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Influence of Weather Parameters on the Population Dynamics of Insect Pests of Pigeonpea (*Cajanus cajan* (L.) Millsp.)

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ABSTRACT

Field experiment was conducted to study the seasonal occurrence of major insect pests of Pigeonpea at Agricultural Research Station, Darsi during *Kharif* 2012-13. The initial oviposition by *Helicoverpa armigera* was observed from 43rd std. week and reached to a peak by 49th std. week. The initial occurrence of *H. armigera* larvae was noticed during 44th std. week and reached the peak during 52nd std. week. The incidence of *H. armigera* moth population was initiated during 41st std. week and peak moth incidence was observed during 51st std. week. The initial occurrence of *Maruca vitrata* larval population was observed during 45th std. week and the peak incidence was recorded during 51st std. week. The initial occurrence of *Exelastis atomosa* larval population was noticed during 44th std. week and attained its peak population at the end of the crop season by 3rd std. week. The occurrence of leafhopper is bimodal where early incidence starts from 37th std. week reaching its first peak during mid October and second peak during mid November. The correlation between oviposition by *H. armigera* and evening relative humidity (r= -0.492) was negative and significant, while minimum temperature showed significant negative influence on the larval (r= -0.487) and adult (r= -0.488) population of *H. armigera.* The correlation between larval population of *M. vitrata* and morning relative humidity (r= 0.309) and evening relative humidity (r= 0.674) showed positive influence. Minimum temperature (r= -0.725) and morning relative humidity (r= -0.450) showed significant negative influence on the larval population of *E. atomosa.* Leafhopper population showed positive correlation with maximum and minimum temperatures, morning and evening relative humidities and rainfall.

Key words : Insect pests, Seasonal Occurrence, Pigeonpea,Weather parameters.

Among the pulse crops, Pigeonpea (*Cajanus cajan* (L.) Millsp.) is an important grain legume crop grown in India. In India, it is grown in an area of 24.45 million ha producing 15.24 million tones. In Andhra Pradesh, it is grown mainly during rainy season in an area of 5.2 Lakh ha producing 2.17 Lakh tones (Haritha, 2008). More than 250 species of insects have been found feeding on Pigeonpea, although only a few of these cause significant and consistent damage to crop *viz.,* spotted pod borer, *Maruca vitrata* (Geyer), the gram pod borer, *Helicoverpa armigera* (Hubner), plume moth (*Exelstis atomosa*) and the pod fly, *Melanagromyza obtusa* (Malloch) are the major pest species inflicting damage to pods causing 70-80% losses during epidemic years and the losses due to *H. armigera* alone extend up to 40% (Malathi, 2010). Pod sucking bugs, blister beetles and sucking pests are also economically important pests on Pigeonpea. However, the relative importance of different species varies with location, season and time of flowering of different cultivars.

Studies on seasonal incidence and dynamics of major insect pests in pigeonpea provide information on the initiation and extent of damage at different growth stages of the crop and their relation to weather parameters which will be of great help to plan appropriate management practices. Due to varied abiotic factors and shifts in varietal composition from time to time, there is every possibility of change in the pest scenario with changing trends. Thus, a study on seasonal incidence involving the effects of abiotic factors is essential for proper monitoring and forewarning of the pest situation and to develop integrated pest management strategies. Hence, an attempt was made to study the seasonal occurrence of major insect pests at different crop growth stages and its correlation with weather parameters in Pigeonpea.

MATERIAL AND METHODS

Study was carried out at Agricultural Research Station, Darsi, Prakasam District during *Kharif* 2012-13 cropping season. Pigeonpea

variety, LRG 41 was grown in a bulk plot of 1000 square meters under unprotected conditions following normal agronomic practices to study the seasonal occurrence of major insect pests infesting Pigeonpea. The pest population was recorded at weekly intervals with the initiation of the pest and continued till the end of the crop growth from 25 randomly selected tagged plants. The number of eggs and larvae of *H. armigera*, the number of larvae of *M. vitrata* and *E. atomosa* were counted at each observation on whole plant basis. The adult and nymphal population of leaf hoppers was counted from five leaves, two from top, one from middle and two from bottom canopy of plant. Adult moth counts of *H. armigera* were taken every day in the morning at 9 AM by placing the two pheromone traps in the experimental non replicated bulk plot and expressed as number of moths / trap / week. The lures were replaced for every three weeks and traps were maintained throughout the crop period. Weather parameters like maximum and minimum temperatures, morning and evening relative humidity and rainfall collected from meteorological observatory, Agricultural Research Station, Darsi were used for correlation and regression studies. The data on egg / larval / adult population of major insect pests were pooled standard week wise and subjected to correlation analysis with major weather parameters of corresponding standard week. Regression studies were worked out to know the relationship between pest incidence and weather parameters using SAS statistical package.

RESULTS AND DISCUSSION

Seasonal occurrence of insect pests of Pigeonpea and influence of weather factors

a) Oviposition by *Helicoverpa armigera*:

The initial oviposition by *H. armigera* was observed from 43rd std. week (4th week of October, 2012) with 1.2 eggs / plant (Table 1). The oviposition increased gradually from 44th std. week (1st week of November, 2012) and reached to a peak by 49th std. week (1st week of December, 2012) with a mean number of 10.7 eggs / plant. There after the oviposition has declined gradually and reached to a minimum by 52nd std. week (4th week of December, 2012) with a mean number of 2.3 eggs / plant. The correlation studies revealed that maximum temperature (r= 0.432), minimum temperature (r= 0.267) and morning relative humidity (r= 0.312) exhibited non-significant positive correlation with the oviposition by *H. armigera,* while the correlation with rainfall (r= -0.194) was negative and non-significant (Table 2). However, significant negative correlation was found with evening relative humidity (r= -0.492). The multiple linear regression analysis indicated 64.2 per cent variation (R^2 = 0.6420) in the oviposition by *H. armigera* due to the influence of all weather factors (Table 3).

b)Larval incidence of *Helicoverpa armigera*:

The data recorded on the larval incidence of *H. armigera* revealed that its population on Pigeonpea was observed from 1st week of November, 2012 to 1st week of February, 2013. The initial occurrence of *H. armigera* larvae was noticed during 44th std. week (1st week of November, 2012) with 0.6 larvae / plant (Table 1). There after the larval population gradually increased and reached the peak during 52nd std. week (4th week of December, 2012) with a mean number of 4.3 larvae / plant. There after larval incidence of *H. armigera* gradually declined and reached a minimum level of 0.2 larvae / plant by 5th std. week (1st week of February, 2013). The correlation analysis revealed that *H. armigera* larval population exhibited negative correlation with maximum temperature (r= -0.261), minimum temperature (r= -0.487), morning relative humidity (r= -0.066) and rainfall (r= -0.171), while correlation was positive with evening relative humidity (r= 0.259). However, minimum temperature showed significant negative influence on the larval population of *H. armigera* (Table 2). The multiple linear regression analysis revealed that all the weather parameters together accounted for 53.43 per cent of total variation (R^2 = 0.5343) in *H. armigera* larval population (Table 3).

c)Adult moth population of *Helicoverpa armigera*:

The incidence of *H. armigera* moth population was initiated during 41st std. week (2nd week of October, 2012) with 0.5 adults / trap /week, there after the adult trap catches remained at low level up to 49th std. week (1st week of December, 2012) ranging from 0.8 to 2.0 adults / trap /week.

The peak moth incidence was observed during 51st std. week (3rd week of December, 2012) with 5.3 male moths / trap /week (Fig. 1). The population levels were declined thereafter and low level of population was recorded during 3rd std. week (3rd week of January, 2013) with 0.3 adults / trap /week. The pheromone trap catches of *H. armigera* correlated with weather parameters revealed that there was negative but non-significant correlation with maximum temperature (r= -0.339), while it was negative but significant with minimum temperature (r= -0.488). The relationship between the moth catches and morning relative humidity (r= 0.057), evening relative humidity (r= 0.197) and rainfall (r= 0.004) was positive and non-significant (Table 2). The multiple linear regression analysis revealed that

Table 1. Seasonal incidence of major insect pests on Pigeonpea and weather parameters during *Kharif*, 2012-13.

Year 2012-13	Std. week	Max Temp (°C)	Min. Temp. (°C)	Mor. RH (%)	Eve. RH (%)	Rain fall (mm)	Incidence of *Helicoverpa armigera*		*Maruca vitrata* Larvae /plant	*Exelastis atomosa* larvae / plant	Leaf hopper population / leaf / plant
							Eggs / plant	Larvae / plant			
Sep 10 - Sep 16	37	34.4	25.6	74.3	48.7	0.0	0.0	0.0	0.0	0.0	0.6
Sep 17- Sep 23	38	34.9	27.7	63.0	42.7	0.4	0.0	0.0	0.0	0.0	0.9
Sep 24- Sep 30	39	33.4	28.3	64.3	42.9	1.1	0.0	0.0	0.0	0.0	0.8
Oct 1- Oct 7	40	35.0	26.2	59.0	32.3	25.9	0.0	0.0	0.0	0.0	1.7
Oct 8- Oct 14	41	32.4	25.3	89.1	63.6	0.0	0.0	0.0	0.0	0.0	0.8
Oct 15- Oct 21	42	34.4	25.0	69.7	40.2	0.0	0.0	0.0	0.0	0.0	3.5
Oct 22- Oct 28	43	30.5	25.1	95.0	82.4	0.0	1.2	0.0	0.0	0.0	2.3
Oct 29- Nov 4	44	27.1	26.1	93.3	75.1	37.0	2.9	0.6	0.0	0.2	2.6
Nov 5- Nov 11	45	30.4	23.4	71.4	42.4	0.0	4.4	0.4	0.8	0.3	2.4
Nov 12- Nov 18	46	30.1	24.3	87.7	47.0	0.0	7.8	0.4	1.1	0.1	4.1
Nov 19- Nov 25	47	30.4	22.1	81.6	49.3	0.0	6.3	0.7	2.3	0.0	2.2
Nov 26- Dec 2	48	29.9	23.8	98.6	58.6	0.0	5.1	1.6	2.5	0.0	1.6
Dec 3- Dec 9	49	29.4	23.2	91.6	52.0	0.0	10.7	1.9	2.9	0.2	1.2
Dec 10- Dec 16	50	28.1	19.8	88.9	62.9	0.0	4.3	2.1	3.2	1.2	0.8
Dec 17- Dec 23	51	26.9	18.4	70.1	50.7	0.0	0.9	2.7	3.9	1.3	1.4
Dec 24- Dec 31	52	28.1	18.6	69.5	58.8	0.0	2.3	4.3	2.9	1.7	1.7
Jan 1- Jan 7	1	26.1	21.8	71.3	58.1	0.0	0.0	0.3	1.8	0.5	0.7
Jan 8- Jan 14	2	24.8	19.0	54.6	43.9	0.0	0.0	1.3	1.3	0.4	0.7
Jan 15- Jan 21	3	30.3	19.9	68.3	45.1	0.0	0.0	0.9	0.7	2.2	0.3
Jan 22- Jan 28	4	29.9	20.3	74.7	49.4	0.0	0.0	0.6	0.2	0.0	0.4
Jan 29- Feb 4	5	30.2	19.9	74.4	43.7	0.0	0.0	0.2	0	0.0	0

the cumulative effect of all the weather factors accounted for 49.09 per cent of total variation (R^2 = 0.4909) on moth catches of *H. armigera* (Table 3).

d)Larval incidence of *Maruca vitrata*:

The initial occurrence of *M. vitrata* larval population was observed during 45th std. week (2nd week of November, 2012) at early flowering stage of the crop with 0.8 larvae / plant (Table 1). The larval population increased gradually and the peak incidence was recorded during 51st std. week (3rd week of December, 2012) with a mean number of 3.9 larvae / plant coinciding with maximum flowering and podding stage of Pigeonpea. Imosanen and singh (2005) reported that the incidence of *M. vitrata* increased with the initiation of flowering having the highest population at full podding stage in Pigeonpea. Later, the larval population was gradually declined and reached minimum by 4th std. week (4th week of January, 2013) with 0.2 larvae / plant and by the 1st week of February, 2013 the pest has disappeared. These results derive support from Gopali *et al.,* (2010) who reported that the incidence of *M. vitrata* reached its peak during December months on Pigeonpea. The correlation studies indicated that the larval population of *M. vitrata* and maximum temperature and minimum temperature were negatively correlated but non-significant (r= -0.361 and r= -0.139, respectively). There was positive correlation between the larval population of *M. vitrata* and the morning relative humidity (r= 0.309), while the evening relative humidity (r= 0.674) was found positively and significantly correlated (Table 2). These results are in agreement with the findings of Reddy *et al.,* (2001), Sahoo and Behra (2001) who reported a positive correlation between populations of *M. vitrata* and morning relative humidity on Pigeonpea. Similarly, Arulmozi (1990), Lakshmi (2001) and Chitti Babu *et al.,* (2009) also reported negative correlation between the maximum and minimum temperatures and the larval population of *M. vitrata* and a positive correlation between morning relative humidity and larval population of *M. vitrata.* The multiple linear regression analysis revealed that the coefficient of determination (R^2) for larval incidence was 0.4797 which showed that the weather factors together were able to cause the variation in larval incidence to the extent of 47.97 per cent (Table 3).

e)Larval incidence of *Exelastis atomosa*:

The initial occurrence of *E. atomosa* larval population was noticed during 44th std. week (1st week of November, 2012) with 0.2 larvae / plant (Table 1). Later a gradual increase was observed and attained its peak population at the end of the crop season by 3rd std. week (3rd week of January, 2013) with a mean population of 2.2 larvae / plant. There after the population was disappeared by 4th std. week (4th week of January, 2013) on Pigeonpea. The correlation studies showed negative correlation with all the weather parameters. However, the minimum temperature (r= -0.725) and morning relative humidity (r= -0.450) showed significant negative influence on the larval population of *E. atomosa* (Table 2). The multiple linear regression analysis showed that all the weather parameters together were responsible for 53.49 per cent (R^2 = 0.5349) of total variation in larval population of *E. atomosa* (Table 3).

f)Adult and nymphal population of Leafhopper:

Leafhopper population was active throughout the season on Pigeonpea. The initial occurrence of leafhopper was observed from 37th std. week (2nd week of September, 2012) with a population of 0.6 / leaf / plant (Table 1). The population remained at low level for a short period between 38th and 41st std. week. There was a sudden increase in population during 42nd std. week (3rd week of October, 2012) with a peak population of 3.5 / leaf / plant. The average maximum and minimum temperatures were high (34.4 and 25.0 ^{0}C, respectively) during this period which coincided with peak population of leafhoppers. A gradual decrease in population was observed from 43rd std. week (4th week of October, 2012) to 45th std. week (2nd week of November, 2012) and again reached a peak population of 4.1 / leaf / plant during 46th std. week (3rd week of November, 2012). Thereafter, the population showed a declining trend and reached to lowest by 4th std. week (4th week of January, 2013) with 0.4 / leaf / plant. The present observations are in agreement with Rohini *et al.,* (2012) who reported that the peak incidence of leafhoppers during mid September to mid November on all *Bt* cotton hybrids. The correlation analysis revealed positive correlation between leafhopper population and maximum temperature (r= 0.087), minimum temperature (r= 0.246),

Table 2. Correlation coefficients between weather parameters and insect pest incidence on Pigeonpea during *Kharif* 2012-13.

Insect Pests	Correlation coefficient values				
	Max. Temp. (°C)	Min. Temp. (°C)	Morning RH (%)	Evening RH (%)	Rainfall (mm)
Oviposition by *Helicoverpa armigera*	0.432	0.267	0.312	-0.492*	-0.194
Larval incidence of *Helicoverpa armigera*	-0.261	-0.487*	-0.066	0.259	-0.171
Adult catch of *Helicoverpa armigera*	-0.339	-0.488*	0.057	0.197	0.004
Larval incidence of *Maruca vitrata*	-0.361	-0.139	0.309	0.674*	—
Larval incidence of *Exelastis atomosa*	-0.068	-0.725**	-0.450*	-0.060	-0.203
Adult and nymphal population of leaf hopper	0.087	0.246	0.295	0.052	0.219

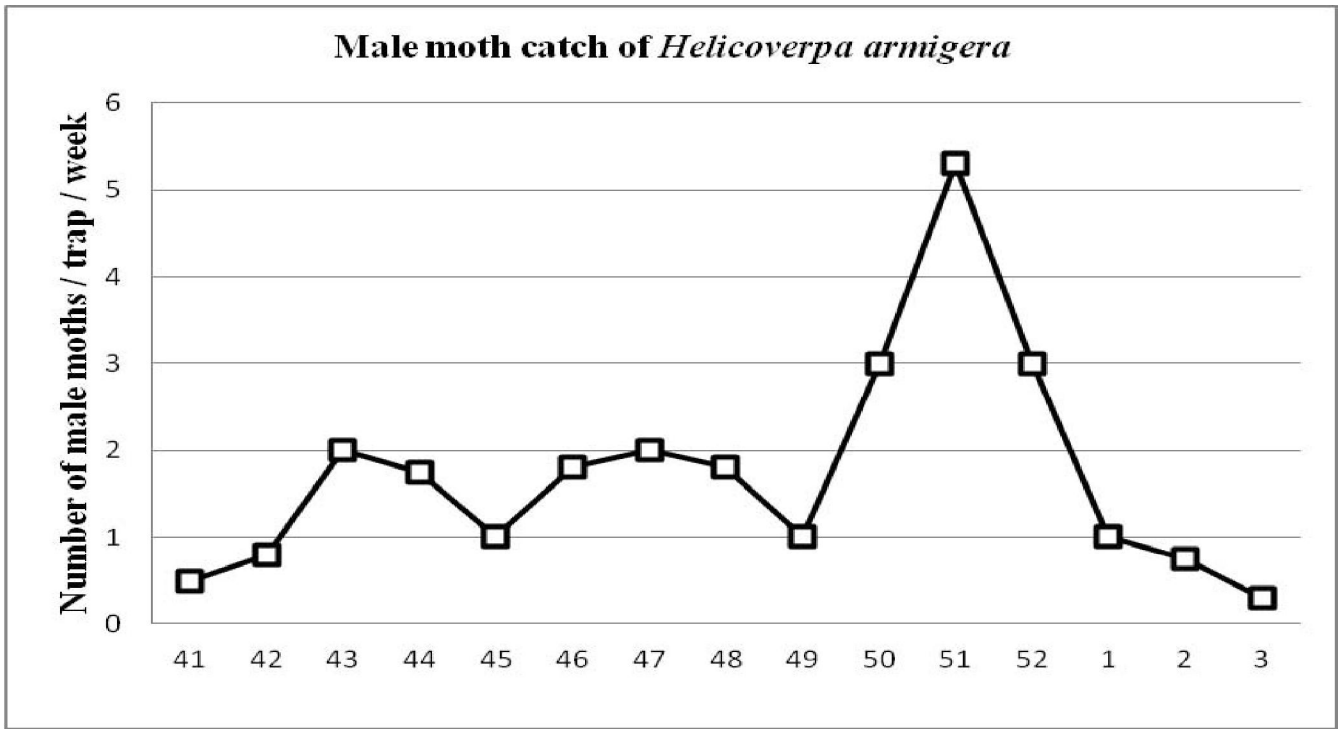
* Significant at 5% level ** Significant at 1% level

Table 3. Multiple linear regression analysis between insect pest incidence of Pigeonpea and weather parameters.

Insect Pests	Regression equation	R^2
Oviposition by *Helicoverpa armigera*	Y = 3.511-0.220X1-0.451X2+0.179X3+0.256X4-0.008X5	0.6420
Larval incidence of *Helicoverpa armigera*	Y = 5.256+0.015X1+0.015X2-0.234X3-0.003X4+0.008X5	0.5343
Adult catch of *Helicoverpa armigera*	Y = 4.767+0.022X1-0.046X2-0.189X3+0.013X4+0.012X5	0.4909
Larval incidence of *Maruca vitrata*	Y = 4.831+0.054X1+0.071X2+0.269X3-0.038X4+0.002X5	0.4797
Larval incidence of *Exelastis atomosa*	Y = 2.885+0.020X1+0.049X2-0.162X3-0.018X4+0.006X5	0.5349
Adult and nymphal population of leaf hopper	Y = 2.866-0.053X1-0.142X2+0.031X3+0.060X4+0.027X5	0.3061

X1 – Maximum Temperature
X2 – Minimum Temperature
X3 – Morning Relative Humidity
X4 – Evening Relative Humidity
X5 –Rainfall

Fig 1. Pheromone trap catches of *Helicoverpa armigera* during *Kharif* 2012-13 in Pigeonpea (LRG 41).



morning relative humidity (r= 0.295), evening relative humidity (r= 0.052) and rainfall (r= 0.219) which were non-significant (Table 2). The present findings are in agreement with Dheeraj Purohit *et al.,* (2006), Shivanna *et al.,* (2009) and Rohini *et al.,* (2012) who reported leafhopper population showed positive correlation with maximum and minimum temperatures, evening relative humidity and rainfall. The multiple linear regression studies showed that all the weather parameters together were responsible for 30.61 per cent ($R^2 = 0.3061$) of total variation in leafhopper population (Table 3).

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