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Insect diversity in chickpea ecosystem

Mari, J.M., Chachar, S.D., Chachar, Q.I.*and Kallar, S.A.

Sindh Agriculture University Tandojam-70060- Pakistan

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A study on the insect diversity in chickpea ecosystem was carried out in the field at Pulse Section, Agricultural Research Institute, Tandojam during winter of 2007-2008. Three insect pests (*Helicoverpa armigera*, *Spodoptera litura* and *Agrotis ipsilon*) and four natural enemies (*Geocorisspp*, *Oriusspp*, *Delta sp* and *Coccinella undecimpunctata*)were recorded from the study plots. The results indicated that the larval instars of cutworms *Helicoverpa armigera*, *Spodoptera litura* and *Agrotis ipsilon* infested on tender foliage, developing buds and pods. The larval population was recorded from January to March on chick pea. The data revealed that over all mean population among three cutworm, *H. armigera* population was significantly highest (74.25) as compared to *S. litura* (55.25) and *A. ipsilon* (42.12). The statistical analysis of data suggested that there were highly significant differences between cutworms population ($P<0.01$). The total mean population of the three pests was maximum (34.75) on 2nd March with a slope of line 5.008X and $r^2 = 0.93$. The population was minimum (0.87) with declining curve -0.049 and R-square was ($r^2 =-0.84$), it depicted that there was 84 percent variation in the population of insect pest due to date intervals. The data further revealed that over all mean population among natural enemies, *Orius sp* population was significantly highest (32.75) as compared to *C. undecipunctate*(10.25), *Geocoris sp.* (3.65) and *Delta sp*.(2.25) The statistical analysis of data suggested that there were highly significant differences between population of natural enemies ($P<0.01$). The total mean population of the natural enemies (Fig. 11) was maximum (34.75) on 2nd March with a slope of line 1.258X it indicated that the population increased with a rate of 1.258. R-square was (0.94) it depicted that there was 94 percent variation in the population of predator was due to date intervals. The population was minimum (0.87) with declining curve -1.4X and R-square was (r2 =0.96), it depicted that there was 96 percent variation in the population of natural enemies due to date intervals. It can be concluded that natural enemies, specially the predators occurred in chickpea crop and preyed on the eggs and young larvae of cutworms. Among others the *Orius* sp. and Coccinellids have the potential in regulating the pest suppression on chickpea crop. This could be suggested that the natural enemies may be utilized by mass rearing and releasing in chickpea fields for as a potential component of biological control of harmful insect pests.

Keywords: Population, pests and natural enemies

*Corresponding author: Chachar, Q.I.; e-mail: qdchachar@yahoo.com

Introduction

Chickpea, *Cicer arietinum* L. belonging to the family Papilionaceate, is an important pulse crop grown in many parts of the world. It is grown in India, Pakistan, Iran, Burma, Turkey, Spain, Portugal, Morocco, Ethiopia, Tanzania, Chile, Mexico, USA and other parts of the world. It is an important source of proteins in human diet and animal feed (Khoso, 1992).

Nutritionally chickpea contains 20% proteins, 4.5% carbohydrates, and 3.0% minerals. The desi type chickpea having brown seed coat is known as Bengal gram is grown mostly in South Asian sub-continent where it is used split (dal) or flour (basin). It is also grown in Mexico and Australia. The Kabuli type chick pea crop having white seed coat is grown in Afghanistan, West Asia, North Africa, South, Europe, North America and Pakistan (Saeed and Ali, 1993).

The chickpea crop is attacked by a number of insect pests from seedling to its maturity. In Sindh province the major insect pests attacking chickpea crop are mainly *Helicoverpa armigera, Spodoptera litura* F., *Agrotis ipsilon, Plusia orichalchea* and *Bemisia tabaci* (Shahwami, 1997; Nizamani, 1998). Similarly Lohar and Rahoo (1993) reported that he *H. armigera, S. litura* and *a. ipsilon* attacked chickpea and many other crops in lower Sindh during winter and summer season.

Among these cutworms, the chickpea pod borer, (*H. armigera*) is the most destructive pest of this crop. The young larvae often feed upon the portion of tender foliage before attacking the fruiting bodies, causing heavy losses to the crop. Sometimes the crop faces failure due to severe infestation by *H. armigera* (Anwar and Shafique, 1993). It causes heavy losses to the formers (Pervez *et al*. 1996).

In Sindh province of Pakistan, the year round cultivation of vegetables and other crops and the continuous application of insecticides have created resistance in the population of many insect pests including *H. armigera*, studies have suggested that proper sowing time and use of resistant varieties can reduce the pest infestation on chickpea crop (Aheer *et al.* 1998; Naich, 2000).

The biological control through parasites and predators holds promise for effective population suppression of insect pests on many crops (Anwar and Shafique, 1993). However, studies have suggested that many natural enemies occur on chickpea crop (Nizamani, 1998). Looking into he importance of chickpea crop, the present studies were therefore carried out to record and identify the natural enemies of cutworms (Noctuidae: Lepidoptera) on chickpea.

Materials and methods

A study on the population of major insect pests (Noctuidae: Lepidoptera) and their natural enemies in chickpea ecosystem was carried out in the field at Pulse Section, Agricultural Research Institute, Tandojam during winter 2007-2008. Seeds of chickpea local variety chhola were sown on December 2007.

The experiment was conducted in a Randomized Block Design plot having four sub blocks, comprising 25 x 25 square meter of land. Observations were initiated after germination of chickpea crop. Ten plants in each sub plot were observed once a week, the major insect pests (Noctuidae: Lepidoptera) and their natural enemies present on chickpea crop were recorded. The eggs and larvae *H. armigera, S. litura* and *A. ipsilon* were also collected from the field and brought to the laboratory. The eggs and larvae were kept in paired petri dishes (9 cm dia) along with chickpea leaves and observed till hatching of eggs or population of larvae. The emergences of egg or larval parasitoids if any were identified. Population growth was analyzed by simple logistic model (Southwood, 1978).

$$Nt_i = Nt_0\, eRT \qquad (1)$$

Where; $Nt_{i\,=}$ number of insects pest and natural enemies at time interval i, $Nt_{0,}$ number of insects pest and natural enemies 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 2).

$$\ln Nt_i = \ln Nt_0 + RT \quad n\ r\ s\ F \qquad (2)$$

Where; Nt_i = natural log of insect at time interval i, Nt_0 the intercept of y on natural log insect 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.

The population of insect was high and the regression equations were computed using Statgraphics (1991). The data were transformed. This equation holds true for single species models with Deeveys type II population growth responses (Deevey, 1947).

Results

Population fluctuation of insect pests

Helicoverpaarmigera

The population incidence of *H. armigera* on chickpea was recorded from the month of January to March, 2008. The attack of *H. armigera* started on the tender foliage and on developing buds and pods of chickpea. The larvae made hole in the pod and entered its head and then fed on developed seeds inside the pod.

The present results (Fig. 1) revealed that larval population of *H. armigera* appeared on chickpea during 1st week of January. At the beginning the attack,it was not severe but later on, it attacked on many plants. The maximum population was (15.50) larvae per plant on 2nd March followed by (10.25) on 26th February, with increasing trend of line 1.91X, it indicated that population increased with a rate of 1.91. R-square (0.92) indicated that there was 92 percent variation in the population of *H. armigera* owing to date intervals, and then it declined (0.5)) larvae per plant on 23rd March with a decreasing trend of line -4.87X and r^2= (0.78), it depicted that 78 percent variation in population which was due to date intervals .

Spodopteralitura

The perusal of data presented (Fig. 1) shows that the population of *S. litura* on chickpea crop increased gradually as the crop growth advanced. The population was maximum (11.50) per plant at the pod formation stage of chickpea on 26th February. The regression analysis indicated that population of cutworm increased with a trend of line 1.42X. R-square (0.89) indicated that there was 89 percent variation in the population of insect pest which was due to date intervals. The minimum population was (0.25) per plant at the end of observation date. The regression analysis indicated that population of cutworm decreased with a trend of line -3.8X and r^2= (0.87), it depicted that 87 percent variation in population which was due to date intervals.

Agrotisipsilon

The perusal of data presented in Fig. 1, indicated that the population *A. ipsilon* was first noted during 3rd week of January (0.50) per plant. The pest multiplied slowly and reached its peak (9.0) per plant on 2nd March with a slope of line 1.195X it indicated that population increased with a rate of 1.195. R-

square (0.81) indicated that there was 81 percent variation in the population of insect pest which was due to date intervals. The minimum (0.15) per plant was observed on 23rd March with a declining curve -3.19X and r^2= (0.96).

Comparative population

The data (Fig. 2) revealed that over all mean population among three cutworms, *H. armigera* population was significantly highest (74.25) as compared to *S. litura* (55.25) and *A. ipsilon* (42.12). The statistical analysis of data suggested that there were significant differences between cutworms population (P<0.01).

Population of predators

Geoloris sp. (Hemiptera: Lygaeidae)

The Lygaeid bug *Geoloris* sp. is a famous predator of soft bodied insects, however during present studies it was found preying on the young cut worm larvae on chickpea from last week of January to last week of March. The results presented in Fig. 6, indicated that the maximum (1.25) per plant population of *Geocoris* sp. was on the 12th February with a slope of line 0.178X, it indicated that predator population increased with a rate of 0.178. R-square was (0.68) it depicted that there was 68 percent variation in the population of predator which was due to date intervals. The predator population decreased upto the end of March with a decreasing curve of line -0.092X and r^2= (0.92).

Orius sp. (Hemiptera: Anthocoridae)

The orius bug was found preying on the eggs and young larvae of on chickpea. The data given (Fig. 7) indicated that the population of orius bug was maximum (5.25) per plant on 19th January with a slope of line 0.895X, it indicated that predator population increased with a rate of 0.895. R-square was (0.88) it depicted that there was 88 percent variation in the population of predator which was due to date intervals. The predator population decreased and reached to their minimum (0.75) up to the end of March with a decreasing curve of line -0.675X and r^2= (0.94).

Delta sp.(Hymenoptera: Sphecidae)

The mud wasp, *Delta* sp was found paralyzing the mature *Heliothis* larvae and taking them to their nest for ovisposition. The mud wasp was active

in chickpea field during last week of January to last week of February. The data in Fig. 8 indicated that the population of mud wasp was maximum (1.55) per plant on 26th February with a slope of line 0.195X, it indicated that the population increased with a rate of 0.195. R-square was (0.98) it depicted that there was 98 percent variation in the population of predator which was due to date intervals. The predator population decreased and reached to their minimum (0.10) up to the end of March with a decreasing curve of line -0.225X and r^2= (0.98).

Lady beetle, Coccinellaundecimpunctata(Coleoptera: Coccinellidae)

The coccinellidae beetle, *C. undecimpunctata*was found preying on the young *Heliothis* larvae on chickpea during January to March. The results (Fig. 9) indicated that the maximum (2.25) per plant population of this predator was recorded on 26 February, with a slope of line 0.254X; it indicated that the population increased with a rate of 0.254. R-square was (0.90) it depicted that there was 90 percent variation in the population of predator which was due to date intervals. The predator population decreased and reached to their minimum (0.10) up to the end of March with a decreasing curve of line -0.325X and r^2= (0.78).

Comparative population

The data (Fig. 10) revealed that the over all mean population among natural enemies, *Orius sp* population was significantly highest (32.75) as compared to *C. undecipunctate*(10.25), *Geocoris sp.* (3.65) and *Delta sp*.(2.25) The statistical analysis of data suggested that there were significant differences between natural enemies ($P<0.01$).

Relationship natural enemies with pest population

Relationship natural enemies with pest population indicated that were 0.12 predators against 0.25 pests. After that, more predators migrated as pest population increased. The fitted regression logistic growth model for defining the relationship between predator and pest population revealed that the predator population increased linearly as their prey population increased and reached 1.43 predators against 8.41 pests.

The population followed a logistic growth pattern as:

Model ($\ln Y=\alpha+\beta X$)	N	r^2	S	F
0.762+0.038X	11	0.072	0.652	0.78

The regression equation showed that the slope rate of predator population increase was 0.038X, which reflected that, due to one unit change in pest population, about 0.038 units in the population of predator was estimated. R-square (0.072) was reported by the model which indicated that about 7% variation in predator population depends upon consolidated pest population.

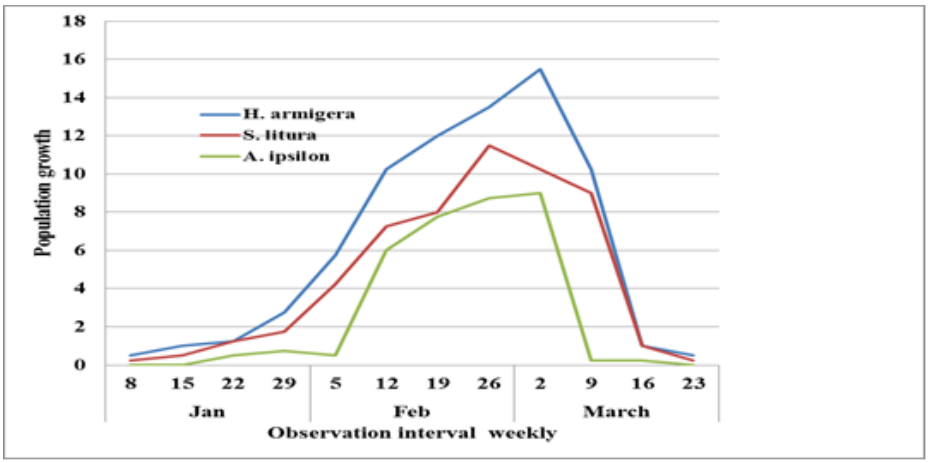

Fig. 1. Population fluctuation of insect pests in chickpea ecosystem

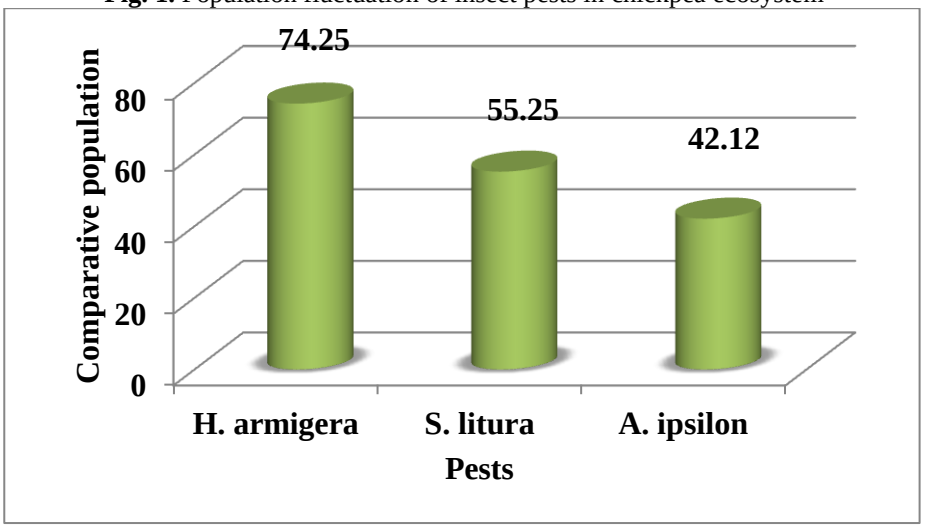

Fig. 2. Comparative population of insect pests in chickpea ecosystem

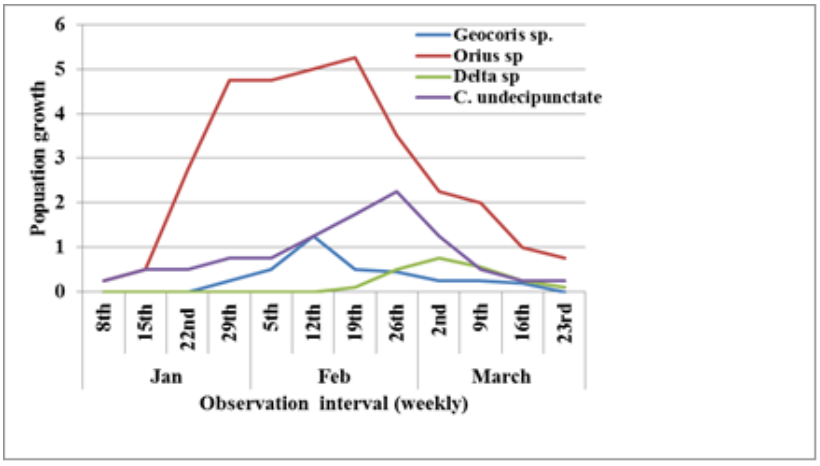

Fig. 3. Population fluctuation of natural enemies in chickpea ecosystem

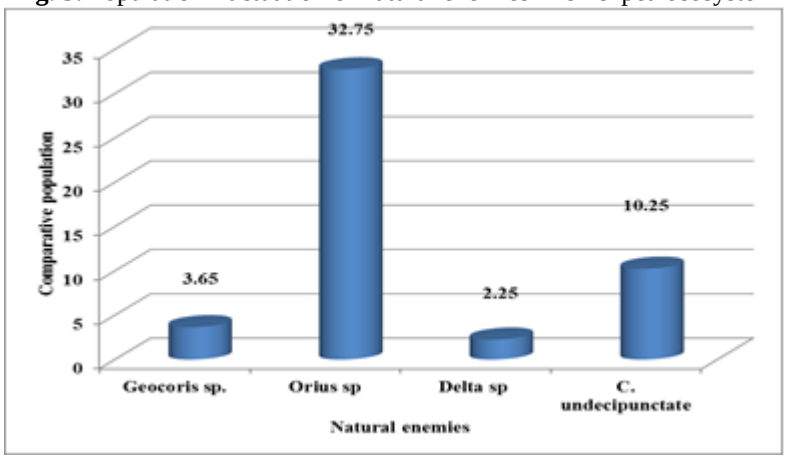

Fig. 4. Comparative population of natural enemies in chickpea ecosystem

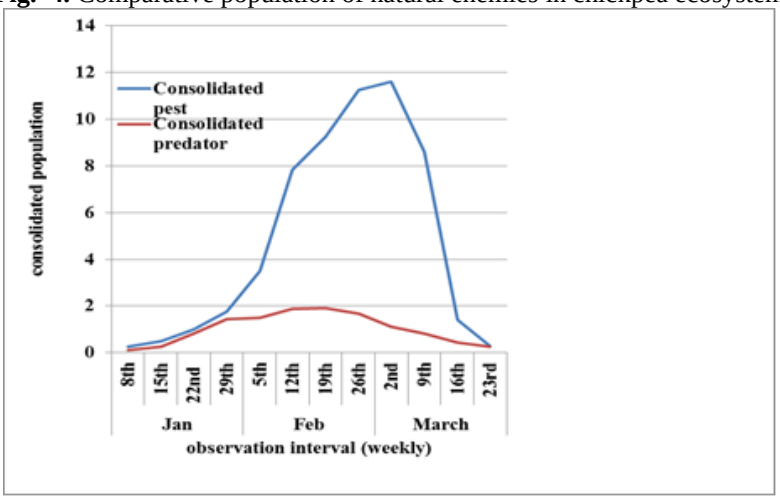

Fig. 5. Relationship natural enemies with pest population

Discussions

During the study, it was observed that chickpea crop was infested by *Helicoverpa armigera*, *Spodoptera litura* and*Agrotis ipsilon* on the tender foliage, buds and developing pods. The maximum population of cutworm was recorded from 1st January up to the end of March. The previous authors also reported that cutworms caused heavy losses to the chickpea crop and sometimes the crop faced failure due to severe infestation by cutworms (Nizamani, 1998; Naich, 2000). Our findings were close to that of Dubey *et al.* (1995) who studied in India that population dynamics of *Helicoverpaarmigera*observed on various crops including chickpea.

Predatory insects live by hunting or trapping other insects (prey), and killing them for food. Over 100 families of insects, spiders and mites contain species that are predaceous, either as adults, immature or both. About 12 of these families play major roles in the biological control of field pests.Lady beetles or "ladybugs" probably are the most universally known group of beneficial insects. They are found almost anywhere and feed on aphids and a variety of soft-bodied insects. Several species are present in alfalfa fields, (Bessing, 1995).

During the present study, many predators were found attacking the younger stages for example, *Georis spp*. Similarly Singh (2005) reported that *Geocoris* sp., were abundant predators particularly in chickpea, cotton, sorghum, sunflower and soybean crop. Nizamani (1998) also reported that the predators, coccinellids, *Geocoris* sp. *Qriussp, Chrysoperla* sp. and the parasitoids i.e. *T. chiloris, c. chloridae, Telonomussp,* attacked the eggs and larvae of cut worms on chickpea crop.

During this study,coccinellidpredators *C. undecimpunctata*was found preying on the young eggs and larvae of *H. arvingera*. Earlier, Nizamani (1998) reported that this predators was recorded preying on the eggs and young larvae of *H. armigera*. The *C. undecimpunctata,* appeared in the crop from January and reached their peak in February and march it is in agreement with Muzaffar and Khuhroo (2004) observed that *C. undecimpunctata* appeared two months after sowing and population increased in month of February and March.

There are numerous beneficial "true" bugs that are predacious on other insects. This includes damsel bugs (nabids), minute pirate bugs (*Orius*), and some stink bugs. Unlike many predators that have chewing mouthparts, true bugs have sucking mouthparts. It is common to see these insects with their pointed, straw-like mouthparts inserted into their prey. These insects will feed on caterpillars of various sizes, other soft-bodied insects, and insect eggs (Obermeyer and Neil, 1994). During the present study, the population of *Orius*

bug was significantly higher than other natural enemies. It was found preying on the eggs and young larvae. Similarly Naich (2000) also recorded *Orius* sp preying upon *H. armigera* larvae on chickpea and pigeon pea.

Parasitoids are insects that, in the immature stages of their life cycle, parasitize other insects but have free living (non-parasitic) adults. Adult parasitoids serve mainly to transport their offspring to new hosts. Two major groups of parasitoids are discussed in this publication: parasitic wasps (Mahar and Ridgeway, 1995).

Parasitic wasps are the largest group of insects that serve as biological control agents. They also are the most diverse in terms of size, shape and lifestyle. Worldwide, it is estimated that there are more than 1 million species of parasitic wasps. Almost all insect pests are attacked by at least one species of parasitic wasp, and many are parasitized by more than one species. Many of these wasps specialize on one target pest. For these reasons, parasitic wasps are an extremely important source of naturally occurring or human managed biological control. Parasitic wasps may be colorful and large (1 to 4 inches in length) as adults. However, most are small to tiny, dark-colored insects (Hoffman and Frodsham, 1995). During present studies the population of *Delta* sp remained all over the season. However, previously Anwar and Shafique (1993) recorded *Delta* sp. paralyzing the mature larvae of cut worms and taking them to the nest for oviposition.

Conclusion

The results manifested that many natural enemies, especially the predators occured in chickpea crop, they predate on the eggs and young larvae of cutworms. Among others, the *Orius* sp. and Coccinellids have the potential in regulating the pest suppression on chickpea crop.

Suggestions

This could be suggested that several natural enemies' predator species may be utilized, mass reared and released in chickpea fields as a potential component of biological control of harmful insect pests.

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