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Seasonal incidence of tur pod bug, *Clavigralla gibbosa* Spinola (Hemiptera: Coreidae) on long duration pigeonpea

Jitendra Khamoriya, Ram Keval, Snehel Chakravarty and Vijay Kumar Mishra

Abstract

The present research was aimed to study the seasonal incidence pattern of tur pod bug, *C. gibbosa* in pigeonpea ecosystem during *Kharif* season of the year 2015-16 and 2016-17. The results revealed that the incidence of pod bug started from the 2nd standard week and it remained active up to 14th standard week of both the years. The *C. gibbosa* population attained its peak level (6.00 bugs per plant) during 9th standard week in 2015-16 while in 2016-17, population of *C. gibbosa* was recorded to be highest in 10th standard week (5.50 bugs per plant). Correlation studies indicated that population of *C. gibbosa* exhibited a significant positive correlation with maximum temperature whereas a significant negative correlation was established with average relative humidity. Other abiotic factors had no significant effect on this insect pest population. The regression equation revealed that variations of different weather variables caused approximately 82.6 and 85.6 per cent variations in *C. gibbosa* population during both years, respectively.

Keywords: Pigeonpea, *Clavigralla gibbosa* Spinola, Pod bug, Abiotic factors

1. Introduction

Pigeonpea, *Cajanus cajan* (L.) Millsp. is the second most important pulse crop grown in India after chickpea [1]. Though, India is largest producer of pigeonpea, contributing more than 90 per cent of the world's production, the productivity has always been a concern. The low productivity of pigeonpea in the country may be attributed to many reasons, among which damage by insect pests is of paramount importance [2]. Nearly 250 species of insect pests are known to infest pigeonpea crop at its various growth stages in India but of these only a few cause significant and consistent damage to the crop [3].

Among the pod damaging insect pests of pigeonpea, next to pod borers, pigeonpea pod sucking bug, *Clavigralla gibbosa* Spinola (Hemiptera: Coreidae) has become a real threat to quality grain production in pigeonpea [4]. The damage in grain yield due to this bug generally ranges between 25 to 40 per cent [5]. Both nymphs and adults of this insect feed by piercing the pod walls and extracting nutrients from the developing grains thereby resulting in premature shedding of pods, deformation of pods and shriveling of grains which results in major reduction to grain yield in pigeonpea [6]. In recent years, this insect has assumed the status of a major pest on pigeonpea in Varanasi region of Uttar Pradesh.

The main reasons for the outbreak of this pest are continuous and indiscriminate use of same insecticides, monocropping and introduction of early maturing pigeonpea cultivars [7, 8]. Further, occurrence of favorable temperature and humidity conditions during reproductive stage of the crop also supports population build up of this bug [9]. Under these circumstances, the scientific investigations for the effective management of *C. gibbosa* in pigeonpea ecosystem are needed to be further strengthened. Before developing insect pest management programme for specific agro ecosystem, it is necessary to have basic information on abundance and distribution of pest in relation to weather parameter as it helps in determining appropriate time of action and suitable effective method of control. Hence, an attempt has been made to study the incidence and population density *C. gibbosa* on long duration pigeonpea with respect to some abiotic factors in Varanasi region of India.

2. Materials and Methods

To study the seasonal incidence of *C. gibbosa* on pigeonpea, field experiments were conducted at Agriculture Research Farm, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during *Kharif* 2015-16 and 2016-17. Long duration pigeonpea cultivar Bahar was used for the study and the crop field was kept free from pesticide sprays. The bug activities starting from first appearance of bug to till they disappeared were watched. Population of *C. gibbosa* was recorded on five randomly selected plants from three middle rows of the crop block at weekly intervals. Influence of weather parameters on population buildup of *C. gibbosa* was also worked out. For this, the data was subjected to correlation and regression analysis with weather parameters *viz*., maximum and minimum temperatures, average relative humidity, sunshine hours and wind velocity in respect of the corresponding standard week. The meteorological data for the above analysis were obtained from the meteorological observatory of the university.

2.1 Statistical analysis
Significance of simple correlation was estimated by using *t*-test [10] and the regression equations were derived by using the formula as suggested by Panse and Sukhatme [11].

3. Results and Discussion
The results obtained from the present investigation as well as relevant discussion have been summarized under the following heads:

3.1 Incidence pattern of tur pod bug, *C. gibbosa*
During 2015-16, the first incidence of pod bug (*C. gibbosa*) was noticed during 2nd standard week. The population persisted in the field from 2nd to 14th standard week. The mean population of pod bug attained its peak level during 9th standard week (6.00 bugs/plant) followed by 8th standard week (3.70 bugs/plant), the lowest mean population was recorded in 14th standard week (1.00 bugs/plant) (Fig. 1). Similarly, during 2016-17, the first incidence of *C. gibbosa* was noticed during 2nd standard week. The population persisted in the field from 2nd to 14th standard week. The mean population of pod bug attained its peak level during 10th standard week (5.50 bugs/plant) followed by 8th standard week (4.54 bugs/plant), the lowest mean population recorded in 14th standard week (1.20 bugs/plant) (Fig. 2).
The present findings are in accordance with the findings of Srujana and Keval [6] who studied the seasonal incidence pattern of tur pod fly and pod bug on long duration pigeonpea (Bahar) during *kharif* season of the year 2011-12. Average adult population of pod bug, *C. gibbosa* attained its peak on 9th standard week (6.4 bugs/plant), followed by 8th standard week (5.8 bugs/plant) and lowest population of (0.2 bugs/plant) was recorded in the 1st standard week. Per cent pod damage was recorded highest in 9th standard week (26.8%) followed by 21.2% damage in 8th standard week. Similar trend of population buildup of pod bug on pigeonpea was also observed by [12, 13]. The results are also in partial accordance with Shukla and Kumar [14] who reported that *C. gibbosa* infestation started in the 35th standard week and continued up to 48th standard week, reaching its peak in the 45th standard week on pigeonpea variety ICPL-87. Similarly, Pandey *et al.* [15] also reported that the first occurrence of *C. gibbosa* on short duration pigeonpea was recorded in 40th standard week and it attained peak during 44th and 45th standard week.

3.2 Influence of weather parameters on population buildup of tur pod bug, *C. gibbosa*
Simple correlation was worked out between the weather parameters and *C. gibbosa* population in order to study the impact of different abiotic factors on population buildup of this pest insect. The analytical data on correlation coefficient during 2015-16 indicated that population of *C. gibbosa* exhibited a significant positive correlation with maximum temperature (r = 0.641*) whereas a significant negative relationship was found with average relative humidity (r = -0.660*). The other abiotic factors did not show any significant impact on incidence of the pest (Table 1). Similarly during 2016-17, the results showed that there was a positive significant association of the pest population with maximum temperature (r = 0.745**) while a significant negative relationship was exhibited with average relative humidity (r = - 0.647*). Correlation coefficient with other abiotic factors was found to be non-significant (Table 1).
The regression coefficient revealed that the various abiotic factors were found to be most influencing factor, which contributed (R^2 = 0.826 and 0.856) 82.6 and 85.6 per cent variation in *C. gibbosa* population during both the years, respectively. The regression equation was fitted to study the effectiveness of weather parameters (2015-16) indicated that for every 1 ºC increase in maximum temperature and one km/hr increase in wind velocity there would be an increase of 0.851 and 0.954 numbers of *C. gibbosa* population, while for every 1 ºC increase in maximum temperature, one per cent increase in average relative humidity and one hour increase in sunshine hour there would be a decrease of 0.271, 0.786 and 1.250 numbers of *C. gibbosa* population respectively (Table 2).
Similarly during 2016-17, for every 1ºC increase in maximum temperature and one km/hr increase in wind velocity there would have been an increase of 4.131 and 0.353 numbers of *C. gibbosa* population, while for every 1ºC increase in minimum temperature, one per cent increase in average relative humidity and one hour increase in sunshine hour there would be a decrease of 1.455, 1.392 and 2.578 numbers of *C. gibbosa* population respectively (Table 3). The results are in accordance with Pandey and Das [16] who reported that temperature (maximum and minimum) and sunshine hours had non-significant correlations with the population buildup of this bug but relative humidity had a negative impact on bug population.
The present results also confirm the findings of Misra and Das [13], they also reported negative impact of relative humidity on the pest population. In our findings also relative humidity exhibited significant negative relationship with pest population. Kaushik *et al.* [17] also reported that both maximum and minimum temperature exhibited positive impact on the pest population that further supported the present findings. On the contrary, Kumar and Nath [18] found that the temperature, relative humidity and water evaporation had negative non-significant correlation with population build-up of pod bug (*C. gibbosa*). Chakravarty *et al*. [4] also found that the variations of different weather variables like temperature, relative humidity, sunshine hours and wind velocity caused approximately 91.1 per cent variation in *C. gibbosa* population in pigeonpea ecosystem. These reports further strengthen the findings of the present study.

Table 1: Correlation studies between weather parameters and *C. gibbosa* population during *Kharif* 2015-17.

Weather Parameters	*C. gibbosa* population	
	(2015-16)	(2016-17)
Maximum temperature (ºC)	0.641*	0.745**
Minimum temperature (ºC)	0.436 ns	0.393 ns
Average relative humidity (%)	- 0.660*	- 0.647*
Sunshine hours	0.141 ns	0.188 ns
Wind velocity (km/hr)	0.069 ns	- 0.026 ns

*Correlation is significant at the 0.05 level (Two-tailed), ** Correlation is significant at 0.01 level (Two-tailed), ns = non-significant

Table 2: Multiple regressions of *C. gibbosa* population with weather parameters during *Kharif* 2015-16.

Multiple regression	Temperature (º C)		Average	Sunshine hours	Wind velocity (km/hr)
	Maximum (X_1)	Minimum (X_2)	Relative humidity (%) (X_3)	(X_4)	(X_5)
Coefficient	0.225	- 0.077	- 0.068	- 0.317	0.590
Standard Error	0.264	0.282	0.087	0.253	0.618
T value	0.851	- 0.271	- 0.786	- 1.250	0.954
F value	2.010				
R^2	0.826				
Regression equation	: $Y_1 = 1.791 + 0.225 (X_1) – 0.077 (X_2) – 0.068 (X_3) – 0.317 (X_4) + 0.590 (X_5)$				

Y_1 = *C. gibbosa* population, **X_1**= Maximum temperature (ºC), **X_2** = Minimum temperature (ºC), **X_3** = Average relative humidity (%), **X_4** = Sunshine (hours), **X_5** = Wind velocity (km/hr)

Table 3: Multiple regressions of *C. gibbosa* population with weather parameters during *Kharif* 2016-17.

Multiple regression	Temperature (ºC)		Average	Sunshine hours	Wind velocity (km/hr)
	Maximum (X_1)	Minimum (X_2)	Relative humidity (%) (X_3)	(X_4)	(X_5)
Coefficient	0.318	- 0.124	- 0.039	- 0.334	0.102
Standard Error	0.077	0.085	0.028	0.129	0.288
T value	4.131	- 1.455	- 1.392	- 2.585	0.353
F value	7.174				
R^2	0.857				
Regression equation:	$Y_2 = 0.112 + 0.318 (X_1) – 0.124 (X_2) – 0.039 (X_3) – 0.334 (X_4) + 0.102 (X_5)$				

Y_2 = *C. gibbosa* population, **X_1**= Maximum temperature (ºC), **X_2** = Minimum temperature (ºC), **X_3** = Average relative humidity (%), **X_4** = Sunshine (hours), **X_5** = Wind velocity (km/hr)

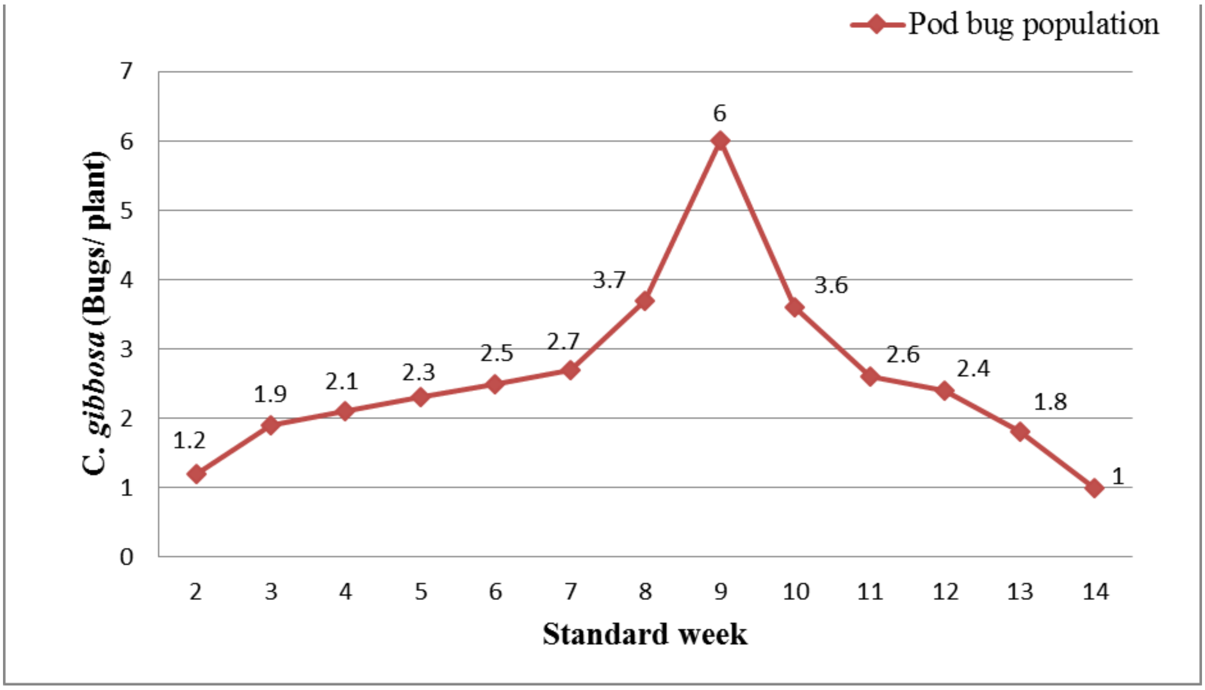

Fig 1: Average population of *C. gibbosa* on long duration pigeonpea during *Kharif* 2015-16.

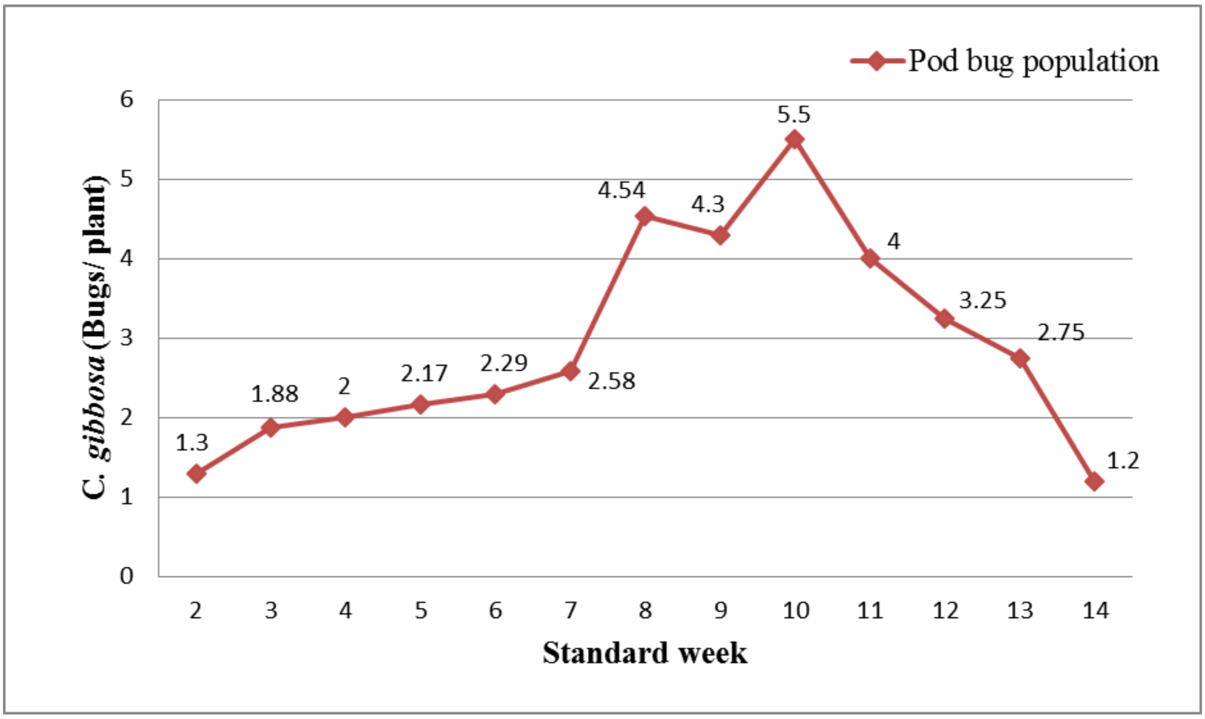

Fig 2: Average population of *C. gibbosa* on long duration pigeonpea during *Kharif* 2016-17.

4. Conclusion

The present study indicates that *C. gibbosa* is emerging as a serious insect pest of pigeonpea in Varanasi region during reproductive stage of pigeonpea crop and its activity increased with increasing maximum temperature and decreased with increasing relative humidity recorded at morning or evening. From the present findings, it can also be inferred that there was only single peak without any multiple peaks or overlapping broods of *C. gibbosa* on pigeonpea. Hence the farmers can be alerted during February month to take up suitable management practices for effective management of this insect pest on long duration pigeonpea. Such studies on population buildup of insect pests and their relationship with weather parameters provide a clue to improve the IPM strategy against insect pests' infestation and also help in making timely prediction of the occurrence of the pest.

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