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Population dynamics of aphid, *Aphis craccivora* Koch during *kharif* season on groundnut in relation to abiotic factors

Anuj Shakya, RK Dwivedi, Sachin Kumar, Amit Raj and Ankur Prakash Verma

Abstract

The experiments were carried out during two consecutive years 2018 and 2019 at NDF, Kalyanpur of CSAUAT, Kanpur to study the population dynamics of aphids during *kharif* season on groundnut crop. Initial infestation of aphid found 0.6 mean number of population started at 30th SW in 2018 whenever during 2019 found 1.0 mean number of population at 31st SW. The aphid population increased gradually and reached its peak on (41st SW) i.e. 9.6, (43rd SW) i.e. 9.3 mean numbers of aphid during 2018 and 2019, respectively. The maximum and minimum temperature prevailed during the study periods (years 2018 and 2019) was 34.0 °C, 30.5 °C and 19.8 °C, 16.7 °C, respectively, and the average relative humidity was recorded in terms of 77, 88 per cent, while total rainfall was observed 0.0 mm, 0.0 mm, respectively. The correlation matrix indicated a significant positive correlation with maximum temperature ($r = 0.535$) with aphid infestation. However, significant negative correlation was found with average relative humidity ($r = -0.820$) and also with total rainfall ($r = -0.513$), while non-significant negatively correlated with minimum temperature ($r = -0.386$).

Keywords: aphid, *kharif*, population, groundnut, temperature

Introduction

Groundnut is the major oil seed crop in India and it plays a major role in bridging the vegetable oil deficit in the country. It is widely grown in the tropics and subtropics, being important to both small and large commercial producers. It is classified as both a grain legume and, due to its high oil content, an oil crop also. A typically among crop plants, peanut pods develop underground rather than aboveground. It is this characteristic that the botanist Linnaeus used to assign the specific name *hypogaea*, which means “under the earth”. The crop is raised on 0.95 lakh hectares with a total production of 0.98 lakh tonnes with average yield of 1011 kg/ha. In U.P. and 55.6 lakh hectares area with production of 101 lakh tonnes in India with a productivity of 1816 kg/ha in 2020-21 (Anonymous, 2021) [1].

The sucking insect pests complex comprising aphids *Aphis craccivora* Koch and thrips, *Thrips dorsalis* Hood, *Megalurothrips usitatus* Bagnall; leaf hoppers, *Empoasca motti* Pruthi, *Batracomorphus angustatus* Osborn, *Cicadulina bipunctata* Melichar, *Empoasca prima* Distant and *Leofa mysorensis* Distant are the major pests of importance on groundnut crop specially when raised under rainfed conditions and bunch varieties are severely infested (David and Ramamurthy, 2011) [7].

Among the insect pests of groundnut, aphid, *Aphis craccivora* Koch is a serious sucking pest with worldwide distribution. It is highly polyphagous and is known to attack several leguminous and non-leguminous plants. Aphids suck the sap from tender shoots and twigs and sometimes severely infest the plant and they are vectors of rosette disease. It settles on green plants and trees of the leguminosae family. Weather parameters play an important role on the population dynamics and distribution of groundnut aphids. It is considered to be one of the most important pests of crops causing great losses to yield.

Materials and Methods

Experiments were conducted at New Dairy Farm at Chandra Shekhar Azad University of Agriculture and Technology, Kanpur Nagar, (U.P.) during two consecutive years i.e. 2018 and 2019 with Divya variety of groundnut for the study of population dynamics of aphid infesting groundnut, *Arachis hypogaea* L. in relation to abiotic factors.

Aphid, *Aphis craccivora* Koch are specific sucking pest of groundnut, hence the initial population of the sucking pest is to be appeared earliest at the time of vegetative stage of the crop. The population of tested insect is to be monitored closely as soon as it appears on the plant. The data regarding the population of sucking pest were recorded on 5 randomly selected plants at weekly intervals till the harvesting of the crop. Aphid population were recorded on top 5cm. shoot length of tagged five plants without disturbing the plants using 10X magnification hand lens. The observation on population of aphid, *Aphis craccivora* Koch were recorded in morning hour i.e. 7-9 A.M. At the same time the meteorological data of the crop period was collected from the observatory, Department of Agronomy, C. S. Azad University of Agriculture and Technology Kanpur.

Results and Discussion

The studies on aphids of groundnut crop were made in the *kharif* seasons of two consecutive years i.e. 2018 and 2019. Aphid observations were recorded to find out the effect of weather conditions on infestation of aphid on groundnut. The data presented in table-1 and figure-1 declared that the initial infestation of aphid during *kharif* -2018 found 0.6 mean number of population at 30thSW. The aphid population increased gradually and reached its peak on (41st SW) i.e. 9.6 mean numbers of aphid. The maximum and minimum temperature prevailed during the study period was 34.0 °C and 19.8 °C, respectively, and the average relative humidity was recorded in terms of 77 per cent, while total rainfall was observed 0.0 mm. The infestation of aphid declined gradually with the decline of total rainfall and reached to minimum i.e. 1.6 mean numbers of aphid at 46th SW. The maximum and minimum temperature recorded during this period was 29.5 °C and 10.6 °C, respectively, thereafter the infestation of aphid declined. The correlation matrix indicated a significant positive correlation with maximum temperature ($r = 0.535$) with aphid infestation. However, significant negative correlation was observed with average relative humidity ($r = -0.820$) and total rainfall ($r = -0.513$), while non-significant negative correlation was found with minimum temperature ($r = -0.386$).

In second year infestation of aphid on groundnut, the data presented in table-2 and figure-2 declared that the initial infestation of aphid during *Kharif* -2019 found 1.0 mean

number of population at 31st SW. The maximum and minimum temperature prevailing during the initial infestation was 34.1 °C and 26.9 °C, respectively, during the study period. The aphid population increased gradually and reached its peak on (43rd SW) i.e. 9.3 mean numbers of aphid. The maximum and minimum temperature prevailed during the study period was 30.5 °C and 16.7 °C, respectively, and the relative humidity was recorded in terms of 88 per cent, while total rainfall was observed 0.0 mm. The infestation of aphid declined gradually and reached to minimum i.e. 3.3 mean numbers of aphid at 46th SW. The maximum and minimum temperature recorded during this period was 29.0 °C and 14.6 °C, respectively, while relative humidity was recorded 86.7 per cent and the total rainfall was observed in terms of 0.0 mm.

The correlation matrix indicated a significant negative correlation with maximum temperature ($r = -0.469$) and minimum temperature ($r = -0.573$) with aphid infestation. However, non-significant negative correlation was observed with total rainfall ($r = -0.415$), while non-significant positive correlation was found with relative humidity ($r = 0.008$).

Rawat *et al.* (2020) [6] recorded similar results that peak incidence of aphid population was observed 29.70 aphids/3 leaves in 36th standard week. Correlation of aphid population with weather parameters shown non-significant positive correlation with maximum and minimum temperature ($r = 0.527$ and $r = 0.096$, respectively), and relative humidity of morning ($r = 0.149$). However, rainfall ($r = -0.612$) indicated significant negative correlation while relative-humidity of evening ($r = -0.397$) showing non-significant negative correlation.

Nayak *et al.* (2019) [4] also confirmed present studies who stated that the peak population of aphid were observed in the first week of September with a mean population of 8.48 top 2cm shoot. Whereas, the peak population of thrips (3.84/top bud leaves) and hoppers (5.68/top 3 leaves) were observed in the second week of September.

Kataria and Kumar (2017) [3] results are also in accordance with present findings who observed that aphid population was showing positive correlation with high temperature and the population of predators and other associated insect was showing negative correlation with minimum temperature, relative humidity and rainfall.

Table 1: Population dynamics of aphid, *Aphis craccivora* Koch on groundnut *Kharif*, 2018.

SW	Mean no. of aphids /5 plants	Abiotic factors			
		Temperature		Relative humidity (%)	Rainfall (mm)
		Min. (°C)	Max. (°C)		
29	0.0	26.9	34.9	83	7.0
30	0.6	25.1	31.1	92	101.0
31	0.0	23.0	28.5	97	333.5
32	0.3	25.7	32.8	86	28.4
33	2.0	25.8	33.8	86	53.1
34	1.3	24.9	31.9	93	122.0
35	3.0	25.7	31.6	90	42.3
36	2.6	23.9	30.8	90	110.2
37	4.0	23.5	32.4	85	19.6
38	5.0	23.6	32.7	82	3.0
39	7.3	22.7	33.9	78	8.6
40	7.6	20.6	35.6	73	0.0
41	9.6	19.8	34.0	77	0.0
42	8.0	16.6	35.2	70	0.0
43	7.6	14.2	33.1	70	0.0
44	4.6	14.4	32.0	76	0.0

45	3.0	12.8	28.3	82	0.0
46	1.6	10.6	29.5	84	0.0

Table 2: Population dynamics of aphid, *Aphis craccivora* Koch on groundnut *Kharif*, 2019.

SW	Mean no. of aphids /5 plants	Abiotic factors			
		Temperature		Relative humidity (%)	Rainfall (mm)
		Min. (°C)	Max. (°C)		
29	0.0	26.3	35.3	80.0	12.4
30	0.0	26.0	32.1	90.0	101.4
31	1.0	26.9	34.1	86.0	28.8
32	1.3	26.1	33.7	84.0	15.4
33	2.3	25.9	33.2	85.0	38.8
34	1.6	24.8	31.5	93.0	148.9
35	3.0	26.4	34.4	85.0	40.0
36	3.6	27.1	34.0	86.0	3.2
37	5.0	26.2	32.2	89.0	35.3
38	6.0	24.1	29.3	89.0	20.4
39	4.3	23.1	27.7	95.0	136.2
40	3.6	22.3	31.1	89.0	23.6
41	6.3	20.3	33.4	85.0	0.0
42	9.0	21.1	31.5	89.0	0.0
43	9.3	16.7	30.5	88.0	0.0
44	7.6	19.8	30.0	77.0	0.0
45	4.6	15.2	29.6	88.0	0.0
46	3.3	14.6	29.0	86.7	0.0

Kandakoor *et al.* (2012) [2] also endorsed this study and reported that the maximum activity was recorded during September and the correlation studies were made between the incidence of major sucking insect pests and select weather parameters. Aphids showed negative correlation with rainfall ($r = -0.134$).

Patel *et al.* (2016) [5] supported present results which found

correlation analysis with the weather parameters *viz.*, temperature, relative humidity and rainfall revealed that maximum temperature showed significant positive effect on all the sucking insect pests. The minimum temperature showed negative effect on aphid population. The relative humidity has non-significant effect, whereas precipitation has negative effect on all the sucking pests.

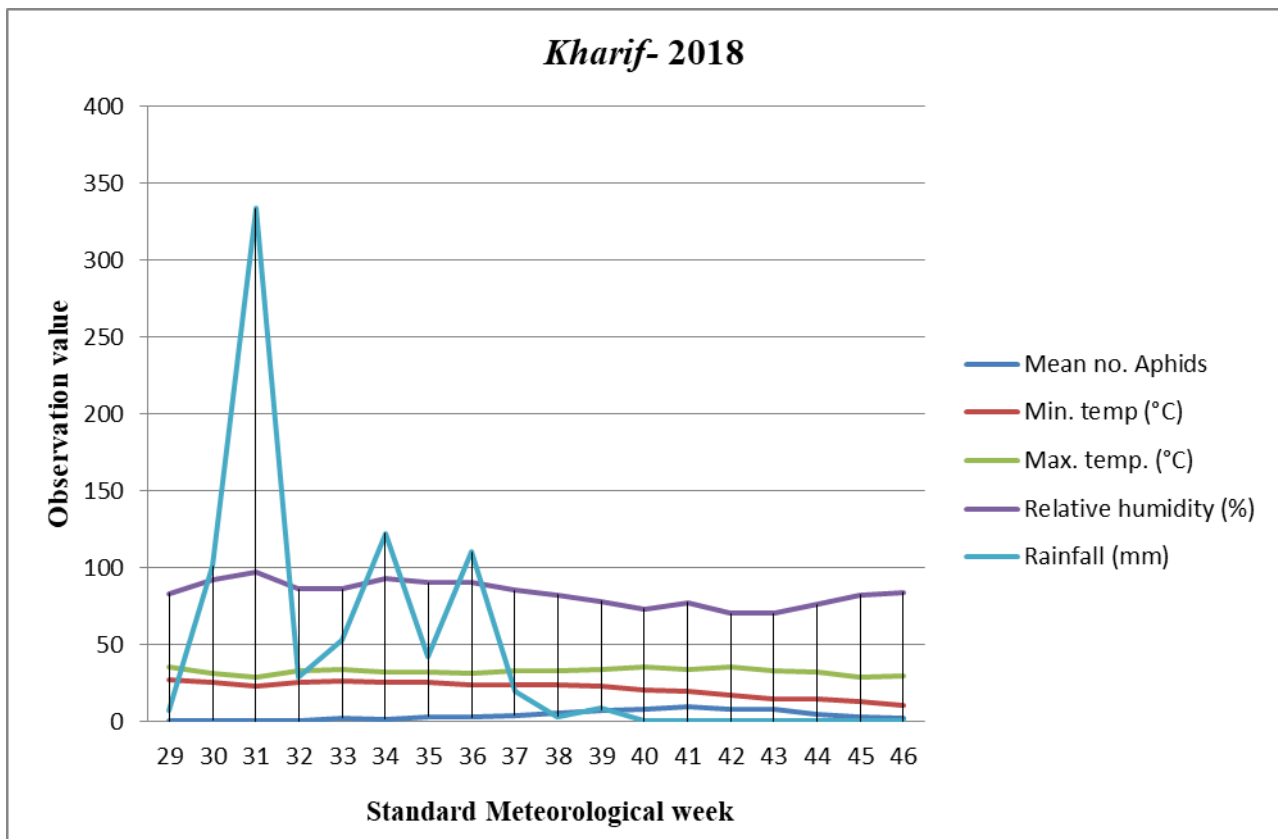


Fig 1: Graphic presentation of the aphid population

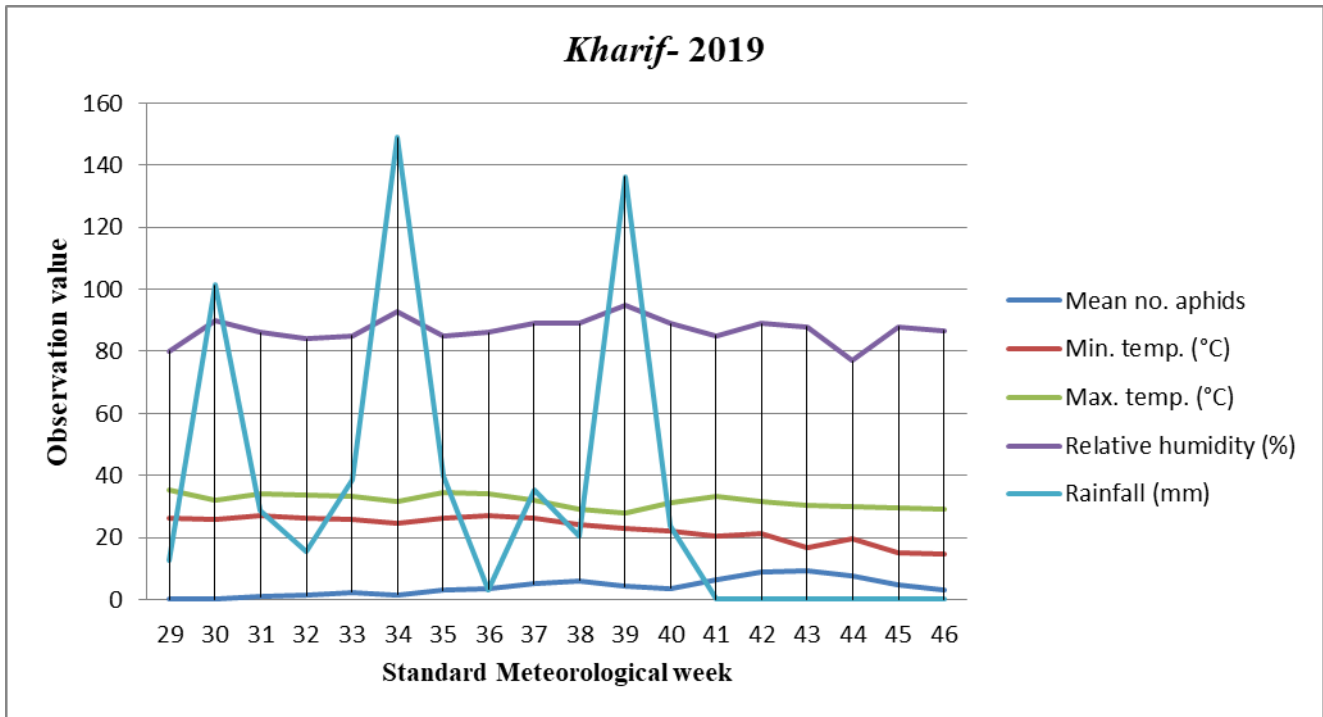


Fig 2: Graphic presentation of the aphid population

Table 3: Correlation coefficient between abiotic factors with population of aphids (Y₁) on groundnut during *Kharif*, 2018 and 2019

Weather variables	Aphids	
	2018	2019
Min. Temperature (°C) (X ₁)	-0.386 NS	-0.573*
Max. Temperature (°C) (X ₂)	0.535*	-0.469*
Relative humidity (%) (X ₃)	-0.820*	0.008 NS
Total Rainfall (mm.) (X ₄)	-0.513*	-0.415 NS

*Significance at 5% level

Table 4: Multiple regression equation between abiotic factor with population of aphids (Y₁) on groundnut during *Kharif*, 2018 and 2019

Years	Particulars	Regression equation	R ²
2018	Aphids	$Y_1 = 51.578 + (0.187)(X_1) + (-0.319)(X_2) + (-0.503)(X_3) + (0.008)(X_4) + 1.923$	0.705
2019	Aphids	$Y_1 = 27.766 + (-0.279)(X_1) + (-0.336)(X_2) + (-0.077)(X_3) + (-0.000)(X_4) + 2.599$	0.352

Conclusion

Initial infestation of aphid was recorded in terms of 0.6 mean number of nymphs and adults at 30thSW in 2018 where as during 2019 it was observed 1.0 mean number of nymphs and adults at 31st SW. The maximum aphid population increased gradually and reached its peak on (41st SW) i.e. 9.6, (43rd SW) i.e. 9.3 mean numbers of aphid during 2018 and 2019, respectively. The infestation of aphid declined gradually with the decline of total rainfall and reached to minimum i.e. 1.6 and 3.3 mean numbers of aphid at 46th SW, 2018 and 2019, respectively. The correlation matrix indicated a significant positive correlation with maximum temperature (r = 0.535) with aphid infestation. However, significant negative correlation was observed with average relative humidity (r = -0.820) and total rainfall (r = -0.513) in 2018 where as maximum temperature (r = -0.469) and minimum temperature (r = -0.573) in 2019, while non-significant negative correlation was found with minimum temperature (r = -0.386) and total rainfall (r = -0.415), 2018 and 2019, respectively. However non-significant positive correlation was found with relative

humidity (r = 0.008) in 2019.

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