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Population dynamics of major insect pests of cowpea [*Vigna unguiculata* L. Walp] and their natural enemies

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Abstract

The studies on the population dynamics of major pests of cow pea were conducted during 2016- 2017 in the agricultural fields of Bangalore, India. Pest population was showing positive correlation with high temperature and the population of predators and other associated insect was showing negative correlation with minimum temperature, relative humidity and rainfall. The activity of jassids were observed from 1st week of September, 2016 with 0.85 nymphs per 3 leaves (36th MW), during this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 27.20 °C, 18.50 °C, 91 percent, 55 percent and 12.8 mm respectively. The population of jassids decreased steadily and was at its lowest level on second week of October. The incidence of thrips were observed from first week of September, 2016 with 1.20 thrips per 3 leaves (36th MW), during this period average maximum and minimum temperature. Then after population started increasing up to 3rd week of September, The activity of pod sucking bugs started after the flowering stage of the crop i.e. third week of October, 2016 (42nd MW) with 0.53 bugs per plant. At the time of first observation in 2nd week of August, 2016 (35th MW) population of coccinellid grubs were increased, population started declining up to second week of October. Hence the information contained in this paper lead to the identification of the proper integrated pest management (IPM) practices for pest management.

Keywords: Insect pests, aphids, jassids, leafhoppers, thrips, sucking pests

Introduction

Major pests of cow pea reveal its economic importance as a major concern for all economically important crops in the agricultural fields of Bangalore. Cowpea [*Vigna unguiculata* L. Walp] is one of the most important legume crops in the world. It is an essential component of cropping systems in the drier regions of the tropics covering parts of Asia and Oceania, the Middle East, Southern Europe, Africa, Southern USA and Central and South America. It has a large spectrum of uses: dried grains for human consumption (main use) but also leaves, fresh beans, fresh bean pods, cowpea as well used as green manure and fodder. It is a main staple food of Bangalore. The major constraint for cowpea grain production is insect damage (Ehlers and Hall, 1997) [4]. Aphids, jassids, sucking bugs, pod borers were considered as key pests of cowpea (Karungi *et al.*, 2000) [9] affecting 90% of plants according to the field study. *Aphis craccivora* (Koch) is polyphagous by nature affecting more than 15 different crops, mainly pertaining to the family Leguminosae (Gomez Souza *et al.*, 2007) [5]. It is considered as major threat to the agricultural and horticultural crops particularly in the drier regions of the tropics attacking 50 host plants species belonging to 19 different families throughout the world. Due to a large number of host range, aphids seem to be present throughout the year. Both nymphs and adults suck plant sap and cause serious damage right from the seedling to pod bearing stage. Due to heavy infestation, young seedlings succumb to death, whereas the older plants show symptoms such as stunting, crinkling and curling of leaves, delayed flowering, shriveling of pods and finally resulting in yield reduction reported 10-90% yield loss in India to the economically important crops depending upon severity of damage by sucking pests. Propensity to cause damage to various host plants and its association with various natural enemies motivated to take the population dynamics study of major pests of cowpea. Application of these studies will be helpful during proper implementation of various control measures against this pest.

Objective of study**Materials and Methods****Population dynamics of major insect pests of cowpea and their natural enemies**

The cowpea variety KM-5 was raised in the plot of 10 × 10 m dimension (with a spacing of 45 × 10 cm) using all the agronomic practices except recommended by the UAS, Bengaluru the plant protection measures to study the incidence of cowpea pests. The experimental field was monitored weekly to know occurrence of insect-pests and their natural enemies from germination till harvesting. Further, the plot was divided into 4 sub plots (4.5 × 4.5 m). The observations were made and plant samples were drawn from each sub plot.

Date of sowing : 17-08-2016 Fertilizers Used : FYM- 10 t/ha NPK -25:50:25 Kg/ha

Date of harvesting : 18-11-2016

Incidence of sucking pests**Aphids, leafhoppers and thrips**

For estimating the population of these sucking insects 10 plants were tagged from each subplot for weekly observations. Three leaves were selected one each from top, middle, bottom and the counts were made separately. Later the average population per plant was worked out.

Pod sucking bugs

In case of hemipteran bugs, ten plants in each sub plots were tagged and number of bugs per plant was recorded. Average number of bugs per plant was worked out.

Pod borer

The pod borer incidence was recorded by counting the number of pod borer larvae per plant after the pod formation at weekly intervals until the harvest of the crop.

Natural enemies or Predator population

The natural enemies population was recorded weekly by taking the observations from tagged plants from each plots (10 plants per plot). In case of coccinellids the number eggs, grubs, pupae and adults per plant were recorded. The other natural enemies like chrysopids, syrphids and spiders population was recorded in the same manner. Later the mean eggs, grubs, pupae and adults per plant were worked out.

Results and Discussion**Incidence of cowpea Jassids**

The activity of jassids (Table 1) were observed from 1st week of September, 2016 with 0.85 nymphs per 3 leaves (36th MW), during this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were

27.20 °C, 18.50 °C, 91 percent, 55 percent and 12.8 mm respectively. There after the population started increasing up to 4th week of September, 2016 (39th MW) i.e. 1.63 jassids nymphs per 3 leaves. During this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 27.50 °C,

19.30 °C, 94 percent, 55 percent and 16.4 mm respectively.

Further, the population of jassids decreased steadily and was at its lowest level on second week of October, 2016 (41st MW) i.e. 0.90 nymphs per 3 leaves. The mean maximum and minimum temperature, morning and evening relative humidity and rainfall recorded during this period were 29.30 °C, 19.00 °C, 94 percent, 51 percent and 30.2 mm respectively. Thereafter, the population started building up to 1st week of November, 2016 (45th MW) and reached at its peak i.e. 4.90 nymphs per 3 leaves, during this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 29.40 °C, 15.80 °C, 79 percent, 45 percent and 0.00 mm respectively. There after the population of jassids decreased during last week of harvesting i.e. (46th MW) with 1.25 nymphs per 3 leaves.

Table 1: Population dynamics of major insect pests of cowpea and their natural enemies

Met. Week No.	Date of observation	Average number of aphids /3 leaves	Average number of predatory lady Bird beetle grubs/ plant	Av. Number of nymphs of leafhoppers/3 leaves	Av. Number of thrips/3 leaves	Av. Number of weevils/plant	Av. Number of pod sucking bugs/plant	Podborer larvae/plant		Av. Number of spiders/plant
								<i>M. vitrata</i>	<i>L. boeticus</i>	
34	24-08-2016	1.55	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
35	31-08-2016	4.13	0.15	0.00	0.00	0.00	0.00	0.00	0.00	0.00
36	07-09-2016	43.68	1.33	0.85	1.20	0.15	0.00	0.00	0.00	0.20
37	14-09-2016	48.63	1.78	1.83	1.28	0.00	0.00	0.00	0.00	0.23
38	21-09-2016	54.30	2.15	1.48	1.84	0.00	0.00	0.00	0.00	0.10
39	28-09-2016	2.48	0.70	1.63	0.05	0.00	0.00	0.00	0.00	0.33
40	05-10-2016	0.08	0.40	1.18	0.03	0.00	0.00	0.13	0.00	0.08
41	12-10-2016	0.00	0.00	0.90	0.18	0.00	0.00	0.25	0.80	0.00
42	19-10-2016	0.05	0.18	2.15	0.15	0.03	0.53	0.86	1.22	0.05
43	26-10-2016	2.08	0.30	2.55	0.48	0.00	1.78	2.05	1.56	0.05
44	02-11-2016	5.60	0.77	4.13	0.60	0.03	2.30	1.35	2.75	0.23
45	09-11-2016	9.90	1.03	4.90	0.08	0.00	0.80	1.06	1.03	0.00
46	16-11-2016	18.38	1.88	1.25	0.00	0.00	0.00	0.78	0.44	0.00

Incidence of thrips

The incidence of thrips were observed from (Table 2) first week of September, 2016 with 1.20 thrips per 3 leaves (36th MW), during this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were

27.20 °C, 18.50 °C, 91 percent, 55 percent and 12.8 mm respectively. Then after population started increasing up to

3rd week of September, 2016 (38th MW) i.e.1.84 thrips per 3 leaves.

During this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 28.10 °C, 18.80 °C, 93 percent, 55 percent and 24.2 mm respectively. After then, the population of thrips decreased steadily and was at its lowest level on first week of October, 2016 (40th MW) i.e. 0.03 thrips per 3

leaves. The mean maximum and minimum temperature, morning and evening relative humidity and rainfall recorded during this period were 29.50 °C, 18.80 °C, 92 percent, 49 percent and 0.8 mm respectively. Then after population started increasing slightly upto first week of November, 2016 (44th MW) i.e. 0.60 thrips percent 3 leaves. During this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 29.70 °C, 18.30 °C, 84 percent, 48 percent and 0.00 mm respectively. After the population of thrips decreased during last week of harvesting i.e. (46th MW) where no population of thrips were observed.

Incidence of pod sucking bugs

The activity of pod sucking bugs started after the flowering stage of the crop i.e. third week of October, 2016 (42nd MW) with 0.53 bugs per plant. The mean maximum and minimum temperature, morning and evening relative humidity and rainfall recorded during this period were 29.60 °C, 16.70 °C, 78 percent, 46 percent and 0.00 mm respectively. After the population was started increasing slightly upto first week November, 2016 (44th MW) i.e. 2.30 bugs per plant. During this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 29.70 °C, 18.30 °C, 84 percent, 48 percent and 0.00 mm respectively. At the harvesting stage of crop the population of bugs decreased, where no bugs were observed in last week of harvesting.

Incidence of coccinellids in cowpea

At the time of first observation in 2nd week of August, 2016 (35th MW) population of coccinellid grubs were 0.15 grubs per plant, during this period average maximum and minimum temperature, morning and evening relative humidity, rainfall and average number of aphids per plant recorded were 27.80 °C, 20.10 °C, 92 percent, 57 percent and 2.20 mm respectively. Then the population of grubs increased slowly up to 3rd week of September, 2016 (38th MW) with 2.15 grubs per plant, when the average maximum and minimum temperature, morning and evening relative humidity, rainfall and average number of aphids per plant recorded were 28.10 °C, 18.80 °C, 93 percent, 55 percent and 24.2 mm respectively. After population started declining up to second week of October, 2016 (41st MW) and it was lowest (0.00 grubs/plant) during the crop period. During this period average maximum and minimum temperature, morning and evening relative humidity and rainfall recorded were 29.30 °C, 19.00 °C, 94 percent, 51 percent and 30.2 mm respectively. Again, increasing trend of coccinellid grubs population was noticed from 42nd MW (0.18 grubs/plant) and reached upto 1.88 grubs per plant during harvesting of crop (46th MW). The mean maximum and minimum relative humidity, morning and evening relative humidity and rainfall recorded during this period was 29.50 °C, 18.40 °C, 83 percent, 46percent and 0.00 mm respectively.

Table 2: Population of all stages of coccinellid predators species viz., *Coccinella transversalis*, *Cheilomenes sexmaculatus*

Met. Week No.	Date of observation	Egg	Larvae	Pupa	Adult	Total
34	24-08-2016	0.13	0.00	0.00	0.00	0.13
35	31-08-2016	0.00	0.15	0.00	0.00	0.15
36	07-09-2016	1.28	1.33	0.08	0.38	3.07
37	14-09-2016	2.43	1.78	0.65	0.75	5.61
38	21-09-2016	1.33	2.15	0.70	0.35	4.53
39	28-09-2016	0.78	0.70	0.40	0.18	2.06
40	05-10-2016	1.00	0.40	0.25	0.15	1.80
41	12-10-2016	0.48	0.00	0.03	0.00	0.51
42	19-10-2016	0.63	0.18	0.03	0.13	0.97
43	26-10-2016	0.88	0.30	0.15	0.20	1.53
44	02-11-2016	1.80	0.77	0.35	0.38	3.30
45	09-11-2016	0.95	1.03	0.40	0.28	2.66
46	16-11-2016	0.30	0.88	0.03	0.03	1.24
Met. Week No.	Date of observation	Egg	Larvae	Pupa	Adult	Total
34	24-08-2016	0.13	0.00	0.00	0.00	0.13
35	31-08-2016	0.00	0.15	0.00	0.00	0.15
36	07-09-2016	1.28	1.33	0.08	0.38	3.07
37	14-09-2016	2.43	1.78	0.65	0.75	5.61
38	21-09-2016	1.33	2.15	0.70	0.35	4.53
39	28-09-2016	0.78	0.70	0.40	0.18	2.06
40	05-10-2016	1.00	0.40	0.25	0.15	1.80
41	12-10-2016	0.48	0.00	0.03	0.00	0.51
42	19-10-2016	0.63	0.18	0.03	0.13	0.97
43	26-10-2016	0.88	0.30	0.15	0.20	1.53
44	02-11-2016	1.80	0.77	0.35	0.38	3.30
45	09-11-2016	0.95	1.03	0.40	0.28	2.66
46	16-11-2016	0.30	0.88	0.03	0.03	1.24

Table 3: Correlataion coefficient (r) of pests of cowpea with their natural enemies and abiotic factors

Variable	Ladybird beetle grub	Meteorological parameters				
		Temp. Max. (°C)	Temp. Min. (°C)	Hum. Morn. (%)	Hum. Even. (%)	Rainfall (mm)
Cowpea aphid	0.914**	-0.470	0.120	0.245	0.321	0.463
Leafhoppers	0.227	0.404	-0.782**	-0.651*	-0.598*	-0.261
Thrips	0.844**	-0.387	0.069	0.223	0.337	0.534
Pod sucking bugs	-	0.466	-0.490	-0.643*	-0.503	-0.434
<i>M. vitrata</i>	-	0.599*	-0.699**	-0.861**	-0.734**	-0.513
<i>L. boeticus</i>	-	0.631*	-0.545	-0.638*	-0.612*	-0.391
LBB grub	-	-0.269	-0.058	0.055	0.80	0.288

*Correlation is significant at the 0.05 level (2-tailed)

**Correlation is significant at the 0.01 level (2-tailed)

Correlation of cowpea pests and coccinellids with weather parameters

From table 3, it was observed that average number of aphids per three leaves showed negative correlation with maximum temperature, and positive correlation with remaining weather parameters. The number of leafhoppers per three leaves showed highly significant negative correlation with minimum temperature (-0.782**), morning relative humidity (-0.651*), evening relative humidity (0.598*) and also rainfall has negative correlation with rainfall. Number of thrips per three leaves showed negative correlation with maximum temperature and positive correlation with remaining weather parameters.

The population of pod sucking bugs showed highly significant negative correlation with morning relative humidity (0.643*) and positive correlation with maximum temperature (0.466). Whereas the incidence of *M. vitrata* was highly significant negative correlation with minimum temperature (-0.699**), Morning relative humidity (-0.861*), evening relative humidity (-0.734*) and highly significant positive correlation with maximum temperature (0.599*). Incidence of *L. boeticus* was also showed highly significant negative correlation with morning relative humidity (-0.638*) and evening relative humidity (-0.612*) and highly significant positive correlation with maximum temperature (0.631*). The lady bird beetle grubs population was positively correlated with evening humidity, rainfall and negatively correlated with maximum temperature.

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correlation with morning relative humidity (-0.638*) and evening relative humidity (-0.612*) and highly significant positive correlation with maximum temperature (0.631*). The ladybird beetle grubs population was positively correlated with evening humidity, rainfall and negatively correlated with maximum temperature.

Conclusion

The presence of large host range and high reproductive rate of pests on cow pea causes its persistence throughout the year. This makes them a great economic threat in agricultural fields of Bangalore. Heavy infestation leads to economic yield losses. So, the present study was implemented to find out the population dynamics of major pests and their associated insects and its correlation with the weather parameters. Results showed that the maximum temperature was positively correlated with sucking pests population. The populations of associated insects were influenced by the relative humidity. Hence, all this information will be helpful during the development of successful Integrated Pest Management program (IPM) for major pests of cowpea which is considered as important pests in the world.

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