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Arjun Lal Choudhary
Department of Entomology, SKNCOA, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Akhter Hussain
Department of Entomology, SKNCOA, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

RG Samota
Department of Entomology, SKNCOA, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Sita Nehra
Department of Entomology, SKNCOA, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Correspondence
RG Samota
Department of Entomology, SKNCOA, Sri Karan Narendra Agriculture University, Jobner, Rajasthan, India

Effect of biotic and abiotic factors on the incidence of aphid, *Aphis craccivora* Koch on cowpea

Arjun Lal Choudhary, Akhter Hussain, RG Samota and Sita Nehra

Abstract
Investigations were conducted on the "Effect of Biotic and Abiotic Factors on the Incidence of Aphid, *Aphis craccivora* Koch on Cowpea". at Agronomy farm, of S.K.N. College of agriculture, Jobner (Rajasthan) during *kharif*, 2016. The aphid population commenced in the first week of August (31st SMW) and the first observation was recorded on 2nd August. Initially, population of aphid was (16.20 aphids/ three leaves). The population gradually increased and reached its peak in 34th SMW (108.13 aphids/ three leaves) when the minimum temperature, maximum temperature, mean relative humidity and rainfall was 24.4^{0}C, 30.5^{0}C, 84 per cent and 17.4 mm and gradually declined thereafter. The population of both the predators *C. septempunctata* and *M. sexmaculatus* were positively correlated (r = 0.82 and r = 0.72, respectively) with aphid population. The population of predators increased with the increase in aphid population. The correlation between population of *C. septempunctata* and *M. sexmaculatus* with abiotic factors *viz*., maximum and minimum temperature, mean relative humidity and rainfall had non significant correlation.

Keywords: Cowpea, *Aphis craccivora*, biotic and abiotic factors

Introduction
Cowpea (*Vigna unguiculata* Linn.) is one of the most important legume crop also known as lobia, belongs to family Leguminaceae. It is used as green legume, fodder, vegetable as well as green manure crop. The seeds of cowpea contain 23.4 per cent protein, 18 per cent fat, 60.3 per cent carbohydrate and also a rich source of lysine and tryptophane (Singh, 1983) [14]. Like other legumes, cowpea has important beneficial effects in increasing soil fertility status because of their ability to fix atmospheric nitrogen. This is of paramount importance of Indian agriculture when we consider this in light of inadequate availability and increased cost of fertilizers.

In India, the pulses occupy nearly 25.26 lakh hectare area with a production of 16.47 million tonnes during the year 2015-16 (Anonymous 2016) [2]. In Rajasthan, cowpea is of great important because of its short duration, high yielding and quick growing capacity along with high protein content. The crop is also known to provide quick cover on the ground and this help in conservation of soil. The area under cowpea cultivation in Rajasthan was 66.32 lakh hectare with the production of 30.68 million tonnes (Anonymous 2016) [3]. In Rajasthan the major cowpea growing districts are Jaipur, Sikar, Jhunjhunu and Nagaur.

As many as 21 insect pests of different groups are recorded damaging the cowpea crop from germination to maturity (Sardhana and Verma, 1986) [12]. The important insect species attacking to cowpea crop 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) [11, 13]. Among these, cowpea aphid, *Aphis craccivora* Koch is the most serious pest of this crop and occurs in different parts of India (Ganguli and Raychaudhuri, 1984) [5], causes 20-40 per cent yield loss (Singh and Allen, 1980) [15].

The cowpea aphid, *A. craccivora* belongs to the family Aphididae of order Hemiptera, suborder Homoptera. 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, aphids usually 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 grain in the pods and decreased yield. David and Kumaraswami (1982) [4] observed that the cowpea aphid also act as vector of several viral diseases like cowpea mosaic and papaya mosaic. The role of natural enemies like coccinellid and syrphid predators are known to be associated with the

control of cowpea aphid (Singh and Jackai, 1985) [16]. Due to variation in the agro climatic conditions of different regions insects show varying trends in their incidence, nature and extent of damage to the crop. Suitable understanding of the population dynamics of aphid pests is important due to variation in the weather condition and changing pest status. The study would give an idea about their peak period of pests activity which may be helpful in developing pest management strategy against them.

Material and methods

The materials used and methodologies adopted during the course of investigation on effect of biotic and abiotic factors on the seasonal incidence of Aphid, *Aphis craccivora* Koch on Cowpea, as envisaged in the plan of work has been described in detail hereunder.

To study the effect of biotic and abiotic factors on the incidence of insect pests of cowpea, the variety RC-19 was sown on 16th July 2016 in plots of 3 m x 4 m keeping row to row and plant to plant distance of 30 cm and 10 cm, respectively.

Observations

The crop was left for natural infestation. The observations of aphid population were recorded from three leaves *viz.*, upper, middle and lower on each of five tagged plants at weekly interval from the first appearance of aphid till harvesting of the crop. When the aphid population appeared, the observations on aphid population were recorded early in the morning by visual counting method. The predator population was recorded on five randomly selected and tagged plants in each plot at weekly interval. The data recorded on aphid, predator populations and meteorological parameters were used for statistical analysis.

Interpretation of data

To interpret the results of seasonal incidence of aphid, *A. craccivora* on cowpea for analysis of variance test was applied and the simple correlation was computed between aphid population and abiotic factors (maximum and minimum temperature, relative humidity and rainfall) and between aphid population and biotic factors (predators).

Results and discussion

The population of aphid, *A. craccivora* recorded during the crop season *Kharif*, 2016 on variety RC-19 has been presented in table 1 along with abiotic factor, *viz.*, minimum and maximum temperature, relative humidity and rainfall. The data revealed that the aphid population commenced in the first week of August (31st standard meteorological week, SMW) and the first observation was recorded on 2nd August. Initially, population of aphid was (16.20 aphids/ three leaves). The population gradually increased and reached its peak in 34th SMW (108.13 aphids/ three leaves). A gradual decline in the pest population was evident thereafter. The population was 8.26 aphids/ three leaves in the 39th SMW and observed in traces thereafter.

The population was 8.26 aphids/ three leaves in the 35 SMW and observed in traces thereafter. Srikanth and Lakkundi (1990) [17] observed that the population of *A. craccivora* on cowpea increased rapidly with crop growth and peaked at pod formation in *Kharif* (August- October), partially corroborates with the present findings. Angayarkanni and Nadarajan (2008) [1] studied the biology and seasonal activity of *A. craccivora* in cowpea ecosystem. It was revealed that the aphid remained active throughout the year.

The maximum temperature was in the range of 30.50 to 37.90 ^{0}C in different weeks of the crop season. The maximum temperature was lowest on 23 August, *i.e*. 34th SMW (30.50) and highest in the 38th SMW (37.90 ^{0}C). The minimum temperature was observed in the range of 22.40 to 24.90 ^{0}C, the minimum being in the 37th SMW and maximum in the 32nd SMW. The relative humidity during the crop season was in the range of 56 to 84 per cent, the minimum in the 38th SMW and received maximum in the 34th SMW. The rainfall during crop season was in the range of 0.00 to 70.00 mm. The rainfall was not received during 36-39th SMW and maximum in the 31st SMW. The highest aphid population, *viz*., 108.13 aphids/ three leaves was observed at 24.40 ^{0}C minimum temperature, 30.50 ^{0}C maximum temperature, 84 per cent relative humidity and 17.40 mm rainfall. Data presented in table 1 and Fig. 1 depicted that the maximum temperature were significant negatively correlated (r = -0.68) whereas, relative humidity showed significant positive correlation (r = 0.67) with aphid population. The results exhibit a non significant relationship of cowpea aphid, *A. craccivora* with minimum temperature and rainfall. The results exhibit a non significant relationship of cowpea aphid, *A. craccivora* with minimum temperature and rainfall. The results are agreement with those of Kumar and Kumar (2014) [9] who also reported that the population of aphids influenced positively by relative humidity and significant negative correlation between aphid population and maximum temperature.

Effect of biotic factors

The data presented in table 1 revealed that the population of *C. septempunctata* and *M. sexmaculatus* were appeared in the second week of August and remained throughout the crop period in more or less numbers. The population of predators increased with the increase in aphid population. In the first observation (9th August, 2016) the population of *C. septempunctata* and *M. sexmaculatus* was 2.70 and 0.80 predators per five plant, respectively with aphid population of 66.06 per three leaves when there was 31.90^{0}C maximum and 24.90^{0}C minimum temperature, 82 per cent relative humidity and 41 mm rainfall. The population of *C. septempunctata* and *M. sexmaculatus* were increased gradually and reached to its peak (5.26 and 4.30 per five plant, respectively) were recorded at 32.70^{0}C maximum and 24.40^{0}C minimum temperature, 80 per cent relative humidity and 16.6 rainfall in the fourth week of August (35th SMW), with aphid population of 91.26 per three leaves. Thereafter, the population of the both the predator decreased with decrease in aphid population at crop reaching to maturity stage. In the 39th SMW (27nd September, 2016) the population of *C. septempunctata* and *M. sexmaculatus* were 0.70 and 0.60 per plant, respectively, with aphid population of 8.26 per three leaves. The present findings are in fully agreement with that of Gauns *et al.* (2014) [6] who reported that the population of lady bird beetle was initially noticed in the second week of August. The present investigations are also in inconformity with that of Jangu *et.al*. (2014) [7], who also observed that the population of *C. septempunctata* and *M. sexmaculatus* were appeared in the fourth week of August and reached to its peak in the 1st week of September These results are in partially agreement with that of Srikanth and Lakkundi (1990) [17] who reported that the predatory coccinellid, *M. sexmaculatus* constituted 77-78 and 83-85 per cent of the total predatory population in the summer and *Kharif* crop seasons, respectively.

The population of both the predator were positively correlated

(r = 0.82 and r = 0.72, respectively) with aphid population. The correlation between population of *C. septempunctata* with maximum temperature and rainfall were negatively correlate (r = -0.33 and r = -0.40 respectively) and minimum temperature and relative humidity had positively correlation (r = 0.11 and r = 0.23). Whereas, both maximum and minimum temperature and rainfall were negatively correlated r = -0.26, r = -0.02 and r = -0.43 for *M. sexmaculatus*, respectively. However, the relative humidity was positively correlated (r = 0.14) for *M. sexmaculatus.*

The present result confirm with the findings of Gauns *et al.* (2014) [6] who reported the positive correlation between weekly aphid and predator populations. The present results are also in agreement with that of Jat (2004) [8] who reported the positive correlation between predator and aphid population. No work is available on correlation between climatic factors and predator populations, however, the present findings are partially corroborates with that of Mathew *et al.* (1972) [10] who reported positive correlation between predators and climatic factors.

Table 1: Effect of biotic and abiotic factors on the incidence of cowpea aphid, *Aphis craccivora* Koch in *Kharif*, 2016

S. No.	Date of observation	Standard Meteorological Week (SMW)	Mean aphid population per three leaves	Mean *coccinella septempunctata* population	Mean *Menochilus sexmaculatus* population	Meteorological conditions			
						Average temperature (^{0}C)		Relative humidity (%)	Rainfall (mm)
						Maximum	Minimum		
1	02.08.2016	31	16.20	0.00	0.00	31.40	24.50	82.00	70.00
2	09.08.2016	32	66.06	2.70	0.80	31.90	24.90	82.00	41.00
3	16.08.2016	33	83.26	3.28	1.80	31.90	24.20	77.00	3.80
4	23.08.2016	34	108.13	3.99	3.60	30.50	24.40	84.00	17.40
5	30.08.2016	35	91.26	5.26	4.30	32.70	24.40	80.00	16.60
6	06.09.2016	36	51.06	3.50	3.00	32.30	22.50	65.00	0.00
7	13.09.2016	37	32.20	3.20	2.20	34.90	22.40	59.00	0.00
8	20.09.2016	38	22.13	2.10	1.60	37.90	23.30	56.00	0.00
9	27.09.2016	39	8.26	0.70	0.60	37.10	22.70	59.00	0.00
Correlation coefficient with mean aphid population (r)				0.818*	0.719*	-0.680*	0.547	0.673*	-0.051
correlation coefficient with *C. septumpunctata* population (r)				-	-	-0.331	0.115	0.236	-0.409
Correlation coefficient with *menochilus sexmaculatus* (r)				-	-	-0.264	-0.028	0.147	-0.439

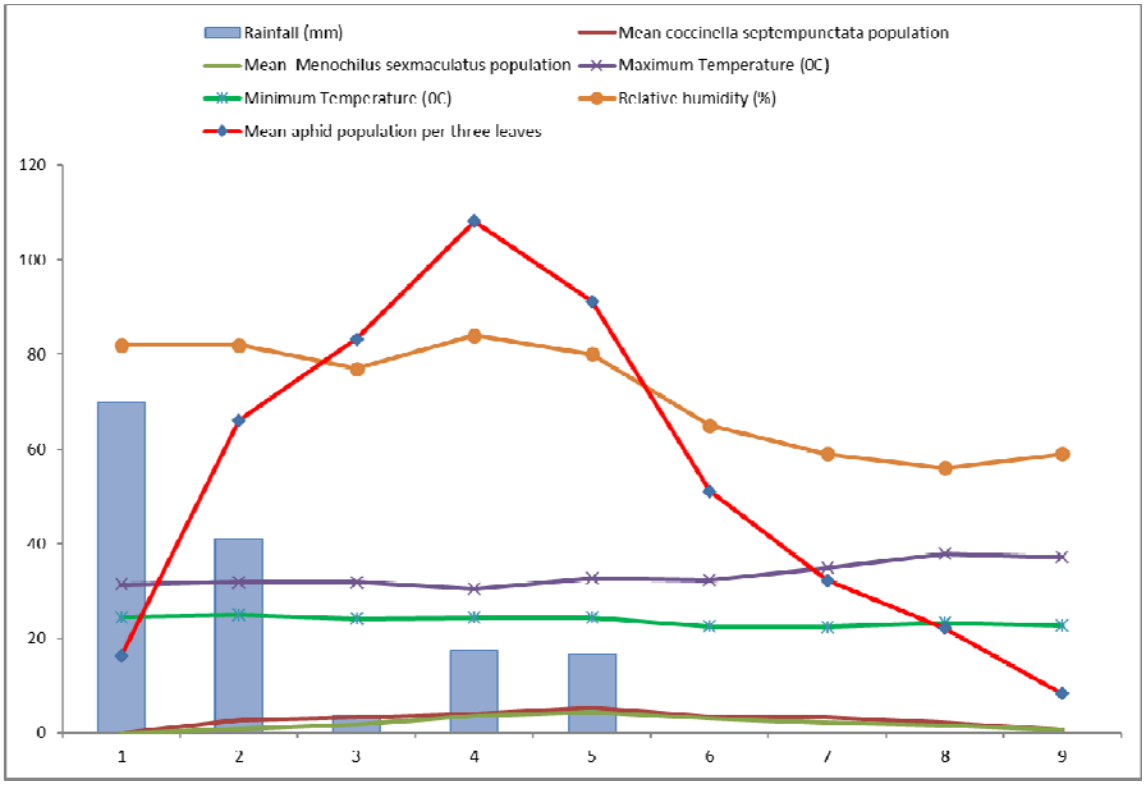

Fig 1: Effect of biotic and abiotic factors on the incidence of cowpea aphid, *Aphis craccivora* Koch in *Kharif*, 2016

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