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Full Length Research Paper

Bio-efficacy of spinosad against tomato fruit borer (*Helicoverpa armigera* Hub.) (Lepidoptera: Noctuidae) and its natural enemies

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The tomato fruit borer, *Helicoverpa armigera* Hub. is a polyphagous pest attacking cotton, tomato, okra, chilli, cabbage, pigeon pea, gram etc. throughout the world as well as in India. Due to its high fecundity, polyphagous nature, quick adaptation against insecticides, control of this pest with any single potent toxicant for a long time is quiet difficult and rather impossible. So the newer chemicals need to be evaluated for controlling this pest. Field experiment was under taken for two cropping seasons during September - December, 2006 and September - December, 2007 to find out the efficacy of Spinosad 45% SC against tomato fruit borer (*H. armigera* Hub.) along with Quinalphos 25% EC, Lambda cyhalothrin 5% EC and Cypermethrin 10 EC at 'Gayespur' village (Nadia, West-Bengal, India). It was found that Spinosad was effective against *H. armigera* on tomato at 73 to 84 gm a.i./ha than Quinalphos, Lambda cyhalothrin and Cypermethrin. Spinosad at 73 to 84 g a.i./ha were very safe to three important predators recorded in tomato field that is, *Menochilus sexmaculaus., Syrphus corollae* and *Chrysoperla carnea.* Spinosad is one of such new chemicals which is derived from fermentation broth of soil actinomycetes, *Saccharopolyspora spinosa*, containing a naturally occurring mixture of spinosyn A and spinosyn D. It is safe to nymphs and adults of the natural enemies.

Key words: Spinosad, *Helicoverpa armigera*, tomato, natural enemies.

INTRODUCTION

Pest problem is main limiting factor for tomato cultivation as this is attacked by different insect pests such as *Helicoverpa* and *Sfruitoptera* etc. The tomato fruit borer, *Helicoverpa armigera* Hub. is a polyphagous pest attacking cotton, tomato, okra, chilli, cabbage, pigeon pea, gram etc. throughout the world as well as in India. Due to its high fecundity, polyphagous nature, quick adaptation against insecticides, control of this pest with any single potent toxicant for a long time is quiet difficult and rather impossible. Now it develops cross resistance to many popular insecticides. To control this insect pest and to save the crop, pesticides are being used in large quantities by human being. But the continuous and enormous use of same or similar groups of pesticides causes problem of pesticide residues in foodstuff and other environmental contamination. This has promoted the necessity for the development of new, safer, biodegradable insecticides and known insecticidal alternatives that could be feasible and effective for insect pest management. Spinosad is one of such new chemicals which are derived from fermentation broth of soil actinomycetes, *Saccharopolyspora spinosa*, containing a naturally occurring mixture of spinosyn A and spinosyn D. Spinosad have rapid contact and ingestion activity in insects, causing excitation of the nervous system, leading to cessation of feeding and paralysis. The present investigation was therefore undertaken to test the effectiveness of Spinosad in controlling *H. armigera* in tomato in comparison to lamda cyhalothrin and quinalphos.

MATERIALS AND METHODS

Field experiment was under taken for two cropping seasons during September- December, 2006 and September - December, 2007 in

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Table 1a. Effect of chemicals on *H. armigera* of tomato and on yield (mean of three sprayings) September - December, 2006.

S/No.	Treatments	Dose (gm a.i./ha)	Pre application count of borer/plant	% reduction/increase (+) in borer popl. after spray		% fruit infested by borer	Fruit yield without borer infestation (q/ha)
				3rd	7th		
1.	Spinosad 45% SC	45	5.33	78.4 (62.3)	70.6 (57.1)	18.6 (25.5)	28.6
2.	Spinosad 45% SC	56	6.00	88.6 (70.2)	82.6 (65.3)	9.2 (17.6)	30.2
3.	Spinosad 45% SC	73	6.33	100 (90.0)	100 (90.0)	2.4 (8.9)	33.8
4.	Spinosad 45% SC	84	5.67	100 (90.0)	100 (90.0)	2.1 (8.3)	34.6
5.	Quinalphos 25% EC	200	5.33	84.8 (67.0)	66.8 (54.8)	26.8 (31.1)	26.4
6.	Lambda cyhalothrin 5% EC	15	6.33	86.2 (68.2)	60.4 (51.0)	20.6(27.0)	30.8
7.	Cypermethrin 10 EC	60	6.00	72.8 (58.5)	51.8 (46.0)	31.6 (34.2)	24.4
8.	Untreated Check	-	5.67	+51.4 (0.0)	+68.4 (0.0)	72.8 (58.5)	11.2
	CD AT 5%		NS	4.60	3.92	3.44	2.90

N. B. Figures in parentheses are angular transformed values.
N.S. = Not significant.

Table 1b. Effect of chemicals on *H. armigera* of Okra and on (yield mean of three sprayings) June - September, 2007.

S/No.	Treatments	Dose (gm a.i./ha)	Pre application count of borer/plant	% reduction/increase (+) in borer popl. after spray		% fruit infested by borer	Fruit yield without borer infestation (q/ha)
				3rd	7th		
1.	Spinosad 45% SC	45	5.67	72.8 (58.5)	70.2 (56.9)	22.8 (28.5)	32.1
2.	Spinosad 45% SC	56	4.67	84.8 (67.0)	78.4 (62.3)	10.6 (19.0)	33.8
3.	Spinosad 45% SC	73	5.33	100 (90.0)	100 (90.0)	2.6 (9.2)	37.9
4.	Spinosad 45% SC	84	5.33	100 (90.0)	100 (90.0)	2.2 (8.5)	38.3
5.	Quinalphos 25% EC	200	5.00	80.2 (63.5)	60.6 (51.1)	31.6 (34.2)	32.8
6.	Lambda cyhalothrin 5% EC	15	4.67	89.1 (70.7)	65.4 (53.9)	25.2 (28.7)	31.6
7.	Cypermethrin 10 EC	60	5.00	68.6 (55.9)	44.3 (41.7)	36.4 (37.1)	2.5
8.	Untreated Check	-	4.67	+38.8 (0.0)	+74.4 (0.0)	78.6 (62.4)	9.4
	CD AT 5%		NS	4.60	3.92	3.44	2.90

N. B. Figures in parentheses are angular transformed values.
N. S. = Not significant.

a randomized block design with eight treatments replicated three times at 'Gayespur' village (Nadia, West-Bengal). The insecticide treatments included four doses Spinosad 45% SC (Spinosyn A 50% minimum and Spinosyn D 50% maximum) at 45, 56, 73 and 84 g a.i/ha, quinalphos 25 % EC at 200 g a.i/ha; lambda cyhalothrin 5% EC at 15 g a.i/ha and Cypermethrin 10 EC at 60 g a.i/ha (Table 1a and b) along with an untreated control. Tomato variety 'Rupali' was grown in plot of size 40 m^2 at spacing of 90 × 40 with recommended package of practices excluding plant protection. The insecticides are sprayed after a sufficient borer population was built up and thereafter two sprays at

Table 2a. Effect of Spinosad 45 SC on important natural enemies found in association with *H. armigera* of tomato during September – December, 2006.

S/No	Treatments	Dose (g a i / ha)	No. of predators per 10 branches		
			Menochilus sexmaculatus	***Syrphus corollae***	***Chrysoperla carnea***
1	Spinosad 45% SC	56	3.12 (1.77)	2.92 (1.71)	1.33 (1.15)
2	Spinosad 45% SC	73	3.28 (1.81)	3.10 (1.76)	1.67 (1.29)
3	Spinosad 45% SC	84	3.02 (1.74)	3.04(1.74)	1.33 (1.15)
4	Untreated Control	-	3.10 (1.77	2.96 (1.72)	1.67 (1.29)
	CD at 5%		NS	NS	NS

N. B. Figures in parentheses are square root transformed values.
N.S = Not significant.

ten days interval with a high volume knack sac sprayer using 500 litres of spray fluid per hectare.

The control plot was sprayed with water only. Ten randomly selected plants were chosen to count the number of *H. armigera* at one day before and 3 and 7 days after each insecticide application. The rate of infestation of fruits by *H. armigera* was taken into account at each picking. For natural enemies, ten plants were selected randomly and ten leaves were again chosen at random from each of the ten plants. Each leaf was examined on 3rd day after each spraying to count the number of predators found on leaves. Three major groups of predators were identified as *Menochilus sexmaculatus*, *Syrphus corollae* and *Chrysoperla carnea.* The data were subjected to analysis of variance after making necessary transformation. Means are differentiated by LSD. Observations were also recorded on yield.

RESULTS AND DISCUSSION

It was revealed from Table 1a that there was no significant difference in the pre-application count of borer population between treatments as well as control during September - December, 2006. All the treated plots with chemicals were significantly superior in their performance over that of control plots. At 3 days after spraying, highest percentage (100%) of reduction of *H. armigera* population was recorded in Spinosad treatments of 73 and 84 g a.i/ha followed by Spinosad at 56 g a.i/ha (88.6%), lamda-cyhalothrin (86.2%), quinalphos (84.8%), Spinosad at 45 g a.i/ha (78.4%) and cypermethrin (72.8%). After 7 days of spraying, Spinosad at 73 and 84 g a.i/ha showed highest parentage of reduction of *H. armigera* population (100%) while lamda-cyhalothrin recorded decreased percent reduction of *H. armigera* population (60.4%). A steady increase in the *H. armigera* population was observed in untreated control plot through out the experiment. Percentage of fruit infested by *H. armigera* was lowest in Spinosad at 73 and 84 g a.i/ha (2.1 - 2.4%) than the other treatments. Maximum uninfested fruit yield was also highest in Spinosad at 73 and 84 g a.i/ha (33.8 - 34.6 q/ha) as compared to untreated control (2.48 q/ha).

As revealed in Table 1b, pre-application count of *H. armigera* larval population was not varied significantly from each other and control during September - December, 2007. After 3 days of spraying, highest percentage of reduction of *H. armigera* population was recorded in Spinosad at 73 and 84 g a.i/ha (100%) followed by lamda-cyhalothrin (89.1%) as compare to other treatments including control. Spinosad at 73 and 84 g a.i/ha retained the highest efficacy in reducing borer population up to 7 days after sprayings. Cypermethrin recorded lowest percentage of reduction of borer population (44.3%) after 7 days of spraying. Lowest percentage of fruit infested by borer was found in plots treated with Spinosad at 73 and 84 g a.i/ha (2.2 – 2.6%) followed by Spinosad at 56 g a.i/ha (10.6%), lamda-cyhalothrin (25.2%), Spinosad at 45 g a.i/ha (22.8%), quinalphos (31.6%) and cypermethrin (36.4%), whereas in control it was 78.6%. Highest fruit yield without borer infestation was also recorded in Spinosad at 73 and 84 g a.i/ha (37.9 - 38.3 q/ha).

Tables 2a and b showed that all the treated plots with Spinosad were very safe to three important predators recorded in tomato field, that is, *M. sexmaculatus*, *S. corollae* and *C. carnea*. Spinosad is an extract of the fermented broth of soil actinomyces *S. spinosa* containing a naturally occurring mixture of spinosyn A and spinosyn D. Spinosad have rapid contact and ingestion activitv in insects, causing excitation of the nervous system, leading to cessation of feeding and paralysis. Spinosad provides effective control of Lepidopteran, thysanopteran pests and some coleopteran, homopteran, hymanopteran and orthopteran species. There is no reported phytotoxic activity of spinosad based products. Degradation of Spinosad in the environment occurs mainly by photodegradation and microbial degredation. Spinosad has relatively low toxicity to mammals and birds and exhibits wide margin of safety to many beneficial insects (Thompson and Hutchins, 1999). Three laboratory studies and three field treated trials in different locations of U. S. A. demonstrated ovicidal and ova-larvicidal action of Spinosad on freshly laid eggs of *Heliothis virescens* and *Helicoverpa zea* in cotton. The labeled rate of 0.06 lb a.i./ha of spinosad gave ovicidal activity at per and the ova-larvicidal activity proved superior than others. As an added IPM benefit, Spinosad allowed natural parasitism by *Trichogramma* sp. similar to that of untresated control (Peterson et al., 1998). Aspect of bio-

Table 2b. Effect of Spinosad 45 SC on important natural enemies found in association with *H. armigera* of tomato during September – December, 2007.

S/No	Treatments	Dose (gm ai/ha)	No. of predators per 10 branches		
			Menochilus sexmaculatus	***Syrphus corollae***	***Chrysoperla carnea***
1	Spinosad 45 SC	56	2.88 (1.70)	3.24 (1.80)	0.96 (0.98)
2	Spinosad 45 SC	73	2.80 (1.67)	3.12 (1.77)	0.88 (0.94)
3	Spinosad 45 SC	84	2.96 (1.72)	3.30 (1.82)	1.06 (1.03)
4	Untreated Control		2.96 (1.72)	2.18 (1.48)	0.92 (0.96)
	CD at 5%		NS	NS	NS

N. B. Figures in parentheses are square root transformed values.
N. S = Not significant.

logical activities of Spinosad to larvae of *H. virescens* and other lepidopteran insects were described by Sparks et al. (1995). Our present findings on the efficacy of Spinosad are similar with the findings of Sidde Gowda et al. (2003). In this findings Spinosad 45 SC for two years was highly effective against pigeonpea fruit borer; *H. armigera* (Hubner) at four dosages, viz., 45, 56, 73 and 90 g a.i./ha.

Conclusion

It is evident from the present investigation that Spinosad was effective against *Helicoverpa armigera* of Tomato at 73 to 84 gm a.i. /ha and was very safe to three important predators recorded in tomato field, that is, *M. sexmaculatus, S. corollae* and *C. carnea* of *H. armigera*.

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