

Performances of Three Cotton Varieties Cultivated under Economic Threshold Level Based Insecticide Sprayed and Non-Sprayed Conditions

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Abstract

Cotton growers of Bangladesh usually cultivate eleven varieties of cotton and abruptly use chemical insecticides for controlling pests. In this study we evaluated the performances of three extensively cultivated varieties (CB9, CB10 and SR05) under economic threshold level (ETL) based insecticide sprayed and non-sprayed conditions. Results showed that number of bolls per plant and yield of the varieties differ significantly and there was found significant difference between the experimental conditions. Our study showed that the variety SR05 produced significantly higher number of bolls (40.5 ± 6.6 /plant) and yield (2498.3 ± 18.9 kg/ha) compared to CB9 and CB10, whereas CB9 produced higher number of seed (36.9 ± 3.7 /boll) and seed index (83.4 ± 0.9 g/100 seed) under ETL based insecticide sprayed condition. The ginning out turn (GOT%) and seed germination percentage of the studied varieties did not differ to a significant level. Overall fitness of the varieties indicated that SR05 possesses comparatively better performances for commercial production of cotton in Bangladesh.

Key words: Cotton, variety, yield, seed quality.

Introduction

Six hundred insects and spider species have been recorded in cotton fields (Hoffmann and Frodsham, 1993). The number of insect species that attack the crop as pest may be about 162 while significant damage is caused by 15 species (Dhawan, 2000). The most destructive pests of cotton in Bangladesh are jassid, aphid, white fly, thrips, spotted bollworm, american bollworm, pink bollworm and armyworm (Annual Research Report, 1999). These pests cause damage to cotton leaves, shoots, flowers, fruits and seeds by feeding and or transmitting diseases (Abou-Elhagag, 1998).

Cotton growers spray insecticides throughout the season to protect their crops, but indiscriminate uses of chemical insecticides create complications in the ecosystem and reduce the abundance of predators and insect pollinators. Morphological, physical or structural qualities of host plants interfere with insect feeding and reproduction behaviour (Goertzen and Small, 1993) and insects mostly feed and oviposit on high quality plants (Chen *et al.*, 2004; Prudic *et al.*, 2005). Researchers are working to establish economic threshold level (ETL) and also

improving varieties at which no action is needed to control pests. Therefore, the objective of this study was to quantify the yield and seed quality performances of three cotton varieties which are morphologically different and were grown under ETL based insecticide sprayed and non-sprayed conditions.

Materials and methods

Cultivation of crop

The experiment was conducted in the Regional Cotton Research Station, Dinajpur, Bangladesh (25°13'N, 88°23'E) during August, 2008 to March, 2009. The land was prepared at field condition by deep ploughing and harrowing followed by laddering. The field layout was done after final land preparation and the experiment was conducted in randomized complete block design. The plot size was 5.4×5.0 m² and the spacing between block to block and plot to plot was 1.5 m and 1.0 m, respectively. Seeds of CB9, CB10 and SR05 were sown in rows with a spacing 45 cm from plant to plant and 90 cm from row to row. Intercultural operations such as mulching, weeding and irrigation etc were done whenever necessary. Crops were cultivated under ETL based insecticide sprayed and non-sprayed conditions. Application of fertilizers and ETL was estimated by the guideline of the Cotton Development Board of Bangladesh. Each cultivation condition was replicated three times for each variety. In the non-sprayed condition crops were exposed to natural infestation whereas in the ETL based insecticide sprayed condition Decis 2.5 EC and Asataf 75 SP were applied for controlling chewing and sucking pests, respectively.

Observation of boll production

Ten plants were selected randomly for each variety, fully opened bolls of these plants were picked up by hand and number of bolls produced in each plant was recorded.

Observation of yield production

Harvested cotton was weighed immediately to avoid hygroscopic effect. Amount of seed cotton of each variety obtained from same cultivation condition was converted to kg/ha. Seeds were exposed from the locks of the boll and number of seeds of each boll was recorded. Following ginning, separated fibers and seeds were weight separately, and the ginning out tern (the ratio of the weight of lint to that of seed cotton expressed as percentage) and seed index (weight in g/100 seeds) of each variety and cultivation conditions were determined.

Germination test was conducted using sand as substratum. The sand was sieved to discard particles bigger than 0.8 mm and smaller than 0.05 mm in diameter. Rectangular plastic boxes were used to put the sand. For every test new sand was used. Seed was placed on a uniform layer of moist sand and then covered to a depth of 10 mm with sand, which was left loose. 200 seeds were planted in each plastic tray and replicated three times. The plastic trays with seeds were incubated at room temperature and irrigated at every odd day. After 5 days, germination percentage was recorded. The normal seedlings and abnormal seedlings and nongerminated seeds were classified according to the prescribed rules given by International Seed Testing Association (ISTA) and germination rates were calculated using the following formula.

Germination (%) =

$$\frac{\text{Number of normal seeds germinated}}{\text{Number of seeds tested}} \times 100$$

Data analysis

One way ANOVA following Duncan’s Multiple Range Test (DMRT) and pair sample ‘T’ test were employed using SPSS (PASW Statistics 18) for analyzing the data.

Results and discussion

Boll production of CB9, CB10 and SR05 showed significant differences both in ETL based insecticide sprayed ($F_{2, 27} = 3.72, p = 0.05$) and no-sprayed ($F_{2, 27} = 5.23, p = 0.05$) conditions (Tab. 1). All the varieties produced significantly higher number of bolls under ETL based insecticide sprayed condition compared to non-sprayed condition (Tab. 1). This study also showed better performances of boll production under ETL based insecticide sprayed conditions compared to Amin *et al.* (2008) who applied insecticides to keep damage below economic injury level and found boll production 27.7, 24.7 and 29.0/plant of the varieties CB9, CB10 and SR05, respectively. Among the studied varieties, SR05 produced significantly higher number of bolls both ETL based insecticide sprayed (40.5±6.6/plant) and non-sprayed (12.6±3.1/plant) conditions, because it is a moderately height and long lived variety having well ventilation (Amin *et al.*, 2011). Yield of the varieties varied significantly both in ETL based insecticide sprayed ($F_{2, 6} = 274.3, p = 0.001$) and non-sprayed ($F_{2, 6} = 233.9, p = 0.001$) conditions (Tab. 2), and all the varieties showed significant differences between ETL based insecticide

sprayed and non-sprayed conditions (Tab. 2). Results showed that yield obtained from ETL based insecticide sprayed conditions ranged from 2173.3±15.3 to 2498.3±18.9 kg/ha and the variety SR05 produced significantly the highest yield. This variety also produced significantly higher yield (792.3±8.7 kg/ha) under non-sprayed condition. Obtained yield of CB9, CB10 and SR05 under ETL based insecticide sprayed condition in this study revealed better performances than Amin *et al.* (2008) who found 1650, 1350 and 1600 kg/ha, respectively yield of these varieties.

Table 1. Number of boll production of three cotton varieties and their comparisons under ETL based insecticide sprayed and non-sprayed conditions

Variety	Boll production (mean ± SD/plant)		t statistics		
	ETL based	Non-sprayed	t	df	P
CB9	34.1 ± 7.1 ab	11.5 ± 2.9 a	8.7	9	<0.001
CB10	32.2 ± 7.6 b	8.2 ± 3.5 b	10.5	9	<0.001
SR05	40.5 ± 6.6 a	12.6 ± 3.1 a	15.7	9	<0.001

N = 10 plants for each variety and treatment. Means within a column followed by same letter(s) are not significantly different by DMRT ($p \leq 0.05$)

Table 2. Yield (seed cotton) of three cotton varieties and their comparisons under ETL based insecticide sprayed and non-sprayed conditions

Variety	Yield (mean ± SD Kg/ha)		t statistics		
	ETL based	Non-sprayed	t	df	P
CB9	2248.3 ± 18.9 b	749.3 ± 9.0 b	120.7	2	<0.001
CB10	2173.3 ± 15.3c	618.3 ± 12.6c	123.6	2	<0.001
SR05	2498.3 ± 18.9 a	792.3 ± 8.7 a	125.6	2	<0.001

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

The studied cotton varieties showed significant differences on production of seeds per boll under ETL based insecticide sprayed ($F_{2,27} = 3.2, p = 0.05$) and non-sprayed ($F_{2,27} = 4.2, p = 0.05$) conditions (Tab. 3). But comparisons between ETL based insecticide sprayed and no-sprayed

conditions for each variety were statistically insignificant (Tab. 3). Among the varieties CB9 produced significantly the highest number of seeds/boll both under ETL based insecticide sprayed (36.9±3.7) and non-sprayed conditions (34.2±2.2). This may be the reason that boll size of CB9 is comparatively bigger (Amin *et al.*, 2011)

Table 3. Number of seed production of three cotton varieties and their comparisons under ETL based insecticide sprayed and non-sprayed conditions

Variety	Seed production (mean ± SD number/boll)		t statistics		
	ETL based	Non-sprayed	t	df	P
CB9	36.9 ± 3.7 a	34.2 ± 2.2 a	2.1	9	0.06
CB10	32.2 ± 4.1 b	30.1 ± 3.3 b	1.9	9	0.09
SR05	35.5 ± 4.7 ab	32.1 ± 3.8 ab	1.6	9	0.12

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

Table 4. Ginning out tern (GOT%) of three cotton varieties and their comparisons under ETL based insecticide sprayed and non-sprayed conditions

Variety	GOT% (mean ± SD)		t statistics		
	ETL based	Non-sprayed	t	df	P
CB9	37.4 ± 0.7 a	37.0 ± 0.4 a	0.6	2	0.59
CB10	37.5 ± 0.7 a	37.3 ± 0.9 a	0.2	2	0.85
SR05	36.6 ± 0.5 a	36.2 ± 0.5 a	4.0	2	0.06

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

Table 5. Seed index (weight of 100 seeds) of three cotton varieties and their comparisons under ETL based insecticide sprayed and non-sprayed conditions

Variety	Seed index (mean ± SD g)		t statistics		
	ETL based	Non-sprayed	t	df	P
CB9	83.4 ± 0.9 a	83.0 ± 0.7 a	0.4	2	0.75
CB10	75.2 ± 1.0 c	75.1 ± 0.6 c	0.5	2	0.67
SR05	78.1 ± 0.5 b	77.9 ± 0.7 b	0.5	2	0.68

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

and thus produced higher number of seeds. Ginning out tern (GOT%) of CB9, CB10 and SR05 varied from 36.6±0.5 to 37.5±0.7 (Tab. 4) and these results were found under

ETL based insecticide sprayed conditions and the results did not vary significantly ($F_{2,6} = 1.86$, $p = 0.24$). GOT% of these varieties under non-sprayed conditions ranged from 36.2±0.5 to 37.3±0.9 (Tab. 4) and these results also did not show significant difference ($F_{2,6} = 2.45$, $p = 0.16$), and comparisons of the varieties grown under ETL based insecticide sprayed and non-sprayed conditions were statistically insignificant (Tab. 4). There were significant differences among the seed index of the varieties both in ETL based insecticide sprayed ($F_{2,6} = 79.8$, $p = 0.001$) and non-sprayed ($F_{2,6} = 107.6$, $p = 0.001$) conditions. But comparisons of the seed index of the varieties were statistically similar between the conditions (Tab. 5). Germination percentage of CB9, CB10 and SR05 were found statistically similar both in ETL based insecticide sprayed ($F_{2,6} = 0.06$, $p = 0.95$) and non-sprayed ($F_{2,6} = 0.03$, $p = 0.98$) conditions, and there was no significant difference between the conditions of the experiment (Tab. 6).

Table 6. Germination performance of three cotton varieties and their comparisons under ETL based insecticide sprayed and non-sprayed conditions

Variety	Germination (mean ± SD%)		t statistics		
	ETL based	Non-sprayed	t	df	P
CB9	87.3 ± 2.9 a	81.3 ± 6.1 a	1.2	2	0.36
CB10	88.3 ± 4.0 a	82.3 ± 6.0 a	1.7	2	0.24
SR05	87.7 ± 4.0 a	81.7 ± 4.7 a	1.2	2	0.36

Means within a column followed by same letter(s) are not significant

The results of this study indicated that all the varieties produced significantly higher number of bolls and yield under ETL based insecticide sprayed condition compared to non-sprayed condition. But seed production, ginning out tern, seed index and germination percentage were

statistically similar under those conditions. Indiscriminate use of chemical insecticides in the cotton field adversely affect the beneficial insect fauna (Khattak *et al.*, 2004) whereas threshold sprayed avoid unnecessary burden of the environment and justifies the use of control measures and resulted more yield and profit (Ali and Karim, 1990). SR05 is a serrated leaf variety with well ventilated, potential and prudent enough to overcome insect attack. It is surprisingly true that the yield contributing characters such as plant height, boll size, boll weight and number of bolls are enthusiastic in the varieties CB9 and SR05. So, these varieties possessed comparatively better performances for commercial cultivation of cotton in Bangladesh.

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