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POPULATION BUILD-UP OF INSECT PESTS OF MUSTARD AND ITS CORRELATION WITH ABIOTIC FACTORS

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ABSTRACT

The present study focused on the population dynamics of major insect pests (mustard aphid, sawfly, painted bug, and coccinellids) affecting mustard and their correlation with weather parameters at the Organic Research Farm, Bundelkhand University, Jhansi (U.P.) during the Rabi season of 2023-2024. The study revealed that various pest populations attack from the germination stage to the maturity stage. The occurrence of aphids was recorded at the 48th SMW, sawflies at the 45th SMW, painted bugs at the 52nd SMW, and coccinellids at the 48th SMW. The populations of aphids and sawflies were found to be negatively non-significant with respect to temperature and rainfall, while they showed a positively non-significant correlation with relative humidity. Similarly, the population of painted bugs showed a non-significant positive relationship with temperature and rainfall, while exhibiting a non-significant negative relationship with relative humidity. The coccinellid population was found to be negatively correlated with temperature and positively correlated with evening relative humidity, while it was non-significantly negatively correlated with rainfall and non-significantly positively correlated with morning relative humidity.

Keywords **:** *Brassica juncea*; *Lipaphis erysimi*; natural enemies; correlation; multiple regression.

Introduction

Mustard (*Brassica juncea* L.) is an important oilseed crop from Egypt and Asia, belonging to the family Brassicaceae or Cruciferae. Different varieties of mustard are cultivated across the nation (Kapure *et al*., 2024; Srija *et al*., 2024). In India, it is grown on 7.9 million hectares, yielding 11.9 million metric tonnes with an average productivity of 1497 kg per hectare (Anonymous, 2022). Various insect pests pose a significant threat to mustard production in India, including aphids, painted bugs, mustard sawflies, leaf miners, flea beetles, cabbage leaf Webbers, and diamondback moths (Arvind *et al*., 2024). Among these, the mustard aphid (Lipaphis erysimi Kalt) causes considerable damage, leading to a reduction in oil content (5-15%) and mustard yield (35.4-96.0%) (Rana, 2005). Painted bugs primarily inflict damage during the seedling stage, resulting in yield losses of about 26.8% to 70.8%. During pod formation and maturity, they also cause damage, leading to yield losses of 30.1% and a reduction in oil content of 3.4% (Srija *et al*., 2024). The frequency of these insect pest populations varies, being influenced by abiotic factors that affect their peak populations, as well as crop yield and oil content. To enhance yield and improve oil content, implementing suitable management practices is essential. The study of meteorological parameters reveals the correlation between insect pest populations and weather factors such as temperature, relative humidity, and rainfall. In this investigation, we examined the population dynamics of various insect pests affecting mustard and their relationships with weather parameters.

Materials and Methods

The present investigation was conducted on mustard during the Rabi season of 2023-2024 at the Organic Research Farm, Institute of Agricultural Science, Bundelkhand University, Jhansi (25°45' N and 78°61' E), using the BK-1008 variety. The mustard was sown by 30th October 2023 in three plots measuring 3X2.5 m², with a spacing of 30 cm (row to row) and 10 cm (plant to plant). Observations of insect

pests were recorded in each plot from five randomly selected plants, which were tagged at weekly intervals. Six leaves (two from each section) were randomly selected per plant from the upper, middle, and lower portions, and the population was counted. Additionally, at the flowering stage, the population was recorded on a randomly selected twig (10 cm long from the tip) of each plant. These observations were taken during the morning hours. Weather data were obtained from the meteorological department of RLBAU, Jhansi. A correlation study between temperature, relative humidity, rainfall, and the incidence of insect pests on mustard was conducted using statistical software OPSTAT and WASP 2.0.

Result and Discussion

The present study observed various insect pests, including mustard aphids, sawflies, painted bugs, and coccinellids.

Population build-up of mustard aphids on mustard crop and correlation with weather parameters

The mustard aphid population was first observed from the 48th SMW to the 6th SMW during the mustard crop-growing period. The initial incidence of the aphid was noted at 48th SMW with 10.21 aphids per top 10 cm of the central shoot, after which the population gradually increased and reached its peak at 50th SMW with 66.85 aphids per top 10 cm of the central shoot. The aphid populations gradually decreased after the plants matured. These observations align with previous studies by Venkateswarlu *et al.* (2011) and Sahoo (2013). Similarly, Hasan and Singh (2011) also supported the current experimental results.

The studies examining the correlation between aphid population and weather parameters found a negative non-significant correlation between the aphid population and both maximum temperature, minimum temperature, and rainfall (r = -0.37, -0.34, and -0.03, respectively), while a positive non-significant correlation was found between aphid population and both morning and evening relative humidity (r = 0.10 and 0.42, respectively). The present values are similar to those reported by Lal *et al*. (2018) and Pawar *et al.* (2010), who also found a non-significant negative relationship with temperature.

Population build-up of sawflies on mustard crop and correlation with weather parameters

The occurrence of sawflies on mustard started from the 45th SMW to the 49th SMW. The initial incidence was found at 45th SMW with 1.86 population after that the population gradually attained peak level at 47th SMW with 5.21 population while the population gradually decreased after 49th SMW. A negative correlation was found between sawfly and maximum, and minimum temperature, and rainfall (r= -0.07, -0.10, and -0.21, respectively) while a positive correlation was found between sawfly and morning, and evening relative humidity (r= 0.30, and 0.09, respectively). Similar results were revealed by Kashyap *et al*., (2018), and Pandey *et al*., (2023) in which the results agreed with the present result.

Population build-up of painted bugs on mustard crop and correlation with weather parameters

The initial incidence of painted bugs was recorded at 52nd SMW with a 0.84 painted bug population, which gradually increased and attained a peak level at 4th SMW with 4.03 painted bug population. The painted bugs are positively correlated with maximum and minimum temperature, and rainfall (r= 0.43, 0.36, and 0.15, respectively) while negatively correlated with morning and evening relative humidity (r= -0.36, and -0.24, respectively). Divya *et al.* (2015) and Pratihar *et al.* (2024) also agreed with this result that the initial incidence started at 52nd SMW while they have a positive non-significant correlation with temperature and rainfall while negative relative humidity.

Population build-up of coccinellids on mustard crop and correlation with weather parameters

Coccinellids were observed at the 48th SMW with a population of 1.64, reaching a peak level at the 52nd SMW with a population of 6.14. The population of coccinellids gradually decreased to 0.69 at the 2nd SMW. A significant negative correlation was found between maximum and minimum temperature (r = -0.71 and 0.69), and a non-significant negative correlation with rainfall (r = -0.25). A significant positive correlation was noted between evening relative humidity (r = 0.70) and coccinellids, while a non-significant positive correlation was found between morning relative humidity (r = 0.40) and coccinellid population. The present results align with those of Shaila *et al*. (2022), Patel *et al*. (2019), and Hugar *et al*. (2008), who agreed that coccinellids attained their peak level at the 52nd SMW and reported a significant negative correlation with temperature and a non-significant correlation with rainfall.

Correlation between mustard aphid and natural enemies

The correlation studied between mustard aphids and their natural enemies shows that the painted bugs (r = 0.40) are non-significantly correlated with mustard aphids and significantly correlated with coccinellids (r = 0.57). The present findings align with Kulkarni and

Patel (2001), Singh *et al*. (2011), and Dotasara *et al*. (2018), which revealed that the populations of natural enemies, namely painted bugs and coccinellids, had a positive significant correlation with the population of mustard aphids.

Conclusion

The present investigation to know the "Population build-up of insect pests of mustard and its correlation with abiotic factors" was carried out at a research farm of Bundelkhand University, Jhansi during 2023-2024. The population build-up of mustard aphids and its natural enemies with relation to weather parameters (temperature, relative humidity, and rainfall) occurrence observed from 44th SMW to 6th SMW. The aphid population occurred at 48th SMW and peak attained at 50th SMW while the natural enemies *i.e.* painted bug and coccinellids occurred at 52nd SMW and 48th SMW, respectively. The sawfly occurrence started at 45th SMW and attained peak level at 47th SMW. There was found a positive correlation between mustard aphid and its natural enemies i.e. painted bugs, and coccinellids (r= 0.40, and 0.57), respectively. The correlation coefficient was found between sawfly and abiotic factors in which negative correlation with temperature, and rainfall, while positive correlation with relative humidity found.

Table 1: Population build-up of insect pests of mustard in relation to weather parameters during *Rabi* season 2023-2024.

SMW	Weather parameters					Population build-up of insect pests			
	Temperature (℃)		Relative humidity (%)		Rainfall (mm)				
	Maximum	Minimum	Morning	Evening		Aphids	Sawfly	Painted bugs	Coccinellids
44	26.2	15.1	76.1	53.0	0.25	0.00	0.00	0.00	0.00
45	24.2	8.70	77.1	58.0	0.00	0.00	1.86	0.00	0.00
46	25.1	9.20	74.5	57.8	0.00	0.00	2.64	0.00	0.00
47	21.3	11.6	82.1	68.7	0.00	0.00	5.21	0.00	0.00
48	19.6	10.4	85.7	71.2	0.00	10.21	1.14	0.00	1.64
49	17.4	8.70	81.5	71.8	0.00	16.34	0.33	0.00	2.98
50	14.6	9.30	77.7	72.4	0.00	66.85	0.00	0.00	4.33
51	15.4	5.70	80.5	72.1	0.00	53.67	0.00	0.00	5.11
52	22.5	8.30	78.2	82.1	0.00	50.64	0.00	0.84	6.14
01	22.0	9.70	76.2	75.8	0.38	56.32	0.00	1.32	1.22
02	25.5	11.7	82.7	70.7	0.57	59.12	0.00	2.34	0.69
03	26.5	12.4	66.5	48.5	0.08	49.26	0.00	3.41	0.00
04	26.9	13.6	70.7	53.8	0.11	30.14	0.00	4.03	0.00
05	27.4	13.5	66.8	44.1	2.50	15.14	0.00	1.11	0.00
06	31.8	15.5	58.7	37.4	0.00	8.74	0.00	0.45	0.00

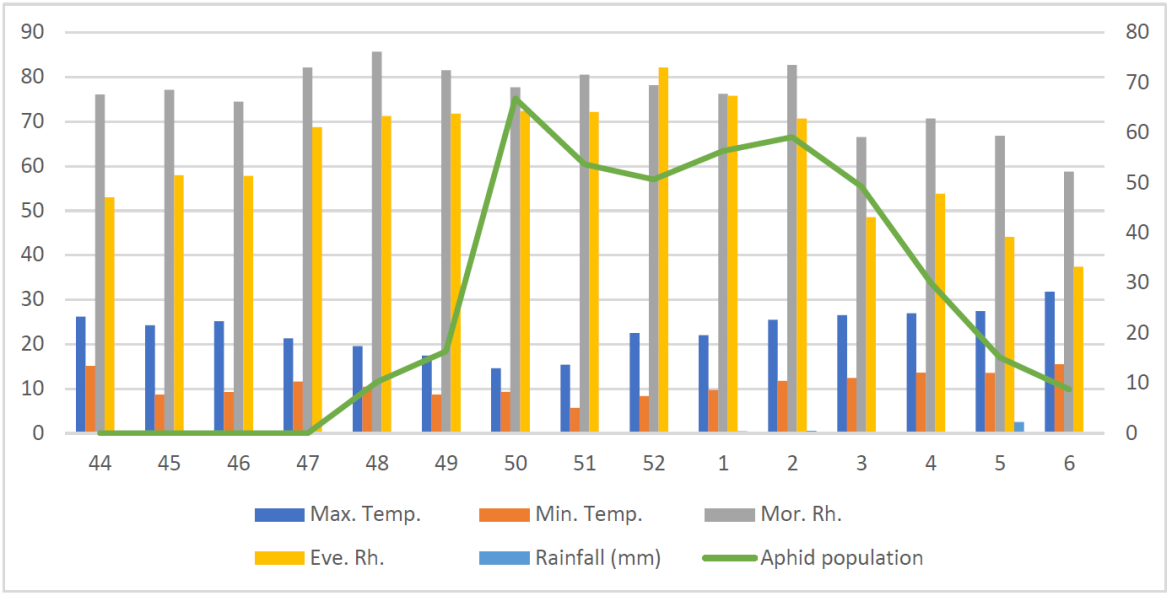

Fig. 1: Population build-up of Mustard aphids in relation with weather parameters.

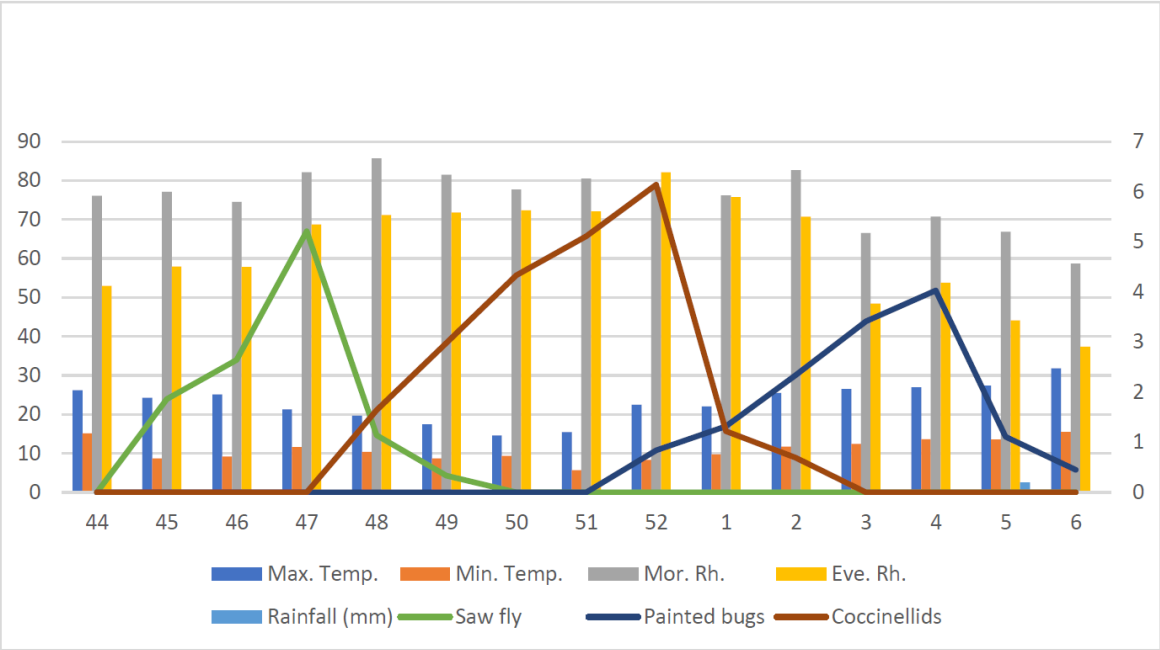

Fig. 2: Population build-up of Sawfly, Painted bug, and Coccinellids in relation with weather parameters.

Table 2: Correlation studies between insect pests of mustard and weather parameters.

Insect pests	Temperature (℃)		Relative humidity (%)		Rainfall (mm)
	Maximum	Minimum	Morning	Evening	
Aphid	-0.37	-0.34	0.10	0.42	-0.03
Sawfly	-0.07	-0.10	0.30	0.09	-0.21
Painted bug	0.43	0.36	-0.36	-0.24	0.15
Coccinellids	-0.71*	-0.69*	0.40	0.70*	-0.25

*Significant at 5% level

Table 3: Correlation studies between mustard aphids and natural enemies

	Painted bugs	Coccinellids
Mustard aphids	0.40*	0.57*

*Significant at 5% level

Table 4: Multiple regression analysis of insect pests of mustard in relation to abiotic factor.

Insect pests	Multiple Regression	R^2
Aphid	$Y= 173.12 -1.70X_1+1.65X_2-3.76X_3+2.54X_4+5.74X_5$	0.55
Sawfly	$Y= -8.61+0.08X_1-0.11X_2+0.17X_3-0.07X_4-0.47X_5$	0.25
Painted bug	$Y= -0.91+0.11X_1+0.11X_2-0.07X_3+0.06X_4+0.08X_5$	0.27
Coccinellids	$Y= 15.51-0.21X_1-0.10X_2-0.22X_3+0.14X_4+0.06X_5$	0.74

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