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Population dynamics of aphid, *Aphis craccivora* Koch on groundnut in relation to biotic and abiotic factors

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Abstract
The field experiment were conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner during *Kharif*, 2020 and 2021 to know the population dynamics of aphid, *Aphis craccivora* Koch. The incidence of aphid *A. craccivora* started in the first week of August in both the years. The population of aphid gradually increased and reached to its peak in the first week of September and last week of August during *Kharif*, 2020 and 2021 respectively. The correlation studies indicated that the aphid population had significant positive correlation with relative humidity (r= 0.71, r= 0.64) and non significant relationship with temperature and rainfall in both the years. Both the predators, ladybird beetle and syrphid fly had significant positive relationship with aphid population during both the years.

Keywords: Aphid, correlation, groundnut

Introduction
Groundnut, *Arachis hypogaea* (L.) also known as peanut belongs to family Fabaceae. In India it is an important crop and occupies second position among oilseed crops. The oil is rich in omega-3 fatty acid and extensively used for cooking purpose. Its seeds are a rich source of edible oil (43-55 per cent) and protein (25-28 per cent) also a valuable source of vitamins *viz*., E, K and B. Groundnut cake after oil extraction is a high protein animal food and haulm provides quality fodder (Blummel *et al.*, 2005) [3]. The major growing states of india includes Gujarat, Andhra Pradesh, Tamil Nadu, Karnataka, Rajasthan, and Maharashtra. Sucking pests suck the sap from tender plant parts as a result plant or parts of plant dry up. They feed on the plant sap (direct damage) and also act as vectors for plant viral diseases (indirect damage). Aphid suck the sap from tender shoots and twigs and sometimes severely infest the plant. Groundnut rosette disease is transmitted by aphid (Vijayalakshmi, 1994 and Naidu *et al.* 1998) [8]. Abiotic conditions such as temperature, relative humidity, sunlight, and rainfall have a significant impact on the population dynamics of any insect pest (Saminathan *et al*., 2003) [15]. The environment, the availability of a host, and the activity of natural enemies all play a role in an insect's survival, reproduction, and development. Weather parameters influence insect life cycles, reproduction, and outbreaks (Pedigo, 2004) [13], and fluctuation in these abiotic factors have a negative effect on insect population dynamics (Prasad and Logiswaran, 1997) [14].

Material and Methods
The experimental study conducted at Agronomy farm, S.K.N. College of Agriculture, Jobner (Rajasthan) during *Kharif*, 2020 and 2021 to know the population dynamics of aphid on groundnut. The groundnut crop, variety RG-510 was sown on 8th July 2020 and 5th July 2021 in five plots. The plot size was 3.0 m x 2.0 m with row to row and plant to plant distance of 40 cm x 15 cm, respectively.

Method of observations
The population of aphid were recorded at weekly interval early in morning hours. The aphid population was counted on three leaves per plant from the five selected and tagged plants from each plot (Ahir *et al.* 2017) [1]. For recording the aphid population marked leaf was grasped at the petiole and twisted until underside of the leaf was clearly visible. Aphid population was expressed as number per three leaves. The population of natural enemies ladybird beetle and syrphid flies were also recorded on the same selected and tagged plants at the same time interval.

Interpretation of data

To interpret the results of population dynamics of aphid on groundnut 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 rainfall was worked out using following formula.

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

Where

r = Simple correlation coefficient

x = Independent variables *i.e.* abiotic components

y = Dependent variables *i.e.* pests

N = Number of observations

Results and Discussion

The mean population of aphid and the standard meteorological week wise weather parameters are presented in Table 1 (*Kharif*, 2020) and Table 2 (*Kharif*, 2021) [17]. The findings of the present study and the related discussion are explained hereunder.

Table 1: Population dynamics of aphid, *Aphis craccivora* Koch on groundnut in relation to biotic and abiotic factors in *Kharif*, 2020

SMW	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Total Rainfall (mm)	Mean aphid population/ three leaves	Mean population/ five plants	
		Max.	Min.				*C. septempunctata*	Maggots of *X. scutellare*
31	29.07.20	36.00	24.20	69	0.00	0.00	0.00	0.00
32	05.08.20	32.90	23.00	83	47.40	4.00	0.00	0.00
33	12.08.20	33.10	23.50	86	57.40	5.20	0.48	0.28
34	19.08.20	30.20	22.00	87	39.40	6.40	1.20	1.00
35	26.08.20	31.10	21.50	83	27.80	7.36	2.60	1.80
36	02.09.20	31.70	21.30	84	24.40	8.80	3.16	2.20
37	09.09.20	36.30	21.10	67	0.00	7.00	3.40	3.00
38	16.09.20	37.30	21.50	63	01.30	6.08	2.60	2.60
39	23.09.20	36.90	20.80	59	03.20	3.88	2.00	2.20
40	30.09.20	37.00	14.30	47	0.00	2.40	1.80	1.60
41	07.10.20	36.60	16.50	43	0.00	0.00	1.40	1.20
42	14.10.20	35.00	20.30	44	0.00	0.00	0.60	0.40
Correlation coefficient with max. temp.						NS	NS	NS
Correlation coefficient with min. temp.						NS	NS	NS
Correlation coefficient with relative humidity						0.712*	NS	NS
Correlation coefficient with rainfall						NS	NS	NS
Correlation coefficient with *C.septempunctata*						0.668*		
Correlation coefficient with maggots of *X. scutellare*						0.592*		

SMW = Standard meteorological weeks

* = Significant at 5 per cent level

NS = non significant

Table 2: Population dynamics of aphid, *Aphis craccivora* Koch on groundnut in relation to biotic and abiotic factors in *Kharif*, 2021

SMW	Date of observations	Temperature (^{0}C)		Mean relative humidity (%)	Total Rainfall (mm)	Mean aphid population/ three leaves	Mean population/ five plants	
		Max.	Min.				*C. septempunctata*	Maggots of *X. scutellare*
30	26.07.21	31.80	24.30	65	55.40	0.00	0.00	0.00
31	02.08.21	30.10	22.80	89	98.90	4.40	0.00	0.00
32	09.08.21	33.50	23.20	75	02.40	4.20	0.60	0.16
33	16.08.21	35.60	22.10	65	00.00	3.00	1.20	1.00
34	23.08.21	33.60	23.80	73	10.80	6.60	1.40	1.20
35	30.08.21	32.80	22.50	75	25.40	8.20	2.28	1.80
36	06.09.21	33.00	23.60	80	07.80	7.28	3.00	2.60
37	13.09.21	32.50	22.60	78	01.60	6.40	2.60	2.46
38	20.09.21	31.60	22.30	79	38.20	4.88	2.40	2.00
39	27.09.21	31.70	22.60	77	08.20	3.20	2.00	1.60
40	04.10.21	33.40	21.50	69	33.00	0.00	1.40	1.20
41	11.10.21	35.50	16.50	50	00.00	0.00	1.00	0.60
Correlation coefficient with max. temp.						NS	NS	NS
Correlation coefficient with min. temp.						NS	NS	NS
Correlation coefficient with relative humidity						0.642*	NS	NS
Correlation coefficient with rainfall						NS	NS	NS
Correlation coefficient with *C.septempunctata*						0.601*		
Correlation coefficient with maggots of *X. scutellare*						0.598*		

SMW = Standard meteorological weeks

NS = non significant, * = Significant at 5 per cent level

Aphid, *Aphis craccivora* Koch

The aphid, *A. craccivora* infestation started in the first week of August in both the years. The aphid population gradually increased and reached to peak with 8.80 and 8.20 aphids per three leaves per plant in the first week of September and last week of August in *Kharif*, 2020 and 2021, respectively. After reaching the peak, the population of aphid started to decline and reached to low level in the last week of September during both the years.

The current findings are in accordance with those of Yadav *et al.* (2007) [19], Ahir *et al.* (2017) [1], Gocher *et al.* (2019 a) [5], Nayak *et al.* (2019) [11], Saritha *et al.* (2020) [16] and Shakya *et al*. (2021) [17] who were reported the incidence of aphid started from last week of July to second week of August and the peak population of aphid from first week of September to fourth week of September which are 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.

The aphid population had positive significant correlation with relative humidity (r= 0.71 and r= 0.64), ladybird beetle (r= 0.66 and r= 0.60) and syrphid fly (r= 0.59 and r= 0.60) during both the years. While, non significant correlation with maximum temperature, minimum temperature and rainfall during both the years. This indicated that with the increase in relative humidity results in increase population of aphid. The other meteorological parameters do not affect the aphid population significant during both the years.

The present investigation on association of aphid population with the biotic and abiotic factors are confirmed by the findings of Yadav *et al.* (2007) [19], Yadav *et al.* (2012) [20], Kandakoor *et al.* (2012) [6], Ahir *et al.* (2017) [1], Nayak *et al.* (2019) [11], Saritha *et al.* (2020) [16] and Shakya *et al*. (2021) [17] those were reported that aphid population had non significant correlation with temperature and rainfall which are in agreement with present results. Bhede *et al.* (2018) [2] found that the population of ladybird beetle and syrphid fly had a significant positive correlation with aphid population these findings are full support with present findings. According to Gocher *et al.* (2019 a) [5] the aphid population had significant positive correlation with relative humidity, ladybird beetle and syrphid fly population the results are in close akin with present results.

Natural enemies

The incidence of ladybird beetle, *C. septempunctata* and syrphid fly, *X. scutellare* commenced in the second week of August in both the years. The peak population of ladybird beetle (3.40 and 3.00/ 5 plants) and syrphid fly (3.00 and 2.60/ 5 plants) in the second and first week of September 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.

Manjula and Prasannalaxmi (2014) [7], Bhede *et al.* (2018) [2] and Gocher *et al.* (2019 a) [5] who were reported that the population of ladybird beetle and syrphid fly were appeared in the first week of August and reached to maximum in the third week of September and both the predators had non significant correlation with all weather parameters which are fully agreement with present results.

Conclusion

The important conclusions drawn from present investigation made on population dynamics of aphid and its natural enemies. The infestation of aphid, *A. craccivora* started in the first week of August in both the years and reached to its peak in the first week of September and last week of August during *Kharif*, 2020 and 2021 respectively. The aphid population had positive significant correlation with relative humidity (r= 0.71 and r= 0.64), ladybird beetle (r= 0.66 and r= 0.60) and syrphid fly (r= 0.59 and r= 0.60) during both the years. While, non significant correlation with maximum temperature, minimum temperature and rainfall during 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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