ISSN 1023-1072

Pak. J. Agri., Agril. Engg., Vet. Sci., 2011, 27 (2): 176-184

FIELD PERFORMANCE OF *TRICHOGRAMMA CHILONIS* AGAINST COTTON BOLLWORMS INFESTATION IN DIFFERENT COTTON VARIETIES AS A SUSTAINABLE IPM APPROACH

A. Masood[1], M. J. Arif[1], M. Hamed[2] and M. A. Talpur[3]

[1]Department of Entomology, University of Agriculture, Faisalabad, Pakistan
[2]Plant Protection Division, NIAB, Faisalabad, Pakistan.
[3]Department of Plant Protection, Sindh Agriculture University Tandojam, Pakistan

ABSTRACT

The experiment was conducted on six cotton varieties to evaluate the performance of *Trichogramma chilonis* against the infestation of *Helicoverpa armigera* and *Earias insulana* at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad. Data regarding percentage infestation from biological control plot and unsprayed plot was recorded at weekly interval. It was observed that due to the presence of egg parasitoid, *H. armigera* damage, reduction over control was ranging from 31.73 to 36.45 % on cotton varieties, i.e. SLH-279, FH-945, NIAB-111, CIM-499, CIM-707 and FH-901, respectively. While *E. insulana* reduction percentage was 32.43 to 45.49 % less compared to control on the same varieties mentioned above. However, maximum suppression of *H. armigera* (49.71%) was observed on NIAB-111 during 2nd week of September and *E. insulana* 54.99% on SLH-279 during 1st week of August followed by 52.68% (NIAB-111) during 1st week of October. It is concluded that *Trichogramma chilonis* is successfully used as biological agent in integrated pest management program.

Keywords: Bollworms, cotton varieties, *Earias* and *Helicoverpa* spp, *Trichogramma*

INTRODUCTION

Cotton is the lifeline of Pakistan's economy and crises that decrease the production of this commodity can adversely affect the economy, therefore plays an important role in the economy of Pakistan and generates significant proportion of foreign exchange. Cotton accounts for 7.3 percent of the value added in agriculture and about 1.6 percent to GDP. The crop was sown on the area of 2820 thousand hectares, 7.7 percent less than last year 2007 (3054 thousand

Corresponding author: fsdasad@gmail.com

hectares). During 2007-08, the production is estimated at 11.8 million bales, higher by 1.1 percent over the last year's production (2007) of 11.7 million bales. However, the cotton production was 14.5 percent less than the target of 14.11 million bales mainly due to the shortage of irrigation water, less use of DAP to cotton crop, attack of Cotton Leaf Curl Virus (CLCV), mealy bug and white fly on the crop and last picking of cotton was affected due to higher prices of wheat announced by the Government (Economic Survey, 2009).

In almost all cotton producing countries of the world, insect pests and crop diseases are considered the major factors contribute to decrease in cotton production. The cotton insect pest complex in Pakistan is diverse i.e. Jassid (*Amerasca devastans* Dist.), Thrips (*Thrips tabaci* Lind), Whitefly (*Bemisia tabaci* Gennadius) and Aphids (*Aphis gossypii* Glov); leaf worm (*Spodoptera* spp.), bollworms such as pink (*Pectinophora gossypiella* Saunders), Spotted (*Earias vittella* Boisduval), Spiny (*E. insulana* Fabricius) and American (*Helicoverpa armigera* Hubner) recorded in abundance (Chamberlain *et al*., 1996). Without chemical control of insects and spider mites, the yield losses can reach up to 75% in upland cotton and 35% in perennial cotton. Losses caused by bollworms (*Pectinophora gossypiella*, *Earias* spp. and *Helicoverpa armigera*) have been reported as about 51% (Sharma and Agarwal, 1983).

Mostly, farmer relies upon chemicals to get rid of these serious pests, although, chemical control is effective but due to tremendous increase in pesticide application in world during the last decades especially in countries like Pakistan, many plant protection issues like resistance, resurgence of new pests have been reported (Bhatti *et al*., 1993). The continuous and indiscriminate use of insecticides, besides creating problem of health hazards and environmental pollution, has also resulted in the development of resistance in large number of insect pests. (Dinther, 1972 and Mohyuddin *et al*., 1997) Indiscriminate use of pesticides kills the natural enemies resulting in flare up of pest population. (Hamburg and Guest, 1997 and Yousuf, 1996). The review of IPM demonstrated that biological control has been economically successful, ecologically sound in modern progressive and intensive agriculture. According to Romeis and Shanower (1996) and Ahmad *et al*. (1998) *Trichogramma* species have the great potential to control bollworms in cotton integrated pest management (IPM).

Some scientists had made significant contribution on the aspect of biological control of cotton bollworms by parasitoids. Kakar *et al*. (1990) tested 5 species of *Trichogramma* for their ability to parasitize *Helicoverpa armigera*. Stam and Elmosa (1990) studied relationship between insect pests and their predators and parasitoids and further investigated that egg and larval population of *Earias insulana* and *H. armigera* were parasitized by *Trichogramma* spp. and *Bracon brevicornis*, respectively. Wang and Zhang (1991) observed that *T. pintoi* and *T. dendrolimi* resulted in 63.7% and 47.9% parasitism, respectively and indicated the feasibility of *Trichogramma wasps* for suppression of *Heliothine* pests in cotton (Suh *et al*., 1998). The significance of Trichogramma against bollworms

was also reported in view of biological control (Hamed *et al*., 2001, Brar *et al*., 2002, Rasool *et al*. 2002 and Rahman *et al*., 2003). Keeping in view the endeavor of aforementioned researchers, this project was planed to evaluate the performance of *Trichogramma spp.* in terms of percent reduction of infestation against cotton bollworms, *Earias insulana* and *Helicoverpa armigera*.

MATERIALS AND METHODS

Experimental trial was conducted at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during 2003-04. The materials employed in present research work were a field crop of six varieties of cotton, viz., IRFH-901, CIM-707, CIM-429, FH-945, NIAB-III and SLH-279. Around 15-20 egg cards of laboratory reared *T. chilonis* containing 500 egg parasitoids in each card and a field available lot of two cotton bollworms, viz., *H. armigera* and *E. insulana*. The layout plan for the experiment was Randomized Complete Block Design (RCBD). There were two treatment plots of one acre each i.e. Biological control plot and Control plot. Six cotton genotypes were sown as a treatment and replicated three times and treatment size 32.5x 66 feets separated by path of 5x66 feet.

Fresh eggs of American bollworm and spotted bollworm were observed on top leaves, flowers, squares and bolls before the application of *Trichogramma* cards during the first week of August. Similarly percentage infestation of bollworms was recorded from flowers, squares and bolls in biological control plot and control plot. In each treatment, five plants were selected at random for recording bollworms infestation. The selected plants were tagged in order to avoid repetition. A single card of parasitoid having 500 eggs/card approximately was attached to ventral side of cotton leaves in order to avoid the impact of direct sunlight in biological control plot. To evaluate the performance of *T.chilonis,* mean infestation of cotton bollworms in the field (American and Spotted bollworm) parasitized by parasitoids under study was compared in biological control plot and control plot simultaneously.

Statistical analysis

Finally the assembled field data in terms of percent reduction were analyzed by using analysis of variance technique and treatment mean values were compared by using Duncan's Multiple Range (DMR) Test at 5% probability level (Steel and Torrie, 1984).

RESULTS AND DISCUSSION

Release of *Trichogramma chilonis* against American bollworm

The results revealed that maximum percentage suppression of American bollworm was recorded (36.99%) on SLH-279 followed by 36.45 and 36.05 on

FH-945 and NIAB-111 respectively. While minimum suppression was 31.73% on FH-901. The perusal of data on weekly basis indicated that the maximum percentage infestation (40.25%) noted on FH-945 during 3rd week of August and the minimum infestation (29.52%) was observed during 4th week of September. However suppression of infestation by parasitoid during all the weeks was found statistically different with one another. The maximum infestation suppression (41.02%) recorded on CIM-499, (53.88%) on SLH-279 during 4th week of August, (49.71%) on NIAB-111 during 1st week of September, (36.32%) on IRFH-901 during the 2nd week of August and (38.83%) on CIM-707 during the 2nd week of August. While minimum percent infestation of American bollworm (12.32 %) was observed during 3rd week of September, (22.60 %) during 1st week of September, (28.37 %) during 4th week of September, (25.05 %) during 1st week of October and (22.82 %) during 2nd week of September on CIM-499, SLH-279, NIAB-111, FH-901 and CIM-707 respectively as displayed in Table 1. Therefore, suppression of American bollworm infestation due to *Trichogramma chilonis* was statistically at par with one another. The overall percent reduction of infestation was calculated on monthly basis which showed non significant difference among varieties (Figure 1). Other scientists also studied the feasibility of *Trichogramma* for suppression of cotton bollworms which indicated increased egg parasitism, leading to overall reduction in infestation (Suh *et al*., 1998). Likewise in our studies, the releases of *Trichogramma* showed significant reduction of *H. armigera* in field ranging from 44- 52% (Wang and Zhang, 1991) and 40-45% (Rasool *et al*., 2002).

Release of *Trichogramma chilonis* against spotted bollworm

The results indicated that maximum suppression of spotted bollworm infestation due to egg parasitoids on FH-945 was 42.57 % (during 1st week of October). While minimum suppression of infestation was 25.06% (3rd week of September) .Maximum suppression of infestation was 47.50% during 2nd week of October, 54.99% 1st week of August, 52.68 % 1st week of October, 44.18 % 1st week of August and 51.81% 2nd week of September on CIM-499, SLH-279, NIAB-111, IRFH-901 and CIM-707 respectively as shown in Table- 2. While minimum suppression of spotted bollworm infestation on CIM-499, SLH-279, NIAB-111, IRFH-901 and CIM-707 were observed 27.57% (4th week of September), 23.06 % (2nd week of October), 31.45 % (3rd week of August), 28.80% (1st week of September), 22.34% (1st week of October) respectively as displayed in Table- 2. Suppressed infestation of spotted bollworm by parasitoids was statistically different with one another during all the observation weeks.

The overall percent reduction of infestation was also recorded on monthly basis which showed no significant differences among cotton varieties (Figure 2). As studied in our experiment, Hamed *et al*. (2001) also observed that *Trichogramma* parasitized its eggs which resulted in 50 % reduction in bollworm damage and the host preferences of *Trichogramma* is dependent on infestation of bollworms on susceptible cotton varieties.

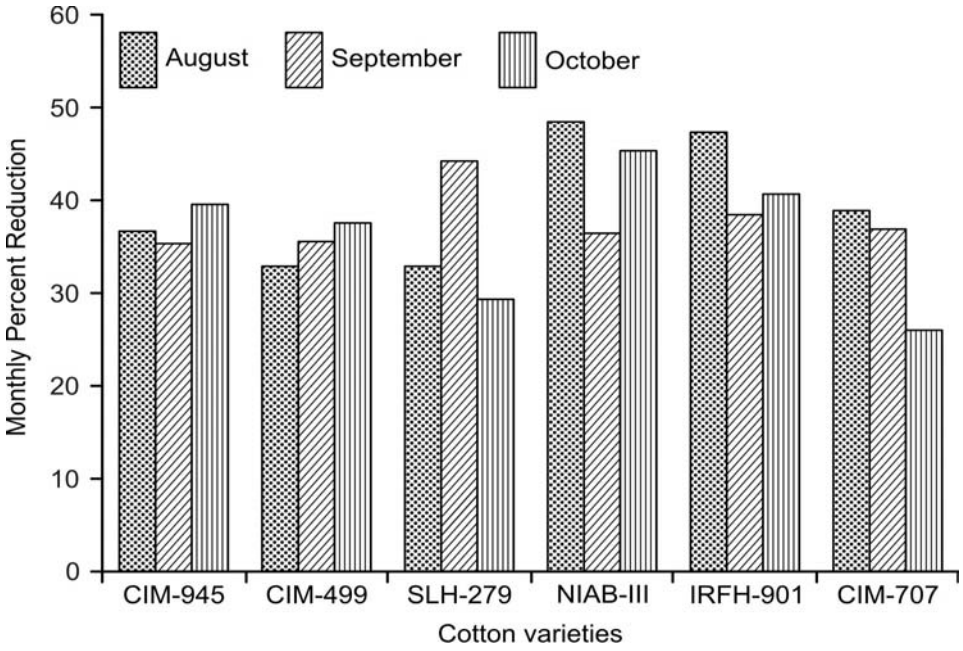

Figure 1. Percent reduction of infestation of *Helicovera armigera* during August- October, 2004.

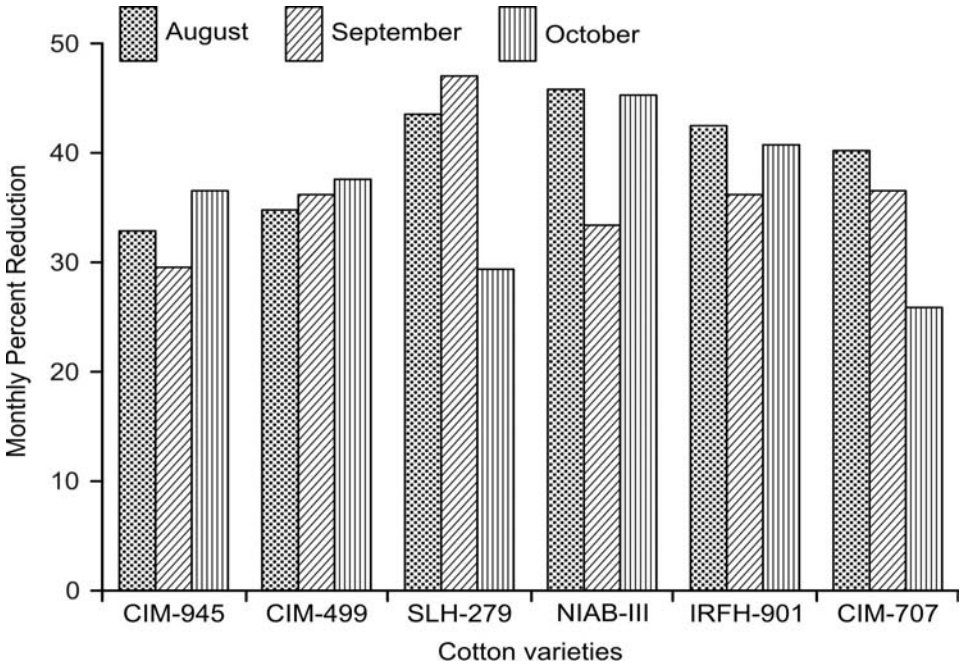

Figure 2. Percent reduction of infestation of *Earias insulana* during August-October, 2004.

Table1. Comparison of control plot and biological control plot of six cotton varieties on the basis of percentage reduction of *Helicovera armigera* infestation on weekly basis.

Variety	Treatment	August				September				October		Mean
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	
FH-945	Control plot	16.12abc	17.81a	15.93abc	16.44ab	13.98bcde	11.55e	15.85abc	13.37cde	14.56bcd	12.79de	14.83
	Biological control plot	10.59ab	11.80a	9.517abcd	10.41ab	8.877bcd	7.013d	10.22abc	9.423abcd	8.750bcd	7.770cd	9.43
CIM-499	Control plot	16.38ab	17.20a	15.98ab	16.41ab	17.16a	14.18bc	13.55bc	17.56a	16.20ab	11.86c	15.64
	Biological control plot	10.30cd	11.45b	10.11b	9.677d	12.10b	10.44c	11.88b	13.48a	10.37c	8.733e	10.85
SLH-279	Control plot	16.96a	17.27a	15.14abc	15.70abc	13.67bcd	13.48cd	12.51d	16.18ab	13.86bcd	11.83d	14.66
	Biological control plot	11.44a	10.09abc	8.353cd	7.240d	10.58ab	8.457cd	7.493d	10.98a	8.383cd	8.803bcd	9.18
NIAB-III	Control plot	15.84ab	15.24b	16.24ab	17.83a	13.92bc	12.12cd	15.30b	11.52de	9.587e	10.58de	12.759
	Biological control plot	10.18ab	10.53ab	10.16ab	11.06a	7.000cd	8.443abcd	9.280abc	7.827bcd	6.867cd	6.483d	8.78
IRFH-901	Control plot	16.46b	19.30a	17.40ab	16.35b	15.85b	16.02b	13.03c	16.26b	10.31c	12.60c	15.35
	Biological control plot	11.58ab	12.21a	11.64ab	10.86abc	11.20ab	10.55abc	9.507bcd	10.38abc	7.727d	8.447cd	10.41
CIM-707	Control plot	17.52abc	18.85a	16.18bcde	17.83ab	14.48e	15.56cde	17.20abcd	18.63a	16.73abcd	15.27de	16.82
	Biological control plot	11.34abc	11.53abc	10.76bc	12.38ab	10.52bc	12.32ab	11.68abc	13.30a	10.84bc	9.420c	11.40

Means sharing common letter do not differ from each.

Table 2. Comparison of control plot and biological control plot of six cotton varieties on the basis of percentage reduction of spotted bollworm infestation on weekly basis.

Variety	Treatment	August				September				October		Mean
		1st	2nd	3rd	4th	1st	2nd	3rd	4th	1st	2nd	
FH-945	Control plot	15.38bcde	18.58a	16.61abc	15.80abcd	13.66cde	14.71bcde	16.24abcd	17.61ab	13.46de	12.41e	15.44
	Biological control plot	11.89a	12.66a	11.42ab	9.150bc	5.373c	10.34abc	12.17a	12.94a	7.730c	8.610c	10.52
CIM-499	Control plot	15.42ab	16.38a	15.33ab	16.69a	14.31b	10.28d	12.06c	11.63cd	10.90cd	12.30c	13.53
	Biological control plot	10.36ab	9.597ab	10.39ab	11.19a	7.787bc	6.573c	7.737bc	8.423bc	7.897bc	6.457c	8.64
SLH-279	Control plot	13.62abc	13.86abc	15.94a	16.03a	14.33ab	10.60cd	11.56bcd	12.24bcd	13.85abc	10.06d	13.21
	Biological control plot	6.130d	7.277cd	9.790ab	10.76a	7.427cd	5.827d	6.080d	6.470d	8.943abc	7.740bcd	7.64
NIAB-III	Control plot	14.22bc	15.03bc	17.84a	16.53ab	13.63cd	11.51d	14.88bc	14.19bc	14.95bc	12.45cd	14.52
	Biological control plot	7.430cd	8.863abcd	9.687ab	8.507abcd	9.177abc	7.840bcd	10.20a	8.877abcd	7.073d	7.740bcd	8.53
IRFH-901	Control plot	14.75a	15.19a	13.35abc	11.62cd	12.23bc	11.59cd	14.09ab	10.20d	12.49bc	11.61cd	12.71
	Biological control plot	8.233abcd	9.303a	8.20abcd	6.10d	5.707abc	6.463cd	8.903ab	6.627bcd	7.467abcd	6.817bcd	7.66
CIM-707	Control plot	12.86bc	13.82abc	15.08ab	16.58a	12.40bc	13.47bc	15.35ab	14.49ab	12.25bc	11.02c	13.73
	Biological control plot	7.103cd	8.523abc	9.220ab	10.13a	8.833abc	6.490d	9.633ab	10.39a	9.513ab	7.773bcd	8.76

Means sharing common letter do not differ from each.

CONCLUSION

The results of this study reveal success of biological control against cotton bollworms, *Earias* sp. and *Helicoverpa armigera.* An egg parasitoid, *Trichogramma chilonis* has been employed for reduction of bollworms infestation up to 30-46 % in field and most efficient performance of *T.chilonis* is recorded in suitable environmental conditions during August to onwards. Wang and Zhang, (1991) and Rasool *et al*., (2002) also indicated that temperature and relative humidity during August to November were conducive for the survival and activity of bollworms and its parasitoids.

Biological control has proven to be effective technique in bollworms integrated management. This strategy is less expensive as compared with insecticides resulting in environment protection and safety for animal and human health .The reduced use of insecticides resulted in higher net return, environmental safety and conservation of beneficial insects (Mohyuddin *et al*., 1997 and Sharma *et al*., 2001). For future prospective, we should encourage biological control based integrated pest management (IPM) rather complete reliance on insecticides. The feasibility of sustainable IPM approach should be demonstrated in other cropping systems especially vegetables and its large scale application is recommended based on promising results.

REFERENCES

Ahmed, N., M. Ashraf, B. Fatima and Nasrullah. 1998. Potential of *Trichogramma chilonis* to parasitize eggs of pink, spotted and spiny bollworms of cotton. Pak. J. Zool., 30 (1): 39-40.

Bhatti, M. A., M. Saeed and M. A. Murtaza. 1993. Host plant resistance for major cotton bollworms. The Pak. Cotton, 37 (1): 1-14.

Brar, K. S., B. S. Sekhon, J. Singh, M. Shenhmar and J. Singh. 2002. Biocontrol-based management of cotton bollworms in the Punjab. J. Biocon., 16 (2):121-124.

Chamberlain, D. J., Z. Ahmad and M. R. Attique. 1996. The first record of *Earias biplaga* walker (Lepidoptera; Noctuidae) and *Dichocrocis punctttferalis* guenee (Lepidoptera: Pyralidae) attacking cotton in Pakistan. The Pakistan cotton, 40 (1-2): 35-40.

Dinther, J. B. M. 1972. Insect control and new approaches. World Crops. July to August, pp: 180-182.

Economic Survey, 2009. Agricultural Statistics of Pakistan, Govt. of Pakistan. Min. Food Agric. And Live stock, Eco. Wing, Finance Div., Islamabad, Pakistan (www.accountancy.com.pk).

Hamburg, H. V. and P. J. Guest. 1997. The impact of insecticide on beneficial arthropods in cotton ecosystem in South Africa. Archives Environ. Contamin. Toxic., 32 (1): 6368.

Hamed, M., S. Nadeem, B. Rasool and M. A. Murtaza. 2001. Field performance of *Trichogramma chilonis* against *Earias spp*. under varying sowing time and variety conditions in cotton. Pak. J. Bio. Sci., 4 (6): 595-596.

Kakar, K. L., J. P. Sharma and G. S. Dogra. 1990. Feasibility of using *Trichogramma spp*. against *Heliothis armigera* Hubner on tomato. Indian J. Plant Protection, 18 (2): 237-239.

Mohyuddin, A. L., G. Jilani, A. G. Khan, A. Hamza, A. Ahmed and Z. Mahmood. 1997. Integrated pest management of major cotton pests by conservation, redistribution and augmentation of natural enemies. Pak. J. Zool., 29 (3): 293-298.

Rahman, S. J., A. G. Rao and P. S. Reddy. 2003. Potential and economics of biointensive insect pest management (BIPM) module in cotton for sustainable production. Proceedings of the Symposium of Biological Control of Lepidopteran Pests, Bangalore, India, pp. 279-283

Rasool, B., J. Arif, M. Hamed and S. Nadeem. 2002. Field performance of *Trichogramma chilonis* against *Helicoverpa armigera* under varying sowing time and varieties of cotton. Int. J. Agric. and Biol., 4 (1): 113-114.

Romeis, J. and T. G. Shanower, 1996. Arthropod natural enemies of *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) in India. Biocon. Sci. Tech., 6 (4): 481-508.

Sharma, H. C. and R. A. Agarwal. 1983. Factors affecting genotypic susceptibility to spotted bollworms, *Earias vittella* Fab. in cotton. Insect sci. and its Application, 4 (4): 363-372.

Sharma, O. P., R. C. Lavekar, A. K. Pande, K. S. Rathod, A. A. Jafri, K. S. Murthy, R. N. Singh, O. M. Bambawale. 2001. Validation and adoption of biointensive ASHTA cotton IPM module at Sonkhed and Dongargaon village in Southern Maharashtra. Annals of Plant Protection Sci., 9 (2):193-200.

Stam, P. A. and H. Elmosa. 1990. The role of predators and parasites in controlling populations of *Earias insulana, Heliothis armigera* and *Bemisia tabaci* on cotton in the Syrian Arab Republic. Entomophaga, 35 (3): 315-327.

Steel, R. G. D. and J. H. Torrie, 1984. Principles and procedures of statistics. McGraw Hill Book Co. Inc., New York.

Suh, C. P. C., B. B. Orr, J. W. V. Duyn, D. J. W. Van, P. Dugger and D. Richter. 1998. Revaluation of *Trichogramma* releases for suppression of *Heliothine* pests

in cotton. Proceeding Beltwide Cotton Conferences, San Diego California, USA., 2: 1098-1101.

Wang, F. C. and S. Y. Zhang. 1991. *Trichogramma pintoi* and *deuterotoky* laboratory multiplication and field releases. Collopues-de-l' NRA., 56:155-157.

Yousaf, M. 1996. A word of caution for chemical control of cotton whitefly. Pak. Entomol., 18 (1-2): 115-116.

(Received 30 June, 2010; Revised 31 December, 2011)