PEST SUCCESSION OF IMPORTANT PESTS AND THEIR NATURAL ENEMIES ON CLUSTER BEAN *Cyamopsis tetragonoloba* (L.) TAUBERT

PAWAR, S. T.; PATEL, P. S.; PAREEK, A. DEB, SUSHMA* AND PATEL, B.C.

DEPARTMENT OF ENTOMOLOGY
C. P. COLLEGE OF AGRICULTURE
SARDARKRUSHINAGAR DANTIWADA AGRICULTURAL UNIVERSITY
SARDARKRUSHINAGAR – 385 506, GUJARAT, INDIA

****Email: debsushma@gmail.com***

ABSTRACT

The investigation on pest succession of important pests infesting cluster bean as well as their natural enemies was carried out under North Gujarat conditions at Centre of Excellence for Research on Pulses, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during kharif 2011. Five insect pests viz., leafhopper (Empoasca kerri Pruthi); whitefly (Acaudaleyrodes rachipora Singh); thrips (Megaleurothrips usitatus Karny); black weevil (Cyrtozemia dispar Pascoe) and termite (Odontotermus obesus Rambur) were recorded on cluster bean. Among them, E. kerri was noted first during 3 weeks after sowing (WAS), which was followed by A. rachipora during 4 WAS. M. usitatus appeared little late (5 WAS) and disappeared from the crop from 13 WAS, while the population of leafhopper and whitefly was noted on cluster bean up to 14 and 15 WAS, respectively. Cyrtozemia dispar appeared on the crop during 7 WAS, whereas incidence of O. obesus commenced during 9 WAS. Population of C.dispar and damage due to O. obesus disappeared from the crop 13 WAS and 16 WAS, respectively. Therefore, based on duration of occurrence and intensity, leafhopper and whitefly were designated as "major pests", whereas thrips, black weevil and termite were designated as "minor pests".

KEY WORDS: Pest succession, cluster bean, weather parameters, correlation

INTRODUCTION

Cluster bean *Cyamopsis tetragonoloba* (L.) Taubert, also called as *guar*, is an important seed as well as vegetable crop. India is the largest producer of guar and contributes 80 per cent of total guar production in the world (Anonymous, 2013-14). Total production of guar in India is estimated around 2.7 million metric tons during the agricultural year 2013-14. In India, it is cultivated in 42.55 lakh hectare with production and productivity of 24.14 lakh tones and 567 kg/ha, respectively. Gujarat shares only 2 per cent of India's total guar production, which comes from an estimated area of 2.98 lakh hectare with a production of 1.79 lakh metric tons and productivity of 600 kg/ha (Anonymous, 2015). There are many factors responsible for low productivity, of which infestation by insect pests is major one. The information regarding appearance of the pests and fluctuation in their population is essential for implementation of management strategies against any pest. Scanty

information is available regarding the aspect particularly in North Gujarat Agro Climatic Zone and hence, the present investigation was carried out on pest succession of important pests their natural enemies on cluster bean.

MATERIALS AND METHODS

The investigation on cluster bean was carried out under North Gujarat Agro Conditions at the Centre of Excellence for Research on Pulses, Sardarkrushinagar Dantiwada Agricultural University, Sardarkrushinagar during *kharif* 2011. Cluster bean (cv. GG 1) was sown during the 3rd week of July and raised by standard agronomical practices. For recording observations, the plot (Gross: 20 x 20 m and Net: 18 x 18 m) was divided into 10 quadrates. Ten plants from each quadrate were selected randomly and tagged to record the population of pests as well as natural enemies. Observations were recorded at weekly interval during morning hours starting two weeks after sowing till maturity of the crop. Experimental plots were kept free from insecticidal spray throughout the crop season.

Number of leafhopper *E. kerri* (nymphs and adult), whitefly *A. rachipora* (adult and pupa) and thrips *M. usitatus* (nymphs and adult) and adult of black weevil *C. Dispar* were counted separately from three leaves one each from top, middle and bottom region per plant at weekly interval. Regarding observation on termite *O. obesus*, total number of plants and number of plants damaged by the pest were counted from each quadrate at weekly interval and per cent plant damage / infestation by *O. obesus* was worked out. Observations on natural enemies (adult, nymph/ larva) *viz.*, coccinellidae, *Chrysoperla* and spider were also recorded from same selected plants.

Mean population of each pest and natural enemy was worked out and discussed for their order of occurrence in light of abiotic and biotic factors. The data on meteorological parameters were utilized to work out simple correlation coefficient. Similarly, correlation coefficient was worked out between pests and their natural enemy population and between various pests.

The insect species were categorized as major, minor and sporadic pests on the basis of their mean level of incidence and duration of their occurrence as per criteria given by Reddy and Singh (1998).

RESULTS AND DISCUSSION

Population dynamics of important insect pests of cluster bean

Five pests *viz.*, leafhopper (*E. kerri*), whitefly (*A. rachipora*), thrips (*M. usitatus*), black weevil (*C. dispar*) and termite (*O. obesus*) and three natural enemies *viz.*, *Chrysoperla*, spider and ladybird beetle were recorded on cluster bean crop.

Leafhopper, E. kerri

The incidence of *E. Kerri* commenced from 3 weeks after sowing (WAS) *i.e* 1st week of August (32nd standard meteorological week) with 0.73 hopper per leaf and reached to a peak level (4.73/leaf) during 10th WAS *i.e.* 3rd week of September (39th SMW). Thereafter, its population gradually declined from 11 WAS *i.e.* 4th week of September (40th SMW) and finally disappeared 15 WAS *i.e.* 4th week of October (44th SMW) (Table 1). Among meteorological parameters, morning (r = 0.71**) and evening relative humidity (0.77**) and rainfall (0.59*) had significant positive influence on leafhopper population, while maximum temperature (-0.78**) and sunshine hours (-0.64*) exhibited significant negative influence on the pest (Table 3).

Earlier, Ram *et al.* (1989) observed highest population of *E. kerri* during the 5 WAS in Uttar Pradesh. Pai and Dhuri (1991) mentioned that the *E. kerri* appeared on cowpea in the 1st week after germination and attained it peak (10.33/plant) during the 2nd week of November under Maharashtra conditions. The maximum and minimum temperatures showed significantly positive correlation, whereas the relative humidity revealed negative significant correlation with leafhopper population in Rajasthan (Yadav *et al.*, 2016). The variation in results with respect to leafhopper activity might be due to difference in environmental conditions of the locations. However, the rainfall showed significantly positive correlation with leafhopper population which was completely corroborative with the present findings.

Whitefly, A. rachipora

The pest population (2.98 whiteflies/leaf) commenced on 4 WAS coinciding with 2nd week of August (33rd SMW) and increased gradually up to 8 WAS coinciding with 1st week of September (37th SMW) and attained the peak level (5.65/leaf) in the very next week (Table 1). Correlation study between the pest and weather parameters indicated that relative humidity in morning (0.80**) and evening (0.75**) exhibited significant positive influence, while the maximum temperature (-0.79**) and sunshine hours (-0.59*) exhibited significant negative influence on *A. rachipora* population (Table 3).

Sardana and Verma (1986) reported that *A. rachipora* was active during vegetative stage of cowpea in *kharif* season. Pai and Dhuri (1991) noticed that the pest appeared after first week of germination and continued throughout the crop growth period with a peak activity during the last week of October under Maharashtra conditions. The maximum and minimum temperatures showed significantly positive correlation, whereas the relative humidity revealed negative significant correlation with whitefly population in Rajasthan (Yadav *et al.*, 2016). The contradiction in the results might be due to difference in environmental conditions of the locations.

Thrips, M. usitatus

The thrips appeared (1.43 thrips/leaf) on cluster bean crop during 5 WAS coinciding with 3rd week of August (34th SMW) and its activity continued till 12 WAS coinciding with 1st week of October (41st SMW). The population of *M. usitatus* reached the peak level (4.62/leaf) during 8 WAS *i.e.* 1st week of September (37th SMW) (Table 1). The results presented in Table 3 showed that morning (0.64*) and evening (0.78**) relative humidity showed positive influence, whereas the maximum temperature (-0.69**) and sunshine hours (-0.74**) had significant negative influence on thrips population.

In early reports, Patel (1997) mentioned that the infestation of thrips started from 2nd week of August and reached to its first peak in the 3rd week of August and thereafter it declined gradually and again reached to second peak in the 2nd week of September. According to Patel (2000), thrips incidence was higher at early winter months. The results of these reports are in accordance with the present findings.

Black Weevil, C. dispar

The results (Table 1) on population of *C. dispar* were recorded during the *kharif* season indicated that the pest appeared (1.80 weevil/plant) on cluster bean crop for the first time during7th WAS coinciding with 5th week of August (36th SMW) and its

activity was continued till 13 WAS coinciding with 2nd week of October (42th SMW) with its peak (3.65/plant) during 9 WAS coinciding with 2nd week of September (38th SMW). Black weevil showed significant positive correlation with morning (0.56*) and evening (0.58*) relative humidity, whereas maximum temperature (-0.62*) showed significant negative correlation with *C. dispar* (Table 3).

Termite, O. obesus

The incidence of *O. obesus* (Table 1) commenced in 9 WAS coinciding with 2nd week of September (38th SMW) during *kharif* 2011 with 1.80 per cent plant damage due to this pest. The damage gradually increased and reached to the peak level (5.10%) during 11 WAS *i.e.* 4th week of September (40th SMW) and thereafter declined. None of the weather parameter caused significant effect on termite population.

Population dynamics of natural enemies of pests on cluster bean

The results (Table 2) clearly indicated that the *Chrysoperla* remained active on cluster bean from 5 WAS *i.e.* 3rd week of August (34th SMW) to 13 WAS *i.e.* 2nd week of October with a single peak in 9 WAS (1.57/plant) *i.e.* 2nd week of September (38th SMW). The population of *Chrysoperla* disappeared on cluster bean crop from 14 WAS coinciding from 3rd week of October (43th SMW). The spider population commenced (0.31/ plant) in 4 WAS *i.e.* 2nd week of August (33rd SMW). Spider population increased slowly and reached to the peak level (2.08/plant) at 9 WAS *i.e.* 2nd week of September (38th SMW). The higher population of spider was noted during 7 WAS coinciding from 5th week of August (36th SMW) to 13 WAS coinciding from 2th week of October (42th SMW). Thereafter, spider population started decreasing and completely disappeared from 16 WAS *i.e.* 5th week of October (45th SMW). The ladybird beetle population commenced from 7 WAS *i.e.* 5th week of August (36th SMW) in cluster bean crop (1.10 beetle/plant) and reached to the peak level (2.06/plant) in next week *i.e.* 8 WAS coinciding with 1st week of September (37th SMW). Subsequently, its population declined and completely disappeared from 13 WAS *i.e.* 2nd week of October (42nd SMW).

Succession of important insect pests of cluster bean

Among the pests, cluster bean crop was invaded first by *E. Kerri* (0.73/leaf) during 3 WAS *i.e.* 1st week of August (32ndSMW) and it was followed by *A. rachipora* (2.98/leaf) which was recorded on the crop 4 WAS coinciding with 2nd week of August (33rd SMW). Their population increased gradually and recorded the peak *i.e.* 4.73 hoppers per leaf and 5.65 whiteflies per leaf during 10 WAS and 9 WAS, respectively. Though, *M. usitatus* (1.43/leaf) appeared on the cluster bean crop little late *i.e.* 5 WAS coinciding with 3rd week of August (34th SMW), but its population reached to the peak level (4.62/leaf) very soon *i.e.* 8 WAS (1st week of September). *M. usitatus* disappeared from the crop 13 WAS coinciding with 2nd week of October (42nd SMW), whereas the population of *E. Kerri* and *A. rachipora* were noted on cluster bean up to 14 and 15 WAS *i.e.* 3rd and 4th week of October (43rd and 44th SMW), respectively.

Cyrtozemia dispar and *O. obesus* were next to earlier pests (leafhopper, whitefly and thrips) with respect to succession of insect pests in cluster bean. The weevil (1.80/leaf) appeared on the crop 7 WAS *i.e.* 5th week of August (36th SMW) and attained the peak level (3.65/leaf) very

soon during 9 WAS *i.e.* 2nd week of September (38th SMW). The activity of *C. Dispar* was recorded on the cluster bean crop up to 13 WAS *i.e.* 2nd week of October (42nd SMW). Incidence of *O. obesus* commenced 9 WAS *i.e.* 2ndweek of September (38th SMW) with 1.80 per cent damaged plants. The damage due to *O. obesus* in cluster bean reached to its maximum during 11th WAS *i.e.* 4th week of September (40th SMW). The termite activity in terms of plant damage disappeared from 16 WAS *i.e.* 5th week of October (45th SMW).

The results revealed that *A. rachipora* and *E. Kerri* colonized the cluster bean crop for quite a long period, while thrips, black weevil and termite remained active for relatively shorter period. Therefore, based on duration of occurrence and intensity, *E. Kerri* and *A. rachipora* were designated as "major pests", whereas *M. usitatus*, *C. Dispar* and *O. obesus* were designated as "minor pests".

It can be further explicated from the results that among three predators, spider was the first to enter (4 WAS) in cluster bean crop and reached to its maximum intensity in 9 WAS. However, spider population prevailed throughout the crop season. Later on, *Chrysoperla* and ladybird beetle swung into action during 5 WAS and reached to the peak level during 9 WAS and 8 WAS, respectively. Both the natural enemies remained on the crop up to availability of their host population *i.e.* 13 WAS.

Correlation coefficient between important insect pests and natural enemies

The results presented in Table 4 revealed that *Chrysoperla* had highly significant positive correlation with *E. Kerri* (r = 0.82**), *A. rachipora* (r = 0.84**) and *M. usitatus* (r = 0.90**). Spider population had highly significant positive association with *E. Kerri* (r = 0.78**), *A. rachipora* (r = 0.86**) and *M. usitatus* (r = 0.75**) populations, whereas ladybird beetle showed highly significant positive correlation with *E. Kerri* (r = 0.83**), *A. rachipora* (r = 0.71**) and *M. usitatus* (r = 0.87**). It is cleared from the data that as the population of insect pests was increased in the cluster bean, their natural enemies responded numerically and higher population of *Chrysoperla*, spider and ladybird beetle was observed in the field providing natural control of the respective insect pests.

Correlation coefficient between various important insect pests

Correlation among the pest population presented in Table 5 indicated that the *E. kerri* population showed highly positive relationship with *A. rachipora* (r = 75**), *M. usitatus* (r = 0.77**) and *C. dispar* (0.85**). Similarly, *A. rachipora* population showed highly positive relationship with *M. usitatus* (r = 0.82**) and *C. dispar* (r = 0.72**). Further, *M. usitatus* also had significant positive relationship with *C. dispar* (r = 0.71**). Therefore, all the positive correlation between various pest populations confirmed that they occurred simultaneously without exerting any adverse effect on each other *i.e.* they are "companion pests". Thus, leafhopper, *A. rachipora*, *M. usitatus* and *C. dispar* were considered as companion pests, as they occurred simultaneously during more or less in same period without hindering activity of each other of this group. However, the *O. obesus* population was non-significantly associated with other pests, which might be due to soil inhabiting nature of the pest.

CONCLUSION

Based on results and discussion, it can be seed that *E. kerri*

was noted first during 3 weeks after sowing (WAS), which was followed by *A. rachipora* during 4 WAS. *M. usitatus* appeared little late (5 WAS) and disappeared from the crop from 13 WAS, while the population of leafhopper and whitefly was noted on cluster bean up to 14 and 15 WAS, respectively. *Cyrtozemia dispar* appeared on the crop during 7 WAS, whereas incidence of *O. obesus* commenced during 9 WAS. Population of *C.dispar* and damage due to *O. obesus* disappeared from the crop 13 WAS and 16 WAS, respectively. Therefore, based on duration of occurrence and intensity, leafhopper and whitefly were designated as "major pests", whereas thrips, black weevil and termite were designated as "minor pests".

REFERENCES

Anonymous. (2013-14). An analysis of performance of guar crop in India (2013-14). CCS National Institute of Agricultural Marketing, Jaipur.

Anonymous. (2015). Advance estimate of guar gum (guar seed) production in India in year 2014-2015. http://www.guargumcultivation.com

Pai, K. M. and Dhuri, A. V. (1991). Incidence of insect pests in early variety of cowpea, *Vigna unquiculata* (L). Walp. *Indian J. Ent.*, **53** (2): 329-331.

Patel, A. G. (1997). Population dynamics, varietal screening and chemical control of pest complex of cowpea. M. Sc. (Agri.) thesis (Unpublished) Submitted to Gujarat Agricultural University, Sardarkrushinagar.

Patel, U. G. (2000). Biology of *Maruca vitrata* (Geyer), population dynamics, varietal screening and chemical control of insect pest complex of cowpea. Ph. D. thesis (Unpublished) Submitted to Gujarat Agricultural University, Sardarkrushinagar.

Ram, S.; Patil, B. D. and Purohit, M. L. (1989). Seasonal incidence of major insect pests of fodder cowpea (*Vigna unguiculata* L.) in Bundelkhand region. *Bull. Ent*., **31**(1) : 44-47.

Reddy, C. N. and Singh, V. S. (1998). Pest complex and their succession on pigeonpea variety P-33. *Indian J. Ent*., **60** (4): 334-338.

Sardana, H. R. and Verma, S. (1986). Preliminary studies on the prevalence of insect pests and their natural enemies on cowpea crop in relation to weather factors at Delhi. *Indian J. Ent*., **48** (4): 448-458.

Yadav, S. K.; Yadav, A. K.; Sanp R. and Deshwal, H. L. (2016). Population dynamics of major sucking pests of cluster bean [*Cyamopsis tetragonoloba* (L.) Taub.] and their correlation with abiotic factors. *Ann. Pl. Protec. Sci.*, **24**(1): 31-33.

Table 1: Periodic incidence of important insect pests on cluster bean during *kharif* 2011

WAS	SMW	Months and Weeks	Sucking Insect Pests / Leaf			*C. dispar* per Plant	Plant Damage by *O. obesus* (%)
			E. kerri	*A. rachipora*	*M. usitatus*		
3	32	August I	0.73	0.00	0.00	0.00	0.00
4	33	II	0.84	2.98	0.00	0.00	0.00
5	34	III	0.92	3.62	1.43	0.00	0.00
6	35	IV	1.73	4.22	2.62	0.00	0.00
7	36	V	2.05	4.86	3.38	1.80	0.00
8	37	September I	3.13	5.26	4.62	2.90	0.00
9	38	II	2.90	5.65	3.43	3.65	1.80
10	39	III	4.73	4.48	2.75	3.00	3.65
11	40	IV	3.15	4.13	2.00	2.50	5.10
12	41	October I	2.07	3.78	1.20	2.38	4.80
13	42	II	1.03	3.11	0.00	1.50	3.80
14	43	III	0.75	2.78	0.00	0.00	3.20
15	44	IV	0.00	1.70	0.00	0.00	3.00
16	45	V	0.0	0.00	0.00	0.00	0.00

WAS : Weeks After Sowing, SMW : Standard Meteorological Week

Table 2: Periodic incidence of natural enemies on cluster bean during *kharif* 2011

WAS	SMW	Months and Weeks	Natural Enemies per Plant		
			Chrysoperla	Spider	Ladybird Beetle
3	32	August I	0.00	0.00	0.00
4	33	II	0.00	0.31	0.00
5	34	III	0.36	0.50	0.00
6	35	IV	0.46	0.74	0.00
7	36	V	1.01	1.05	1.10
8	37	September I	1.30	1.80	2.06
9	38	II	1.57	2.08	1.66
10	39	III	1.05	1.39	1.43
11	40	IV	0.72	1.39	1.01
12	41	October I	0.51	1.31	0.40
13	42	II	0.50	1.01	0.00
14	43	III	0.00	0.84	0.00
15	44	IV	0.00	0.62	0.00
16	45	V	0.00	0.00	0.00

WAS : Weeks After Sowing, SMW : Standard Meteorological Week

Table 3 : Correlation coefficient between pest population and weather parameters in cluster bean during *kharif* 2011

Sr. No.	Pests	Weather parameters						
		Temperature (^{0}C)		Relative Humidity		Wind speed (Km/hr)	Sunshine (hours/day)	Rainfall (mm)
		Max.	Min.	Mor.	Eve.			
1.	Leafhopper	- 0.78**	0.32	0.71**	0.77**	0.16	- 0.64*	0.59*
2.	Whitefly	- 0.79**	0.38	0.80**	0.75**	- 0.12	- 0.59*	0.31
3.	Thrips	- 0.69**	0.39	0.64*	0.78**	0.06	- 0.74**	0.42
4.	Black weevil	- 0.62*	0.11	0.56*	0.58*	- 0.21	- 0.41	0.37
5.	Termite	- 0.18	- 0.38	0.11	- 0.12	- 0.36	0.31	0.14

** Significant at 5 per cent (r = 0.53) ** Significant at 1 per cent (r = 0.66)*

Table 4 : Correlation coefficient between pest population and natural enemies in *kharif* cluster bean

Sr. No.	Pests	Natural Enemies		
		Chrysoperla	Spider	Ladybird Beetle
1.	Leafhopper	0.82**	0.78**	0.83**
2.	Whitefly	0.84**	0.86**	0.71**
3.	Thrips	0.90**	0.75**	0.87**

*** Significant at 1 per cent (r = 0.66)*

Table 5 : Correlation coefficient between various pests occurred in *kharif* cluster bean

Pests	Pests				
	Leafhopper	Whitefly	Thrips	Black weevil	Termite
Leafhopper	-	0.75**	0.77**	0.85**	0.31
Whitefly		-	0.82**	0.72**	0.15
Thrips			-	0.71**	- 0.15
Black weevil				-	0.41
Termite					-

** Significant at 5 per cent (r = 0.53) ** Significant at 1 per cent (r = 0.66)*

[MS received:January 18, 2017] *[MS accepted: February 16, 2017]*