



COMPARATIVE EFFICACY OF VARIOUS INSECTICIDES AGAINST WHITEFLY, *Bemisia tabaci* (Genn.) ADULT (HOMOPTERA: ALEYRODIDAE) ON TRANSGENIC COTTON VARIETY Bt-886

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ABSTRACT

The studies were conducted at Entomological Research Sub-Station, Multan during 2009-2010 and 2010-2011. The efficacy of eight insecticides viz., Pyramid 10SL (nitenpyram), Imidacloprid 25WP (imidacloprid), Confidor 200SL (imidacloprid), Mospilan 20SP (acetamiprid), Polo 500EC (diafenthiuron), Buprofezin 25WP (buprofezin), Talent 48SC (thiacloprid) and Movento 240SC (spirotetramat) + Bio power were tested on transgenic cotton (Bt-886) against adult whitefly. Maximum mortality of whitefly was recorded in acetamiprid 20SP i.e., 82 and 86 percent 24 and 168 hours after spray while minimum mortality was recorded in buprofezin 25WP and nitenpyram 10SL i.e., 40 and 41 percent 24h after spray. Imidacloprid 200SL and acetamiprid 20SP showed similar mortality of whitefly i.e., 76 and 75 percent 72 hours after spray. Our results suggest that acetamiprid 20SP @ 125 g per 100 liters of water is effective against whitefly adult and can included in IPM programme for the management of whitefly.

Keywords: Adult whitefly, Cotton Bt- 886, Insecticides, Punjab, Pakistan

INTRODUCTION

Cotton, *Gossypium hirsutum* L. is the backbone of our economy, commonly known as silver fibber (Tayyib *et al.*, 2005). It is one of the most important cash crops and contributes about 68% to the foreign exchange earning of Pakistan (Khan and Khan, 1995). Pakistan ranks 4th as a grower and 3rd as an exporter of raw cotton in the World (Ahmad, 1999), but still lint yield is very low as compared to other cotton growing countries of the world. Many factors are contributing towards low yield, among them the heavy attack of sucking insect pest complex. In sucking insect pest Whitefly, *Bemisia tabaci* (G.) is the most injurious pest of crop. It is a key pest of many field and horticultural crops throughout the sub tropical regions of the world (Bayhan *et al.*, 2006; Naranjo, 2001). It damages the plants directly by depriving the host plants of their nourishment because it sucks the cell sap. The result is about a 50% reduction in the boll formation as well as the transmission of the viral diseases. It is one of the regular sucking pests of the various crops especially cotton which causes significant losses by sucking

sap from the lower side of leaves. It is estimated that about 40-50% of crop is damaged due to sucking insect pests (Naqvi, 1976). It is found to play a significant role in the spread of CLCV during the last a few years (Ali *et al.*, 1999; Malik *et al.*, 1995; Singhal, 2003). Its attack started from seedling to the harvesting stage, resulted in reducing the yield and quality of cotton (Amer *et al.*, 1999). The insect not only desaps the leaves but also transmits various types of diseases which makes cotton plants feeble and resulted in stunted growth. For example, Whitefly transmits viral diseases (Khan and Khan, 1995; Mushtaq, 1995), especially deadly CLCV (Iqbal, 1993). Due to CLCV the area approximately 243949 acres was suffered in 1992 with significant losses of 543294 numbers of bales (Anon., 1995). The insect also deteriorates the quality of the lint by secreting honeydews. Due to honeydews, sooty-mould develops on the lint of cotton which renders the quality of fibre and make it unfit for marketing (Denhoia and Brinie, 1990). These insects impose heavy losses to the cotton crop from seedling stage to the harvesting stage and reducing its yield and quality (Amer *et al.*, 1999).

To overcome whitefly, insecticides are considered the only

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weapons to control this insect (Afzal and Ali, 1983). Although an injudicious and continuous use of insecticides rendering the environment with mutagenic, carcinogenic and teratogenic effects (Pedigo, 1996), but also insect developed varying levels of resistance (Ahmad *et al.*, 2000, Ahmad *et al.*, 2001; Ahmad *et al.*, 2003). The new classes of insecticides neonicotinoids (diafenthiuron, acetamiprid, imidacloprid and thiamethoxam) have proved the best in managing resistance to *B. tabaci* against conventional insecticides in different parts of USA and Israel on different crops (Palumbo *et al.*, 2001).

The present study was conducted to manage this notorious pest of cotton by comparing the efficacy of some commonly used chemicals against whitefly adults to know that either these insecticides can reduce the populations of this pest under field conditions and can be included in IPM programme for the management of whitefly.

MATERIALS AND METHODS

Following insecticides and their combinations viz., Pyramid 10SL (nitenpyram) @200ml, Imidacloprid 25 WP (imidacloprid) @250g, Confidor 200SL (imidacloprid) @250ml, Mospilan 20SP (acetamiprid) @125g, Polo 500EC (diafenthiuron) @200ml, Buprofezin 25WP (buprofezin) @600g, Talent 48SC (thiachloprid) @125g and Movento 240SC (spirotetramat) + Bio power @500ml were sprayed in the field having maximum population of adult whitefly at Cotton Research Station, Multan. There were eight treatments and control under three replications. The plot size for each treatment was 6.45 x 4.94 m. There were six lines in each plot, 75 cm apart; while plant-to plant distance was 23 cm. All the inputs applied were same in all the treatments. The population of whitefly was counted from upper, middle and lower leaves of fifteen plants selected at random from each treatment before spray and then 24h, 72h and 168h after spray. The data was consolidated and percent mortality was calculated by using the below mentioned formula:

$$\% \text{ Mortality} = \frac{\text{Population before spray} - \text{Population after spray}}{\text{Population before spray}} \times 100$$

Statistical Analysis

The data were subjected to analysis of variance (ANOVA) using Statistix version 9 (www.statistix.com/free_trial.html) (Lawes Agricultural Trust Rothamsted Experimental Station, Rothamsted, UK). The means were separated by Tukey's HSD (Honestly Significant Difference).

RESULTS

MORTALITY OF WHITEFLY 24 HOURS AFTER SPRAY DURING 2009-2010

The data on the effectiveness of various insecticides for the control of whitefly after 24 h of spray revealed a highly significant difference among treatments in the 2009 trials (F=251.20; df=8, 16; P<0.01; Table 1). The maximum mortality of the pest was observed in treatment where acetamiprid was applied with 88.09 percent mortality of the pest followed by imidacloprid 200SL having 69.54 percent

mortality. Spirotetramat, imidacloprid 25WP and thiacloprid gave statistically similar percentage mortality of the pest i.e. 60.74, 60.43 and 59.87. Diafenthiuron and buprofezin gave statistically i.e. 46.75 and 45.74 percent mortality of the pest. The minimum mortality of whitefly was observed in nitenpyram (37.24%) 24 hours after spray.

MORTALITY OF WHITEFLY 72 HOURS AFTER SPRAY DURING 2009-2010

Highly significant difference were found among treatments for the control of whitefly after 72 hour post treatment in the 2009 trials (F=214.60; df=8, 16; P<0.01; Table 1). The highest mortality of the pest was recorded to be 77.25, 75.88 and 75.56 percent in those treatments where acetamiprid, imidacloprid 200SL and spirotetramat were sprayed and having statistically similar mortality followed by imidacloprid 25WP, thiacloprid diafenthiuron and buprofezin having 63.24, 62.47, 56.63 and 56.54 percent mortality of whitefly. The minimum mortality of whitefly was observed in nitenpyram (42.77%) 72 hours after spray.

MORTALITY OF WHITEFLY 168 HOURS AFTER SPRAY DURING 2009-2010

The data on the effectiveness of various insecticides for the control of whitefly after 168 h revealed a highly significant difference among treatments in the 2009 trials (F=272.79; df=8, 16; P<0.01; Table 1). The results reveal that acetamiprid was found to be the most effective insecticide resulted in maximum mortality of the pest i.e. 84.51 percent followed by imidacloprid 200 SL, spirotetramat, imidacloprid 25WP, thiacloprid and diafenthiuron i.e. 77.28, 76.30, 73.34, 58.99 and 56.63 percentage mortality. The minimum percent mortality of the pest was in nitenpyram (33.68) 168 hours after spray.

MORTALITY OF WHITEFLY 24 HOURS AFTER SPRAY DURING 2010-2011

The data on the effectiveness of various insecticides for the control of whitefly after 24 h of spray revealed a highly significant difference among treatments in the 2010 trials (F=393.88; df=8, 16; P<0.01; Table 2). The maximum mortality of the pest was observed in the treatments where spirotetramat + Bio power was applied with 79.48 percent mortality of the pest followed by diafenthiuron 77.43 percent and acetamiprid having 76.21 percent mortality which are statistically similar and followed by imidacloprid 200SL i.e. 69.55 percent of mortality. Thiacloprid and imidacloprid 25WP gave 61.38 percent and 58.86 percent mortality which are statistically at par. The minimum percent mortality of whitefly was observed in nitenpyram and buprofezin i.e. 44.50 and 39.38 which are all statistically similar to each other, respectively 24 hours after spray.

MORTALITY OF WHITEFLY 72 HOURS AFTER SPRAY DURING 2010-2011

Highly significant difference were found among treatments for the control of whitefly after 72 h post treatment in the 2010

trials ($F=324.36$; $df=8, 16$; $P<0.01$; Table 2). Variations were found to be significant among treatments. The highest mortality of the pest was recorded by diafenthiuron, imidacloprid 200SL, and spirotetramat i.e. 79.49, 76.59 and 75.93 which are all statically similar and followed by acetamiprid, thiachloprid, imidacloprid 25WP and nitenpyram i.e. 73.26, 66.95, 66.59 and 35.93 percent mortality. The minimum percent mortality of whitefly was observed in buprofezin (35.93) after 72 hours of spray.

MORTALITY OF WHITEFLY 168 HOURS AFTER SPRAY DURING 2010-2011

The data on the effectiveness of various insecticides for the control of whitefly after 168 h revealed a highly significant difference among treatments in the 2010 trials ($F=274.37$; $df=8, 16$; $P<0.01$; Table 1). Significant difference was found among treatments. The results reveal that acetamiprid was found to be the most effective insecticide resulted in

Table 1

Mean comparison of percent mortality of adult whitefly 24, 72 and 168 hours after spray during 2009- 2010.

Insecticides			Post treatment average percent mortality of whitefly adult after		
Trade Name	Common Name	Dose/hec.	24h Mean±SE	72h Mean±SE	168h Mean±SE
Mospilan 20SP	acetamiprid	313 gm	88.09±1.33a	75.88±0.64a	84.51±1.28a
Confidor 200 SL	imidacloprid	625 ml	69.54±0.93b	75.56±0.99a	76.34±0.95b
Movento 240 Sc + Bio power	spirotetramat	1500 gm	60.74±0.49c	63.24±0.96b	33.68±0.16e
Imidacloprid 25WP	imidacloprid	625 gm	60.43±0.87c	62.45±0.73b	58.99±1.09c
Talent 48SC	thiachloprid	313 gm	59.87±0.51c	77.25±1.60a	77.28±0.29ab
Polo 500SC	diafenthiuron	500 ml	46.75±1.27d	56.54±0.51b	73.34±1.06b
Buprofezin 25WP	buprofezin	1250 ml	45.74±0.48d	42.77±0.53c	33.68±0.16e
Pyramid 10SL	nitenpyram	500 ml	37.24±0.53e	56.63±0.51b	42.57±1.06d
Control			2.75±0.17f	4.11±0.15e	4.96±0.22f
Tukey's HSD@ 5%			7.56	7.86	8.16
F-Value			251.20	214.60	272.79

Means sharing similar letters are not significantly different by Tukey's Test at $P = 0.05$ HSD = Honestly Significant Difference Value
Significant at $P \leq 0.05$.
Significant at $P \leq 0.01$

Table 2

Mean comparison of percent mortality of adult whitefly 24, 72 and 168 after spray during 2010-2011.

Insecticides			Post treatment average percent mortality of whitefly adult after		
Trade Name	Common Name	Dose/hec.	24h Mean±SE	72h Mean±SE	168h Mean±SE
Mospilan 20SP	acetamiprid	313 gm	76.21±.84a	73.26±1.29ab	88.25±0.98a
Confidor 200 SL	imidacloprid	625 ml	69.55±0.55b	76.59±0.72a	80.62±0.71a
Movento 240 Sc + Bio power	spirotetramat	1500 gm	79.48±0.16a	75.93±0.42a	86.35±1.35a
Imidacloprid 25WP	imidacloprid	625g m	58.86±0.92c	66.59±0.77bc	60.36±0.43b
Talent 48SC	thiachloprid	313 gm	61.38±0.67c	66.95±0.83bc	61.90±0.19b
Polo 500SC	diafenthiuron	500 ml	77.43±0.94a	79.49±0.65a	82.37±0.90a
Buprofezin 25WP	buprofezin	1250 ml	39.38±0.71d	35.93±0.21d	31.35±0.42d
Pyramid 10SL	nitenpyram	500 ml	44.45±0.56d	63.26±0.93c	48.25±1.79c
Control			3.74±0.06e	4.61±0.12e	5.23±0.30e
Tukey's HSD@ 5%			6.20	6.87	8.58
F-Value			393.88	324.36	274.37

Means sharing similar letters are not significantly different by Tukey's Test at $P = 0.05$ HSD = Honestly Significant Difference Value
Significant at $P \leq 0.05$
Significant at $P \leq 0.01$

maximum mortality of the pest i.e. 88.25 percent which is statistically similar to spirotetramat, diafenthiuron, imidacloprid 200 SL having 86.35, 82.37 and 80.62 percent mortality followed by thiacloprid, imidacloprid, nitenpyram i.e. 61.90, 60.36 and 48.25 percent mortality. The minimum percent mortality of the pest was recorded in spirotetramat (31.35) after 168 hours of spray.

AVERAGE PERCENT CUMULATIVE MORTALITY OF WHITEFLY 24 HOURS AFTER SPRAY DURING 2009-2011

The data regarding percent cumulative mortality of adult whitefly at 24 h of post treatment intervals in different treatments during 2009-2011 showed highly significant ($P < 0.01$) difference ($F=474.64$; $df=8, 16$; $P < 0.01$; Table 3). The maximum mortality 82.15 % of the pest was observed in those treatments where acetamiprid was sprayed followed by spirotetramat and imidacloprid 200 SL having 70.11, 69.55 percent mortality. The minimum mortality of whitefly was recorded in buprofezin and nitenpyram having 42.57 and 40.85 percent mortality 24 hours after spray.

AVERAGE CUMULATIVE MORTALITY OF WHITEFLY 72 HOURS AFTER SPRAY DURING 2009-2011

The data regarding percent cumulative mortality of whitefly adult 72 hours after spray showed highly significant difference ($F=362.33$; $df=8, 16$; $P < 0.01$; Table 3) among treatments during 2009-2011. The maximum percent mortality of adult whitefly was recorded in imidacloprid 200SL followed by acetamiprid, spirotetramat, diafenthiuron, thiacloprid, imidacloprid 25WP showing 76.07, 74.57, 70.11, 62.09, 60.63 and 59.65 percent mortality of the pest.

The minimum mortality of whitefly was recorded in buprofezin and nitenpyram having 42.57 and 40.85 percent mortality 72 hours after spray.

AVERAGE CUMULATIVE PERCENT MORTALITY OF WHITEFLY 168 HOURS AFTER SPRAY DURING 2009-2011

The data regarding percent cumulative mortality of various insecticides for the control of whitefly adult after 168 h revealed a highly significant difference among treatments in the 2009-2011 ($F=484.18$; $df=8, 16$; $P < 0.01$; Table 3). The maximum mortality 86.38 percent of the pest was observed in those treatments where acetamiprid was sprayed followed by imidacloprid 200SL, diafenthiuron, thiacloprid and imidacloprid 25WP having 78.48, 77.86, 69.59, 59.68 percent mortality. The minimum mortality of whitefly was recorded in nitenpyram having 45.41 percent 168 hours after spray.

DISCUSSION

Different control practices viz., cultural, mechanical, chemical and biological are being adopted worldwide for the control of insect pests of different crops. The success of pest control is judged by the results and the best control strategy is that which gives adequate pest control. Among different management practices insecticides are considered the only source of rapid control measures. Although some insecticides have lethal effects on some non target organism, but still it is one of the best management practices to save the crop from pest outbreak. In our experiment eight insecticides were tested for the control of whitefly adult under field conditions, some insecticides were found to be effective against whitefly adults while others were not. Our results suggested that acetamiprid was found to be the most effective insecticide

Table 3

Mean comparison of percent mortality of adult whitefly 24, 72 and 168 after spray during 2010-2011

Insecticides			Post treatment average percent mortality of whitefly adult after		
Trade Name	Common Name	Dose/hec.	24h Mean±SE	72h Mean±SE	168h Mean±SE
Mospilan 20SP	acetamiprid	313gm	82.15 ±0.55a	74.57± 0.94ab	86.38±0.95 a
Confidor 200 SL	imidacloprid	625ml	69.55±0.74 b	76.08 ±0.24a	78.48± 0.46b
Movento 240 Sc + Bio power	spirotetramat	1500gm	70.11 ±0.18b	69.59 ±0.66	60.02±1.13d
Imidacloprid 25WP	imidacloprid	625gm	59.65±0.88 c	64.52 ±0.62	59.68±0.44 d
Talent 48SC	thiacloprid	313gm	60.63± 0.32c	72.10 ±1.19	69.59± 0.10c
Polo 500SC	diafenthiuron	500ml	62.09 ±1.08c	68.02 ±0.24	77.86±0.08 b
Buprofezin 25WP	buprofezin	1250ml	42.57 ±0.29d	39.35 ±0.26	32.52± 0.13f
Pyramid 10SL	nitenpyram	500ml	40.85 ±0.16d	59.95 ±0.81	45.41±1.05 e
Control			3.25 ±0.07e	4.36 ±0.14	5.10± 0.04g
Tukey's HSD@ 5%			5.37	6.13	5.92
F-Value			474.64	362.33	484.18

Means sharing similar letters are not significantly different by Tukey's Test at $P = 0.05$ HSD = Honestly Significant Difference Value
Significant at $P \leq 0.05$
Significant at $P \leq 0.01$

resulted in significant reduction of whitefly adult populations as compared to all other insecticides. The present finding can be compared to the work of different researchers (Aslam *et al.*, 2004; Natwick and Deeter, 2001; Parrish and Assail, 2001; Nadeem *et al.*, 2011; Said, 2011; Singh and Kumar, 2006) who have reported that acetamiprid was effective for the control of whitefly adult on cotton crop. Palumbo *et al.* (2001) worked on chemical of whitefly and reported that a neonicotinoids insecticide like acetamiprid was successful for managing the *B. tabaci* in USA and Israel on various crops. In our experiments imidacloprid and diafenthiuron were also gave good results after acetamiprid which belongs to neonicotinoids group of insecticides. The present findings are partially in line with that of (Khattak *et al.*, 2004) who reported that imidacloprid is effective against sucking pest of cotton. Similarly (Saleem and Khan, 2001) also obtained good results by the use of imidacloprid against sucking pest of cotton. IGR's are only effective against immature stage of the pest. In our experiment buprofezin was used against whitefly adults who did not give effective control. The reasons could be that it is effective against nymphs rather than adults. By applying these insecticides against the nymphal population of whiteflies, the population of adult whiteflies could be reduced. Similar observations have been found by (Yasui *et al.*, 1990 ; De Cock *et al.*, 1990) who overcome adult whitefly population through control of nymphal stage.

CONCLUSION

From the present study it is concluded that acetamiprid, imidacloprid and diafenthiuron were effective against whitefly adults as compared to all other insecticides tested. These insecticides can be included in the IPM schedule of whitefly management.

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