

Evaluation of some synthetic pyrethroids for management of cotton bollworm at different locations of Bangladesh

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Abstract: Three synthetic pyrethroids viz. Ripcord 10 EC, Decis 2.5 EC and Relothrin 25 EC were sprayed using different doses for management of spotted and american bollworm of cotton at three locations viz. Dinajpur, Jessore and Gazipur of Bangladesh. Performances of the insecticides were also evaluated on the lady beetle abundance, yield of seed cotton and on benefit cost ratio. This study revealed that higher doses and decreased spray number of insecticides showed lower incidence of pest and predator populations. Doses of insecticides and spray number significantly affect the production of yield. The benefit cost ratio indicated that management of bollworms using Ripcord 10EC or Decis 2.5EC or Relothrin 25EC @ 3.0 ml/l water is more profitable.

Key words: Cotton, bollworms, insecticides

Introduction

Cotton (*Gossypium hirsutum*) is highly susceptible to insect pests and attacked by different species from germination to final picking. The sub-tropical climate in Bangladesh resulted severe pest infestation and the crop is subject to damage by 162 species of insects those are generally categorized into sucking and chewing pests (Amin *et al.*, 2008). The most destructive chewing pests of cotton in Bangladesh are spotted bollworm (*Earias insulana*) and american bollworm (*Helicoverpa armigera*). Bollworms cause about 30 to 40% losses of yield of seed cotton (Haque *et al.*, 1991). They mainly feed on fruiting parts of cotton resulting in considerable losses both in quality and quantity (Ahmed, 1980).

Crop protection with chemicals is desirable and unavoidable part of integrated pest management (Mohyuddin *et al.*, 1997). Even in the technological advanced countries, about 3% of market value of agricultural crops is spent on toxic chemicals and their application. In Pakistan, pesticides worth more than 10 billion rupees, out of which 70 to 80% are sprayed against cotton pests (Aslam *et al.*, 2004). Synthetic pyrethroids are most active insecticides in terms of their effective concentrations. These should be applied at the proper rates and should be used only when necessary. Thus, the present study was conducted to evaluate different products of synthetic pyrethroids available in the market for their efficacy against bollworms of cotton at three locations of Bangladesh.

Materials and Methods

Cultivation of crop: The experiment was conducted during August to December 2005 and 2006 at three regional cotton research, training and seed multiplication farm namely Dinajpur, Jessore and Gazipur. The stations are located in different agro-ecological zones of Bangladesh. The soil was sandy loam with pH 4.5 to 5.5. At all the station previous crop was sunheamp as a green manure. Irrigation and drainage facilities were readily available in the farm. The Land was prepared at field condition by deep ploughing and harrowing followed by laddering. The field layout was done after final land preparation. The experiment was conducted in randomized complete block design with the cotton variety CB-9. The plot size was 10 × 10 m. The spacing between block-to-block and plot-to-plot were 1.5 and 1m and respective

footpath was 2 m. Seeds were sown on 1st week of August 2005 and 2006, at the rate of 15 kg /ha in a north-south row. The seeds were sown by hand keeping a distance of 45 cm from plant to plant and row-to-row distance was 90 cm. Necessary intercultural operations such as mulching, weeding, irrigation and application of fertilizer were done properly.

Treatments and application: Three synthetic pyrethroids viz. Ripcord 10 EC, Decis 2.5EC and Relothrin 25EC were used in this experiment. Spraying was done on the basis of threshold level by using a knapsack sprayer. Threshold levels for bollworms were 0.25 larvae or 0.50 eggs per plant. Evaluation of the pyrethroids was assessed by the incidence (number of insect/ plant) of pests, predator abundance (lady beetle) and economic return of the crop. To estimate the incidence of pests and predator abundance, sampling was carried out from August to December. It was done by weekly scouting taking 5 plants randomly from each replication. Plants were examined for spotted bollworm, american bollworm and lady beetle. A scouting form was used during estimation of the pests.

Data analysis: Variable cost and net return was calculated as per Tague and Shelstad (1981). The benefit cost ratio was calculated by dividing the net return by total variable cost. Data of the different parameters were analyzed by analysis of variance and the mean values were separated by Duncan's Multiple Range Test (DMRT).

Results

Table 1 showed that at Dinajpur station, insecticides were sprayed 4 to 7 times @ 2.0 to 3.0 ml/l. The incidence of spotted bollworm was lowest (0.06) when Decis was sprayed 5 times @ 3.0 ml/l. American bollworm incidence was statistically indifferent (0.13 to 0.16) in all the treatments. Doses of insecticides and their spray number significantly effect on the lady beetle abundance. The highest abundance (1.33) occurred to the treatment Relothrin @ 2.0 ml/l and the treatments Ripcord and Decis @ 2.0 ml/l showed statistically identical results (1.25 and 1.32). On the other hand, Ripcord, Decis and Relothrin @ 3.0 ml/l showed significantly lowest lady beetle abundance. The treatment Ripcord @ 3.0 ml/l sprayed for 4 times resulted the highest amount (2088 kg/ha) of yield (seed cotton) while Relothrin @ 2.0 m l/l produced the lowest amount (1438 kg/ha) of seed cotton.

Table 1. Evaluation of some synthetic pyrethroids on the mean incidence of pest, predator abundance and yield of cotton at Dinajpur station for the year 2005 and 2006

Treatments	Dose (ml/l)	No. of Spray	Number of insect/plant			Yield (Kg/ha)
			Spotted bollworm	American bollworm	Lady beetle	
Ripcord	2.0	6	0.12 a	0.16 a	1.25 a	1539 b
Ripcord	2.5	5	0.10 ab	0.14 a	0.81 ab	1810 ab
Ripcord	3.0	4	0.08 b	0.13 a	0.62 b	2088 a
Decis	2.0	7	0.11 a	0.16 a	1.32 a	1459 b
Decis	2.5	6	0.09 ab	0.15 a	0.82 ab	1698 ab
Decis	3.0	5	0.06 b	0.14 a	0.68 b	1901 a
Relothrin	2.0	7	0.09 ab	0.16 a	1.33 a	1438 b
Relothrin	2.5	6	0.08 b	0.15 a	0.88 ab	1648 ab
Relothrin	3.0	4	0.07 b	0.14 a	0.69 b	1800 ab

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Table 2 showed the results obtained from the Jessore station where the treatments were applied 5 to 8 times. At this station, incidence of spotted bollworm ranged from 0.16 to 0.20 and there was no significant difference. The incidence of american bollworm varied from 0.17 to 0.23 and the results were statistically indifferent. The lady beetle abundance ranged from 0.62 to 1.36, and the results

showed that lower doses and increased spray number of insecticides revealed the higher number of predator abundance. Table 2 showed that spray number and doses of insecticides significantly effect on the production of yield. The highest (1511 kg/ha) and lowest (922 kg/ha) amount of yield were obtained by the treatments Ripcord @ 3.0 ml/l and Relothrin @ 2.0 ml/l, respectively.

Table 2. Evaluation of some synthetic pyrethroids on the mean incidence of pest, predator abundance and yield of cotton at Jessore station for the year 2005 and 2006

Treatments	Dose (ml/l)	No. of Spray	Number of insect/plant			Yield (Kg/ha)
			Spotted bollworm	American bollworm	Lady beetle	
Ripcord	2.0	7	0.18 a	0.20 a	1.27 a	1127 b
Ripcord	2.5	6	0.17 a	0.18 a	0.73 b	1471 a
Ripcord	3.0	5	0.16 a	0.17 a	0.62 b	1511 a
Decis	2.0	8	0.20 a	0.23 a	1.36 a	1030 b
Decis	2.5	7	0.18 a	0.21 a	0.77 b	1365 ab
Decis	3.0	6	0.17 a	0.20 a	0.67 b	1380 ab
Relothrin	2.0	8	0.19 a	0.22 a	1.32 a	922 b
Relothrin	2.5	7	0.17 a	0.20 a	0.93 ab	1168 ab
Relothrin	3.0	6	0.16 a	0.19 a	0.74 b	1202 ab

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$).

At Gazipur station, the insecticides were sprayed 5 to 8 times @ 2.0 to 3.0 ml/l (Table 3). The incidence of spotted bollworm was statistically indifferent in all the treatments and ranged from 0.12 to 0.22. The incidence of american bollworm ranged from 0.11 to 0.25 and the results were statistically insignificant. Abundance of predator was dependent on the spray number and doses of insecticides

and it ranged from 0.34 to 0.53, and the highest abundance obtained in the treatment Ripcord @ 2.0 ml/l. Doses of insecticides and their spray number significantly effect on the production of yield. The highest (940 kg/ha) and lowest amount (640 kg/ha) of yield were obtained by the treatments Decis @ 3.0 ml/l and Relothrin @ 2.0 ml/l, respectively.

Table 3. Evaluation of some synthetic pyrethroids on the mean incidence of pest, predator abundance and yield of cotton at Gazipur station for the year 2005 and 2006

Treatment	Dose (ml/L)	No. of Spray	Number of insect/plant			Yield (Kg/ha)
			Spotted bollworm	American bollworm	Lady beetle	
Ripcord	2.0	8	0.21 a	0.22 a	0.53 a	680 b
Ripcord	2.5	6	0.15 a	0.17 a	0.44 a	710 b
Ripcord	3.0	5	0.14 a	0.13 a	0.38 ab	830 ab
Decis	2.0	7	0.21 a	0.20 a	0.46 a	663 b
Decis	2.5	6	0.16 a	0.15 a	0.36 ab	777 ab
Decis	3.0	5	0.12 a	0.11 a	0.34 ab	940 a
Relothrin	2.0	8	0.22 a	0.25 a	0.47 a	640 b
Relothrin	2.5	7	0.18 a	0.18 a	0.37 ab	760 ab
Relothrin	3.0	6	0.14 a	0.13 a	0.34 ab	817 ab

Means within a column followed by the same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Benefit cost ratio of some synthetic pyrethroids used for controlling bollworm at Dinajpur station in the year 2005 and 2006 presented in table 4. Results showed that insecticide cost increased with increasing doses while the labour cost decreased. Total variable cost ranged from 3240 to 4200 Tk. and was dependent on the number of

spray and doses of insecticides. All the treatment showed that gross return, net return and benefit cost ratio increased with increasing doses of insecticides. The highest (17.04) and lowest (8.75) benefit cost ratio were achieved by the treatments Ripcord @ 3.0 ml/l and Relothrin @ 2.0 ml/l, respectively.

Table 4. Polled benefit cost ratio of some synthetic pyrethroids used at Dinajpur station for the year 2005 and 2006

Treatment	Dose (ml/L)	No. of Spray	Variable cost (Tk)			Return (Tk)		Benefit cost ratio
			Insecticide	Labour	Total	Gross	Net	
Ripcord	2.0	6	2640	900	3540	43092	39552	11.17
Ripcord	2.5	5	2750	750	3500	50680	47180	13.48
Ripcord	3.0	4	2640	600	3240	58454	55214	17.04
Decis	2.0	7	3080	1050	4130	40842	36712	8.89
Decis	2.5	6	3300	900	4200	47544	43344	10.32
Decis	3.0	5	3300	750	4050	53228	49178	12.14
Relothrin	2.0	7	3080	1050	4130	40254	36124	8.75
Relothrin	2.5	6	3300	900	4200	46162	41962	9.99
Relothrin	3.0	4	2640	600	3240	50400	47160	14.56

Insecticides: Decis/ Ripcord/ Relithrin-1100Tk. /l, Labor: 2 labor /spray/ha (75 Tk. / labor)

Table 5 showed the benefit cost ratio obtained from Jessore station where insecticide cost ranged from 3080 to 3960 Tk. and varied with increasing doses. Labour cost was dependent on number of spray and varied from 750 to 1200 Tk. Total variable cost ranged from 4050 to 4900 Tk., and was dependent on number of spray and doses of insecticides. Both gross and net return increased with

increasing doses of insecticides and varied from 25816 to 42308 and 21096 to 38258 Tk., respectively. Benefit cost ratio also dependent on the doses of insecticides and ranged from 4.47 to 9.45, and were obtained by the treatments Ripcord @ 3.0 ml/l and Relothrin @ 2.0ml/l, respectively.

Table 5. Polled benefit cost ratio of some synthetic pyrethroids used at Jessore station for the year 2005 and 2006

Treatment	Dose (ml/L)	No. of Spray	Variable cost (Tk)			Return (Tk)		Benefit cost ratio
			Insecticide	Labour	Total	Gross	Net	
Ripcord	2.0	7	3080	1050	4130	31556	27426	6.64
Ripcord	2.5	6	3300	900	4200	41188	36988	8.81
Ripcord	3.0	5	3300	750	4050	42308	38258	9.45
Decis	2.0	8	3520	1200	4720	28840	24120	5.11
Decis	2.5	7	3850	1050	4900	38220	33320	6.80
Decis	3.0	6	3960	900	4860	38640	33780	6.95
Relothrin	2.0	8	3520	1200	4720	25816	21096	4.47
Relothrin	2.5	7	3850	1050	4900	32704	27804	5.67
Relothrin	3.0	6	3960	900	4860	33656	28796	5.93

Insecticides: Decis/ Ripcord/ Relithrin-1100Tk. /l, Labor: 2 labor /spray/ha (75 Tk. / labor)

Polled benefit cost ratio of some synthetic pyrethroids used at Gazipur station for controlling bollworms of cotton during the year 2005 and 2006 presented in Table 6. Table showed that insecticide, labor and total variable cost ranged from 3080 to 3960, 750 to 1200 and 4050 to 4900 Tk., respectively. Gross and net return were dependent on

the number of spray and doses of insecticides and ranged from 17920 to 26320 and 13200 to 22270 Tk. respectively. The benefit cost ratio ranged from 2.80 to 5.50, and were obtained by the treatments Decis @ 3.0 ml/l and Relothrin @ 2.0 ml/l, respectively.

Table 6. Polled benefit cost ratio of some synthetic pyrethroids used at Gazipur station for the year 2005 and 2006

Treatment	Dose (ml/L)	No. of Spray	Variable cost (Tk)			Return (Tk)		Benefit cost ratio
			Insecticide	Labour	Total	Gross	Net	
Ripcord	2.0	8	3520	1200	4720	19040	14320	3.03
Ripcord	2.5	6	3300	900	4200	19880	15680	3.73
Ripcord	3.0	5	3300	750	4050	23240	19190	4.74
Decis	2.0	7	3080	1050	4130	18564	14434	3.49
Decis	2.5	6	3300	900	4200	21756	17556	4.18
Decis	3.0	5	3300	750	4050	26320	22270	5.50
Relothrin	2.0	8	3520	1200	4720	17920	13200	2.80
Relothrin	2.5	7	3850	1050	4900	21280	16380	3.34
Relothrin	3.0	6	3960	900	4860	22876	18016	3.71

Insecticides: Decis/ Ripcord/ Relithrin-1100Tk. /l, Labor: 2 labor /spray/ha (75 Tk. / labor)

Discussion

In this study, three pyrethroids viz. Ripcord 10EC, Decis 2.5EC and Relothrin 25EC were sprayed for controlling spotted and american bollworm of cotton at three locations of Bangladesh. Effect of the pyrethroids on the pest as well as on the predator and yield of cotton were studied. All the insecticides were sprayed @ 2.0, 2.5 and 3.0 ml/l water and their spray number varied from 4 to 8 times. The pyrethroids were sprayed varied times at different locations because of the emergence of pest at economic threshold level. The incidence of pests and predator abundance were not similar at all the locations because of different ecological factors. At different ecological zones, crops were subjected to the fatal consequences of pest and weather that significantly affect the yield and benefit cost ratio.

The results obtained from Dinajpur station stated that the doses of pyrethroids significantly effect on the incidence of spotted bollworm and lady beetle abundance. The incidence of bollworm and lady beetle abundance decreased with increasing doses of insecticides. Though the incidence of american bollworm decreased with increasing doses of insecticides but the results were statistically indifferent. The yield of cotton at Dinajpur station increased with the increasing doses of insecticides and there were significant differences. At Jessore and Gazipur stations, the incidence of spotted bollworm and american bollworm decreased with the increasing doses of insecticides and there were no significant difference. The lady beetle abundance decreased significantly with increasing doses of insecticides and increasing doses of insecticides effect on the yield of seed cotton. Findings of the study indicated that applied insecticides were confident

and prudent enough to control the bollworms of cotton but showed toxic effect on the predator.

In this study, insecticides were applied at the threshold level to avoid unnecessary burden of the environment. As a result, lady beetles were abundant in the field. However, to protect predators, insecticides should be applied at the proper doses and should be applied only when necessary, as determined by frequent field inspections, to prevent economic losses from pests.

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