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INFLUENCE OF ABIOTIC FACTORS ON THE POPULATION DYNAMICS OF GRAM POD BORER (*HELICOVERPA ARMIGERA*) IN CHICKPEA

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ABSTRACT

The study examined the population dynamics of *Helicoverpa armigera* larvae on chickpea (*Cicer arietinum* L.) in relation to weather parameters. The larval population was first appeared at a density of 0.20 larvae per plant in the 2nd Standard Meteorological Week (SMW) and increased progressively, reaching a peak of 3.80 larvae per plant in the 11th SMW. The population subsequently declined to 2.80 larvae per plant in the 12th SMW. The peak larval population coincided with a maximum temperature of 28.70°C, a minimum temperature of 13.10°C, and no recorded rainfall. Correlation analysis indicated a significant positive relationship between larval population and maximum temperature ($r = 0.53^{*}$). However, non-significant correlations were observed with minimum temperature ($r = 0.43^{NS}$), sunshine hours ($r = 0.41^{NS}$), rainfall ($r = 0.28^{NS}$), evening relative humidity ($r = 0.04^{NS}$), while morning relative humidity showed a slight negative correlation ($r = -0.02^{NS}$).) These findings emphasize the role of climatic factors in influencing *H. armigera* infestation on chickpea crop.

Key words: Chickpea, Population dynamics, gram pod borer, Weather factors, Temperature, Relative Humidity.

Introduction

Chickpea (*Cicer arietinum* L.) is an agriculturally and nutritionally significant legume (Dixit *et al*., 2017), commonly known as Bengal gram, ceci bean, chana, and garbanzo bean (Patil *et al.*, 2017). India cultivates two major varieties: the small brown-seeded desi type, covering 80–85% of the area (Gaur *et al*., 2016), and the cream-colored kabuli type, occupying 10–15% area. Chickpea is rich in protein (19 g/100 g), energy (364 kcal/ 100 g), carbohydrates (61 g/100 g), and essential micronutrients, including iron 34 per cent, with medicinal properties beneficial for gastrointestinal health and cholesterol reduction (Anon.,2018). Additionally, it provides higher calcium and phosphorus levels than other pulses and contains more calcium than whole cow's milk (120 mg/100 g) (Yegrem, 2021). India cultivates chickpea over 10.74 million hectares, producing 13.54 million tons with a productivity of 1261 kg/ha, while Bihar accounts for 0.051 million hectares and 0.054 million tons with a productivity of 1053 kg/ha (Anon., 2023). However, production is constrained by biotic and abiotic factors, with insect pests being a major threat. The gram pod borer (*Helicoverpa armigera*), aphids, leafhoppers, and gram semi-loopers are significant pests, with *H. armigera* being the most destructive. This Noctuidae lepidopteran is highly polyphagous, infesting over 182 host plants, including pigeon pea, cotton, maize, and tomato (Pawar, 1998; Gowda *et al*., 2005). Early instars feed on foliage, while later stages damage floral buds and pods, causing 75–90% yield losses and, in severe cases, total crop failure (Jeyarani *et al*., 2010). Abiotic factors such as temperature, humidity, rainfall, and photoperiod (Yadava *et al*., 1991) significantly influence *H. armigera* incidence, necessitating meteorological data integration for pest forecasting and management (Hameed *et al*., 2015), ensuring yield stability and enhanced productivity.

Materials and Methods

A field experiment was conducted during the *Rabi* season, 2023-24 at the agricultural research farm of TCA, Dholi, Bihar. The popular chickpea variety P-3043, was sown in plot size of 10 m × 10 m at spacing of 30 cm x 10 cm. The crop was grown by adopting standard agronomic practices recommended by RPCAU, Pusa, Bihar except plant protection measures (spraying). Observations were conducted on the number of gram pod borer larvae found on five randomly selected plants. These observations took place at weekly intervals, beginning three weeks after sowing. This systematic approach allowed for consistent monitoring of larval populations over time, providing valuable data on their development and potential impact on the plants throughout the cropping period. Weather data including temperature (max & min), rainfall, bright sunshine hours, and relative humidity (RH) were taken from meteorological observatory, TCA, Dholi. The data were subjected to statistical analysis to determine the correlation between the gram pod borer larvae and abiotic factors.

Results and Discussion

The data indicates that the larval population was present on chickpea after 4 weeks of sowing and which was exhibiting low numbers during the early vegetative stage, intermediate levels during the flowering stage, and elevated populations during the pod development stage. The initial appearance of *H. armigera* larvae (0.20 larvae per plant) was recorded in the 2nd SMW. At this time, the maximum temperature was 18.10°C, the minimum temperature was 7.5°C, morning relative humidity was measured at 87.50 per cent, evening relative humidity at 84.10 per cent, and bright sunshine duration was recorded at 2.11 hours (Table 1 and Fig. 1). It is noteworthy that no rainfall was observed during this period.

The larval population peaked at the 11th meteorological week, with an average of 3.8 larvae per plant. At this time, the maximum temperature was 28.70°C, the minimum temperature was 13.10°C, morning humidity was 86.70 per cent, evening humidity was 86.10 per cent, there was no recorded rainfall (0.00 mm), and bright sunshine lasted for 4.83 hours (refer to Table 1 and Fig. 1). In the following week, the larval population exhibited a gradual decline, with an average of 2.8 larvae per plant recorded during the 12th Standard Meteorological Week. During this period, the maximum temperature was 25°C and the minimum temperature was 13.70°C. Morning relative humidity was measured at 86.40 per cent, while evening relative humidity was at 91.00 per cent. Additionally, rainfall amounted to 51 millimeters, and bright sunshine duration was recorded at 5.51 hours (refer to Table 1 and Fig. 1).

Analysis of the simple correlation coefficient between the larval population of *Helicoverpa armigera* and various weather parameters, including maximum and minimum temperature (°C), relative humidity (morning and evening), and bright sunshine hours, revealed significant findings (Table 2). The larval population exhibited a significantly positive correlation with maximum

Table 1: Mean larval population of gram pod borer, (*H. armigera*)in relation to the weather parameter on chickpea during *Rabi*, 2023-2024.

SMW	Mean No. of larvae per plant	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Bright sunshine (hrs)
		Max.	Min.	Morning	Evening		
1 (01 Jan- 07 Jan)	0.00	21.70	5.40	88.70	82.00	0.00	0.00
2 (08 Jan - 14 Jan)	0.20	18.10	7.50	87.50	84.10	0.00	2.11
3 (15 Jan - 21 Jan)	0.20	14.70	6.50	87.00	87.80	0.00	2.81
4 (22 Jan - 28 Jan)	0.40	14.40	5.20	86.70	88.00	0.00	2.33
5 (29 Jan - 04 Feb)	1.20	22.20	6.50	87.50	80.00	0.00	4.39
6 (05 Feb - 11 Feb)	1.00	20.70	9.80	85.80	91.00	0.00	6.37
7 (12 Feb - 18 Feb)	1.40	22.40	11.00	77.70	88.20	0.00	6.86
8 (19 Feb - 25 Feb)	2.60	25.40	10.70	84.20	79.70	0.00	5.90
9 (26 Feb – 04 Mar)	2.80	25.90	10.70	88.10	92.00	0.00	6.84
10 (05 Mar – 11 Mar)	3.20	25.70	12.00	85.80	73.20	0.00	7.54
11 (12 Mar - 18 Mar)	3.80	28.70	13.10	86.70	86.10	0.00	4.83
12 (19 Mar - 25 Mar)	2.80	25.00	13.70	86.40	91.00	51.00	5.51
13 (26 Mar - 01 Apr)	2.20	25.20	16.20	91.20	98.80	0.00	7.61
14 (02 Apr - 08 Apr)	1.00	25.20	16.20	91.20	91.80	0.00	9.13
15 (09 Apr - 15 Apr)	0.40	33.20	17.70	83.20	77.00	0.00	9.16

SMW: Standard Meteorological Week

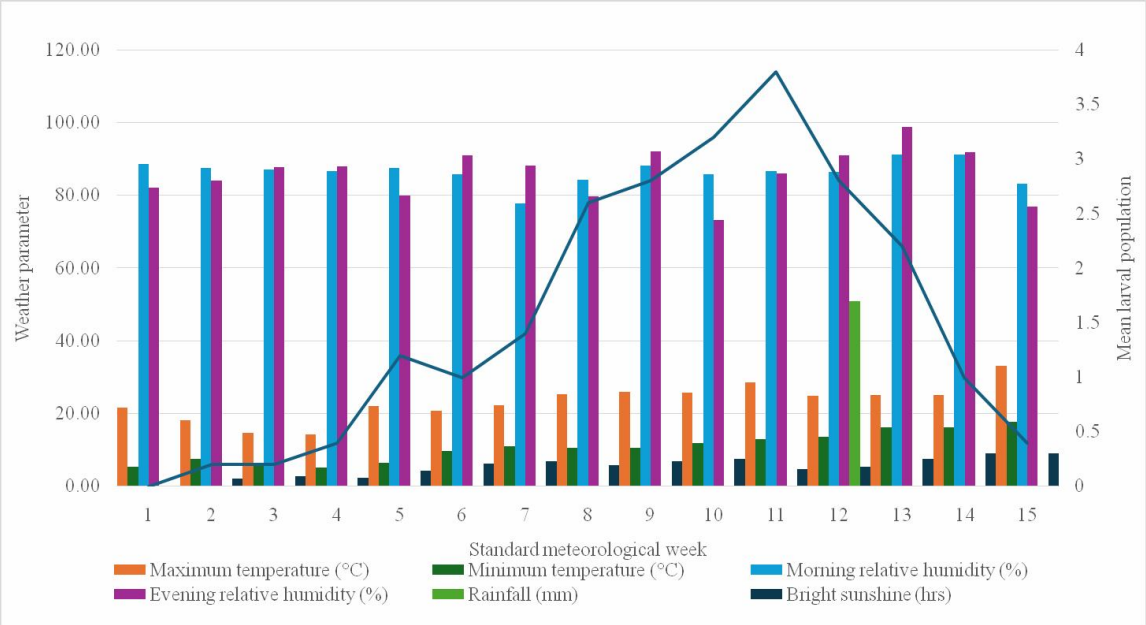

Fig 1: Population dynamics of gram pod borer on chickpea in relation to abiotic factors during *Rabi*, 2023 –2024. Correlation between larval population of *H. armigera* and weather parameter

Table 2: Correlation of weather parameters with gram pod borer (*H. armigera*) during *Rabi*, 2023-2024.

Weather parameters	Correlation Coefficient
Maximum temperature (°C)	0.53*
Minimum temperature (°C)	0.43^{NS}
Morning relative humidity (%)	-0.02^{NS}
Evening relative humidity (%)	0.04^{NS}
Rainfall (mm)	0.28^{NS}
Bright sunshine (hrs)	0.41^{NS}

*5% Level of Significance, NS = non-significant

temperature (r = 0.53*) while showing non-significant positive correlations with minimum temperature (r = 0.43^{NS}), bright sunshine hours (r = 0.41^{NS}), rainfall (r = 0.28^{NS}), and evening relative humidity (r = 0.04^{NS}). Additionally, morning relative humidity demonstrated a non-significant negative correlation with the larval population (r = -0.02^{NS}).

The present findings are similar those of Sharma *et al.* (2020) and Kumar *et al.* (2022) they reported that the highest larval population was observed at 11th standard meteorological week. The findings of Bajya *et al.* (2022) were in line with the present study, who reported highest larval population during the pod formation stage and had significant positive correlation with maximum temperature (r = 0.58*) and non-significant positive correlation with minimum temperature (r = 0.287), while relative humidity showed negative correlation with gram pod borer. Similarly, Tomar *et al.* (2023) reported that the mean larval population of *H. armigera* had significant positive correlation with maximum temperature (r = 0.57*). The minimum temperature (r = 0.21) and bright sunshine (r = 0.45) showed non-significant positive correlation with larval population of gram pod borer. Reddy *et al.* (2009) also noted that rainfall (r = 0.03) and sunshine hours (r =0.23) showed non-significant positive correlation with larval population of gram pod borer.

Conclusion

In conclusion, the study reveals that the larval population of *Helicoverpa armigera* on chickpea follows a distinct pattern, with low numbers during the early vegetative stage, increasing during flowering, and peaking at the pod development stage. The population first appeared in the 2nd Standard Meteorological Week and reached its highest levels in the 11th week before gradually declining. Correlation analysis revealed a significant positive relationship between larval population and maximum temperature, while other weather parameters showed non-significant correlations. These findings suggest that temperature plays a key role in influencing larval dynamics, which can help in developing effective pest management strategies.

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