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SEASONAL OCCURRENCE OF POD BORER COMPLEX IN AGRO-ECOSYSTEM OF PIGEONPEA AND ITS INTERACTION WITH EXISTING WEATHER VARIABLES IN BUNDELKHAND INDIA

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ABSTRACT

Pigeon pea, *Cajanus cajan* (L.) Millsp. is known as a versatile legume crop in all over the world under semi-arid tropics and subtropical region. The present experiment was carried out at the agricultural research farm of Banda University of Agriculture and Technology, Banda, Uttar Pradesh during two consecutive crop seasons *viz.* k*harif*, 2023-24 and 2024-25. The data recorded on seasonal occurrence of pod borer complex revealed that the chickpea pod borer, *Helicoverpa armigera* Hub. found active from 45th (0.12 larvae/plant) to 01st (1.24 larvae/plant) standard meteorological week (SMW) with peak level of infestation during 48th to 49th MSW (2.98 larvae/plant & 3.95 larvae/plant), whereas legume pod borer, *Maruca vitrata* Fab. recorded on crop from 42nd (0.12 larvae/plant) to 01st (0.98 larvae/plant) standard meteorological week (SMW) with peak level of activity in 49th to 50th SMW (1.85 larvae/plant & 1.75 larvae/plant) during both the years. The values of correlation coefficient showed that the maximum temperatures (r= -0.75* & r= -0.76**), minimum temperature (r= -0.62** & r= -0.72**) and its average (r= -0.60** & r= -0.74**) indicated significant negative interaction, while morning relative humidity (r= -0.01 & r= -0.33), evening relative humidity (r= -0.05 & r= -0.45) and its average affect negatively (r= -0.03 & r= -0.40) affected the occurrence of pod borer complex in agro-ecosystem of pigeon pea non-significant adversely. However, rainfall showed non-significant positive effect during both the cropping seasons.

Keywords **:** Bundelkhand, Interaction, Pigeon pea, Pod borer, Weather Variables.

Introduction

Pigeon pea, *Cajanus cajan* (L.) Millsp. is one of the most significant pulse crop in the semi-arid tropics and many people rely on this crop for their food and livelihood. Pigeon peas were domesticated in the Indian subcontinent and travelled with the slave trade across Asia, Africa and eventually the Americas. More than 50 nations in Asia, Africa, the Americas, and Australia currently grow this crop (Volp *et al*., 2025). It requires comparatively less input that is why mostly cultivated by small and marginal farmers of the region. Pigeon pea shows resistant response against stress as heat and drought. It is a staple food crop which is the mostly used by the vegetarian population as a major source of dietary protein in India (Mula and Saxena, 2010). Over the past ten years, 5.7 million hectares of pigeon pea have been produced about 4.9 million tonnes of grain yearly. Among the world, India is the largest producer and contributor with approximately 77% area and 73% production over the last decades (FAO, 2024). Various biotic and abiotic factors play vital role in the production as well as productivity of this crop out of these, insect pests are the major ones, which causes the serious damage at various growth stages of the crop, ultimately affect the yield. Pigeon peas are attacked by about 300 different insect pest species (Das *et al*., 2025). In India, about 78% of pigeon pea productivity losses were estimated by

different scientists due to insect infestations. At early stage of crop growth, the pod borer complex typically damages 57.07% of the pods and 34.79% of the seeds, resulting in a yield loss of 28.07% (Selvaraj *et al*. 2025). Among pod borer complex, chickpea pod borer, *Helicoverpa armigera* Hub. reported as the most destructive and economically important insect pest, which causes severe damage to legumes by feeding on buds, flowers and pods, and also reduced the yield up to 90% under favourable conditions (Kumar *et al*., 2025). However, legume pod borer, *Maruca vitrata* Fab. is also an important insect pest of many edible legume crops in various growing regions (Das *et al*., 2025). Keeping the above fact in mind, this experiment was designed to investigate the seasonal occurrence pod borer complex on pigeon pea during the crop season and to find out the interaction between occurrence of pod borer complex and different parameters of existing weather.

Materials and Methods

The field experiment was laid out at agricultural research farm of Banda University of Agriculture and Technology, Banda, Uttar Pradesh during two consecutive cropping season of *kharif*, 2023-24 and 2024-25. The pigeon pea var. IPA-15-6 was sown in 1st week of July with plot size of 45 m^2 (10 rows of 6 meter length) having crop spacing of 75×60 cm and replicated thrice. The recommended agronomic practices except plant protection measures were followed. The seasonal incidence of pod borer complex was recorded at weekly interval on 5 randomly selected plants from each plot. The incidence of pod borer complex was estimated by making the larval count.

The observations on infestation of pod borer complex and fluctuations in weather variables were recorded at weekly interval. The infestation of pod borer complex were averaged and subjected to analysis of simple correlation coefficient by considering the occurrence of pod borer complex as dependent factor and weather variables as maximum temperature, minimum temperature, average temperature, morning relative humidity, evening relative humidity, average relative humidity and rainfall as independent factors of pigeon pea agro-ecosystem. The values of correlation coefficient were computed using the formula mentioned herewith:

$$\text{Correlation coefficient } (r) = \frac{\Sigma(X-\bar{X})(Y-\bar{Y})}{\sqrt{\Sigma(X-\bar{X})^2\,\Sigma(Y-\bar{Y})^2}}$$

Where:

X → Independent variables (weather variables),

$\bar{X}$ → Mean of independent variables,

Y → Dependent variables (insect populations),

$\bar{Y}$ → Mean of dependent variables and

Result and Discussion

The observations on seasonal occurrence of pod borer complex in respect to weather variables were recorded and presented in different tables and figures. The data recorded showed that the pod borer complex were found active from 41st standard mean week to 01st standard meteorological week (SMW) during the crop season of k*harif*, 2023-24 & 2024-25 (Table- 1&2). The interaction between seasonal occurrence of pod borer complex and existing weather variables were graphically reprented in figure- 1&2.

Chickpea pod borer, *Helicoverpa armigera* Hub.: The incidence of chickpea pod borer, *Helicoverpa armigera* Hub. noticed from 45th SMW (October) and continued up to 01st SMW (January). The average population of larvae was highest during 48th and 49th SMW (2.98 & 3.95 larvae/plant) during the crop seasons. At highest period activity of this insect temperature ranged from 15.6^{0}C to 27.5^{0}C and relative humidity from 59.90% to 85.00% during both the cropping seasons (Table- 1 & 2). These findings were supported by Chandel *et al*. (2005) and Vennila *et al*. (2020) who reported that the infestation of *H. armigera* commenced from October till harvesting of the crop. In another study Singh *et al*. (2023) reported that the incidence of *H. armigera* was noticed from 49th to 12th Standard Meteorological Week (SMW). Its incidence was increased at vegetative stage from 50th to 1st SMW in first date of sown crop and at reproductive stage from 10th to 12th SMW in 3rd date of sown crop. According to Harshita *et al*. (2024), the peak activity of gram pod borer (3.63 larvae/plant) was observed during 50th SMW.

Legume pod borer, *Maruca vitrata* Fab.: The population density of legume pod borer, *Maruca vitrata* Fab. ranged from 0.12 larvae/plant (42 SMW) to 1.85 larvae/plant (49th SMW) during *kharif*, 2023-24, whereas it ranged from 0.12 larvae/plant (41st SMW) to 1.57 larvae/plant (50th SMW) during *Kharif*, 2024-25. At highest level of activity (1.85 larvae/plant & 1.75 larvae/plant) temperature fluctuated between 17.80^{0}C to 27.00^{0}C, while relative humidity ranged from 45.30% to 83.70% (Table 1 & 2). Similar findings were obtained by Rachappa *et al*. (2016) as the emergence of flower buds and blossoms on the crop signalled the beginning of the pest invasion. Harshita *et al*. (2024) reported that the peak activity of spotted pod borer (3.63 larvae/plant) was observed during 50th SMW.

Interaction between occurrence of pod borer complex and weather variables: The interaction of different weather variables *viz*, maximum temperature, minimum temperature, average temperature, morning relative humidity, evening relative humidity, average relative humidity and rainfall with seasonal occurrence of pod pest complex in agro-ecosystem of pigeon pea were obtained by calculating correlation coefficients. The value of correlation coefficients revealed both positive and negative interaction between seasonal occurrence of pod borer complex and existing weather variables (Table- 3 and Figure- 1&2). The infestation of chickpea pod borer, *Helicoverpa armigera* showed significant negative correlation with maximum temperature (r= -0.57* & r= -0.76**), minimum temperature (r= -0.62** & r= -0.72**), average temperature (r= -0.60* & r= -0.74**) and non-significant negative correlation of morning relative humidity (r= -0.01 & r= -0.33), evening relative humidity (r= -0.05 & r= -0.45), average relative humidity (r= -0.03 & r= -0.40). However, the rainfall (r= 0.03) had non-significant positive interaction with seasonal occurrence of chickpea pod borer under the agro-ecosystem of pigeon pea during both the crop seasons i.e. *kharif*, 2023-24 & 2024-25. Similar findings were reported by Ramkumar *et al*. (2023) as incidence of *H. armigera* affected negatively by evening relative humidity, however maximum temperature showed significant positive association. According to Harshita *et al*. (2024), gram pod borer was more prevalent as the minimum temperature rose, while maximum relative humidity, minimum relative humidity and rainfall affected adversely to population build-up of this insect. Rathore *et al*. (2017) reported non-significant negative correlation of *H. armigera* with relative humidity while significant positive correlation with mean temperature.

The legume pod borer, *Maruca vitrata* Fab. showed negative association with maximum temperature (r= -0.43 & r= -0.79**), minimum temperature (r= -0.45 & r= -0.76**), average temperature (r= -0.44 & r= -0.78**), morning relative humidity (r= -0.33 & r= -0.33), evening relative humidity (r= -0.06 & r= -0.38) and average relative humidity (r= -0.15 & r= -0.36), whereas rainfall (r= 0.32) was associated non-significant positively with seasonal occurrence of this insect during the period of experimentation *i.e. kharif*, 2023-24 & 2024-25. According to Rathore *et al*. (2017), non-significant negative correlation was observed between relative humidity and the larval population of *M. vitrata*. Sahoo and Behera (2001) noticed positive correlation of *Maruca vitrata* with maximum, minimum and average temperatures. As per the observation of Harshita *et al*. (2024), spotted pod borer was more prevalent as the minimum temperature rose, while maximum relative humidity, minimum relative humidity and rainfall affected adversely to population build-up of this insect. Singh *et al*. (2023) indicated highly significant positive association between larval incidence of chickpea pod borer and maximum and minimum temperature. However, relative humidity and rainfall showed a non-significant negative correlation.

The present investigation concluded as the commencement of the pod borer complex *viz*. *Helicoverpa armigera* Hub. and *Maruca vitrata* Fab. was started from the 41st standard meteorological week and 45th standard meteorological week respectively. The peak level of activity was recorded during 48th to 50th standard meteorological week. The pod borer complex showed significant negative association with maximum and minimum temperature as well as mean temperature. The morning and evening relative humidity and its average exhibited non-significant adverse effect on population build-up of pod bore complex under the agro-ecosystem of pigeon pea.

Table 1: Seasonal occurrence of pod borer complex in respect to weather variables during *Kharif*, 2023-24.

SMW	Population density of pod borer complex (No. Larvae/plant)		Prevalent weather variables						
			Temperature (℃)			Relative humidity (%)			Rainfall (mm)
	Chickpea pod borer	Legume Pod borer	Maximum	Minimum	Average	Morning	Evening	Average	
42	0.00	0.12	34.30	24.60	29.45	89.30	56.70	73.00	0.00
43	0.00	0.23	33.50	18.50	26.00	84.30	47.90	66.10	0.00
44	0.00	0.68	31.80	18.80	25.30	87.30	48.30	67.80	0.00
45	0.12	1.01	30.60	19.30	24.95	86.00	53.70	69.85	0.00
46	0.48	1.25	30.10	18.80	24.45	85.10	49.00	67.05	0.00
47	1.56	1.56	28.50	18.20	23.35	80.40	50.40	65.40	0.00
48	2.98	1.76	27.50	15.60	21.55	85.00	59.90	72.45	22.00
49	2.85	1.85	27.00	17.80	22.40	83.70	45.30	64.50	0.00
50	4.05	1.63	23.80	12.20	18.00	90.30	58.00	74.15	0.00
51	3.02	1.55	18.50	10.80	14.65	85.10	45.60	65.35	0.00
52	2.16	1.14	16.10	9.20	12.65	84.30	48.60	66.45	0.75
01	1.24	0.98	15.60	9.60	12.60	89.6	69.90	79.75	4.25

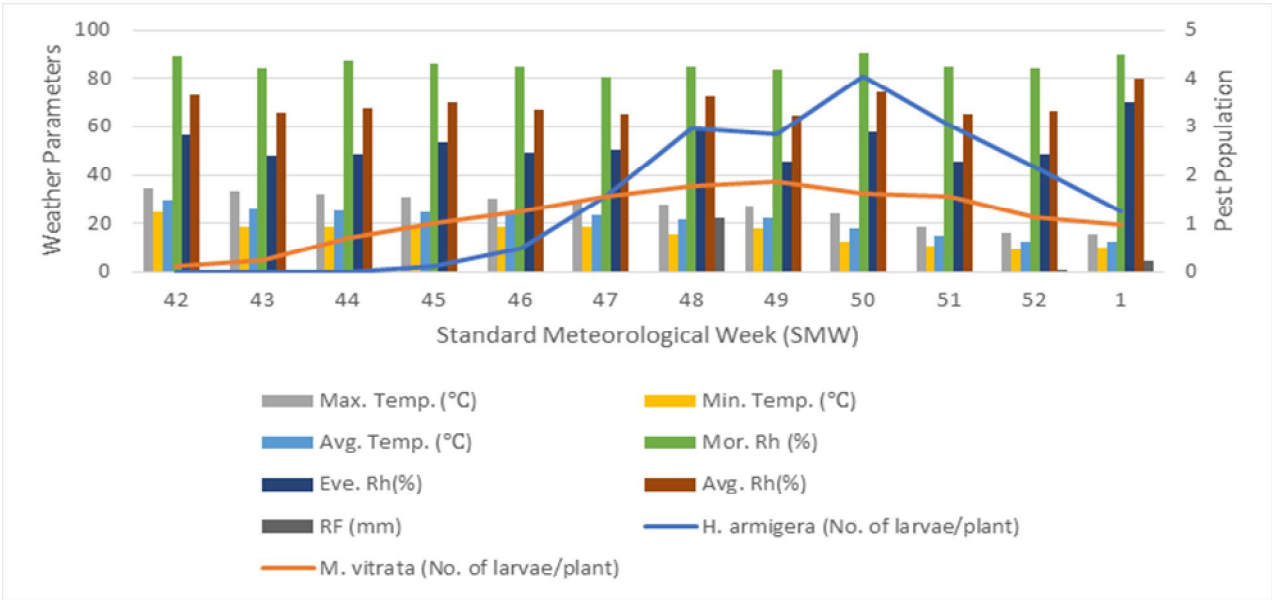

Fig. 1: Influence of weather variables on seasonal occurrence of pod borer complex during 2023-25

Table 2: Seasonal occurrence of pod borer complex in respect to weather variables during *Kharif*, 2024-25.

SMW	Population density of pod borer complex (No. Larvae/plant)		Prevalent weather variables						
			Temperature (℃)			Relative humidity (%)			Rainfall (mm)
	Chickpea pod borer	Legume Pod borer	Maximum	Minimum	Average	Morning	Evening	Average	
41	0.00	0.12	33.96	29.01	31.49	73.57	72.00	72.79	0.00
42	0.00	0.25	33.61	29.71	31.66	77.71	77.28	77.50	0.00
43	0.00	0.36	33.28	29.57	31.43	76.14	75.85	76.00	0.00
44	0.00	0.58	33.64	28.93	31.29	82.85	84.28	83.57	0.00
45	0.23	0.72	31.71	27.64	29.68	66.85	71.42	69.14	0.00
46	1.53	0.88	30.75	26.52	28.64	61.14	63.71	62.43	0.00
47	1.98	0.99	26.53	22.92	24.73	73.28	71.28	72.28	0.00
48	2.56	1.05	26.75	23.28	25.02	74.00	67.28	70.64	0.00
49	3.95	1.53	26.68	22.75	24.72	68.85	68.71	68.78	0.00
50	3.83	1.75	22.92	18.56	20.74	62.14	65.57	63.86	0.00
51	2.95	1.36	22.50	19.10	20.80	74.85	69.07	71.96	0.00
52	2.01	1.02	22.03	17.43	19.73	87.50	88.00	87.75	0.00
01	1.52	1.00	21.00	15.71.	18.35	81.10	78.45	79.77	0.00

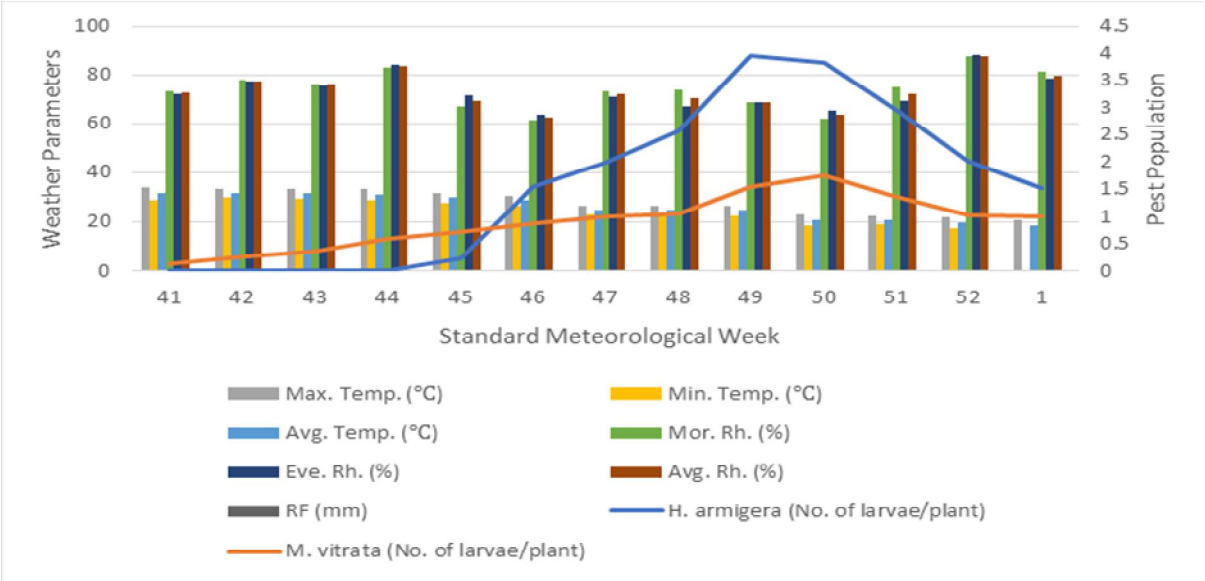

Fig. 2: Influence of weather variables on seasonal occurrence of pod borer complex during 2024-2025

Table 3: Correlation coefficient between occurrence pod borer complex and weather variables during crop season

Pod borer complex	Year	Temperature (℃)			Relative Humidity (%)			RF (mm)
		Maximum	Minimum	Average	Morning	Evening	Average	
Legume pod borer	2023-24	-0.43	-0.45	-0.44	-0.33	-0.06	-0.15	0.32
	2024-25	-0.79**	-0.76**	-0.78**	-0.33	-0.38	-0.36	0.00
Chickpea pod borer	2023-24	-0.57*	-0.62**	-0.60**	-0.01	0.05	0.03	0.30
	2024-25	-0.76**	-0.72**	-0.74**	-0.33	-0.45	-0.40	0.00

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