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Study on population dynamics of *Helicoverpa armigera* (Hübner) in chickpea

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Abstract

The experiment were carried out under field conditions during two consecutive crop season *Rabi*, 2017-18 and 2018-19 at five Farmer field at Acharya Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). During the course of investigation "Study on population dynamics of *H. armigera* in chickpea" revealed that the maximum larvae were recorded in the 10th SMW and 9th SMW with respective larval population of 3.15 & 3.16 during *Rabi*, 2017-18 and *Rabi*, 2018-19, respectively and Minimum over all mean larvae recorded in 45th SMW were 0.24 & 0.39 larvae/ plant during *Rabi*, 2017-18 and *Rabi*, 2018-19. It is evident from data that larval population showed non-significant negative correlation with minimum temperature (-0.050), relative humidity (-0.349) and rainfall (-0.063) while maximum temperature showed non-significant positive correlation (0.088) during *Rabi*, 2017-18. During 2018-19 the larval population showed non-significant negative correlation with minimum temperature, maximum temperature and rainfall (-0.403), (-0.022) and (-0.060) while relative humidity showed non-significant with positive correlation (0.149).

Keywords: larvae, population, plant, temperature, humidity & rainfall

Introduction

Chickpea (*Cicer arietinum* L.), also known as Bengal gram or gram, channa, garbanzo *etc.*, is one of the most important pulse crops of India and is considered as 'king of pulses' (Bhatt and Patel, 2001). Globally, chickpea is the third most important food legume grown in 14.56 m ha with an average production of 14.77 million tonnes and an average productivity of 982 kg ha⁻¹ (FAO, 2017) [2].

Insect pests are the main constraints which limit the production of chickpea. Pod borer, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is the most prominent insect that causes major economic damage to this crop. It is highly polyphagous pest attacks over 182 plants species including both widely grown and economically important crops as cotton, maize, tobacco, pigeonpea, chickpea and tomato *etc.* (Gowda *et al.*, 2005) [6]. The yield loss in chickpea due to *Helicoverpa armigera* was reported as 10-60 per cent in the normal weather conditions, while it was 50-100 per cent in favorable weather conditions, particularly in the states where frequent rains and cloudy weather are prevailing during the crop season. The larvae which is the damaging stage of this pest cause damage to crop by feeding on the leaves and destroying the seedling in early stage of crop and at pod formation stage. The 3rd & 4th instar larvae feeds on developing grain after cutting a hole in pods and thrusting its head therein. Full-grown larvae drop to the ground for pupation. The life cycle is completed in 30-37 days. There are 5-7 generations in a year.

H. armigera is an insatiable feeder on chickpea plant. It infests the crop at the seedling stage and continues to devour flowers, pods and developing seeds until crop maturity (Reed *et al.*, 1987) [12]. 'The larvae prefer nitrogen rich plant parts such as flowers and pods (Fitt, 1989) [5]. A single larva damages several pods per day leading to severe losses in crop yield (Patankar *et al.*, 1999) [10]. The yield loss in chickpea due to pod borer has been estimated to be 10 to 60 % under normal weather conditions (Vaishmpayam and Veda, 1980) [15], and 50 to 100 % in favourable weather conditions, particularly when there are frequent rains and cloudy weather during the cropping season. Annual yield losses attributable to this pest in India alone are over Rs.1000 crores (Saminathan *et al.*, 2003) [13].

Material and methods

1. Experiment site

The experiment was conducted at Farmer field at Acharya Narendra Deva University of Agriculture and Technology, Narendra Nagar, (Kumarganj), Ayodhya (U.P.) during season 2017-18 & 2018-19. The experimental site is located at a distance of 42.0 Km away from the Ayodhya district Headquarter on Ayodhya-Raibareilly road.

2. Population dynamics of *H. armigera*

In order to study on population dynamics of *H. armigera* in chickpea. For recording the larvae of *H. armigera* in chickpea during crop season 2017-18 & 2018-19 were counted on 10 randomly selected plants at five locations at weekly interval starting with 30 DAS (Days after Sowing). Weekly meteorological data during crop period were collected from meteorological observatory in the university. Data were noted as larvae per plant at weekly interval starting.

3. Correlation studies

The correlation between larvae of *H. armigera* and abiotic factors *viz.* minimum temperature, maximum temperature, relative humidity and rainfall were worked out.

Results and discussion

The data recorded on population dynamics of *H. armigera* during *Rabi*, 2017-18 & *Rabi*, 2018-19 have been presented in Table- 1&2. It is evident from the data that the pest activity started since vegetative growth and continued till maturity stage of the crop. The larvae of *H. armigera* were noticed for the first time during 45th standard meteorological week (SMW) of *Rabi*, 2017-18 and 2018-19 at the minimum temperature of 12.7 °C & 12.7 °C, maximum temperature of 29.7 °C & 28.7 °C, relative humidity 67.2 & 68.3 per cent and there were no rains during *Rabi*, 2017-18 & *Rabi*, 2018-19. The larvae of *H. armigera* on chickpea at five locations 1st location, 2nd location, 3rd location, 4th location and 5th location were 0.22 & 0.25, 0.27 & 0.36, 0.26 & 0.62, 0.23 & 0.32 and 0.24 & 0.42 larvae/ plant. Over all mean larvae were recorded during first observation in 45th SMW were 0.24 & 0.39 larvae/ plant. Thereafter activity of *H. armigera* continued though in fluctuating number throughout crop season. In 46th SMW at the minimum temperature 11.8 °C & 14.1 °C, maximum temperature 29.0 °C & 30.3 °C and relative humidity 67.4 & 71.2 per cent and no rainfall, respective larvae recorded at fifth locations was 0.41 & 0.46, 0.41 & 0.40, 0.44 & 0.44, 0.46 & 0.42 and 0.45 & 0.52 larvae/ plant with over all mean of 0.43 & 0.45 larvae/ plant. The overall mean of 0.58 & 0.47 and 0.85 & 0.80 larvae/ plant was respectively recorded during 47th and 48th SMW during *Rabi*, 2017-18 and 2018-19. The mean larval population in the 49th SMW of *Rabi*, 2017-18 and 2018-19 with respective mean of 1.12 & 1.35 larvae/ plant. The respective minimum and maximum temperatures were 11.7 °C & 8.5 °C, 19.2 °C & 25.2 °C, relative humidity 86.6 & 71.0 per cent and no rainfall during this week. Over all mean larval population in 50th 1.00 & 1.23 larvae/ plant, the respective minimum and maximum temperatures recorded during this week were 9.0 °C and 7.5 °C and 19.5 °C and 24.2 °C, relative humidity 86.9 & 69.0 per cent and there were no rains during *Rabi*, 2017-18 & *Rabi*, 2018-19. The mean larvae in the 51st SMW were 1.54 & 1.53 larvae/ plant during this week, the minimum temperature 7.5 °C and 5.0 °C, maximum temperature 23.2 °C & 23.2 °C and relative humidity of 74.0 & 71.3 per cent was

recorded and there were no rains. During 52nd SMW the respective mean larval population was 1.72 & 1.80 larvae/ plant. During this week temperature range from 10.6 & 6.3 to 20.1 & 23.5 °C, relative humidity 84.1 & 70.5 per cent and no rainfall. During the 1st SMW the mean larvae of 1.32 & 1.35 larvae/ plant. The respective temperatures during this week and ranged from 10.2 & 5.3 to 18.0 & 22.5 °C, relative humidity 88.2 & 72.2 per cent and no rainfall during *Rabi*, 2017-18 and *Rabi*, 2018-19. Maximum larvae were recorded in the 10th SMW and 9th SMW with respective larval population of 3.15 & 3.16 larvae/ plant during *Rabi*, 2017-18 and *Rabi*, 2018-19, respectively. During this week, the minimum temperature was 12.3 °C & 10.0 °C maximum temperature 27.8 °C & 22.9 °C, relative humidity 62.4 & 7.7 per cent and again there was no rainfall followed by mean larvae during the 9th & 10th SMW with respective over all mean larval population of 2.82 & 2.79 larvae/ plant during *Rabi*, 2017-18 & 2018-19, minimum and maximum temperatures 11.5 °C & 9.8 °C and 28.8 °C & 22.8 °C and, relative humidity 57.8 & 74.0 per cent and there were no rainfall during this week. Minimum over all mean larvae recorded in 45th SMW were 0.24 & 0.39 larvae/ plant at the minimum temperature 12.7 °C & 12.7 °C, maximum temperature 29.7 °C & 28.7 °C and relative humidity 74.50 & 73.60 per cent and no rainfall followed by over all mean larval population of 0.43 & 0.45 larvae/ plant during *Rabi*, 2017-18 and *Rabi*, 2018-19 was recorded in the 46th SMW at the minimum temperature 11.8 °C & 14.1 °C, maximum temperature 29.0 °C & 30.3 °C and relative humidity 67.4 & 71.2 per cent and no rainfall. The present findings are also in accordance with the findings of Ali and Kumar (2001)^[1] who reported that *H. armigera* was found most active between 47th to 16th standard week on chickpea and attained peak density 5th to 11th standard week. The present findings are also in accordance with the findings of Shah and Shahzad (2005)^[14] reported that the pest population was low during 49th to 6th standard weeks but increased from 7th standard week onwards and declined again during 14th standard week. The present investigations are in accordance with those of Kant and Kanaujia (2008)^[7] who found that the larval population build-up in chickpea started during standard week 9 at the vegetative stage of the crop and reached its maximum during standard weeks 14 and 15. This is in partial agreement with the findings of Chatar *et al.*, (2010)^[3] who revealed that the pest appeared from 2nd week of December and attained a peak of 3.12 larvae per plant during 2nd week of January. The pest was active during the last week of December to 3rd week of January. Later on, the pest population declined gradually towards the maturity of the crop.

Correlation between larval population and weather parameters *viz.*, minimum temperature, maximum temperature, relative humidity and rainfall has been given in Table- 3. It is evident from data that larval population showed non-significant negative correlation with minimum temperature (-0.050), relative humidity (-0.349) and rainfall (-0.063) while maximum temperature showed non-significant positive correlation (0.088) during *Rabi*, 2017-18. During *Rabi*, 2018-19 the correlation between larval population and weather parameters *viz.*, minimum temperature, maximum temperature, relative humidity and rainfall has been given in Table- 3. It is evident from data that larval population showed non-significant negative correlation with minimum temperature, maximum temperature and rainfall (-0.403), (-0.022) & (-0.060) while relative humidity showed non-

significant with positive correlation (0.149). The present findings are also in accordance with the findings of Kumar *et al.* (2015) [8] who found that the larval population recorded in chickpea had positive correlation with minimum and maximum temperatures and significant negative correlation with relative humidity. Present findings are also in accordance with the findings of Patel (2015) [11] who reported that the significant negative correlation between larval population of *H. armigera* and evaporation (-0.551) and non-significant effect was observed between larval population of *H. armigera*

and maximum temperature, evening relative humidity. present findings are also in accordance with the findings of Kumar *et al.* (2018b) [9] who found that the mean larval population of *Helicoverpa armigera* on chickpea variety KPG-59 was found positively correlated with maximum temperature (0.495), whereas minimum temperature and relative humidity (7 Hrs and 14 Hrs) shows negative and non-significant correlation (-0.055), (-0.553), respectively. Correlation between rainfall and larval population was found negative and significant (-0.666).

Table 1: Population dynamics of *H. armigera* (Hub.) in chickpea during *Rabi*, 2017-18

| SMW | Larval population/ plants | | | | | | Temperature (°C) | | Relative humidity (%) | Rainfall (mm) |
|-----|---------------------------|------------|------------|------------|------------|------|------------------|---------|-----------------------|---------------|
| | Location 1 | Location 2 | Location 3 | Location 4 | Location 5 | Mean | Minimum | Maximum | | |
| 44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 14.1 | 31.0 | 65.4 | 0.0 |
| 45 | 0.22 | 0.27 | 0.26 | 0.23 | 0.24 | 0.24 | 12.7 | 29.7 | 67.2 | 0.0 |
| 46 | 0.41 | 0.41 | 0.44 | 0.46 | 0.45 | 0.43 | 11.8 | 29.0 | 67.4 | 0.0 |
| 47 | 0.59 | 0.6 | 0.61 | 0.65 | 0.45 | 0.58 | 11.1 | 27.3 | 67.4 | 0.0 |
| 48 | 0.79 | 0.86 | 0.96 | 0.9 | 0.72 | 0.85 | 12.2 | 25.8 | 79.9 | 0.0 |
| 49 | 1.23 | 0.98 | 1.18 | 1.12 | 1.07 | 1.12 | 11.7 | 19.2 | 86.6 | 0.0 |
| 50 | 1.12 | 0.92 | 0.97 | 0.98 | 1.00 | 1.00 | 9.0 | 19.5 | 86.9 | 0.0 |
| 51 | 1.59 | 1.65 | 1.48 | 1.49 | 1.47 | 1.54 | 7.5 | 23.2 | 74.0 | 0.0 |
| 52 | 1.72 | 1.68 | 1.73 | 1.76 | 1.70 | 1.72 | 10.6 | 20.1 | 84.1 | 0.0 |
| 01 | 1.39 | 1.24 | 1.31 | 1.23 | 1.41 | 1.32 | 10.2 | 18.0 | 88.2 | 0.0 |
| 02 | 1.19 | 1.11 | 1.06 | 1.12 | 1.14 | 1.12 | 4.9 | 20.6 | 66.3 | 0.0 |
| 03 | 1.51 | 1.54 | 1.48 | 1.44 | 1.42 | 1.48 | 5.9 | 22.4 | 68.0 | 0.0 |
| 04 | 1.26 | 1.21 | 1.44 | 1.38 | 1.20 | 1.30 | 9.1 | 23.7 | 76.0 | 16.8 |
| 05 | 1.12 | 1.08 | 1.2 | 1.18 | 1.15 | 1.15 | 8.2 | 21.9 | 80.2 | 0.0 |
| 06 | 1.24 | 1.32 | 1.28 | 1.26 | 1.35 | 1.29 | 8.4 | 24.5 | 69.3 | 41.0 |
| 07 | 2.02 | 1.96 | 1.92 | 2.1 | 1.98 | 2.00 | 9.9 | 25.7 | 70.3 | 0.0 |
| 08 | 2.52 | 2.57 | 2.55 | 2.46 | 2.55 | 2.53 | 11.1 | 27.9 | 63.9 | 0.0 |
| 09 | 2.91 | 2.86 | 2.92 | 2.75 | 2.66 | 2.82 | 11.5 | 28.8 | 57.8 | 0.0 |
| 10 | 3.12 | 3.15 | 3.11 | 3.2 | 3.18 | 3.15 | 12.3 | 27.8 | 62.4 | 0.0 |
| 11 | 3.08 | 3.08 | 2.64 | 2.54 | 2.64 | 2.80 | 10.0 | 29 | 56.8 | 0.77 |
| 12 | 1.70 | 1.76 | 1.78 | 1.82 | 1.72 | 1.76 | 15.5 | 33.4 | 50.9 | 0.0 |
| 13 | 1.40 | 1.53 | 1.62 | 1.56 | 1.64 | 1.55 | 18.8 | 37.8 | 52.0 | 0.0 |
| 14 | 0.81 | 0.84 | 0.75 | 0.69 | 0.76 | 0.77 | 20.2 | 37.2 | 57.5 | 0.0 |

Table 2: Population dynamics of *H. armigera* (Hub.) in chickpea during *Rabi*, 2018-19

| SMW | Larval populations/plants | | | | | | Temperature (°C) | | Relative humidity (%) | Rainfall (mm) |
|-----|---------------------------|------------|------------|------------|------------|------|------------------|---------|-----------------------|---------------|
| | Location 1 | Location 2 | Location 3 | Location 4 | Location 5 | Mean | Minimum | Maximum | | |
| 44 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 0.00 | 15.5 | 31.8 | 69.6 | 0.0 |
| 45 | 0.25 | 0.36 | 0.62 | 0.32 | 0.42 | 0.39 | 12.7 | 28.7 | 68.3 | 0.0 |
| 46 | 0.46 | 0.40 | 0.44 | 0.42 | 0.52 | 0.45 | 14.1 | 30.3 | 71.2 | 0.0 |
| 47 | 0.47 | 0.66 | 0.16 | 0.56 | 0.49 | 0.47 | 11.0 | 27.8 | 67.5 | 0.0 |
| 48 | 0.90 | 0.90 | 0.82 | 0.72 | 0.65 | 0.8 | 11.0 | 26.8 | 70.7 | 0.0 |
| 49 | 1.4 | 1.35 | 1.30 | 1.32 | 1.40 | 1.35 | 8.5 | 25.2 | 71.0 | 0.0 |
| 50 | 1.28 | 1.35 | 1.15 | 1.18 | 1.20 | 1.23 | 7.5 | 24.2 | 69.0 | 0.0 |
| 51 | 1.85 | 1.20 | 1.56 | 1.72 | 1.32 | 1.53 | 5.0 | 23.2 | 71.3 | 0.0 |
| 52 | 1.68 | 1.75 | 1.95 | 1.83 | 1.78 | 1.8 | 6.3 | 23.5 | 70.5 | 0.0 |
| 01 | 1.44 | 1.32 | 1.27 | 1.34 | 1.40 | 1.35 | 5.3 | 22.5 | 72.2 | 0.0 |
| 02 | 0.85 | 0.70 | 0.95 | 0.73 | 0.85 | 0.82 | 5.7 | 21.8 | 72.0 | 0.0 |
| 03 | 1.26 | 1.40 | 1.30 | 1.35 | 1.28 | 1.32 | 5.0 | 22.5 | 70.5 | 0.0 |
| 04 | 1.16 | 1.20 | 1.05 | 1.20 | 1.00 | 1.12 | 10.6 | 21.1 | 76.1 | 41.0 |
| 05 | 1.78 | 1.92 | 1.74 | 1.68 | 1.75 | 1.77 | 7.1 | 21.7 | 74.9 | 0.0 |
| 06 | 1.66 | 1.68 | 1.84 | 1.41 | 1.15 | 1.55 | 6.7 | 21.8 | 72.5 | 41.0 |
| 07 | 2.30 | 2.46 | 2.35 | 2.24 | 2.56 | 2.38 | 10.5 | 21.8 | 76.6 | 0.0 |
| 08 | 2.30 | 2.76 | 2.69 | 2.14 | 2.42 | 2.46 | 11.2 | 25.3 | 69.1 | 0.0 |
| 09 | 3.60 | 2.45 | 3.29 | 3.14 | 3.32 | 3.16 | 10.0 | 22.9 | 72.7 | 0.0 |
| 10 | 2.44 | 2.66 | 3.64 | 2.66 | 2.56 | 2.79 | 9.8 | 22.8 | 74.0 | 0.0 |
| 11 | 3.60 | 2.44 | 2.47 | 2.24 | 2.28 | 2.61 | 12.7 | 30.0 | 60.4 | 0.0 |
| 12 | 1.36 | 1.90 | 1.22 | 1.24 | 1.36 | 1.42 | 15.5 | 31.9 | 60.5 | 0.0 |
| 13 | 1.33 | 1.21 | 1.24 | 1.14 | 1.67 | 1.32 | 18.8 | 34.0 | 62.1 | 0.0 |
| 14 | 0.74 | 0.67 | 0.47 | 0.57 | 0.37 | 0.56 | 20.2 | 29.4 | 64.3 | 7.0 |

Table 3: Correlation between Larval population of *H. armigera* (Hub.) and abiotic factors on chickpea during *Rabi*, 2017-18

| Larval population | Temperature (°C) | | R.H. (%) | Rainfall (mm) |
|-----------------------|------------------|---------|----------|---------------|
| | Minimum | Maximum | | |
| <i>Rabi</i> , 2017-18 | -0.050 | 0.088 | -0.349 | -0.063 |
| <i>Rabi</i> , 2018-19 | -0.403 | -0.222 | 0.149 | -0.060 |

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