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Seasonal abundance of major sucking insect pest of cowpea, *Vigna unguiculata* (Linn.) Walp. and their natural enemies

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Abstract
A field experiment was conducted to seasonal incidence of major sucking insect pests of aphid, *Aphis craccivora* Koch, leafhopper, *Empoasca fabae* (Harris), whitefly, *Bemisia tabaci* (Genn.) on cowpea, *Vigna unguiculata* (Linn.) Walp. at Sri Karan Narendra College of Agriculture, Jobner, Rajasthan. Revealed that sucking insect pest population were commenced in the last week of July (30th standard meteorological week) and reached to a peak of 123.00 aphids/10 cm terminal shoot, 15.30 leafhoppers/ three leaves and 14.60 whiteflies/ three leaves on 18th August (33rd standard meteorological week), respectively. The population of aphid, leafhopper, and whitefly showed significant positive correlation r=0.743, r=0.717 and r=0.719, respectively, with maximum temperature. The population of ladybird beetle, *Coccinella septempunctata* Linn. started one week after initiation of sucking insect pests (31th Standard Meteorological Week) and reached to maximum 9.60/ five plants on 25th August (34th standard meteorological week). The ladybird beetle population showed positive significant correlation with the population of aphid (r=0.708), leafhopper (r=0.727) and whitefly (r=0.722).

Keywords: Aphid, leafhopper, whitefly, seasonal incidence, cowpea

Introduction
Cowpea, *Vigna unguiculata* (Linn.) Walp. is one of the important legume crops grown in Rajasthan. It belongs to family Leguminosae. It is used as a green legume, vegetable and fodder as well as green manure crop. Cowpea increases soil fertility because of its ability to fix atmospheric nitrogen. In India, pulses occupied nearly 29.99 million hectares area with a production of 25.23 million tonnes during the year 2018-19 (Anonymous, 2018) [2, 3]. The area under pulses in Rajasthan was 4.82 million hectares with the production to the tune of 2.97 million tonnes; whereas, cowpea covered an area of 0.93 lakh ha with a production of 0.38 lakh tonnes (Anonymous, 2018) [2, 3]. The major cowpea growing districts of Rajasthan are Sikar, Jhunjhunu, Nagaur, Jaipur, Ajmer and Pali.

The low productivity of cowpea is attributed to the infestation by insect pests and diseases. Sardhana and Verma (1986) [15] reported 21 insect pests of different groups damaging the crop from germination to maturity. The important insect species infesting cowpea are aphid, *Aphis craccivora* Koch; jassid, *Empoasca fabae* (Harris)*;* thrips, *Megaleurothrips distalis* Karny; army worm, *Mythimna separata* (Walker); semilooper, *Thysanoplusia orichalcea* (Fab.); Leafminer, *Phytomyza horticola* Meigen and pod borer, *Helicoverpa armigera* (Hubner) resulting in heavy yield losses (Prasad *et al.*, 1983 and Satpathy *et al*., 2009) [13, 16]. Among these, the cowpea aphid, *A. craccivora* is serious sucking insect pest of this crop and occurs in different parts of India (Ganguli and Raychaudhuri, 1984) [6] that causes 20-40 per cent yield loss (Singh and Allen, 1980) [17]. Both nymph and adult cause damage by sucking cell sap from leaves, petioles, tender stems, inflorescence and pods. Due to their fast multiplication within few days, the aphids cover the entire surface of apical shoots and with the result of continuous feeding by such a large population, yellowing, curling and subsequent drying of leaves take place, which ultimately leads to the formation of weak pods and undersized grains in them and decreased yield. It also acts as a vector of several viral diseases like cowpea mosaic and papaya mosaic (David and Kumaraswami, 1982) [5].

The leafhopper, *E. fabae* sucks the cell sap from lower surface of the leaves and injects toxic substances in it, resulting in yellowing and curling of leaf margins and stunted plant growth. Narke and Suryawanshi (1987) [11] reported severe infestation that causes burning of leaves which fall down later resulting in 40–60 per cent decrease in yield.

The whitefly, *B. tabaci* ingest plant juice and produce a sticky substance known as honeydew which leads to sooty mould growth. Plants become extremely weak and unable to carry out photosynthesis. Leaves dry out and turn yellow and growth is stunted. In addition to damage caused by direct feeding, whiteflies transmit plant viruses also (Gerling, 1990) [8].

The study aimed in order to find out the correlation of aphid, *A. craccivora*, leafhopper, *E. fabae*, whitefly, *B. tabaci* and its natural enemies in cowpea ecosystem with the abiotic parameters. Suitable understanding of the seasonal incidence of sucking insect pests is important due to variation in the weather conditions and changing sucking insect pest scenario on the cowpea.

Materials and Methods

The experiment was conducted at Agronomy Farm, S.K.N. College of Agriculture, Jobner (Rajasthan) on cowpea crop during *Kharif*, 2018. Geographically, Jobner is located at longitude of 72º 28' East, latitude of 26º 06' North and at an elevation of 427 meters from mean sea level in Jaipur district of Rajasthan. The climate of the region is typically semi-arid which is characterized by extremes of the temperature both during the summer and winter. During summer, temperature may rise as high as 45ºC and in winter it may fall as low as 0ºC. the total rainfall was 480 mm which was mostly received from July to September. This region provides a safe long growing season for most crops during *kharif*. The fertilizers and cultural practices were followed as per the recommendations in the package of practices of Rajasthan. Meteorological data regarding minimum and maximum temperature, relative humidity (RH) and rainfall were obtained from the meteorological section, S.K.N. College of Agriculture, Jobner (Rajasthan). The seeds of variety RC-19 were sown on first week of July at the rate of 20 kg per hectare. Row to row and plant to plant spacing were 30 cm and 10 cm, respectively. After sowing, the seeds were covered with a thin layer of soil.

Method of observations

The methods used for recording the population of major insect pests, *viz*., aphid, *A. craccivora*, leafhopper, *E. fabae*, whitefly, *B. tabaci*. The observations on population of sucking insect pests were recorded soon after their appearance. All the observations were recorded early in the morning.

Aphid, *Aphis craccivora* Koch

The observation of aphid population was recorded by counting both nymph and adults from five randomly selected and tagged plants from each plot on 10 cm terminal shoots at weekly interval from the appearance till harvesting of the crop.

A. Ladybird beetle feeding on aphid

B. Leafhopper, *Empoasca fabae (*Harris) **C.** Whitefly, *Bemisia tabaci* (Genn.)

Leafhopper, *Empoasca fabae* (Harris)

The population of leafhopper (nymphs and adults) was recorded on five randomly selected and tagged plants in each plot. Three leaves, *viz*., one each from top, middle and lower

canopy of the plant were taken into account for recording the leafhopper (Rawat and Saha, 1973) [14].

Whitefly, *Bemisia tabaci* (Genn.)

The population of whitefly was recorded by counting the nymph and adults on five randomly selected plants and tagged in each plot. Three leaves, *viz*., one each from top, middle and lower canopy of the plant were taken into account for recording the population.

Natural enemies

The population of natural enemies, *viz.* Coccinellid predators was recorded on five randomly selected and tagged plants from each plot (whole plant count).

To interpret the results of seasonal incidence of major insects *viz.*, aphid, leafhopper and whitefly on cowpea, simple correlation was computed between major sucking insect pest populations, biotic (predators) and abiotic factors (maximum and minimum temperature, relative humidity and rainfall). The following formula was used for calculating correlation coefficient:

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

Where,

r = Simple correlation coefficient

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

y = Dependent variables *i.e.* pests

N = Number of observations

Result and Discussion

The population of aphid, *A. craccivora*, leafhopper, *E. fabae* and whitefly, *B. tabaci*, presented in table 1 along with meteorological parameters, *viz*., maximum and minimum temperatures, relative humidity and rainfall.

Aphid, *Aphis craccivora* Koch.

The aphid, *A. craccivora* population commenced in the last week of July (30th SMW). In the first observation on 28th July, the aphid population was 12.40 aphids/10 cm terminal shoot. The population gradually increased and reached to peak of 123.00 aphids/10 cm terminal shoot on 18th August (33th SMW). Earlier, Gauns *et al*. (2014) [7] and Choudhary *et al*. (2017) [4] reported that the population commenced from the first week of August which reached to maximum in fourth week of August. A gradual decline in the population was evident thereafter. In the last observation, 15th September (37th SMW) the population was 13.20 aphids/10 cm terminal shoot. The population of aphid showed significant positive correlation r=0.743 with maximum temperature. Kumar *et al.* (2017) [10] reported that the population of aphid showed significant positive correlation with maximum temperature on cowpea which corroborate with the present findings. Anandmurthy *et al.* (2018) [1] observed that maximum temperature showed a significant positive correlation aphid population in summer cowpea.

Table 1: Effect of biotic and abiotic factors on the incidence of major sucking insect pests of cowpea.

S. No.	Date of observation	Standard Meteorological Week (SMW)	Temperature (^{0}C)		RH (%)	Rainfall (mm)		Mean population		
			Max.	Min.			*Coccinella septempunctata*/5 pl.	Aphids/ 10 cm terminal shoot	Leaf hoppers/3 leaves	Whiteflies/ 3 leaves
1	28.07.2018	30	31.4	24.0	79.0	39.8	0.00	12.40	2.00	1.60
2	04.08.2018	31	34.0	24.2	62.0	0.00	2.80	49.80	6.50	6.10
3	11.08.2018	32	32.8	24.9	77.0	13.6	4.60	99.20	9.60	9.20
4	18.08.2018	33	34.4	24.7	72.0	14.6	6.20	123.00	15.30	14.60
5	25.08.2018	34	31.2	23.8	80.0	48.4	9.60	71.60	8.50	8.10
6	01.09.2018	35	31.5	24.0	77.0	34.0	4.40	39.00	7.70	7.20
7	08.09.2018	36	30.5	22.9	81.0	33.0	2.20	22.40	4.40	4.00
8	15.09.2018	37	30.0	21.0	74.0	01.6	0.80	13.20	3.20	2.90
Correlation with maximum temperature							NS	0.743*	0.717*	0.719*
Correlation with minimum temperature							NS	NS	NS	NS
Correlation with relative humidity							NS	NS	NS	NS
Correlation with rainfall							NS	NS	NS	NS
Correlation with *Coccinella septempunctata*								0.708*	0.727*	0.722*

*Significant at 5% level

NS = Non-significant

Leafhoppr, *Empoasca fabae* (Harris)

The leafhopper population commenced in the last week of July (30th SMW). In the first observation on 28th July, the leafhopper population was 2.0 leafhoppers/ three leaves. The population gradually increased and reached to the peak of 15.30 leafhoppers/ three leaves on 18th August (33th SMW). A gradual decline in the population was evident thereafter. In last observation on 15th September (37th SMW) the population was 3.20 leafhoppers/ three leaves. The population of leafhopper, *E. fabae* showed significant positive correlation r=0.717 with maximum temperature. Kumar *et al.* (2017) [10] reported that the population of leafhopper showed significant positive correlation with maximum temperature on cowpea which corroborate with the present results. Anandmurthy *et al.* (2018) [1] observed that maximum temperature showed a significant positive correlation with jassid population

Whitefly, *Bemisia tabaci* (Genn.)

The whitefly, *B. tabaci* population commenced in the last week of July (30th SMW). In the first observation on 28th July, the whitefly was 1.60 whiteflies/ three leaves presented in table- 1. The population gradually increased and reached to the peak of 14.60 whiteflies/ three leaves on 18th August (33th SMW). A gradual decline in the population was evident thereafter. In the last observation on 15th September (37th SMW) the population was 2.90 whiteflies/ three leaves. The

population of whitefly showed significant positive correlation r=0.719 with maximum temperature. Anandmurthy *et al.* (2018) [1] observed that maximum temperature showed a significant positive correlation with whitefly population in summer cowpea. Nitharwal (2013) [12] observed that the whitefly population commenced from the first week of August and its population reached to maximum in first week of September.

During the peak infestation of sucking insect pests *viz.*, aphid, leafhopper and whitefly, the maximum temperature was 34.4^{0}C, minimum temperature was 24.7^{0}C, relative humidity was 72 per cent and rainfall was 14.6 mm.

Ladybird beetle, *Coccinella septempunctata* (L.)

The occurrence of ladybird beetle started one week after infestation by sucking insect pests (31th SMW). In the first observation, on 4th August, the population of ladybird beetle was 2.80/ five plants. The population gradually increased and reached to maximum 9.60/ five plants on 25th August (34th SMW). A gradual decline in the population was evident thereafter. In last observation on 15th September (37th SMW) the population was 0.80/ five plant. During maximum population of ladybird beetle the maximum temperature and minimum temperature, relative humidity and rainfall, were 31.2^{0}C and 23.8^{0}C, 80 per cent and 48.4 mm, respectively. The findings presented in table- 1, the ladybird beetle population showed positive significant correlation with the population of aphid (r=0.708), leafhopper (r=0.727) and whitefly (r=0.722). The present result agree with the findings of Gauns *et al* (2014) [7] who reported a positive correlation between aphids and predator populations, likewise, Jat (2004) [9] also reported positive correlation between *cocinellid* predator and aphid population.

Conclusion

The aphid, leafhopper and whitefly populations were commenced in the last week of July and reached to a peak on 33rd standard meteorological week and the population of sucking insect pest showed significant positive correlation with maximum temperature. The population of ladybird beetle started one week after initiation of sucking insect pests and reached to maximum 34th standard meteorological week. The ladybird beetle population showed positive significant correlation with the population of sucking insect pest.

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