Research Article

Effect of different insecticides against spotted bollworms (*Earias Vittella* F.) on okra at BARDC Quetta

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Abstract

The effect of different insecticides (Radiant, Steward, Coragen) was evaluated against spotted bollworm on okra during 2016. The experiment was conducted in RCBD with three replications and three treatments. Pretreatment observation was taken 24 hours before application of insecticides and post treatment observations were taken 48, 96 hours and 7 days after treatment. First spray after 96 hours' the larvae population was lowest (0.90 plant⁻¹) and after 7 days of spray highest (1.28 plant⁻¹) while (2.09 plant⁻¹ live larvae plant⁻¹) was recorded in control plot. The Steward showed high reduction (1.46 plant⁻¹), followed by Coragen (1.20 plant⁻¹) and Radiant (0.79 plant⁻¹) in live larvae population. After second spray of 96 hours in live larvae population was lowest (0.58 plant⁻¹) and after 7 days of spray highest (1.01 plant⁻¹) while (1.04 plant⁻¹) was recorded in control plot. The Steward resulted higher reduction in live larvae population (0.86 plant⁻¹), Coragen (0.64 plant⁻¹), Radiant (0.57 plant⁻¹) as compared with control (0.97 plant⁻¹). Steward insecticide showed great effect against spotted bollworm and its live larvae population as compared to other insecticides. The maximum number of fruits plant⁻¹ (55.66) and average fruit yield per acre (7062 kgs) was recorded in plot spread with Radiant and lowest (4070) in control plot.

Keywords: Efficacy; Insecticides; Okra; *Spotted bollworms*

Introduction

Okra, *Abelmoschus esculentus* L., is one of the important vegetable crops grown throughout the tropical and warm temperate regions of the world. Okra belongs to the family Malvaceae and it is a warm season crop. okra is cultivated old world Ethiopian

region [1]. The plant is 1-2-meter-tall, herbaceous annual, leaves alternate, stem green, palmately 3-7 lobed, erect, hirsute, serrate, flowers solitary, broadly chordate, axillary with about 2 cm long peduncle; epicalyx upto 10. Its edible fruits are used by farmers as a vegetable crop and are normally

promoted in the fresh condition, commonly in preserved or dehydrated form [2]. It may be cooked and fried in butter or oil with essential elements [3]. Okra is attacked by many insect pests right from germination to harvest [4, 5]. Sucking pests in the early stage and the fruit borers, *Earias vittella* Fabricius, *Earias insulana* Boisduval and *Helicoverpa armigera* (Hübner) in the later stage causes extensive damage to fruits and results in 69 per cent yield loss [6,7]. Application of insecticides had been found to provide acceptable solution to tackle these problems [8- 10]. Biologically *Bacillus thuringiensis* can be controlled the Loopers. They can be handpicked and destroyed. [11]. [12] reported that the occurrence of *Bemisia tabaci* and different insect pest damage the okra from year to year depending upon favorable climatic conditions for suitable for insect pest attack. In Pakistan an average about 145 insect pest's species are recorded on cotton plant and also attack on okra crop. Although, only few of these are major pests which causes economic losses in crops. The six jassid, American bollworm, spotted bollworm, and whitefly, Thrip, and pink bollworm are the key insect pests: The chemicals are highly effective, rapid in action, adaptable to most situations and relatively economical. Bollworms cause about 30 to 40% losses of yield of seed cotton [13]. Among bollworms, American bollworm, spotted bollworm, and spinny bollworm are important pests of okra. Bollworms mainly feed on fruiting parts of the crop resulting in considerable losses both in quality and quantity [14]. The spotted bollworm larvae damage the soft and growing tissues especially from terminal bud of main stem, flower buds and bolls. [15] Spotted bollworms (*Earias vittella* and *Earias insulana*) damage crops from germination to maturity which causes 19-20% yield losses in cotton and are severe pests of okra [16]. [17] reported that

cypermethrin (Cyperkill 25 EC), deltamethrin (Decis 2.8 EC), fluvalinate (Mavrik 25 EC), diflubenzuron (Dimilin 25 WP), quinalphos (Ekalux 25 EC), monocrotophos (Monocil 36 SL) carbaryl (Hexavin 50 WP), and fenvalerate (Sumicidin 20 EC), were measure against *Earias vittella* 1-day-old eggs. Opposed *Earias vittella*, particularly egg-hatch decreased in all treatments, while diflubenzuron at 600 g p/ha is remained minimum impact. To overcome the losses and to increase the yield, pesticides application is utmost important, previous investigation about the evaluation of different insecticides for the control of spotted bollworm were conducted by [18-24]. A several group of the insecticides are currently present in the local market which may be in adequately redesign in brands but having same group of insecticides. It is essential to estimate the effect of insecticides for reduction of spotted bollworm. Therefore, the current study was conducted to check the different group of insecticides on okra and their effect against spotted bollworm.

Materials and methods

The studies were carried out in Kharif season in 2016 at Balochistan Agricultural Research and Development Centre, Quetta. Experiment was laid out in RCBD with three replications and three treatments (Radiant, Steward, Coragen, Control) were applied against spotted bollworm on okra to check the efficacy. The okra variety Rama Krishna was sown. The distance between the lines was 75 cm. The recommended doses of insecticides, using with 100 liter of water, were sprayed against spotted bollworm on Kharif season. Five plants were selected randomly from each plot and larval population was counted by splitting or opening the infested flower buds, flowers and fruits after 48, 96 hours and 7 days after treatment. The pest population was observed

at three leaves per plant of okra crop in early stage of growing and time of harvesting, fruiting bodies were picked out from control and treated plots, and compared to observe the effect of different insecticides against spotted bollworm on okra crop. Overall two sprays were carried out. The yield was determined by tagging five plants randomly in each treatment and the total number of fruits produced was counted throughout the season. The weight of these numbers of fruits produced by these tagged plants was taken and multiplied by the total number of plants per acre to determine the yield per acre.

Data analysis: The data analysis ANOVA was carried out through software SXW 8.1 [25], to categorize the effectiveness of selected groups of insecticides.

Results and discussion

Total number of fruits (First spray)

The results (Table 1) indicated that the total number of okra fruits differed significantly ($P < 0.05$) between pesticides ($F = 4.39$; $DF = 3, 39$; $P = 0.0018$) and post treatment

observation periods ($F = 25.43$; $DF = 2, 39$; $P = 0.0000$). The post-treatment count of total okra fruits at 48, 96 hours and 7 days after treatment was 16.13, 17.20 and 10.86 (av. 20.10) in plants sprayed with Radiant; 15.53, 16.86 and 11.26 (av. 14.55) sprayed with Steward; 16.00, 17.36 and 11.86 (av. 15.07) sprayed with Coragen; respectively. On average, the highest was (16.50) in total fruits plant⁻¹ after 96 hours of spray, the lowest (11.41) after 7 days of spray while 16.12 was recorded in control plot. The comparative effect of pesticides indicates that okra plants sprayed with Radiant had relatively greater number of total fruits plant⁻¹ (20.10), while Coragen ranked second with 15.07 fruits plant⁻¹. Similarly, Steward ranked third with 14.55 fruits plant⁻¹; while in control plots, relatively lower number of total fruits i.e. 13.50 was recorded. Hence, it was concluded that Radiant showed positively better impacts on total number of okra fruits as compared to rest of the products sprayed.

Table 1. Mean total number of fruits per plant in treated plots during 1st spray

Treatments	Pre-treatment	Post-treatment observation (days after treatment)			
		48 hours	96 hours	7-days	Mean
Radiant	15.80	16.13	17.20	10.86	20.10 a
Steward	16.46	15.53	16.86	11.26	14.55 b
Coragen	17.90	16.00	17.36	11.86	15.07 b
Control	14.33	14.26	14.60	11.66	13.50 bc
Mean	16.12 a	15.48 a	16.50 a	11.41 b	-
	Treatment (T)	Post treatment period (DAT)		T X DAT	
S.E.	0.6210	0.5669		1.3885	
LSD 0.05	1.2430	1.1347		2.7795	
LSD 0.01	1.6538	1.5097		0.6981	

Number of damaged fruits (First spray)

The results (Table 2) revealed that there was significant ($P < 0.05$) difference in damaged fruits in plants sprayed with various pesticides ($F = 2.67$; $DF = 3, 39$; $P = 0.0309$) at

different post-treatment periods ($F = 11.21$; $DF = 2, 39$; $P = 0.0000$). The number of damaged fruits after 48, 96 hours and 7 days after treatment was 2.73, 2.40 and 1.06 (av. 2.60) when crop sprayed with Radiant; 4.66,

3.40 and 2.53 (av. 3.53) sprayed with Steward; 2.33, 2.53 and 1.26 (av. 2.04) sprayed with Coragen respectively. In treated crop on average, after 7 days of spray the damaged fruits plant⁻¹ were minimum (1.86) and maximum (3.34) after 48 hours while 4.29 were recorded in control. The comparative effect of pesticides Steward

resulted more reduction in damaged was (3.53 plant⁻¹), followed by Radiant and Coragen (2.06 and 2.04 plant⁻¹). Although in control plots the damaged fruits okra were maximum 3.30 fruits plant⁻¹. It was observed that Steward showed positively better impacts on damaged fruits as compared to rest of the products sprayed.

Table 2. Mean number of damaged fruits per plant in treated plots during 1st Spray

Treatments	Pre-treatment	Post-treatment observation (days after treatment)			
		48 hours	96 hours	7-days	Mean
Radiant	4.13	2.73	2.40	1.06	2.06 a
Steward	3.73	4.66	3.40	2.53	3.53 b
Coragen	4.60	2.33	2.53	1.26	2.04 a
Control	4.73	3.66	3.65	2.60	3.30 b
Mean	4.29 b	3.34 b	2.99 b	1.86 a	
	Treatment (T)	Post treatment period (DAT)		T X DAT	
S.E.	0.4127	0.3767		0.9228	
LSD 0.05	0.8261	0.7541		1.8473	
LSD 0.01	1.0992	1.0034		2.4578	

Live larvae population (First spray)

The results presented in (Table 3), and it was observed that there was significant ($P<0.05$) difference in live larvae population on okra plants sprayed with various pesticides ($F=2.53$; $DF=2, 89$; $P=0.0386$) at different post-treatment periods ($F=9.33$; $DF=3, 39$; $P=0.0000$). The data showed that after 48, 96 hours and 7 days after treatment the live larvae population was 0.86, 0.60 and 0.93 (av. 0.79) on crop sprayed with Radiant; 1.46, 1.20 and 1.73 (av. 1.46) on crop sprayed with Steward; 1.00, 0.80 and 1.26 (av. 1.20) sprayed with Coragen, respectively. In treated crop on average, after 96 hours of spray the live larvae population was lowest (0.90 plant⁻¹) and highest after 7 days of spray (1.28 plant⁻¹) and live larvae population 2.09 in control. The comparative effect of pesticides indicates that Steward resulted higher

reduction in live larvae population on okra (1.46 plant⁻¹), followed by Coragen and Radiant (1.20 and 0.79 plant⁻¹) against 1.53 plant⁻¹ in control plots. It was observed that Steward proved to be more essential insecticide for controlling of live larvae population of spotted bollworm rather than other pesticides.

Total number of fruits (Second spray)

The data (Table 4) showed that after second spray, total number of okra fruits significantly differed ($P<0.05$) between observation dates ($F=350.47$; $DF=2, 39$; $P=0.0000$) and non-significant for treatments ($F=1.65$; $DF=3, 39$; $P=0.1608$). The post-treatment counts of total okra fruits plant⁻¹ at 48, 96 hours and 7 days after treatment was 12.46, 15.40 and 16.66 (av. 14.84) in crop sprayed with Radiant; 12.13, 13.33 and 14.93 (av. 13.46) when treated with Steward; 12.20, 14.66 and

16.46 (av. 14.44) when sprayed with Coragen, respectively. On average, after 7 days of second spray the total fruits plant⁻¹ was highest (15.56) and after 48 hours of treatment were lowest (12.28) while 11.57 was recorded in control. The effect of pesticides suggested that okra plants sprayed with Radiant resulted greater number of total

fruits plant⁻¹ (14.84), while Coragen ranked second with 14.44 fruits plant⁻¹. Similarly, Steward ranked third with 13.46 fruits plant⁻¹ respectively against control 12.88 fruits plant⁻¹. Thus Radiant proved high efficacy against spotted bollworm as compared to rest of the pesticides.

Table 3. Mean number of Larvae per plant in treated plots during 1st Spray

Treatments	Pre-treatment	Post-treatment observation (days after treatment)			
		48 hours	96 hours	7-days	Mean
Radiant	2.0	0.86	0.60	0.93	0.79 a
Steward	1.66	1.46	1.20	1.73	1.46 b
Coragen	2.13	1.00	0.80	1.26	1.20 a
Control	2.60	1.20	1.00	1.20	1.13 b
Mean	2.09 b	1.13 a	0.90 a	1.28 a	-
	Treatment (T)	Post treatment period (DAT)		T X DAT	
S.E.	0.23202	0.2101		0.5147	
LSD 0.05	0.4608	0.4206		1.0304	
LSD 0.01	0.6131	0.5597		1.3709	

Table 4. Mean number of fruits per plant in treated plots during 2nd Spray

Treatments	Pre-treatment	Post-treatment observation (days after treatment)			
		48 hours	96 hours	7-days	Mean
Radiant	11.66	12.46	15.40	16.66	14.84 a
Steward	11.86	12.13	13.33	14.93	13.46 b
Coragen	11.26	12.20	14.66	16.46	14.44 a
Control	11.53	12.33	12.13	14.20	12.88 b
Mean	11.57 c	12.28 c	13.88 b	15.56 a	-
	Treatment (T)	Post treatment period (DAT)		T X DAT	
S.E.	0.4603	0.4202		1.0293	
LSD 0.05	0.9214	0.8412		2.0604	
LSD 0.01	1.2260	1.1192		2.7414	

Number of damaged fruits (Second spray)

The data (Table 5) indicated that the number of damaged plant⁻¹ significantly varied for post treatment observations dates (F=10.74;

DF=2, 39; P=0.0000) and non-significant for treatments (F=1.65; DF=3, 39; P=0.1608). The number of damaged fruits after second spray recorded after 48, 96 hours and 7 days

of treatment was 2.86, 1.13 and 1.53 (av. 1.84 plant⁻¹) when okra was sprayed by Radiant; 2.80, 1.26 and 2.06 (av. 2.04 plant⁻¹) when treated with Steward; 2.60, 0.93 and 1.06 (av. 1.53 plant⁻¹) when sprayed with Coragen, respectively. After 96 hours of spray the damaged fruits plant⁻¹ was minimum (1.29 plant⁻¹) and after 48 hours of spray was maximum (2.94 plant⁻¹) while

3.04 in control. The Steward showed higher reduction in damaged fruits (2.04 plant⁻¹), followed by Radiant and Coragen with 1.84 and 1.53 damaged fruits plant⁻¹ respectively as compare to control 2.68 damaged fruits plant⁻¹. This suggested that Steward impacted more positively to reduce damaged fruits in okra than other pesticides used.

Table 5. Mean number of damaged fruits per plant in treated plots during 2nd Spray

Treatments	Pre-treatment	Post-treatment observation (days after treatment)			
		48 hours	96 hours	7-days	Mean
Radiant	2.53	2.86	1.13	1.53	1.84 a
Steward	3.40	2.80	1.26	2.06	2.04 b
Coragen	2.60	2.60	0.93	1.06	1.53 a
Control	3.66	3.53	1.86	2.66	2.68 b
Mean	3.04b	2.94 b	1.29 a	1.82 a	
	Treatment (T)	Post treatment period (DAT)		T X DAT	
S.E.	0.3972	0.3626		0.881	
LSD 0.05	0.7951	0.7258		1.7778	
LSD 0.01	1.0578	0.9657		2.3654	

Live larvae population (Second spray)

The live larvae population on okra sprayed with some approved pesticides against spotted bollworm was recorded after 48, 96 hours and 7 days of treatment (Table 6), and it was noted that the live larvae population differed significantly ($P < 0.05$) when observed at different days after treatment ($F = 5.38$; $DF = 2, 39$; $P = 0.0009$) and non-significant ($P > 0.05$) for treatments ($F = 1.19$; $DF = 3, 39$; $P = 0.3258$). It is obvious from the data (Table 6) that after 48, 96 hours and 7 days of treatment the live larvae population was 0.66, 0.40 and 0.66 (av. 0.57) on crop sprayed with Radiant; 0.80, 0.46 and 1.33 (av. 0.86) on crop sprayed with Steward; 0.54, 0.40 and 1.00 (av. 0.64) sprayed with Coragen, respectively. In treated crop on average, the live larvae population after 96 hours of spray was lowest (0.58 plant⁻¹) and after 7 days of spray was highest (1.01 plant⁻¹)

and 1.04 plant⁻¹ in control. This indicates that after 7 days of spray, the pesticide lost its efficacy and growth of live larvae was restarted. The comparative effect of pesticides indicates that Steward resulted higher reduction in live larvae population on okra (0.86 plant⁻¹), followed by Coragen and Radiant with live larvae population of 0.64 and 0.57 plant⁻¹, respectively as compared with control 0.97 plant⁻¹. It was observed that Steward showed to be more useful insecticide for controlling of spotted bollworm live larvae population as compared to all treatments.

Number of fruits plant⁻¹

Number of okra fruits plant⁻¹ were significantly higher (55.66) in plots sprayed with Radiant, followed by Coragen (48.66) and Steward (44.33) respectively. Although, in control plot lowest (32 fruits plant⁻¹) was recorded (Table 7).

Weight of fruits plant⁻¹/acre⁻¹

The result in (table 8) the plots sprayed with Radiant, was higher (321 g plant⁻¹/7062 kg acre⁻¹) Fruit yield plant⁻¹/acre⁻¹ and lowest (272 g plant⁻¹/5984 kg acre⁻¹) okra yield was

recorded in plots sprayed with Steward. While the lowest fruit yield was (185 g plant⁻¹/4070 kg acre⁻¹) recorded in control plots.

Table 6. Mean number of Larvae per plant in treated plots during 2nd Spray

Treatments	Pre-treatment	Post-treatment observation (days after treatment)			
		48 hours	96 hours	7-days	Mean
Radiant	0.73	0.66	0.40	0.66	0.57 a
Steward	1.00	0.80	0.46	1.33	0.86 a
Coragen	1.20	0.54	0.40	1.00	0.64a
Control	1.26	1.26	0.66	1.06	0.99 b
Mean	1.04b	0.81 a	0.58 a	1.01 b	-
	Treatment (T)	Post treatment period (DAT)		T X DAT	
S.E.	0.2062	0.1883		0.4612	
LSD 0.05	0.4128	0.3769		0.9231	
LSD 0.01	0.5493	0.5014		1.2282	

Table 7. Average number of fruits per plant treated with different pesticides

Treatments	RI	RII	RIII	Average
Control	26	37	33	32.00 c
Radiant	48	62	57	55.66 a
Steward	47	46	40	44.33 b
Coragen	55	51	40	48.66 a
S.E.	4.4146			
LSD 0.05	9.8364			
LSD 0.01	13.991			

Table 8. Average weight of fruits per plant / per acre treated with different Pesticides.

Treatments	RI	RII	RIII	Average fruit yield plant ⁻¹ (g)	Average fruit yield acre ⁻¹ (kg)
Control	148	217	190	185 c	4070 c
Radiant	281	354	328	321 a	7062 a
Steward	287	277	252	272 a	5984 a
Coragen	333	304	248	295 a	6490 a
S.E.	25.759				
LSD 0.05	57.394				
LSD 0.01	81.636				

These results are further supported by [26] who evaluated the effect of Nighaban, Talstar, Confidor, Patriot, Taophos, Larvin, Lorsban, Vital 1.8EC and Tracer 240SC was found to be most effective against spotted bollworms. Although, the pesticides may be available in the local markets but may be in relatively change in brands but having same chemical groups. However, the minor differences in efficacies most probably related to dose applied and environmental conditions at the time of application.

Conclusion

The present study was concluded that the effect of Steward and Radiant on suppression of pest population of okra pests mainly proved best in reducing the pest population from the field. The Spotted bollworms population can be reduced greatly by using of Steward and Radiant. This study can be exploited for pest control in different fruits and vegetables. The Present findings of this research, it is suggested that Steward and Radiant may be applied more preferably against spotted bollworm in okra, followed by Coragen.

Authors' contributions

Conceived and designed the experiments: S Ahmed, Performed the Experiments: N Ahmed, MA Khetran, Amanullah & M Yaqub, Analyzed the Data: S Ahmed & MI Jakhro, Contributed reagents/ Materials/ Analysis tools: N Sadiq & I Ahmed, Wrote the paper: S Ahmed & N Ahmed.

References

1. Jacquelyn W (1999). Agriculture Businesses Communities Families Home and Garden Kids AR Us Natural. University of Arkansas Cooperative Extension Program, University of Arkansas at Pine Bluff, United States Department of Agriculture and County Governments Cooperating, Arkansas (USA). pp 1-3
2. Henry E (2001). Commercial Okra Production. University of Arkansas Cooperative Extension Program, University of Arkansas at Pine Bluff, United States Department of Agriculture and County Governments Cooperating. pp 1-3.
3. Yadav SK, Dhankhar BS, Deswal DP & Tomer RPS (2001). Effect of sowing date and plant geometry on seed production and quality of okra, *Abelmoschus esculentus* (L.) cv. Varsha Uphar. *Seed Res* 29(2): 149-152.
4. Sharma M, Patidar S, Rath PK & Sharma U (1997). Effectiveness and residual toxicity of different insecticides against gram pod borer. *Crop Res Hisar* 14(3): 493-495.
5. Jagtab CR, Shetgar SS & Nalwandikar PK (2007). Fluctuation in population of lepidopterous pest infesting okra in relation to weather parameters during Kharif. *Ind J of Entomol* 69(3): 218-220.
6. Atwal AS & Singh B (1990). Pest population and assessment of crop losses, Publication, *Ind Agri Res Inst.* (New Delhi). pp 536.
7. Mani M, Krishnamoorthy A & Gopalakrishnan C (2005). Biological control of lepidopterous pests of Horticultural crops in India. *A Rev of Agri Res* 26(1): 39-49.
8. Pawar AD, Prasad J & Singh R (1988). Field evaluation of traps and sex pheromones of *Heliothis armigera* (Hub.) (Noctuidae: Lepidoptera) and effect of release of parasites on male moth catches in pheromone traps. *Plant Protec Bulletin* 36(3): 29-30.
9. Verma S (1989). Efficacy and persistence of some insecticides against jassid infesting okra (*Abelmoschus esculentus*). *Plant Protec Bulletin* 41(1/2): 42-45.
10. Priya BS & Misra HP (2007). Biopesticides for the management of okra fruit borer, *Earias vittella* (Fab.) *Pest Manag in Horti Eco* 13(2): 176-179.
11. Kumar A (2004). Effect of neem based pesticides on germination of okra

- (*Abelmoschus esculentus*). *Seed Shashpa* 11(1): 83-85.
12. Mazumder N, Borthakur U & Choudhury D (2001). Incidence of yellow vein mosaic virus of bhindi (*Abelmoschus esculentus* L.) in relation to cultivar and vector population under different sowing dates. *Ind J of Virol* 12(2): 137-141.
 13. Haque H (1991). Imported generic pesticides need to be checked before marketing, PAPA (*Pak Agri Pesti Asso*) Bulletin, pp 16-17.
 14. Verma DK (1999). *Applied Entomology*, Mittal Publications, New Delhi, pp 117-174.
 15. Munro JM (1987). *Tropical Agriculture*, Longman Scientific and Technical, New York, pp 147-183.
 16. Kamaluddin S (1994). Redescription of spotted bollworm *Earias fabia* Stoll (*Lepidoptera: Arctiidae*) from Pakistan with special reference to its genitalia, life cycle, nature of damage and control. *14th Pak Congr Zool* 14(1): 321-325.
 17. Singh J, Gill JS & Singh J (1993). Ovicidal effect of insecticides on eggs of gram podborer (*Helicoverpa armigera*) and spotted bollworm (*Earias vittella*). *Ind J Agri Sci* 63(2): 853-855.
 18. Patil CS, Jodhar RG, Note UN & Khair VM (1990). Control of pigeon pea pod borer complex with insecticides dust formulation. *J Maharashtra Agric Uni* 15(2): 258-259.
 19. Talpur MA, Rustamani MA, Hussain T, Lakho J, Sabhayo RB & Memon A (1993). Comparative effectiveness of Pyrethroids combination against spotted bollworm (*Earias insulana*) on cotton. *Pak J Zool* 25(1): 41-43.
 20. Ravi G, Shashi S & Veram S (1997). Evaluation of pesticides against *Heliothis armigera* and its parasitoid *Campoletic chloridae* on chickpea. *Ind J Entomol* 59(1): 69-77.
 21. Sharma ML, Raj HS & Verma ML (1997). Biopesticides for management *Helicoverpa armigera* (Hub.) in Chickpea. Intern. *Chickpea. Pigeon Pea Newsletter* 4(2): 26-27.
 22. Akber R & Hasan M (1999). Comparative efficacy of some traditional and non-traditional insecticides against insect pests of Okra. *Pak Entomol* 21(2): 77-80.
 23. Naveed M, Rafiq M & Attique MR (1999). Efficacy of new insecticides Pirate 360SC and Steward 15SC against *Helicoverpa armigera* (Hub.) (Noctuidae: Lepidoptera) on cotton. *Pak J Zool* 31(4): 343-346.
 24. Allen CT, Kharbouthli MS, Capps CE & Earnest LD (2000). Insecticides for tobacco budworm control. Special Report, Arkansas Agri Experiment. Station. pp 136-139
 25. Statistix (2006). Analytical Software. Statistix 8.1 User's Manual. Analytical Software, Tallahassee (Florida).
 26. Bohmfalk GT, Frishie RE, Sterling WL, Mitzer RB & Knutson AE (2001). Identification, biology and sampling of cotton insects, Extension Bulletin B-933, The Texas Agricultural Extension Service, Texas A & M University System.