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SEASONAL OCCURRENCE OF MAJOR INSECT PESTS INFESTING FIELD PEA (*Pisum sativum* L.) IN RELATION WITH WEATHER PARAMETERS IN VARANASI, U.P., INDIA

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ABSTRACT

Field pea (*Pisum sativum* L.) is a significant pulse crop, but its productivity is substantially constrained by insect pests whose occurrence is strongly influenced by prevailing weather conditions. The present study was carried throughout the Rabi season of 2025-26 at the Agricultural Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi, to investigate the seasonal prevalence of major field pea insect pests and their relationship with abiotic factors. Weekly observations were recorded on gram pod borer (*Helicoverpa armigera*), pea leaf miner (*Chromatomyia horticola*), aphid (*Aphis craccivora*) and pea pod borer (*Etiella zinckenella*), and correlated with maximum temperature, minimum temperature and morning and evening relative humidity. Correlation analysis revealed a strong positive association of gram pod borer with maximum and minimum temperature, while population of aphid was correlated negatively with maximum and minimum temperature. Multiple regression analysis explained 87% and 91% of the variation in gram pod borer and aphid populations, respectively, whereas lower coefficients of determination were observed for pea leaf miner and pea pod borer. According to Principal Component Analysis, the first two principal components accounted for 78.19% of the overall variation, with PC1 and PC2 explaining 57.02% and 21.16%, respectively. The study demonstrated that temperature was the predominant weather factor influencing pest incidence, highlighting the potential of weather-based forecasting for timely and sustainable integrated pest management in field pea.

Key words : Field pea, Seasonal prevalence, Correlation analysis, Principal Component Analysis, Integrated pest management.

Introduction

Field pea (*Pisum sativum* L.), a member of the family Fabaceae, is a significant cool-season pulse crop grown widely during the rabi season in India. It is valued for its nutritional richness, economic importance, and role in sustainable agriculture through biological nitrogen fixation (Jensen *et al.*, 2003). The crop acts as a valuable source of carbohydrates, proteins, dietary fiber, minerals, and vitamins, making it an important component of human nutrition and livestock feed (Grela *et al.*, 2010). Field pea is grown for its green pods, fresh seeds, dry grains, and fodder, and is cultivated widely in states such as Madhya Pradesh, Uttar Pradesh, Bihar, West Bengal,

Jharkhand and Assam.

India is one of the top producers of peas in the world, contributing about 27% of world-wide production and 33% of the total cultivated area (Chaturvedi and Ali, 2002). The crop occupies approximately 5.91 lakh ha with an annual production of 9.10 lakh tonnes and an average productivity of 1222 kg ha⁻¹ (MA and FW, 2025). Despite its significance, field pea productivity remains lower than its potential due to several biotic and abiotic constraints. Among the biotic factors, damage caused by insect pests are considered one of the major causes of yield reduction.

More than 24 species of insects have been reported

to infest field pea at various crop growth stages (Bijur and Verma, 1995). Important pests include pea leaf miner (*Chromatomyia horticola*), pea aphid (*Acyrtosiphon pisum*), pea stem fly (*Ophiomyia phaseoli*), field thrips (*Thrips angusticeps*), gram pod borer (*Helicoverpa armigera*), pea pod borer (*Etiella zinckenella*), bean pod borer (*Maruca vitrata*) and blue butterfly (*Lampides boeticus*) (Mittal and Ujagir, 2005; Yadav and Patel, 2015; Tare *et al.*, 2023; Khaliq *et al.*, 2023). Among these, *E. zinckenella* is one of the most destructive pests, causing around 50.9% infestation within pod and 77.64% seed damage, resulting in significant yield losses (Yadav *et al.*, 2000). Similarly, the damage reported from pod borer complex ranged from 13.45-40.38% pod damage in field pea (Dahiya and Naresh, 1993). Leaf miner infestation can also result in substantial foliage damage, adversely affecting crop growth and productivity (Singh *et al.*, 2004).

The occurrence and abundance of insect pests are greatly correlated with prevailing weather conditions such as temperature, relative humidity, rainfall, and sunshine hours. Seasonal fluctuations in these abiotic factors directly affect pest population dynamics, feeding activity, survival, and reproduction (Kumar and Kumar, 2014; Sharma *et al.*, 2024). Understanding the relation between pest incidence and meteorological parameters, therefore becomes essential in prediction of pest outbreaks and implementation of timely management strategies. Information related to seasonal pest occurrence also helps in identifying peak infestation periods and developing effective, eco-friendly pest management practices. Considering the economic importance of field pea and the substantial crop losses caused by insect pests, the present study was undertaken to determine the seasonal incidence and population dynamics of major insect pests of field pea in relation to abiotic environmental factors.

Materials and Methods

The current investigation was carried out during the Rabi season of 2025-26 at the Agricultural Research Farm of Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. HUDP 15 variety of field pea was being sown in different plots of 8 rows of 5-meter length with the spacing of 30 × 10 cm. The crop was grown in Randomized Block Design using three replications and standard agronomic techniques. Five plants were randomly chosen and tagged from each plot that received treatment to observe the Seasonal incidence major insect pest of field pea variety HUDP-15. Regular observations of major insect pests of pea, that are gram pod borer (*Helicoverpa armigera*), pea leaf miner

(*Chromatomyia horticola* aphid (*Aphis craccivora*), and pea pod borer (*Etiella zinckenella*) were recorded. During the year 2025-26 the mature and immature stage of major pests located on various plant sections were regularly counted at frequent interval. The average number of insects from each of the five replications was calculated on standard week basis. The insect infestation for each week was associated with weather parameters such as maximum and minimum Temperature and relative humidity during the Morning and Evening hours. Multiple regression analysis was performed for different pest incidence with weather parameters. Principal Component Analysis was also carried out to estimate the best contributing weather parameter towards the increase in the pest incidence.

Results and Discussion

Incidence of *Helicoverpa armigera*

The pod borer *H. armigera* first appeared in 2025-26 during the 1st standard week. The population remained consistent from the 1st to the 11th standard week in the field. The pod borer population peaked in the 7th standard week (4.40 larvae/meter row length), and then in the 9th standard week (3.64 larvae/meter row length). The 1st standard week had the lowest mean pod borer population (0.35 larvae/meter row length) (Table 1). The current results were consistent with those of Anil *et al.* (2026).

Incidence of *Chromatomyia horticola*

The first instance of *C. horticola* was noticed in the second standard week of 2025-26. From the second to eleventh week, the population remained in the field. The leaf miner population attained its peak level during ninth standard week (73.58% leaf infestation), then in the eighth standard week (65.37% leaf infestation). The second standard week had the lowest leaf miner population (6.10 leaf infestation). The current results were in close agreement with the results of Deepti and Ashwani (2012) who found that the leaf infestation peaked between the third week of February to the second week of March. The infestation persisted until the crop was harvested.

Incidence of *A. craccivora*

The first incidence of *A. craccivora* was noted in the 1st standard week of 2026-27. From the 1st till the 11th standard week, the population remained on the field. Aphid populations peaked in the 5th standard week (67 aphids per top 15 cm twig), then in the 4th standard week (64 aphids/top 15 cm twig). The 11th standard week had the lowest mean aphid population (0.50 aphids/ top 15 cm twig) (Table 1). Rein and Shukla (2021) findings also showed similar observations, who observed highest peak

Table 1 : Population dynamics of major insect-pest of field pea with relation to abiotic parameters during *Rabi* 2025-26.

SMW	Mean population				Temperature		Relative Humidity	
	Gram pod borer (Mean number of larvae/ meter row length)	Pea leaf miner (% leaf infestation)	Aphids (Mean aphid count/ top 15 cm twig on average)	Pea pod borer/ plant	Max	Min	Morning	Evening
1	0.35	0	45.00	0	16.4	8.7	91	61
2	0.53	6.10	63.02	0.38	16.1	7.4	74	55
3	0.85	10.20	57.45	0.56	16.5	8.6	76	62
4	1.91	24.21	64.24	0.73	23.1	9.2	79	50
5	3.49	33.6	67.67	0.97	21.4	8.1	78	38
6	3.73	51.00	41.35	1.21	23.9	10.9	80	53
7	4.40	59.07	30.50	0.86	26.9	13.4	64	44
8	4.05	65.37	14.08	0.74	28.1	15.5	87	44
9	3.64	73.58	7.50	0.48	28.8	16.4	75	54
10	4.80	38.00	3.25	0.32	28.9	14.3	67	48
11	4.95	9.50	0.50	0.11	33.7	19.3	68	41

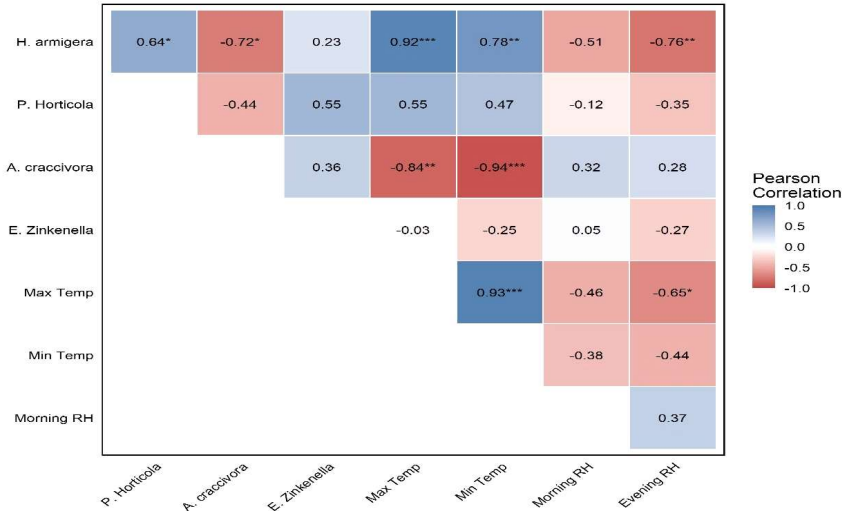


Fig. 1 : Heat map showing correlation between major insect pest of field pea and weather parameters.

population during 6th SMW.

Incidence of *Etiella zinckinella*

The pea bod borer infestation began during the second SMW with a total average of 0.38 larvae per plant. The pest population grew steadily peaking during the sixth SMW (1.21 larvae per plant) and then declining in the weeks that followed. Mane and Singh (2025), who noted the highest pest infestation during the sixth SMW, and Dubey *et al.* (1993), who found peak insect activity during February and March both corroborate these findings.

Correlation analysis of major pests of field pea with weather parameters

Correlation analysis was performed to assess the relationships between major insect pests and weather parameters (Fig. 1). Maximum temperature showed a very strong correlation with gram pod borer incidence ($r=0.92$), gram pod borer also exhibited a significant positive correlation with minimum temperature ($r=0.78$) indicating that higher temperature favored its incidence. Evening relative humidity was significantly and negatively correlated with gram pod borer ($r= -0.76$). The present findings were supported by Shinde *et al.* (2013) and Keval *et al.* (2020), who made a conclusion that there was a strong positive association between both maximum and minimum temperature. Aphid population exhibited a significant negative association with both maximum temperature ($r= -0.84$) and minimum temperature ($r= -0.94$), suggesting that elevated temperatures suppressed aphid population. Moderately positive correlation was observed between both morning and evening relative humidity and aphid population. These results are consistent with those of Rien and Shukla (2021), who found that relative humidity had a positive effect on aphid population. Pea leaf miner showed moderate positive correlations with maximum temperature ($r=0.55$) and minimum temperature ($r=0.47$). Overall, the analysis indicated that temperature was the

Table 2 : Multiple regression models for major pests of field pea with meteorological variables

Pests	Coefficient of determination (R^2)	Equation
Gram pod borer	0.87	$0.404 + (0.308 X_1) + (-0.132 X_2) + (-0.014 X_3) + (-0.042 X_4)$
Pea leaf miner	0.38	$-141.641 + (6.247 X_1) + (-4.596 X_2) + (0.641 X_3) + (0.630 X_4)$
Aphid	0.91	$152.29 + (0.372 X_1) + (-6.182 X_2) + (-0.005 X_3) + (-0.659 X_4)$
Pea pod borer	0.41	$-0.561 + (0.105 X_1) + (-0.162 X_2) + (-0.008 X_3) + (-0.004 X_4)$

Where, X_1 - Maximum Temp, X_2 - Minimum Temp, X_3 - Morning RH, X_4 - Evening RH.

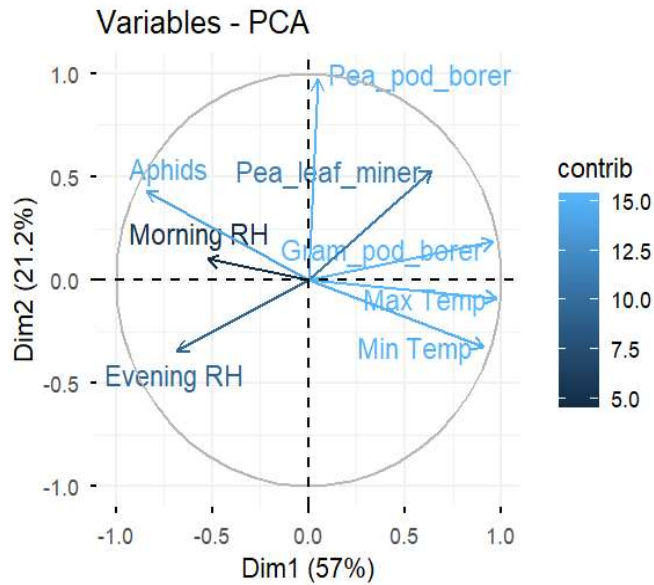


Fig. 2 : Biplot showing the association between pest populations and weather parameters of major pests of field pea.

primary climatic factor. The findings of Mane and Singh (2025), who found a substantial positive association with both maximum and minimum temperature, are supported by our results.

Regression Analysis of major pests of field pea with weather parameters

Multiple regression analysis indicated that weather parameters influenced the populations of insect pests to varying degree. The models explained 87% ($R^2 = 0.90$) and 91% ($R^2 = 0.91$) of the variation in green gram pod borer and aphid populations, respectively demonstrating a strong impact of weather parameters on pest incidence as shown in Table 2. Maximum temperature showed a strong positive correlation with pest incidence, whereas morning relative humidity and evening relative humidity and minimum temperature had negative effects. The regression models for pea leaf miner ($R^2 = 0.38$) and pea pod borer ($R^2 = 0.41$) explained a relatively lower proportion of population variability, indicating that additional factors may also influence their abundance. Maximum temperature consistently favored the buildup of both

pests, whereas higher minimum temperatures were associated with reduced pest populations. Morning and evening relative humidity enhanced the incidence of pea leaf miner but tended to suppress pea pod borer populations. Overall, maximum temperature emerged as the most influential weather variable, showing a consistent positive association with the abundance of all major pea pests.

Principal Component analysis

Principal Component Analysis (PCA), a multivariate statistical technique, was employed to summarize the variation in the dataset and identify the weather variables that contributed most to the overall response of the insect population. The first two principal components (PC1 and PC2) having eigen value greater than one, accounted for 78.195 of the total variation, with PC1 explaining 57.02% and PC2 explaining 21.16% of the variance. The PCA biplot revealed distinct associations between insects and weather parameters as illustrated in Fig. 2. PC1 was primarily influenced by maximum temperature, minimum temperature, gram pod borer, pea leaf miner and pea pod borer which were positively associated with other indicating that higher temperature favoured these pest incidences. Contrary to that, aphid populations were positioned on the negative side of PC1 showing closer association with morning relative humidity. PC2 was primarily characterized by pea pod borer and pea leaf miner. The opposite orientation of the temperature and humidity vectors suggested a negative relationship between these environmental factors. Overall, temperature predominantly influenced gram pod borer, pea leaf miner and pea pod borer incidence, whereas aphid populations were more closely associated with relative humidity.

Conclusion

The present study demonstrated that the incidence and population dynamics of major insect pests of pea are strongly influenced by prevailing weather conditions. Seasonal fluctuations in pest abundance were closely associated with changes in temperature and relative

humidity, which emerged as the most important factors governing pest occurrence. The multivariate analyses revealed clear relationships between climatic variables and pest populations, indicating that weather parameters can serve as reliable indicators for predicting pest outbreaks. Among the weather factors, temperature showed a more consistent influence on pest development, while the effects of relative humidity varied among different pest species. These findings highlight the importance of incorporating weather-based monitoring into pest management programs. Timely forecasting of pest incidence based on meteorological conditions can support informed decision-making, reduce unnecessary pesticide applications, and enhance the effectiveness of integrated pest management strategies. Overall, the study provides valuable insights for developing sustainable and climate-resilient pest management approaches to improve pea productivity and crop protection.

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