International Journal of Environment and Climate Change

Volume 13, Issue 11, Page 2322-2328, 2023; Article no.IJECC.107816
ISSN: 2581-8627
(Past name: British Journal of Environment & Climate Change, Past ISSN: 2231–4784)

Population Dynamics of Mustard Aphid, *Lipaphis erysimi* (Kaltenbach) on Cauliflower in Relation to Biotic and Abiotic Factors

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

Article Information

DOI: 10.9734/IJECC/2023/v13i113395

Open Peer Review History:
This journal follows the Advanced Open Peer Review policy. Identity of the Reviewers, Editor(s) and additional Reviewers, peer review comments, different versions of the manuscript, comments of the editors, etc are available here: https://www.sdiarticle5.com/review-history/107816

Original Research Article

Received: 24/08/2023
Accepted: 31/10/2023
Published: 06/11/2023

ABSTRACT

The field experiment was conducted at Horticulture Farm, S.K.N. College of Agriculture, Jobner during *Rabi* 2021/22 to know the population dynamics of mustard aphid, *Lipaphis erysimi* (Kaltenbach). The incidence of aphid started in the first week of December and second week of December remained active throughout the crop season during both years. The population of aphid gradually increased and reached to its peak in the second week of February and first week of February in *Rabi*, 2021/22, respectively. The correlation studies indicated that the aphid population had non-significant correlation with temperature, relative humidity and sunshine hours in both the years. Both the predators, ladybird beetle and syrphid fly had significant positive relationship with aphid population during both the years.

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Keywords: Aphid; correlation; cauliflower.

1. INTRODUCTION

"Cauliflower (*Brassica oleracea* var. *botrytis* Linn.) is one of the most significant vegetable crops in India and the rest of the world. It is a member of the *Brassicaceae* family. In India, cauliflower ranks third in term of vegetable production. The centre of origin is Mediterranean coastal area" [1]. "The area under cauliflower in India is 473 thousand hectares with a production of 9283 metric tons" [2]. "Cauliflower is mostly grown in Uttar Pradesh, Bihar, Assam, West Bengal, Maharashtra and Haryana states. India loses about 30% of its crops because of pests and diseases every year" [3]. "cauliflower aphid, *Lipaphis erysimi* Kalt. (Aphididae: Hemiptera) is the most important pests causing severe yield loss to cauliflower every 12 months. Aphids are most communal and destructive pests of brassicaceous crops internationally and often cause heavy losses in yield" [4]. Due to varying climatic conditions and shifting pest status, the population dynamics of significant insect pests are crucial. The peak period for bug pest interest provides ideas for creating defenses against them. Determining how weather variables affect the frequency of insect pests on cauliflower will help to create a forecasting system that will enable the use of scheduled preventative measures. Natural enemies such as predators and parasitoids provide the important surroundings carrier of conservation via biological manipulate [5].

2. MATERIALS AND METHODS

The experimental study conducted at Horticulture Farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during *Rabi*, 2021/22 to know the population dynamics of aphid on cauliflower. The cauliflower crop, variety F_1 hybrid cauliflower 456 was transplanting on 16th November 2021 and 17th November 2022 in five plots. The plot size was 3.0 m x 2.25 m with row to row and plant to plant distance of 60 x 45 cm, respectively.

2.1 Method of Observations

The estimation of aphid population was based on the numerical count method as described by Lal [6]. The ten plants of cauliflower were randomly selected from each plot and tagged. Total number of aphids on ten plants were counted visually with the help of magnifying lens at weekly interval and converted into aphids per plant. For recording the aphid population at early plant stage, leaves were grasped at the petiole by thumb and four fingers and twisted until entire underside of the leave clearly visible.

2.2 Interpretation of Data

"To interpret the results of population dynamics of aphid on cauliflower and its natural enemies the simple correlation was computed between aphid population, natural enemies and abiotic factors, *i.e.* minimum & maximum temperatures, relative humidity and sunshine hours was worked out using following formula". [7] "The following formula was used for calculating the correlation coefficient" [8].

$$r = \frac{N \sum xy - (\sum x)(\sum y)}{\sqrt{N\sum x^2 - (\sum x)^2 . N \sum y^2 - (\sum y)^2}}$$

Where;

r = Simple correlation coefficient
x = Independent variables *i.e*., abiotic components
y = Dependent variables *i.e*., pests
N = Number of observations

3. RESULTS AND DISCUSSION

The mean population of aphid and the standard meteorological week wise weather parameters are presented in Table 1 (*Rabi*, 2021-22) and Table 2 (*Rabi*, 2022). The findings of the present study and the related discussion are explained hereunder. The infestation of aphid, *L. erysimi* commenced in 49th and 50th SMW (Standard Meteorological Week) *i.e,.* first week of December and second week of December remained active throughout the crop season during the years 2021/22, respectively. Initially, the population of aphid was 7.40 and 9.40 per plants which gradually increased and reached to its peak with 161.20 and 269.80 aphids per plant in the second week of February (7th SMW) and first week of February (6th SMW) in *Rabi*, 2021/22, respectively. After reaching the peak, the population of aphid started to decline during both the years. The current findings are in accordance with those of Bhavani and Punnaiah [9], Varmora et al. [10], Patra et al. [11], Saranya et al. [12], Sahu et al. [13], Dwivedi et al. [14], Mishra et al. [15], Yadav et al. [16], Lal et al. [17], Pradhan et al. [18] Arvind [19] and Amarchand et al. [20],who were reported the incidence of aphid

started from the different weeks of December and the peak population of aphid from the February month which support the present results. The somewhat variation in commencement of incidence and peak period as reported by above researchers might be due to the difference in agro climatic conditions of the locality and time of sowing.

Table 1. Population dynamics of mustard aphid, *Lipaphis erysimi* (Kaltenbach) on cauliflower in relation to biotic and abiotic factors in *Rabi,* 2021-22

SMW	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Sunshine (hrs)	Aphid/plant	Mean population/ 10 plant	
		Max.	Min.				*C. septempunctata*	Maggots of *Xanthogramma spp.*
48	27/11/2021	27.20	8.30	59	6.40	0	0	0
49	4/12/2021	24.30	7.00	65	5.10	7.4	1.8	1
50	11/12/2021	22.90	3.60	60	6.70	23.2	3.6	2.2
51	18/12/2021	22.40	-0.30	55	7.50	46.8	6.2	4.8
52	25/12/2021	22.70	6.00	65	3.80	78.6	8.8	5.6
1	2/01/2022	20.30	6.10	73	4.10	98.8	9.2	6
2	9/01/2022	17.30	4.50	69	5.00	63.8	9.6	6.4
3	16/01/2022	18.90	3.90	65	6.00	99.6	10.2	7.8
4	23/01/2022	18.90	3.40	66	6.30	113.4	10.6	8.4
5	30/01/2022	23.50	4.10	61	8.60	126.6	11	8.8
6	6/02/2022	23.50	5.10	58	8.90	143.8	11.6	9.2
7	13/02/2022	26.30	4.70	50	9.70	161.2	12	9.8
8	20/02/2022	29.00	7.40	51	9.00	91.2	6.4	3.2
9	27/02/2022	30.1	8.0	49	9.3	47.2	3.8	1.2
Correlation coefficient with max. temp.						-0.169	-0.482	-0.497
Correlation coefficient with min. temp.						-0.226	-0.415	-0.489
Correlation coefficient with relative humidity						-0.075	0.180	0.167
Correlation coefficient with Sunshine (hrs.)						0.379	0.125	0.161
Correlation coefficient with *C. septempunctata*						0.929**		
Correlation coefficient with Maggots of *Xanthogramma spp.*						0.917**		

SMW= Standard meteorological weeks
** Significant at 5 per cent level*
*** Significant at 1 per cent level*

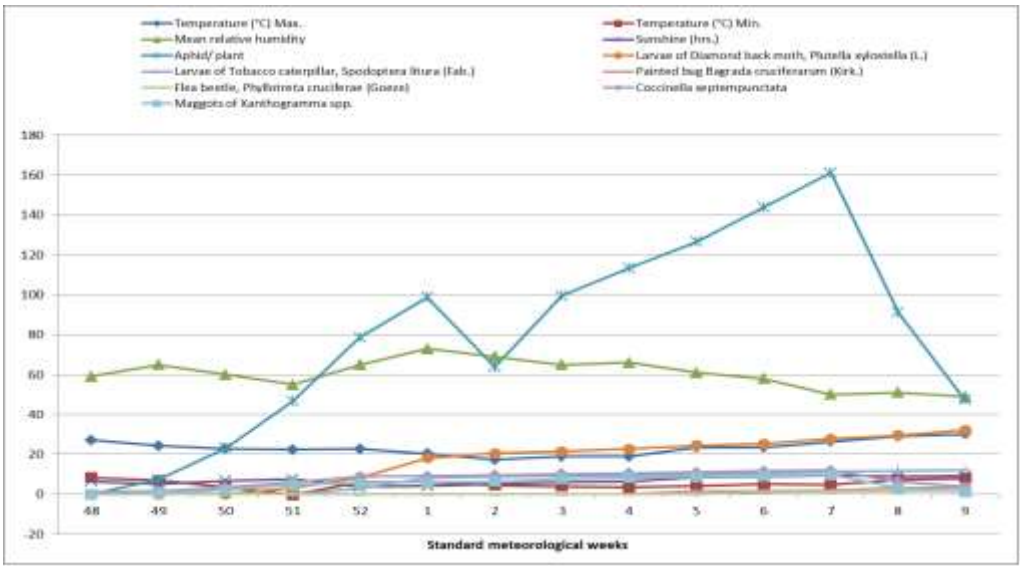

Fig. 1. Population dynamics of major insect pests of cauliflower in relation to biotic and abiotic factors,rabi 2021-22

Table 2. Population dynamics of mustard aphid, *Lipaphis erysimi* (Kaltenbach) on cauliflower in relation to biotic and abiotic factors in *Rabi,* 2022-23

SMW	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Sunshine (hrs)	Aphid/plant	Mean population/ 10 plant	
		Max.	Min.				*C. septempunctata*	Maggots of *Xanthogramma spp.*
48	29/11/2022	27.90	4.80	49.00	8.90	0	0	0
49	6/12/2022	25.50	3.70	55.00	8.10	0	0	0
50	13/12/2022	26.60	4.60	54.00	8.90	9.4	2	1.6
51	20/12/2022	25.50	4.60	58.00	8.10	27.8	3.8	2.8
52	27/12/2022	23.30	2.20	56.00	7.90	77.8	6.8	5.8
1	3/01/2023	20.70	-0.10	60.00	7.50	126.6	10.2	6.6
2	10/01/2023	24.50	4.90	55.00	7.30	175.2	10.8	7
3	17/01/2023	20.10	-0.50	55.00	8.30	194.6	11	7.4
4	24/01/2023	21.30	3.60	61.00	4.10	215.4	11.8	8.8
5	31/01/2023	22.00	5.20	69.00	7.30	237.2	12.6	9.6
6	7/02/2023	26.90	6.90	56.00	9.00	269.8	14.8	13.2
7	14/02/2023	28.40	5.80	51.00	9.40	199.2	9.6	7.8
8	21/02/2023	31.90	9.80	49.00	8.60	112.8	7.6	4.8
9.	28/02/2023	32.10	12.00	49.00	8.80	88.2	4.6	3.2
Correlation coefficient with max. temp.						-0.308	-0.401	-0.345
Correlation coefficient with min. temp.						-0.020	-0.124	-0.077
Correlation coefficient with relative humidity						0.423	0.484	0.471
Correlation coefficient with Sunshine (hrs.)						-0.297	-0.341	-0.270
Correlation coefficient with C. septempunctata						0.967**		
Correlation coefficient with Maggots of *Xanthogramma spp.*						0.962**		

SMW= Standard meteorological weeks
** Significant at 5 per cent level*
*** Significant at 1 per cent level*

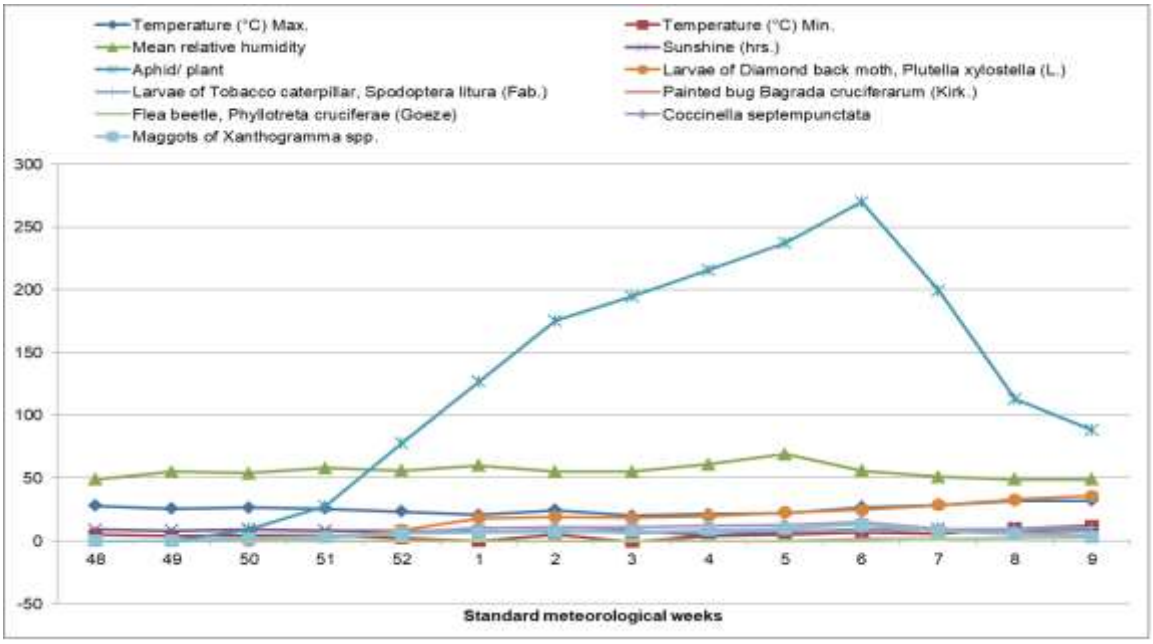

Fig. 2. Population dynamics of major insect pests of cauliflower in relation to biotic and abiotic factors, Rabi 2022-23

The aphid population had non-significant negative correlation with maximum temperature (r= -0.169 and r= -0.308), minimum temperature (r= -0.226 and r = -0.020) in both the year. The relative humidity showed non significant negative correlation (r= -0.075) in the first year (2021/22) while, non significant positive correlation (r= 0.423) in the second year (2022/23). The sunshine hours showed non significant positive correlation (r= 0.379) in the first year (2021/22) while, non significant negative correlation (r= -0.297) in the second year (2022/23). The aphid population had positive significant correlation with ladybird beetle (r= 0.929 and r= 0.967) and syrphid fly (r= 0.917 and r= 0.962) in both the years.

The present investigation on association of aphid population with the biotic and abiotic factors are in conformity with the findings of Varmora et al. [10] was reported non-significant negative correlation with maximum temperature and bright sunshine hours and relative humidity showed non significant positive correlation with pest population. Arvind [19] reported the aphid population showed non- significant negative correlation with minimum and maximum temperature and non significant positive correlation with relative humidity.

Bana et al. [21] reported that relative humidity and sunshine hours showed non-significant correlation. Pradhan et al. [18] reported relative humidity had non-significant negative correlation with aphid population. Amarchand et al. [20] reported that minimum temperature had non-significant negative correlation, whereas, relative humidity had non- significant positive with aphid population. Jandial and Kumar [22] reported that non-significant correlation existed between maximum and minimum temperature, relative humidity and aphid population. Triphati et al. [23], Varmora et al. [10] Pardhan et al. [18] Amarchand et al. [20], Dotasara et al. [24] were found that the population of ladybird beetle and syrphid fly had a significant positive correlation with aphid population and these findings are full support with present findings.

3.1 Natural Enemies

The incidence of ladybird beetle, *C. septempunctata* and syrphid fly, *Xanthogramma* spp. commenced in first week of December and second week of December in both the years. The peak population of ladybird beetle and syrphid fly in the second week of February and first week of February during both the years. “The correlation studies indicated that the ladybird beetle and syrphid fly population had non-significant correlation with all the weather parameters during both the years”. [7]

The current findings are in accordance with those of Vakaria and Patel [25] and Sharma et al. [26] who were reported the incidence of ladybird beetle started from the first week of December and the peak population of ladybird beetle from the third week of February and supports the present results. Patra et al. [11], Dwivedi et al. [14] and Amarchand et al. [20] reported that the *C. septempunctata* and syrphid fly population was maximum in the third and second week of December. Bana et al. [21], Mishra et al. [15] and Sharma et al. [26] reported that the *C. septempunctata* population was maximum in the third and fourth week of January.The work of studies on correlation of predators population with the weather parameters are supported by the findings of Arvind [19] Amarchand et al. [20] and Dotasara et al. [24] reported that the non significant correlation with all weather parameters.

4. CONCLUSION

The important conclusions drawn from present investigation made on population dynamics of aphid and its natural enemies. The infestation of aphid started in the first week of December and second week of December remained active throughout the crop season during both two years. The population of aphid gradually increased and reached to its peak in the second week of February and first week of February in *Rabi*, 2021-22 respectively. The aphid, ladybird beetle and syrphid fly had non-significant correlation with maximum temperature, minimum temperature relative humidity and sunshine hours during both the years. Both the predators ladybird beetle and syrphid fly had significant positive relationship with aphid population during both the years.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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