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C Raghu Prasad
Department of Entomology, SV Agricultural College, Tirupati, ANGRAU, Andhra Pradesh, India

A Rajesh
Department of Entomology, SV Agricultural College, Tirupati, ANGRAU, Andhra Pradesh, India

SR Koteswara Rao
Department of Entomology, SV Agricultural College, Tirupati, ANGRAU, Andhra Pradesh, India

B Ramana Murthy
Department of Entomology, SV Agricultural College, Tirupati, ANGRAU, Andhra Pradesh, India

Corresponding Author:
C Raghu Prasad
Department of Entomology, SV Agricultural College, Tirupati, ANGRAU, Andhra Pradesh, India

Seasonal incidence of pod bugs in cowpea (*Vigna unguiculata* L.) in dry land eco-system

C Raghu Prasad, A Rajesh, SR Koteswara Rao and B Ramana Murthy

Abstract
Seasonal incidence of pod bugs in cowpea (*Vigna unguiculata* L.) in dry land eco-system was carried out during *Kharif* 2018 at dry land farm, S.V. Agricultural College, Tirupati. Three dates of sowing at fortnightly intervals starting from June 15th was considered for the study. The incidence of pod bugs was low in early sown crop when compared to the mid and late sown crop. Among the five sps of pod bugs, the incidence of *Riptortus pedestris* and *Clavigralla gibbosa* was high compared to other species of pod bugs. Correlation studies between incidence of pod bugs and weather parameters *viz:* Maximum temperature, minimum temperature, relative humidity, rainfall, sunshine hours, evaporation, revealed that incidence of *R. pedestris* exhibited significant positive correlation with sunshine hours and rainfall in early and mid-sowing. The population of *C. gibbosa* in early sowing exhibited significant positive correlation with the minimum temperature and negative correlation with relative humidity, rainfall. In mid sowing exhibited positive correlation with relative humidity and negative correlation with rainy days, evaporation. The population of *N. viridula* in early sowing exhibit significant positive correlation with sunshine hours, relative humidity and rainfall while negative correlation with the evaporation in mid sowing. The population of *C. cribraria, A. phasiana* in mid sowing exhibited a positive correlation with the relative humidity and negative correlation with the evaporation. The population of *A. phasiana* in mid sowing exhibit negative correlation with minimum temperature.

Keywords: Pod bugs, population, seasonal incidence and cowpea

Introduction
Cowpea (*Vigna unguiculata* L.) is one of the most important pulse crops, native to central Africa, belongs to family Fabaceae. Cowpea is called as vegetable meat due to high amount of protein in grain with better biological value on dry weight basis. It is an important source of dietary protein in the tropics and sub tropics, where the consumption rate of animal protein is very low (Voster *et al*., 2007) [19].

Among the insect pests attacking cowpea pod sucking bugs are the most ingenious intruders during the post flowering phase of the crop. These bugs feed by desapping the juice from developing pods thereby affecting the quantity and quality of the produce.

Among the insect pests of cowpea, the most destructive post flowering pests that affects the seed quality are the pod bugs *viz*., Riptortus pedestris Fabricius; Clavigralla gibbosa Spinola; Nezara viridula Linnaeus etc. During its peak infestation, more than 80 percent yield loss occur (Singh and Singh, 1990). In recent years pod sucking bug, C. gibbosa (Hemiptera: Coreidae) has become a real threat to quality grain production in cowpea. The loss in grain yield due to this bug generally ranges between 25 and 40 percent (Gopali *et al*., 2012). Both nymphs and adults feed by piercing the pod walls and extracting nutrients from the developing grains thereby resulting in premature shedding of pods, deformation of pods and shrivelling of grains which results in major reduction in grain yield (Srujana and Keval, 2014) [14].

Temporal distribution of insect pests is often governed by complex interactions exerted by abiotic and biotic factors. Therefore, information pertaining to seasonal abundance of the pest would be beneficial while combating with them, to keep their populations below damaging levels. Perusal of literature indicated deficit of data regarding population of pod bugs on a temporal scale.

Materials and Methods
Field trails were conducted at the dry land farm, S.V. Agricultural College, Tirupati during Kharif, 2018, to study the seasonal incidence of pod bugs in cowpea. The popular variety of cowpea i.e.

TPTC-29 was grown in 10X10 m2 area with spacing of 45 cm between the rows and 10 cm between the plants. Three sowing dates, at every 15 days interval from June 15th (early) followed by July 1st (mid), July 15th (late) considered for the study. Three plots of each of 10 m2 area were raised with TPTC-29 variety of cowpea. The data on incidence of pod bugs were collected by fixed plot sampling technique (10X10m2). From each plot 10 plants were selected randomly and tagged to count the number of nymphs and adults bugs on each of the 10 randomly selected plants. Insects were sampled by direct counting at weekly intervals during different phases of crop growth. Observations were recorded in the morning hours on number of nymphs and adults of Pod bugs in undistrubed conditions in the experimental plots.

The average number of nymphs and adults of each species of pod bugs attack the cowpea at each stage of the crop growth was estimated. These values were correlated with the weather parameter recorded during the crop growth period as to infer the impact of temperature, relative humidity and rainfall on the building up of the pest.

Results and Discussion

Seasonal incidence of *Riptortus pedestris*

In early sowing, the incidence of *Riptortus pedestris* was observed on 31 standard week (SW) (1.00 bug/plant), which gradually increased and reached peak level (5.50 bugs/plant) at 34 SW. Thereafter, the population gradually decreased to 0.5 bugs per plant at 37 SW (Fig.1). In mid sowing, the incidence started from 33 SW (2.6 bugs/plant), which gradually increased and reached peak level (6.0 bugs/plant) at 37 SW. Thereafter, the population gradually decreased to 0.8 bug per plant at 40 SW (Fig.2). In late sowing, the incidence started at 34 SW (2.0 bugs/plant), which gradually increased and reached peak level (7.4 bugs/plant) at 39 SW. Thereafter, the population gradually decreased to 3.2 bugs per plant at 41 SW (Fig. 3).

Correlation studies with weather parameters revealed that incidence of *R. pedestris* in early sowing exhibited a significant positive correlation with sunshine hours of the day (r = 0.856) and did not show any significant correlation with other abiotic factors (Table 1). In mid sown crop, significant positive correlation with rainfall (r = 0.750) and did not show any significant correlation with other abiotic factors (Table 2). In late sown crop, no significant correlation was observed with any of the abiotic factors (Table 3).

Seasonal incidence of *Clavigralla gibbosa*

In early sowing, the incidence of *Clavigralla gibbosa* was observed on 30 SW (2.00 bugs/plant), which gradually increased and reached peak (5.5 bugs/plant) at 32 SW. Thereafter, the population gradually decreased to 0.00 bugs per plant at 37 SW (Fig.1). In mid sowing, the incidence started from 33 SW (1.5 bugs/plant), which gradually increased and reached peak (5.6 bugs/plant) at 37 SW. Thereafter, the population gradually decreased to 2.30 bugs per plant at 40 SW (Fig.2). In late sowing, the incidence started from 34 SW (2.40 bugs/plant), which gradually increased and reached peak (7.50 bugs/plant) at 38 SW. Thereafter, the population gradually decreased to 1.90 bugs per plant at 41 SW (Fig.3).

Correlation studies with weather parameters revealed that, population of *C. gibbosa* in early sowing exhibited a significant positive correlation with minimum temperature (r = 0.709) and negative correlation with relative humidity (r = -0.742), rainfall (r = -0.732) and rainy days (r = -0.736) (Table 1). In mid sowing, a significant positive correlation was observed with relative humidity (r = 0.750), rainy days (r = 0.752) and negative correlation with the evaporation (r = -0.744) (Table 2). In late sown crop, no significant correlation was observed with any of the abiotic factors (Table 3).

Seasonal incidence of *Nezara viridula*

In early sowing, the incidence of *Nezara viridula* was observed on 31 SW (0.5 bug/plant), which gradually increased and reached peak (4.80 bugs/plant) at 34 SW. Thereafter, the population gradually decreased to 1.0 bug per plant at 37 SW (Fig.1). In mid sowing, the incidence started from 33SW (2.0 bugs/plant), which gradually increased and reached peak (5.0 bugs/plant) at 37 SW. Thereafter, the population gradually decreased to 2.5 bugs /plant at 40 SW (Fig.2). In late sowing, the incidence started from 34 SW (2.1 bugs/plant), which gradually increased and reached peak (6.2 bugs/plant) at 38 SW. Thereafter, the population gradually decreased to 2.24 bugs per plant at 41 SW (Fig. 3).

Correlation studies with weather parameters revealed that, incidence of *N. viridula* in early sowing exhibited significant positive correlation with sunshine hours of the day (r = 0.770) and did not show any significant correlation with other abiotic factors (Table 1). In mid sown crop, a significant positive correlation was observed with relative humidity (r = 0.722), rainy days (r = 0.782) and significant negative correlation with the evaporation (r = -0.732) (Table 2). In late sown crop, no significant correlation was observed with any of the abiotic factors (Table 3).

Seasonal incidence of *Coptosoma cribraria*

In early sowing, the incidence of *C. cribraria* was observed on 32 SW (1.0 bug/plant), which gradually increased from 32 SW and reached peak (4.0 bugs/plant) at 35 SW. Thereafter, the population gradually decreased to 1.0 bug per plant at 37 SW (Fig. 1). In mid sowing, the incidence was started from 33 SW (1.0 bug/plant), which gradually increased and reached peak (4.0 bugs/plant) at 38 SW. Thereafter, the population gradually decreased to 2.80 bugs per plant at 40 SW (Fig. 2). In late sowing, the incidence started from 34 SW (1.50 bugs/plant), which gradually increased and reached peak 5.0 bugs/plant at 38 SW. Thereafter, the population gradually decreased to 1.60 bugs per plant at 41 SW (Fig.3).

Correlation studies with weather parameters revealed that, population of *C. cribraria* in early sowing did not show any significant correlation with the abiotic factors (Table 1). In mid sown crop, a significant positive correlation was observed with relative humidity (r = 0.820), and significant negative correlation with the evaporation (r = -0.792) and did not show any significant correlation with the other abiotic factors (Table 2). In late sown crop, no significant correlation was observed with any of the abiotic factors (Table 3).

Seasonal incidence of *Anoplocnemius phasiana*

In early sowing, the incidence of *A. phasiana* was not observed during the crop grown period (Fig 1). In mid sowing, the incidence started from 35 SW (1.0 bug/plant), which gradually increased and reached peak (3.2 bugs/plant) at 38 SW. Thereafter, the population gradually decreased to 1.40 bugs per plant at 40 SW (Fig. 2). In late sowing, the incidence started from 35 SW (1.50 bugs/plant), which gradually increased and reached peak (4.50 bugs/plant) at 39 SW. Thereafter, the population gradually decreased to 1.50

bugs per plant at 41 SW (Fig. 3).

Correlation studies with weather parameters revealed that, incidence of *A. phasiana* in early sowing did not showed significant correlation with any of the abiotic factors (Table 1). In mid sown crop, a significant negative correlation was observed with maximum temperature (r = -0.709), evaporation (r = -0.797) and significant positive correlation with the relative humidity (r = 0.847) (Table 2). In late sown crop, no significant correlation was observed with any of the abiotic factors (Table 3).

In present findings all the three dates of sowings (early, mid and late) of cowpea the pod bugs incidence started from 43-48 days after sowing and remained on the crop till harvesting, attained the peak at 75-85 days after sowing (Fig. 1- 3). The present findings are in agreement with Niba (2011) [12] who reported that incidence of pod sucking bugs in cowpea was observed at eight weeks after sowing and the infestation continued till harvesting, with peak infestation level at 12 weeks after sowing. In early sowing, the pod bug incidence started at 31 SW and continued till the 37 SW. The peak incidence of pod bugs was noticed between 32 to 34 SW and gradually decreased during post flowering period (34 to 37 SW) (Fig. 1). In mid sowing, pod bugs incidence started from 33 SW and continued till the 40 SW (Fig. 2). In late sowing, pod bugs incidence was started from 34 SW and continued up to 41 SW, but in both sowings peak incidence of the pod bugs was noticed between the 38 to 40 SW (Fig. 3). Similar results were also reported by Sujithra and Chander (2014) [15]. The results of present investigation are in contrary with Parvathy (2011) who has noticed that negligible incidence of the pod bugs during vegetative growth.

The results of the correlation studies revealed that, in early sowing; *C. gibbosa* incidence exhibited a significant positive correlation with the minimum temperature and a significant negative correlation with the relative humidity, rain fall and rainy days. Similar results were reported by Jakhar *et al*. (2017) [6] they reported that *C. gibbosa* incidence had significant and negative correlation with the maximum temperature, rainfall and relative humidity. In mid sowing, *R. pedestris* exhibited a significant positive correlation with the rainfall and remaining factors such as temperature, relative humidity, sunshine hours did not show any correlation with the *R. pedestris* population. Similar results were reported by Reddy *et al*. (2017a) [13] who noticed that *R. pedestris* showed a significant positive correlation with the rainfall and rainy days. Minimum temperature, sunshine hours and wind speed were negatively and non–significantly correlated. In mid sowing, *C. cribraria* incidence exhibited a significant positive correlation with the relative humidity and significant negative correlation with the evaporation. The present findings are in conformity with Reddy *et al*. (2017b) [13] who revealed that *C. cribraria* had significant positive correlation with the relative humidity and wind speed, whereas minimum, maximum temperature and rainfall did not show any correlation with the *C. cribraria* population.

Summary and Conclusion

In early sown crop the incidence of pod bugs was high in the vegetative stage compared to reproductive stage where as the population was high during reproductive stage compared to vegetative stage in mid and late sowing. This results in less pod damage in early sown crop compared to mid and late sown crop. The low incidence of two pod bugs *R. pedestris* and *C. gibbosa* in early sown crop was may be due to the negative correlation with the rainfall, relative humidity, rainy days.

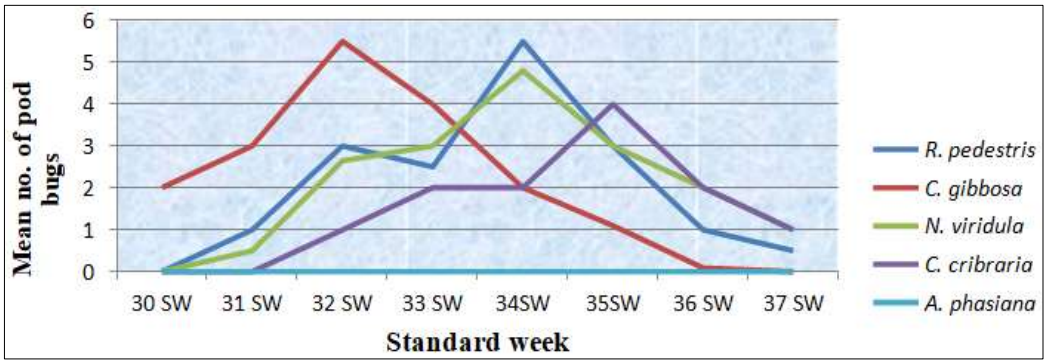

Fig 1: Seasonal incidence of pod bugs in cowpea during kharif 2018 – Early sowing (June 15th)

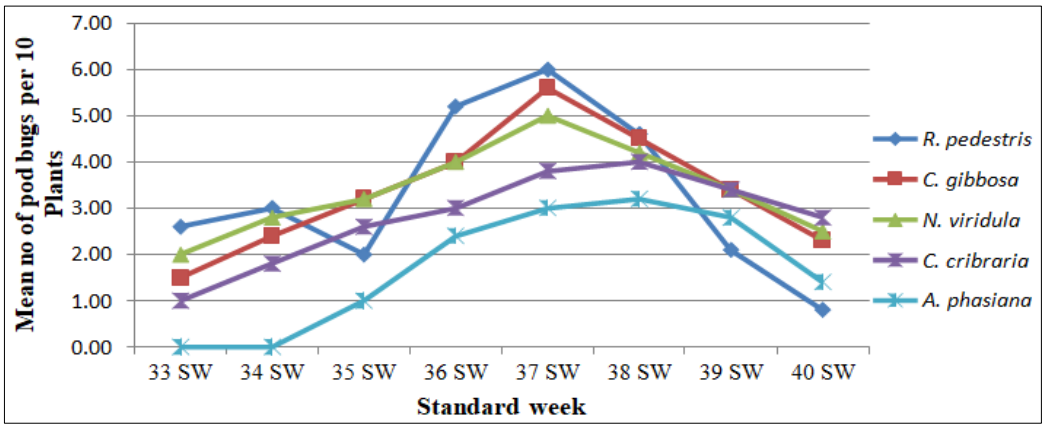

Fig 2: Seasonal incidence of pod bugs in cowpea during kharif 2018 – Mid sowing (July 1st)

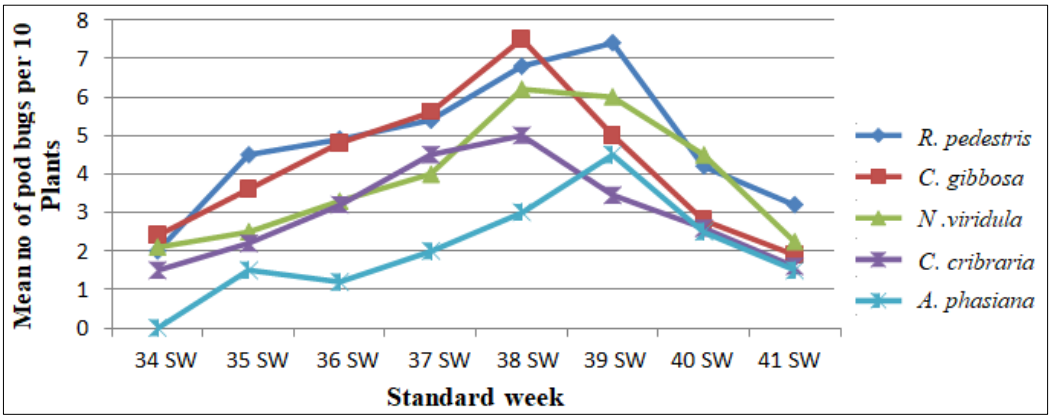

Fig 3: Seasonal incidence of pod bugs in cowpea during kharif 2018- late sowing (july15)

Table 1: Simple correlations between weather parameters and pod bugs in cowpea during kharif 2018- early sowing (June 15th)

Weather parameters	Correlation coefficients (r)				
	R. pedestris	***C. gibbosa***	***N. virudula***	***C. cribaria***	***A. phasiana***
Maximum temperature	.544NS	.466 NS	.422 NS	.145NS	.b
Minimum temperature	.336NS	.709*	.125 NS	-.233NS	.b
Relative humidity	-.323NS	-.742*	-.130 NS	.374NS	.b
Rainfall	-.303NS	-.732*	-.045NS	.406NS	.b
No of rainy days	-.272 NS	-.736*	-.062NS	.408NS	.b
Evaporation	.339NS	.663 NS	.240NS	-.109NS	.b
Sunshine hours	.856**	.153NS	.770*	.401NS	.b

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). b. Cannot be computed because at least one of the variables is constant. NS- non significant.

Table 2: Simple correlations between weather parameters and pod bugs in cowpea during kharif 2018-mid sowing (July 1st)

Weather parameters	Correlation coefficients (r)				
	R. pedestris	***C. gibbosa***	***N. virudula***	***C. cribaria***	***A. phasiana***
Maximum temperature	-.334NS	-.612 NS	-.593NS	-.633NS	-.709*
Minimum temperature	-0.22NS	-.429 NS	-.393NS	-.615NS	-.469NS
Relative humidity	0.418 NS	.722*	.722*	.820*	.847**
Rainfall	.750*	.656 NS	.689NS	.303 NS	.300 N
No of rainy days	.694 NS	.752*	.782*	.530 NS	.532 NS
Evaporation	-4.29 NS	-.744*	-.732*	-.792*	-.797*
Sunshine hours	-3.89 NS	-.045NS	-.073NS	.287NS	.171NS

*Correlation is significant at the 0.05 level (2-tailed). ** Correlation is significant at the 0.01 level (2-tailed). NS- non significant.

Table 3: Simple correlations between weather parameters and pod in cowpea during kharif 2018- late sowing (July 15th)

Weather parameters	Correlation coefficients (r)				
	R. pedestris	***C. gibbosa***	***N. virudula***	***C. cribaria***	***A. phasiana***
Maximum temperature	-.354NS	-.229NS	-.225NS	-.395NS	-.364NS
Minimum temperature	.232NS	.383NS	.082NS	.146NS	-.076NS
Relative humidity	. 582NS	.423NS	.558NS	.567NS	.591NS
Rainfall	-.073NS	.208NS	-.203NS	.283NS	-.345NS
No of rainy days	.129NS	.297NS	-.022NS	.377NS	-.120NS
Evaporation	-.542NS	-.441NS	-.542NS	-.613NS	-.555NS
Sunshine hours	.165NS	.000NS	.128NS	-.120NS	.228NS

*Correlation is significant at the 0.05 level (2-tailed). **Correlation is significant at the 0.01 level (2-tailed). NS- non significant.

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