate 5 SG 11.0 g a.i.ha^{-1}	9.3	8.3^{ab} (2.97)	9.0^{ab} (3.08)	9.7^{bc} (3.19)	11.0^{b} (3.39)	9.50	9.7^{b} (3.19)	11.0^{bc} (3.39)	11.7^{bc} (3.49)	12.7^{bc} (3.63)	11.28	11.7^{bc} (3.49)	12.7^{bc} (3.63)	14.0^{bc} (3.81)	15.7^{b} (4.02)	13.53
Emamectin benzoate 5 SG 15.0 g a.i.ha^{-1}	8.7	8.0^{b} (2.92)	8.7^{b} (3.03)	9.3^{bc} (3.13)	10.7^{b} (3.35)	9.18	9.3^{b} (3.13)	10.3^{c} (3.29)	11.0^{c} (3.39)	12.3^{c} (3.58)	10.73	11.0^{c} (3.39)	12.0^{c} (3.54)	13.0^{cd} (3.67)	14.3^{c} (3.85)	12.58
Emamectin benzoate 5 SG 20.0 g a.i.ha^{-1}	9.3	8.0^{b} (2.92)	8.3^{b} (2.97)	9.3^{bc} (3.13)	10.7^{b} (3.35)	9.08	9.3^{b} (3.13)	10.0^{c} (3.24)	11.0^{c} (3.39)	12.3^{c} (3.58)	10.58	10.7^{c} (3.35)	11.7^{c} (3.49)	12.7^{d} (3.63)	14.0^{c} (3.81)	12.28
Endosulfan 35 EC 350.0 g a.i.ha^{-1}	8.3	6.3^{c} (2.61)	6.7^{c} (2.68)	7.3^{d} (2.79)	8.7^{c} (3.03)	7.25	6.7^{c} (2.68)	7.3^{d} (2.79)	8.0^{d} (2.92)	9.3^{d} (3.13)	7.83	7.0 ^{d} (2.74)	7.7 ^{d} (2.86)	8.7 ^{e} (3.03)	10.0 ^{d} (3.24)	8.35
Emamectin (Proclaim®) 5 SG 11.0 g a.i.ha^{-1}	9.3	8.3 ^{ab} (2.97)	9.0 ^{ab} (3.08)	9.7 ^{bc} (3.190	11.0 ^{b} (3.39)	9.50	10.0 ^{b} (3.24)	11.0 ^{bc} (3.39)	11.7 ^{bc} (3.49)	12.7 ^{bc} (3.63)	11.35	11.7 ^{bc} (3.49)	12.7 ^{bc} (3.63)	14.0 ^{bc} (3.81)	15.7 ^{b} (4.02)	13.53
Untreated check	8.3	9.3 ^{a} (3.13)	10.0 ^{a} (3.24)	11.0 ^{a} (3.39)	13.7 ^{a} (3.77)	11.0	14.0 ^{a} (3.81)	14.3 ^{a} (3.85)	14.7 ^{a} (3.90)	16.0 ^{a} (4.06)	14.80	16.7 ^{a} (4.15)	17.3 ^{a} (4.22)	18.0 ^{a} (4.30)	19.3 ^{a} (4.45)	17.83

Mean of three observations; PTC- Pre treatment count

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)

In the second field experiment, the pretreatment population of coccinellids ranged from 9.3 to 10.3 per 10 plants (Table 2). Emamectin benzoate 1.9 EC at 7 g a.i.ha^{-1} recorded higher mean coccinellids of 10.90 per 10 plants next to untreated check (11.9 per 10 plants). The highest dose of emamectin benzoate 1.9 EC @ 20 g a.i ha^{-1} recorded a maximum population of 10.2 coccinellids/ 10 plants which was higher than the standard check Proclaim® at 11 g a.i.ha^{-1} (9.8 coccinellids / 10 plants). After the second round of spray, emamectin benzoate 5 SG and 1.9 EC @ 7g a.i.ha^{-1} recorded a mean of 12.5 and 12.7 coccinellids per 10 plants, respectively. All the emamectin benzoate treatments had little effect on coccinellids when compared to standard check, endosulfan 35 EC (9.90 per 10 plants) throughout the investigation period (Table 2).

The effect of emamectin benzoate on coccinellids revealed that after first spray, emamectin benzoate at all doses reduced the population on 3 DAT. The observations on 7, 10 and 14 showed the recolonization of coccinellids in all the treatments irrespective of concentrations.

The present finding is in accordance with the observations of Jyoti and Goud (2008) who reported that emamectin benzoate 5 SG was safer to coccinellids, chrysopids and spiders in brinjal ecosystem. Acharya *et al*. (2002) stated that abamectin was safer to lady bird beetles. Avermectins were safe to non target organisms viz., *Dolycoris bauarum* (L.), *Pentatoma rufipes* (L.), *Adalia bipunctata* (L.) and *Coccinella septem punctata* (L.) (Chizhov *et al.,* 2000) The populations of lacewings and coccinellids were not significantly different between insecticide treated (emamectin benzoate, indoxacarb, and spinosad) and untreated plots. (Anwar Ruly, 2008)

Sansone and Minzenmayer (2000) reported that spinosad had the least impact on spiders and *Scymnus* sp. as compared to indoxacarb (Steward®) and emamectin benzoate (Denim®). In contrast Yogesh Patel *et al.*, (2009) recorded minimum reduction in population of natural enemies coccinellids, green lacewings, and chrysopids over control, in plots treated with emamectin benzoate @ 8 g a.i. ha^{-1} followed by emamectin benzoate @ 9.8 g a.i. ha^{-1}, spinosad 45 SC @ 75 g a.i. ha^{-1} and spinosad 45 SC @ 100 g a.i. ha^{-1} respectively. Emamectin benzoate had minimum negative impact on the predator population and may be considered

Table 2. Effect of emamectin benzoate 5 SG and 1.9 EC on coccinellids on bhendi eco system (Location-Maampalli)

Treatment	PTC	Number of coccinellids / 10 plants														
		Days after first treatment					Days after second treatment					Days after third treatment				
Emamectin benzoate 1.9 EC 7.0 g a.i.ha^{-1}	9.0	9.7^{b} (3.2)	10.7^{b} (3.3)	11.3^{b} (3.4)	11.7 ^{b} (3.5)	10.9	11.7 ^{b} (3.5)	12.3 ^{b} (3.6)	12.7 ^{c} (3.6)	13.3 ^{c} (3.7)	12.5	13.3 ^{b} (3.7)	13.7 ^{b} (3.8)	14.0 ^{b} (3.8)	14.0^{b} (3.8)	13.8
Emamectin benzoate 1.9 EC 11.0 g a.i.ha^{-1}	9.3	9.7^{b} (3.2)	10.3^{c} (3.3)	10.7^{c} (3.3)	11.3^{c} (3.4)	10.5	10.7^{d} (3.3)	11.3^{c} (3.4)	11.7^{e} (3.5)	12.7 ^{d} (3.6)	11.6	12.0 ^{d} (3.5)	13.3^{c} (3.7)	13.7^{c} (3.8)	14.0^{b} (3.8)	13.3
Emamectin benzoate 1.9 EC 15.0 g a.i.ha^{-1}	9.0	9.3^{c} (3.1)	9.7^{d} (3.2)	10.7^{c} (3.3)	11.3 ^{c} (3.4)	10.3	10.3 ^{e} (3.3)	10.7 ^{d} (3.3)	11.7^{e} (3.5)	12.3 ^{e} (3.6)	11.3	11.7^{e} (3.5)	12.3 ^{e} (3.6)	12.7 ^{e} (3.6)	13.0 ^{d} (3.7)	12.4
Emamectin benzoate 1.9 EC 20.0 g a.i.ha^{-1}	9.0	9.3 ^{c} (3.1)	9.7 ^{d} (3.2)	10.7 ^{c} (3.3)	11.0^{d} (3.4)	10.2	10.3 ^{e} (3.3)	10.7 ^{d} (3.3)	11.3 ^{f} (3.4)	11.7 ^{f} (3.5)	11.0	10.7 ^{g} (3.3)	11.0 ^{g} (3.4)	11.7 ^{g} (3.5)	12.3 ^{f} (3.6)	11.4
Emamectin benzoate 5 SG 7.0 g a.i.ha^{-1}	8.7	9.7^{b} (3.2)	9.7 ^{d} (3.2)	10.3 ^{d} (3.3)	11.7 ^{b} (3.5)	10.4	11.7 ^{b} (3.5)	12.3 ^{b} (3.6)	13.0 ^{b} (3.7)	13.7 ^{b} (3.8)	12.7	13.0 ^{c} (3.7)	13.3^{c} (3.7)	13.7^{c} (3.8)	14.0 ^{b} (3.8)	13.5
Emamectin benzoate 5 SG 11.0 g a.i.ha^{-1}	9.3	9.3^{c} (3.1)	9.7^{d} (3.2)	10.3 ^{d} (3.3)	11.3^{c} (3.4)	10.2	11.0^{c} (3.4)	11.3^{c} (3.4)	12.0^{d} (3.5)	12.7^{d} (3.6)	11.8	12.0 ^{d} (3.5)	12.7^{d} (3.6)	13.3^{d} (3.7)	13.7^{c} (3.8)	12.9
Emamectin benzoate 5 SG 15.0 g a.i.ha^{-1}	8.7	9.3^{c} (3.1)	9.0 ^{f} (3.1)	10.0 ^{e} (3.2)	11.0 ^{d} (3.4)	9.8	10.7 ^{d} (3.3)	10.7 ^{d} (3.3)	11.3 ^{f} (3.4)	11.7 ^{f} (3.5)	11.1	11.0 ^{f} (3.4)	11.3 ^{f} (3.4)	12.0 ^{f} (3.5)	12.7 ^{e} (3.6)	11.8
Emamectin benzoate 5 SG 20.0 g a.i.ha^{-1}	9.3	8.7 ^{d} (3.0)	9.3 ^{e} (3.1)	9.7^{f} (3.2)	10.3^{f} (3.3)	9.5	9.3^{g} (3.1)	9.7^{f} (3.2)	10.3 ^{h} (3.3)	11.0^{g} (3.4)	10.1	8.7 ^{h} (3.0)	9.3 ^{h} (3.1)	10.0 ^{h} (3.2)	11.7 ^{g} (3.5)	9.9
Endosulfan 35 EC 350.0 g a.i.ha^{-1}	8.3	8.3 ^{e} (3.0)	8.7^{g} (3.0)	9.7^{f} (3.2)	10.7 ^{e} (3.3)	9.4	8.7 ^{h} (3.0)	9.7 ^{f} (3.2)	10.3 ^{h} (3.3)	11.0^{g} (3.4)	9.9	8.3 ^{i} (3.0)	9.0 ^{i} (3.1)	9.7 ^{i} (3.2)	11.3 ^{h} (3.4)	9.6
Emamectin (Proclaim®) 5 SG 11.0 g a.i.ha^{-1}	9.3	8.7 ^{d} (3.0)	9.7^{d} (3.2)	10.0 ^{e} (3.2)	10.7 ^{e} (3.3)	9.8	9.7 ^{f} (3.2)	10.0 ^{e} (3.2)	10.7 ^{g} (3.3)	11.0^{g} (3.4)	10.4	8.7 ^{h} (3.0)	8.7 ^{j} (3.0)	9.3 ^{j} (3.1)	11.3 ^{h} (3.4)	9.5
Untreated check	8.3	10.3 ^{a} (3.3)	11.3 ^{a} (3.4)	12.7 ^{a} (3.6)	13.3^{a} (3.7)	11.9	13.7 ^{a} (3.8)	14.7 ^{a} (3.9)	15.3 ^{a} (4.0)	16.3 ^{a} (5.0)	15.0	16.7 ^{a} (4.1)	17.3 ^{a} (4.2)	18.3 ^{a} (4.3)	19.0 ^{a} (4.8)	17.8

Mean of three observations; PTC- Pre treatment count

Values in parentheses are $\overline{x}$+0.5 transformed values

In a column, means followed by a common letter are not significantly different by DMRT (P=0.05)

as ideal chemical for use in Integrated Pest Management programmes.

Although emamectin reservoir with the mesophyll layer of leaf tissues 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 bhendi fields.

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