Original Research Article

Seasonal incidence of aphid(*Aphis craccivora* Koch) on pea crop and it's correlation with different abiotic factors under field condition

ABSTRACT

The present investigation was carried out in randomized block design (RBD) during *Rabi* 2022-23 and 2023-24 at research farm, College of Agriculture,Gwalior (M.P.). The crop's pest situation is also greatly influenced by the weather factors. The objective of this investigation was to study the seasonal incidence of aphid (*Aphis craccivora* Koch) on pea crop and it's correlation with different abiotic factors in this region.During *Rabi* 2022-23,the aphid population ranged from 3.80 to32.10 aphids/10 cm apical twig/plant. Whereas during *Rabi* 2023-24,the aphid population ranged from 2.90 to 28.70 aphids/10 cm apical twig/plant. The occurrence of aphids was first observed during the 52ndSMW(Standard Meteorological Week)for both years. The population of this pest began to increase and reached its peak during the 6th SMW. However, minimum population was recorded during the 10th SMW in both the years. During *Rabi* 2022-23,the incidence of aphids was significantly and positively correlated with the maximum and minimum temperature, whereas, a significant and negative correlation was found between evening relative humidity and the aphid population. While, morning relative humidity and rainfall showed a non-significant negative correlation with aphids. During *Rabi* 2023-24, the incidence of aphids was significantly and positively correlated with the maximum temperature, but the minimum temperature showed a positive non-significant correlation with aphids. Whereas, morning relative humidity was found significant and negatively correlated with population of aphids. However, evening relative humidity and rainfall showed a non-significant negative correlation with the aphid population.

Keywords: aphid, Aphis craccivora Koch,seasonal incidence, correlation,meteorological, pea.

1. INTRODUCTION

Pea (*Pisum sativum* L.) is important herbaceous annual crop in Fabaceae family which is majorly grown in temperate climates, and it is categorized into field pea and garden pea (Mohan *et al.*, 2013)[1]. Pea has adapted to a wide range of climates and altitudes. It is commonly recognized as consisting of spring, mediterranean, and winter types (Stoddard *et al.,* 2010)[2]. The tender seeds are also used in soups. In some countries, such as China, young shoots of pea seedlings are also cooked by several methods for popular consumption (Bhat and Karim, 2009)[3]. It is highly nutritive containing high proportion of digestible proteins, carbohydrates, minerals and vitamins. One hundred gram of dried edible portion of pea seed contains 62.1 gm carbohydrates, 22.5 gm protein, 1.8 gm fat, 64 mg calcium, 4.8 mg iron, 0.15 mg riboflavin,0.72 mg thiamine and 2.4mg niacin (Gueguen and Barbot, 1988)[4]. InIndia, it is grown in an area of 0.42 million ha with the production of 4.01 million metric ton and productivity is 9.5 t/ha. Pea is cultivated on a large scale in the states like Uttar Pradesh, MadhyaPradeshand Jharkhand. It is also grown in Himachal Pradesh, Punjab, West Bengal, Haryana, Bihar, Uttarakhand, Jammu and Kashmir, Odisha, parts of Rajasthan and Maharashtra. In the south it is grown in Karnataka and in the hilly regions like Ooty and Kodaikanal (Singh*et al.*, 2023)[5].*Aphiscraccivora*(Koch),belong to the family Aphididae of order Hemiptera and suborder Homoptera and it is widely distributed species of insect prevalent throughout India. It is one of the most dangerous pests of legumes such as faba bean, cowpea and pea, it primarily infests the crop at seedling stage, but as the plant mature it frequently invades the flowers and pods, feeds by sucking out of the stem, terminal shoots, petioles, flowers and pods, resulting in heavy

yield loss. Besides this, it also acts as a vector of several viral diseases (David and Kumaraswami, 1982)[6].Biotic factors are the insect-pests infesting the pea crop at different stages from seedling to maturity. Twenty-four insect species are reported to attack all parts of the plant at different stages (Bijjur and Verma, 1995 and Ibrahim *et al.*, 2020)[7][8]. Among the insect pest, aphid, pea stem fly, pea leaf miner, pea pod borer, gram pod borer and thrips often cause substantial loss to the crop (Singh and Singh, 2017)[9]. Hence, the present research was aimed to **Seasonal incidence of aphid (*Aphis craccivora*Koch) on pea crop and it's correlation with different abiotic factors under field condition.**

2. MATERIALS AND METHODS

A research experiment was conducted at the research farm, College of Agriculture, RVSKVV, Gwalior (M.P.) during two consecutive years *i.e.*, *Rabi* 2022-23 and 2023-24. To conduct comprehensive research on the major insect pests affecting pea crops in the Gird region of Madhya Pradesh, a detailed investigation was carried out. In the experiment, variety "Arkel" was sowed on 25th November 2022 and 23rd November 2023 during both the consecutive years respectively, maintaining 30 cm row to row and 10 cm plant to plant distance. The size of the plot was maintained as 6.0 m x 6.0 m. After sowing, light irrigation was done for good germination of seeds. Fertilizers were applied at the rate of 20 kg N, 60 kg P and 40 kg K per hectare.
The population of aphids was counted visually on top 10 cm apical twig of ten randomly selected plants at weekly interval starting with vegetative stage of the crop till maturity. The simple correlation and regression analysis was carried out between aphid population and environmental factors, *viz.*, maximum and minimum temperature(°C), morning & evening relative humidity (%) and rainfall (mm).

3. RESULTS AND DISCUSSION

The population of *Aphis craccivora*and its correlation and regression with weather parameters during *Rabi* 2022-23 are presented in Table 1 & 2 and Figure1-4.During *Rabi* 2023-24, the aphid population and itscorrelation and regression with weather parametersare presented in Table 3 & 4 and Figure5-7.During *Rabi* 2022-23 and 2023-24, the incidence of aphid population commenced from four WAS *i.e.*, 52nd SMW with 3.80 aphids/10 cm apical twig and 2.90 aphids/10 cm apical twig. Present findings are in conformity with the findings of Ramesh *et al.* (2019)[10] andChouhan*et al.*(2023)[11] who reported that incidence of aphid started at 52nd SMW. The current findings are also consistent with Omar(2022)[12] who also noted the incidence of aphid was first occurred in December at vegetative stage of the crop.

During *Rabi* 2022-23, the mean population indicated that the activity of this pest increased steadily and reached peak level of 32.10 aphids/10 cm apical twigin 6thSMW, when the maximum and minimum temperature were 28.6˚C and 9.6˚C, respectively, with 84.5 per cent morning and 37.2 per cent evening relative humidity and 0.00 mm of rainfall. During *Rabi* 2023-24, the population of *Aphis craccivora*reached its peak level of 28.70 aphids/10 cm apical twigin 6thSMW, when the maximum and minimum temperature were 23˚C and 7.2˚C, respectively, with 88.7 per cent morning and 67.6 per cent evening relative humidity and 6.20 mm of rainfall. Ultimately, the aphid population reached its peak level coinciding with 6th SMW in both the years. Present findings are infully agreement with those of Keval *et al.* (2020)[13] and Nayak (2014)[14] who also noted that aphid population increased rapidly with the growth of the crop and peaked in 6th SMW. Afterward, aphid population gradually declined, which was in line with the reports of Jakkaray (2020)[15] and Soratur (2017)[16] who also observed aphids population followed a declining trend during later stages of the crop growth.

Table 1: Seasonal incidence of aphid (*Aphis craccivora*)population on pea during *Rabi* 2022-23

SMW	Nymphs & adults of aphids/10 cm apical twig/plant	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
		Maximum	Minimum	Morning	Evening	
51	0.00	25.2	6.4	89.1	54.7	0
52	3.80	23.7	6	80.1	60.3	0
1	4.20	17.9	3.5	95.7	73.4	0

2	9.30	24.1	6.7	93.7	53.8	0
3	11.40	20.2	2.8	86.2	56.4	0
4	14.10	20.2	9.8	91.5	63.7	13
5	20.00	21.9	7.8	89.8	46.5	2
6	32.10	28.6	9.6	84.5	37.2	0
7	25.20	27.4	10.3	83	52.1	0
8	24.90	31.7	12.6	87	41.8	0
9	21.80	32.7	13.2	85.2	43.1	0
10	15.90	30.9	13.9	84.5	48.1	0

*SMW = Standard Meteorological Week

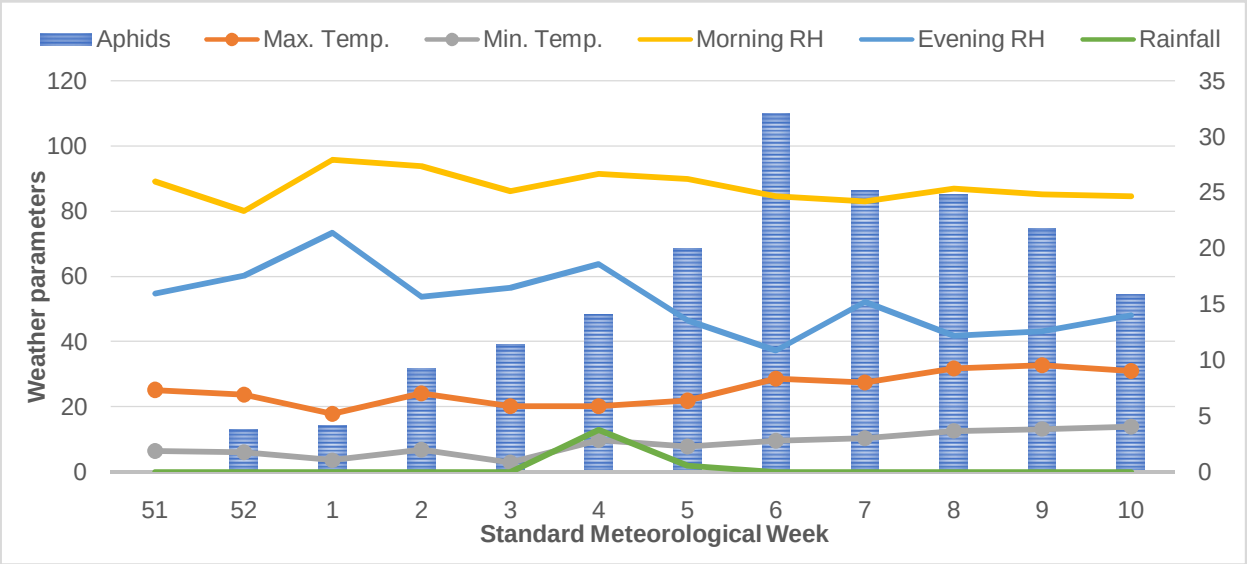

Fig 1: Interaction of weather parameters with aphid population during *Rabi* 2022-23

Table 2: Correlation and regression of prevalent weather parameters on aphid population during *Rabi* 2022-23

Weather parameters	Correlation coefficient	Regression equation
Maximum Temperature (°C)	0.58*	y = 1.1656x - 14.353
Minimum Temperature (°C)	0.64*	y = 1.7395x + 0.3522
Morning RH (%)	-0.35^{NS}	-
Evening RH (%)	-0.76*	y = -0.7452x + 54.414
Rainfall (mm)	-0.01^{NS}	-

*Significant at 5% level of significance; NS= non-significant

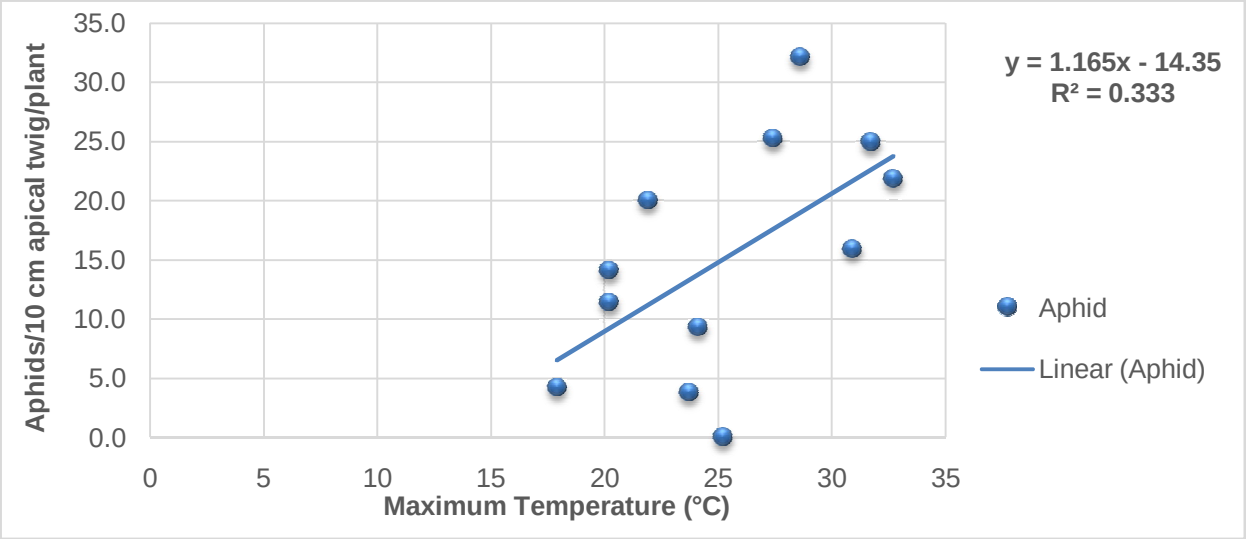

Fig 2: Regression between maximum temperature (°C) and aphid population during *Rabi* 2022-23

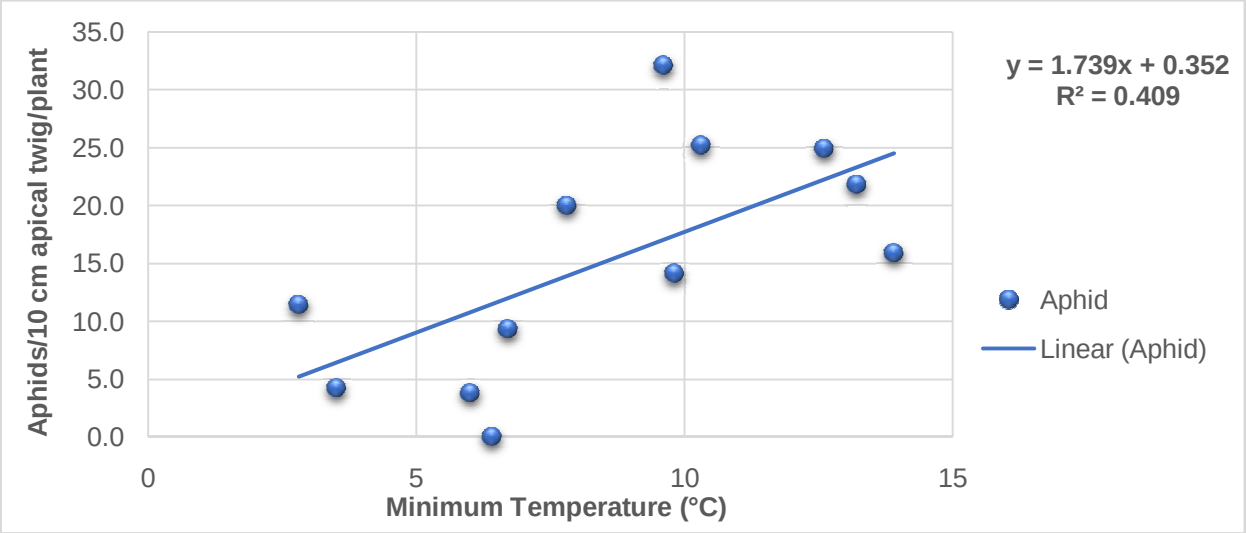

Fig 3: Regression between minimum temperature (°C) and aphid population during *Rabi* 2022-23

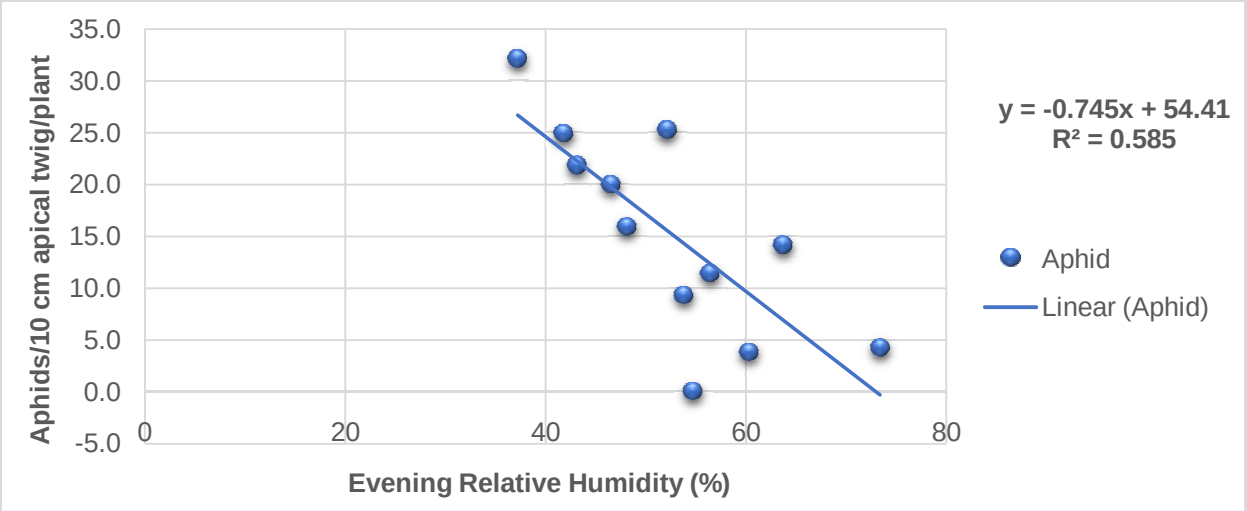

Fig 4: Regression between evening relative humidity and aphid population during *Rabi* 2022-23

During *Rabi* 2022-23 and 2023-24, result of correlation studies revealed that aphid population was influenced with significantly positive correlation by the maximum temperature. The scientific evidences supporting the current findings are also supported by Baladhiya (2018)[17], Ramesh *et al.* (2019)[10] and Jakkaray (2020)[15] who also reported that the incidence of aphids was found significant and positively correlated with maximum temperature.

Whereas, during the year 2022-23, minimum temperature was found to have significantly positive influence on the aphid population. These findings of the present investigation are in conformity with earlier findings by Keval *et al.* (2020)[13], Omar (2022)[12] and Ramesh *et al.* (2019) [10]who reported that the minimum temperature found significantly positive effect on aphid population. While during 2023-24, minimum temperature exhibited positive non-significant correlation with the influence of aphid population. Similar results were also reported by Kale (2009)[18], Choudhary (2017)[19], Soratur (2017)[16], Borade*t al.* (2020)[20],Mishra *et al.* (2023)[21] and Singh *et al.* (2024)[22] as according to them, aphid population was non-significant and positively correlated with minimum temperature.

Table 3: Seasonal incidence of aphid (*Aphis craccivora*)population on peaduring *Rabi* 2023-24

SMW	Nymphs & adults of aphids/10 cm apical twig/plant	Temperature (°C)		Relative Humidity (%)		Rainfall (mm)
		Maximum	Minimum	Morning	Evening	
51	0.00	24.6	6.2	94.5	63.8	0
52	2.90	22.3	7	95.3	75.7	0
1	3.00	15.6	8.7	94.4	67.1	0
2	5.40	21	5.7	93.1	61.6	36
3	8.20	17.2	5.3	94.9	66.6	0
4	13.10	20.6	5.3	87.9	63.1	0
5	19.90	25.7	9.6	89	60	0
6	28.70	23	7.2	88.7	67.6	6.2
7	24.60	26.7	7.2	91.6	57.1	0
8	22.90	29.4	10.2	83	56.3	0
9	18.70	27.2	10.7	85.4	63.3	20.6
10	15.60	28	8.1	79.9	48.6	0

*SMW = Standard Meteorological Week

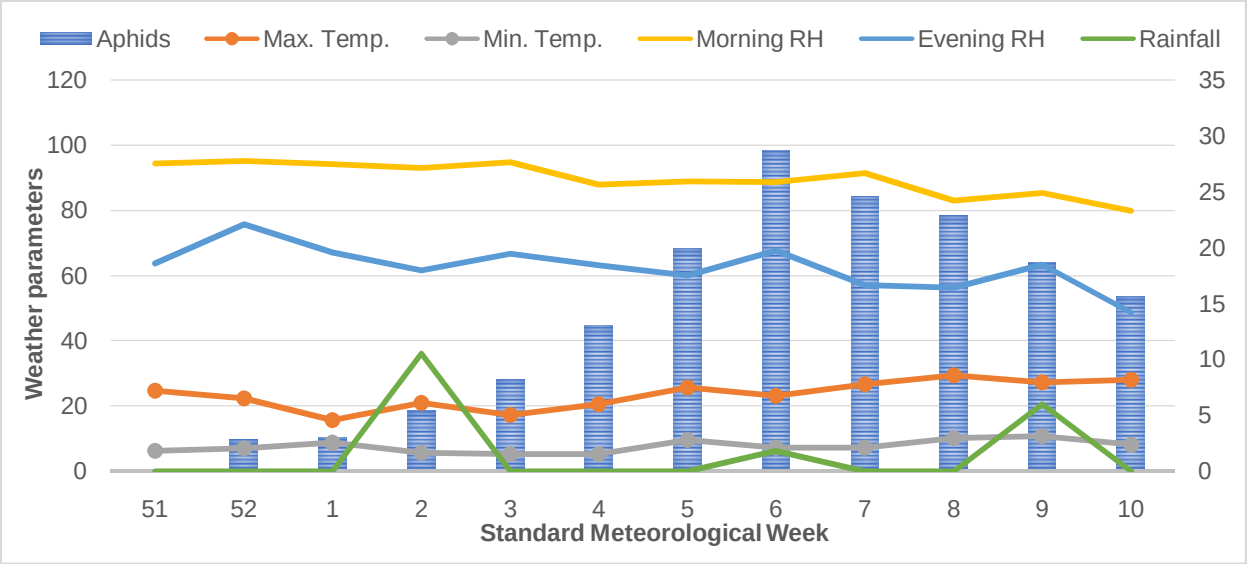

Fig 5: Interaction of weather parameters with aphid population during *Rabi* 2023-24

Table 4: Correlation and regression of prevalent weather parameters on aphid population during *Rabi* 2023-24

Weather parameters	Correlation coefficient	Regression equation
Maximum Temperature (°C)	0.58*	y = 1.2869x - 16.585
Minimum Temperature (°C)	0.43^{NS}	-
Morning RH (%)	-0.62*	y = -1.1761x + 119.21
Evening RH (%)	-0.42^{NS}	-
Rainfall (mm)	-0.08^{NS}	-

*Significant at 5% level of significance; NS= non-significant

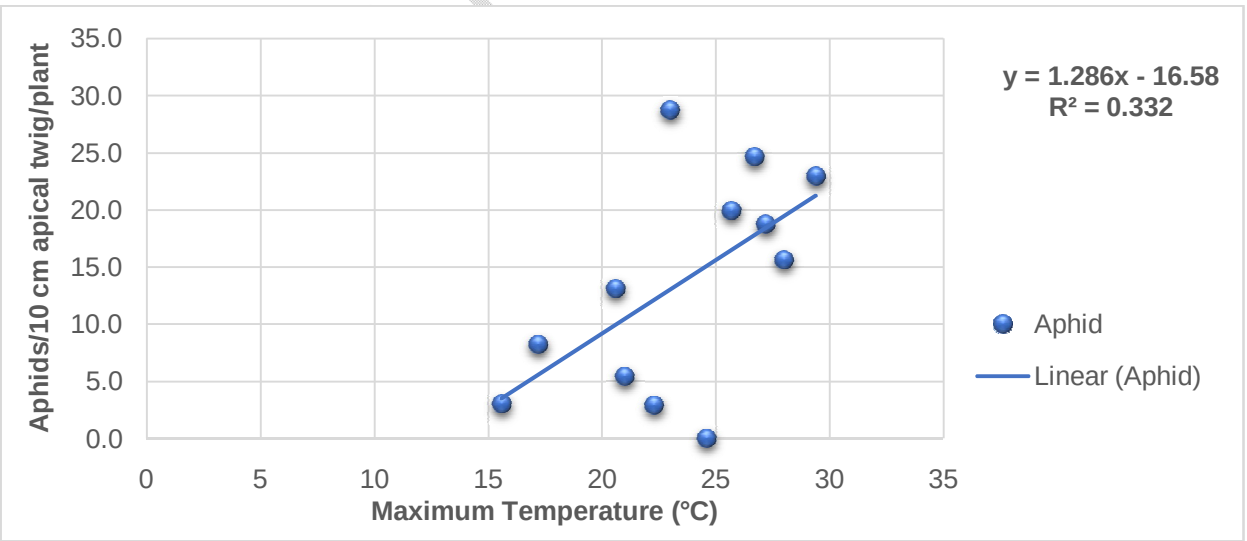

Fig 6: Regression between maximum temperature (°C) and aphid population during *Rabi* 2023-24

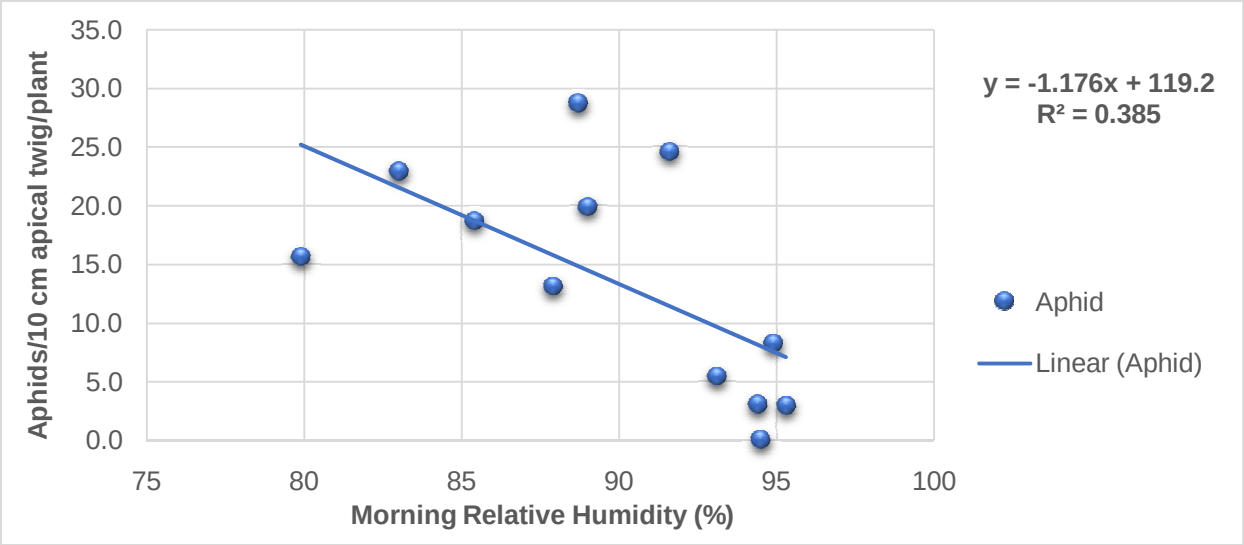

Fig 7: Regression between morning relative humidity and aphid population during *Rabi* 2023-24

In present investigation during *Rabi* 2022-23, morning RH exhibited negative and non-significant correlation with the influence of aphid population. The present findings are the full conformity with the findings of Kale (2009)[18],Sahoo (2014)[23], Borad *et al.* (2020)[20], Jakkaray (2020)[15], Chauhan *et al.* (2023)[24], Howal *et al.* (2024)[25] and Patnaik *et al.* (2024)[26]. However, during *Rabi* 2023-24, result of correlation studies revealed that aphid population was showed negative and significant correlation with morning RH. Similar findings have been reported by Bashir (2020)[27] and Kallappa (2012)[28] who also observed that negative and significant correlation with aphids.

The result of correlation studies revealed that aphid population was showed negative and significant correlation with evening RH in *Rabi* 2022-23. The results of the current study closely match with those ofChakraborty (2006)[29] and Kallappa (2012)[28] who observed significant and negative correlation with aphid population. Further, evening RH showed negative and non-significant correlation in 2023-24, which is close conformity with the findings of Sahoo (2014)[23], Nayak (2014)[14], Baladhiya (2018)[17], Borad*et al.*(2020)[20], Jakkaray (2020)[15], Ahlawat*et al.* (2022)[30], Chauhan *et al.* (2023)[24], and Pandit (2023)[31], Ramesh *et al.* (2019)[10], Howal *et al.* (2024)[25] and Patnaik *et al.* (2024)[26].

Also, a rainfall exhibited non-significant and negative correlation with aphid population in both the years. The findings of present study are corroborated with that of Sahoo (2014)[23], Nayak (2014)[14], Kumar and Yadav (2018)[32], Choudhary (2017)[19], Baladhiya (2018)[17], Borad*et al.* (2020)[20], Ahlawat *et al.* (2022)[30] and Singh *et al.* (2024)[22], who also revealed that the rainfall found non-significant negative correlation with aphids.

4. CONCLUSION

The result concluded that *Aphis craccivora* was first observed during the 52nd Standard Meteorological Week (SMW) in *Rabi* 2022-23 and 2023-24. The population increased gradually from the 52nd to the 6th SMW, reaching its peak during the 6th SMW. The population declined and disappeared after the 10th SMW in both seasons of *Rabi* 2022-23 and 2023-24.The correlation study between weather parameters and aphid population revealed that the aphid population foundsignificant positive correlation with maximum temperature in both consecutive years. Whereas, the aphid population exhibited significant positive correlation with minimum temperature during *Rabi* 2022-23. A significant and negative correlation found between aphid population and morning RH during *Rabi*2023-24. However, Evening RH found a significant negative correlation with aphid population during *Rabi* 2022-23. Based on the result of present investigation, it was found that seasonal incidence of *Aphis craccivora* will be helpful and play a vital role in prediction and forecasting of pest incidence.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT,etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

AUTHORS' CONTRIBUTIONS

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

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