Studies on Seasonal Incidence of Aphid on Potato (*Solanum tuberosum* L.)

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ABSTRACT: The main objective of present investigation is to study seasonal incidence of aphid on potato crop and establishing correlations with different weather parameters viz; temperature (maximum temperature, minimum temperature and average temperature), relative humidity (morning relative humidity, evening relative humidity and average relative humidity), wind velocity, rainfall. The experiment was carried out at farmer's field at Kodit Tal. Purandar, Dist. Pune (Maharashtra) during *Rabi* season 2020-2021. The studies on seasonal incidence revealed that the first incidence of aphid was commenced after three weeks of planting at 48th SWM and it remains active throughout the crop growth period. The peak infestation of aphid (496 aphids/100 compound leaves) was observed at 1st SMW (1st week of January, 2021) when maximum temperature (28.39°C), minimum temperature (13.24°C), average temperature (20.82°C), morning relative humidity (91.88%), evening relative humidity (54.33%), average relative humidity (73.11%), wind velocity (3.21 km/hr) and rainfall (0.00 mm) were recorded. The weather correlation studies indicated that the highly significant negative correlation between population of aphid and maximum temperature with correlation value r = -0.691 while, non-significant negative correlation was observed with minimum temperature (r= -231), average temperature (r = -469) and wind velocity (r = -0.139). The non-significant positive correlation were observed with morning relative humidity (r=0.343), evening relative humidity (r = 0.041) average relative humidity (r =0.150) and rainfall (r = 0.307).

Keywords: Potato, Aphid, Seasonal incidence, Correlation, Weather parameters.

INTRODUCTION

Potato (*Solanum tuberosum* L.) belongs to family *Solanaceae* is one of the most important vegetable tuber crop and it ranks at third position in production after rice and wheat in the world as well as in India. Potato is found to be originated from the Andean mountains of South America in the areas lying between Bolivia and Peru, but diversity and adaptability of tuber has spread it from its origin to all major zones in temperate regions of all the continents and its production has been increased most rapidly in the warm, humid, tropical Asian lowlands during the dry season and now presently it is cultivated in about one hundred and forty countries. The complete vegetable basket will not be possible without potato due to its properties and characters like dry matter content, edible energy i.e. carbohydrates and edible proteins content of potato which makes it superior in terms of nutrition as well as staple food not only in our country but also throughout the world. Now, it not only remained as an essential part of different consumption patterns throughout worldwide but also largely becoming as raw material for processing of different food products, food

ingredients, starch alcohol and as feed for animals. Therefore, potato is considered to be the "King of Vegetable" because of its greater utility. Looking at the importance, year 2008 declared as the International Year of the Potato by United Nations to increase awareness of the relationship that exists between poverty, food security, malnourishment and the potential contribution of the potato to defeating hunger.

In India the major potato growing states are Uttar Pradesh, West Bengal, Bihar, Gujarat, Madhya Pradesh, Punjab and Assam. Production of potato in India is highly concentrated in gangetic plain region as three largest potato producing states, *viz.*, Uttar Pradesh (32.38%), West Bengal (26.94%) and Bihar (14.56%) collectively contribute about 74% to the national production. India has exported 4,32,895 tonnes of potato with estimated value of Rs. 547.14 crores during 2019-20 (Anonymous, 2020).

Various abiotic and biotic factors not only play an important role in development of crop but also found to be indirectly responsible for infestation of various pests and diseases on potato. India's tropical and humid climate also favours the development and infestation of

different insect and pest. Potato crop are prone to attacked by more than 80 insects and nematode pests in the field and in store which are one of the important limiting factor in raising productivity and production of potato in India, (Misra and Agrawal, 2008). In Maharashtra, the sucking pests *viz.*, aphids, hoppers, whiteflies and thrips are considered as a major group because of their role as the vectors of viral diseases. The yield loss caused by the potato viruses may continue to spread as long as the farmers use the same lot or the infected tubers for planting purpose and the average yield loss were upto 6 per cent of total yield due to aphid (Basavaraju *et al.*, 2009).

Aphids are economically important polyphagous pests known to cause damage to many crops. Thirteen aphid species were found associated with potato crop in different parts of India namely *Myzus persicae* (Sulzer), *Aphis gossypii* (Glover)*, Aphis fabae* (Scopoli)*, Aphis spiraecola* (Patch)*, Aphis nerii* (Boyer de)*, Hydaphis coriandri* (Das)*, Rhophalosiphum rufiabdominalis* (Sasaki)*, Macrosiphum euphorbiae* (Thomas)*, Brevicoryna brassicae* (Linnaeus)*, Lypaphis erysimi* (Kaltenbach)*, Rhopalosiphoninus latysiphon* (Davidson)*, Aulacorthum solani* (Kaltenbach) and *Brachycaudus helichrysi* (Kaltenbach) (Bhatnagar *et al.*, 2017). Among them, *Myzus persicae* (Sulzer) and *Aphis gossypii* (Glover) are extremely important species of aphid. The nymphs and adults damage the plants by sucking plant cell sap from tender leaves, etc. which results into curling and twisting of tender parts and general revitalization causing heavy losses and reduction in yield as well as adversely affecting quality of potato.

In present studies, efforts are taken for correlating aphid population dynamics with different weather parameters with an aim to study the incidence pattern of such an important pest.

MATERIAL AND METHODS

Potato tuber seed: Potato tuber seed of variety *Kufri Pukhraj* for seasonal incidence of aphid was provided by AICRP on Potato, NARP, Ganeshkhind, Pune.

Method: the potato tubers were planted at experimental field during the *Rabi* 2020-21. All the agronomical practices were adopted as per recommendations for potato crop.

Experimental details:

1	**Crop**	:	**Potato**
2	Season and Year	:	*Rabi* 2020-21
3	Variety	:	*Kufri Pukhraj*
4	Plot size	:	20×20 m
5	Spacing	:	60×20 cm
6	Fertilizer application	:	N:P:K @ 150:60:120 kg/ha
7	Date of planting	:	06 November, 2020
8	Date of harvesting	:	15 February, 2021

Method of observation: The aphid population recorded at weekly interval from on 100 compound leaves (top, middle and bottom compound leaves/plant) of 34 tagged plants during plant emergence stage to plant maturity period was correlated with meteorological data to study the influence of weather parameters on seasonal incidence of aphid.

The meteorological data viz., temperature (maximum and minimum), relative humidity (morning and evening), wind speed (km/hr) and rain fall (mm) were collected from meteorological observatory located at the All India Coordinated Research Project on Arid Zone fruits (Fig and Custard apple) Jadhavwadi, Tal. Purandar, Dist. Pune.

RESULTS AND DISCUSSION

The first incidence of aphid on potato was observed immediately after plant emergence i.e. three weeks after planting and it remains active throughout the crop growth period. The population of aphid was (90 aphids/ 100 compound leaves) on tagged plants in 48th Standard Meteorological Week (SMW) i.e. at 4th week of November, 2020. Incidence of aphid was increasing along with crop growth and it was 255, 340, 416, 450 number of aphids per 100 compound leaves on tagged plants during 49, 50, 51 and 52nd SMW, respectively. The aphid incidence was increased during vegetative growth of potato crop and maximum incidence of aphid was observed in 1st SMW (496 aphids per 100 compound leaves) i.e. 9 weeks after planting. Later on the population of aphid was declined on potato crop and it was 438, 360, 264 and 118 per 100 compound leaves from 2nd SMW to 5th SMW.

The present finding on first incidence of aphid on potato at three week after planting or at 4th week of November are in close confirmation with reports of Pandey *et al.,* (2014) they had reported incidence of aphid from 4th week of November. Similarly, Nayak *et al*. (2019) also noticed the occurrence of aphid between 22 to 25 days after planting. However, reports of first incidence of aphid during 2nd week of December (Konar *et al*., 2010), 45th SMW (Anand, 2015) and 2nd week of December (Nag, 2016) are disagree with present investigation. The variation in first occurrence might be due to planting time, prevailing weather condition and availability of alternate host in a particular locality.

The findings of maximum population of aphid was noticed during 51th SMW to 2nd SMW i.e. 49 to 70 days after planting was in accordance with More *et al.,* (2012) they reported that the maximum number of aphid was observed during 45 to 65 days after planting. The present finding of peak population of aphid was noticed at 1st week of January, 2021 are not in line with earlier reports made by different worker *viz.*, Konar *et al*., (2010); Nag, (2016); Nayak *et al.,* (2019). The discrepancy in peak activity of aphid might be due to planting time and weather condition in a particular locality.

The fluctuations in the population of any living organism in natural condition is largely depends upon biotic and abiotic factors like natural enemies, temperature, relative humidity, wind velocity, rainfall etc. To know the effect of various weather parameters on the population of aphid on potato crop during crop growth period, a simple correlation was worked out.

between weekly mean population of aphid and weekly mean value of different weather parameters. The correlations between aphid population and weather parameters are presented in Table 1.

Table 1: Incidence of aphid and Influence of various abiotic factors on the population of aphid on potato crop during *Rabi* 2020- 21.

Month	Standard meteorological Week	Aphid population/ 100 Compound leaves	Temperature (°C)			Relative humidity (%)			Wind velocity (Km/hr)	Rainfall (mm)
			Maximum	Minimum	Average	Morning	Evening	Average		
November	45	0	29.9	17.2	23.55	92.2	65.2	78.70	3.2	0.00
	46	0	29.66	13.61	21.64	84.56	56.76	70.66	3.50	0.00
	47	0	29.43	17.15	23.29	88.47	63.56	76.02	3.75	0.00
	48	90	31.43	18.88	25.16	96.51	68.91	82.71	3.35	0.00
December	49	255	28.81	17.14	22.98	92.80	68.74	80.77	4.02	0.00
	50	340	29.55	12.32	20.94	89.51	52.76	71.14	3.71	0.00
	51	416	28.98	17.59	23.29	91.76	68.79	80.28	3.34	0.00
	52	450	27.67	12.42	20.05	90.74	55.17	72.96	3.16	0.00
January	1	496	28.39	13.24	20.82	91.88	54.33	73.11	3.21	0.00
	2	438	27.28	17.27	22.28	91.90	71.19	81.55	3.70	4.70
	3	360	28.20	18.02	23.11	95.00	68.74	81.87	3.51	0.00
	4	264	30.40	17.19	23.80	91.23	53.20	72.22	3.12	0.00
February	5	118	29.86	14.21	22.04	80.20	44.04	62.12	3.57	0.00

Table 2: Correlation studies between aphid population and weather parameters during 2020-21.

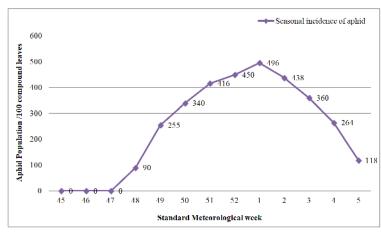| Environmental factor		Correlation coefficient (r)
Temperature (°C)	Maximum	-0.691**
	Minimum	-0.231[NS]
	Average	-0.469[NS]
Relative Humidity (%)	Morning	0.343[NS]
	Evening	0.041[NS]
	Average	0.150[NS]
Wind velocity (km/hr)		-0.139[NS]
Rain fall (mm)		0.307[NS]

Note: Aphid population are analyzed with preceding week weather data; * Significant at 5 per cent level (r= ± 0.553); ** Significant at 1 per cent level (r= ± 0.684); NS= Non significant

Temperature. Correlations were worked out between temperature (maximum temperature, minimum temperature and average temperature) and weekly mean aphid population to determine influence on aphid population.

Maximum Temperature. The highly significant negative correlation was found between maximum temperature and population of aphid/100 compound leaves for overall crop growth period with correlation value r = -0.691**. The peak activity of aphid was observed at 1st SMW of 2021, when maximum temperature was 28.39°C. This implies that with the increase in maximum temperature, aphid population decreases and vice versa. The present findings are more or less similar with reports of Niaz and Ayub, (2007) who reported that the temperature of 15.60 to 31.40°C

is congenial for the maximum build up of aphid population in field. Similarly, the peak population of aphids was observed at temperature between 12.00 to 29.60°C (Thakur, 2017) and 13.43 to 29.64°C as reported by Nayak *et al.,* (2019).

The significant negative correlation between aphid population and maximum temperature was reported earlier by Pandey *et al.,* (2014); Anand, (2015); Sharma *et al.,* (2019). The findings of above worker are close in conformity with present investigation. However, Kumara *et al.,* (2017); Nayak *et al.,* (2019) reported positive correlation of aphid population with maximum temperature. The dissimilarity in findings with above workers might be due to prevailing weather conditions of experimental location.

Fig. 1. Seasonal incidence of aphid on potato crop during *Rabi* 2020-21.

Minimum Temperature. The correlation between minimum temperature and aphids/100 compound leaves was carried out. There was a non-significant negative trend with "r" value -0.231 was observed. The peak activity of aphid population was recorded in the 1st SMW of 2021 and then population showed slightly decreasing trend. The minimum temperature was 13.24°C recorded on this week.

The more or less identical results are observed by Nag, (2016); Sharma *et al*., (2019) they revealed that the minimum temperature had negative correlation with aphid population. The maximum aphid population was observed when minimum temperature was 13.43°C as reported by Nayak *et al.,* (2019). These reports are partially tally with present findings.

Average Temperature. The correlation coefficient studies revealed that the aphids population showed a non-significant negative correlation with average temperature having value "r" = -0.469. The peak activity of aphid was recorded in the 1st SMW 2021 which was associated with average temperature of 20.82°C. The present results are in line with Furiatti and Almeida, (1993) they reported that the highest aphid population was trapped at 18 to 20°C temperature.

Relative humidity. To determine influence of relative humidity on aphid population the correlations were worked out between relative humidity (morning relative humidity, evening relative humidity and average relative humidity) and weekly mean aphid population.

Morning Relative Humidity. It is seen from the data presented in Table No. 2 that the aphids population had non-significant positive correlation with morning relative humidity with correlation value "r"= 0.343. The morning relative humidity was 91.88 % during the period of peak activity at 1st SMW of 2021. Pandey *et al.,* (2014); Sharma *et al*., (2019) recorded positive correlations of aphid with relative humidity are in close agreements with present findings. further, Anand, (2015) who had also reported non-significant positive correlation with morning relative humidity.

Evening Relative Humidity. A non-significant positive correlation was found between evening relative humidity and population of aphid per 100 compound leaves of potato with correlation value "r"= -0.041. During the period of peak activity of pest evening relative humidity was 54.33 %.

Niaz and Ayub, (2007) reported the relative humidity of 44.25 to 73.70 % were congenial for build up of maximum aphid population in potato which is in conformity with present findings. The variation in correlation might be due to prevailing weather condition and aphid population of particular location.

Average Relative Humidity. The correlation between average relative humidity and aphid population revealed that, there was non-significant positive correlation with "r" value 0.150. The peak activity of aphid was recorded in the 1st SMW of January 2021 which was associated with average relative humidity 73.11%. The results obtained in present studies are more or less similar with reports of Niaz and Ayub, (2007); Sharma *et al*., (2019).

Wind velocity. The population of aphid on potato was correlated with the wind velocity and was found non significant with r value -0.139. The wind velocity of 3.21 km/hr was recorded during the peak activity of aphid. The results obtained in present investigation are in line with Nag, (2016) who noticed negative correlation of aphid with wind velocity.

Rainfall. The correlation between population of aphids and rainfall showed non-significant positive trend with "r" value 0.307 during crop growth period. 1st SMW of 2021 was recorded with peak activity of aphid with no rainfall recorded. Pandey *et al.,* (2014) reported positive correlation of rainfall with aphid population.

CONCLUSION

The incidence of aphid was commenced after three weeks of planting and it remains thereafter throughout the growth period of crop. The first incidence of aphid (90 aphids/100 compound leaves) was recorded from 48th SMW i.e. at 4th week of November, 2020. The maximum infestation of aphid was observed during 51th SMW of 2020 to 2nd SMW of 2021 and the peak population (496 aphids/100 compound leaves) was recorded at 1st SMW (1st week of January, 2021) when maximum temperature (28.39°c), minimum temperature (13.24°C), average temperature (20.82°C), morning relative humidity (91.88%), evening relative humidity (54.33%), average relative humidity (73.11%), wind velocity (3.21 km/hr) and rainfall (0.00 mm) were recorded.

The correlation between population of aphid per 100 compound leaves and maximum temperature was found to be highly significant negative with correlation value r= -0.691 while, correlation for minimum temperature, average temperature and wind velocity was negative but non-significant with values (r = -231), (r = -469) and (r=-0.139) respectively. The non-significant positive correlation were found with morning relative humidity (r=0.343), evening relative humidity (r=0.041) average relative humidity (r=0.150) and rainfall (0.307).

Conflict of Interest. The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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