Use of *chrysoperla carnea* and *Trichogramma chiloni* (Ishii) on the population of insect pests in chilli ecosystem

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Abstract. Field experiment was conducted at Kunri, Hasul Rind Farm during 2011-12 to assess the effect of *Chrysoperla carnea* Stephens and *Trichogramma chiloni* (Ishii) on the population of insect pests in chilli ecosystem. The experiment consisted tree treatments viz; (1) pest population were left untreated (2) *C. carnea* 1500 eggs /card were released (3) *T. chilonis* 1500 eggs /cards were released. Results concluded that sucking also chewing pest population in chilli was suppressed significantly in plot B and C where natural enemies were released. Reduction in thrips, aphid, mite and whitefly numbers was found due to release of *C. carnae,* it was 57.31, 70.86, 65.12 and 80% %, respectively. An impact of *C. carnae* on tobacco caterpillar population was 53.18%. Gram pod borer and tobacco caterpillar population was observed enormously in untreated plots. Reduction in its population in plot C was found owing to release of *T. chilonis,* it was 74.14 and 89.38 % when compared to untreated plots. It is concluded from the findings that *C. carnae* should be released in initial days when sucking complex raised at economic threshold level and *T. chiloni* release is necessary when crop reached flowers and buds stage.
Keywords: Effect**,** *C. carnea*, *T. chiloni,* chilli

Introduction

Chilli (*Capsicum annuum* L.) is a member of Solanaceae family and grown in tropical and subtropical areas (Heiser, 1976). As per the results of the survey conducted by Asian Vegetable Research and Development Centre (AVRDC) in Asia, the major insect pests attack chilli are aphid, *Aphis gossypii* (Glover), mites, *Polyphagotarsonemus latus* (Banks), thrips, *Scirtothrips dorsalis* (Hood), Whitefly, *Bemisia tabaci* (Genn), have been identified as key sucking pests of chilli crop (Vasundarajan, 1994). Kulkarni (2001) reported that 20-30% damage observed due to gram pod borer, *Helicoverpa armigera* (Hübner) and tobacco caterpillar, *Spodptera litura* (Shivaramu). Logistic, economic, and ecological distresses on the use of pesticides in chilli crop agro-eco-system have focused pests' management efforts on biological control (Dhotre *et al.*, 2001; Gogi *et al*., 2006; Desneux *et al*., 2007).

Biological control is count the most important and ecofriendly components of IPM (Naranjo, 2001; Sarfraz *et al*., 2005; Gogi *et al*., 2006). In recent times, predators and parasitoids has been preferred for better efficacy and to avoid ecological problems (Kakar *et al*. 1990; Williamson and Smith, 1994). However, a significant attention has been made to biological control agents since they control many crop pests by keeping it at low levels population.

Keeping in view the problems, an experiment was conducted on the use of two selected natural enemies *Chrysoperla carnea* (Stephens) and *Trichogramma chiloni* **(**Ishii) in chilli crop ecosystem. The both are commonly released bio-agents. They have been used for the biological control of several pests (Jallali and Singh, 1993; Prabhakar and Prasad, 2005). The focal points of this paper were (i) to clarify, via field study, with participation of growers to enhance their knowledge and sureness about the efficiency rate of the predator and parasitoid to most frequent pests present in the chilli ecosystem, and (ii) to assess the choice of predator and parasitoid from the results on the population dynamics of the pests under natural conditions.

Materials and Methods

An experiment to evaluate the impact of *C. cornea* and *T. chilonis* on insect pest population in chilli ecosystem was carried out at Experimental Farm, near Kunri from August to February 2011-12.

Chilli variety longi was sown in at the experimental farm, distance between rows and plants was 75 and 22.5 cm, respectively. The eggs of *C. carnea* and parasitoid *T. chilonis* in host eggs were obtained from Nuclear Institute of Agriculture (N.I.A.), Tando Jam. The experiment was conducted in a completely randomized design (CRD) and was distributed in three different plots (A, B and C). All normal agronomical practices were carried out as usual.

Release of natural enemies

The chryso and trichocards were released in the field 45 days after sowing to observe their impact on the populations of insect pests. The plot wise release of these bio- agents are given in Table 1.

Table 1. Plot and bio-agent and eggs per card used in the experiment

Treatments	Bio-agents released	Egg Per Card	No. of Cards per plot
Plot (A)	None of the agents released	(control)	None
Plot (B)	*Chrysoperla cornea*	1500 eggs	5
Plot (C)	*Trichogramma sp*	1500 eggs	5

The egg cards were released at 15 days intervals. These cards were tied up with the plant parts. After 15 days interval the old cards were replaced with new ones. Weekly population of insect pests was taken. The counting of the pests was made by examining 30 plants from each plot. The plants were randomly selected by making cross movement in the field. Data were analyzed by analysis of variance (ANOVA) and differences between means were compared using LSD. Population growth and cumulative degree-days was analyzed by simple logistic model (Southwood, 1978) as given in equation 1.

$$Nt_i = Nt_0 \quad eRT \text{---------------------------------------} (1)$$

Nt_i = number of aphids at time interval **i**, Nt_0, number of pests at time interval zero. **e** the base of natural logarithm **R** the rate of increase, **T** the time elapsed in days and the equation was linearized (equation 3.11).

$$\ln Nt_i = \ln Nt_0 + RT \quad n \quad r \quad s \quad F \text{------------------------} (2)$$

Nt_i = natural log of pests at time interval **i**, Nt_0 the intercept of y on natural log pest population, **R** the slope of curve and **T** the time in days, **n** the observations used in calculation, **r** the correlation coefficient, **s** standard deviation from regression and **F** – statistics.

Pest population was also correlated with physiological time expressed as cumulative degree-days (equation 3). A derivative of equation 2.

$$\ln Nt_i = \ln Nt_0 + RT^* \quad n \quad r \quad s \quad F \text{----------------------------} (3)$$

Degree-days were calculated by:

$$DD = \frac{(\text{maximum} + \text{minimum})}{2} - \text{base temperature} \text{---------} (4)$$

The regression equations were computed using Statgraphics (1991) and the data transformed in log. This holds true for single species model with Deeveys type II population growth responses (Deevey, 1947).

Results and Discussion

Sucking Insect Pests

Natural enemies release significantly decreased thrips population, the results indicate highly significant difference ($F=158.12$ $df=2$, $P<0.01$) between different treatments and both treatments were found superior over untreated to decline pest population. Thrip population lineally increased till 24th October and it slowly decreased and reached to minimum 20th February. Regression equations showed that in the initial weeks the population growth was highly significant. It increased from 1.9 to 5.9 with a slope of line 0.402X and $r^2 = 0.79$ indicate the variation in population due to date interval. After that, it started decreasing from 31 October to 9th January with slope a line -0.165X and $r^2 = 0.75$. Another increasing trend in population was found from 16th January to 20th February with a slope of line 0.249X and r^2= 0.71, it depicted that 71 percent variation in population was due to date intervals. There was a positive and highly significant correlation between pest population and cumulative degree-days with a slope of line 0.002DD and r =0.91(Table-01). Aphid found late in crop, first time it recorded on 7th November and reached their highest on 20th February. The analysis (ANOVA) revealed that there was a highly significant differe Table-01nce ($F=17.25$ $df=2$, $P< 0.01$) between different treatments. The population fluctuation curves in regression analysis defining the relationship between pest population and date intervals revealed that pest population increased linearly from 7th November with a slope of line 0.018X and r^2= 0.77 (Table-01).

According to data the population of mites was its peak in all treatment plots (A, B and C) on 3rd, 17th October and 19th September, respectively. Afterward, it decreased and reached its minimum on 20th February. The analysis (ANOVA) revealed that there was a highly significant difference (F=120.50 df=2, P< 0.01) between different treatments. Population was found increasing till 3rd October. The regression equation showed that the slope rate of increase was 1.53X, it revealed that owing to one unit change in time interval, about 1.53 units in the population of pest was estimated. Quite a large R-square (0.85) was stated by the model which specified that about 85% variation in pest population depends upon time interval. Population decreased from 10th October till harvesting the crop with a slope of line = - 0.3582X and r^2 = 0.93 (Table-01). The results (Table-01) indicated that the population of whitefly was its peak on plot (A, B and C) on 17th and 31st October, respectively and it disappeared from 19th December to 23rd January from Plot A, from 21st November till harvest from plot B and from plot C it was disappeared from 26th December to 23rd January. The analysis (ANOVA) revealed that there was a highly significant difference (F=29.52 df=2, P< 0.01) between different treatments.

Chewing insect pests

The analysis (ANOVA) revealed that there was a highly significant difference (F=21.64 df=2, P< 0.01) between different treatments. The result of different treatments on gram pod borer (GPD) is depicted that population was its peak on Plot (A, B and C) on 7th November and 31st October, respectively. Pest was not seen in in Plot A from 26th December and in plot B and C from 12th December till the harvest the crop. Population of tobacco caterpillar (TCP) was its peak on Plot A, B and C, respectively on 24th October, respectively. It was absent from 2nd January in Plot A and in plot B and C from 12th December and 28 November till the harvest the crop, respectively. The analysis (ANOVA) revealed that there was a highly significant difference (F=36.22 df=2, P< 0.01) between different treatments (Table-01). The regression equation for both pests (GPB and TCP) showed that the slope rate of increase was 0.1614X and 0.197 X, it revealed that owing to one unit change in time interval, about 0.161 and 0.197 units in the population of pest was estimated. Quite a large R-square 0.91 and 0.83 was stated by the model which specified that about 91 and 83% variation in pests population depends upon time interval. Population decreasing trend was observed till harvesting the crop with a slope of line = - 0.290X and -0.1417X, respectively. R-square r^2 = 0.98 and 0.74 for both pests, respectively.

Comparative population of sucking insect pests

Multiple Range (DMR) test indicate highly significant difference between populations of insect pests in different plots. It found from data that thrips population decreased 57.31% and 5.82% in plots where chrysoperla and trichogramma were released, respectively as compared to untreated plots. Multiple Range (DMR) test also indicated that there was no difference in population between plot A and C (Table 2). It was perceived that 65.12% and 4% population of mite decreased due to release of chrysoperla and trichogramma, respectively. In the case of aphid, it is also obvious from data that 70.86 % population of pest decreased due to release of chrysoperla and there is no effect of trichogramma on the population aphid. Whitefly population decreased at the percent of 80% and 15.66% in the plots where chrysoperla and trichogramma were released, respectively as compared to untreated plots.

Comparative population of chewing insect pests

The findings shown that population of GPB decreased 4.4 and 74.14% owing to release of chrysoperla and trichogramma, respectively. For TCP the percentage of decrease in population was 53.18 and 89.38% after the release of chrysoperla and trichogramma, respectively as compared to untreated plots.

Table 2. Efficiency of *Chrysoperla carnea* and *Trichogramma chiloni* (Ishii) on the population of insect pests in chilli ecosyste

	Thrips			Aphid			Whitefly			Mite			GPB			TCP		
Date	Plot A	Plot B	Plot C	Plot A	Plot B	Plot C	Plot A	Plot B	Plot C	Plot A	Plot B	Plot C	Plot A	Plot B	Plot C	Plot A	Plot B	Plot C
15-Aug	1.9	1.1	1	0	0	0	0.22	0.02	0.19	1	0.19	0.89	0.11	0.11	0.09	0.91	0.32	0.02
22-Aug	3.2	2.12	3	0	0	0	1.03	0.03	0.33	2.2	0.2	1.02	0.22	0.22	0.02	1.03	0.43	0.03
29-Aug	4	2.33	3.33	0	0	0	1.14	0.04	0.64	7.9	0.33	7.09	0.25	0.25	0.05	1.18	0.58	0.08
5-Sep	4.2	2.42	3.82	0	0	0	1.19	0.09	0.89	9	2.88	8.77	0.3	0.3	0.09	1.9	0.9	0.09
12-Sep	4.2	2.52	4	0	0	0	1.2	0.12	1.02	10.3	3.3	9.83	0.34	0.34	0.1	2.09	1	0.21
19-Sep	4.3	2.63	4.44	0	0	0	1.18	0.16	1.08	10.6	4.16	9.96	0.4	0.4	0.14	2.13	1.08	0.23
26-Sep	4.52	2.72	4.66	0	0	0	1.3	0.23	1.13	10.7	4.7	10.43	0.51	0.51	0.19	2.21	1.09	0.25
3-Oct	4.9	2.89	4.67	0	0	0	1.7	0.37	1.27	10.9	5.19	10.54	1.02	1.02	0.22	2.28	1.09	0.29
10-Oct	5.2	2.92	4.88	0	0	0	1.9	0.79	1.39	8.5	5.25	10.65	1.12	1.12	0.32	2.24	1.11	0.3
17-Oct	5.3	3	5.54	0	0	0	2.15	0.85	1.55	8.3	5.3	10.11	1.67	1.67	0.47	2.39	1.12	0.32
24-Oct	5.9	2.08	6.43	0	0	0	2.13	0.55	1.63	8.4	5	9.89	1.72	1.72	0.72	2.56	1.16	0.34
31-Oct	4.9	2	7	0	0	0	2.04	0.34	1.94	7.8	3.8	9.7	1.83	1.83	0.73	2.21	1.2	0.32
7-Nov	4	2	6.87	0.12	0.02	0.11	1.14	0.14	1.44	7.9	3.49	9.66	1.91	1.91	0.61	2.03	0.93	0.3
14-Nov	3.23	1.92	6.23	0.16	0.06	0.17	1.09	0.09	1	6.2	2.2	5.92	1.71	1.71	0.29	1.94	0.91	0.28
21-Nov	3.23	1.73	5	0.19	0.09	0.18	0.97	0	0.87	5.3	2.13	4.83	1.29	1.29	0.19	1.5	0.5	0.21
28-Nov	3.21	1.21	4.12	0.18	0.1	0.46	0.25	0	0.55	5	2.05	4.5	1.09	1.09	0.09	1.09	0.49	0
5-Dec	3.2	1.2	4	0.97	0.12	0.99	0.1	0	0.3	4.2	2	3.92	0.78	0.78	0.08	0.67	0.37	0
12-Dec	3.18	1.18	3.88	1.05	0.15	1	0.05	0	0.15	4.8	1.8	3.88	0.6	0	0	0.17	0	0
19-Dec	3.5	1.15	3.12	1.09	0.18	1.12	0	0	0.09	4.5	0.5	3.5	0.15	0	0	0.08	0	0
26-Dec	3.52	1.12	2.99	1.27	0.2	1.22	0	0	0	4.6	0.41	3.36	0	0	0	0.2	0	0
2-Jan	3.6	1.06	2.65	1.06	0.26	1.26	0	0	0	4	0.4	3.26	0	0	0	0	0	0
9-Jan	3.6	1.02	2.5	1.55	0.45	1.56	0	0	0	3.8	0.38	3.08	0	0	0	0	0	0
16-Jan	4.1	1.01	2	2.08	0.68	2.18	0	0	0	3.2	0.22	2.82	0	0	0	0	0	0
23-Jan	4.9	1	1.91	2.99	0.99	3.19	0	0	0	3.6	0.16	2.76	0	0	0	0	0	0
30-Jan	3.78	0.78	1.08	3.1	1	3.31	0.07	0	0.07	2.9	0.13	2.39	0	0	0	0	0	0
6-Feb	3.1	0.61	1.07	3.13	1.01	3.33	0.1	0	0.1	2.5	0.11	2	0	0	0	0	0	0
13-Feb	3	0.5	1.03	3.12	1.02	3.42	0.13	0	0.13	2	0.1	1.82	0	0	0	0	0	0
20-Feb	2.5	0.45	1	3.24	1.04	3.14	0.11	0	0.11	1.75	0.07	1.05	0	0	0	0	0	0
Total	108.2	46.17	102.2	25.3	7.37	26.64	21.19	3.82	17.87	161.9	56.45	157.6	17.02	16.27	4.4	30.81	14.23	3.27
% age		57.32	5.82		70.87			80.04	15.67		65.12	4.00		74.15	4.41		53.81	89.39

The data showed that during the vegetative stage, major pests recorded were thrips, mite, aphids whitefly, which were found major sucking insect pests. Similar observations were also reported by Butani (1976), who observed that 20 species of insects infesting the crop. The damage found by sucking insect pests in this study was significantly considerable, which is also in agreement with the findings of Butani (1976). Our findings indicate that whitefly and aphid population decreased at the percent of 80% and 70.86 %, respectively when chrysoperla was released as compared to untreated plots. It is in conformity with findings of Jokar and Zarabi, 2012. They reported that *Chrysoperla carnea* (steph.) is a major, cosmopolitan predator of whitefly and aphid. The damage was observed by fruit borer (*H. armigera*) at reproductive stage. These observations are in agreement with the findings of Reddy and Puttaswamy (1985) who reported *H. armigera* is a major pest in chilli crop.

It was obvious from the data that the efficiency of *C. carnea and T. chiloni* varied in different pest species in chilli ecosystem regarding pests' population *C. carnea* found highly effective on sucking insect pests as compare *T. chiloni*. These findings provide strong base to conclude that *C. carnea*, being the generalist predator, consumes a large number of sucking pests and chewing pests. The results of the present findings are in conformity with (Chang, 1998). Gautam and Tasfaye (2002) reported that chrysoperla consumed 216-950 nymphs and adults of aphids and 510 nymphs of whitefly. Simultaneously, *T. chiloni* was more influential on the population of chewing pests than sucking pest. These results are in line with the findings obtained by Patel (1996). He reported that release of *C. carnea* and *T. chilonis* proved effective in reducing damage caused by sucking pests as well as bollworm incidence in cotton, it has also been supported by Patel (2001) from Gujarat. Bolkan and Reinert (1994) observed that egg parasite also gives substantial to very high rates of parasitism of various species of *H. armiger* eggs.

Conclusions

It is concluded that *C. carnea* was found effective in reducing damage caused by sucking pests as well as by fruit, leave, and flower and pod borers. *T. chilonis* proved to be an important bio agent against gram pod borer and tobacco caterpillar. It is concluded that in initial days as crop attracted specially by sucking pests the *C. carnea* should be released. When crops reaches their fruit, leave, and flowering and pod stages and damage of borers reaches their economic thresh hold level the *T. chilonis* may be used at proper time.

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