Indian Journal of Entomology Online published Ref. No. e23276 DoI. No.: 10.55446/IJE.2023.1276

POPULATION DYNAMICS OF *HELICOVERPA ARMIGERA* (HUBNER) AND ITS PARASITIZATION BY *CAMPOLETIS CHLORIDEAE* UCHIDA IN CHICKPEA

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ABSTRACT

Experiments were conducted on three dates of sowing i.e., 20th October, 15th November and 1st December during 2018-19 and 2019-20 at Banda to assess the population dynamics of gram pod borer *Helicoverpa armigera* (Hubner) and % larval parasitization in chickpea. The incidence of *H. armigera* was noticed from 49th to 12th Standard Meteorological Week (SMW). Its incidence was increased at vegetative stage from 50th to 1st SMW in first date of sown crop and at reproductive stage from 10th to 12th SMW in 3rd date of sown crop. The highest and lowest parasitization of larvae by *Campoletis chlorideae* were recorded as 58.67 and 55.00% (49th SMW) and 10.67% (12th SMW) and 7.30% (13th SMW) during 2018-19 and 2019-20, respectively. Maximum and minimum temperature showed a negatively by significant correlation with larval parasitization whereas, relative humidity and rainfall had a positively non-significant correlation.

Key words: *Helicoverpa armigera*, *Campoletis chloridae*; correlation, date of sowing, larval parasitization, natural enemy, population dynamics, weather factors, seasonal incidence, temperature, rainfall humidity

Pulses constitute a staple diet of the vegetarian population in India and other neighboring countries and among pulses, chickpea is a valuable crop. Among various biotic factors responsible for low production of chickpea, *Helicoverpa armigera* (Hubner) is the most important which causes heavy losses. In India, losses caused by *H. armigera* on chickpea and pigeonpea exceeded Rs. 12000/- million/ year (Anonymous, 1996). Lifecycles of *H. armigera* take about 30-34 days at 28°C from egg to adult (Zalucki et al., 1986). The larvae attack crops from seedling to maturity, damaging all parts (leaves, flowers, and pods), 3.6-72.8% pod damage in chickpea is known (Patnaik et al., 1991). During rabi season the incidence of *H. armigera* is noticed from October to first week of April. Farmers using excessive use of the chemical not only causes the economic burden on farmers but also produces the harmful side effects on the environment as well as human being. The best way to overcome this situation is to destroy the pest at initial stage of the life cycle. This is possible if timely prediction of the incidence of the pest can be made. Hence, an attempt was made to study the incidence of pod borer, *H. armigera* infesting chickpea in relation to abiotic factors. In addition, incidence of natural enemies also plays a key role in limiting the population of *H. armigera* endoparasitoid *C. chlorideae* Uchida (Hymenoptera: Ichneumonidae) is an effective bio control agent against *H. armigera* and parasitized the larval stage (Pandya, 2019). *C. chlorideae* preferably 2nd instar larval period. *C. chlorideae* account 10- 80% parasitization of host larvae in chickpea in different parts of the country (Banchhor et al., 2000). The augmentation and conservation of this parasitoid is very important, in order to quantify the natural field mortality of the pest by the action of this parasitoid. Since *Trichogramma* spp. do not work in chickpea ecosystem, the role play by *C. chlorideae* in nature needs exploration for the formulation of future bio-intensive management strategy for *H. armigera* in chickpea ecosystem. Keeping in view the above-mentioned facts the percent parasitization of *C. chloridae* was also estimated under present study.

MATERIALS AND METHODS

The experimental fields were prepared as per recommended agronomic practices and other practices were followed to raise the crop, viz. once deeply ploughed, followed by two harrows in first fortnight of October. Manures and fertilizers were applied as per recommended dosage i.e. @ 120 kg DAP/ ha. The experiments were laid in randomized block design. The variety JG-14 was sown on three dates of sowing i.e., 20th October, 15th November and 1st December with plot size of 10 x 10 m at Banda University of Agriculture and

Technology, Banda during rabi 2018-19 and 2019-20. To estimate the population dynamics of *H. armigera*, larval counts were undertaken from 5 randomly selected plants from each date of sowing at weekly intervals, starting from germination to harvesting. To estimate the larval parasitization by *C. chloridae*, 50 larvae of 2nd and 3rd stages were collected in three replications from germination to harvesting. The collected larvae were reared on natural diet till pupation and the emerging parasitoids were identified and recorded. The data on weather parameters were collected at weekly interval, and subjected to statistical analysis to find out the correlation coefficients. The data were analyzed with online statistical analysis tool (OPSTAT) for ANOVA and comparison of treatments.

RESULTS AND DISCUSSION

The maximum larval counts (3 larvae/ 5 plants) was recorded on 51st Standard Meteorological Week (SMW) maximum count in the 1st date of sown crop during rabi 2018-19. The larval were seen only vegetative stage and when crop reached in reproductive stage it was nil. Maximum counts (3 larvae/ 5 plants) was recorded in 11th and 12th SMW on 3rd date of sown crop. Correlation study indicated highly significant positive association between larval count and maximum and minimum temperature (Fig. 1). However, relative humidity had significant negative correlation and rainfall had non-significant negative correlation. In rabi 2019-20, 1st date of sown crop, Maximum larval count (3 larvae/ 5 plants) was recorded on 51st SMW followed by 50th, 52nd SMW and onwards up to 10th SMW except 1st, 2nd and 8th SMW. The relative humidity had a significant negative correlation with larval counts. Two larvae/ 5 plants was recorded in 8th and 9th SMW and population increased and maximum (4 larvae/ 5 plants) was recorded in 11th and 12th SMW. Correlation study indicated highly significant positive association between larval count and maximum and minimum temperature (Fig. 2).

A positive correlation existed between the larval counts and the average of maximum and minimum temperatures. However, a negative correlation existed with relative humidity. Hossain et al. (2009) observed that the population was higher in early sown crops and decrease in the delayed sown crops. It was observed that both early and late sown crops received higher infestation. Alok et al. (2022) observed that the larval counts of *H. armigera* when correlated with abiotic parameters revealed a negative non-significant correlation with maximum and minimum temperatures; however, it showed a positive correlation with relative humidity in the morning which was non-significant; and with evening relative humidity, it was significant. Kumar et al. (2022) reported that larval incidence of *H. armigera* on chickpea was found positively correlated with maximum temperature, while minimum temperature and relative humidity showed negative and non-significant correlation. Correlation between rainfall and larval incidence was found negative and significant. Bhagat et al. (2020) reported that *H. armigera* larva showed non-significant and negative correlation with maximum temperature but minimum temperature showed negative significant correlation. Rainfall was positively and non-significantly correlated but relative humidity showed highly positive significant correlation. Dindor et al. (2020) evaluated the population dynamics of *H. armigera* on chickpea. The eggs were observed from 49th (first week of December) till 3rd standard week (third week of January); and the larvae from 49th standard week till crop harvesting i.e., 11th standard week (second week of March). Correlation coefficients between egg counts and minimum temperature and morning relative humidity revealed a negative relationship, while evening relative humidity and rainfall showed positive but non-significant effects; and a negative effect of maximum temperature was observed. As regards larvae, it was a positive one with maximum temperature, and negative with minimum temperature, evening relative humidity and rainfall. A

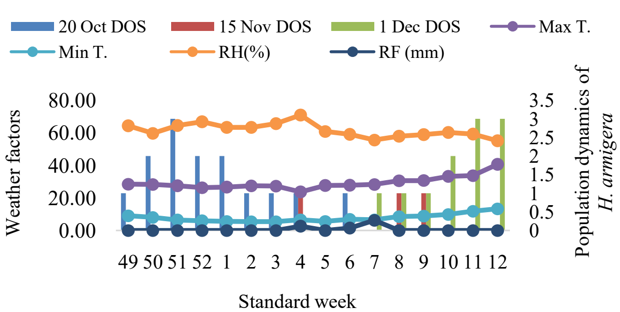

Fig. 1. Population dynamics of *H. armigera* (2018-19)

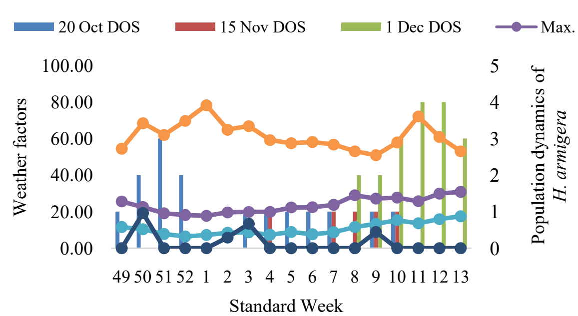

Fig. 2. Population dynamics of *H. armigera* (2019-20)

highly significant negative correlation with morning relative humidity was observed. Sharma et al. (2020) also revealed that the larval incidence showed a non-significant negative correlation with minimum temperature, relative humidity and rainfall while maximum temperature showed non-significant positive correlation; non-significant negative correlation with minimum temperature, maximum temperature and rainfall; and relative humidity showed non-significant with positive correlation. The present finding is also in the same line as reported by Narayan et al. (2020).

The parasitized larvae by *C. chlorideae* varied from week to week in rabi 2018-19, with maximum parasitization during 49th SMW (58.67%) and minimum during 12th SMW (10.67%). Maximum and minimum temperature revealed a negative significant correlation with parasitization. Parasitization varied from month to month too; maximum parasitization (52.25%) was during December followed by January (44.42%) and February (44.00%) and minimum (18.66%) was in March (Fig. 3). Maximum parasitization was recorded in 49th SMW (55.00%) and minimum in 13th SMW (7.3%) in rabi 2019- 20; it varied from 41.30 to 55.00% up to 8th SMW, thereafter abruptly decreased and varied from 32.20 to 7.30% from 9th to 13th SMW. Maximum and minimum temperature had a negative significant correlation with parasitization by *C. chlorideae*; maximum parasitization (52.17%) was recorded in December and minimum (26.07%) was in March (Fig. 4). This a solitary larval endo-parasitoid, was observed at the second and third instar stage, exhibiting parasitization from 42.00 to 58.67% up to 7th SMW. Bhagat et al. (2020) observed that the larval parasitoid, *C. chlorideae* showed non-significant and negative correlation with maximum and minimum temperature; however, rainfall was non-significant and positively correlated but relative humidity was highly significant and with positive correlation. The present result is also corroborated with the findings of Rai et al. (2014) on parasitization ranging between 25.00 to 93.33% during January and February. Kaur et al. (2000) also reported parasitization by *C. chlorideae* from 0.98 to 68.50%.

It was observed that both early and late sown crops showed higher infestation. Correlation studies indicated highly significant positive association between larval incidence and maximum and minimum temperature. However, relative humidity and rainfall showed a non-significant negative correlation. Similarly, parasitization of *H. armigera* larvae by *C. chlorideae* varied during the cropping period, with maximum parasidization during 49th SMW. Maximum and minimum temperatures showed negative and significant correlation with *H. armigera* larval parasitization by *C. chlorideae*.

ACKNOWLEDGEMENTS

The authors thank the Dean, College of Agriculture and Head, Department of Entomology, College of Agriculture, Banda University of Agriculture & Technology, Banda for providing facilities.

FINANCIAL SUPPORT

None.

AUTHOR CONTRIBUTION STATEMENT

BKS conceived and designed the research SS conducted the experiments. SS KS and HS collected the data AKS analyzed the data. SS and RP wrote the manuscript and all the authors read and approved the manuscript.

CONFLICT OF INTEREST

No conflict of interest.

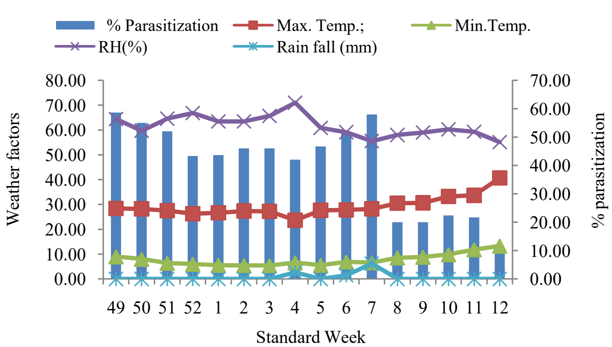

Fig. 3. Effect of *C. chlorideae* parasitization on larval incidence of *H. armigera* (2018-19)

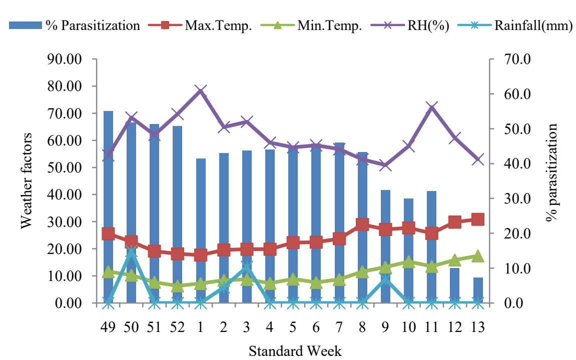

Fig. 4. Effect of *C. chlorideae* parasitization on larval incidence of *H. armigera* (2019-20)

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(Manuscript Received: May, 2023; Revised: September, 2023;
Accepted: September, 2023; Online Published: September, 2023)
Online First in www.entosocindia.org and indianentomology.org Ref. No. e23276