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Use of *Chrysoperla Carnea Larvae* as an IPM strategy against Jassid, *Amrasca devastans* Dist. and Whitefly, *Bemisia tabaci* (Genn.) in Okra crop

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Abstract:

Among the sucking insect pests, both jassid and whitefly are counted as the most dangerous pests of different crops and vegetables, thus they play a vital role in reducing the population of any crop. Okra crop is one of the most edible vegetable around the globe and it is also being affected by these two pests. However, the farmers mainly cope

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with this problem by using the number of national as well as international synthetic pesticides around the globe. The present study was conducted shortly to recommend the farming community about the proper utilization of releasing the natural enemies against the harmful insect pests in their crop fields. Herein the release of Chrysoperla larvae depicted significant results against the jassid and whiteflies in okra crop. The results revealed that both the jassid and whitefly population were significantly reduced in all of the treatments except control. However the control plot showed the graduate increase in the jassid population. Moreover, the results further illustrated that the jassid and whitefly population decreased significantly with the increase of releasing numbers of Chrysoperla larvae. The results further derived that by this IPM technique of releasing Chrysoperla larvae the okra crop yield and production also increased. The statistical analyses results showed the significant reduction at (P < 0.05).

Key words: Okra, jassid, whitefly, IPM strategy *Chrysoperla Carnea*, population reduction, yield.

1. INTRODUCTION

This present study was aimed to produce an effective and cheapest IPM technique for the farming community. Here we used the biological control strategy by using the larvae of *Chrysoperla Carnea* in the field of Okra crop against the two major sucking pests i.e. jassid and whitefly, with prospective resources available to the poor farmers.

Okra, *Abelmoschus esculentus* L. (Family: Malvaceae) is a warm-season, annual vegetable in Pakistan. The origin of this vegetable is considered as Africa and Asia. Okra is a good source of vitamins, minerals, salts and has good calories values. It is one of the cash crops of Sindh (Khoso 2002). The immature green pods of okra are used as a vegetable, and in canned or dehydrated forms. The okra is also fried in butter or oil and cooked with necessary ingredients (Yadav et al. 2001). Okra is attacked by many insect pests right from germination to harvest (Jagtab et al. 2007). Sucking pests in the early stage and the fruit borers in the later stage cause extensive damage to fruits, and the yield losses have been reported up to 69 percent (Mani et al. 2005). Whitefly and jassid are counted as the major sucking insect pests on leaves and tender shoots of okra and cause severe damage in okra (Atwal 2004). This magnitude of infestation and the nature of extent of injury vary with plant variety, seasons and localities (Greathead 1996).

The green lacewings, *Chrysoperla carnea* (Stephens) (Neuroptera: Chrysopidae) larvae have been reported to feed on several species of aphids, red spider mites, thrips, whitefly, leafhoppers and neonates of budworm. The presence of the larvae on the foliage was found to inhibit visitation and oviposition by *B. tabaci* which suggests the larvae may produce a volatile semio-chemical which repels the whitefly (Hoffmann and Frodsham, 1993). To determined whether a predator enters or remains in a habitat, as well as the type of prey and relative numbers of prey that the predator consumes. Although some predators' prey preference is fixed (maintained irrespective of relative availability in the environment), other predators may switch to more common prey species (Begon et al. 1996).

Despite massive applications of synthetic chemicals by the farmers which is considered as a temporary measure of controlling insect pests, cause of environmental pollution and are also big threat for the naturally available population of crop friendly insects (Carvalho et al. 2002; Phokela et al. 2009; Solangi et al. 2011). Due to the setting of restrictions by the WTO (World Trade Organization) for maximum residues levels, particularly for the vegetables, emphasis must be placed on the non-chemical means of pests control in crops and vegetables.

In view of the above facts, there is hard need to manage the insect pests in more eco-friendly approaches. Hence, efforts have been given towards the use of *C. carnea* larvae for the knockdown the population of jassid and whitefly in okra field crop and alternatively to increase the production of Okra in Tandojam, Sindh-Pakistan.

2. MATERIALS AND METHODS:

(i) *Chrysoperla carnea Source*:

The larvae of *C. carnea* used in this study were borrowed from Nuclear Institute of Agriculture (NIA) of Atomic Energy Tandojam, Sindh-Pakistan. After receiving the desired number of larvae, they were directly used into the okra field accordingly.

(ii) *Experimental field details*:

The present experiment was conducted at Tandojam; District Hyderabad, Sindh-Pakistan, during okra season (sowing till harvesting), all the agronomical practices, irrigation strategy and other crop nutrient requirements were fully mannered. As usual, the use of pesticides carried on by the farmers about 12 times a year. The okra variety (Noori-786) was under observed for this experiment with Randomized Complete Block Design (RCBD) on area of 2 acres. The plot was divided into four sub-plots for four different treatments, each plot comprised of ½ acre. The row to row distance was 2 feet and plant to plant distance 1 foot was maintained.

(iii) *Chrysoperla carnea strategy to distribute into okra field*:

The larvae of *Chrysoperla* were randomly released four different treatment plots (T1:7-days plot, T2: 14-days plot, T3: 21-days plot and T4: a control plot). The equal numbers of larvae (750) per treatment were released on the top, mid and bottom of the okra plants into three (T1:7-days plot, T2: 14-days plot, T3: 21-days plot) treatments, while the fourth one (T4) was kept as control (without release of Chrysoperla). The larvae were released as per treatment and thus in total eight (8) releasing numbers were carried out until the crop was harvested.

(iv) *Data Observation Method*:

We used visual and sweeping net methods to investigate jassid and whitefly insect pest populations. Data were taken as (a) Pre-treatment observation (before the release of *C. carnea*) and (b) Post-treatment observation (after the release of *C. carnea*) throughout the study. The pre-treatment observations were taken 24 hours before the releasing the larvae and post-treatment observations were taken at weekly basis. The numbers of jassid and whiteflies were counted from top, middle and bottom parts of the twenty five (25) randomly selected plants from all of the four treatment plots. Further the data for environmental factors like temperature and relative humidity were taken by hygrometer containing thermometer weekly at the interval of each post observation.

(v) Statistical analyses:

All statistical analyses were determined by using SPSS Statistics 18.0 software (SPSS Inc., Chicago, IL, USA). Both, the one-way nested analysis of variance (ANOVA) and the least significant difference test (LSD) ($P < 0.05$) were used to determine whether differences in all the treatments were significant. The pest's population decline levels after each release of Chrysoperla larvae and treatment wise effects on the final crop yield were graphically represented by using "GraphPad Prism version 5.00 for Windows, GraphPad Software, San Diego California USA, www.graphpad.com".

3. RESULTS:

The present study was conducted shortly to recommend the farming community about the proper utilization of releasing the natural enemies against the harmful insect pests in their crop fields. Herein the release of Chrysoperla larvae depicted significant results against the jassid and whiteflies in okra crop.

The results revealed that jassid population was significantly declined in all the treatments except control. The peak population reduction after all (8) releases of chrysoperla larvae for jassid pest were recorded in 7-days (2.20 ± 0.37) of treatment followed by 14 (3.68 ± 0.48) and 21 days (4.72 ± 0.54), respectively. However the control plot showed the graduate increase in the jassid population (Table-1). Moreover, the results further illustrated that with the increase of releasing numbers of Chrysoperla larvae the population of jassid was also gradually decreased (Fig.1).

The results for whitefly population also showed significantly decrease in all the treatments except control. The peak population reduction after all (8) releases of chrysoperla larvae for whitefly pest were recorded in 7-days (2.56 ± 0.40) of treatment followed by 14 (4.20 ± 0.51) and 21 days (5.77 ± 0.60), respectively. However the control plot showed the graduate increase in the whitefly population (Table-2). Moreover, the results further illustrated that with the increase of releasing numbers of Chrysoperla larvae the population of whitefly was also gradually decreased (Fig.2).

The results further evaluated that the release of Chrysoperla larvae as natural enemies against jassid and whitefly drastically showed significant increase in the okra yield for 7-days (99 Mds) of treatment followed by 14 (73 Mds) and 21 days (68 Mds), respectively as compared to control (30 Mds) (Fig.3).

The statistical analyses results showed the significant reduction at ($P < 0.05$) in the population of jassid and whitefly with increase in the yield with the release of Chrysoperla larvae in okra crop. The LSD tests further confirmed separate groups indicating variance among all the treatments.

4. DISCUSSION:

Among the sucking insect pests, both jassid and whitefly are counted as the most dangerous pests of different crops and vegetables, thus they play a vital role in reducing the population of any crop. Okra crop is one of the most edible vegetable around the globe and it is also being affected by these two pests. However, the farmers mainly cope with this problem by using the number of national as well as international synthetic pesticides around the globe. With this increase in the use of insecticides, the environmental has been polluted drastically and in addition the pests have adopted resistance and natural enemies also being reduced in the universe. To get rid of these complexes, the present study was conducted for producing an effective and cheap IPM strategy with easily approach to the farmers.

In the present study we used Biological Control strategy in which the larvae of Chrysoperla were used to help in decline the population of jassid and whitefly in the okra crop and alternatively increase the yield of okra. Our strategy also resembled to those of Jung *et al*. (2004) who concluded that the release rate of a biological control agent had a relatively small impact on the control of a pest compared to the method and timing of application of the agent. The method of application primarily affects the ability of a biological control agent to establish in the field, which is necessary for long-term control of a pest. Present study also agreed with those of Krischik (2011) who examined the release rate and timing of *C. carnea* on various crops and reported that in gardens and greenhouses, release rate is about 1,000 eggs/2,500 sq. ft., 10 to 50 thousand per acre. Once the larvae emerge, they feed for 1 to 3 weeks before they become adults. Adults eat only honey, pollen, and nectar, which they need to reproduce. Repeated releases may be necessary if the infestation has not been arrested 5 to 7 days after the larvae have emerged. In case of release time, favorable conditions are 78 degrees F, 60 to 65% humidity females lay 60 to 100 eggs within 10 to 14 days inside aphids. Each larva completely consumes its host. The results of present study revealed the significant effects of use of Chrysoperla larvae against jassid and whitefly in okra crop. The present study results depicted that at least all (8) releases of chrysoperla larvae showed the great reduction of jassid population in okra crop. However, the jassid population in control plot was being increased gradually throughout the study period. These results also agree with Sattar (2010) who used *C. carnea* as a biological control agent and recorded 83.70 and 76.07% population reduction of jassid, 37. 59 and 60.32% for thrip and 51.84 and 44.05% for white fly during 2005 and 2006, respectively. The results further illustrated that with the increase of releasing numbers (8) of Chrysoperla larvae the population of whitefly was also gradually decreased in okra crop. Such results agreed with those of Yolde et al. (2000), who released native strain *C. carnea* against whiteflies, spider mites, and aphids, respectively and found effective results in decrease of whitefly population. Further these results also showed proof by Simmons and Rabou (2011), who concluded that weekly releases of green lacewing predator, *C. carnea* successfully managed the whitefly populations and reduced by ≈ 25%–45%.

These results help define wisely that by decreasing the pest populations the yield was significantly increased of any crop and this also proved b our results that the treated okra fields significantly increased okra yield as compared to non-control fields.

CONCLUSIONS AND SUGGESTIONS:

The present manuscript elucidated an effective IPM technique by using of Chrysoperla larvae against jassid and whitefly insect pests on okra crop. The study concluded that different release times and number of release dramatically decreased the pest population and thus increased the okra yield and production compared to control. The other new models for the use of Chrysoperla predators should be carried out in lab as well as field conditions.

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Conflict of interest declaration: The authors have declared that no conflicts of interests exist.

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Table-1 Population for jassid before and after the release of Chrysoperla larvae in okra crop

Releases	**Week of Observation**	**Release Intervals (Treatments)**							
		Pre-Treatment				**Post-Treatment**			
		T1	T2	T3	T4	T1 (7-days)	T2 (14-days)	T3 (21-days)	T4 (control)
First	**1st week February**	4.96	4.88	5.16	5.08	4.26	4.58	5.02	5.28
	2nd Wk	4.38	4.72	5.28	5.56	3.96	4.48	5.04	5.72
Second	3rd Wk	4.12	4.66	5.44	5.88	3.56	4.40	5.18	6.14
	4th Wk	3.66	4.52	5.36	6.26	3.22	4.24	5.06	6.34
Third	**1st week March**	3.30	4.40	5.28	6.46	3.04	4.16	5.12	6.54
	2nd Wk	3.12	4.32	5.24	6.72	2.84	4.08	5.06	6.86
Fourth	3rd Wk	3.02	4.26	5.20	6.94	2.60	4.00	5.02	7.08
	4th Wk	2.84	4.24	5.16	7.28	2.44	4.02	4.96	7.36
Fifth	**1st week April**	2.52	4.14	5.28	7.48	2.16	3.88	5.02	7.68
	2nd Wk	2.38	4.02	5.08	7.76	1.96	3.62	4.88	7.86
Sixth	3rd Wk	2.12	3.86	4.94	7.98	1.56	3.40	4.68	8.14
	4th Wk	1.70	3.52	4.86	8.26	1.22	3.24	4.44	8.34
Seventh	**1st week May**	1.40	3.36	4.58	8.46	1.04	3.06	4.28	8.58
	2nd Wk	1.22	3.18	4.34	8.72	0.70	2.98	4.16	8.88
Eighth	3rd Wk	1.02	3.12	4.10	9.04	0.40	2.60	3.96	9.38
	4th Wk	0.84	2.84	4.02	9.48	0.24	2.08	3.66	9.68
Mean ± S.E		**2.66 ± 0.41**	**4.00 ± 0.50**	**4.96 ± 0.56**	**7.34 ± 0.68**	**2.20 ± 0.37 d**	**3.68 ± 0.48 c**	**4.72 ± 0.54 b**	**7.49 ± 0.68 a**

Table-2 Population for whitefly before and after the release of Chrysoperla larvae in okra crop

Releases	**Week of Observation**	**Release Intervals (Treatments)**							
		Pre-Treatment				**Post-Treatment**			
		T1	T2	T3	T4	T1 (7-days)	T2 (14-days)	T3 (21-days)	T4 (control)
First	**1st week February**	6.79	6.56	6.84	6.62	5.60	5.90	6.30	6.68
	2nd Wk	6.08	6.42	6.60	6.88	5.02	5.82	6.20	6.94
Second	3rd Wk	5.12	5.96	6.38	6.96	4.04	5.20	6.02	6.98
	4th Wk	4.12	5.30	6.06	7.12	3.46	4.98	5.80	7.18
Third	**1st week March**	3.56	5.08	6.08	7.30	3.12	4.78	5.64	7.36
	2nd Wk	3.30	4.94	6.70	7.42	2.92	4.70	6.50	7.52
Fourth	3rd Wk	3.20	4.84	6.62	7.68	2.80	4.60	6.46	7.74
	4th Wk	3.14	4.74	6.40	7.88	2.62	4.48	6.20	7.94
Fifth	**1st week April**	2.70	4.66	6.30	8.08	2.38	4.32	5.96	8.30
	2nd Wk	2.48	4.42	6.18	8.48	2.12	4.02	5.80	8.56
Sixth	3rd Wk	2.38	4.30	6.00	8.68	2.02	3.88	5.68	8.72
	4th Wk	2.18	4.18	5.88	8.84	1.82	3.32	5.46	8.90
Seventh	**1st week May**	2.04	3.58	5.68	8.92	1.34	3.12	5.32	8.98
	2nd Wk	1.38	3.34	5.48	9.08	0.96	2.98	5.28	9.14
Eighth	3rd Wk	1.02	3.16	5.38	9.36	0.52	2.84	5.12	9.58
	4th Wk	0.60	3.00	5.26	9.76	0.20	2.24	4.56	10.12
Mean ± S.E		**3.13 ± 0.44**	**4.66 ± 0.54**	**6.12 ± 0.62**	**8.07 ± 2.56**	**2.56 ± 0.40 d**	**4.20 ± 0.51 c**	**5.77 ± 0.60 b**	**8.17 ± 0.71 a**

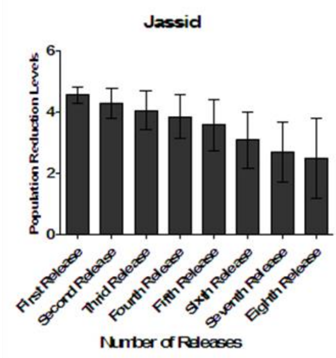

Figure.1 Effect of different releasing numbers of Chrysoperla larvae against Jassid Population in Okra

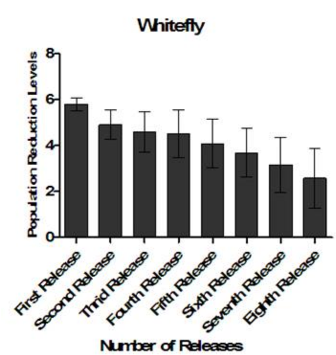

Figure.2 Effect of different releasing numbers of Chrysoperla larvae against Whitefly Population in Okra

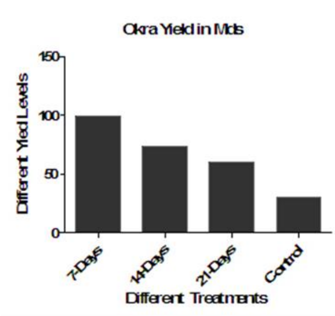

Figure.3 Effect of different releasing numbers of Chrysoperla larvae in the yield production of Okra