J. Farm Sci., 38(1): (48-51) 2025

RESEARCH PAPER

Population dynamics of cowpea aphid *Aphis craccivora* (Koch) in fodder cowpea *Vigna unguiculata* (L.) walp

M. J. ABHIGNA[1*], NARENDRA S. KULKARNI[1], R. CHANNAKESHAVA[1] AND K. SRIDHAR[2]

[1]Department of Entomology, [2]Department of Genetics and Plant Breeding
College of Agriculture, Dharwad
University of Agricultural Sciences, Dharwad - 580 005, India
*E-mail : abhignamj1999@gmail.com

(Received: November, 2023 ; Accepted: March, 2025)

DOI: doi.org/10.61475/JFS.2025.v38i1.10

Abstract: The present study was conducted at Indian Grassland and Fodder Research Institute (IGFRI), Southern Regional Research Station (SRRS), Dharwad, Karnataka, India during *kharif* 2022. This study investigates the dynamics of aphid populations. The investigation found that the highest number of aphids (95.85 aphids/ 3 leaves) during the third week of September (38th MSW) while the lowest number of aphids was observed during the last week of July (31st MSW). Meteorological factors, such as rainfall, relative humidity and minimum temperature influenced the aphid population, showed a non significant negative correlation, whereas maximum temperature showed a non-significant positive correlation. Even though there is a correlation but they were not statically significant. The population dynamics of cowpea aphid influenced by various factors including, crop phenology, ecological interactions and biological processes which were beyond the scope of investigation. Similarly, the population of major natural enemies, such as coccinellid adults, grubs and syrphid fly maggots showed a highly significant positive correlation with the increase in aphid population, suggesting their potential role in regulating aphid numbers. The presence of diverse predators further emphasizes the intricate interplay between predator and prey species in the ecosystem.

Key words: Cowpea aphid, Natural enemies, Population dynamics

Introduction

In regions characterized by semi-arid tropical conditions, cowpea (*Vigna unguiculata* (L.) Walp) holds notable significance as a food legume, forming a crucial part of traditional cropping systems. The grains of cowpea serve as a dietary staple, while the stalks are utilized as nutritious animal fodder. It's common for farmers to cultivate a variety of cowpea for grain with a short growth cycle and another variety for fodder with an extended growth period. It is adapted to warm climates and capable of with standing drought, cowpea is a crop that flourishes in semi-arid tropical zones, areas where many other food legumes struggle. An exceptional trait of cowpea is its capacity to fix atmospheric nitrogen through its nodules, making it well-suited to soils with high sand content exceeding 85 per cent, low organic matter below 0.2 per cent and limited phosphorus levels (Kolawole *et al*., 2000; Sanginga *et al*., 2000).

Cowpea exhibits shade tolerance, rendering it suitable for use as an intercrop alongside diverse plantation crops like maize, millet, sorghum, sugarcane and cotton (Singh and Emechebe, 1997). In addition to these attributes, its rapid growth and dense ground cover play a role in preventing soil erosion. The decomposition of its roots in the soil contributes nitrogen-rich residues, enriching soil fertility and structure (Mortimore *et al*., 1997). The cowpea fodder displays varying levels of Crude protein, Neutral Detergent Fibre and lignin content, encompassing values within the ranges of 22.23 - 23.41 per cent, 50.54 - 55.10 per cent and 8.48 - 10.76 per cent, respectively (Sultan *et al*., 2018).

Globally, cowpea cultivation spans 23.4 million hectares of land resulting in an output of 18.29 million tonnes with an average yield of 637 kg per hectare. In India, cowpea is grown on 4 million hectares, yielding 2.7 million tonnes at a rate of 567 kg per hectare. In Karnataka, it is cultivated on a total of 62,009 hectares, generating a production of 21,311 tonnes. The Belagavi district leads in both cowpea area (3,470 hectares) and production (875 tonnes). Furthermore, Dharwad contributes 287 tonnes to the production with an area of 1,454 acres for cowpea cultivation (Anon., 2019).

A field study indicated that *Aphis craccivora* (Koch), a significant pest of cowpea, is responsible for a substantial toll, killing around 90 per cent of the plants (Karungi *et al*., 2000). This pest directly affects leaves, stems, fruits and roots, resulting in yield reduction. Furthermore, it indirectly causes harm by excreting honeydew, which facilitates the growth of sooty mould and attracts ants. These ants then serve as transportation agents for the aphids, spreading them to various host plants (Singh *et al*., 2014). The infestation of aphids has been associated with yield drops of up to 100 per cent in various bean crops (Atle *et al*., 1987).

When facing a severe and uncontrolled aphid infestation or even in cases of legume virus infection at low population levels, the resulting losses in cowpea yield can exceed 50 per cent. Although the cowpea aphid affects various plant species, it particularly favours members of the Fabaceae family such as beans, peas and groundnuts (Obopile and Ositile, 2010). Considering the factors mentioned above, minimal to no previous research has been undertaken on "Population dynamics of cowpea aphid *Aphis craccivora* (Koch) in fodder cowpea *Vigna unguicuata* (L.) Walp.This study aims to

Table 1. Population dynamics of cowpea aphid and its major natural enemies on fodder cowpea and prevailing weekly weather parameters during *kharif* 2022

Week days	MSW	Average number of aphids/ 3 leaves*	Average number of predators/ plant			Temperature (°C)		Relative humidity (%)		Rainfall (mm)
			Coccinellids*		Syrphid fly Maggots*	Maximum	Minimum	Morning	Evening	
			Adults*	Grubs*						
30 Jul – 5 Aug	31	0.00	0.00	0.00	0.00	29.70	20.90	85.30	77.40	12.20
6 - 12 Aug	32	0.00	0.00	0.00	0.00	25.30	20.20	92.10	86.30	53.80
13 - 19 Aug	33	6.50	0.47	0.00	0.20	26.80	19.90	92.90	86.00	9.20
20 - 26 Aug	34	19.40	1.40	1.35	0.85	27.70	20.20	90.90	78.30	3.20
27 Aug - 2 Sep	35	1.25	0.25	0.15	0.10	29.60	20.40	91.10	74.00	127.20
3 - 9 Sep	36	57.65	3.80	2.60	1.85	29.30	21.00	90.10	77.40	48.80
10 - 16 Sep	37	66.15	4.45	3.45	2.65	26.60	20.50	95.00	89.10	48.20
17 - 23 Sep	38	95.85	6.35	5.40	4.05	28.30	19.00	88.10	67.40	0.00
24 - 30 Sep	39	50.50	2.90	1.60	1.05	30.00	19.30	85.10	66.10	6.20
1 - 7 Oct	40	7.90	0.25	0.15	0.10	29.00	19.60	91.30	76.00	69.40

MSW – Meteorological Standard Week, *Mean of 20 plants

investigate the population dynamics of *Aphis craccivora* and its interactions with natural enemies in fodder cowpea under field conditions

Material and methods

The popular fodder cowpea variety MFC-09-1 was raised in *kharif* 2022 as per the recommended package of practices A block of 200m^2 was maintained without any plant protection measures with the spacing of 30 x 10 cm between the rows and plants, respectively at IGFRI, SRRS, Dharwad.

Weekly observations on the incidence of aphids and their natural enemies were taken on randomly selected 20 plants from four different spots in "Z" fashion to ensure proper representation and distribution of the sample as reported by Nishmitha *et al*., 2021 . The aphids count taken from the 3 leaves/ plant. The observations on number of aphids and their natural enemies were taken starting from the 15 days of sowing from the experimental plot at IGFRI, SRRS, Dharwad. Weather data *viz*., temperature (°C), relative humidity (%) and rainfall (mm) were recorded from the meteorological unit of MARS, UAS, Dharwad.Total period of observation during a cropping season was approximately for 90 days.

Results and discussion

Observations of cowpea aphid population changes and its natural enemies were documented on a weekly basis. The data is presented in table 1 to 3.

Cowpea aphids (*Aphis craccivora* Koch)

Cowpea aphid populations were first noticed in the second week of August 2022 (33rd MSW) with (6.5 aphids/ 3leaves) and reached their peak (95.85 aphids/ 3 leaves) during third week of September 2022 (38th MSW). Maximum and minimum temperatures during the peak period were 28.3°C and 19°C, respectively, with morning and evening relative humidity of 88.1 per cent and 67.4 per cent, respectively. There was no rainfall during the peak period. From the fourth week of September until the first week of October 2022, population decline is nearly non-existent (Table 1).

Correlation studies with the weather parameters shown that the minimum temperature (r = -0.348), the relative humidity in the morning (r = -0.105), the relative humidity in the evening (r = -0.345), and the amount of precipitation (r = -0.354) all showed negative correlations with aphid population whereas, the maximum temperature showed the positive relationship (Table 2). Even though there is a correlation but they were not statistically significant. The population dynamics of cowpea aphid influenced by various factors including, crop phenology, ecological interactions and biological processes which were beyond the scope of investigation.

These results were consistent with the research findings of Karane *et al*. (2019) who reported that the average number of aphids correlated positively with the highest temperature and negatively with the other weather variables, including the lowest temperature, the morning and evening relative humidity and rainfall. Sharma *et al*. (2019) reported that the aphid population showed a substantial inverse relationship with relative humidity and rainfall and a positive relationship with temperature.

Coccinellids adults

The presence of coccinellid adults was monitored from the end of July to the first week of October. Their population varied between zero to 0.25 per plant. However, during the later stages of the crop, specifically at 39th week onwards the population

Table 2. Correlation of cowpea aphid with weather parameters in fodder cowpea during *kharif* 2022

Variable	Correlation coefficient(r) Meteorological parameters				Rainfall (mm)	Coefficient of determination (R^2)
	Temperature (°C)		Relative humidity (%)			
	Maximum (°C)	Minimum (°C)	Morning	Evening		
Cowpea aphids	0.078	-0.348	-0.105	-0.345	-0.354	0.499

Table 3. Correlation of cowpea aphid with its natural enemies during *kharif* 2022

Variable	Coccinellid adults	Coccinellid grubs	Syrphid fly maggots
Cowpea aphids	0.997**	0.974**	0.968**
Coefficient of determination (R^2)	0.993	0.949	0.938

**Correlation is significant at 1%

starts falling down. Table 1 illustrates the population trend of coccinellid adults, indicating that they first appeared on the cowpea crop during the 33rd MSW with an initial density of 0.47 coccinellid adults per plant. As the crop matured, both the coccinellid population and the pest population increased, reaching their highest level of 6.35 coccinellid adults per plant on the 38th MSW when the pest population attained a peak of 95.85 aphids/ 3 leaves. Correlation studies of aphids with the coccinellid adults showed a significant positive relationship with r = 0.993 (Table 3).

Coccinellid grubs

Observations were made on the population of coccinellid grubs from late July to early October. Towards the later stages of the crop, particularly in the 40thMSW, the coccinellid density was very low. Analysing the population trend presented in Table 1, it was found that coccinellids initially appeared on the fodder cowpea during the 34th MSW, with an initial density 0.35 grubs per plant, reaching their peak of 5.4 grubs per plant during the 38th MSW . Correlation studies of aphids with the coccinellid grubs showed a significant positive relationship with r=0.949 (Table 3).

Syrphid fly maggots

The population of syrphid fly maggots were observed in fodder cowpea from late July to 1st week of October. The data in the Table 1 illustrates that the presence of syrphid fly maggots began in the 33rd MSW with an initial density of 0.2 maggots per plant. As the pest population increased, it reached a peak density of 4.05 maggots per plant in the 38th MSW. Correlation studies of aphids with the syrphid fly maggots indicated a significant positive relationship with r=0.938 (Table 3).

Coccinellids (ladybugs) and syrphid flies (hoverflies) are important natural predators of aphids, playing a crucial role in aphid population control as both larvae and adults consume aphids, contributing to biological pest management. These results were supported by Borad *et al*. (2020) reported that the population of natural enemies, such as coccinellids and syrphid fly, was found to be highly connected with that of aphids. As aphid populations increased, so did the activity of natural enemies. The natural enemy population peaked when aphid populations were at their maximum. There was a significant positive correlation between the population of aphids and the quantity of ladybird beetles (Choudhary *et al*., 2021). Similar studies on role of coccinellids and syrphid flies were reported by Bugg *et al*., 2008.

Conclusion

During the *kharif* season in 2022, a study was conducted on a population dynamics of cowpea aphid *Aphis craccivora* (Koch) and its major natural eniemies in fodder cowpea. The investigation found that the highest number of aphids (95.85 aphids/ 3 leaves) found during the third week of September (38th MSW) while the lowest number of aphids was observed during the last week of July (31st MSW). Meteorological factors, such as rainfall, relative humidity and minimum temperature influenced the aphid population, showed a non-significant negative correlation, whereas maximum temperature showed a non-significant positive correlation.

Similarly, the population of major natural enemies, such as coccinellid adults, grubs and syrphid fly maggots showed a highly significant positive correlation with the increase in aphid population. The study also recorded various predators and parasitoids. Aphids need to be managed because they damage plants by sucking their sap, potentially spreading diseases, and producing “honeydew” that attracts ants and can lead to sooty mold growth, ultimately impacting plant health and yield.

References

Anon, 2019, Food and Agriculture Organisation. www.faoorg/ statistics/en/.

Atle A, Elihenneidy A H and El-Kady E A, 1987, Studies on the aphid, *Aphis craccivora* in Egypt. *Bull de la Societe Entomold Egypte*, 66: 319-324.

Borad M G, Patel H P, Damor M P, Pipaliya G K and Aniyaliya M D, 2020, Population dynamics of aphid, *Aphis craccivora* Koch on cowpea ecosystem in middle Gujarat. *Journal of Entomology and Zoology Studies*, 8(1): 805-810.

Bugg R, Colfer R G, Chaney W E, Smith H A and Cannon J, 2008, Flower Flies (Syrphidae) and other biological control agents for aphids in vegetable crops. *Agriculture and Natural Resources Publication,* 8285. 1-25.

Choudhary S, Khinchi S K and Kumawat K C, 2021, Seasonal abundance of major sucking insect pest of cowpea *Vigna unguiculata* (Linn.)Walp. and their natural enemies. *The Pharma Innovation Journal*, 10(10): 685-688.

Karane P, Sharanabasappa S B, Adivappar N and Satish K M, 2019, Population dynamics of coccinellid, *Cheilomenes sexmaculata* (Fab.) on cowpea aphid. *Journal of Entomology and Zoology Studies*, 7(2): 1236-1238.

Karungi J, Adipala E, Kyamangyawa S, Ogenga-Latigo M, Oyobo N and Jackai L, 2000, Pest management in Cowpea. Part 2. Integrating planting time, plant density and insecticide application for management of cowpea field insect pest in Eastern Uganda. *Crop Protection*, 19: 237-245.

Kolawole G O, Tian G and Singh B B, 2000, Differential response of cowpea lines to aluminium and phosphorus application. *Journal of Plant Nutrition*, 23(6): 731-740.

Mortimore M J, Singh B B, Harris F and Blade S F, 1997, Cowpea in traditional cropping systems. *Advances in Cowpea Research*, 99-113.

Nishmitha K ,Kulkarni N S, Shekharappa and Shivakumar B G, 2021, Studies on seasonal incidence of aphids in Lucerne [*Medicago Sativa* (L.)] and their relationship with weather parameters *Journal of Farm Sciences*, 34(4): (414-417)

Obopile M and Ositile B, 2010, Life table and population parameters of cowpea aphid, *Aphis craccivora* Koch (Homoptera: Aphididae) on five cowpea *Vigna unguiculata* (L. Walp.) varieties. *Journal of Pest Science*, 83: 9-14.

Sanginga N, Lyasse O and Singh B B, 2000, Phosphorus use efficiency and nitrogen balance of cowpea breeding lines in a low P soil of the derived savanna zone in West Africa. *Plant and Soil*, 220(1-2): 119.

Sharma P, Rana B S, Mordia A and Kumawat K, 2019, Seasonal incidence of sucking insect pests of cowpea *Vigna unguiculata* [Linn] Walpers in relation to abiotic factors. *Journal of Entomology and Zoology Studies*, 7: 1242-1244.

Singh B B and Emechebe A M, 1997, Advances in research on cowpea Striga and alectra.Collaborative study or cassava In Africa, Chatham, United Kingdom, pp.7

Singh G, Singh N P and Singh R, 2014, Food plants of a major agricultural pest *Aphis gossypii* Glover. (Homoptera: Aphididae) from India: an updated checklist. *International Journal of Life Sciences Biotechnology and Pharma Research*, 3: 1-26.

Sultan S, Geetanjali S, Misra A K, Singh K K, Das M M, Maity S B and Mahanta S K, 2018, Nutritive value of cowpea fodder cultivars and their effect on nutrients intake, digestibility and nitrogen balance in sheep. *Indian Journal of Animal Sciences*, 88(5): 567-573.