EFFICACY OF DIFFERENT SYNTHETIC INSECTICIDES AGAINST APHID AND BUDWORM (*Helicoverpa armigera*) ON TOBACCO (*Nicotiana tabaccum* L.) AND THEIR IMPACT ON YIELD AND QUALITY OF THE CROP IN THE PROVINCE OF KHYBER PAKHTUNKHWA

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Abstract

A field study was carried out at Tobacco Research Station, Khan Ghari, Mardan (Khyber Pakhtunkhwa) Pakistan during 2003-04 to determine the effectiveness of different synthetic insecticides against aphid and budworm on tobacco and their impact on yield and quality of the crop in the province of Khyber Pakhtunkhwa. Flue Cured Virginia (FCV) tobacco was raised as test crop and six different synthetic insecticides, namely Imidachloprid WG70, Thiamethaxan 25WG, Methamedophos 50 SCW, Deltamethrin+Triazophos 350+10EC, Spinosad 240 SC, Lannate 20 EC and un-treated control plot were tested on tobacco to assess their impact on different growth parameters and yield (kg ha^{-1}) as well. The results indicated that plant height (cm), number of leaves per plant and leaf area (cm^2) did not varied significantly. However, grade index (%), reducing sugar (%), Nicotine content (%) and yield (kg ha^{-1}) were considerably varied among different insecticidal treatments. Treatments with Spinosad 240 SC and Lannate 20 EC showed the highest yield of (2253 and 2121 kg ha-1) whereas the lowest (1717 kg ha^{-1} was obtained from the control plots where no insecticide was used.

Introduction

Tobacco (*Nicotiana tabacum* L.) is an important cash crop of Khyber Pakhtunkhwa, Pakistan. In the province of Khyber Pakhtunkhwa, it is mainly grown in Peshawar, Mardan, Buner, Charsadda, Swabi, Swat and Hazara districts. Two species of tobacco viz *Nicotiana tabacum* L. and *N. rustica* L. are commonly grown in different regions of the province (Ali, 1986). In Pakistan, tobacco is major a source of revenue, employment and foreign exchange and cultivated on approximately 0.27% area of Pakistan (Anon., 2005). It has been observed that numerous factors are responsible for poor quality of tobacco. Among which, insect pests and the chemicals applied for their control and management are the major concern (Anon., 1979). Different species of cutworms namely, *Agrotis ipsilon, A. segetum, A. flammatra*, budworm, *Heliothis virescens* and two species of aphids i.e. *Myzus persicae* and *Aphis tabaci* are the most important insect pests that seriously harm to the tobacco crop during different stages of development and may lead to low yield (Sajjad *et al*., 2011). Infestation of these insect pests starts right from the nursery and continues until maturity of the crop. According to Mistrick and Clark, (1983) aphid, *M. persicae* cause damage to tobacco crop from seedling stage till crop maturity. Nymphs and adults of *M. persicae* suck sap from the green parts of the leaves and growth of plants is badly damaged. Consequently, vitality of tobacco crop is shrinked, the infested leaves turned curled, deformed which, later causes chlorosis and thus the leaves become susceptible to the attack of the pathogens. Among these pests, budworm, *Heliothis virescens* is the most serious and injurious to the crop (Badshah *et al.,* 2011). As tobacco plant begins to top, *Helicovera* larvae eat into the buds or unfolded leaves and the leaves that expand from the buds are often ragged and distorted. If the tiny larvae go through the unfolded leaves, ultimately the affected leaves will have hideous holes when they are fully expanded. The attack on the buds renders the leaves unfit for cigar wrappers and greatly cuts the price. The larvae of the second generation eat into the seedpod and on the suckers (Hussain *et al.,* 1979). Quality of the tobacco leaves are heavily affected due to the attack of budworm that fetches low market price and eventually the growers face enormous financial losses (Patil & Chari, 1977). Tobacco yield in Pakistan is superior than many tobacco growing countries across the world like Brazil, America, India, China and Greece etc, but for as quality is concerned, our local tobacco is far inferior to foreign tobacco which do not get excellent price in global market (Badshah, 2005). A number of insecticides have been used for the control of *pests on tobacco*. However, still huge losses to tobacco crop occur due to heavy infestation of these pests (Brickle *et al.,* 2001). For the efficient control of tobacco pests, Lannate 90 WP and Tamaran 50 EC have been proved the most successful insecticides.

The present research study was therefore, carried out with the objectives to determine relative efficacy of different chemical insecticides against aphid and budworm for better growth, quality and yield of tobacco crop.

Materials and Methods

The present experiments on "Efficacy of different synthetic insecticides against aphid and budworm on tobacco and their impact on yield and quality of the crop in province of Khyber Pakhtunkhwa" were carried out during 2003-04 at Tobacco Research Station, Khan Ghari, Mardan. The experiment was laid out in Randomized Complete Block (RCB) Design with four replications. There were seven treatments, including control in each replication with three rows per treatment. Plant-to-plant and row-to-row distance was kept 60 cm and 90 cm, respectively. In the control treatment, fresh tape water was sprayed on the crop. Two insecticides spray were applied on need basis whenever the population level of aphid and budworm reached economic threshold level (ETL). Spray materials were applied with the help of knapsack sprayer. Data on plant height, no. of leaves per plant and leaf area were recorded at physiological maturity of the crop, whereas data on percent grade index, percent reducing sugar, percent nicotine content and yield (kg ha^{-1}) were recorded after harvesting and currying of the crop.

The insecticides applied according to the recommended rates were as follow.

Table 1. List of synthetic insecticides used against Aphid and Budworm on Tobacco during 2003-04

Trade name	Common Name	a.i/ac *
Confidor WG70	Imidachloprid	12 g
Actara 25WG	Thiamethaxan	24 g
Sundaphos 50 SCW	Methamedophos	500 mL
Deltaphos 350+10EC	Deltamethrin+ Triazophos	400 mL
Tracer 240 SC	Spinosad	66 mL
Methomyl 20 EC	Lannate	250 mL

*, active ingredients / acre.

The data were regularly recorded during the course of experimentation on the following parameters.

Plant height (cm)

After the plants attained maturity, 10 randomly selected plants from the central two 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 /plant

Number of leaves per plant was recorded by selecting 10 plants randomly in each treatment. The numbers of leaves from bottom to top of the main stalk of each plant was counted and later on its means were calculated.

Leaf area (cm^2)

In order to determine this parameter, length and breadth of 5^{th}, 10^{th} and 15^{th} leaf of ten randomly selected plants was measured (cm) in each treatment. To measure leaf size (cm^2), the following formula was used by Suggs *et al.* (1960) and Idrees and Khan (2001).

Leaf Size = Leaf length x Leaf breadth x 0.634 (Factor).

Grade Index (%)

Grade index of the leaves picked from the different treatments was determined by the following formula:

$$\text{Grade index}(\%) = \frac{\text{Number of leaves of top/middle or bottom x 100}}{\text{Total number of leaves in a treatment}}$$

Reducing sugar (%)

Reducing sugar (%) was also estimated in the randomly collected tobacco leaves in the Chemistry Section of Tobacco Research Station Khan Ghari, Mardan, using Lane and Eynon (1986) formula

$$\text{Reducing sugar}(\%) = \frac{25 \text{ x } 100 \text{ x } 0.05}{\text{Titrate sample}}$$

Nicotine content (%)

The nicotine content was measured by taking middle leaves samples from the plant to avoid any effect of plant position. Half kilogram of these cured leaves from each replication at each environment was combined to make uniform sample of each genotype. Nicotine content was calculated by the following formula as used by Idrees and Khan (2001).

$$\text{Nicotine content}(\%) = \frac{V1 \text{ x } N1 \text{ x } 32.45}{\text{Weight of the sample}}$$

Where

V1= Volume of the titrant of non-acetylated aliquot
N1= Normality of perchloric acid

Yield/ha (kg)

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

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

Statistical Analysis

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, as outlined by Steel and Torrie (1984).

RESULTS

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 Sundaphos and 101.97 cm in actara 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 deltaphos treatment (Table 2). In the control treatment, plant height was 96.22 cm.

Table 2: Efficacy of different chemical insecticides against aphid and budworm on tobacco and their impact on plant height (cm), number of leaves per plant and leaf area (cm^2) of the crop during 2003-04

Treatments	Plant height (cm)	Number of leaves /plant	Leaf area (cm^2)
Actara	101.975 a	20.875 a	732.793 a
Sundaphos	102.093 a	24.025 a	656.300 a
Methomyl	103.425 a	22.500 a	790.892 a
Confidor	95.425 a	22.200 a	742.170 a
Tracer	94.092 a	22.275 a	712.250 a
Deltaphos	99.905 a	21.813 a	672.427 a
Control	96.228 a	22.025 a	590.985 a

Means in columns followed by the different letters are significantly different at 5% level of probability (F-test)

Number of leaves per plant

The data of number of leaves per plant was not significantly different among the different treatments (Table 2). The maximum number of leaves per plant (24.02) was recorded in Sundaphos treatment, which was followed by 22.50 in methomyl and 22.27 in tracer. Lower number of 20.87, 21.81 and 22.02 leaves per plant were recorded in actara, deltaphos 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 2). 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 732.79 cm^2 in actara treatments. Leaf area was 656.30 cm^2 in sundaphos, 672.42 cm^2 in deltaphos treatments. It was 990.98 cm^2 in the control treatment.

Grade index (%)

The data showed that the grade index was significantly different among the different treatments (Table 3). The maximum grade index of 70.36% was recorded in tracer treatment, which was followed by 70.19% in actara and 65.99% in confidor treatment. Minimum grade index of 57.06% was recorded in deltaphos and 57.94% in sundaphos. Grade index in the control treatment was 52.24%.

Table 3: Efficacy of different chemical insecticides against aphid and budworm on tobacco and their impact on grade index (%), reducing sugar (%), nicotine content (%) and yield/ha (kg) of tobacco crop during 2003-04

Treatments	Grade Index (%)	Reducing sugar (%)	Nicotine content (%	Yield/ha (kg)
Actara	70.19 a	16.86 ab	2.362 a	1834 bc
Sundaphos	57.94 bc	15.38 ab	1.960 a	2015 abc
Methomyl	65.40 ab	15.65 ab	2.325 a	2121 a
Confidor	66.00 ab	18.09 a	2.197 ab	1732 c
Tracer	70.36 a	15.85 ab	1.997 bc	2253 a
Deltaphos	57.06 bc	15.14 bc	1.970 bc	1908 bc
Control	52.24 c	12.35 c	1.800 c	1717 c

Means in columns followed by the different letters are significantly different at 5% level of probability (F-test)

Reducing sugar (%)

The results of this experiment showed significant difference among the different treatments (Table 3). The maximum percent reducing sugar of 18.07% was recorded in confidor treatment, which was followed by 16.86% in actara and 15.85% in tracer treatment. A 15.14% reducing sugar was found in deltaphos and 15.38% in sundaphos treatment. It was 12.35% in the control treatment.

Nicotine Content (%)

Data of nicotine content (%) in tobacco was also found significantly different among the different treatments (Table 3). It was significantly higher in actara treatment with 2.36%, which was followed by 2.32% in methomyl, 2.19% in confidor, 1.96% in sundaphos and 1.97% in deltaphos treatments. In control treatment, Nicotine content was 1.80%.

Yield/ha (Kg)

The data showed that yield/ha was significantly different among the different treatments (Table 3). The maximum yield of 2253 kg was recorded in Tracer treatment, which was followed by 2121 kg in methomyle, 2015 kg in sundophos and 1908 kg in deltaphos treated plot. Minimum yield of 1717 kg was recorded in control treatment, which was followed by 1732 kg in Confidor and 1834 kg in actara treated plot.

Discussion

In the present studies, plant height, number of leaves per plant and leaf area was significantly not 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 sundaphos, while lower number of leaves per plant in actara treatment.. Similarly, maximum leaf area was recorded in methomyl treated plots, while lower in sundaphos treatment. As different insecticides are may be used for the control of pests (Brickle *et al.,* 2001) and it has no effect on the physiological characteristics of plants. Therefore, it may be one of the reasons that plant height, number of leaves per plant and leaf area is non-significant (Anon., 1979).

In Pakistan the production of tobacco is superior but their quality is inferior as compared to other tobacco yield countries (Badshah, 2005) this is due to the losses by bedworm (Patil & Chari, 1977). The budworm (*H. armigera*) inflicted losses up to 11.35% in tobacco fields, (Aslam *et al.,* 1982; Patil, 1977) however in the present study the low infestation of budworm is due to excellent efficacy of chemical insecticides directly affected the physiological characteristics of the plants like leaf area, grade index, reducing sugars, nicotine content and yield per ha our results is closed to the results earlier workers (Ramaswamy et al., 1987; Thurston, 1972). These are the basic parameters, which in addition to good quality of leaves also contribute fundamental role in the yield of the crop.

The grade index was significantly different among the different treatments. The maximum grade index was recorded in tracer, while minimum in deltaphos treated plots. Tobacco leaf is generally marketed by its physiological characteristics like color, texture, size and aroma, etc., which when grouped together represent its quality. Percent reducing sugar and percent nicotine content was also significantly different among the different treatments. The maximum percent reducing sugar was recorded in confidor treatment, while lower percent reducing sugar was recorded in control treatment. Similarly, maximum percent nicotine content was found in actara treatment, while lower percent nicotine content was recorded in sundaphos treated plot. Reducing sugar and nicotine are the most important constituents for the evaluation of tobacco quality and exercise the most favorable influence on aroma, taste and quality of the leaf. The maximum yield was recorded in confidor treatment, while lower yield was found in the control treatment. Vasudevan and Baskaran (1981) obtained best control of *spodoptera litura* and *H. armigera* on tobacco with the application of 0.05 percent endosulfon, 0.04 percent monocrotophos, 0.02 percent phosphamidon and 0.03 percent dimethoate. The result also indicated that yield of tobacco crop was mainly reduced by *S. litura* and *H. armigera* attack.

Conclusion and Recommendations

Based upon the present findings, it can be concluded that actara and confidor showed encouraging results in reduction of aphid counts on tobacco crop. Similarly, tracer and methomyl also produced significant results in term of least infestation caused by budworm and hence significant higher yield. Therefore, these synthetic insecticides are recommended to be used for the effective management of aphids and budworms on tobacco and best quality of the crop with higher yield and good quality leaves of excellent texture and aroma, which is prerequisite for good quality of tobacco leaves used in cigar and cigarettes throughout the world.

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