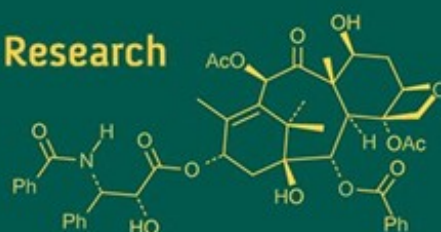


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Seasonal dynamics of major insect pests of chickpea in relation to weather parameters

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ABSTRACT

A field investigation was conducted during the rabi season of 2024-25 at the Student Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India, to study the seasonal incidence of major insect pests of chickpea (*Cicer arietinum* L.) and their association with weather parameters. The incidence of gram pod borer (*Helicoverpa armigera* Hübner), cutworm (*Agrotis ipsilon* Hufnagel) and termite (*Odontotermes obesus* Rambur) was monitored at weekly intervals under natural field conditions. Correlation analysis was performed to assess the relationships between pest incidence and meteorological parameters, including maximum and minimum temperature, relative humidity, rainfall, wind speed and sunshine duration. *H. armigera* exhibited substantial seasonal fluctuations, with its highest recorded incidence of 5.80 larvae per plant during the 9th standard meteorological week (SMW). Cutworm and termite incidence was comparatively higher during the early crop-growth period, with initial occurrence recorded in the 47th SMW. Correlation analysis revealed positive associations of *H. armigera* incidence with minimum temperature ($r = 0.554$) and sunshine hours ($r = 0.383$), whereas morning RH showed a negative association ($r = -0.412$). Cutworm incidence was negatively associated with wind speed ($r = -0.564$), while termite incidence exhibited negative associations with sunshine hours ($r = -0.355$), minimum temperature ($r = -0.425$) and wind speed ($r = -0.444$). These findings demonstrate species-specific associations between weather parameters and pest population dynamics. Integrating regular field surveillance with meteorological parameters may improve pest forecasting and support the timely implementation of integrated pest management strategies in chickpea under similar agro-climatic conditions.

Keywords: Chickpea, *Helicoverpa armigera*, Seasonal incidence, Weather parameters

Introduction

Chickpea (*Cicer arietinum* L.), commonly known as gram or bengal gram, is one of the most important pulse crops cultivated in the semi-arid and subtropical regions of the world. It is an important source of protein, carbohydrates and other essential nutrients and plays a significant role in ensuring food and nutritional security. Chickpea grains contain approximately 21.5% protein, 64.5% carbohydrates and 4.5% fat (Sahu *et al.*, 2021) [1]. Besides its nutritional importance, the crop also contributes to sustainable agriculture through its ability to fix atmospheric nitrogen and improve soil fertility (Gebremariam *et al.*, 2021) [2]. Chickpea (*Cicer arietinum* L.) is one of the most important pulse crops cultivated globally and holds particular significance in Indian agriculture. During the year 2024, chickpea was cultivated over approximately 14.12 million ha worldwide, producing about 16.88 million tonnes with an average productivity of 1,195.2 kg/ha. Alone in India chickpea was cultivated over an area of about 9.59 million hectares producing 11.04 million tonnes with an average productivity of 1,151.4 kg/ha (FAO, 2024) [3].

However, chickpea productivity is constrained by several biotic and abiotic stresses, with insect pests being among the important factors limiting crop production. The crop is attacked by a diverse range of insect pests at different stages of growth, of which the chickpea pod borer, *Helicoverpa armigera* (Hübner), termites, cutworm, *Agrotis ipsilon* (Hufnagel), beet armyworm, *Spodoptera exigua* (Hübner) and black aphid, *Aphis craccivora* Koch, are reported as important pests. Among these, the chickpea pod borer is considered a highly serious pest and has been reported to cause 44-74% damage in Uttar Pradesh, while termites and cutworms are also recognized as serious pests of chickpea. The beet armyworm has emerged as an important pest particularly in southern India, whereas the black aphid, previously considered a minor pest, has gained prominence and has been associated with substantial yield losses (Bhowmik *et al.*, 2025) [4]. The occurrence and population abundance of insect pests vary throughout the crop season. Their appearance, population build-up and peak activity are influenced by crop growth stages and prevailing environmental conditions (Kumar *et al.*, 2026) [5]. However, the intensity and period of pest occurrence may vary among locations and

seasons (Bapatla *et al.*, 2021) [6]. Meteorological factors play an important role in regulating insect pest populations. Temperature, relative humidity, rainfall and other weather parameters can influence insect development, survival, reproduction and activity. These factors may also affect crop growth and host plant suitability, thereby indirectly influencing pest incidence (Likhitar *et al.*, 2025) [7].

The study of seasonal incidence provides information on the time of appearance, population build-up, peak activity and decline of insect pests during the cropping season. When pest incidence is studied in relation to meteorological parameters, it helps in identifying the environmental conditions favourable for pest development and population increase. Such information is useful for strengthening pest surveillance, developing forecasting systems and improving the timing of pest management decisions (Heeb *et al.*, 2019) [8]. Therefore, a systematic understanding of the seasonal incidence of major insect pests and their relationship with weather parameters is essential for predicting pest occurrence under specific agro-climatic conditions. In view of this, the present investigation was undertaken to study the seasonal incidence of major insect pests of chickpea and to determine the effect of meteorological parameters on their incidence.

Material and Methods

Experimental site

The present investigation was conducted during the Rabi season of 2024-25 at the Student Instructional Farm, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur, Uttar Pradesh, India. Kanpur is situated in the central-western region of Uttar Pradesh within the Indo-Gangetic Plains and lies at 26.449923°N latitude and 80.331874°E longitude, at an average elevation of 126.83 meters above mean sea level.

Crop and field preparation

The experimental field was prepared by providing a pre-sowing irrigation followed by ploughing and harrowing to obtain a suitable seedbed. The field was subsequently levelled by planking. Chickpea variety Uday (KPG-59) was grown, following the recommended agronomic practices for chickpea cultivation. The crop was maintained under normal field conditions and no insecticidal treatment was applied so that the natural occurrence and population development of insect pests could be observed throughout the cropping season.

Observation on seasonal incidence of major insect pests

Observations on the seasonal incidence of major insect pests of chickpea were recorded at weekly intervals throughout the crop season. The occurrence, population build-up and peak activity of the major insect pests were recorded from the germination of the crop until crop maturity.

The population of gram pod borer, *Helicoverpa armigera* (Hübner), was recorded by counting the number of larvae on 5 randomly selected plants in the untreated crop area (Kumawat *et al.*, 2025) [9]. The incidence of cutworm, *Agrotis ipsilon* (Hufnagel), was recorded by counting the total number of plants and damaged plants at weekly intervals. Similarly, observations on termite infestation, were recorded by counting the total and damaged plants per square metre during the seedling and vegetative stages (Yadav *et al.*, 2025) [10]. The observations recorded during successive standard meteorological

weeks were used to determine the period of initial appearance, population fluctuation, peak incidence and decline of the major insect pests during the cropping season.

Statistical analysis

Correlation analysis

The relationship between pest incidence and weather parameters was assessed using correlation coefficients to determine the direction and strength of association between pest population and individual meteorological parameters. Correlation-based assessment of meteorological parameters has been widely used in studies on the seasonal incidence of major insect pests of chickpea by calculating the correlation values and multiple regression equations between the mean population of insect pests and meteorological parameters. Weekly meteorological data during the crop period were obtained from the Agro-meteorological Observatory, Department of Agronomy, Chandra Shekhar Azad University of Agriculture and Technology, Kanpur.

Results

Seasonal incidence of major insect pests of chickpea

The seasonal incidence of major insect pests of chickpea was monitored at weekly intervals during the *rabi* season 2024-25 and is represented in Table 1. The incidence of gram pod borer, *Helicoverpa armigera* (Hübner), cutworm, *Agrotis ipsilon* (Hufnagel) and termite, *Odontotermes obesus* Rambur, was recorded in relation to the prevailing weather conditions. During the crop period, maximum temperature ranged from 15.20 to 33.40 °C, minimum temperature from 6.10 to 17.40 °C, morning relative humidity from 70 to 95%, evening relative humidity from 31 to 79%, wind speed from 1.50 to 7.50 km/h, and rainfall from 0.00 to 0.30 mm/day.

Gram pod borer, *Helicoverpa armigera* (Hübner)

The first occurrence of *H. armigera* was recorded during the 50th SMW. The larval population ranged from 0.25 to 5.80 larvae/plant during the crop season. The population showed considerable fluctuations and two distinct periods of higher incidence were observed. The first peak was recorded during the 52nd SMW, after which the population declined during the 1st to 4th SMW, with larval populations of 1.67, 0.90, 0.60 and 0.85 larvae/plant, respectively. Thereafter, the population increased gradually and attained the highest recorded incidence of 5.80 larvae/plant during the 9th SMW.

Cutworm, *Agrotis ipsilon* (Hufnagel)

Cutworm incidence was first observed during the 47th SMW. The population ranged from 0.10 to 1.80 larvae/plant during the observation period. The population increased after its initial appearance and attained its peak during the 48th SMW, followed by a gradual decline. The seasonal fluctuation indicates that cutworm activity was concentrated during the early part of the crop season.

Termite, *Odontotermes obesus* Rambur

Termite infestation was first recorded during the 47th SMW. The population ranged from 0.15 to 1.60 individuals/plant during the crop season. The population showed fluctuations during the observation period, with a higher incidence recorded around the 50th SMW, followed by a decline.

Table 1. Seasonal incidence of major insect pests of chickpea

SMW	Temperature (°C)		Relative Humidity (%)		Wind Speed (km/hr)	Rainfall (mm/day)	Sunshine hours	Mean Population of Insect Pests		
	Maximum Temp.	Minimum Temp.	Morning RH	Evening RH				Gram pod borer (Number of larvae/plant)	Cutworm (No. of damaged plant/m ²)	Termites (No. of damaged plant/m ²)
47	26.70	11.50	90.00	48.00	1.60	0.00	0.00	0.00	1.20	0.50
48	26.70	9.80	92.20	45.80	1.60	0.00	6.60	0.00	1.80	0.85
49	26.80	10.00	80.00	34.00	3.00	0.00	6.20	0.00	1.40	1.20
50	23.40	7.30	80.00	33.00	4.40	0.00	4.90	0.25	0.75	1.60
51	24.40	6.10	90.00	45.20	1.50	0.00	1.50	0.80	0.40	1.00
52	22.40	11.70	91.40	66.80	4.10	0.20	0.00	1.55	0.10	0.75
1	15.20	7.30	91.00	79.00	3.40	0.00	0.00	1.67	0.00	0.40
2	19.10	6.60	95.00	61.10	3.30	0.30	0.00	0.90	0.00	0.15
3	21.70	9.20	90.00	60.00	5.30	0.00	2.70	0.60	0.00	0.00
4	24.50	8.20	83.00	36.00	5.00	0.00	7.70	0.85	0.00	0.00
5	27.20	9.20	91.00	39.00	2.70	0.00	5.50	1.60	0.00	0.00
6	25.80	10.10	75.00	38.00	6.40	0.00	8.70	2.50	0.00	0.00
7	28.10	11.80	80.00	38.00	5.80	0.00	9.20	3.40	0.00	0.00
8	27.80	11.70	84.00	39.00	3.80	0.00	7.30	4.10	0.00	0.00
9	29.40	14.90	80.00	41.00	4.70	0.00	5.50	5.80	0.00	0.00
10	29.70	11.90	70.00	31.00	7.50	0.00	9.10	3.00	0.00	0.00
11	33.40	17.40	72.00	32.00	4.10	0.00	8.80	2.30	0.00	0.00
12	32.90	13.30	73.00	32.00	3.20	0.00	9.20	1.50	0.00	0.00

Correlation between insect pest incidence and meteorological parameters

The correlation coefficient values were assessed between the incidence of major insect pests and meteorological parameters (maximum and minimum temperature, relative humidity, wind speed, rainfall and sunshine hours) and is represented in Table 2.

Gram pod borer, *Helicoverpa armigera* (Hübner)

Pearson's correlation analysis revealed that the population of *Helicoverpa armigera* exhibited a significant positive correlation with minimum temperature ($r = 0.554^*$) and wind velocity ($r = 0.497^*$). This indicates that the population of *H. armigera* tended to increase with an increase in minimum temperature and wind velocity during the study period. Thus, an increase in minimum temperature was associated with an increase in *H. armigera* population, suggesting that comparatively higher minimum temperatures may favour population build-up of the pest. Similarly, increasing wind velocity was associated with an increase in *H. armigera* population. Positive but non-significant correlations were observed with maximum temperature ($r = 0.358$) and sunshine hours ($r = 0.383$). Negative but non-significant correlations were recorded with morning relative humidity ($r = -0.412$), evening relative humidity ($r = -0.184$) and rainfall ($r = -0.125$).

Cutworm, *Agrotis ipsilon* (Hufnagel)

The cutworm population showed a significant negative correlation with wind velocity ($r = -0.564^*$). This negative association indicates that an increase in wind velocity was associated with a reduction in cutworm population during the study period. Thus, increasing wind velocity may be associated with a decline in cutworm population, whereas comparatively lower wind velocity may favour its population build-up. The population showed positive but non-significant correlation with maximum temperature ($r = 0.026$) and morning relative humidity ($r = 0.233$). Negative and non-significant correlations were observed with minimum temperature ($r = -0.156$), evening relative humidity ($r = -0.102$), rainfall ($r = -0.170$) and sunshine hours ($r = -0.125$).

Termite, *Odontotermes obesus* Rambur

The termite population did not exhibit a statistically significant correlation with any of the meteorological parameters studied. Negative correlations were observed with maximum temperature ($r = -0.280$), minimum temperature ($r = -0.425$), wind velocity ($r = -0.444$) and sunshine hours ($r = -0.355$), whereas positive correlations were recorded with morning relative humidity ($r = 0.240$), evening relative humidity ($r = 0.053$) and rainfall ($r = 0.022$). However, since none of these relationships were statistically significant no definite inference regarding an increase or decrease in termite population with changes in these meteorological parameters can be drawn from the present correlation analysis.

Table 2. Correlation coefficients between the mean insect pest population and meteorological parameters

Insect pests	Max. temp.	Min. temp.	Morning RH	Evening RH	Wind velocity	Rainfall	Sunshine hours
Gram pod borer	0.358	0.554*	-0.412	-0.184	0.497*	-0.125	0.383
Cutworm	0.026	-0.156	0.233	-0.102	-0.564*	-0.170	-0.125
Termites	-0.280	-0.425	0.240	0.053	-0.444	0.022	-0.355

Significance levels: *significant at $p < 0.05$

Discussion

Seasonal incidence of major insect pests of chickpea

The seasonal incidence of *Helicoverpa armigera* showed considerable fluctuations during the chickpea growing season, with the second peak during the 9th SMW potentially associated with pod development. Similar findings were reported by Singh *et al.* (2006) [11], who highlighted the susceptibility of chickpea during the podding stage. The possible influence of rainfall on pest persistence is supported by Reddy *et al.* (2009) [12], who reported the adverse effects of rainfall on eggs and early-instar larvae. The early incidence of *Agrotis ipsilon* may be attributed to the availability of young seedlings, which are vulnerable to cutworm damage, as similarly reported by Batham *et al.* (2019) [13]. Population fluctuations associated with environmental conditions are consistent with the findings of Yadav *et al.* (2025) [10]. Similarly, the incidence of *Odontotermes obesus* may affect crop establishment through damage to germinating seeds and seedlings, as reported by Batham *et al.* (2019) [13], while Ojha *et al.* (2017) [14] also highlighted the adverse effects of termite infestation on plant growth. These findings emphasize the importance of regular pest monitoring and timely management throughout the chickpea growing season.

Relationship between insect pest incidence and meteorological parameters

Malik *et al.* (2016) [15] and Spoorthi *et al.* (2017) [16] reported that temperature influences the development and survival of *Helicoverpa armigera*. Singh *et al.* (2006) [11] reported that suitable temperatures favour pest development. Reddy *et al.* (2009) [12] documented the adverse effects of rainfall and humid conditions on pest survival. Devi *et al.* (2024) [17] reported that windy conditions can restrict moth flight and mating activities in noctuid pests. Sharma *et al.* (2020) [18] observed reduced cutworm survival under prolonged sunlight due to desiccation and predation. Singh *et al.* (2025) [19] and Batham *et al.* (2019) [13] reported declines in noctuid pest populations under prolonged wet conditions. Juergens *et al.* (2023) [20] highlighted the importance of sustained soil moisture in regulating termite activity rather than individual rainfall events.

Conclusion

The present study revealed considerable seasonal variation in the incidence of major insect pests of chickpea during the *rabi* season 2024-25. *Helicoverpa armigera* exhibited the highest population fluctuation, with the maximum incidence of 5.80 larvae/plant recorded during the 9th SMW, whereas cutworm and termite incidence was comparatively higher during the early crop period. The correlation analysis showed that pest incidence was associated differently with the prevailing weather parameters. *H. armigera* showed positive associations with temperature, sunshine hours and wind speed, while cutworm and termite showed predominantly negative associations with wind speed and sunshine hours. Relative humidity exhibited contrasting relationships with the three pests. The findings indicate that weather conditions play an important role in the seasonal fluctuation of chickpea insect pests. Regular monitoring of pest populations along with weather parameters can therefore contribute to better understanding and prediction of pest occurrence under local agro-climatic conditions.

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