

Seasonal incidence of mustard aphid, *Lipaphis erysimi* (Kalt.) and its relationship with weather parameters in western Uttar Pradesh

Kartik Rathi¹, Hem Singh^{1*}, Gaje Singh¹, D.V. Singh¹, Ramesh Singh², Adesh Singh³

¹Department of Entomology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110, Uttar Pradesh, India

²Department of Plant Pathology, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110, Uttar Pradesh, India

³Department of Agronomy, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut-250110, Uttar Pradesh, India

Corresponding mail- hemsingh@svpuat.edu.in

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Abstract

A two-season field investigation was conducted during Rabi 2024-25 and 2025-26 at the Crop Research Centre, Sardar Vallabhbhai Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, to determine the seasonal incidence of mustard aphid, *Lipaphis erysimi* (Kalt.), and its relationship with major weather variables. Aphid population was recorded weekly from first appearance to crop maturity, and the data were related to maximum and minimum temperature, morning and evening relative humidity, and rainfall. During 2024-25, aphid incidence began in the 51st standard meteorological week (SMW) at 4.10 aphids/plant and reached a maximum of 112.67 aphids/plant in the 7th SMW. During 2025-26, the corresponding population increased from 3.24 aphids/plant in the 51st SMW to 112.32 aphids/plant in the 7th SMW. Thereafter, aphid abundance declined toward crop maturity, reaching 4.84 and 1.47 aphids/plant, respectively, in the 13th SMW. Reanalysis of the revised weekly data showed that, in 2024-25, aphid abundance was weakly positively correlated with maximum temperature ($r=0.170$), weakly negatively correlated with minimum temperature ($r=-0.011$), and negatively correlated with morning relative humidity ($r=0.425$), evening relative humidity ($r=-0.429$) and rainfall ($r=-0.122$). In 2025-26, correlations were positive with maximum temperature ($r=0.347$) and minimum temperature ($r=0.212$), and negative with morning relative humidity ($r=-0.082$), evening relative humidity ($r=-0.492$) and rainfall ($r=0.152$). Multiple regression explained 63.3% of variation in 2024-25 and 75.5% in 2025-26, with the latter model significant ($p=0.013$). The repeated 7th-SMW peak indicates that late January to mid February is the critical surveillance period for mustard aphid under the study conditions.

Introduction

Mustard, *Brassica juncea* (L.) Czern. & Coss., is an important oilseed crop in India, but its productivity is constrained by several biotic and abiotic stresses. Among insect pests, the mustard aphid, *Lipaphis erysimi* (Kaltenbach) (Hemiptera: Aphididae), is particularly important because both nymphs and adults feed on tender shoots, inflorescences and developing siliquae. Heavy infestations may reduce crop vigour, pod development and seed yield, while honeydew deposition can favour sooty mould and interfere with photosynthesis.

The abundance of *L. erysimi* varies greatly over the winter crop season and is influenced by temperature, relative humidity, rainfall, crop phenology and local microclimate. Mishra and Kanwat observed aphid appearance in the 52nd SMW and a peak in the fourth SMW under Jobner conditions, with negative correlations with maximum and minimum temperature and a positive association with relative humidity. Other studies have reported peaks between the fourth and eighth SMWs and have shown that the direction and magnitude of

weather correlations may vary with location and season [2-12].

Because these relationships are not spatially uniform, local field data are essential for identifying the period of greatest aphid risk. Western Uttar Pradesh has a distinct winter environment and mustard production system, and a two-season assessment can provide a more reliable basis for surveillance than a single-season observation.

The present investigation was therefore undertaken to study the effect of weather parameters on the population dynamics of mustard aphid in mustard crop during Rabi 2024-25 and 2025-26 at Meerut, Uttar Pradesh.

Materials and Methods

Study site and period

The field investigation was carried out at the Crop Research Centre (C.R.C.), Sardar Vallabhbhai

Patel University of Agriculture & Technology, Meerut, Uttar Pradesh, during the Rabi seasons of 2024-25 and 2025-26.

Aphid population observations

Population dynamics were assessed by randomly selecting ten plants from each plot. At each weekly observation, the number of mustard aphids present per plant was counted from the first appearance of the pest until crop maturity. The observation period extended from the 51st SMW to the 13th SMW in each season.

Weather variables

Weekly maximum temperature (T_{max}), minimum temperature (T_{min}), morning relative

humidity (RH-M), evening relative humidity (RH-E) and rainfall were used to examine weather associations with aphid abundance.

Statistical analysis

Pearson correlation coefficients were calculated between weekly aphid population and each weather variable. Multiple linear regression was performed with aphid population as the dependent variable (Y) and maximum temperature (X_1), minimum temperature (X_2), morning relative humidity (X_3), evening relative humidity (X_4) and rainfall (X_5) as predictors. Because the weekly aphid counts were revised in Tables 1 and 2, the correlation and regression statistics used in this manuscript were recalculated from those revised values. Pooled analysis was based on weekly means across the two seasons.

Results

Mustard aphid population showed a clear seasonal pattern in both years. During Rabi 2024-25, the pest was first recorded in the 51st SMW at 4.10 aphids/plant. The population remained low through the early crop period but increased from 25.12 aphids/plant in the 4th SMW to 40.15 in the 5th SMW and 58.15 in the 6th SMW. The highest population, 112.67 aphids/plant, was recorded in the 7th SMW (14-20 February) when maximum and minimum temperatures were 25.0 and 10.0°C, respectively, morning relative humidity was 92.2%, evening relative humidity was 36.5%, and no rainfall occurred (Table 1). Thereafter, the population declined to 94.25 aphids/plant in

the 8th SMW, 78.15 in the 9th SMW and 62.13 in the 10th SMW. A sharp decline followed, with 10.56, 8.13 and 4.84 aphids/plant during the 11th, 12th and 13th SMWs, respectively (Table 1).

During Rabi 2025-26, the first aphid population was 3.24 aphids/plant in the 51st SMW. The population increased gradually to 20.17 aphids/plant in the 4th SMW, 52.64 in the 5th SMW and 76.87 in the 6th SMW. As in the previous season, maximum abundance occurred in the 7th SMW, when 112.32 aphids/plant were recorded. At that time, maximum and minimum temperatures were 26.9 and 12.5°C, morning and evening relative humidity were 85.7 and 46.6%, respectively, and rainfall was 0.0 mm (Table 2). The aphid population subsequently declined to 70.15 aphids/plant in the 8th SMW, 63.86 in the 9th SMW and 39.87 in the 10th SMW, and then to 22.64, 9.46 and 1.47 aphids/plant during the 11th, 12th and 13th SMWs, respectively (Table 2).

Correlation analysis of the revised 2024-25 data showed a weak positive relationship between aphid population and maximum temperature ($r=0.170$), an essentially null negative relationship with minimum temperature ($r=-0.011$), and negative relationships with morning relative humidity ($r=0.425$), evening relative humidity ($r=-0.429$) and rainfall ($r=-0.122$). The multiple regression model explained 63.3% of the variation in aphid abundance ($R^2=0.633$), but the overall model did not reach the 5% significance level ($F=3.099$, $p=0.067$). The fitted equation was Y

$$= 891.1185 - 5.2474X - 4.8291X - 5.7371X - 2.8832X + 1.1434X \text{ (Table 3).}$$

For 2025-26, aphid abundance was positively correlated with maximum temperature ($r=0.347$) and minimum temperature ($r=0.212$), whereas negative correlations were obtained with morning relative humidity ($r=-0.082$), evening relative humidity ($r=-0.492$) and rainfall ($r=-0.152$). The regression model accounted for 75.5% of the observed variation ($R^2=0.755$) and was statistically significant ($F=5.545$, $p=0.013$). The fitted equation was $Y = 79.4845 - 18.3181X + 21.6252X + 6.1340X - 6.5903X - 0.4307X$ (Table 3).

Pooled weekly means across the two seasons showed the same general population trajectory. The mean aphid population increased from 3.67 aphids/plant in the 51st SMW to 112.50 aphids/plant in the 7th SMW and declined to 3.16 aphids/plant by the 13th SMW. In pooled analysis, aphid abundance was positively associated with maximum temperature ($r=0.301$) and minimum temperature ($r=0.129$), and negatively associated with morning relative humidity ($r=-0.185$), evening relative humidity ($r=-0.534$) and rainfall ($r=-0.217$). The pooled regression explained 46.6% of variation ($R^2=0.466$) and was non-significant ($F=1.569$, $p=0.262$). The fitted equation was $Y = -9.2685 + 1.0624X - 3.2796X + 2.1561X - 2.4170X - 0.6126X$ (Table 3).

Across both seasons, the most reproducible feature was the concentration of peak aphid activity in the 7th SMW. Although individual weather correlations were weak to

moderate, evening relative humidity consistently showed the strongest negative association with aphid abundance, particularly in 2025-26 and in the pooled analysis (Table 3).

Table 1. Weekly weather parameters and mustard aphid population during Rabi 2024-25

SMW	Date	Tmax (°C)	Tmin (°C)	RH-M (%)	RH-E (%)	Rainfall (mm)	Aphids/ plant
51	Dec 20-26	23.26	6.24	91.0	71.17	0.0	4.10
52	Dec 27-Jan 2	19.98	9.88	93.0	83.0	32.0	5.24
1	Jan 3-9	15.30	7.80	95.6	72.7	0.0	8.64
2	Jan 10-16	17.60	7.30	95.8	66.6	4.2	14.12
3	Jan 17-23	19.10	9.20	95.7	62.2	2.6	21.63
4	Jan 24-30	23.30	9.00	95.9	44.7	0.6	25.12
5	Jan 31-Feb 6	24.20	8.90	94.5	51.3	0.1	40.15
6	Feb 7-13	23.70	8.90	90.2	41.5	0.3	58.15
7	Feb 14-20	25.00	10.00	92.2	36.5	0.0	112.67
8	Feb 21-27	25.10	10.90	91.8	46.9	0.0	94.25
9	Feb 28-Mar 6	26.10	13.90	82.6	52.0	14.4	78.15
10	Mar 7-13	29.80	12.70	86.0	42.7	0.0	62.13
11	Mar 14-20	26.80	16.10	92.3	48.7	0.0	10.56
12	Mar 21-27	31.20	15.90	92.7	39.7	0.0	8.13
13	Mar 28-Apr 3	33.10	16.90	89.6	28.4	0.0	4.84

Table 2. Weekly weather parameters and mustard aphid population during Rabi 2025-26

SMW	Date	Tmax (°C)	Tmin (°C)	RH-M (%)	RH-E (%)	Rainfall (mm)	Aphids/plan t
51	Dec 20-26	19.4	8.2	96.7	73.0	0.0	3.24
52	Dec 27-Jan 2	17.9	7.8	97.1	79.9	0.0	5.45
1	Jan 3-9	16.5	8.3	92.3	76.4	0.0	8.42
2	Jan 10-16	18.5	4.3	95.3	57.7	0.0	9.48
3	Jan 17-23	19.7	6.5	96.0	67.7	0.0	11.64
4	Jan 24-30	20.0	8.4	88.1	59.0	62.0	20.17
5	Jan 31-Feb 6	19.6	10.0	97.6	73.1	6.4	52.64
6	Feb 7-13	24.2	10.4	87.0	52.3	0.0	76.87
7	Feb 14-20	26.9	12.5	85.7	46.6	0.0	112.32
8	Feb 21-27	27.9	13.4	91.0	49.9	0.0	70.15
9	Feb 28-Mar 6	30.4	15.7	75.8	38.8	0.0	63.86
10	Mar 7-13	33.2	17.7	80.9	45.6	0.0	39.87
11	Mar 14-20	31.6	17.1	69.9	41.4	5.1	22.64
12	Mar 21-27	23.6	15.1	86.9	74.1	15.5	9.46
13	Mar 28-Apr 3	32.9	19.1	65.9	43.9	0.0	1.47

Table 3. Recalculated correlation coefficients and multiple regression statistics from the revised weekly data

Parameter	2024-25	2025-26	Pooled
Maximum temperature (r)	0.170	0.347	0.301

Minimum temperature (r)	-0.011	0.212	0.129
Morning RH (r)	-0.425	-0.082	-0.185
Evening RH (r)	-0.429	-0.492	-0.534
Rainfall (r)	-0.122	-0.152	-0.217
R ²	0.633	0.755	0.466
F statistic	3.099	5.545	1.569
p value	0.067	0.013	0.262

Pooled statistics were calculated from weekly arithmetic means of the two seasons. RH, relative humidity.

Discussion

The revised field data demonstrate a highly consistent temporal pattern of *L. erysimi* infestation across the two seasons. In both 2024-25 and 2025-26, the population was low during late December and early January, increased rapidly from the 5th SMW onward and reached its maximum in the 7th SMW. The peak densities were almost identical between years (112.67 and 112.32 aphids/plant), strengthening the evidence that mid-February represents the period of greatest aphid pressure under the study conditions.

The observed timing agrees broadly with studies in which maximum mustard aphid populations occurred between the fifth and eighth SMWs [4,6,8-12], although it was later than the fourth-SMW peak reported by Mishra and Kanwat [1] under Jobner conditions. Such differences are expected because aphid phenology depends on locality, sowing date, cultivar, crop stage and winter weather. The repeatability of the 7th-SMW maximum in the

present study is therefore more useful for local surveillance than direct transfer of a peak week from another agro-climatic zone.

The revised correlation analysis showed that evening relative humidity had the strongest and most consistent inverse association with aphid population, with $r=-0.429$ in 2024-25, $r=-0.492$ in 2025-26 and $r=-0.534$ in pooled analysis. Maximum temperature had weak positive relationships in both years, while the association with minimum temperature was negligible in 2024-25 but positive in 2025-26. Rainfall showed weak negative relationships in both seasons. Earlier studies have reported both positive and negative associations between aphid abundance and these variables [1-12], indicating that individual weather coefficients should be interpreted in the context of crop phenology and interactions among meteorological factors.

The multiple regression models further demonstrated year-to-year variation. The weather variables explained 63.3% of aphid

variation in 2024-25, but the overall model was marginal and nonsignificant at the 5% level ($p=0.067$). In contrast, 75.5% of the variation was explained in 2025-26, and the combined model was significant ($p=0.013$). The pooled model explained 46.6% of variation and was non-significant. Thus, weather clearly contributed to aphid population dynamics, but the strength of the combined relationship was not stable across seasons. Other factors, including crop growth stage, host condition and natural enemies, may account for part of the unexplained variation.

From a practical perspective, the strongest management implication is the repeatable acceleration of aphid abundance between the 5th and 7th SMWs. Field surveillance should therefore be intensified from late January through mid-February. Management decisions based on actual aphid density during this period are likely to be more defensible than calendar-based intervention, particularly because the population declined sharply after the seasonal peak in both years.

Conclusion

The revised two-season dataset confirmed a distinct seasonal pattern of mustard aphid abundance at Meerut. Aphids first appeared during the 51st SMW and reached nearly identical maxima of 112.67 and 112.32 aphids/plant during the 7th SMW in 2024-25 and 2025-26, respectively. Evening relative humidity showed the strongest negative relationship with aphid abundance, while the direction and magnitude of temperature effects

varied between seasons. Weather variables explained 63.3% and 75.5% of aphid variation in the two seasons, with a statistically significant combined regression only in 2025-26. The findings indicate that the 5th-7th SMW is the most important period for intensive scouting and timely management of mustard aphid under western Uttar Pradesh conditions.

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