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Seasonal incidence of mustard aphid relation to abiotic factors

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Abstract
Gobhi sarson-07 was sown as an experimental crop. Crop were seeded on November 6th during the 2023 experimental year.Occurrence of *Lipaphis erysimi* Kalt on mustard began in the first standard week in the experimental year of 2024 at Lovely professional university, Phagwara, Punjab. Initially *Lipaphis erysimi* Kalt population was low, at (4.9 per 10 cm top twig) but it rapidly increased, peaking at (166.30) during 8th standard week in the year of 2024. Population started decline in the Thirteen standard week. During 2023-24 the windspeed is positively significant and it had a negative correlation with relative humidity (both morning and evening), minimum temperature, and rainfall. Maximum temperature exhibited a positive correlation as well number of rainy days is non-significant.

Keywords: *Lipaphis erysimi*, mustard aphid, abiotic factors, standard meteorological week (SMWs)

Introduction

Rapeseed-mustard (*Brassica juncea*) is a crucial oilseed crop cultivated in tropical and subtropical regions (Pandey *et al.*, 2023) [12]. In India, it ranks as the second most important oilseed after soybeans, contributing approximately 20-22% to the total production (Singh *et al.*, 2017) [22]. The seeds of rapeseed-mustard contain 35-45% oil and 20-24% protein (Gill *et al.*, 2011) [7]. Similarly, Gobhi sarson (*B. napus* L.) is a high-yielding oilseed variety cultivated in regions like Punjab, Haryana, and Himachal Pradesh. It is recognized for its adaptability and the quality of its oil (Shekhawat *et al.*, 2012) [17]. However, insect pests are a significant factor in reducing mustard yields, with more than 43 species impacting rapeseed-mustard crops in India. The major pests are leaf miners (*Phytomyza horticola*), painted bugs (*Bagrada hilaris*), aphids (*Lipaphis erysimi*), and sawflies (*Athalia lugens proxima*). (Singh *et al.*, 2000) [22]. Among these, the mustard aphid is particularly harmful, causing notable yield reductions. While mustard aphids remain active throughout the year, they are most prevalent from September to March, which coincides with the growth period of cruciferous crops. During less favorable times, they can feed on wild or cultivated crucifers found in moist environments, orchards, and home gardens (Sidhu & Singh, 1964) [19]. *Lipaphis erysimi* primarily reproduces through viviparous parthenogenesis, with males appearing only during cooler months (Kawada and Murai, 1979) [8]. With two in January, three in February, and three in March, the aphid completes an average of eight generations during this time. (Dwivedi *et al.*, 2018) [6]. When mustard crops are out of season, these pests do not vanish but instead find refuge in other plants such as Ashwagandha (*Withania somnifera*), cauliflower (*B. oleracea*), cabbage (*Brassica oleracea* var. capitata), and radish (*Raphanus sativus*) between May and July. These alternative hosts allow the pests to survive, enabling them to reinfest mustard crops once they are replanted (Das, 2002) [4]. Aphids damage plants by feeding on the sap of young shoots, flowers, and tender pods, which weakens the plants and hinders their growth. They also secrete honeydew, which fosters the growth of black sooty mold on the leaves, blocking photosynthesis. This leads to yellowing, curling, and drying of the leaves. In severe cases, the plants develop fragile pods with few seeds, and the sooty mold further hampers the plant's ability to photosynthesize (Chaudhary and Pal, 2006; Sekhon, 1989) [22, 15]. Mustard aphid (*Lipaphis erysimi*) represents a significant threat to rapeseed-mustard crops, leading to considerable yield and quality losses. It has the potential to cause up to 96% yield loss and a 5-6% reduction in oil content (Shylesha *et al.*, 2006) [18].

Under different agro-climatic conditions, yield losses can range from 35.4% to 73.3%, with some instances resulting in complete crop failure (Bakhetia, 1983; Ashutosh & Kunwar, 2024) [2, 1].

Materials and Methods

In the Rabi seasons of 2023-24, the current study was carried out at Lovely Professional University in Phagwara, Punjab. .The test crop, *Gobhi Sarson* (*Brassica napus*) variety GSC-07, was cultivated under field conditions. The crop was sown on November 6th and grown in 100-square-meter plots following standard agronomic practices. Throughout the study period, no insecticides were applied to the crop to allow for the natural progression of mustard aphid infestation. *Lipaphis erysimi* was recorded weekly from its initial appearance until its population declined . The observations were made under natural field conditions without any plant protection measures. Aphid counting was performed on the top 10 cm of the terminal shoot (twig) using a camel hairbrush to dislodge the aphids onto a white paper sheet for accurate enumeration. To assess the influence of environmental factors on aphid population dynamics, key meteorological parameters were recorded daily for both cropping seasons. These included maximum and minimum temperatures, morning and evening relative humidity, rainfall, wind speed, evaporation, and the number of rainy days. Weather data were obtained from meteorological observatory at Lovely Professional University, Phagwara, Punjab, India. To study the correlation between the physical parameters with aphid population was worked out by bivariate coefficient of correlation in IBM SPSS 22.0 Software.

Results and Discussion

The data in Table 1 shows that aphid infestation began in the first standard week, starting on January 3rd 2024. At first, the aphid population was quite low, with just (4.9 per 10 cm of the top twig). However, it gradually started to increase from the second standard week, reaching (12.40 per 10 cm top twig). Over the next few weeks, the aphid population continued to rise (47.50 per 10 cm top twig in the third standard week, 67.70 per 10 cm top twig in the fourth standard week, and 93.50 per 10 cm top twig in the fifth standard week). By the sixth and seventh standard weeks, the population reached higher numbers, with (125.30 and 146.30 aphids per 10 cm top twig, respectively). The highest population was recorded in the eighth standard week at (166.30 per 10 cm top twig). After that, the aphid population slowly started to decline, with (108.60 per 10 cm top twig in the ninth standard week, 88.40 per 10 cm top twig in the tenth standard week, 63.40 per 10 cm top twig in the eleventh standard week, and 41.60 per 10 cm top twig in the twelfth standard week). The lowest count was observed in the thirteenth standard week, with just (21.70 per 10 cm top twig).

Table 1: Population dynamics of mustard aphid on Gobhi Sarson-GSC-07(2023-24)

SMW	Temperature		Relative humidity (%)		Wind speed (km/hr)	Rainfall (mm)	No. of. rainy days	Evaporation (mm)	Mean No. of. aphid per 10 cm top twig
	T max	T min	RH I (Morning)	RH II (Evening)					
51	20.28	6.18	92.32	46.63	2.95	0.00	0.00	1.07	0.00
52	16.71	8.37	93.98	69.68	4.42	0.00	0.00	0.94	0.00
1	12.40	6.59	95.00	85.86	3.08	0.00	0.00	0.61	4.9
2	11.76	6.43	94.29	78.29	2.92	0.00	0.00	0.64	12.40
3	13.14	5.57	94.57	78.86	3.19	0.00	0.00	0.76	47.50
4	14.14	5.57	93.57	75.00	4.91	0.00	0.00	0.94	67.70
5	16.00	9.25	92.00	72.75	5.28	1.65	3.00	1.63	93.50
6	20.23	3.48	93.48	54.37	5.33	0.00	0.00	2.76	125.30
7	23.30	5.56	93.96	54.14	4.37	0.00	0.00	2.77	146.30
8	22.84	7.53	89.27	47.03	10.08	0.00	0.00	2.79	166.30
9	22.66	9.65	83.63	50.43	6.35	0.00	2.00	2.60	108.60
10	22.37	6.43	92.36	54.71	6.07	0.00	0.00	1.41	88.40
11	26.30	9.51	90.44	53.05	6.53	0.00	0.00	2.84	63.40
12	29.49	12.88	91.31	50.59	6.94	0.00	0.00	2.86	41.60
13	30.94	16.55	87.25	53.16	6.48	2.00	0.00	6.64	21.70
SMW: Standard Meteorological Week, Tmax: Maximum temperature, Tmin: Minimum Temperature									

The correlation coefficients suggest a positive correlation with maximum temperature (r= 0.241), evaporation (r=0.228), No. of. Rainy days (r= 0.246).while Relative humidity Morning (r=-0.274) and Evening (r=-0.428) and rainfall (r=-0.087) showed negative effects, and a positive significant association with wind speed (r=0.602) at 0.05 level was noticed (Table 2).

Table 2: Correlation Coefficient analysis of abiotic factors and population of *Lipaphis erysimi* during Rabi season 2023-24

Weather parameter	Aphid
Maximum Temperature (℃)	0.241
Minimum temperature (℃)	-0.254
RH I (%)	-0.274
RH II (%)	-0.428
Wind speed (km/hr)	0.602*
Rainfall (mm)	-0.087
Evaporation (mm)	0.228
No. of Rainy days	0.246
Note : *Correlation is significant at 0.05 level; **Correlation is significant at 0.01 level;	

The present findings is in conformation with the results of Dotasara *et al.,* (2022) [5] who revealed that population of *Lipaphis erysimi* arrived in 1st Standard mean week of January during the period of 2017-18. An experiment conducted by Singh and Lal (2012) [20] conclude that mustard aphid population began to appear second week of January which may differ from the above research result due to certain climatic conditions and factors which can affect the growth and development of the pest. The findings was in conformation with Singh *et al.,* (2018) [23] who revealed that peak population of mustard aphid found between 6th and 8th Standard mean week it also supports Kumar *et al.,* (2024) [9]. The present study is in accordance with the observations of Dwivedi *et al.* (2018) [6], who reported the disappearance of the aphid population by the fourth week of March in both study years. The above results are in conformity with the findings of Patel *et al.,* (2019) [13] who reported windspeed showed significant positive correlation and tells that maximum temperature are positive but non-significant correlation. However, the presents findings were in accordance with results of Pradhan *et al.,* (2020) [14] non-significant negative correlation was observed with evening relative humidity. The results are in conformity with Shaila *et al.,* (2022) [16] Relative humidity morning is correlated negatively. Minimum temperature exhibited non-significant negative correlation in the present findings which is in accordance with the findings of Srija *et al.,* (2024) [24]. The above results are similarly to Mishra and Mukherjee (2020) revealed that rainfall and No. of. rainy days was non-significant. Evaporation exhibited that non-significant positive correlation in the present findings which is accordance to the findings of Kumar *et al.,* (2021) [10].

Conclusion

Based on the findings, it can be concluded that the appearance of *Lipaphis erysimi* Kalt. began in the first standard week of 2024. The mustard aphid population peaked during the sixth and Eight standard weeks. The correlation analysis between various weather parameters and insect pest populations showed that aphids had a significant positive correlation with wind speed and a negative correlation with relative humidity (both morning and evening), minimum temperature, and rainfall. Aphids also showed a positive correlation with maximum temperature as well number of rainy days is non-significant was observed.

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