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Comparative efficacy of some insecticides against white fly (*Bemisia tabaci* Genn.) on bt cotton crop in ecological zone of Bahawalnagar

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Keywords

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Abstract

A field experiment was conducted during summer seasons 2014 and 2015 to determine the efficacy of different insecticides against white fly (*Bemisia tabaci*) on bt cotton at farmer's field of Adaptive Research station Bahawalnagar in Randomized Complete Block Design (RCBD) with three replications. Six insecticides viz. Spirotetramat 240SC, pyriproxyfen 10.8EC, Baprofezin 25WP, Diafenthuran 500SC, Acetamaprid 20SP and Imidacloprid 200SL were tested against whitefly, *Bemisia tabaci* Lind on bt cotton under field conditions. All insecticide whether alone or in combinations were applied at their recommended doses with the help of knapsack sprayer. The results of the present study revealed that all insecticides were almost equally effective to control *B.tabaci*. But Spirotetramat 240SC was comparatively more effective against *B. tabaci.*

Introduction

Cotton possesses a unique position in the Asian countries. It provides fiber, food, feed and fuel. It sustains million of the people for livelihood at farms, ginning factories, textile mills, edible oil and soap industries etc. Cotton is therefore, rightly called the lifeblood of economy of many countries in Asia. Pakistan is the 4th largest cotton producer after USA, China and India. However, national average per hectare yield is low as compared to these countries (Khan, 1997). It contributes a huge share in the foreign exchange earnings of the country (Ahmad et al. 2011). In cotton, the insect pests' infestation caused deterioration in lint quality and 10–40% losses in crop production (Gahukar, 2006). Cotton (*Gossypium hirsutum* L.) is the most important cash crop in Pakistan, which is cultivated on 2.879 million hectares and is the source of large amount of foreign exchange, contributing about 7.0percent of value added in agriculture and about 1.5 percent of GDP and contributes about 66.50% share in national oil production (Anonymous, 2013). Among various factors responsible for low yield, insect pests are one of the most important factors causing 30-40% yield losses (Haque, 1991). The major insect pests of cotton can be broadly divided into two groups i.e. sucking insect pests (whitefly, *Bemisia tabaci*; jassid, *Amrasca devastans* and thrips, *Thrips tabaci* etc.) and chewing insect pests or bollworms (spotted bollworm, *Earias insulana*, American bollworm, *Helicoverpa Armigera*, Pink bollworm, *Pictonifera gossipella* etc.). The sucking insect pests are injurious to cotton crop. They cause damage by sucking the sap from the under surface of the leaves, transmit viral diseases (Butler & Henneberry, 1994). Whitefly, *B. tabaci* is one of the key pest of cotton in our country, sporadically appeared before 1985 and gained the status of a persistent pest of cotton since 1987 (Aslam et al., 2001) sucking plant sap and secreting honey dews (Ali and Aheer, 2007) which ultimately hampers plant's photosynthetic activities due to the

development of sooty mold (Aslam et al., 2001). *Bacillus thuringiensis* cotton i.e. transgenic cotton or genetically modified cotton, have a lepidopterous toxic gene of *Bacillus thuringiensis* var. kurstaki was introduced in South Africa during the cotton growing season of 1998-99 and has since been widely adopted by farming community. Bt cotton is lepidopteran specific and direct mortality of non lepidopteran or non target organisms is not expected (Mallet and Schoeman, 2007). To overcome the losses due to the attack of insect pests and to increase the yield it is necessary to follow intelligent control strategies. Integrated pest management is a broad ecological approach to pest control utilizing a variety of control techniques compatible in a single management system. Among these techniques chemical control is the quickest and surest way of insect pest control. It has the advantage of speed of control where as the bioloical and cultural control works over a long span of time. Pesticides are the only mean to control large-scale infestation and sudden outbreaks of pests (Afzal, 1969). The population of *A. devastans* and *B. tabaci* was recorded by leaving one row on each side of the treatment early in the morning. For this purpose 15 plants were selected randomly. Insects were counted from the upper leaves of 1st plant, middle leaves of 2nd plant and lower leaves of 3rd plant and so on (Razaq et al., 2003). IGRs (buprofezin and pyriproxyfen) were used as key factor in the resistant management, integrated management of whitefly in USA (Ellsworth and Martinez Carrillo, 2001), and reducing the number of insecticides treatments applied for whitefly control in the coming years in Arizona, USA (Simmons et al., 1994). Various researchers have conducted the research regarding the effectiveness of different insecticides against sucking insect pests of cotton crop (Saleem et al., 2001; Aslam et al., 2004; Shah et al., 2007). So use of chemicals is an essential part of integrated pest management in crop protection measures (Mohyuddin et al 1997). Neonicotinoids are among the most effective insecticides for the control of sucking insect pests. The insecticide, imidacloprid was the first insecticide of this class released in 1991 (Elbert et al., 2008) and is effective against a number of insect pests. Imidacloprid has been found efficient against sucking pests (Elbert and Nauen, 2004). Mohan & Katiyar (2000) founded that Confidor significantly suppressed whitefly population in cotton. Non selective use of pesticides leads to water pollution, soil degradation, pest resistance and resurgence and ozone depletion (Naeem et al. 2012). Chemical control, being rapid method of pest control, is an important practice of integrated pest management (IPM) program to overcome losses caused by insect pest to crop (Mohyuddin *et al.*, 1997 and Gogi et al. 2006).

The District Bahawalnagar is located in the southern side of District Pakpattan. Climate of the District is mainly arid in the south Western Part. Average annual rain ranges from 130 mm to 275mm. Average day time temperature during cotton growing season (June to November) is 40°C while night time temperature is 25°C. Relative humidity during this period ranged from 60-70%. The soil of the District Bahawalnagar is mainly formed by alluvial sediments. The soils are moderately to strongly calcareous with pH ranging from 8.0 to 9.5. Keeping in view the economic importance and pest status of white fly and environmental hazards imposed by nonselective synthetic insecticides, this study was conducted to evaluate and screen out the most effective selective synthetic insecticide for management of white fly on *Bt* cotton crop.

Materials and Methods

The experiment was conducted at farmer's field of Adaptive Research Station Bahawalnagar during 2014 and 2015 against cotton white fly (*Bemisia tabaci* Genn.) to test the efficacy of six insecticides viz. Spirotetramat 240SC @625ml/ha, Pyriproxyfen 10.8EC @1.25lit/ha, Baprofezin 25WP @1.5kg/ha, Diafenthiuran 500SC @625ml/ha, Acetamaprid 20SP @375g/ha and Imidacloprid 200SL @625ml/ha. The Bt cotton variety was used as 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 cotton white fly was 5 nymph or adults/leaf. 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. Twenty plants were selected, at random, per treatment/plot for recording pest population early in the morning. For this purpose, an upper leaf was taken from the first plant, middle from the second plant and a lower from the third plant, and so on. To study the efficacy of different insecticides as mentioned in (Table 1), population of cotton white fly was recorded by the same method a day before spray and 3rd, 5th and 7th days after treatment. Crop was kept free from weeds. Mortality of pest was calculated with following formula:

$$\text{Percent mortality} = \frac{A-B}{A} \times 100$$

Where A = population of cotton white fly in control plot

B = post treatment population of cotton white fly in each treatment

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

Results and Discussion

Insecticides (Table 1) were sprayed in recommended doses when the population of cotton mealy bug 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, 5th and 7th days after application of insecticides. The data on pest population were analyzed by using Fisher's analysis of variance technique and LSD test at 0.05 probability level was employed to compare the differences among the treatments mean (Steel *at al*., 1997). 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.

Table 1. Different insecticides used against cotton white fly *Bemisia tabaci* with respective doses per hectare.

S. #	Insecticides with formulation	Dose (ml or gm/ha)
1	Spirotetramat 240SC	625
2	Pyriproxyfen 10.8EC	1250
3	Baprofezin 25WP	1500
4	Diafenthuran 500SC	625
5	Acetamaprid 20SP	375
6	Imidacloprid 200SL	625
7	Control	

The population of cotton white fly was significantly lower (P<0.05) in insecticides treated plots as showed in (Table 2). All tested insecticides (Table 1) caused significant mortality in population of cotton white fly even 7 days after spray. Spirotetramat 240SC was statistically highly effective with mortality in cotton white fly population as 72.9 and 77.7% even 5th and 7th days of treatment during 2014 followed by Pyripyroxyfen 10.8EC and Buprofezin 25WP that caused a mortality in population of (71.7 and 75.3) and (69.4 and 78.2) after 5th and 7th days of treatment. Diafenthiuran 500SC and Acetamiprid 20SP have been found similar effect against white fly after 5th and 7th days of treatment (68.2 & 70.3) and (63.5 & 69.1). In case of Imidacloprid 200SL the mortality in population as 58.8 and 66.6% after 5th and 7th days of treatment. Spirotetramat 240SC proved to be the best product even 5th and 7th days after application of insecticides. Afzal et al. (2002) who reported that Imicon 25 WP @ 200 gm/acre (imidacloprid) was found to be effective for whitefly. These results are in accordance with those of (Cahill et al.1994; Singh et al., 1998; Assad et al., 1999; Jadhav et al.,1999; Ahmad, 1999; Mushtaq Ahmad et al., 2000; Mushtaq Ahmad et al.,2002).

Table 2. Mean percent population mortality of cotton white fly after application of different insecticides on cotton during 2014.

Treatments	Dose/ha (g,ml)	A.v pest population before spray	Post treatment average population/plant			Mortality (%)		
			3rd day	5th day	7th day	3rd day	5th day	7th day
Spirotetramat	625	5.5	3.0	2.3	1.8	62.5	72.9	77.7
Pyriproxyfen	1250	6.0	4.0	2.4	2.0	50.0	71.7	75.3
Baprofezin	1500	5.7	4.1	2.6	2.2	48.7	69.4	72.8
Diafenthuran	625	6.0	4.2	2.7	2.4	47.5	68.2	70.3
Acetamaprid	375	5.8	4.4	3.1	2.5	45.0	63.5	69.1
Imidacloprid	625	7.0	4.8	3.5	2.7	40.0	58.8	66.6
Control		7.0	8.0	8.5	8.1	-	-	-

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

It is evident from the (Table 3) that insecticides were found to be effective in controlling population of cotton white fly during 2015 under field conditions. All tested insecticides (Table 1) caused significant mortality in population of cotton white fly even 7 days after spray. Spirotetramat 240SC was statistically highly effective with mortality of cotton white fly population as 75.7 and 82.1% even 5th and 7th days of treatment during 2015 followed by Pyriproxyfen 10.8EC and Diafenthuran 500SC that caused a mortality in population of (71.5 and 78.2) and (70.5 and 75.2) after 5th and 7th days of treatment. In case of Buprofezin 25WP the mortality in population as 68.4 and 72.2% after 5th and 7th days of treatment. Then in case of Acetamaprid 20SP the population mortality was 67.3 and 71.2% after 5th and 7th days of treatment as described in table 3. Imidacloprid 200SL proved to be the least effective product even 5th 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). Khattak, et al. (2004) also reported that Imidacloprid and Diafenthiuran showed significant reduction in the whitefly population at 24 hours, 72 hours and even 120 hours after spray Buprofezin prevents the adult emergence from the pseudopupa of *Bemisia tabaci* (Valle et al.,2002).

Table 3. Mean percent population mortality of cotton white fly after application of different insecticides on bt cotton during 2013.

Treatments	Dose/ha (g,ml)	A.v pest population before spray	Post treatment average population/plant			Mortality (%)		
			3rd day	5th day	7th day	3rd day	5th day	7th day
Spirotetramat	625	6.2	4.0	2.3	1.8	55	75.7	82.1
Pyriproxyfen	1250	6.3	4.4	2.7	2.2	50	71.5	78.2
Baprofezin	1500	7.4	4.8	3.0	2.8	46	68.4	72.2
Diafenthuran	625	7.2	5.0	2.8	2.5	43	70.5	75.2
Acetamaprid	375	6.8	5.6	3.1	2.9	37	67.3	71.2
Imidacloprid	625	6.9	5.6	3.2	3.2	37	66.3	68.3
Control		8.4	8.9	9.5	10.1	-	-	-

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 mealy bug but Spirotetramat 240SC @625ml/ha proved to be more effective against cotton white fly followed by Pyriproxyfen, Baprofezin and Diafenthiuran.

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