Pakistan Journal of Life and Social Sciences
www.pjlss.edu.pk

RESEARCH ARTICLE

Bioefficacy of Organophosphates, Pyrethroids and New Chemistry Insecticides against a Field Population of Dusky Cotton Bug, *Oxycarenus* spp. (Hemiptera: Oxycarenidae) in Bt Cotton Ecosystem

Muhammad Akram[1], Muhammad Ramzan Asi[1]*, Mehfooz-ul-Haq[1], Muhammad Afzal[2]* and Muhammad Saleh Saleem[3]
[1]Department of Pest Warning and Quality Control of Pesticides, Vehari, Pakistan
[2]Faculty of Agriculture, University of Sargodha, Sargodha, Pakistan
[3]Department of Pest Warning and Quality Control of Pesticides, Multan, Pakistan

ARTICLE INFO
Received: Nov 21, 2012
Accepted: Feb 14, 2013
Online: Feb 16, 2013

Keywords
Bt cotton
Dusky cotton bug
Insecticides
Organophosphates
Pyrethroids

***Corresponding Authors:**
chafzal64@yahoo.com
ramzan_asi@yahoo.com

ABSTRACT
The dusky cotton bug is a widespread polyphagus pest of economic importance. Both nymphs and adults feed on immature seeds and cause quantitative and qualitative loss in cotton. As information on its susceptibility to insecticides under field conditions was scarce; susceptibility of dusky cotton bug to different pyrethroid, organophosphate and new chemistry insecticides was tested under field conditions at Government Agricultural Farm, Vehari, Pakistan in the year 2012. The experiment was conducted under Randomized Complete Block Design with three replications of each treatment. All the insecticides tested, except deltamethrin 2.5EC proved effective against both adults and nymphs of dusky cotton bug. Triazophos 40EC, Nurelle-D 505EC, Curacron 500EC, Fiprox 5SC, Adder Plus 360EC and mixture of Lancer 2.5EC & triazophos 40EC were significantly effective in reducing dusky cotton bug population 72 hours (23.75-55.85%) and even 168 hours (27.49-54.02%) post treatment under field conditions in Bt cotton ecosystem. These chemical insecticides may be considered to be appropriate for field use against this pest.

INTRODUCTION

Cotton (*Gossypium hirsutum* L.) is an important fiber and cash crop of Pakistan. It is a dual purpose crop which provides fiber as well as vegetable oil (Mallah et al., 1997). It is considered as main stay of the country economy because it is important source of foreign exchange. Despite of all efforts, average per acre yield of cotton in Pakistan is still low as compared to other countries (Bakhsh et al., 2005). Among various factors responsible for low yield of cotton, insect pests are the most important causing 30-40% yield loss (Kannan et al., 2004; Haque, 1991;). About 93 (Yunus and Yousuf, 1979) to 145 (Haque, 1994) insect and mite pests attack cotton crop. These include sucking as well as chewing insect pest complex. Among sucking insect pests, dusky cotton bug, *Oxycarenus* ~~species~~ sp. or spp. (Hemiptera: Oxycarenidae) recently has become common widespread pest of economic importance. Both nymphs and adults feed on immature seeds causing multiple types of injuries to the crop including reduction in cotton yield, seed weight and oil contents (Srinivas and Patil, 2004; Sewify and Semeada, 1993;). It causes severe damage to the embryo and reduces seed viability (Srinivas and Patil, 2004; Pearson, 1958; Kirkpatrick, 1923). It also deteriorates quality of cotton by staining lint (Henry, 1983). The incidence of dusky cotton bug is increasing on Bt cotton compared to non-Bt. cotton because of reduction in the number of insecticides application for bollworm management (Patil and Rajanikanth, 2005). Recently, it has become a high risk pest (PERAL, 2006) which poses a significant economic threat (Smith and Brambila, 2008).

Despite of important advances in technology, only limited control measures have been devised to manage the population of dusky cotton bug. A common strategy preferred by farmers to protect cotton crop is the utilization of chemical pesticides as they are highly effective and often have knock down effect. It is reported that about 90% of the farmers protect crops from pests using chemical insecticides (Prayogo et al., 2005). But use of insecticides against the particular insects continuously over a long period causes resistance in them (Wang et al., 2011). Therefore, highly effective new chemistry products against particular pest must be identified and manipulated to reduce risk of resistance in insects against insecticides. Previous investigations on susceptibility of dusky cotton seed bug to various insecticides have been conducted by Ibrahim et al. (1993) and Roger et al. (1997). As information on its susceptibility to pesticides under field conditions was scarce in Pakistan; present studies were carried out to assess the susceptibility response of field population of dusky cotton bug to various pyrethroid, organophosphate and new chemistry insecticides in Bt cotton.

MATERIALS AND METHODS

The experiment was laid out in Completely Randomized Block Design with three replications of each treatment at area of Government Agricultural Farm, Vehari, Pakistan in 2012. Cotton variety Bt- 886 was sown on April 2, 2012 with net plot size of 12.25 x 6.35 m. There were 8 rows in each plot, 75 cm apart; while plant to plant distance of 25-30 cm was maintained during thinning. There were twelve treatments including a control. Eleven chemical insecticides, viz. Triazophos 40EC, Nurelle-D 505EC, Curacron 500EC, Fiprox 5SC, Adder Plus 360EC, Delegate 25WG, Goldstar 200EC, deltamethrin 2.5EC, Karate 2.5EC, Polytrin-C 440EC and mixture of Lancer 2.5EC & triazophos 40EC were obtained from local market and applied as spray ats field recommended doses (Table 1) with the help of a hand operated knapsack sprayer fitted with an hollow cone nozzle when the population of dusky cotton bug reached at economic threshold level (ETL). Control plots were sprayed with water only. The sprayer was calibrated using water by calculating the amount of water required for spraying on a unit area prior to the experiment. All agronomic practices like hoeing, irrigation and fertilizer application were kept uniform throughout the experiment in all plots. Data regarding population of dusky cotton bug was recorded in each plot 24 hours before spray, 72 hours and 168 hours after spray by counting both adults and nymphs separately from all opened bolls of five randomly selected plants. Percent population change (increase or decrease) was calculated using modified Abbot's formula (Fleming and Ratnakaran, 1985) as below:

% Population change = 1-[(Post treatment population in treatment/ Pre treatment population in treatment) × (Pre treatment population in control/ Post treatment population in control)] × 100

Statistical analysis

The final data were subjected to analysis of variance (ANOVA) using SAS System 2004 and means were compared by the Tukey HSD test at $P \leq 0.05$.

RESULTS

Susceptibility of nymphs of dusky cotton bug to different insecticides varied significantly (F=40.29, df=10, P<0.0001) 72 hours after spray. Nurelle-D was highly effective against nymphs of dusky cotton bug followed by triazophos, Adder Plus, Fiprox, mixture of Lancer & triazophos and Curacorn (Table 2). The population reductions caused by these insecticides were statistically same but significantly higher from that of Polytrin-C, Goldstar, Karate, deltamethrin and Delegate. Polytrin-C and Goldstar with population reduction of 45.31% and 30.02% respectively were statistically at par. Similarly, population reductions caused by Goldstar and karate were also same in terms of statistics. Delegate and deltamethrin were least effective against the nymphs of dusky cotton bug.

The insecticides significantly (F=11.26, df=10, P<0.0001) reduced the mean percent population of nymphs of dusky cotton bug (12.22-59.68%) even at 168 hours after spray. Fiprox caused maximum population reduction (Table 2) followed by Curacron, mixture of Lancer & triazophos, Nurelle-D, Adder Plus and Goldstar. Population reductions caused by these insecticides were not different in terms of statistics. Mean percent population reductions in dusky cotton bug caused by deltamethrin, Karate, triazophos and Polytrin-C ranged 26.16 to 33.32% that were statistically at par. Delegate was least effective against nymphs of dusky cotton bug 168 hours post treatment.

Susceptibility of adult population of dusky cotton bug to different insecticides varied significantly (F=124.18, df=10, P<0.0001) 72 hours after spray. The maximum population reduction (Table 3) was observed in plots treated with Curacron followed by triazophos, Fiprox and Nurelle-D. Population reductions caused by these insecticides were non significantly different but significantly higher from that of Polytrin-C, Karate and Adder Plus. Population reductions in plots treated by Adder Plus, Karate, Polytrin-C and Delegate were also non significantly different. Conversely, Goldstar and deltamethrin was not able to bring reduction in population of adults of dusky cotton bug.

The adults population reduction caused by different insecticides also varied significantly (F=89.26, df=10, P<0.0001) among insecticides even 168 hours after spray. Statistically equal reduction in adult population of dusky cotton bug was observed in plots treated with Fiprox, Curacron, triazophos and Polytrin-C. Population reductions in plots treated with Delegate,

Table 1: Insecticides tested against dusky cotton bug, *Oxycarenus* species

Sr. No.	Chemical insecticides used in experiment		Dose (gm/acre))
	Trade Name	Common Name	
1	Fiprox 5SC	Fipronil	500
2	Curacron 500 EC	Profenophos	1000
3	Karate 2.5EC	Lambdacyhalothrin	330
4	Triazophos 40EC	Triazophos	1000
5	Deltamethrin 2.5EC	Deltamethrin	330
6	Delegate 25WG	Spintoram	40
7	Adder Plus 360EC	Deltamethrin + Triazophos	500
8	Nurelle-D 505EC	Cypermethrin + Chlorpyriphos	500
9	Polytrin-C 440EC	Cypermethrin+ Profenophos	500
10	Goldstar 200EC	Bifenthrin + Pyridaben	250
11	Lancer 2.5EC + Triazophos 40EC	Lambdacyhalothrin + Triazophos	330 +750

Table 2: Percent population change (increase or decrease) and mean per opened boll (in parenthesis) population of nymphs of dusky cotton bug on cotton pre and post treatment

Sr. No.	Treatments/Insecticides	Mean Population 24 Hours Before Treatment	Population Change (– or +)	
			72Hours After Treatment	168 Hours After Treatment
1	Control	(9.91) ns	(17.16)	(16.15)
2	Fiprox 5SC	(10.75)	54.94ab(6.62)	59.68a(5.45)
3	Curacron 500 EC	(11.85)	52.06ab(9.86)	55.97a(8.47)
4	Karate 2.5EC	(10.97)	23.84de(14.53)	28.36bcd(12.87)
5	Triazophos 40EC	(9.17)	63.04a(5.87)	29.87bcd(10.50)
6	Deltamethrin 2.5EC	(10.08)	14.05e(14.98)	26.15cd(12.07)
7	Delegate 25WG	(8.33)	12.76e(12.57)	12.22d(11.88)
8	Adder Plus 360EC	(10.85)	60.37ab(7.32)	39.39abc(10.63)
9	Nurelle-D 505EC	(9.15)	64.21a(5.63)	46.70abc(7.96)
10	Polytrin-C 440EC	(8.97)	45.31bc(8.5)	33.32bcd(9.7)
11	Goldstar 200EC	(13.38)	30.20cd(16.35)	38.39abc(13.16)
12	Lancer 2.5EC + Triazophos 40 EC	(10.75)	53.02ab(8.65)	49.07ab(9.15)

The values given are mean of three replicates. Means in columns followed by different letters are significantly different from each other according to Tukey HSD Test at $P \leq 0.05$. ns = non significantly different.

Table 3: Percent population change (increase or decrease) and mean per opened boll (in parenthesis) population of adults of dusky cotton bug on cotton pre and post treatment

Sr. No.	Treatments/ Insecticides	Mean Population 24 Hours Before Treatment NS	Population Change (– or +)	
			72Hours After Treatment	168 Hours After Treatment
1	Control	(14.6)	(17.16)	(14.28)
2	Fiprox 5SC	(13.05)	45.00ab(9.75)	48.39a(10.26)
3	Curacron 500 EC	(13.83)	51.04a(8.08)	42.304ab(7.55)
4	Karate 2.5EC	(14.08)	23.67de(13.56)	26.62cde(9.91)
5	Triazophos 40EC	(9.65)	48.65a(6.37)	39.16abc(6.00)
6	Deltamethrin 2.5EC	(7.22)	-66.97g(15.98)	-41.85g(10.37)
7	Delegate 25WG	(10.81)	14.45e(11.56)	18.74e(8.50)
8	Adder Plus 360EC	(15.56)	28.78cde(16.12)	21.31de(13.15)
9	Nurelle-D 505EC	(11.76)	44.37abc(8.80)	33.43bcd(8.63)
10	Polytrin-C 440EC	(13.73)	23.26 de(14.27)	35.80abc(9.70)
11	Goldstar 200EC	(14.88)	-10.72f(23.68)	2.20f(16.67)
12	Lancer 2.5EC + Triazophos 40EC	(13.05)	32.42bcd(12.31)	26.69cde(10.27)

The values given are mean of three replicates. Means in columns followed by different letters are significantly different from each other according to Tukey HSD Test at $P \leq 0.05$. ns = non significantly different.

Table 4: Percent population change (increase or decrease) and mean per opened boll (in parenthesis) population of adults & nymphs of dusky cotton bug on cotton pre and post treatment

Sr. No.	Treatments/ Insecticides	Mean Population 24 Hours Before Treatment	Population Change (– or +)	
			72 Hours After Treatment	168 Hours After Treatment
1	Control	(12.26) ns	(17.17)	(15.22)
2	Fiprox 5SC	(12.5)	49.97ab (8.18)	54.04a (6.32)
3	Curacron 500 EC	(12.84)	51.55ab (8.97)	49.14ab (8.01)
4	Karate 2.5EC	(12.52)	23.75de (14.05)	27.49cde (11.39)
5	Triazophos 40EC	(9.50)	55.85a (6.12)	34.51c (8.25)
6	Deltamethrin 2.5EC	(8.65)	-26.37g (15.48)	-7.84f (11.21)
7	Delegate 25WG	(9.57)	13.61ef (12.07)	15.48e (10.19)
8	Adder Plus 360EC	(13.21)	44.57abc (11.72)	30.35cd (11.89)
9	Nurelle-D 505EC	(10.46)	54.29ab (7.22)	40.07bc (8.30)
10	Polytrin-C 440EC	(11.35)	34.29cd (10.48)	34.56c (9.70)
11	Goldstar 200EC	(14.13)	9.74f (20.02)	20.30de (14.91)
12	Lancer 2.5EC + Triazophos 40EC	(11.90)	42.73bc (10.48)	37.88bc (9.71)

The values given are mean of three replicates. Means in columns followed by different letters are significantly different from each other according to Tukey HSD Test at $P \leq 0.05$. ns = non significantly different.

Adder Plus, Karate, mixture of Lancer & triazophos and Nurelle-D were statistically at par but significantly lower than that of Fiprox. Minimum population reduction was caused by Goldstar that was significantly different from all other treatments. Conversely, deltamethrin remained ineffective against adults of dusky cotton bug and resulted in increase in population.

Susceptibility of field population containing nymphs and adults of dusky cotton bug again varied significantly ($F=96.95$, $df=10$, $P<0.0001$) among insecticides tested 72 hours after spray. The population reductions caused by triazophos, Nurelle-D, Curacron, Fiprox and Adder Plus were non significantly different (Table 4) but significantly higher from plots treated with Polytrin-C, Karate, Delegate, and Goldstar. Adder Plus, mixture of Lancer & triazophos and Polytrin-C were also statistically at par. Similarly, effects of Karate and Delegate were also equal in terms of statistics. Goldstar caused minimum population reduction (9.74%) that was non significantly different from that of Delegate but significantly different from all other treatments while deltamethrin resulted in increase in dusky cotton bug population.

Susceptibility of dusky cotton bug to different insecticides varied significantly ($F=39.00$, $df=10$, $P<0.0001$) even at 168 hours after spray. Maximum reduction in population of dusky cotton bug was caused by Fiprox followed by Curacron, Nurelle-D, mixture of Lancer and triazophos, Ploytrin-C, triazophos, Adder Plus and Karate 168 hours post treatment. Fiprox was statistically at par with Curacron but significantly higher from other treatments. Decrease in population of dusky cotton bug in plots treated with Nurelle-D, triazophos, mixture of Lancer & triazophos, Adder Plus and Karate was non significantly different. Delegate and Goldstar were least effective against dusky cotton bug but non significantly different from karate. Deltamethrin remained ineffective and resulted in increase in dusky cotton bug population.

DISCUSSION

All organophosphates, pyrethroids and new chemistry insecticides tested, except deltamethrin were effective with varying degree of potential against both nymphs and adults of dusky cotton bug. Population of dusky cotton bug was highly susceptible to triazophos, Nurelle-D, Curacron, Fiprox, Adder Plus and mixture of Lancer & triazophos under field conditions. However, it was less susceptible to Goldstar, Delegate and Karate, while deltamethrin was ineffective against the pest under field conditions.

Ibrahim et al. (1993) investigated insect growth regulators, pyrethroids and insecticide mixtures and observed that all insecticides proved highly effective against adult and nymph population of dusky cotton bug in cotton fields. Similarly, Roger et al. (1997) found that many pyrethroids and organophosphates were effective against dusky cotton bug, *Oxycarenus lavaterae* with Tralomethrin having more profound effects. Chemical control using various insecticides is effective against dusky cotton bug on the crop, minimizing damage (Chin et al., 2009). Insecticides may kill the pest it comes into contact with it. Chemical insecticides may be applied in the form of sprays or dusts when the bugs are seen on newly opened bolls (Hill, 1983) to control them.

Our investigations revealed that mixture of different pyrethroids, organophosphates and other insecticides like Nurelle-D (mixture of deltamethrin & triazophos), Adder Plus (mixture of cypermethrin & chlorpyriphos) and mixture of Lancer & triazophos were found effective in reducing dusky cotton bug population under field conditions. Effective control of the dusky cotton bug can be achieved through the use of a mixture of different insecticides with both contact and systemic action (Smith and Brambila, 2008; Ibrahim et al., 1993).

We propose that Triazophos, Curacron, Fiprox, Nurelle-D, Adder Plus and mixture of Lancer & triazophos can effectively reduce the population of the dusky cotton bug under field conditions. It is therefore suggested that these insecticides should be recommended to the growers to manage this pest below economic threshold under field conditions.

REFERENCES

Bakhsh K, I Hassan and A Maqbool, 2005. Factors affecting cotton yield: A case study of Sargodha in Pakistan. Journal of Agriculture and Social Sciences, 1: 332-334.

Chin D, B Thistleton and H Brown, 2009. Factsheet: Swarming Bugs (family Lygaeidae) (ENT7). Department of Regional Development, Primary Industry, Fisheries and Resources, Northern Territory Government. pp: 2.

Fleming R and A Retnakaran, 1985. Evaluating single treatment data using Abbot's formula with modification. Journal of Economic Entomology, 78: 1179.

Haque H, 1991. Imported generic pesticides need to be checked before marketing. Pakistan Agriculture and Pesticide Association Bulletin, pp: 16-17.

Haque H, 1994. Insect pests of fiber crops In: AA Hashmi (Ed.) Insect pest management, Cereal and cash crops. Pakistan Agricultural Research Council. Islamabad, pp: 193-206.

Henry TJ, 1983. Pests not known to occur in the United States or of limited distribution, no. 38: cotton seed bug. USDA-APHIS-PPQ, pp: 6.

Hill DS, 1983. Agricultural insect pests of the tropics and their control. Cambridge University Press, pp: 746.

Ibrahim SA, JA Ottea and SH Martin, 1993. Field evaluation of certain synthetic pyrethroids and IGR's/insecticide mixtures against cotton pests. Proceedings of Beltwide Cotton Conference, 2: 769-772.

Kannan M, S Uthamasamy and S Mohan, 2004. Impact of insecticides on sucking pests and natural enemy complex of transgenic cotton. Current Science, 86: 726-729.

Kirkpatrick TW, 1923. The Egyptian cotton seed bug (*Oxycarenus hyalinipennis* (Costa). Its bionomics, damage, and suggestions for remedial measures. Bulletin Ministry of Agriculture, Egypt, Technical Science Service, 35: 28-98.

Mallah GH, AR Soomor and AW Soomoro, 1997. A review of varietal resistance and crop management to control whitefly in cotton. Pakistan Cotton, 41: 46-51.

Patil BV and R Rajanikanth, 2005. Dusky cotton bug: A future threat for Bt cotton cultivation. Insect Environment, 11: 77-79.

Pearson EO, 1958. The insect pests of cotton in tropical Africa. Empire Cotton Growing Corporation and Commonwealth Institute of Entomology, London, pp: 164-200.

PERAL, 2006. Qualitative analysis of potential consequences associated with the introduction of the cotton seed bug (*Oxycarenus hyalinipennis*) into the United States. USDA-APHIS-PPQ-CPHST. Plant Epidemiology and Risk Analysis Laboratory (PERAL). Center for Plant Health Science and Technology, Raleigh, NC. pp: 41.

Prayogo Y, W Tengkano and D Marwoto, 2005. Prospect of entomopathogenic fungus *Metarhizium anisopliae* to control *Spodoptera litura* on soybean. Journal Litbang Pertanian, 24: 19-26.

Roger E, A Carles, G Marta and E Miguel, 1997. Laboratory Tests of Pyrethroid and Organophosphate Insecticides on *Oxycarenus lavaterae* (Heteroptera: Lygaeidae). Journal of Economic Entomology, 90: 1508-1513.

Sewify GH and AM Semeada, 1993. Effect of population density of the cotton seed bug *Oxycarenus hylinipennis* Costa on yield and oil content of cotton seeds, Bulletin of Faculty of Agriculture, University of Cairo, 44: 445-452.

Smith TR and J Brambila, 2008. A major pest of cotton, *Oxycarenus hyalinipennis* (Heteroptera: Oxycarenidae) in the Bahamas. Florida Entomologist, 9: 479-482.

Srinivas M and BV Patil, 2004. Quantitative and qualitative loss caused by dusky cotton bug, *Oxycarenus laetus* Kirby on cotton. Karnataka Journal of Agricultural Science, 17: 487-490.

Wang, SY, YJ Liu, XH Zhou, AS Zhang, LL Li and XY Men, 2011. Mechanisms of imidacloprid resistance in *Frankliniella occidentalis* (in Chinese). Chinese Bulletin of Entomology, 48: 559-565.

Yunus M and M Yousuf, 1979. Insect and mite pests of cotton in Pakistan. Pakistan journal of Agricultural Sciences, 16: 67-71.