RESEARCH ARTICLE

Seasonal abundance of the key cluster bean sucking insect pests and their relationship to abiotic variables

Vijay Kumar*

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Cluster bean, scientifically identified as *Cyamopsis tetragonoloba* (L.) Taub and colloquially known as guar, plays a vital role as a leguminous crop resilient to drought conditions, typically grown in arid and semi-arid regions.

A study was carried out at Instructional Farm, RNB Global University, Bikaner during the kharif season of 2023 to investigate the seasonal occurrence of major sucking insect pests affecting cluster bean plants and their relationship with abiotic factors. The research suggested that the jassid abundance fluctuated between 0.50 and 10.40 per three leaves, with peak activity recorded at 10.40 during the 38th standard meteorological week, corresponding to the third week of September. The whitefly population (1.77 whitefly) began during the third week of August commenced on 3rd WAS coinciding with 3rd week of August (34th standard week). After that the pest activity gradually increased up to 8 WAS coinciding with 3rd week of September (38th standard week) and reached a peak level (11.57 whitefly). It was observed that there was a positive correlation between the highest and lowest temperatures. The abundance of jassid resulted significant positive correlation (r=0.67) at 5 per cent level and rainfall had negatively correlation (r=-0.31). The population of whitefly was saw that the maximum temperature showed significant positive correlation (r=0.65) at 5 per cent level, the minimum temperature showed significant positive correlation (r=+0.46) at 1 per cent level and relative humidity revealed significantly negative correlation (r=-0.54) at 1 per cent level. The rainfall showed significantly negative correlation (r=-0.30) at 5 per cent level.

Key Words: *Cluster bean; Pest incidence; Sucking pest; Abiotic factors; Correlation*

INTRODUCTION

Cluster bean, scientifically known as *Cyamopsis tetragonoloba* (L.) Taub and commonly referred to as guar, holds significant importance as a drought-resistant leguminous crop cultivated in arid and semi-arid regions. Its primary role lies in enhancing soil health through atmospheric nitrogen fixation, with an estimated average nitrogen fixation potential of nearly 30 kg N per hectare. Additionally, the plant tends to shed most of its leaves upon maturity, contributing to increased organic carbon content in the soil. This phenomenon is particularly noteworthy in arid regions where elevating organic carbon levels is a major concern.

In India, the states of Rajasthan, Haryana, Gujarat and Punjab stand out as significant producers of cluster beans. Rajasthan and Haryana emerge as the most significant contributors, responsible for around 85% of the whole production. The total cultivated area for cluster beans in India spans approximately 41.03 lakh hectares, yielding an annual production of 18.49 tonnes [1]. Specifically, in Rajasthan, the cultivated area for cluster beans extends over 7.09 lakh hectares, yielding a production of 2.72 lakh tonnes, with a productivity rate of 384 kg per hectare [2]. Notable cluster bean cultivation districts in Rajasthan include Barmer, Churu, Jaipur, Jhunjhunu, Hanumangarh and Alwar. Bikaner alone contributes to this cultivation, covering an area of 7.09 lakh hectares and yielding an annual production of 2.72 lakh tonnes, with a productivity rate of 384 kg per hectare [3].

Insect pests pose significant challenges to the productivity of cluster beans. Notable among them are the leaf hopper *Empoasca motti* Pruthi, whiteflies *Bemisia tabaci* (Genn.), *Acaudaleyrodes rechipora*, aphids *Aphis craccivora* Koch, pod borers *Helicoverpa armigera* (Hub.), leaf perforators *Dichomeris inthes* Meyr, *Maruca testulalis* Geyer and *Protaetia terrosa* G and P. These pests have been identified in previous studies as major threats to cluster bean crops [4-6].

The leaf hopper, *E. motti*, frequently referred to as jassid, is a significant polyphagous pest that detrimentally impacts vegetative growth, resulting in observed seed yield losses of up to 20%. Similarly, the whitefly, *B. tabaci*, a polyphagous insect, poses a substantial threat to crops by extracting large amounts of cell sap. Additionally, the aphid, *A. craccivora*, feeds on plant cell sap, leading to considerable losses. Understanding the timing of pest appearance and fluctuations in their populations is essential for creating successful management plans against these pests [7,8].

MATERIALS AND METHODS

To investigate the seasonal occurrence of primary sucking insect pests affecting cluster bean plants and their relationship with abiotic factors, cluster bean variety RGC-1033 was sown on July 29th 2023. The planting was conducted in a plot measuring 10.0 × 9.0 m^2, with row-to-row and plant-to-plant distances set at 30 and 10 cm, respectively.

Following their initial appearance, observations on the absolute abundance of jassid and whitefly were promptly recorded. This involved assessing the abundance of jassid and whitefly on five randomly selected and tagged plants within each plot. For each plant, three leaves from different canopy levels (top, middle and lower) were considered for population recording. These observations were conducted during the early morning hours.

The data on weather parameters was obtained from meteorological observatory RNB global university, Bikaner.

Statistical analysis

To analyze the findings regarding the seasonal occurrence of primary sucking insect pests on cluster beans, a simple correlation analysis was conducted between pest population and various abiotic factors. These factors included minimum and maximum temperature, relative humidity and rainfall.

The following equation was applied 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

Department of Entomology, School of Agriculture, RNB Global University, Bikaner, India

Correspondence: *Vijay Kumar, Department of Entomology, School of Agriculture, RNB Global University, Bikaner, India, E-mail: vijay.kumar@rnbglobal.edu.in*

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x=Independent variable i.e., biotic and abiotic component

y=Dependent variable i.e., pest

N=Number of observation

RESULTS AND DISCUSSION

To study the seasonal abundance of the key cluster bean sucking insect pests and their relationship to abiotic variables

Jassid, *Empoasca motti* pruthi: The abundance of the key cluster bean sucking insect pests, (*Cyamopsis tetragonoloba* (L.) Taub). The observations gathered during monitoring are presented in Table 1 and Figure 1. The incidence of jassid was noted to begin in the third week of August (34th Standard Meteorological Weeks (SMW)), reaching its peak by the third week of September (38th SMW) and subsequently declining until the crop matured by the third week of October (42nd SMW). Jassid abundance fluctuated between 0.50 and 10.40 per three leaves, with peak activity recorded at 10.40 during the 38th standard meteorological week, corresponding to the third week of September.

The incidence of jassid started when maximum and minimum temperature was 35°C and 26°C however relative humidity and rainfall were 70.8 and 13.4 mm, respectively. The jassid abundance increased its peak (10.40 jassid) at 39.1°C maximum 25.4°C minimum, relative humidity 44.25 per cent and rainfall 0.00 mm. The data which is shown in Table 1 indicated the abundance of jassid resulted significant positive correlation (r=0.67) at 5 per cent level and rainfall had negatively correlation (r=-0.31).

TABLE 1

Seasonal abundance of the key cluster bean sucking insect pests and their relationship to abiotic variables

SMW	Date of observation	Mean Population/three leaves		Meteorological parameters				
		Jassid	Whitefly	Temperature (°C)		Relative humidity (%)		Total
				Maximum	Minimum	Morning	Evening	
34	20.08.2023	1.43	1.77	35	26	86.4	55.2	13.4
35	27.08.2023	2.9	3.4	33.5	24.8	75.2	53	52.2
36	03.09.2023	4.77	5.71	34.8	25.3	74.1	49.5	8.2
37	10.09.2023	7.9	8.1	39.4	25.6	62.5	39	0
38	17.09.2023	10.4	11.57	39.1	25.4	59	29.5	0
39	24.09.2023	8.5	9.8	38.7	23.5	78.1	50	1.6
40	01.10.2023	5.53	6.05	38.7	19.6	69.2	31.7	0
41	08.10.2023	2.03	2.37	38	17.9	70.1	39	0
42	15.10.2023	0.5	0.8	36.1*	17.9	77.5	44.2	0
Correlation coefficient with mean jassid population (r)				0.67*	0.44 (NS)	-0.62 (NS)	-0.44 (NS)	-0.31 (NS)
Correlation coefficient with mean whitefly population (r)				0.65*	0.46 (NS)	-0.63 (NS)	-0.46 (NS)	-0.30 (NS)

Note: SMW: Standard Meteorological Weeks; (*): Significant level at 5% level; NS: Not Significant.

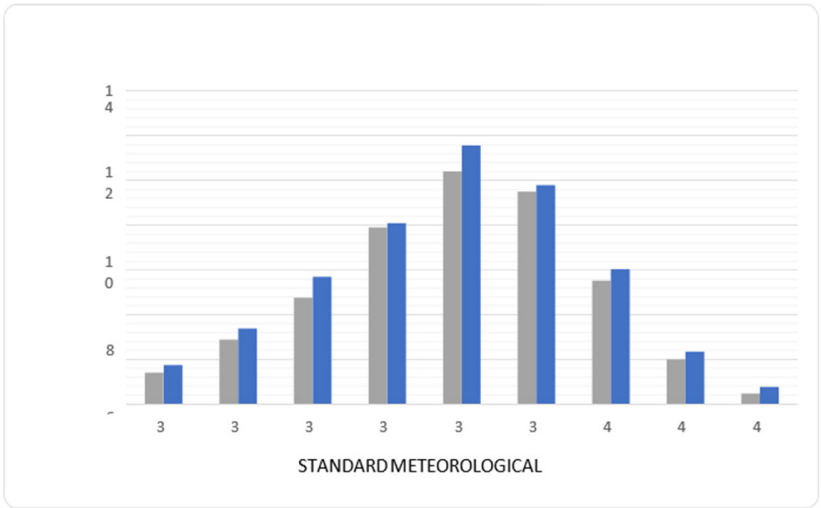

Figure 1) *Seasonal abundance of the key cluster bean sucking insect pests and their relationship to abiotic variables.* **Note:** (▒): *E. pruthi/3 leaves;* (▒): *B. tabaci/3 leaves*

Whitefly, *Bemesia tabaci* (Genn.): The observations on *B. tabaci* abundance recorded during the kharif, 2023 (Table 1 and Figure 1) showed that once the pest started activity on cluster bean was continued up to harvesting stage of the crop. The pest abundance (1.77 whitefly) commenced on 3rd Weeks After Sowing (WAS) coinciding with 3rd week of August (34th standard week). The whitefly activity gradually increased up to 8 WAS coinciding with 3rd week of September (38th standard week) and reached a peak level (11.57 whitefly). The meteorological parameters like maximum and minimum temperature, relative humidity and rainfall were recorded during the peak activity of pest as 39.1°C, 25.4°C, 44.25 per cent and 0.00 mm, respectively (Table 1 and Figure 1). The activity of this pest declined from 9 WAS coinciding with 4th week of September (39th standard week) and disappeared 12 WAS i.e., 2nd week of October (42nd standard week).

From the above results, it can be concluded that the *B. tabaci* remained active on cluster bean crop from 3 WAS to 8 WAS with a single peak during 8 WAS.

The maximum temperature showed significant positive correlation (r=0.65) at 5 per cent level, the minimum temperature showed significant positive correlation (r=+0.46) at 1 per cent level and relative humidity revealed significantly negative correlation (r=-0.54) at 1 per cent level. The rainfall showed significantly negative correlation (r=-0.30) at 5 per cent level.

CONCLUSION

The investigation into the seasonal occurrence of primary sucking pests affecting cluster beans and their correlation with abiotic factors unveiled that jassid (*E. motti*) and whitefly (*B. tabaci*) emerged during the third week of August (34th SMW). Their populations escalated until the third week of September (38th SMW) and then dwindled as the crop matured, reaching its peak decline by the third week of October (42nd SMW). The occurrence of jassid and whitefly commenced when the maximum and minimum temperatures were recorded at 35°C and 26°C, respectively, alongside a relative humidity of 70.86% and rainfall measuring 13.4 mm. The population of jassid and whitefly reached its peak, with 10.40 jassid per 3 leaves and 11.57 whitefly per 3 leaves, observed under conditions of 39.1°C maximum temperature, 25.4°C minimum temperature, 44.25% relative humidity and no recorded rainfall.

To investigate the impact of abiotic factors on the population dynamics of jassid and whitefly on cluster beans, correlation coefficients were calculated between the mean population of these pests and various weather parameters, including maximum and minimum temperature, relative humidity and rainfall. The analysis revealed a significantly positive correlation between maximum and minimum temperature and the population of both jassid (r=0.67, r=0.44) and whitefly (r=0.65, r=0.46). Conversely, relative humidity exhibited a significant negative correlation with jassid (r=-0.53) and whitefly (r=-0.54) populations. Furthermore, rainfall demonstrated a significantly negative correlation with both jassid (r=-0.31) and whitefly (r=-0.30) populations on cluster beans.

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