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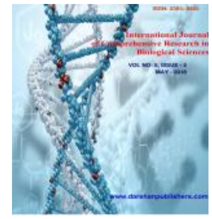

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Research Article

EFFICACY OF DIFFERENT INSECTICIDES AGAINST PINK BOLLWORM *Pectinophora gossypiella* (SAUND.) (LEPIDOPTERA:GELECHIIDAE) ON COTTON CROP IN ECOLOGICAL ZONE OF RAHIM YAR KHAN.

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Abstract

A field experiment was conducted during summer seasons 2016-17 to evaluate the efficacy of different insecticides against pink bollworm *Pectinophora gossypiella* (Saund.) (Lepidoptera:Gelechiidae). Pink bollworm is the major pest of cotton. The larvae feed on the seeds and destroy the fibers of cotton, reducing quality and crop yield.
Six different insecticides Triazophos 40EC @2500ml/ha, Deltamethrin 2.5EC @1000ml/ha, Triazophos + Deltamethrin 40EC+2.5EC @ 2500+1000ml/ha, Gamma cyhalothrin 60CS @250ml/ha, Spinetoram 120SC @300ml/ha and Chlorantraniliprole 20SC @312ml/ha were evaluated with a check plot. Experiment was laid out in RCBD with three replications. Before application of insecticides, the pre treatment observations were taken out, while post treatment observations were taken after 3rd and 7th day of application of insecticides. However, Triazophos + Deltamethrin 40EC+2.5EC @ 2500+1000ml/ha, (89.8%) showed its effectiveness up to 7th day of the spray during both years. The mortality percentage of pink bollworm on cotton was observed in case of Gamma cyhalothrin 60CS as (79.1%), Spinetoram 120SC (73.4%), Deltamethrin 2.5 EC as (65.1%) and Triazophos 40 EC as (59.8%). The effectiveness of insecticides was observed up to 7th day after application during both years 2016-17. Chlorantraniliprole 20SC showed less efficacy (51.6%) during both years.

Keywords: *Pectinophora gossypiella*, pink bollworm, insecticides, mortality percentage.

Introduction

Cotton is the most important crop of Pakistan, cultivated on 2917 thousands hectares and is the source of large amount of foreign exchange, contributing about 5.2% of value added in agriculture and about 1.0 percent of GDP and contributes about 66% share in national oil production (Anonymous, 2015). In textile manufacturing, it produces seeds with a potential multi product base such as hulls, oil, lint and food for animals (Ozyigit et al. 2007). The insect pest infestation in cotton caused deterioration in lint quality and 10–40% losses in crop yield

(Gahukar, 2006). Pink bollworm, *Pectinophora gossypiella* (Saund.) and the spiny bollworm, *Earias insulana* (Boisd.) are the most serious cotton pests of cotton (Hussein *et al*. 2002). The spiny bollworm larvae damage buds early in the growing season and squares, and bolls later in the season. The reduction in cotton yield was mostly related to the late season infestation with two species and the economic yields are almost impossible to achieve without their chemical control (Younis *et al* 2007). The pink bollworm (PBW) was described by W.W. Saunders in 1842 from specimens damaging cotton in India. More recent studies suggest the origin of the PBW as the eastern Indian Ocean area bordered on the east by northwestern Australia and on the west by various islands of Indonesia-Malaysia (Common, 1958; Wilson, 1972). Female pink bollworm moths lay eggs singly or, more commonly, in small groups. The eggs of this bollworm are minute and difficult to see without some magnification. Eggs are white when first laid but then turn orange, and later the larval head capsule is visible prior to hatching. Eggs hatch in about three to four days after they are laid (Vennila *et al*., 2007). Pink bollworm larvae feed on flower buds, flowers, bolls and the seeds within Damage to developing seeds, and the termination of growth results in boll rotting, premature or partial boll opening, reduction of staple length, strength, and increases trash content in the lint (Schwartz, 1983), although 100% crop loss can occur with heavy infestations. Pink bollworms spend the winter as diapausing larvae, then pupate and emerge as adults in spring and early summer (Bariola & Henneberry, 1980). Cotton growers have experienced severe economic losses from the PBW due to reduced yields, low lint quality and the increased costs of insecticides (Watson and Fullerton, 1969; Burrows et al., 1982). When susceptible bolls are available, eggs are laid under the calyx or on bracts and are relatively inaccessible to insecticide deposits. Larvae enter the boll soon after hatching from the eggs and are not killed by insecticides when they are within the boll. Sampling for bolls infested with eggs instead of larvae can reduce insecticide use by 28±35% without any significant loss of yield or lint quality (Hutchison et al., 1988, 1991). PBW resistance to chlorinated hydrocarbons was reported in Mexico and Texas in the 1950s and 1960s (Lowry and Berger, 1965) and tolerance to certain synthetic pyrethroid compounds has occurred more recently (Haynes et al., 1986, 1987). Insecticide applications are generally terminated in mid- to late September because of the high treatment costs and reduced benefits in the potential yield. High larval populations that occur in late season bolls represent the overwintering diapause generation. Typically, 90% of the total upland cotton bolls produced are set by 15 September. Bolls set after late August to mid-September may not mature or may produce fiber of low quality (Bennett et al., 1967). Also, biotic compound played an important role in pest control, among these compounds spinosad, it is a soil dwelling bacterium called *Saccharopolyspora spinosa*. Spinosad posses less rich than most insecticides to mammals, birds, fish and beneficial insects. It was used for control of Lepidoptera insect (Temarak, 2007, Ghure et. al., 2008 and Gosalwad et. al., 2009). For assessing the infestation by the pink and spiny bollworms, 100 green bolls were collected weekly at random from both diagonals of the inner square area for each plot (25 bolls for each replicate) according to the method of Shaaban and Radwan (1974). Integrated pest management (IPM) has been defined as a sustainable approach to managing pests by combining biological, cultural, physical and chemical tools in a way that minimizes economic, health and environmental risks (Greenberg *et al*., 2012). During the last two decades gossyplure, the sex pheromone of the pink bollworm, is widely used for monitoring and timing of the insecticidal applications. However, due to several reasons, trap catches do not always correspond to actual changes in infestation levels (Henneberry and Clayton 1982, Flint et al. 1993). Abd El-Mageed et. al. (2007) reported that the sequence of betacyfluthrin, malathion and spinosad and the sequence of lufenuron, malathion and spinosad induced the highest reduction (81.04 and 86.08%) in infestation of pink bollworm larvae, respectively. El-Metwally et. al. (2003) showed that synthetic pyrethroids (Fenpropathrin,

esfenvalerate and lambdacyhalothrin) gave the highest reduction of bollworms infestation followed by IGRs, flufenoxuron, hexaflumzuron mixed with O.P chlorpyrifos, while IGRs alone gave least reduction. In response to this problem effort to control or suppress bollworm damage to growing cotton frequently involve using insecticides of different groups in rotation program which may be useful to delay the resistance problem. Khidr et. al. (1996), El-Sorady et. al. (1998), and Abd El Mageed et. al. (2007) indicated that application of insecticides in sequential use induced higher reduction in larval number as compared with the lower reduction resulting from several applications with the same insecticide alone. So use of chemicals is an essential part of integrated pest management in crop protection measures (Mohyuddin et al. 1997). Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012).
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The pink bollworm is now recorded in nearly all the cotton growing countries of the world, and is a key pest in many of these areas. Keeping in view the economic importance and pest status of pink bollworm, this study was conducted to evaluate and screen out the most effective selective insecticide for the management of pink bollworm on cotton crop.

Materials and Methods

The experiment was conducted at Adaptive Research Farm Rahim Yar Khan on pink bollworm *Pectinophora gossypiella* (Saund.) (Lepidoptera:Gelechiidae) on cotton crop during 2016 and 2017 to test the efficacy of six insecticides viz. Triazophos 40EC @2500ml/ha, Deltamethrin 2.5EC @1000ml/ha, Triazophos + Deltamethrin 40EC+2.5EC @ 2500+1000ml/ha, Gamma Cyhalothrin 60CS @250ml/ha, Spinetoram 120SC @300ml/ha and Chlorantraniliprole 20SC @312ml/ha on cotton variety, MNH-886. The experiment was laid out in Randomized Complete Block Design (RCBD). The insecticides used in the present experiment were obtained from the local market and were sprayed at field recommended doses when the population of pest reached the Economic Threshold Level (ETL). The ETL for the pink bollworm is considered as 5 live larvae/100 bolls. There were 7 treatments including control, having 3 repeats. The plot size was kept as 20 ft x 60 ft. The plant inspection method was used for sampling the pest population. The field recommended doses of the insecticides as presented in Table 1 were sprayed with hand operated knapsack sprayer having 20 liters capacity fitted with hollow cone nozzle. The control plot remained un sprayed. The sprayer was calibrated using simple water by calculating the amount of water required for spraying on a unit area prior to experiment. All agronomic practices like irrigation, fertilizer applications etc. were kept uniform throughout the experiment on all plots. Pest data was recorded from 10 randomly selected plants. To study the efficacy of different insecticides as mentioned in (Table 1), population of pink bollworm was recorded by the same method 3rd and 7th days after treatment. Crop was kept free from weeds. Mortality of pest was calculated with following Henderson Tilton's formula (1955):

$$\left(1 - \frac{\text{n in Co before treatment} * \text{n in T after treatment}}{\text{n in Co after treatment} * \text{n in T before treatment}}\right) \times 100$$

Where : n = Insect population , T = treated , Co = control

Data were analyzed statistically with M-stat package and means were compared by DMR test at 5 percent probability level (Duncan, 1955).

Table 1. Different insecticides used against pink bollworm, *Pectinophora gossypiella* (Saund.) with respective doses per hectare.

S. #	Insecticides with formulation	Dose (ml or gm/ha)
1	Triazophos 40EC	2500
2	Deltamethrin 2.5EC	1000
3	Triazophos + Deltamethrin 40EC+2.5EC	2500+1000
4	Gamma Cyhalothrin 60CS	250
5	Spinetoram 120SC	300
6	Chlorantraniliprole 20SC	312

Results and Discussion

Insecticides (Table 1) were sprayed in recommended doses when the population of cotton pink bollworm reached economic threshold level (ETL). Insecticides were dissolved in water to prepare insecticide solutions on vol. / vol. and Wt. / Vol. basis. The crop was sprayed in the morning before 10 a. m. The population of insect pests was recorded 3rd and 7th days after application of insecticides. The effectiveness of various insecticides was considered to be an indirect reflection of pest population in various treatments i.e. lower population of insect pests would represent higher toxicity and vice versa.

The population of cotton pink bollworm was significantly lower ($P<0.05$) in insecticides treated plots as showed in (Table 2). All tested insecticides in (Table 2) caused significant mortality in population of cotton pink bollworm even 7th days after spray. Triazophos + Deltamethrin 40EC+2.5EC was statistically highly effective with mortality in cotton pink bollworm population as 61.1 and 90.2% on 3rd and 7th days of treatment during 2016 followed by Gamma cyhalothrin 60CS that caused a mortality in population of cotton pink bollworm as 59.2 and 73.4. In case of Spinetoram 120SC the mortality in population as 54.3 and 71.6% after 3rd and 7th days of treatment. While in case of Deltamethrin 2.5EC and Triazophos 40EC similar effect on the mortality of cotton pink bollworm was observed even after 3rd and 7th days after treatment i.e (50.4 & 63.7) and (44.6 & 58.4) as described in table 3. The minimum control was observed by Chlorantrniliprole 20 SC as 38.8 and 53.9 on 3rd and 7th days after application. Triazophos + Deltamethrin 40EC+2.5EC proved to be the best product after 3rd and 7th days after application of insecticides. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012). Younis *et al*. (2007) reported that, the synthetic pyrethroid, Lambda cyhalothrin and deltamethrin exhibited the greatest reduction in bollworms infestation compared with the organophosphrus pesticide treatment.

Table 2. Mean percent population mortality of cotton Pink bollworm after application of different insecticides on cotton during 2016.

Treatments	Dose/ha (g,ml)	Av. pest population before spray	Post treatment average population/plant		Mortality (%)	
			3th day	7th day	3th day	7th day
Triazophos	2500	8	5.7e	4.7e	44.6	58.4
Deltamethrin	1000	9	5.1d	4.1d	50.4	63.7
Triazophos + Deltamethrin	2500+ 1000	7	4.0a	1.1a	61.1	90.2
Gamma Cyhalothrin	250	8	4.2b	3.0b	59.2	73.4
Spinetoram	300	9	4.7c	3.2c	54.3	71.6
Chlorantraniliprole	312	7	6.3f	5.2f	38.8	53.9
Control		8	10.3	11.3	-	-

Each value is a mean of three replications. Means sharing similar letters in columns are not significantly different byDMR test (P=0.05)

It is evident from the (Table 3) that insecticides were found to be effective in controlling population of cotton pink bollworm during 2017 under field conditions. All tested insecticides (Table 1) caused significant mortality in population of cotton pink bollworm even 7 days after spray. Triazophos + Deltamethrin 40EC+2.5EC was statistically highly effective with mortality in cotton pink bollworm population as 59.3 and 89.4% on 3rd and 7th days of treatment during 2016 followed by Gamma cyhalothrin 60CS that caused a mortality in population of cotton pink bollworm as 58.6 and 84.9%. In case of Spinetoram 120SC the mortality in population as 49.8 and 75.2% after 3rd and 7th days of treatment. While in case of Deltamethrin 2.5EC and Triazophos 40EC similar effect on the mortality of cotton pink bollworm was observed even after 3rd and 7th days after treatment i.e (45.8 & 66.) and (45.2 & 61.2) as described in table 3. The minimum control was observed by Chlorantrniliprole 20 SC as 37.8 and 49.4% on 3rd and 7th days after application. Triazophos + Deltamethrin 40EC+2.5EC proved to be the best product after 3rd and 7th days after application of insecticides. PBW resistance to chlorinated hydrocarbons was reported in Mexico and Texas in the 1950s and 1960s (Lowry and Berger, 1965). El-Metwally et. al. (2003) showed that synthetic pyrethroids (Fenpropathrin, esfenvalerate and lambdacyhalothrin) gave the highest reduction of bollworms infestation followed by IGRs, flufenoxuron, hexaflumzuron mixed with O.P chlorpyrifos, while IGRs alone gave least reduction.

Table 3. Mean percent population mortality of cotton Pink bollworm after application of different insecticides on cotton during 2017.

Treatments	Dose/ha (g,ml)	Av. pest population before spray	Post treatment average population/plant		Mortality (%)	
			3th day	7th day	3th day	7th day
Triazophos	2500	8	4.49e	3.6e	45.2	61.2
Deltamethrin	1000	9	4.44d	3.1d	45.8	66.6
Triazophos + Deltamethrin	2500+ 1000	7	3.33a	0.98a	59.3	89.4
Gamma Cyhalothrin	250	8	3.39b	1.4b	58.6	84.9
Spinetoram	300	9	4.11c	2.3c	49.8	75.2
Chlorantraniliprole	312	7	5.10f	4.7f	37.8	49.4
Control		7	8.2	9.3	-	-

Each value is a mean of three replications. Means sharing similar letters in columns are not significantly different by DMR test (P=0.05)

Conclusion

It is concluded from the research trial that all the insecticides proved to be effective for controlling cotton pink bollworm but Triazophos + Deltamethrin 40EC+2.5EC @ 2500+1000 ml/ha proved to be more effective against cotton pink bollworm followed by Gamma cyhalothrin 60CS and Spinetoram 120SC.

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