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Presence and Abundance of Different Insect Predators Against Sucking Insect Pest of Cotton

[1]G.S. Solangi, [2]G.M. Mahar and [3]F.C. Oad
[1]Center for Agriculture and Biosciences International,
South Asia Regional Center, Rawalpindi, Pakistan
[2]Granulars, Pvt. Ltd., Jacobabad, Pakistan
[3]Sindh Agriculture University, Tandojam, Pakistan

Abstract: The study on appearance and abundance of different insect predators against sucking insect pest of cotton in field conditions was conducted in the farmer's field, Kot Banglow District Khairpur, Pakistan. The population of sucking insect pests and insect predators were observed 20 days after sowing of the cotton crop. The insects were counted with the help of the magnifier lens. The analysis of data indicates that there was highly significant difference in days of observations, population of sucking insect pests and predator population. The mean maximum population of whitefly (31.98 plant^{-1}) was observed in first week of the September at relative mean temperature 32.60°C, however the maximum population of thrips (29.96 plant^{-1}) and jassids (3.93 plant^{-1}) was found in last week of the August at relative mean temperature 32.88°C. The maximum overall means of whitefly in various observation days were observed (15.90 plant^{-1}), followed by thrips (14.30 plant^{-1}) and jassid (2.08 plant^{-1}). The predator population of Green Lacewing, *Chrysoperla carnea*, Big eyed bug, *Geocoris punctipes* linearly increased but the population of Pirate bug, *Orius insidiosus* decreased in the last week of August at relative mean temperature 32.88°C. The maximum overall means of Green Lacewing in various observation days was 2.07 plant^{-1}), followed by Pirate bug (1.84 plant^{-1}) and Big eyed bug (1.28 plant^{-1}). The results indicated that the sucking insect pests were below the economic injury level at all phenological stages of the cotton plant due to the regular increase in predator population. The predators were active throughout the cotton season due to non-application of pesticides in and around the experimental area. The correlation coefficient (R = 0.563) showed a positive relationship between insect predators and sucking insect pest population. The increase in sucking insect population also exhibited an increase in predator population in observed days and trend line shows increase in insect predator population with sucking insect pest population during the growth stages of cotton crop.

Key words: Cotton, IPM, sucking, insects, whitefly, jassids, thrips, predator population, temperature

INTRODUCTION

Cotton, *Gossypium hirsutum* L., belonging to genus Gossypium, family Malvaceae; Order Mallow is one of the main commercial and most important cash crop of many warm climate countries of the world i.e., USA, Egypt, Brazil, Sudan, China, India and Pakistan. Cotton plant is sun loving and requires 180 days with temperature 28 to 35°C. The crop requires approximately 30 inches of rain or irrigation (Afzal, 1986). There are many constraints for low yield of cotton; one of them is the damage caused by insect pests. Cotton is very sensitive in nature and damaged at its

Corresponding Author: F.C. Oad, Sindh Agriculture University, Tandojam, Pakistan

different phenological stages by different insect pests, which attack the roots, shoots, tender leaves and fruiting bodies. Among all insect pests, the sucking insect pests of the cotton i.e., whitefly, thrips and jassid are serious and dangerous. The nymphs as well as adults suck the cell sap of leaves and other tender parts there by weakening the cotton plant (Naqvi, 1973). It is estimated that in Pakistan 20 to 30% of the crop loss every year due to the insect pests (Zahoor, 1999). Predators are natural enemies they consume several preys during their development. They are usually considerably larger than their prey and are active hunters or ambushers. In entomology biological control of sucking insect pests of cotton i.e., whitefly, thrips and jassid is made through the insect predators i.e., Green Lacewing, Pirate bug and Big eyed bug. Adult Green Lacewing *Chrysoperla carnea* are pale green, about 12-20 mm long, with long antennae and bright, golden eyes. They have large, transparent, pale green wings and a delicate body. Pale green oval shaped eggs were observed at the end of long distinctive silken stalks in bottom and middle plant layer on cotton plant leaves. The larvae, which are very active, are gray or brownish and alligator like with well-developed legs and a pair of curved, sickle-shaped sucking mouthparts used to puncture the prey and suck out the internal body fluids (Mahar and Ridgway, 1993). Kapadia and Puri (1990) reported from India that *Bemisia tabaci* was observed that attacked by *Chrysoperla carnea* and six aphelinid parasitoids in cotton fields. Gerling *et al*. (1997) observed that the population fluctuations of the common green lacewing, *Chrysoperla carnea* Stephens and those of the sweetpotato whitefly, *Bemisia tabaci* (Gennadius), were followed for 4 years in cotton, *Gossypium hirsutum* L., fields in Israel. Samples were taken and insecticidal controls were applied to determine the importance of *C. carnea* as a controlling factor of Bemisia in cotton. The results showed that although the lacewings occurred in the field together with Bemisia and their larvae fed on Bemisia nymphs, *C. carnea* was not an efficient controlling agent of whiteflies. Balasubramani and Swamiappan (1998) observed in Laboratory that early-instar nymphs of *Amrasca biguttula biguttula* were preferred as prey by *Chrysoperla carnea*, each larva of the predator consuming 4.8, 20.6 and 59.6 first, second and third-instar nymphs, respectively. Fourth and fifth-instar nymphs and adults were highly mobile and could not be preyed on by the chrysopid. Adult lacewings need nectar or honeydew as food before egg laying and they also feed on cotton flower pollen. Pirate Bugs are very small (3 mm long), oval-shaped and black with white wing patches. Nymphs are small, wingless yellow-orange to brown in colour, teardrop-shaped and fast moving. Both adults and nymphs feed by sucking juices from their prey through a sharp; needle-like beak (rostrum). Orius holds its prey with its front legs and inserts its beak into the host body, generally several times, until the soft body is empty and only the exoskeleton remains. Big eyed bug, *Geocoris punctipes* is compact, brightly coloured, most abundant and important predator of many insect species in cotton crop and on all life stages of whiteflies, thrips and jassid eggs of the bollworms. Their most distinguishing characteristic is their large, bulging eyes. Big eyed bug walk with a distinctive waggle. Both the immatures and adults feed by sucking juices from their prey through a needle-like beak. Adults and immatures can consume dozens of prey per day Geocoris (Hagler and Cohen, 1991). Avila *et al*. (2001) conducted a survey to identify the natural enemies of whiteflies in various crops and regions of Colombia and Ecuador. Various samples of whiteflies and its predators were collected and identified. Predators, *Delphastus pusillus*, *Hyperaspis festiva*, *Delphastus* sp., *Nephaspis* sp., *Geocoris* sp., *Chrysopa* sp. as natural enemies and potential biological control agents of whiteflies. However, due to the small size and cryptic nature of this beneficial, quantification of predation in the field is difficult (Hagler and Naranjo, 1994). Keeping in view the above facts and economic importance of Integrated Pest Management in the cotton crop, the study on appearance and abundance of different insect predators (natural enemies) against sucking insect pests of cotton in field conditions was conducted. It is hoped that this information will encourage further

studies and awareness rising of the Biological Control in Integrated Pest Management of cotton crop in the field of agriculture.

MATERIALS AND METHODS

The field study on appearance and abundance of different insect predators against sucking insect pests of cotton was conducted at the farmer's field, Khairpur, Sindh, Pakistan during, Kharif (June 4, 2005).

Sampling

Four locations each having area 30×30 m was selected. Twenty-five whole plants were randomly selected from each replication for weekly observed visually for the number of immature and mature population of sucking insect pests (whitefly *Bemisia tabaci*, thrips *Thrips tabaci* and jassid *Amrasca devastans*) and predators (Green lacewing *Chrysoperla carnea*, Pirate bug *Orius insidiosus* and Big eyed bug *Geocoris punctipes*). The whole plant was observed from bottom to top and both sides (first upper and after that lower side) of the plant leaves. The insect population was carefully counted with the help of 5x magnifier lens.

Cotton Cultural Practices

Preparation of Land

The experimental area was first ploughed with the help of furrow turning plough followed by leveling for the equal supply of the irrigation water.

Variety of Cotton

Variety of Cotton CIM-109 was sown.

Seed Rate and Method of Sowing

The recommended seed rate 12 kg $acre^{-1}$ was applied through dibbling method and seed were placed on the both sides of the furrows.

Interculturing

Three interculturings were performed in the experimental field for eradication of weeds near the root zone of plant for nutrient availability and weed control.

Fertilizers

The recommended level of the fertilizer one bag of Diammonium phosphate (DAP) per acre before the time of sowing and one bag of Nitrogen Phosphate Potassium (NPK) was supplied to the experimental plot at flowering stage of cotton crop.

Irrigation

After sowing, the first irrigation was applied after 15 days and subsequent irrigations were applied as per requirement of crop.

Data Gathered

The four replicated data within plant population of sucking insect pests and population of predators were gathered through random whole plant sampling method. The first observation was

taken twenty days after sowing of crop and continued with weekly interval up to first picking. The data were analyzed following the procedures of (Gomez and Gomez, 1984).

RESULTS AND DISCUSSION

Population of Sucking Insect Pests in Cotton Crop

Average weekly population of sucking insect pests i.e., whitefly *Bemisia tabaci* (Genn.) Aleyrodidae; Homoptera, thrips *Thrips tabaci* (Linn.) Thripidae; Thysanoptera and jassid, *Amrasca devastans* (Dist.) Cicadellidae; Homoptera. The nymphs and adults were recorded in cotton crop during June to September (Table 1). The data indicates that maximum mean population of whitefly, 31.98 plant^{-1} in the first week of September at relative temperature 32.60°C, thrips 29.96 plant^{-1} and jassids 3.93 plant^{-1} were observed in the last week of August on relative temperature 32.88°C during the study period. The observations for sucking insects showed that insects emerged from eggs had lazy movement and suck the sap from foliage, incontrast predators move fast in search of the food. The result supported by Sewify *et al*. (1996) who reported that the sucking insects on cotton and their associated predators. The highest population of *Thrips tabaci* occurred on the early sown crop, but the population density was very low on the late-sown crop. In late-sown plants in all 3 years, the maximum population densities of sucking insects (*Aphis gossypii*, *Bemisia tabaci* and *Empoasca decipiens*) occurred during August and September. The abundance of associated predators appeared to coincide with the seasonal abundance. Comparatively, maximum sucking insect pest population were observed in the last week of August and first week of September with vegetative growth and succulence of leaves coupled with maximum temperature. Elhagag (1998) studied the pests i.e., cotton aphid, *Aphis gossypii*, tomato whitefly, *Bemisia tabaci*, leafhoppers, *Empoasca* spp. and onion thrips, *Thrips tabaci*, spiny bollworm. *Earias insulana* and the pink bollworm, *Pectinophora gossypiella*. The studied predators were ladybird *Coccinella undecimpunctata* and *Scymnus* sp., rove beetle, *Paederus alfierii*, flower bugs. *Orius* sp., green lacewing, *Chrysoperla carnea* and some unidentified true spiders (Araneae). The results showed that the population of cotton aphid, the tomato whitefly and the leafhoppers occurred in relatively low numbers during the early season and later on disappeared from cotton fields. The population of these pests reappeared and increased again in relatively high numbers during the second half of the growing season to reach its maximum level of abundance on 19, 5 and 5 August month of 1996, respectively and on 19 August,

Table 1: Mean population of sucking insect pests and predators in cotton crop during June to September 2005

	Sucking insect population			Predator insect population		
Odas	Whitefly	Thrips	Jassids	Green lacewing	Pirate bug	Big eyed bug
20	0.34	0.78	0.17	0.18	0.24	0.07
27	1.02	1.52	0.33	0.31	0.36	0.08
34	3.93	4.44	0.61	0.61	0.47	0.09
41	6.35	6.66	0.66	0.66	0.79	0.10
48	8.03	9.05	1.14	1.29	1.10	0.23
55	12.43	11.02	1.73	1.46	1.55	0.39
62	22.13	16.61	2.23	2.02	1.97	0.67
69	24.36	21.58	2.62	2.31	2.40	1.27
76	26.25	23.69	3.14	2.63	2.78	1.46
83	30.25	29.96	3.93	3.04	2.90	1.80
90	31.98	25.51	3.84	3.11	2.80	1.83
97	28.39	25.48	2.74	3.15	2.68	1.85
104	24.59	22.08	2.87	3.17	2.74	2.35
111	11.75	10.83	3.06	3.43	2.61	3.46
118	6.74	5.23	2.11	3.69	2.22	3.62
Mean	15.90	14.30	2.08	2.07	1.84	1.28

ODAS = Observation Days After Sowing; Crop Sowing Date 4-6-2005

29 July and 12 August of the 1997, respectively. The population of onion thrips appeared during the second week of April in both seasons and fluctuated to reach its maximum abundance level on 24 June and 6 May of 1996 and 1997, respectively. The population fluctuation of associated predators was studied and the mean number of each predator during the whole season was calculated. The obtained results showed that the peak of these predators occurred in late June and during July of both seasons. Vennila (1998) reported that the abundance of sucking pests, jassids, *Amrasca biguttula biguttula* and aphids, *Aphis gossypii* and their native predators, *Cheilomenes sexmaculata* and *Chrysoperla carnea*, on nine hybrids (NHH 44, PKV HY2, Kirti, JKHy1, H4, H6, H8, Savita and HH2) and four open pollinated cultivars (CNH 36, LRK 516,LRA 5166 and Supriya) of cotton was studied under rainfed conditions of Maharashtra. In general, hybrids harbored more number of jassids (4.85 plant^{-1}) and aphids (47.56%) than the open pollinated cultivars (4.22 plant^{-} and 38.88%, respectively). Predators were almost four times higher on hybrids (2.4 plant^{-1}) than on the open pollinated cultivars (0.55 plant^{-1}). Among hybrids, NHH 44 and PKV Hy 2 were consistently tolerant and H4 was highly susceptible to both the aphids and jassids. Differential reaction of cultivars to jassids and aphids was also observed. Varying nature of associations of jassids and aphids to their predators was manifested by cultivars. While associations of jassids and predators were significantly positive on Kirti (R = 0.93), H6 (R = 0.86) and Savita (R = 0.86), it was negative on PKV Hy 2 (R = -0.66). The only significant aphid-predator association was negative in relation to CNH 36 (R = -0.69). This suggests that the compatibility of natural enemies and sucking pests would facilitate developing new cultivars and pest management models and modify thresholds. The over all maximum means of whitefly in various observation days were (15.90 plant^{-1}), followed by thrips (14.30 plant^{-1}) and jassids (2.08 plant^{-1}). There after, the pest population decreased due to physiological maturity of leaves and lower range of temperature. It shows that temperature was favourable for pest population on cotton crop coupled with succulent leaves containing sufficient chlorophyll.

Population of Insect Predators in Cotton Crop

Mean predator population of Green Lacewing *Chrysoperla carnea* (Stephens) Chrysopidae; Neuroptera, Pirate bug *Orius insidiosus* (Say) Anthocoridae; Hemiptera and Big eyed bug, *Geocoris punctipes* (Say) Lygaeidae; Heteroptera, the nymphs and adults appeared on cotton crop during June to September at weekly intervals. The data Table 1 indicates that the predator population of Green Lacewing on the crop was found in the last observation i.e., in the month of June. The result are supported by Mannan *et al.* (1995) reported that in Indian Punjab, India, *Chrysoperla carnea* laid eggs on cotton during the first week of July and afterwards, the eggs were present throughout the crop season. Mallah *et al.* (2001) observed that the predators appeared 10 days after germination of cotton plant. The species observed during the season were i.e., chrysoperla, orius, geocoris, spiders, coccinellids, zanchius and campylomma. Khuhro *et al.* (2002) reported that the population abundance of predators in alfalfa and cotton fields were *Campylomma nicolasi*, *Brumus suturalis*, *Staphylinid hutchinsoni*, *Paederus fuscipes*, *Coccinella undecimpunctata*, *Orius laevigatus*, *Chrysoperla carnea*, *Geocoris tricolor*, *Formicomus antiqumus*, *Laius malleifer*, *Delta* sp. and Spider (un-identified). These predators were active throughout the cotton season with a peak population during July and August. Yuan *et al.* (1996) from China showed that the cotton fields had abundant predators of cotton insects. They found 8 species of lady birds (Coccinellidae), 4 species of green lacewings (Chrysopidae), 10 species of spider mite (Acari), 4 species of *Epistrophe* sp. and 3 species of *Orius* sp. on cotton crop. The population of predators had two peaks: 25 June-15 July and 25 July-15 August. The mean population of Green Lacewing and Big eyed bug increased during the entire study period, however the population of Pirate bug decreased slowly during the last week of August at relative temperature 32.88°C. The over all means of Green Lacewing in various

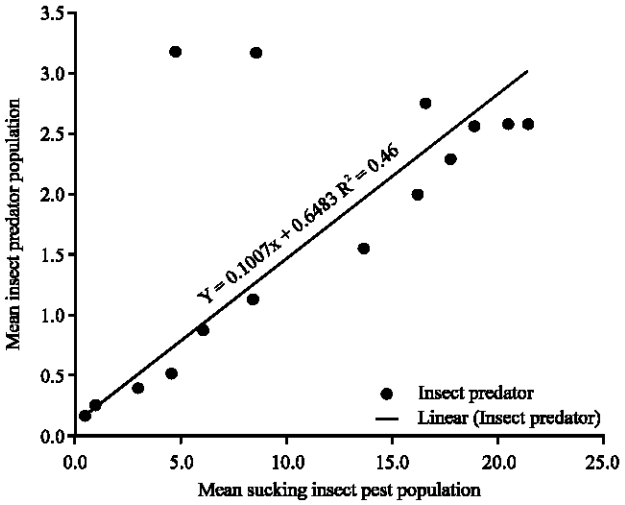

Fig. 1: Trend line showing the mean population of insect predators in cotton crop during June to September 2005

observation days were maximum (2.07 plant^{-1}), followed by Pirate bug (1.84 plant^{-1}) and Big eyed bug (1.28 plant^{-1}). The regression line y = 0.1007x+0.6483 and R^2 = 0.46 shows the regular increase of the insect predator population with sucking insect pest population and clearly justifies that there is no use of any pesticide at any phenological stage of the cotton crop (Fig. 1).

Coefficient of Determination of Insect Predators with Sucking Insect Pests

The coefficient of determination R^2 = 0.46 showed a 46% association between insect predators and sucking insect pest population (Fig. 1). The increase in sucking insect population also exhibited an increase in predator population in observed days during the crop growth stages of the crop.

CONCLUSION

On the basis of the results presented, it could be concluded that the maximum population of sucking insect pests were observed in the last week of August and first week of September, when leaves were juicy and succulent and the predator population increases for keeping in balance the sucking insect pest activity in cotton field. The major focus on cotton crop is to reduce its dependence on synthetic insecticides for the control of pests in cotton crop. This can be achieved through the development of alternative pest control strategies that place more emphasis on the role of beneficial insects and the correlation of insect predators with sucking insect pests was positive.

SUGGESTIONS

Based on the result of the present study on presence and abundance of different insect predators against sucking insect pests of cotton in field conditions suggested that spray program be planned after proper pest scouting and injury level of the sucking insect pest at all phenological development stages of cotton. Thus, in the present study the results were satisfied at the all development stages of cotton plants and sucking insect pests below the economic injury level because the number of insect predators was present in the field throughout the cotton season.

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