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Evaluation of *Chrysoperla carnea* for population management of thrips, *Thrips tabaci* (Lind.); in *B.T.* cotton crop

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Abstract
The experiment was conducted to evaluate the *Chrysoperla carnea* Steph. For the management of sucking insect pest in B.T. cotton crop. Experimentation of releasing the Predator in field conditions was carried out in Randomized Complete Block Design (RCBD) with 4 replications. There were four treatments: T1= *Chrysoperla carnea* natural enemy, T2= Confidor insecticide, T3= B.T. control and T4= NIAB-78 control plot. The treatments were applied at fortnightly intervals stating from 2nd week of June. The data on thrips shown that the maximum population was recorded (8.79 thrips/leaf) in T3, while the minimum population was recorded in T1 (1.5/leaf). The overall, minimum mean population of Thrips was recorded (1.58/leaf) in T1 (*Chrysoperla carnea* natural enemy) plot, while the overall maximum mean population for Thrips (2.32/leaf) was recorded (B.T. control) plot. The overall maximum mean population of *C. carnea* (0.39/plant) was recorded in T1 and the minimum population was recorded (0.06/plant) in T2 (Confidor Insecticide Plot). The maximum seasonal mean of bolls (20.84bolls/plant) was recorded in T4 followed by T2 (20.13bolls/plant).

Keywords: *Chrysoperla carnea*, Management, *Thrips tabaci*, Experimentation

Introduction
Cotton *Gossypium hirsutum* L., was cultivated by the inhabitants of the Indus Valley civilization by the 5th millennium BCE – 4th millennium BCE. (Moseley and Gray, 2008) [8]. accordingly, the Ministry of Food, Agriculture and Livestock has prepared a cotton Vision envisaging 20.70 million bales production by 2015. (Pakissan, 2008) [9]. Cotton crop is very sensitive and much infested by many insect pests throughout its growing period. Thrips, *Thrips tabaci* (Lind.); Jassid, *Amrasca devastans* (Dist.); Whitefly, *Bemisia tabaci* (Genn.); cotton Aphid, *Aphis gossypii* (Glov.); cotton mite, *Tetranychus cinnabarinus* (Boise) and bollworm complex, such as spotted bollworm, *Earias insulina* (Boise); and *Earias vittela* (Stoll), pink bollworm *Pectinophora gossypiella* (saund) and African bollworm, *Helicoverpa armigera* (Hub.) a (Lohar, 1994) [5]. Different approaches are applied by the farmers to control the insect pests including the cultivation of Bt cotton. Bt cotton was among the first genetically modified (GM) crops to be used in commercial agriculture. A gene from the soil bacterium *Bacillus thuringiensis* (Bt) was transferred to the cotton genome. This gene encodes the production of a protein that is toxic to certain lepidopteran insects. Cotton is attacked by a variety of insect species, and the crop is the single largest insecticide consumer worldwide (Matthews and Tunstall, 1994) [7] In the USA and China, Bt cotton was commercialized in the mid-1990s, and today the technology covers about 30–40 per cent of the cotton area in both countries. Recent studies show that USA and Chinese Bt adopters realize significant pesticide and cost savings in most cotton-producing regions (Carpenter *et al*. 2002) [2] transgenic plants have shown good results against targeted Insect pests, but they are infested by the other insect pests. The green lacewing, *C. carnea* (Steph) is a potential predatory biological control agent that can be used in augmentation programs for sustainable crop pest suppression. It attacks a variety of soft-bodied insects and mites found on various agro-ecosystems. This predator is widely distributed in India, Europe, USSR, North America, South America, Tanzania, Sudan, Egypt, Kenya and Nigeria. The predator has a significant potential for commercialization and use against a variety of pests in combination with other insect pest management tactics (cultural, mechanical, host plant resistance, chemical and microbial insecticides). The predatory potential of the predator varies depending on the prey species (Gautam and Tesfaye 2002) [3]. In present study green lacewing, *C. carnea* is used as biological control agent against the sucking insect pests in Bt cotton.

Materials and Methods
The study was carried out to evaluate *Chrysoperla cornea* for the management of insect pests in Bt-Cotton crop, at Sindh Agriculture University, Tando Jam.
The study started from the 2nd week of June and continued up to the last week of September. The process of recording data continued up to 16 week, up to that 20 observations were recorded, the experiment was carried out in four treatments with four replications in a ½ acre. Each treatment plot size was 5445sq ft.

Layout of the Plot
T_1 = Biology control, (*Chrysoperla carnea*)
T_2 = Confidor (Insecticide)
T_3 = Bt – Control
T_4 = NIAB– 78 Control

R_1	R_2	R_3	R_4
T_1	T_3	T_4	T_2
T_4	T_2	T_1	T_3
T_2	T_1	T_3	T_4
T_3	T4	T_2	T_1

Comparative population development of Thrip, *Thrips tabaci* recorded in NIAB-78 and Bt cotton. The *Chrysoperla carnea* cards were purchased from Biological Entomology section, Agriculture Research Institute, Tandojam. The predators were released in the field at fortnight interval. Efficiency of *C. carnea* was compared with Confidor, one of the most popular insecticides widely used for the control of sucking insect pests by the farmers. The treatments were applied at fortnightly interval. Pre-treatment data were recorded 24 hours before application and post treatment data were taken after three and seven days of application of treatments. The data were recorded by selecting five plants at random from each treatment. From each plant five leaves were observed for recording the population of sucking insects i.e., one from top, 2 from middle and 2 from bottom portion of plant and whole plant was observed for recording predator population. Finally collected data were analyzed using ANOVA.

Results

1. Thrips, *Thrips tabaci* (Lind.)

Thrips appeared in the crop in the 2nd week of July; their infestation was observed till last week of September. The maximum population of Thrips (8.79/leaf) was recorded in T3 (B.t Control treatment) plot, while the minimum population (0.35/leaf) was recorded in T1 (*Chrysoperla carnea* natural enemy) during the last week of September (Table-1). The overall, minimum mean population of Thrips was recorded (1.58/leaf) in T1 (*Chrysoperla carnea* natural enemy) plot. The overall maximum mean population for Thrips (2.32/leaf) was recorded (B.t. control) plot as shown in (Table-1). The analysis showed that there was a significant ($P<0.05$) difference of thrip population development on different treatments.

Table 1: Mean Population of Thrips, *Thrips tabaci* (Lind.) in different treatments on cotton crop under field conditions.

Mean population of Thrips/leaf					
Observation Date	**T1**	**T2**	**T3**	**T4**	**Mean**
15.06.08	0.00	0.00	0.00	0.00	000
19.06.08	0.00	0.00	0.00	0.00	000
23.06.08	0.00	0.00	0.00	0.00	000
30.06.08	0.00	0.00	0.00	0.00	000
04.07.08	0.00	0.00	0.00	0.00	000
08.07.08	0.62	1.90	1.93	2.13	1.65D
15.07.08	2.89	1.68	6.74	1.02	3.07C
19.07.08	5.27	2.80	5.44	3.45	4.24B
23.07.08	2.88	4.07	5.47	4.25	4.17B
31.07.08	4.37	6.76	8.79	5.49	6.34A
10.08.08	1.14	1.75	2.00	1.85	1.69D
14.08.08	1.14	1.22	0.71	1.46	1.14E
18.08.08	0.82	0.77	0.90	1.16	0.91DE
25.08.08	0.59	0.94	0.78	0.76	0.77E
29.08.08	0.75	0.37	0.60	0.70	0.60E
02.09.08	0.53	0.51	0.65	0.51	O.55E
09.09.08	0.99	1.52	0.78	0.46	0.94DE
13.09.08	0.79	0.54	0.51	0.59	0.61E
17.09.08	0.47	0.65	0.67	0.67	0.62E
24.09.08	0.35	0.64	0.65	0.53	0.57E
Mean	1.58	1.78	2.32	1.67	1.84

* Means followed by same letters are not significantly ($P< 0.05$) different from each other by LSD.

Table 2: Mean Population of Thrips, *Thrips tabaci* (Lind.) after application of different IPM options on cotton crop under field conditions.

Application	Mean population of Thrips/leaf											
	Pre Treatment				Post Treatment 3D				Post Treatment 7D			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
01	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
02	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.62	1.90	1.93	2.13
03	2.89	1.68	6.74	1.02	5.27	2.80	5.44	3.45	2.88	4.07	5.47	4.25
04	1.14	1.75	2.00	1.85	1.14	1.22	0.71	1.46	0.82	0.77	0.90	1.16
05	0.59	0.94	0.78	0.76	0.75	0.37	0.60	0.70	0.53	0.51	0.65	0.51
06	0.99	1.52	0.78	0.46	0.79	0.54	0.51	0.59	0.47	0.65	0.67	0.67
Mean	1.40	1.47	2.58	1.02	1.98	1.21	1.83	1.55	1.06	1.58	1.92	1.75

2. Green lacewing, *Chrysoperla carnea* (Steph.)

Green lacewing *Chrysoperla carnea* (Steph.) is an important predator of aphid, whitefly, thrips and jassid. It is also called aphid lion. The *C. carnea* was recorded from the 2nd week of June till the last week of September when the 1st picking was taken, their maximum activities were recorded during

1st week of August. The maximum population (0.85/plant) was recorded in T1 in which natural enemies (*C. carnea* cards) were released as a pest management option (Table-8) the minimum population (0.05/plant) was recorded in the various treatments T2, T3 and T4 (Confidor treatment), (B.T. control) and (NIAB-78) plots respectively. The overall mean population of *C. carnea* shown in (Table-10) indicated that the maximum *C. carnea* population was recorded (0.34/plant) in T1 (*C. carnea* natural enemies) plot, whereas the minimum population was recorded as (0.06/plant) in T2 (Confidor insecticide) plot. The analysis of data showed that there was a significant (P<0.05) difference in population development of *C. carnea* on different treatments.

Table 3: Mean Population of green lacewing, *Chrysoperla carnea* (Steph.) in different treatments on cotton crop under field conditions.

Mean population of green lacewing/plant					
Observation Date	**T1**	**T2**	**T3**	**T4**	**Mean**
15.06.08	0.30	0.25	0.20	0.15	0.23ABC
19.06.08	0.55	0.05	0.10	0.25	0.24ABC
23.06.08	0.40	0.10	0.20	0.10	0.19BCDE
30.06.08	0.55	0.10	0.25	0.20	0.28AB
04.07.08	0.85	0.05	0.15	0.15	0.30A
08.07.08	0.50	0.10	0.20	0.20	O.25ABC
15.07.08	0.35	0.10	0.10	0.15	0.17CDEF
19.07.08	0.55	0.05	0.15	0.20	0.24ABC
23.07.08	0.45	0.05	0.10	0.15	0.18BCDE
31.07.08	0.35	0.05	0.10	0.15	0.16CDEF
10.08.08	0.30	0.10	0.15	0.05	0.15CDEF
14.08.08	0.40	0.05	0.15	0.25	0.21ABC
18.08.08	0.35	0.05	0.15	0.20	0.17CDEF
25.08.08	0.35	0.00	0.20	0.25	0.20BCD
29.08.08	0.55	0.00	0.20	0.20	0.23ABC
02.09.08	0.15	0.00	0.05	0.05	0.06G
09.09.08	0.15	0.05	0.10	0.05	0.09FG
13.09.08	0.35	0.05	0.05	0.00	0.11DEFG
17.09.08	0.25	0.00	0.00	0.05	0.09FG
24.09.08	0.30	0.05	0.00	0.05	0.10EFG
Mean	0.39	0.06	0.13	0.14	0.18

* Means followed by same letters are not significantly (P< 0.05) different from each other by LSD.

Table 4: Mean Population of green lacewing, *Chrysoperla carnea* (Steph.) after release of predator on cotton crop under field conditions.

Application	Mean population of green lacewing/plant											
	Pre Treatment				Post Treatment 3D				Post Treatment 7D			
	T1	T2	T3	T4	T1	T2	T3	T4	T1	T2	T3	T4
01	0.30	0.25	0.20	0.15	0.55	0.05	0.10	0.25	0.40	0.10	0.20	0.10
02	0.55	0.10	0.25	0.20	0.85	0.05	0.15	0.15	0.50	0.10	0.20	0.20
03	0.45	0.10	0.10	0.15	0.45	0.05	0.15	0.20	0.45	0.05	0.10	0.15
04	0.30	0.01	0.15	0.20	0.40	0.05	0.15	0.15	0.35	0.05	0.15	0.20
05	0.35	0.00	0.20	0.25	0.55	0.00	0.20	0.20	0.15	0.00	0.05	0.05
06	0.15	0.05	0.10	0.05	0.35	0.05	0.00	0.05	0.25	0.00	0.00	0.05
Mean	0.35	0.10	0.16	0.16	0.52	0.04	0.12	0.16	0.35	0.05	0.11	0.12

Table 5: Overall mean population of green lacewing, *Chrysoperla carnea* (Steph.) and Thrips, *Thrips tabaci* (Lind.) in different treatments on Cotton crop under field conditions.

Per Plant		Per Leaf
Treatments	***C. Carnea***	**Thrips**
T1	0.39A	1.58B
T2	0.06C	1.87B
T3	0.13B	2.32A
T4	0.14B	1.78B

* Means followed by same letters are not significantly (P< 0.05) different from each other by LSD.

Discussion

In present study different pest management options were tested on Bt- cotton against thrips. Release of *C. carnea* cards in cotton reduced the population of thrips compared with control. Thrip population was significantly higher in Bt- cotton control compared with NIAB-78 control, indicating that Bt cotton is susceptible to thrips compared with conventional cotton variety NIAB – 78. Hanumantharaya and Naik (2008) studied the release of *Chrysoperla carnea* grubs at 0.75 and 1.0 lakhs/ha. Starting from 43 DAS reduced the sucking pest (leaf hoppers, thrips, aphids and whiteflies) and bollworm *H. armigera* and increased the seed cotton yield. Wadhawa and Gill (2007) studied the biodiversity of natural enemies on Bt and non-Bt

cotton hybrids and found that Bt cotton hybrid recorded higher population of *Chrysoperla carnea*, spiders, *Geocoris* bug, and yellow wasps. Manju *et al.* (2007) investigated the effect of Bt- cotton fed aphids on the feeding potential and development of *C. carnea* and reported no variation in the feeding potential and development period of larvae of *C. carnea* fed on aphids feeding on Bt and non Bt cotton plants. They recorded significantly higher number of natural enemies on Bt – Cotton compared with non Bt- cotton. In present study, confidor was applied on Bt- cotton for the control of sucking insect pests, results indicated that confidor significantly reduced jassid population compared with *C. carnea* and control treatments. Confidor was not much effective against thrips. Although thrip population in confidor applied treatment was at par with *C. carnea* treatment and NIAB-78 control. However, it was significantly lower than Bt-control. Results further indicate that confidor was toxic to *C. carnea* and lowest population of *C. carnea* was recorded in confidor applied treatment. Ameta and Sharma (2005) recorded reduction in population of *A. gossypii*, *A. biguttula* and *T. tabacci* after application of confidor.

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