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## Testing of *Chrysoperla carnea* (S) against *Bemisia tabaci* in Bt. cotton crop under field conditions

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### Abstract

The Green Lacewing, *Chrysoperla carnea* (Steph.) (Neuroptera: Chrysopidae) is a successful predatory insect; augmented for bio control practices especially for Integrated Pest Management. It is observed that green lacewing *C. carnea* (Steph.) has good potential of predation and caught good attention for its successful use against sucking insect pests. Currently it was evaluated for the management of white fly *Bemisia tabaci* infesting cotton crop. The data shown that the predator reduced white fly *B. tabaci* population significantly. Overall maximum population reduction was recorded in T-1 Chemical Control ( $6.01 \pm 3.75/\text{leaf}$ ) followed by T-2 Bio-Control (green lacewing *C. carnea*) ( $6.84 \pm 3.90/\text{leaf}$ ) as compare with control ( $8.50 \pm 4.93/\text{leaf}$ ) While maximum population of Whitefly *B. tabaci* ( $10.40 \pm 5.75/\text{leaf}$ ) recorded in non Bt. Control (NIAB-78). Acetamaprid 20SL has good toxicity recoded minimum predatory population ( $0.04/\text{plant}$ ) in T-1 (Chemical Control plot); maximum were observed ( $0.3/\text{plant}$ ) in T2 Bio-Control (Green Lacewing *C. carnea*) released plot.

**Keywords:** Bt. cotton, bio-control, *Chrysoperla carnea*, *Bemisia tabaci*, management

### 1. Introduction

Cotton (*Gossypium hirsutum* L.) is widely preferred cash crop and being source of raw material for textile industry, importance is always on rise. Cotton accounts for 5.2% of value added in agriculture and 1% of Gross Domestic Product; GoP (2017). Practiced across the Punjab and Sindh provinces of Pakistan, but the Punjab province is lead 80% production comes from Punjab while 18% from Sindh province (Ali *et al.*, 2013) [2]. Cotton is attacked by a variety of insect pests, out of which jassid, *Amrasca devastans*; whitefly, *Bemisia tabaci*; thrips, *Thrips tabaci*; spotted bollworm, *Earias spp.*, pink bollworm, *Pectinophora gossypiella* and American bollworm, *Helicoverpa armigera*, are the most important Ahmed (1999) [1]. Different approaches are applied by the farmers to manage these insect pests. In this aspect different approaches are applied in different ways. This includes 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. (Matthews and Tunstall, 1994) [11] In USA and China, Bt cotton was commercialized in the mid1990s, and today the technology covers about 30–40 per cent of the cotton area in both countries. (Carpenter *et al.* 2002) [4] transgenic plants have shown good results against targeted insect pests, but they are infested by the other insect pests such as sucking insects. Cotton whitefly (*B. tabaci*) severely affect the economics of several cotton producing countries such as Pakistan due to direct damage by inhibition of photosynthetic activity and transmission of viral diseases to cotton that impairs the fiber quality (Ahmad, 1999) [1]. Natural enemies are a key component of IPM, and they are often recommended as the first line of defense in an IPM program (Lugojja *et al.*, 2001) [9]. *Chrysoperla carnea*, one of the most important natural enemies has a great role in reducing the use of pesticides and environmental pollution in field crops and vegetables (Dean and Sterling, 1992) [6] Biological control by the use of predator *C. carnea* has also gained importance for pest management in Pakistan. Some recent studies provide a crucial example of release sites for lacewings against *Bemisia tabaci* (Genn.) in cotton (Zia *et al.*, 2008) [16]. The larval stage are more voracious feeder of soft bodied insect such as aphid, whitefly, mealy bugs, thrips, mites, leaf hoppers, jassids, caterpillar and insect eggs (Ulhaq *et al.*, 2006 and Sarwar and Salman, 2016) [14, 13]. In present study green lacewing, *C. carnea* a general predator evaluated as biological control agent in Bt. Cotton crop against the white fly (*B. tabaci*) insect one of the most important and heavy damaging sucking insect reported in Cotton under field conditions.

## 2. Materials and Methods

The research was conceded to appraise *Chrysoperla carnea* for the management of Whitefly *Bemisia tabaci* in Bt-Cotton crop under field conditions. Comparative population development of whitefly (*B. tabaci*) were recorded in NIAB-78 and Bt cotton.

The crop was sown in the month of 2<sup>nd</sup> week of April at

farmer's field near Sindh Agriculture University, Tandojam. Sowing was done by dibbling method on ridges. All the inputs like fertilizer and irrigation were applied accordingly with recommended dosage.

The experiment was design with RCBD with four replications and four treatments;

Treatment	Control Measure	Product	Dose
01	Chemical Control	Acetamaprid 20 SL	200ml/Acre
02	Biological Control	<i>Chrysoperla carnea</i>	250-300 eggs/Card(15Cards/Acre)
03	Natural	Check Bt	-
04	Natural	Check Non Bt (NIAB-78)	

The *Chrysoperla carnea* cards were acquired from Biological control laboratory, Nuclear Institute of Agriculture (NIA) Tandojam, Pakistan. The predators were released in the field at fortnight interval. The 1<sup>st</sup> application of predatory cards were practiced after 40 days of sowing, the cards were fixed below the leaves with stapler preferably on central leaves at the center of treated plots.

Efficiency of *C. carnea* was compared with Acetamaprid 20 SL, one of the most popular insecticides widely used for the control of whitefly *B. tabaci* 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. Predatory population was recorded per plant, 20 plants were selected from each Treatment for collecting the data. Finally Data was analyzed through statistical procedure.

## 3. Results

### 3.1 Whitefly, *Bemisia tabaci* (Genn.)

Whitefly *Bemisia tabaci* (Genn.) appeared on cotton crop from 1<sup>st</sup> week of June and remained till the last week of November. Initial population was recorded in NIAB-78 plots, while Bt infestation was recorded soon after. The maximum whitefly population in Chemical Control treated plots were (12.35/leaf) on 31<sup>st</sup> July, in Bio-Control plots (13.65/leaf) observed on 31<sup>st</sup> July, T-3 was Bt. Control and (15.21/leaf) population of whit fly recorded on 03<sup>rd</sup> August, (17.51/leaf) population was observed in NIAB (non Bt.) Control on 31<sup>st</sup> July. It was recorded that population was at its peak in the last week of July and 1<sup>st</sup> week of August. Maximum infestation was recorded in non Bt. Control. Overall Average Mean shown that the minimum population was recorded in T-1 Chemical treatment (6.01/leaf) followed by T-2 Bio-Control (*Chrysoperla carnea* natural enemy) (6.84/leaf) as compared with Control, where population recorded average (8.5/leaf) while non Bt. Control (NIAB-78) treatment average population was highest among all treated plots observed (10.40/leaf). The analysis showed that there was significantly ( $P < 0.05$ ) different from each other. The results are presented in table I to V

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

Observation Date	Mean population of whitefly/leaf				Mean
	T1	T2	T3	T4	
01-06-16	0	0	0	0	
04-06-16	0	0.1	0	0.1	0.05
07-07-16	0.21	0.21	0	0.5	0.23
15-06-16	5.77	5.51	5.23	5.22	5.4325
18-06-16	3.26	5.56	5.49	5.11	4.855
22-06-16	4.17	4.28	6.4	6.38	5.3075
30-06-16	5.39	6.17	6.19	6.27	6.005
03-07-16	3.1	4.9	5.19	6.18	4.8425
07-07-16	4.24	4.46	5.3	6.46	5.115
15-07-16	12.3	12.45	13.43	16.23	13.6025
18-07-16	9.28	12.27	11.53	16.63	12.4275
22-07-16	10.08	9.9	12.53	16.44	12.2375
31-07-16	12.35	13.65	12.62	17.51	14.0325
03-08-16	7.4	12.54	15.21	17.32	13.1175
07-08-16	9.33	9.51	14	16.5	12.335
15-08-16	11.34	10.7	15.14	15.97	13.2875
19-08-16	8.14	9.3	15.2	14.17	11.7025
23-08-16	7.1	7.23	13.16	14.66	10.5375
30-08-16	10.05	8.07	12.09	13.08	10.8225
02-09-16	6.1	7.25	10.11	11.66	8.78
06-09-16	4.12	6.11	8.32	10.11	7.165
15-09-16	4.77	5.51	5.87	12.22	7.0925
18-09-16	2.26	4.56	5.49	11.11	5.855
22-09-16	3.5	4.1	5.5	9.9	5.75
Mean SD	6.01 ± 3.75	6.84 ± 3.90	8.50 ± 4.93	10.40 ± 5.72	7.94 ± 4.58

Means followed by significantly ( $P < 0.05$ ) different from each other

**Table 2:** Mean Population of Whitefly, *Bemisia tabaci* (Genn.) 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	5.77	5.51	5.23	5.22	3.26	5.56	5.49	5.11	4.17	4.28	6.40	6.38
02	5.39	6.17	6.19	6.27	3.10	4.90	5.19	6.18	4.24	4.46	5.30	6.46
03	12.30	12.45	13.43	16.23	7.10	7.23	13.16	14.66	9.33	9.51	14.00	16.50
04	11.34	10.7	15.14	15.97	8.14	9.30	15.20	14.17	7.10	7.23	13.16	14.66
05	10.05	8.07	12.09	13.08	6.10	7.25	10.11	11.66	7.10	7.23	13.16	14.66
06	10.05	8.07	12.09	13.08	6.10	7.25	10.11	11.66	4.12	6.11	08.32	10.11
07	4.77	5.51	5.87	12.22	2.26	4.56	5.49	11.11	3.50	4.10	5.50	9.90
Mean	8.52	8.06	10.0	11.7	5.15	6.57	9.25	10.6	5.65	6.13	9.40	11.2

**Table 3:** Comparative Control Percentage difference between Chemical and Bio-Control

Application	Observation	Chemical	<i>C. carnea</i>
1 <sup>st</sup>	Pre-Treatment	-10.32	-5.35
	Post-Treatment 3D	40.6193	-1.27
	Post-Treatment 7D	34.84	33.12
2 <sup>nd</sup>	Pre-Treatment	12.92	0.32
	Post-Treatment 3D	40.26	5.58
	Post-Treatment 7D	20.00	15.84
3 <sup>rd</sup>	Pre-Treatment	8.41	7.29
	Post-Treatment 3D	19.51	-6.418
	Post-Treatment 7D	19.55	20.98
4 <sup>th</sup>	Pre-Treatment	2.13	-8.16
	Post-Treatment 3D	51.34	17.55
	Post-Treatment 7D	33.35	32.07
5 <sup>th</sup>	Pre-Treatment	25.09	29.32
	Post-Treatment 3D	46.44	38.81
	Post-Treatment 7D	46.04	45.06
6 <sup>th</sup>	Pre-Treatment	16.87	33.25
	Post-Treatment 3D	39.66	28.28
	Post-Treatment 7D	50.48	26.56
7 <sup>th</sup>	Pre-Treatment	18.73	6.13
	Post-Treatment 3D	58.83	16.93
	Post-Treatment 7D	36.36	25.45

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

Green lacewing *Chrysoperla carnea* (Steph.) is an important predator of aphid as well as for other sucking insects like whitefly, thrips and jassid and certain mites. It is commonly known as aphid lion. The eggs were released in the experimental field. The *C. carnea* larval population was recorded from the 2<sup>nd</sup> week of June till the last week of September when the 1<sup>st</sup> picking was taken, their maximum activities were recoded during 1<sup>st</sup> 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-IV) 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 over all mean population of *C. carnea* shown in (Table-IV) indicated that the maximum *C. carnea* population was recorded (0.3/plant) in T2 (*C. carnea* natural enemies) plot, whereas the minimum population was recorded as (0.04/plant) in T1 (Acetamaprid 20 SL insecticide) plot. The analysis of data showed that there was not significant ( $P < 0.05$ ) difference in population development of *C. carnea* on different treatments.

**Table 4:** Mean Population of green lacewing, *Chrysoperla carnea* (Steph.) in different treatments on cotton crop under field conditions.

Observation Date	Mean population of green lacewing/plant				Mean
	T1	T2	T3	T4	
01-06-16	0	0	0	0	0
04-06-16	0	0	0	0	0
07-07-16	0	0	0	0	0
15-06-16	0.1	0.55	0.25	0.2	0.275
18-06-16	0.05	0.85	0.15	0.15	0.3
22-06-16	0.1	0.5	0.2	0.2	0.25
30-06-16	0.1	0.35	0.1	0.15	0.175
03-07-16	0.05	0.55	0.15	0.2	0.2375
07-07-16	0.05	0.45	0.1	0.15	0.1875
15-07-16	0.05	0.35	0.1	0.15	0.1625
18-07-16	0.1	0.3	0.15	0.05	0.15
22-07-16	0.05	0.4	0.15	0.25	0.2125
31-07-16	0.05	0.35	0.15	0.2	0.1875
03-08-16	0	0.35	0.2	0.25	0.2
07-08-16	0	0.55	0.2	0.2	0.2375
15-08-16	0	0.15	0.05	0.05	0.0625
19-08-16	0.05	0.15	0.1	0.05	0.0875
23-08-16	0.05	0.35	0.05	0	0.1125
30-08-16	0	0.25	0	0.05	0.075
02-09-16	0.05	0.3	0	0.05	0.1
06-09-16	0.06	0.39	0.13	0.1	0.17
15-09-16	0	0.25	0	0.05	0.075
18-09-16	0.05	0.3	0	0.1	0.1125
22-09-16	0.05	0.25	0	0.05	0.0875
MEAN	0.04	0.3	0.092917	0.110417	0.13583

SD	0.03	0.19	0.080675	0.083379	0.08338
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\* Means followed are not significantly ( $P < 0.05$ ) different from each other by LSD.

**Table 5:** 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	0.25	0.30	0.20	0.15	0.05	0.55	0.10	0.25	0.10	0.40	0.20	0.10
02	0.10	0.55	0.25	0.20	0.05	0.85	0.15	0.15	0.10	0.50	0.20	0.20
03	0.10	0.45	0.10	0.15	0.05	0.45	0.15	0.20	0.05	0.45	0.10	0.15
04	0.01	0.30	0.15	0.20	0.05	0.40	0.15	0.15	0.05	0.35	0.15	0.20
05	0.00	0.35	0.20	0.25	0.00	0.55	0.20	0.20	0.00	0.15	0.05	0.05
06	0.05	0.15	0.10	0.05	0.05	0.35	0.00	0.05	0.00	0.25	0.00	0.05
Mean	0.10	0.35	0.16	0.16	0.04	0.52	0.12	0.16	0.05	0.35	0.11	0.12

#### 4. Discussion

In present study different management options were tested on Bt- cotton against most damaging sucking insect pest. Release of *Chrysoperla carnea* cards in cotton for reduction of population of white fly was compared with control. Whitefly population was lower in Bt-cotton control compared to NIAB-78 control. Pest infestation was recorded continuous after its appearance.

However, in Chemical Control; Whitefly population was significantly lower than Bt-control. Results further indicate that Acetamaprid (20SL) was toxic to *C. carnea* and lowest population of *C. carnea* was recorded in Acetamaprid (20SL) applied treatment. Ameta and Sharma (2005) [3] recorded reduction in population of *A. gossypii*, *A. biguttula* and *T. tabacci* after application of Insecticide. Chaudhary *et al.* (2005) [5] also reported that confidor was superior than Clothianidia in controlling the aphid and jassid populations in cotton.

Saleh *et al.*, (2017) [14] studied that *Chrysoperla carnea* is a major predator of some white fly, aphid and thrips. Mansoor-ul-Hasanv (2015) experiment results shown that integration of bio control agents such as *Chrysoperla carnea* proved as effective as chemical control using recommended insecticides against sucking insect pests.

Hamid *et al.* (2020) released the larvae of *Chrysoperla carnea* against whitefly in a greenhouse. Adult, eggs and nymph of *Bemisia tabaci* were affected by *C. carnea*. Overall mean population of whitefly indicated positive correlation with the number of larvae introduced.

Hanumantharaya and Naik (2007) [8] 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) [10] 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.

#### 5. Conclusion

Both the treatments (*Chrysoperla carnea* and Acetamaprid 20SL) suppressed the whitefly population. The Acetamaprid (20SL) was toxic to *C. carnea* (predator); lowest population was recorded in chemical control plot.

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