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Population Dynamics of Major Sucking Insect Pests of cowpea, *Vigna unguiculata* Linn. and their Correlation with Weather Parameters

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ABSTRACT: Population dynamics of major sucking insect pests of cowpea experiment was carried out at Vegetable Research Plot of Dr. Rajendra Prasad Central Agricultural University, Pusa, Bihar during summer, 2023. The Aphid, *Aphis craccivora* Koch, Leaf hopper, *Empoasca fabae* Harris, Whitefly, *Bemesia tabaci*, Ginn and Flower thrips, *Megalurothrips distalis* were noticed during the study. The occurrence of these pests and their relationship with abiotic factors were described. Occurrence of three pests were noticed during 12th Standard Meteorological Week (4th week of March) and reached a peak during 16thStandard Meteorological Week. Whereas, flower thrips, commenced during the 14thStandard Meteorological Week (5th week of March) and maximum population was recorded during 16th Standard Meteorological Week (3rd week of April). The population of aphid, whitefly, leafhopper and flower thrips showed positive and significant correlation with maximum temperature. The correlation coefficient of aphid was positive significant with minimum temperature while the correlation coefficient of remaining were non-significant. They showed negative and significant correlation with relative humidity at morning hours and evening hours. The rainfall showed negative and non-significant correlation with all these sucking insect pests. The contemporary investigation into population dynamics underscores the necessity for comprehensive consideration of location-specific pest constellations in cowpea, with the aim of formulating prophylactic measures for enduring and sustainable management initiatives.

Keywords: Cowpea, major sucking insect pests, correlation, population dynamics.

INTRODUCTION

Cowpea, *Vigna unguiculate* Linn is most important legume crops in India. It is used as a vegetable, pulse, fodder as well as green manure crop. The seeds of cowpea contain protein content of 23.4 per cent, a fat content of 18 per cent, a carbohydrate content of 60.3 per cent, with high lysine and tryptophan content (Singh, 1983). It has emerged as a consequential crop in numerous tropical African, Asian, and South American countries in the relatively recent past (Mahalakshmi *et al.*, 2007). Area under cowpea in India is 3.9 million ha with production of 9.8 million tonnes. The incidence of insect pests and diseases cause lower production and productivity of cowpea due to direct or indirect damage. As many as 21 insect pests of different orders are recorded damaging the cowpea crop from germination to maturity (Sardana and Verma 1986). The available losses in yield due to insect pests have been recorded in the range of 66 to 100 per cent in cowpea (Pandey *et al.*, 1993). The important insect species attacking cowpea crop include aphid (*Aphis craccivora*) which cause yield loss of 13 to 100 per cent (Shoyinka *et al.*, 1997), thrips (*Megalurothrips* spp) causes up to 20 – 100% yield loss in case of severe infestation (Karungi *et al.*, 2000), Leafhopper (*Empoasca fabae*) causes loss upto 60 per cent. The loss due to whitefly (*Bemisia tabacci*) was 10-100 per cent which depended on the cultivars employed, the infestation stage, and the current weather (Chandra and Rajak 2004). Pod sucking bugs (*Clavigralla* spp), mites (*Tetranychus* spp), Semilooper (*Trichoplusia orich*), caterpillar (*Spodoptera litura*), Gram pod borer (*Helicoverpa armigera*), Bihar hairy caterpillar (*Spilosoma obliqua*) and spotted pod borer (*Maruca vitrata*) are the other major pests in cowpea. Population of these pests are greatly affected by abiotic factors as major contributing factor to the outbreaks of insect pests on the crops. Keeping this in view, the present investigation was carried out to study a direct relationship of weather factors to the pest population.

MATERIALS AND METHODS

Field trails were conducted during summer, 2022-2023 at Vegetable Research Plot for Rajendra Prasad Central Agricultural University, Pusa, Bihar. The selected plot had uniform topography with well drained sandy loam soil. Latitude, longitude and altitude of place are 85.67°E 25.98°N and 52.92 m respectively. Climate in this region is hot dry summers with mild winter. Other climatic factors such as temperature, humidity and rainfall in this region are highly favorable for the growth of vegetables and other crops in all seasons with proliferation of insect infesting cultivars/varieties of crops. The plot was divided into three replications in Randomized Block Design with size of 1.8 m × 3.0 m and 45 cm × 30 cm spacing. Cowpea cultivar "Kashi Nidhi" was selected as a test variety and sown on 3th February 2023. The crop was cultivated by following recommended agricultural practices and no insecticides were applied at any stage of the crop growth. The population of sucking insect pests were recorded at weekly intervals. The meteorological data were taken from university observatory. After that, these abiotic parameters where correlated with corresponding the pest population.

The observations on the occurrence of the major sucking insect pests were taken at weekly interval beginning from 25 days after germination and continued till the harvest of the crop with five randomly selected plants in each plot during early in the morning hours. Aphid population was recorded on five randomly selected twigs (10 cm length) from each tagged plant and mean number of aphids per centimeter shoot tip was worked out. Leafhopper and whiteflies were recorded on each plant randomly selected and tagged plant in each plot. Three compounds leaves (upper, middle and lower) from each tagged plant and average population of leafhopper and whiteflies per compound leaf were computed. Thrips population was assessed by randomly selecting five flowers on each selecting five flowers on each selected plant and number of thrips per flowers were calculated.

During the cropping period, the main abiotic factors *viz.,* minimum and maximum temperature (°C), relative humidity at morning and evening hours (%) and rainfall (mm) were measured and averaged on a weekly basis. With the use of statistical analysis, the data were used to determine the simple correlation coefficient between the population of major sucking insect pests and abiotic parameters. The statistics are performed using SPPS (Statistical Package for Social Sciences) which was used in analysis of simple correlation coefficient between the pest population and abiotic factors.

RESULTS AND DISCUSSION

The incidence of major sucking pests recorded on cowpea during summer season, 2023 at weekly interval starting from 25 days after sowing to harvesting and represented in Table 1.

The incidence of aphid population was first observed during 12th SMW (21st- 27th March) as 2.00/ 10 cm twig of plant at the temperature range of 14.6- 30.84°C relative humidity 48.57-92.00 per cent and rainfall of 2.57 mm. The population increased gradually and reached its peak 22.50/10 cm twig/plant during 16th SMW (18th- 24th April) at the temperature range of 18.6 – 39.14°C, relative humidity 20.14- 73.57 per cent and rainfall of 0.00mm (Table 1). Furthermore, the population was declined during next two weeks and again reached to peak 19.53 during 19th SMW (15th-21st May). There after a decline in the aphid population was noticed throughout the crop period. The present findings were corporate with Borad *et al.* (2020) they reported that the aphid population appeared first during March (10th SMW) at vegetable stage and attained peak during 14th SMW. Then the population decline with maturity of crop. Similar result observed by Prajapati *et al.* (2020) who reported that aphid population on cowpea during March (13th SMW) and present until the 23rd SMW and continued till crop maturity period.

Correlation of aphid population with weather parameters (Table 2) showed that significant positive correlation with maximum temperature (r = 0.837**) and minimum temperature (r = 0.597*). Whereas significant negative correlation with both morning (r = –0.849**) and evening (r = –0.604*) relative humidity. This is in contrary with findings of Choudhary *et al.* (2017) reported that temperature had negative influence on population of aphids and significant positive correlation with relative humidity.

The incidence of leafhoppers first appeared during 12th SMW (21st – 27th March) with an average population of 0.80/3 leaves at a temperature range of 14.6 to 30.84°C, relative humidity of 48.57 to 92.00 per cent and rainfall of 2.5 mm. The population increased gradually and peak population of 8.17/3 leaves during 16th SMW at temperature range of 18.6- 39.14°C, relative humidity of 20.14-73.57 per cent and no rainfall (mm). The population was declined for subsequent weeks during the crop period. The results on correlation study indicated that leafhopper showed significant positive correlation with maximum (r=0. 559*) and negative non significance with minimum (-0.037^{NS}) temperature. Whereas, significant negative correlation with both morning (–0.617*) and evening (–0.754**) relative humidity with leafhopper on cowpea (Table 2). These results are supported by Soratur *et al.* (2017) who reported that positive correlation with high temperature and inverse relationship with minimum temperature (r = -0.782**), morning (r = -0.651**) as well as evening (r = - 0.598*) relative humidity. Additionally, there was a negative correlation between leafhopper and rainfall.

The infestation of whitefly were first observed during 0.47/3 leaves (Table 2) during 12th SMW (21st – 27th March) at temperature range of 14.6 – 30.84°C, relative humidity 14.6-92.00 per cent and rainfall of 2.57 mm. the population increased gradually and peak was attained during the 16th SMW (18th-24th March) at temperature range of 18.63-39.14°C, relative humidity 20.14 to 73.57 per cent and rainfall 0.00 mm. Subsequently, the population was declined for remaining weeks throughout the crop period. This findings was agreement with the findings of Anandamurthy *et al.* (2017) reported that *B. tabaci* population first appeared in the second week of March and reached a peak during fifth week of April (4.89 white flies/3 leaves) when the maximum and minimum temperature, were high and gradually decline throughout the crop period. The whitefly population showed significant positive correlation (r = 0.657*) with maximum temperature and non-significant positive correlation with minimum temperature (r = 0.084^{NS}). Whereas, negative significant relation with morning relative humidity (r = -0.755**) and evening relative humidity (r = -0.794**). These results are supported by Kumar *et al*. (2004) who reported that temperatures were conductive to the whitefly population, showing a positive association in mung and urd bean. These findings had been previously examined and validated by Yadav *et al*. (2015) they reported that a positive correlation with temperature, that the populations of *B. tabaci* had a significant positive correlation with maximum temperature (r= 0.75).

The incidence of flower thrips were first observed during 13th SMW (28th – 3rd March) as 0.87/5 flower buds with the corresponding of temperature ranges of 16.23°C to 31.91°C, relative humidity 38.57°C - 86.29 per cent and no rainfall (00 m). The population increased gradually and peak population (15.27/5 flower buds) during the 16th SMW (18th – 24th March) at the temperature range of 18.60 to 39.14°C, relative humidity 20.14-73.57 per cent and rainfall (0.00 mm). Later subsequently, the population was declined for the next week during the cropping period. The results on correlation study indicated that flower thrips showed (Table 2) positive significant correlation with maximum temperature (r= 0.592*) and non-significant positive correlation with minimum temperature (r = 0.085^{NS}). Whereas, negative significant between both morning (r = - 0.688*) and evening (r = -0.710**) relative humidity. Flower thrips had non-significant negative correlation with rainfall (r= 0.392^{NS}). This finding are nearly similar to the study of Manrao and Choudhary (2016) who reported that the population dynamics of thrips, *Megalurothrips distalis* should a positive significant relation with maximum temperature. Whereas, the population of thrips should negative significance with rainfall, which is inconsistent to the present study.

Table 1: Influence of abiotic factors on major sucking insect pests of cowpea during summer, 2023.

Month	Date of observation	SMW*	**Mean number of insects/ plants			
			Aphids (No. of aphids/10 cm twig of plant)	Whiteflies (No. of insects/ 3 leaves)	Jassids (No. of insects/ 3 leaves)	Flower thrips (No. of insects/ 5 flower buds)
March	07-03-2023	10	0.00	0.00	0.00	0.00
	14-03-2023	11	0.00	0.00	0.00	0.00
	21-03-2023	12	2.00	0.47	0.80	0.00
	28-03-2023	13	2.87	2.33	1.87	0.87
April	04-04-2023	14	6.13	5.47	3.33	3.53
	11-04-2023	15	13.47	8.60	5.73	9.07
	18-04-2023	16	22.80	11.20	8.17	15.27
	25-04-2023	17	18.40	10.20	4.73	12.33
May	02-05-2023	18	16.87	7.40	3.40	7.27
	09-05-2023	19	19.53	5.93	1.27	2.53
	16-05-2023	20	13.47	2.07	0.93	1.07
	23-05-2023	21	11.27	1.13	0.60	0.73
	30-05-2023	22	10.33	0.87	0.27	0.00

***SMW**-Standard Meteorological Week; ** Mean of three replications

Table 2: Correlation coefficient (r) between major sucking insect pests of cowpea against weather parameters during Summer, 2023.

Name of insects	Temperature (°C)		Relative humidity(%)		Rainfall(mm) (X_5)
	Maximum(X_1)	Minimum(X_2)	0700 hrs. (X_3)	1400 hrs. (X_4)	
Aphids	0.837**	0.597*	–0.849**	–0.604*	$–0.178^{NS}$
Whiteflies	0.657*	0.084^{NS}	–0.755**	–0.794**	$–0.435^{NS}$
Jassids	0. 559*	$- 0.037^{NS}$	–0.617*	–0.754**	$–0.467^{NS}$
Flower thrips	0.592*	0.085^{NS}	–0.688**	–0.710**	$–0.392^{NS}$

**** Level of significance**=1%(p=0.01); ***Level of significance** =5%(p=0.05); **NS** = Non-significant

Table 3: Regression analysis for weather parameters and major sucking insect pest population of cowpea during Summer, 2023.

Name of insect pests	Regression equation	R^2 value
Aphids	Y = 27.012-0.651 (X_1) + 2.124 (X_2) - 0.186 (X_3) – 0.419 (X_4) – 0.116 (X_5)	0.8738
Whiteflies	Y= 25.818- 0.437 (X_1) + 0.353 (X_2) – 0.083 (X_3) -0.183 (X_4) – 0.056 (X_5)	0.7567
Jassids	Y =19.867- 0.357 (X_1) + 0.291 (X_2) - 0.030 (X_3)- 0.189 (X_4) -0.070 (X_5)	0.6365
Thrips	Y=48.768- 0.835 (X_1) + 0.672 (X_2) - 0.171 (X_3) – 0.340 (X_4) –0.111 (X_5)	0.6147

Whereas X_1=Maximum temperature (°C); X_2=Minimum temperature (°C); X_3= Maximum R.H(%); X_4=Minimum R.H(%); X_5=Rainfall (mm/day)

CONCLUSIONS

The incidence of sucking insect pests on cowpea was mostly observed from March to May in summer. The peak population of sucking pests were mostly observed during 3rd week of April. Most of the sucking insect pests showed positive significance with maximum temperature and negative significance with relative humidity and non-significance with rainfall.

FUTURE SCOPE

Studying the population dynamics of major sucking insects can have significant implications for agriculture, ecology, and pest management. It could lead to more sustainable farming practices, better pest control strategies, and a deeper understanding of ecosystems. It might delve into areas such as integrated pest management, which involves using a combination of biological, cultural, and chemical control methods to manage pest populations. Additionally, understanding the ecological roles of these insects and their interactions with other species could contribute to broader ecosystem management. Advancements in technology, such as remote sensing and data analytics, could also play a role in monitoring and predicting insect population dynamics. This field could be a blend of biology, ecology and technology.

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Conflict of Interest. None.

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