International Journal of Science and Research (IJSR)
ISSN (Online): 2319-7064
Index Copernicus Value (2013): 6.14 | Impact Factor (2014): 5.611

Efficacy of the New Chemistry Pesticides on Nymph and Adult Population of Whitefly *Bemisia tabaci* Gen. and their Effect on Naturally Existing Beneficial Fauna of Cotton in Punjab, Pakistan

Ghulam Abbas[1], Muhammad Farhan[2]

[1]Regional Agricultural Economic Development Centre (RAEDC), Vehari, Pakistan

[2]Pest Warning and Quality control of Pesticides, Punjab, 21- Agha khan Road, Lahore

Running title*: effect of new chemistry pesticides against whitefly and beneficial fauna*

Novelty statement: Effect of new chemistry against whitefly and natural beneficial fauna

Abstract: ***This study was conducted at Lodhran (Punjab, Pakistan) against cotton whitefly Bemisia tabaci Genn. (Hemiptera: Aleyrodidae) in the field of a farmer. Modern insecticides, relatively safer to the natural beneficial fauna, commonly available and used by the farmers, viz., buprofezin, Flonicamid, spintoram, pyriproxyfen, diafenthiuron, acetamiprid, spirotetramid were tested against a control treatment where no action was taken at all. The objective was to screen out the effective chemicals which are also safe for naturally existing beneficial fauna so that these could be included in effective IPM of whitefly.Two applications of the treatments were made in RCBD with 10 days interval.***

Keywords: nymphs**,** Bemisia tabaci, cotton, ETL, beneficial fauna, Aleyrodidae

1. Introduction

Cotton (*Gossypium hirsutum L.*) is the most important cash crop in Pakistan, and is the source of large amount of foreign exchange, contributing about 7.0% of value added in agriculture and about 1.5% of GDP. It contributes about 66.50% share in national oil production (Anonymous, 2013). It is also a reasonable source of income for poor unskilled village labor and farming community, particularly women. The rural population constitutes more than two third of total national population. Pakistan is considered the fourth largest world producer and third largest consumer of cotton throughout the world (Zeeshan *et al.,* 2010).. Bt varieties supposed to have resistance against *Helicovepa armigera* and other bollworms have gained a very rapid adoption among farming communities, and now Bt varieties have almost replaced the conventional non Bt varieties in Pakistan. By the introduction of Bt varieties the boll worm problem has been solved to some extent except army worm, but the problem of sucking insect pests attack has remained unsolved still now. (Ahsan and Altaf, 2009; Abdullah, 2010; PWQCP,2014).

Among sucking cotton pest complex, whitefly *Bemisa tabaci* (Hemiptera: Aleyrodidae) is very important and dangerous cotton pest and cotton leaf curl virus (CLCuV) vector. It has the potential of destabilizing cotton production. Its attack on cotton starts from the early phase up to maturity (T ayyab *et al.,* 2005). It damages the cotton plant by sucking cell sap ensuring 50% decrease in boll yield (Ashfaq *et al.,* 2010). Whitefly feeds on cotton leaves and causes damage to the cotton crop, by sucking the cell sap from under surface of leaves, it secrets the honey dews, as a result sooty mold grows on secretions of honey dew which reduces the photosynthetic area of leaves and transmitting the viral diseases to cotton crop (Khan & Ahmad, 2005) by transmitting vector of leaf curl virus disease (CLCuV) (Ahmad, 1999) which is great threat to our cotton-based economy (Amjad *et al.,* 2009). It transmits more than hundred plant viruses belonging to Begomovirus (Geminiviridae),Grinivirus (Closteroviridae) and Carlavirus (Potyviridae) (Jones, 2003). Among different control measures against sucking pests, the use of chemical pesticides for the control of insect pests is quick and rapid one, hence it is an effective component for integrated pest management (IPM) of crops.

This study was conducted at Lodhran (Punjab, Pakistan) against cotton whitefly in the field of a farmer. Modern insecticides, relatively safer to the natural beneficial fauna, commonly available and used by the farmers, viz., buprofezin, Flonicamid, spintoram, pyriproxyfen, diafenthiuron, acetamiprid, spirotetramid were tested against a control treatment where no action was taken at all. The objective was to screen out the effective chemicals which are also safe for naturally existing beneficial fauna so that these could be included in effective IPM of whitefly.

2. Materials and Methods

The study was conducted at a farmer's field at Mouza Kotla Ali Dasti tehsil & district Lodhran (Punjab: Pakistan) during the cotton season 2014. Lodhran is at 29.40 latitude and 71.68 longitude (Maps, 2014). The experiment was repeated twice at 10 days interval for confirmation of the results. Applications of the treatments were made in Randomized

Complete Block Design. Different insecticides, which are relatively safer for beneficial fauna, against whitefly *Bemisa tabaci* were used.

Four acre field of cotton *Gossypium hirsutum* L. cultivars MNH 992, IUB 2013, Lalazar and VR 305 were selected, one acre each. 1 acre measures 43560 sq. ft. and 1 hectere is 2.49 acres. All the selected cultivars were Bt., supposed to have resistance against *Helicovepa armigera* and other bollworms. The fields were selected keeping in view the accessibility of field and consent of the farmer to spare his field at the disposal of research team till the record of final data. The experiment was laid out in a RCBD with eight treatments including a control with four replications. The date of sowing of research field of cotton was May 20, 2014 and the cotton plants were 96 days old at the time of the first application of treatments under uncontrolled natural conditions of the area. The plot size was 8 m X 60 m. The crop was sown on raised beds of 75 cm width planted from both side with plant to plant distance 20 to 25 cm.

Seven insecticides viz., Buprofezin (buprofezin), manufactured and distributed by FMC United (pvt.) Ltd, Philadelphia @ 600 gm/acre, Ulala (flonicamid 50 WG), manufactured by United Phosphorus Ltd. India, distributed by ICI (Pakistan) Ltd.@ 6o gm/acre, Delegate (spintoram), Ali Akbar enterprises (pvt.) Ltd, manufactured by Dow Agro Sciences, USA @ 60 g/acre. Jegwar (pyriproxyfen), Al Noor Agrochemicals (pvt) Ltd, manufactured by Jiangxi Anlida chemical co.Ltd China @ 300 ml/acre. Polo (diafenthiuron), Syngenta (Pakistan) Ltd. @ 200 ml/acre, Acetamiprid (acetamiprid), FMC United (pvt.) Ltd, manufactured by FMC corporation, Philadelphia @ 125 ml/acre, Movento (spirotetramid), Bayer Pakistan (Pvt) Ltd., manufactured by Bayer crop science (Pvt) Ltd. @ 125 ml/acre, 8th treatment was control where no action was taken at all. The criteria of selection of pesticides were that it should be new chemistry, relatively safer to mammalians, safer to the environment and claims the mortality of *Bemisa tabaci*. The per acre doses applied against whitefly were those recommended by manufacturer or distributer firms. All these insecticides are commonly available in the market and their trade names have been included in the paper so that common men and less educated farmers can easily recognize it with its brand name which is usually advertised by the distributer firms through electronic and print media as well as other advertising tools. For spraying 100 litres of tube well / hand pump water was used to make a spray able material in one acre. It may be added that usual ground water in this area contains 4-6 ppm total dissolved salts (TDS) and an alkaline pH up to 8.7. The hand operated knapsack sprayer was used for spraying. All the insecticides were tried on a relatively ignored field of cotton crop having maximum population of *Bemisa tabaci* so that effect of the tested pesticides could be judged fairly. The maximum & minimum average temperature for the period under study (20 days) was recorded to be 38.4 ºC and 27 ºC for Lodhran. Average relative humidity RH for morning and evening was 59% and 32% respectively. There was 12 mm and 8mm rainfall on 15th and 16th day respectively during this period.

Five parameters were recorded in the study viz., population of whitefly nymphs, adults & beneficial fauna, number of mature fuits and number of immature fruits. Population of following insects naturally present in the fields of cotton at that stage was collectively taken as the population of beneficial fauna (BF).

1.Orius Bug 2. Campyloma 3. Big-eyed Bug 4. Pirate Bug 5. Assasian Bug 6. Chrysoperla 7. Lady bird beetles 8. Scymminus 9. Predatory mite 10. Spiders 11. Ants 12. Hymenopterous Parasitoids

Pre spray data of *Bemisa tabaci* (nymphs & adults), beneficial fauna was taken and then after calibration, plots were treated with recommended doses of insecticides mentioned in above paragraph on August 26, 2014. Post treatment data was recorded after 4 & 10 days. The experiment was repeated again on 10th day after recording the data and results were again recorded after 4 &10 days of 2nd application, that is 20 days of the initial treatment. The effect of insecticides was compared on the basis of relative % mortality as compared to control where no action was taken at all, with respect to pre spray population of the whitefly nymphs (table 1), whitefly adults (table 2) and beneficial fauna(table 3) .

[1-{(Post treatment population in treatment / Pre treatment population in treatment) X (Pre treatment population in check / Post treatment population in check)} X 100]

For the purpose of data collection, method of on sito count was adopted. In this experiment 5 plants were selected randomly from each treatment, and two leaves were taken into record one each from upper half and lower half. Thus data of one plot consisted on ten observations. Similarly number of fruiting parts, mature as well as immature, was counted from three plants selected at random from each treatment. All the treatments were observed on the standard of control to assess the performance of the treatment in uncontrolled field condition. The data were then compiled and subjected to statistical analysis. Statistix 8.1 software was used for analysis. The comparisons were made under Tuckey's HSD test at 5 % level of significance.

3. Results

The study revealed statistically significant results which are reported as follows. Prespray data in all the cases show that population of the tested parameters was same having non significant difference but data after application has significant differences (table 1,2,3) which are discussed below.

1. Percent mortality of whitefly nymphs with respect to different pesticides

The results (table 1) reveal that plots of control treatment already had a distinctly high, when population was again recorded 4 day after treatment (4 DAT), the treatments did not behave alike rather there was statistically significant difference among treatments (p value 0.000). When treatments were compared statistically with Tukey honestly significant difference (HSD) test, results revealed that treatment were significantly different from one another, as shown (table 1, C.2). There were two distinct groups in which means were not significantly different from one

another. The group A included acetamiprid> buprofezin > flonicamid > spintoram and the group B included spirotetramid> diafenthiuron> pyriproxyfen as regards % mortality of whitefly nymph. After 10 days the results were not much different as seen on 4DAT, anyhow, here spirotetramid has improved the results and it was not different from pesticides described above in group A (table 1, C.3). When this experiment was repeated after 10 days and data was taken after 4 days(4 DAT 2nd), the results acetamiprid has performed less effectively, and performance of spintoram> diafenthuiron> spirotetramid is also not statistically different from it, although later three pesticides are also statistically similar to Pyriproxyfen > buprofezin> flonicamid (table 1, C4). After laps of 10 days (10 DAT 2nd), unlike prior results, surprisingly the plots treated with flonicamid performed significantly low as compared to plots treated with other chemicals led by pyriproxyfen (table 1, C5) . It is worth mention that all these treatments were compared with control. When the treatments were compared on the basis of average of all the 4 observation it was it was noted that buprofezin provided best % mortality of the white where as flonicamid the least and acetamiprid> diafenthuiron> spirotetramid are also statistically similar to it (table 1, C6).

Table 1: Fluctuation In Whitefly Nymphal Population Per Leaf In Response to Various Treatments at Different Timings During the Study

Name of the Treatment	*Population of whitefly nymphs*				
	4 DAT	*10 DAT*	*4 DAT (2nd)*	*10 DAT (2nd)*	*Av. 4 Observations*
Buprofezin	97.5 A	95.4 A	90.8 A	69.5 A	88.3 A
Flonicamid	93.7 A	94.9 A	82.3 A	-0.9 B	67.5 C
Spintoram	94.8 A	95.4 A	76.9 AB	58.2 A	81.3 AB
Pyriproxyfen	78.1 B	80.4 B	92.5 A	75.2 A	81.6 AB
Diafenthiuron	83.8 B	83.2 B	75.0 AB	47.6 A	72.4 BC
Acetamiprid	93.8 A	94.6 A	51.4 B	60.1 A	75.0 BC
Spirotetramid	84.1 B	89.4 AB	70.1 AB	45.3 A	72.2 BC
p values	0.000	0.000	0.000	0.000	0.000

2. Effect of treatments on population of whitefly adults

The average population of whitefly adults before start of treatments (prespray) was same statistically (p value 0.423, rough data). The data were recorded after 4 days which shows that although treatments are different from control but when compared with one another they do not differ significantly, which indicates that all the treatments had similar effect on adult population of whitefly (Table 2, C.2),.

Table 2: Fluctuation in Whitefly Adult Population In Response to Various Treatments Recorded at Different Timings During The Study

Name of the Treatment	*Population of whitefly adults*				
	4 DAT	*10 DAT*	*4 DAT (2nd)*	*10 DAT (2nd)*	*Av. 4 Observations*
Buprofezin	87.0 A	62.3 A	62.8 A	2.2 A	53.8 A
Flonicamid	87.3 A	64.2 A	54.0 AB	12.0 A	54.4 A
Spintoram	69.3 A	64.3 A	47.2 AB	10.9 A	53.5 A
Pyriproxyfen	61.1 A	30.0 BC	43.7 ABC	20.9 A	38.9 A
Diafenthiuron	64.8 A	39.7 AB	14.5 ABC	-29.3 A	22.4 AB
Acetamiprid	63.9 A	63.1 A	43.4 ABC	-9.4 A	40.2 A
Spirotetramid	73.1 A	69.6 A	-9.7 BC	-23.5A	27.4 AB
P values	0.000	0.000	0.002	0.6.09	0.001

The results have shown the % mortality in adult whitefly has changed and significant differences were recorded after 10 days 10 DAT. According to results after 10 days, (10 DAT, Table 2, C. 3), all the plots had statistically similar population of whitefly adults except in the plot treated with pyriproxyfen had the least % mortality ie., 30% which is statistically different from all other treatments (Table 2, C. 3).

In the next session of the same experiment which was repeated ater 10 days, and data were taken after 4 days 4 DAT (2nd), the results revealed that plot treated buprofezin yielded the best % mortality of the adult which is followed by flonicamid and spintoram respectively. Results of the two later plots were statistically similar to plots treated with other pesticides (Table 2, C. 3). After 20 days the condition was worst and entirely different rather opposite from that observed after 10 days. As the results in (table 2, C5) show there was no difference in control and treated plots in almost all plots, condition of the plots was not worth mention because maximum % mortality calculated with respect to control at the maximum was20.9% in the plot treated with pyriproxyfen which was followed by the plots treated with flonicamid and spintoram respectively. In some cases the % mortality was much less than the control where no pesticide was applied at all diafenthuiron< spirotetramid <acetamiprid were among these treatments having negative % mortality (table 2, C5). Statistically all the treatments have similar effect.

The average of all four observations was computed (Table 2, C 6), the results reveal that performance of the chemical pesticides used in the experiment in descending orders were flonicamid > buprofezin > spintoram> acetamiprid> pyriproxyfen> spirotetramid> diafenthiuron.

3. Effect of treatments on population of natural beneficial fauna

It is pertinent to mention that all the pesticides used were new chemistry pesticides. These were selected on the basis of reports from the researches or claim from the manufacturers that their products are relatively safe to the environment and beneficial fauna as compared to conventional groups Chlorinated Hydro Carbons (CHC), Organo Phosphates(OP) and Carbamates. Inspite of all this the results of the experiment show that population of beneficial fauna (BF) which was statistically same before treatment (fig.1) has tremendously reduced the population of beneficial fauna as compared to control 4 days after treatment.

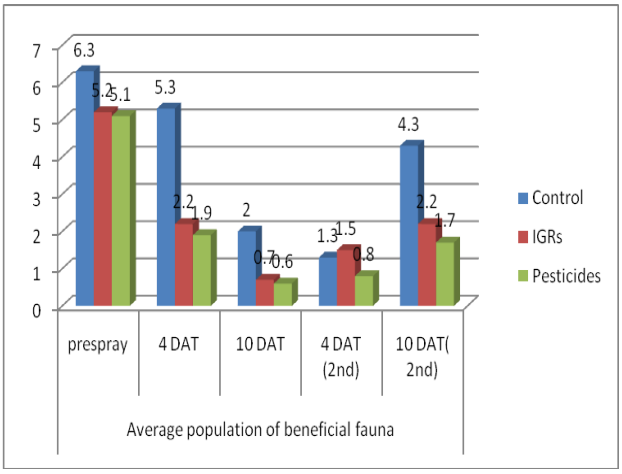

Figure 1: Graph Showing Population of Beneficial Fauna In Treated With Different Groups Of Pesticides

It is also evident from the comparison of the control plot that even insect growth retarders IGRs have certain adverse effects on the population of BF (Fig. 1).

Table 3: Fluctuation In Population of Natural Beinificial Fauna in Response to Various Pesticides Recorded At Different Timings During the Study

Name of the Treatment	% mortality of beneficial fauna in comparison to control				
	4 DAT	10 DAT	4 DAT (2nd)	10 DAT (2nd)	% mort Av 4 o
Buprofezin	36.1 AB	47.9 B	-77.5 B	24.8 A	7.8 BC
Flonicamid	40.2 AB	53.2 B	-14.1 AB	9.3 A	22.2 BC
Spintoram	49.2 A	63.1 AB	49.6 A	39.7 A	50.4 AB
Pyriproxyfen	63.5 A	72.8 AB	10.5 AB	26.1 A	43.2 ABC
Diafenthiuron	57.8 A	84.2 A	71.4 A	75.6 A	72.2 A
Acetamiprid	68.5 A	53.4 B	14.6 AB	60.3 A	49.2 ABC
Spirotetramid	60.5 A	56.2 B	7.4 AB	44.2 A	42.0 ABC
P value	0.003	0.000	0.002	0.130	0.001

It is also evident that plots treated with buprofezin and flonicamid had relatively low % mortality of beneficial fauna as compared to other treatments although it was statistically not much different from other treatments but all the treatments were significantly different from control (p value 0.003). After lapse of ten days the % mortality of beneficial fauna (BF) in the plots treated with diafenthiuron was maximum it was followed by the plots treated with pyriproxifen and spintoram, all the remaining treatments had relatively low % mortality of BF (Table 3, C3). It may be disclosed that control plot still had 3 times more population (1.95/leaf, rough data) as compared to cumulative average of all the treated plots (0.50/leaf, rough data). At this stage another repetition of the same experiment was conducted and the results 4 DAT (2^{nd}) show that population of BF has not changed much rather increased in some cases (table 3, C 4). It is true for some cases because all the pesticides have a relative effect on BF. After 20 days (20 DAT 2^{nd}) the % mortality of BF led by diafenthiuron >acetamiprid> spirotetramid was statistically similar in all the treated plots(table 3, C 5) and the % mortality was not significantly different from the control plot (p value 0.130). When these four observations were averaged and % mortality was compared with one another on the standard of control plot, the of % mortality of BF in descending order looks as follows diafenthiuron> spintoram> acetamiprid> pyriproxyfen> spirotetramid> flonicamid > buprofezin . Hence buprofezin being at the last, is the most safe to beneficial fauna and diafenthiuron being the most harmful among the tested pesticides.

The situation has been analyzed with another angle, the pest population (whitefly A+N) per leaf and population of beneficial fauna per leaf has been compared with respect to average of all the treated plots in all the four replications, 4 days after the application of the treatments in first session 4 DAT in fig. 1 and in second session 4 DAT (2nd), response of the beneficial fauna has been compared in fig. 2 . It could be visualized that in the second application although population per leaf of beneficial fauna has little visible change but the population per leaf of the pest (whitefly A+N) has a visible increase in most of the treatments as compared to first corresponding observation.

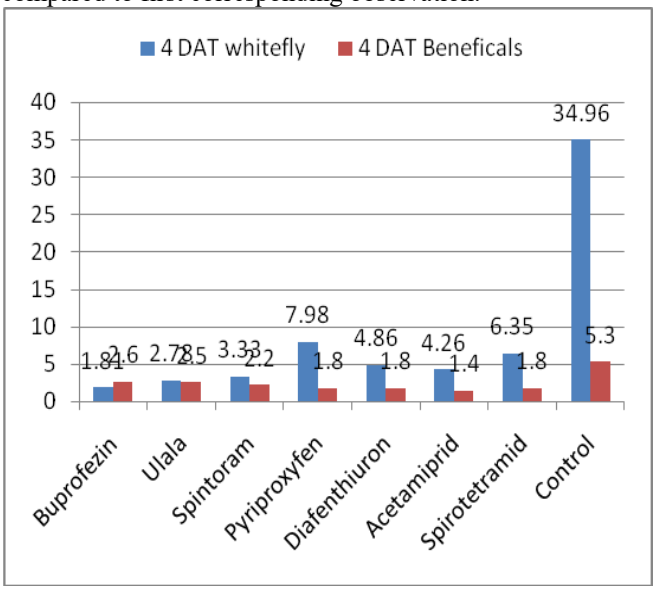

Figure 2: Population of Whitefly(A+N) and Beneficial Fauna 4 Days after Treatment of the First Phase Of Experiment In All Treatments

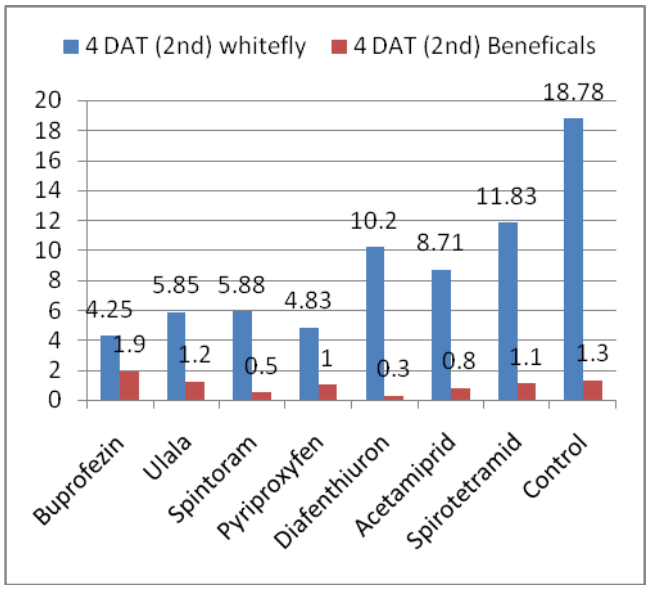

Figure 3: Population of Whitefly (A+N) and Beneficial Fauna 4 Days after Treatment of the Second Phase of Experiment in all treatments

It can also be observed that the population of whitefly (N+A) per leaf 4 days after the treatment is still above or near economic threshold level ETL ie. 5/leaf, and efficacy has decreased as compared to previous treatment at the same time of observation.

4. Discussions

These results partially confirm the findings of other researchers (Ali *et al.,* 2005,) who have reported that acetamiprid (Aslam et al., 2014), diafenthiuron (Barrania and Taleb, 2014) buprofezin (Das and lslam, 2014), pyriproxifen (Asrar *et al.,* 2014, Irshad *et al.,* 2014) and are effective against whitefly whereas they have not tested the and modern pesticides like spirotetramid, spintoram and flonicamid were also not used. Asrar et al., (2014) have reported that Priority (pyriproxyfen), Talent (thiacloprid) ,Actara (thiamethoxam) ,Polo(diafenthiuron) , Ascort (imidacloprid) ,Confidor (imidacloprid) and Pyramid (nitenpyram) have less fatal effect on beneficial fauna like *C. carnea a*nd *C. septempunctata.* Whereas acetamiprid, fipronil and abamectin+ bifenthrin were found to be toxic for *C. carnea*. For *C. septempunctata* only puriproxyfen, thiamethaxam and diafenthiuron of these tested pesticides were found safe and remaining were found to be toxic the beetle, these results also endorse their findings. The better performance of the same was reported 7 days after application. These results are more or less similar to the results observed in this experiment. The selection of pesticides was made on the basis of such reports and the application of all these pesticides although decreased the population of beneficial fauna drastically but it was not altogether eliminated as it has been observed or reported in case of some broad spectrum pesticides from OP or CHC group.

Flonicamid performed well in 3 observations but in the last observation (10 DAT 2nd, C 5) it was because in one replication out of four its efficacy was poor. It provided (-0.44, 6.0, 18.9, 23.3 in case of adult whitefly and -35.1, 88.9, 14.3, -7.1 % mortality in case of whitefly nymphs, rough data). It seems a field mismanagement and odd observation which needs further research.

It was reported (Zidan Lobna *et al.,* 2013) that buprofezin has the translaminar action and is suitable for management for whitefly, and if we see the result pyriproxyfen, spintoram and buprofezin have proved a good options in whitefly management even if whitefly was mismanaged deliberately by injudicious application of pesticides.

5. Conclusion

No doubt that Whitefly *Bemisia tabaci* has been reported as serious pest of cotton and so far no rapid and effective alternative means are available to combat this pest except use of insecticides. Insecticides relatively safe to beneficial fauna and environment can be selected for use. This use should be justified, ie., when pest population reaches the ETL. Unnecessary application of these selected pesticides is not only wastage of resources and money but it also supports the factors which cause rapid multiplication and intensification of pest population resulting in complication of whitefly infestation and ultimately loss in yield. It should be avoided keeping in view the conservation of naturally existing beneficial fauna.

6. Acknowledgements

Thanks are due to the farmer Muhammad Abbas, Kotla Ali Dasti, where these studies were carried out. Authors are also thankful to trainee students Mr. Malik Muhammad Shahbaz Sharif, students department of Agri. Entomology, University of Agriculture, Faisalabad for their help in collection of data and literature during their training over here. Thanks are also due to Govt. of the Punjab, Pakistan for using the official resources in the conduct of research trial.

References

[1] Ahmad, Z., 1999. 'Pest Problems of Cotton, A Regional Perspective', Proceedings of ICAC-CCRI, Regional Consultation Insecticides Resistance Management in Cotton, June 28-July 1 , Multan, Pakistan, pp. 5-20.
[2] Ahsan, R. and Z. Altaf, 2009. Development, adoption and performance of Bt cotton In Pakistan: A review. Pak. J. Agri. Sci., 22: 73-85.
[3] Ali, M. A., R. Rehman, Y. H. Tatla and Z. Ali, 2005. Evaluation of different insecticides for the control of *Bemisa tabaci* on cotton crop in Karor district Layyah.Pak.Entomol..27(1): 5-8.
[4] Amjad, M., M. H .Bashir, M. Afzal and M. A. Khan, 2009. Efficacy of Some Insecticides Against (*Bemisa tabaci* Genn.) Infesting Cotton under Field Conditions. Pak.J. Life Soc. Sci., 7(2): 140-143.
[5] Anonymous, 2013. Economic Survey of Pakistan, Ministry of Food and Agriculture, Islamabad.17-33.
[6] Ashfaq, M., M. Noor-ul-Aen, K. Zia, A. Nasreen and M. Hassan, 2010. The correlation of abiotic factors and physico-morphic charateristics of (*Bacillus thuringiensis*) Bt transgenic cotton with *Bemisa tabaci* (Homoptera: Aleyrodidae) and jassid, *Amrasca devastans* (Homoptera: Jassidae) populations. African J. Agric. Res., 5 (22): 3102-3107.
[7] Aslam,M., M.Razaq, S.A.Shah and F. Ahmad, 2014. Comparative efficacy of different insecticides against sucking pests of cotton. J. Res. (Science), B.Z.U.,Multan, Pakistan.15(1):53-58.
[8] Asrar, M., A. Ghafoor, M. Hassan and K. Zia, 2014. Laboratory bioassay for determination of residual toxicity of different insecticides against two predators, *Chrysoperla carnea* (Chrysopidae: Neuroptera) and *Coccinella septempunctata* (Coccinellidae: Coleoptera). Pak. Entomol., 36 (1):61-67.
[9] Barrania, A. A. and H. K. A. Taleb, 2014. Field efficiency of Some Insecticide Treatments against *Bemisa tabaci*, Cotton Aphid, *Aphis gossypii* and Their Associated Predator, *Chrysopa vulgaris* in Cotton Plants. Alex. J. Agric. Res., 59 (2):105-111.
[10] Das, G. and T. Islam, 2014. Relative efficacy of some newer insecticides on the mortality of jassid and whitefly in brinjal. Int. J. of Res. in Biol. Sci. 2014; 4(3): 89-93.
[11] Irshad, M., K. M. Khali, M. Ashraf, M. Ahmad, M. F. Iqbal, M. Hussain and R. K. Shahzad, 2014. In-vitro study of insecticides used for controlling *Bemisa tabaci*

of Cotton in district Layyah. Intl. J. Comprehen. Res. in Bio. Sci.,1(1) 2014: 55-58.

[12] Khan, J. A. & J. Ahmad, 2005. Diagnosis, monitoring and transmission characteristics of cotton leaf curl virus. Cur. Sci., 88: 1803-1809.

[13] Maps, 2014. On line information about various cities available at http://www.maps-street view.com/Pakistan/Lodhran, accessed on Dec., 25, 2014.

[14] PWQCP, 2014. Official unpublished reports of Pest Warning and Quality Control of Pesticides, Punjab, Lahore, partial information is available at www.pestwarning.agripunjab.gov.pk

[15] Tayyib, M., A. Sohail, Shazia, F . Murtaza, and F . F . Jamil. 2005. Efficacy of some New-hemistry Insecticides for controlling the Sucking insect pests and mites on cotton. Pak. Entomol., 27(1): 63-66.

[16] Zeeshan A., T .M. Khan, and I. R. Noorka. 2010. Detail analysis to determine gene action for lint percentage and fiber traits in upland cotton. Int. J. Agric. Appl. Sci,. 2(1):11-14.

[17] Zidan_Lobna. T. M, M. H. Rashwan and M. A. A Abd-El-Razik, 2013. Comparative Curative and Preventive Ovicidal Effectiveness of Certain Selected IGRs and Insecticides Against The Cotton Leafworm and Sweet potato Whitefly. N Y Sci. J. 6(2): 83-91.