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Field evaluation of different insecticides against spotted bollworm (*Earias* spp.) and comparative yield assessment for BT and non-Bt cotton

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Abstract

Cotton (*Gossypium hirsutum* L.) is an important cash crop of Indo-Pak region. Spotted bollworm (*Earias* spp. Fab.) is one of the serious lepidopterous pests of cotton. This study evaluated the comparative efficacy of Triazophos (Trizone 40 EC), Thiamethoxam+Chlorantraniliprole (Voliam-flexi 300 SE), Flubendiamide (Belt 480 SC), Emmamectin benzoate (Sajan 1.9 EC) and Gamma-Cyhalothrin (Proaxis 60 CS) against spotted bollworms on three Bt (Bt-703, Bt-3701, Tarzan) and three non-Bt (Anmol, C-26, FH-942) cotton cultivars. Apart from infestation, comparative cotton yield was also assessed. Insecticides were applied at their label-recommended doses upon reaching ETL of spotted bollworm infestation. Experiment was conducted in RCBD with three replications. Pest infestation was recorded 24 h pre- and 1, 2, 3 and 7 days post-treatment. Results revealed that Triazophos 40 EC gave the best control of spotted bollworms concomitantly with maximum cotton yield and, hence, should be incorporated with other pest control strategies in an integrated way.

Keywords: *Gossypium hirsutum*, *Earias* spp., Insecticides efficacy, field evaluation, Bt cotton

1. Introduction

Cotton (*Gossypium hirsutum* L.) is an important commercial non-food crop of global importance and main cash crop of Pakistan which contributes significantly to national economy of Pakistan. Cotton products contribute about 7% to the value-added in agriculture and about 1.5% to GDP [1]. In Pakistan, the average yield of the cotton seed is nearly 520 kg per ha, which far less when compared with the production average of other countries such as Australia, USA, India and Turkey. There are many factors associated with this low cotton seed and fiber production. Among these insect pest attack is the most important [1]. More than 1,326 species of insects have been reported to attack cotton crop in the world [2]. In cotton, the insect pests' infestation cause deterioration in lint quality and 10–40 % losses in crop production [3], and over all nearly 30–45% yield reduction can be incurred by insect pests [4].

Among major insect pests, spotted bollworm (*Earias* spp.) is one the most deleterious pest. The larvae of spotted bollworm, particularly of *Earias* spp. attack soft and growing tissues especially terminal buds of main stem, flower buds and bolls which ultimately shed [5]. Being relatively a hardy species among insect pests, *Earias* spp. complex tolerate a wide range of environmental conditions and, hence, is prevalent in many regions of the world including Indo-Pak continent. Spotted bollworm causes huge loss to cotton crop each year and has been reported to cause a yield loss up to 15% in Pakistan [6].

Crop protection with synthetic chemicals has been an indispensable and unavoidable part of integrated pest management all over the world [7]. To overcome the crop losses and to increase the yield, pesticides application is of utmost importance for cotton growers. According to Pakistan Bureau of Statistics, volume of insecticides import reached up to 23,033 metric tons having a worth of USD 110.70 million.

The main objective of this study was to evaluate the *in-situ* efficacy of different insecticide formulations against spotted bollworm infestation and their comparative impact on average yield of conventional (non-Bt) and transgenic (Bt) cotton cultivars.

2. Materials and Methods

Six cultivars of upland cotton (*Gossypium hirsutum* L.) were acquired from Cotton Research Institute (AARI, Faisalabad), and were sown from May to December 2014 in the experimental

area of Post Graduate Agriculture Research Station (PARS) of University of Agriculture, Faisalabad (31°23'53" N-73°03'19" E). Three of these cultivars were conventional, namely Anmol, C-26 and FH-942, while three were of transgenic cotton, namely Bt-703, Bt-3701 and Tarzan.

The experiment was laid out in Randomized Complete Block Design (RCBD). There were five treatments viz; *Triazophos* (*Trizone 40 EC*), *Thiamethoxam + Chlorantraniliprole* (*Voliam flexi 300 SE*), *Flubendiamide* (*Belt 480 SC*), *Emmamectin benzoate* (*Sajan 1.9% EC*) and *Gamma-Cyhalothrin* (*Proaxis 60 CS*) along with a control treatment. Insecticides were obtained from registered pesticide dealers located in the local grain market of district Faisalabad (Punjab, Pakistan). Each treatment was replicated thrice. The plot size of each experimental unit was 6.0 × 10.0 m. Row-to-row and plant-to-plant distance was maintained as 60 and 30 cm, respectively. The percent infestation was calculated by the following formula;

$$\text{Percent infestation} = \frac{\text{No. of bolls/ squares/ buds damaged}}{\text{Total No. of bolls/ squares/ buds}} \times 100$$

Biweekly pest-scouting was carried out before and after the application of insecticides. Upon attainment of economic threshold level (ETL) of spotted bollworm infestation (5 larvae per 25 plants or 10% infestation of fruiting bodies), insecticides were sprayed according to their label recommended doses (i.e. *Triazophos* (*Trizone 40 EC*) @ 1000 ml acre⁻¹, *Thiamethoxam + Chlorantraniliprole* (*Voliam flexi 300 SE*) @ 80 ml acre⁻¹, *Flubendiamide* (*Belt 480 SC*) @ 50 ml acre⁻¹, *Emmamectin benzoate* (*Sajan 1.9% EC*) @ 200 ml acre⁻¹, and *Gamma-Cyhalothrin* (*Proaxis 60 CS*) @ 100 ml acre⁻¹) with the help of knapsack hand sprayer early in the

morning using hollow-cone nozzle. The data regarding percent infestation was taken 24 h before and 1, 2, 3 and 7 days after insecticide application. Comparative per plot yield of each cotton cultivar sprayed with above mentioned insecticides and that of control (non-treated) plots was calculated by weighing the produce. The data regarding spotted bollworm infestation and yield was analyzed statistically using Statistix® (version 8). Mean spotted bollworm infestation values of insecticide treatments and yield of cotton cultivars were compared by DMR test at 95% confidence interval.

The means

Were compared by DMR Test at p=0.05

3. Results and Discussion

Five synthetic insecticides with different modes of action have been evaluated under field conditions against spotted bollworm infestation on conventional non-Bt and transgenic Bt cotton cultivars. Moreover, per plot cotton yield was also worked out to determine the impact of these pesticide applications on cotton produce. Among varieties, mean maximum infestation was recorded on FH-942 (14.5%) in non-Bt cotton and on BT-703 (5.5%) in Bt cotton. However, difference is non-significant in either case. As a whole, transgenic cultivars showed 2 to 3 fold less attack of spotted bollworms as compared to conventional non-Bt cultivars (Table 1).

Regarding insecticides used, *Tiazophos 40EC* resulted in a significant reduction of spotted bollworm infestation on all transgenic and conventional varieties (Table 1). Although other insecticides also caused reduction of infestation till 7 days after spray, but the different is not statistically significant. In control plots, there was, on the average, a 1 to 2% increase in pest infestation from 24h before to 7 days after treatment.

Table 1: Percent infestation of spotted bollworm infestation before and after insecticides application on Bt- and non-Bt cotton cultivars

Treatments / Cultivars	Volium flexi		Proaxis		Sajan		Trizone		Belt		Control	
	1DBT	7DAT	1DBT	7DAT	1DBT	7DAT	1DBT	7DAT	1DBT	7DAT	1DBT	7DAT
BT 703	6.23	4.56	5.20	3.66	5.10	4.00	5.05	2.73*	5.76	4.83	5.73	5.96
BT 3701	3.43	1.96	3.36	2.46	3.00	2.20	3.20	1.30*	2.96	2.10	4.26	6.16
Tarzan	4.93	3.10	4.93	3.96	5.13	4.10	5.03	2.66	5.13	4.26	6.06	7.00
Anmol	11.4	8.33	11.36	10.50	11.33	10.56	10.76	4.66*	11.16	10.60	11.46	13.86
C-26	12.16	6.50	10.61	9.26	11.02	10.20	11.30	3.86*	10.65	9.70	12.52	15.03
FH-942	14.86*	8.00	13.88	11.50	14.84	13.43	15.033	6.50*	14.16	13.00	14.18	16.50

Values are means of three independent replications for each treatment. * indicates significant reduction of pest infestation 7 days post-treatment.

These findings were in line with the results described by Ashfaq *et al.* [8] and Khan [4], who conducted experiments to evaluate the infestation trend of spotted bollworm in different conventional and transgenic cotton cultivars and resulted that all the transgenic cotton cultivar showed significantly less

infestation of spotted bollworms on squares, flowers and bolls and showed resistance toward this insect pest. On contrary, all three conventional cotton cultivars revealed more infestation of spotted bollworms, exhibiting low level resistance.

Table 2: Average cotton yield (kg plot⁻¹) of Bt- and non-Bt cotton cultivars treated with different synthetic insecticides

Treatments/ Cultivars	Volium flexi	Proaxis	Sajan	Trizone	Belt	Control
BT 703	2.03	1.95	1.86	2.31	1.81	1.66
BT 3701	2.12	2.06	1.95	2.44	1.86	1.74
Tarzan	2.11	1.98	1.86	2.26	1.80	1.64
Anmol	1.51	1.46	1.31	1.88	1.33	0.99
C-26	1.51	1.39	1.31	1.80	1.13	0.88
FH-942	1.40	1.31	1.14	1.62	1.03	0.80

Values are means of three independent replications for each treatment.

The results about cotton yield reveal that the plot gives more yields which were treated with Triazophos in all BT and non-BT cultivars, and minimum yield was observed in control treatment which was untreated. These findings of present study are in line with Acharya *et al* ^[9], who conducted an experiment and stated that the maximum seed cotton yield was observed in the treatment of Triazophos and minimum was observed in the treatment of water spray. Conclusively, Triazophos is recommended to be incorporated in future integrated pest management programs as an effective chemical tool and resistance should also be determined in parallel among the local populations of *Earias* spp.

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