Testing the Toxic Effects of Six Different Groups of Chemical Insecticides against Tobacco Bud Worm *Helicoverpa armigera Hub*. Lepidoptera: Noctuidae in FCV Tobacco *Nicotiana tabaccum L.*

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Abstract

Six different groups of insecticides i.e. Ripcord 10 EC, Siron 20 EC, Confidor 20 SL, Methomyl 20 EC, Regent 50 SC and Tracer 240 SC were tested to find out the most effective one for the control of *Helicoverpa armigera* on tobacco in Department of Crop Development, Lakson Tobacco Company Limited Mardan Khyber Pakhtunkhwa, Pakistan during the year 2006. All the treatments gave significant control of the pest as compare to check one. Minimum percent infestation and maximum yield and grade index were recorded in plots receiving the Tracer applications and were significantly different to observations recorded in plots receiving other spray applications and untreated check. Maximum percent infestation and minimum yield, grad index were observed in check plots where no application was practiced. Based on the total yield and level of infestation Tracer 240 SC or Methomyl 20 EC is recommended as the most promising insecticide for the effective management of *Helicoverpa armigera in* FCV (Flue cured Virginia) tobacco.

Keywords: FCV tobacco, insecticides, bud worm *Helicoverpa armigera*

Introduction

Tobacco *Nicotiana tabaccum L.* (Local name Tambaku) is an important cash crop, grown in many parts of the world. In 2004-05 it occupied 4.49 million ha of the world cropped area with an annual production of 6.85 million tones. China is the leading tobacco producer, followed by India, Brazil, USA and Turkey.

In Pakistan, tobacco is the third prominent cash crop after sugarcane and cotton, in 2004-2005 it occupied an area of about 0.06 million ha with an annual production of 0.11 million tones. Khyber Pakhtunkhwa leads all the other three provinces of the country both in area and production of tobacco. It covered an area of about 0.04 million ha with production of 0.08 million tones in 2004-2005 in Khyber Pakhtunkhwa. (MINFAL, 2004-2005).

The main types of tobacco cultivated in Pakistan are Flue cured Virginia (FCV), Burley, White Patha (W P) and Dark Air Cured (DAC) tobacco. FCV is cultivated in Mardan, Charsadda, Swabi, Swat, Buner and Hazara Districts. Burley tobacco is cultivated in sub- mountainous area like Swat and Mansehra. WP is cultivated in Mardan, Swabi and Charsadda districts but Swabi is the main growing district where 70% of the production is raised. DAC is cultivated in Gujrat, Sahiwal and Okara (LTC, 2005).

The yield in Pakistan is low as compared to other countries like China, India, Brazil, America and Greece. A lot of factors are responsible for its low yield. Among these, insect pests are the serious constraints. In Pakistan tobacco crop is attacked by a number of insects pest like cutworms (*Agrotis ipsilon, A. segetum, A. flammatra*) (Lepidoptera: Noctuidae), budworms (*Heliocoverpa armigerea Hub*) (Lepidoptera: Noctuidae) and aphids (*Myzus persicae* and *Aphis tabaci*) (Homoptera: Aphididae). These pests adversely affect the crop growth and yield. Insects pest attack start right from the nursery and continue till crop maturity. Among these pests the most damaging one is the budworm, *Helicoverpa armigera* (Lepidoptera; Noctuidae). The moth (adult) of budworm is usually light yellowish olive with a single dark spot near centre of each forewing. The moths generally appear during March-April, and lay white or cream color, spherical eggs on the leaves. After hatching, the young larvae start feeding on leaves. Larvae have 5-6 instars and most of the damage is done in larval stage. During development the larvae may go from one plant to another one. Late at August the pest pupate in the top 4 cm of soil. There are 3-4 generations per year of this pest. Usually a single caterpillar can damage up to 12 leaves. By doing this the quality of the tobacco is highly affected and has low market price ultimately .The farmers bear great financial losses with low crop value. Along with feeding they also act as vector of diseases. The insect attacks all portions and all growth stages of Tobacco (Patil et al., 1977).

Various control measures are used to minimize losses caused by this pest (*Helicoverpa armigera*). Varietal resistance, biological control, cultural control and chemical control are among these control tactics but chemical control is the most effective one and nobody can ignore its importance because of its knock down effect on insect pests. Number of new products are launched every year. It is always needed to the researchers to evaluate these new insecticides for their effectiveness.

Keeping in view the above facts the experiments were initiated with the following objectives:

1) To screen out the most effective insecticide against Tobacco budworm.
2) Effect of the application of these chemicals on Physiology and total yield of the tobacco plant.

Materials and Methods

Healthy seedlings of FCV tobacco variety Speight G-28 about 5-6 inches in length with pencil size were selected and transplanted in 1st week of March, 2006. Irrigation was given immediately after plantation and fertilizer application.

The experiments were laid out in Randomized Complete Block Design (RCBD) with four replications. There were seven treatments in each replication with three rows per treatment. Plant-to-plant and row-to-row distance were kept 60 cm and 90 cm, respectively. There were at least 30 plants per treatment (10 plant row^{-1}). The size of each treatment was 3 x 5.40 m^2. The insecticides (Table 1) were applied according to the recommended rates. In the control treatment, fresh tape water was sprayed on the crop.

Table 1 List of different insecticides applied against tobacco bud worm (*Helicoverpa armigera)* on tobacco crop.

S. No	Trade name	Chemical name	Dose recommended mL ($g\ L^{-1}H_2O$)
1	Ripcord 10 EC	Cypermethrin	2.50
2	Siron 20 EC	Chloropyriphos	2.0
3	Confidor 20 SL	Imidacloprid	2.0
4	Methomyl 20 EC	Lannate	2.0
5	Regent 50 SC	Phenyl Pyrazole	2.0
6	Tracer 240 SC	Spinosid	1.0
7	Control (Water)	Hydrogen Oxide	--

The following parameters were recorded during the course of experimentation:

a. Efficacy of different chemical against *H. armigera*
b. Plant height (cm)
c. Number of leaves per plant
d. Yield per hectare (kg)

The methodology adopted to determine the above-mentioned parameters were as under:

Efficacy of Different Chemicals Against *H. armigera*

In this experiment, efficacy of six different chemical insecticides were determined against *H. armigera* on tobacco crop. The number of damaged plants by *H. armigera Hub.,* in each treatment were randomly selected from all three rows, counted one by one after 24, 48, 72 and one week of insecticides application.

Plant Height (cm)

After the plants attained maturity, 10 randomly selected plants from all the three rows in each treatment were measured (cm) from soil level to tip of the upper most leaf of plant by a measuring rod.

Number of Leaves per Plant

Number of leaves per plant were recorded by selecting 10 plants randomly in each treatment. The number of leaves from bottom to top of the main stalk of each plant were counted after topping the plants (flowers removal) keeping in view the 22 leaves per plant as the standard numbers of leaves per plant for this variety i.e. Speight G 28.

Yield per Hectare (kg ha^{-1})

Total weight (kg) of cured leaves in each treatment after each picking were summed and yield per hectare for each treatment were obtained as under:

$$\text{Cured leaf yield}(\text{kg ha}^{-1}) = \frac{\text{Total cured weight (kg)}}{\text{Net area harvested}} \text{ x } 10000$$

The data for individual parameters were analyzed according to appropriate statistical procedure for RCB design using F-test and the means were separated by using LSD test.

Results and Discussion

The experiment on "Testing the toxic effects of six different groups of chemical insecticides against tobacco bud worm *Helicoverpa armigera Hub.* in FCV Tobacco *Nicotiana tabaccum L.)"* was carried out at Lakson Tobacco Company Limited in Crop Development Department KPK Pakistan during May, 2006. The data were recorded and the results were summarized regarding different parameters in Tables 1 to 4, all the means were tested for their significant effect on tobacco budworm attack and for other parameters too, all are described below.

Effects of Spray Application of Different Chemicals Insecticides against Tobacco Bud Worm *(Helicoverpa armigera)*

Effect on Plant Damage

First chemical spray

One day after pesticide application the results showed no significant differences among the different insecticides against *H. armigera*, however, the maximum percent plants damage of 4.17 were recorded with confidor, while minimum no. of 2.50 percent plants damaged with tracer (Table 1). In the control treatment damage was recorded as 3.33 percent plants.

Two days after pesticide application, maximum percent plants damage of 5.00 was recorded in confidor treated plot, while minimum percent damage of 2.50 with tracer. In the control treatment it was recorded as 5.00 percent.

Three days after chemical spray, significantly higher percent plant damage of 5.83 was counted in Ripcord and confidor treated plots, which was followed by 5.00 percent with Siron, while minimum percent plant damage of 2.50 with tracer. Percent damage was 3.33 in methomyl and 4.17 in Regent treated plots. In the control treatment, 7.5 percent damaged was recorded.

Data recorded on fourth day of chemical application showed that percent plant damage was significantly higher of 7.5 in confidor treated plots, which was followed by 6.67 % in Ripcord and 5.00 % in Siron treated plots. Lower percent plants damage of 3.33 was recorded in tracer, methomyl and in Siron treated plots. In the control treatment percent damage was recorded as 9.17 plants.

Table 2 Percent plants damaged caused by *H. armigera* after application of first chemical spray in tobacco field.

Chemical	Pre-treatment population	Post-treatment percent plants damaged by *H. armigera* after					%Decrease in plant damage[1/]
		1st day	2nd day	3rd day	4th day	one week	
Ripcord	8.33 a	3.33 a	4.17 a	5.83 ab	6.67 ab	7.50 bc	30.748
Siron	8.33 a	3.33 a	4.17 a	5.00 abc	5.00 bc	5.83 bcd	46.168
Methomyl	8.33 a	8.33 a	8.33 a	3.33 bc	3.33 c	3.33 d	69.252
Confidor	9.33 a	4.17 a	5.00 a	5.83 ab	7.50 ab	8.33 ab	23.084
Tracer	8.33 a	8.33 a	8.33 a	8.33 c	3.33 c	3.33 d	69.252
Regent	7.67 a	8.33 a	8.33 a	4.17 bc	5.00 bc	5.00 cd	53.832
Control	8.33 a	3.33 a	5.00 a	7.50 a	9.17 a	10.83 a	00.000

[1/] After one week of spray application in comparison with control.
Means in columns followed by the different letters are significantly different at 5% level of probability.

One week after first chemical spray, percent plant damage was significantly higher 8.33 in confidor treated plots, which was followed by 7.5% in Ripcord and 5.83% in Siron treated plots. Lower percent damage of 3.33 was observed in tracer and methomyl treatments. In the control treatment, it was 10.83% significantly different than the other treatments. As for as % reduction in plant damage is concerned it showed that highest % reduction was observed in methomyl and Tracer treated plots i.e. 69.252 while lowest % reduction was recorded in confidor treated plots i.e. 23.084 followed by Regent and Siron in comparison with untreated check.

Second chemical spray

The data recorded one day after the second application of different insecticides showed maximum percent plant damage of 12.50 in confidor treatment, which was followed by 10.83% in Ripcord and 9.17% in Siron treatments. Lower percent plant damage of 3.33 was counted in tracer treatment, 5.00% in methomyl and 6.67% in Regent treatments (Table 3). In the control treatment plant damage was 15.00%. Two days after pesticide application, maximum percent plant damage of 13.33 was recorded in confidor treatment, while in Ripcord treatment it was 11.67% and in Siron and tracer treatments it was 9.17 and 4.17% respectively. In methomyl treated plots the damage was recorded as 5.00% only significantly different from the control and in Regent treatment it was noted as 7.50%. In the control treatment percent plants damage was recorded as 16.17 highly significant from the rest of the treatments. Three days after second chemical spray higher percent damage of 14.17 plants were found in confidor treatment, which was followed by 12.50% in Ripcord, 10.00% in Siron, 5.0% in methomyl, 9.17% in tracer and 8.33% in Regent treatments. In the control treatment damaged was recorded as 17.50% highly significant from all the applied treatments. On fourth day of second spray the recorded data showed that significantly higher percent damage of 16.17 plants were found in confidor, 14.17 in Ripcord, 10.83 in Siron, 4.17 in tracer, 5.00 in methomyl and 9.17 in Regent treatments. A significant percent damage was found in the control plots which were noted as 20.00%. After seven days of the second pesticide application, significantly higher percent damage of 18.33 plants were found in confidor, 16.17% in Ripcord, 11.67% in Siron, while lower percent plant damage of 4.17 in tracer, 5.00% in methomyl and 10.00% in Regent. In the control treatment, it was 23.33 % significantly different from rest of the

Table 3 Percent plants damaged by *H. armigera* after application of second chemical spray in tobacco field.

Chemical	Pre-treatment population	Post-treatment percent plants damaged by *H. armigera* after					% Decrease in plant damage[1/]
		1st day	2nd day	3rd day	4th day	one week	
Ripcord	10.00 b	10.83 bc	11.67 bc	12.50 ab	14.17 b	16.17 b	30.69
Siron	8.33 bc	9.17 cd	9.17 cd	10.00 bc	10.83 a	11.67 c	49.979
Methomyl	4.17 de	5.00 ef	5.00 ef	5.00 c	5.00 d	5.00 d	78.568
Confidor	10.83 ab	12.50 ab	13.33 b	14.17 ab	16.17 b	18.33 b	21.432
Tracer	3.33 e	3.33 f	4.17 f	9.17 bc	4.17 d	4.17 d	82.126
Regent	6.67 cd	6.67 de	7.50 de	8.33 bc	9.17 c	10.00 c	57.137
Control	13.33 a	15.00 a	16.17 a	17.50 a	20.00 a	23.33 a	00.000

[1/] After one week of spray application in comparison with control. Means in columns followed by the different letters are significantly different at 5% level of probability.

treatments. Percent reduction of plant damage also showed that Tracer gave maximum % reduction (82.126) followed by methomyl (78.568), Confidor gave minimum % reduction (21.432), the other three insecticides action were also close to each other. It showed among the different pesticides tested for the control of *H. armigera* methomyl and tracer gave significant control after 1, 2, 3, 4 and 7 days of pesticide application, as compared to other pesticides. Minimum control of *H. armigera* was recorded in confidor and Ripcord treated plots. Johnson et al. (1990) conducted a field experiment in Arkansas, to evaluate the performance of some insecticides against *H. armigera.* According to their result *H. armigera* was controlled effectively with tracer. Allen *et al.* conducted a field experiment in Mexico on *H. armigera* treated with tracer. They achieved best control of *H. armigera* after five days of treatment. Allen et al. (1999) tested different insecticides for the control of H. armigera in Arkansas in 1999. They concluded that larval damage was reduced following treatment with tracer. Kharboutti et al. (1999) conducted a field experiment on *H. armigera* in 1999 in Monticello, U.S.A. According to their result tracer was found to be more effective against this pest. Allen et al. (2000) tested different insecticides for the control of *H. armigera* and showed that tracer had greatest effect in *H. armigera* in three days after treatment.

Effect on Plant Physiology

Plant height (cm)

Data of this experiment showed that plant height was not significantly different among the different treatments. Maximum plant height of 103.42 cm was recorded in methomyl treatment, which was followed by 102.09 cm in Siron and 101.97 cm in Ripcord treatment. Minimum plant height of 94.02 cm was found in tracer treatment, which was followed by 95.42 cm in confider and 99.05 cm in Regent treatment (Table 3). In the control treatment plant height was 96.22 cm.

Number of leaves per plant

The data of number of leaves per plant was not significantly different among the different treatments (Table 4). However, the maximum number of 24.02 leaves per plant was recorded in Ripcord treatment which was followed by 24.33 in methomyl and 22.27 in tracer. Lower number of 20.87, 21.81 and 22.02 leaves per plant were recorded in Ripcord, Regent and in control treatments respectively.

Leaf area (cm^2)

The data of leaf area (cm^2) was also found significantly not different among the different treatments (Table 4). However, the maximum leaf area of 790.82 cm^2 was recorded in methomyl

treatment, which was followed by 742.17 cm^2 in confidor and 726.63 cm^2 in Ripcord treatments. Leaf area was 656.30 cm^2 in Siron, 672.42 cm^2 in Regent treatments. It was 590.98 cm^2 in the control treatment. From the above figures it is clear that plant height, number of leaves per plant and leaf area was not significantly different among the different treatments. Maximum plant height was recorded in methomyl treatment, while minimum in tracer treatment. Maximum number of leaves per plant was recorded in methomyl, while lower number of leaves per plant in Ripcord treatment. Similarly, maximum leaf area was recorded in methomyl treated plots, while lower in Siron treatment. As the insecticides are mainly used for the control of pests and it has no effect on the physiological characteristics of plants. So, it may be one of the reason that plant height, number of leaves per plant and leaf area are non significant.

Effect on Grade Index and Total Yield

Grade Index (%)

The data showed that the grade index was significantly different among the different treatments (Table 4). The maximum grade index of 75.43% was recorded in tracer treatment, which was followed by 73.21 % in Ripcord and 69.82% in Methomyl treatment. Minimum grade index of 55.68% was recorded in Regent and 66.72% in Siron. Grade index in the control treatment was 52.23%. Over all results revealed that the grade index was significantly different among the different treatments. The maximum grade index was recorded in tracer, while minimum was recorded in check plots followed by Regent treated plots.

Yield (kg ha^{-1})

The data showed that yield was significantly different among the different treatments (Table 5). The maximum yield of 2917 kg ha^{-1} was recorded in Tracer treatment, which was followed by 2631 kg ha^{-1} in Ripcord, 2729 kg ha^{-1} in Methomyl these all treatments were non significantly different at 5% level of significance while significantly different from control and rest of the treatments. Minimum yield of 2007 kg ha^{-1} was recorded in control treatment, which was followed by 2234, 2253 kg ha^{-1}, and 2394 kg ha^{-1} in Regent, Confidor and Siron treated plots respectively.

Tobacco leaf is marketed by its physiological characteristics like color, texture, size and aroma, etc., which when grouped together represent its quality. Tobacco leaf yield was also significantly different among the different treatments. The maximum yield was recorded in Tracer treatment, while lower yield was found in the control treatment.

Table 4 Effect of chemical insecticides on plant height, number of leaves per plant and leaf area.

Chemical	Plant height (cm)	Number of leaves per plant	Leaf area (cm^2)
Ripcord	101.975	20.875	726.630
Siron	102.093	24.025	656.300
Methomyl	103.425	24.330	790.892
Confidor	95.425	22.200	742.170
Tracer	94.092	22.275	777.500
Regent	99.905	21.813	672.427
Control	96.228	22.025	590.985

Table 5 Effect of different chemical insecticides on grade index, and yield in tobacco.

Chemical	Grade index (%)	Yield (kg ha^{-1})
Ripcord	73.21 a	2631 a
Siron	66.72 bc	2394 b
Methomyl	69.82 ab	2729 a
Confidor	66.00 ab	2253 bc
Tracer	75.43 a	2917 a
Regent	55.68 bc	2234 bc
Control	52.24 c	2007 d

Recommendations

Keeping in view the total yield and level of infestation Tracer 240 SC or Methomyl 20 EC is recommended as the most promising insecticide for the effective management of *Helicoverpa armigera in* FCV tobacco.

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