



## POPULATION DYNAMICS OF *HELICOVERPA ARMIGERA* (HUBNER) IN CHICKPEA

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### ABSTRACT

A field experiment was carried out to study the population dynamics and bionomics of gram pod borer *Helicoverpa armigera* (Hubner) in chickpea at Agronomy farm and laboratory, S K N College of Agriculture, Jobner, Jaipur (Rajasthan) during rabi 2021-22. The data revealed that the first appearance was in 50<sup>th</sup> standard meteorological week (SMW) and attained peak in 8<sup>th</sup> SMW. Statistical analysis of weather parameters with larval incidence showed significant positive correlation only with maximum temperature ( $r = 0.56^*$ ). The biological traits of *H. armigera* has been studied at  $20 \pm 1^\circ\text{C}$  coupled with  $60 \pm 5\%$  RH and 12 L: 12 D photoperiod in the laboratory revealed that the single female produced  $445.25 \pm 50.02$  eggs; incubation period ranged from  $3.92 \pm 0.81$  days; hatchability was  $78.611 \pm 9.73\%$ ; larvae passed through five instars and total larval duration lasted 12 to 21 days; pupal stage varied from 10 to 17 days; and total life cycle took 44 to 66 days; longevity of male and female moths varied from  $5.42 \pm 1.28$  and  $8.52 \pm 1.72$  days, respectively.

**Key words:** Bionomics, biology, *Cicer arietinum*, *Helicoverpa armigera*, oviposition, weather factors, correlation coefficient, seasonal incidence, survival, development

Chickpea is an important rabi pulse crop (Bhatt and Patel, 2001; Ahlawat and Om Prakash, 1996); and it has a productivity of 1116 kg/ha (Anonymous 2021). The major insect pests of chickpea are cutworm, *Agrotis ipsilon* Hufnagel, gram pod borer, *Helicoverpa armigera* (Hubn.), gram semilooper, *Autographa nigrescens* Walker and aphid, *Aphis craccivora* Koch (Raj et al., 2022) of these *H. armigera* and is the most noxious cosmopolitan (Rao et al., 2001). Climate changes leads to change in the seasonal activity of *H. armigera* such as changing habitats, host range, survival and resistance. Its single larva can damage up to 25-30 chickpea pods in its lifetime (Sanap et al., 1987) and the production losses ranged from 75 to 90% and sometimes it's up to 100% (Jeyarani et al., 2010). Only the larva was found destructive and in order to develop IPM strategies and proper identification of different stages of *H. armigera*, the study of biological characters during different developmental stages are essential (Ali et al., 2009). The population density of insect pests fluctuates when there is a change in weather conditions and become more noxious to control. The best way to overcome this situation is to destroy the

pest at its initial susceptible stage of life cycle. Hence, the study has been taken to investigate the seasonal incidence and bionomics of *H. armigera*.

### MATERIALS AND METHODS

The field experiment was conducted at the Agronomy farm S.K.N. College of Agriculture, Jobner (Rajasthan) during rabi, 2021-2022. The chickpea variety, RSG-902 was sown @ 80 kg ha<sup>-1</sup> seed in furrows at a row to row distance of 30 cm and plant to plant distance of 10 cm. Randomly five plants were selected from each plot. The data of mean larval counts of *H. armigera* and weather parameters were carried out by simple correlation by using WASP 2.0 software developed by ICAR Research Complex, Goa. Studies on biology of *H. armigera* were carried out under laboratory conditions at the SKN. College of Agriculture, Jobner during rabi season. Initially, the larvae of *H. armigera* were collected from chickpea and reared under laboratory conditions till pupation. Larvae were reared individually to avoid cannibalism. Standard methodology was followed to record all the observations on the life stages.

## RESULTS AND DISCUSSION

The data on seasonal incidence of *H. armigera* revealed that the mean larval population of *H. armigera* was observed 1.94 per 5 plants during 50<sup>th</sup> SMW (Standard Meteorological Week), when maximum and minimum temperature was 22.9°C and 3.6°C, respectively; relative humidity of morning and evening was 78 and 42%, respectively with no rainfall (Fig. 1). The larvae suddenly increased and reached peak during 8<sup>th</sup> SMW being 4.40 larvae/ 5 plants. These results are analogous with the findings of Mahapatra et al. (2007). Reddy et al. (2009), Chater et al. (2010), Pandey et al. (2013) and Malik et al. (2015) reported incidence of *H. armigera* on chickpea from the first week of December, second week of December, third week of December and second week of February respectively. Patel et al. (2001), Shinde et al. (2013) and Kumar et al. (2015) reported that the infestation of *H. armigera* on chickpea started in November; it reappeared and started to increase in the first week of February (5<sup>th</sup> SMW) and gradually increased and reached peak in the third week of February (8<sup>th</sup> SMW). This finding is in agreement with Galav et al. (2021) who reported the peak in 8<sup>th</sup> SMW. Correlation between larval incidence with weather parameters revealed that maximum temperature was positively significant ( $r=0.56$ ). The relative humidity (morning and evening) had a negatively significant correlation. The present findings agree with those of Galav et al. (2021) and Shinde et al. (2013), Pandey et al. (2013) and Kumar et al. (2015) observing positive correlation with both temperatures and negative correlation with relative humidity. Reddy et al. (2009), Pandey et al. (2013), Singh et al. (2006) reported significant positive correlation with maximum and minimum temperatures and significant negative correlation with relative humidity. Chater et al. (2010) and Malik et al. (2015) indicated that maximum, minimum and mean temperature exhibited highly significant negative correlation.

Freshly laid eggs were yellowish, turning deep

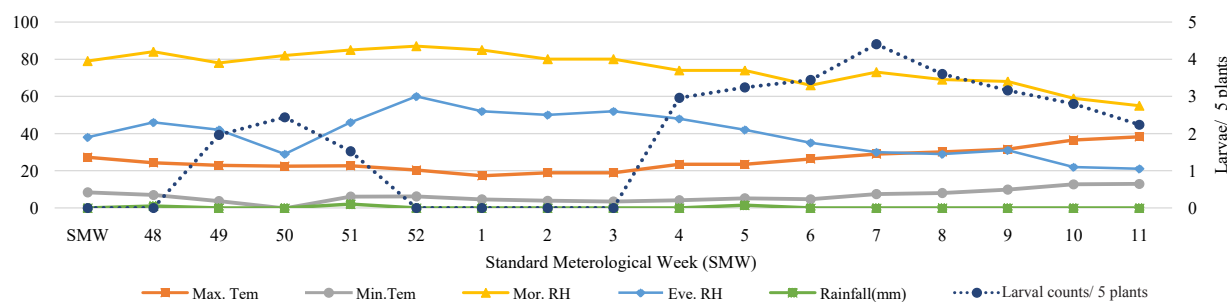


Fig. 1. Seasonal incidence of *H. armigera* in chickpea (rabi, 2021-2022)

yellow after 24 hr and dark brown at hatching. They were hemispherical, sculptured with ridges, measuring  $0.49 \pm 0.03$  mm in length and  $0.47 \pm 0.04$  mm in breadth. Incubation varied from 3 to 5 days, averaging  $3.92 \pm 0.81$  days, with a hatching percentage of 78.61% (Table 1). The little bit similar size and incubation period of eggs was also observed by Ali et al. (2009) and Patel et al. (2011). Ghadiya et al. (2014) also recorded 59% hatchability on groundnut. Hatchlings reared on gram leaves passed through five instars. The first two were semitranslucent, dirty white, with durations of  $3.32 \pm 0.47$  and  $3.62 \pm 0.75$  days. The third to fifth instars, with lengths and widths ranging from  $8.46 \pm 0.59$  to  $31.69 \pm 1.55$  mm and  $1.98 \pm 0.53$  to  $3.37 \pm 0.05$  mm, completed their stages in  $3.37 \pm 0.48$ ,  $3.12 \pm 0.88$ , and  $4.64 \pm 0.48$  days, respectively. The full-grown larva was straw-yellow to green with lateral brown strips. After feeding, the pre-pupa stage lasted 1-4 days with dimensions of  $26.44 \pm 1.61$  mm in length and  $4.23 \pm 0.35$  mm in breadth (Table 1). The obtect pupa, mahogany-brown, measured  $19.37 \pm 0.66$  mm and  $4.49 \pm 0.44$  mm, with a pupal period of 9 to 13 days. Medium-sized adults had yellowish-brown forewings, males were greenish-grey, females orange-brown with tufted abdomen tips. Adult dimensions varied, with males at  $17.47 \pm 0.56$  mm length and  $33.65 \pm 1.19$  mm breadth, and females at  $18.85 \pm 0.70$  mm length and  $40.30 \pm 1.40$  mm breadth. Preoviposition ranged from 2 to 4 days, oviposition from 4 to 7 days and post-oviposition from 1 to 3 days. Females laid 406 to 550 eggs. Males lived for 4 to 8 days, while mated females lived for 7 to 12 days. The male's total life span was 32 to 52 days, and the females was 44 to 66 days (Table 1), aligning with previous studies (Ali et al., 2009; Patel et al., 2011; Ghadiya et al., 2014; Baikaar and Naik, 2016; Patil et al., 2018).

## ACKNOWLEDGEMENTS

The authors thank to the Head, Department of Agricultural Entomology, College of Agriculture, S.K.N.A.U. Jobner, Jaipur for designing the research

Table 1. Bionomics of *H. armigera*

| Stage  | Development period (Days) |              |             |
|--|---------------------------|--------------|-------------|
|  | Minimum                   | Maximum      | Mean± S.D.  |
| Incubation   | 3                         | 5            | 3.92± 0.81  |
| Egg period (3-5) days  |                           |              |             |
| 1 <sup>st</sup> instar   | 3                         | 4            | 3.32± 0.47  |
| 2 <sup>nd</sup> instar   | 2                         | 3            | 3.62± 0.75  |
| 3 <sup>rd</sup> instar   | 3                         | 4            | 3.37± 0.48  |
| 4 <sup>th</sup> instar   | 2                         | 4            | 3.12± 0.88  |
| 5 <sup>th</sup> instar   | 4                         | 5            | 4.64± 0.48  |
| Larval period (12-21) days   |                           |              |             |
| Pre-Pupa   | 1                         | 4            | 2.96± 0.99  |
| Pupa   | 9                         | 13           | 10.92± 1.38 |
| Pupal period (10-17) days  |                           |              |             |
| Male   | 7                         | 10           | 8.65± 1.03  |
| Female   | 10                        | 14           | 11.9±1.44   |
| Adult period (17-24) days; Life cycle (Egg to adult death): 44-66 days |                           |              |             |
| Particulars  | Mean ± S.D.               |              |             |
| Fecundity  | 445.25 ±50.02             |              |             |
| Hatching (%)   | 78.61±9.73                |              |             |
| Longevity  |                           |              |             |
| Male   | 5.42±1.28                 |              |             |
| Female   | 8.52±1.72                 |              |             |
| Preoviposition   | 2.90±0.83                 |              |             |
| Oviposition  | 5.19±1.07                 |              |             |
| Post oviposition   | 1.71±0.78                 |              |             |
| Morphometrics  |                           |              |             |
| Stage  | Length (mm)               | Breadth (mm) |             |
|  | Mean± SE                  | Mean± SE     |             |
| Egg  | 0.49± 0.03                | 0.47± 0.04   |             |
| 1 <sup>st</sup> instar   | 1.66± 0.15                | 0.47± 0.02   |             |
| 2 <sup>nd</sup> instar   | 4.02± 0.29                | 0.71± 0.03   |             |
| 3 <sup>rd</sup> instar   | 8.46± 0.59                | 1.98± 0.53   |             |
| 4 <sup>th</sup> instar   | 19.8± 2.38                | 2.25± 0.38   |             |
| 5 <sup>th</sup> instar   | 31.69± 1.55               | 3.37± 0.05   |             |
| Pre pupa   | 26.44± 1.61               | 4.23± 0.35   |             |
| Pupa   | 19.37± 0.66               | 4.49± 0.44   |             |
| Male **(Breadth wing expanded)   | 17.47± 0.56               | 33.65± 1.19  |             |
| Female **(Breadth wing expanded)                                       | 18.85± 0.70               | 40.30± 01.40 |             |

\*25 larvae used for instar study; \*\*20 pair used for mating

and providing necessary facilities and financial support.

#### FINANCIAL SUPPORT

No financial support received.

#### AUTHOR CONTRIBUTION STATEMENT

Each author has made equal contribution to the manuscript.

#### CONFLICT OF INTEREST

No conflict of interest.

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(Manuscript Received: June, 2023; Revised: January, 2023;

Accepted: April, 2024; Online Published: April, 2024)

Online First in [www.entosocindia.org](http://www.entosocindia.org) and [indianentomology.org](http://indianentomology.org) Ref. No. e24384