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Monitoring of *Helicoverpa armigera* through pheromone and light traps on pigeonpea and impact of weather parameters on trap catch

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Abstract
The experiment conducted during *Kharif*, 2018 on pigeonpea (*Cajanus cajan* (I) Millsp) yielded a good amount of information on the trend of population build up of gram pod borer, *Helicoverpa armigera*. The peak moth population of *H. armigera* observed during last week of October *i.e.*, 43rd SMW and was found significantly correlated with maximum temperature (r= 0.632), minimum temperature (r= 0.516) and evaporation (r= 0.544). All the weather variables together contributed to the incidence of *H. armigera* adult population by 62.00 (R^2= 0.62) per cent. Whereas, the peak larval population of *H. armigera* observed during second week of November *i.e.*, 45th SMW and was found significantly correlated with maximum temperature (r= 0.474), wind speed (r= 0.487) and evaporation (r= 0.479). All the weather variables together contributed to the incidence of *H. armigera* larval population by 74.00 (R^2= 0.74) per cent. Adult and larval populations were found significantly correlated with maximum temperature and evaporation.

Keywords: Pigeonpea, Pheromone trap, Light trap, *Helicoverpa armigera*, Weather parameters

Introduction
India is the major pulse growing country in the world of which pigeonpea *Cajanus cajan* (L.) ranks second in area and production and contribute about 90% in the world's pulse production. In Andhra Pradesh, it is cultivated in an area of 2.76 lakh hectares with 1.39 lakh tonnes of production and with productivity of 504 kg/ha [1]. In recent years, there has been significant decline in the pigeonpea production in India, leading to price increase and reduction in per capita availability. The relatively low crop yields may be attributed to non-availability of improved cultivars, poor crop husbandry and exposure to a number of biotic and abiotic stresses in pigeonpea growing regions. Among the various constraints, insect pests are one of the major and important ones affecting the productivity of pigeonpea apart from ecological and biological constraints. It is attacked by more than 300 species of insects of which gram pod borer, *Helicoverpa armigera* (Hubner) is the most important pest causing heavy yield loss [2]. It attacks at early stage and become severe during maturity stage of the crop. The pest accounts for 90-95% of total damage. A single larva can damage 25-30 pods of gram in its life time. It feeds on tender shoots and young seeds. It make holes in pods and insert its half body inside the pod to eat developing seeds [3]. The yield and monitory loss was estimated to be more than 60 % [4] and US $ 400 million [5], respectively. Indian farmers depend heavily on the use of synthetic insecticides to combat these insect pests. Extensive use of synthetic insecticides in crop protection programmes around the world has resulted in disturbances of the environment, pest resurgence, pest resistance to pesticides and lethal effect to non target organisms in the agro-ecosystem in addition to direct toxicity to users. In order to optimize application of insecticides proper monitoring of the pest is very essential. Furthur, various weather parameters influencing the population bulid up and suppression of the pest need to be studied for planning an effective pest management strategy that can benefit farmers financially. Keeping all these in view, the present studies on monitoring of pod borers in pigeonpea were contemplated at Regional Agricultural Research Station, Lam, Guntur during *Kharif*, 2018.

Materials and Methods
A Field experiment was conducted at Regional Agricultural Research Station (RARS), Lam, Guntur during *Kharif*, 2018. The pigeonpea entry, LRG 52 was sown in an area of 1000 m^2 by

adopting 1.5 x 0.2 m spacing between rows and plants, respectively with the help of gorru. All agronomic practices were adopted as per the recommendation of Acharya N G Ranga Agricultural University in raising the crop except the plant protection measures. The adult population was monitored by erecting pheromone traps @ 10/ha (Plate 1). The male moth catches were recorded at each standard meteorological week starting from vegetative stage to pod maturation stage. The lure was replaced at 30 days interval. Manually prepared light trap with mercury incandescent lamp 200 W was used to monitor the adult population and expressed as number of moths/ trap/ week (Plate 1). Larval counts were recorded at weekly intervals on 5 randomly selected tagged plants and expressed as number of larvae/plant. Weather parameters such as temperature (maximum and minimum), relative humidity (morning and evening), rainfall, no. of rainy days, sunshine hours, wind speed and evaporation were obtained from meteorological observatory, RARS, Lam, Guntur. The data collected was subjected to simple correlation and regression analysis with larval population and male moth catches to know the influence of abiotic factors.


Plate 1: Monitoring of *H. armigera* adult population through pheromone and light traps

Results and Discussion

The data revealed that occurrence of pest was observed during the first week of September *i.e*., 35th standard meteorological week (SMW) (0.60 moths/trap/week) which gradually increased and peak population was observed during last week of October *i.e*., 43rd SMW (6.8 moths/trap/week). The population declined completely in 3rd SMW (0.0 moths/trap/week) (Table 1 and Fig 1). These results were in accordance with the reports of [6], who reported that peak adult activity of *H. armigera* on pigeonpea was during mid October to November.

The light traps used for recording the adult population also followed the same trend as that of pheromone traps. The light trap data also revealed that intial occurrence of the pest was observed during the first week of September *i.e.,* 35th SMW (1.00 moths/trap/week), which gradually increased and peak population was observed during last week of October *i.e.*, 43rd SMW (7.0 moths/trap/week). Thereafter declined completely with nill population at second fortnight of January *i.e.*, 3rd SMW (Table 1).

The data recorded on larval population of *H. armigera* revealed that the initial occurrence of pest was observed during the first week of September *i.e*., 35th SMW (0.20 larvae/plant). It gradually increased and peak population was observed during second week of November *i.e*., 45th SMW (4.00 larvae/plant). The population declined completely in 4th SMW (0.0 larvae/plant). Table 1). The results were in accordance with the reports of [7, 8], who reported that peak larval population of *H. armigera* on pigeonpea was during November.

Table 1: Weekly mean male moth of *Helicoverpa armigera* caught in pheromone and light trap and weekly mean larval population in pigeonpea

SMW	Date	No. of moths /trap/week		No. of larvae/plant
		Pheromone trap	Light trap	
35	27-02 SEP	0.6	1.0	0.2
36	03-09	2.8	2.6	1
37	10-16	4	4.0	1.2
38	17-23	4.2	4.4	1.4
39	24-30	4.6	4.4	1.4
40	01-07 OCT	5	5.2	1.4
41	08-14	5.4	5.6	1.8

42	15-21	6	6.2	2.2
43	22-28	6.8	7.0	2.4
44	29-04 NOV	5.8	5.4	2.6
45	05-11	5.6	5.2	4
46	12-18	5	5.0	2.2
47	19-25	4.4	4.2	1
48	26-02 DEC	4	4.2	1
49	03-09	2.8	3.4	0.8
50	10-16	2	3.0	1
51	17-23	2	2.0	0.8
52	24-31	1.8	2.0	1
1	01-07 JAN	1.6	1.8	0.8
2	08-14	0.8	1.4	0.4
3	15-21	0	0	0.4
4	22-28	0	0	0

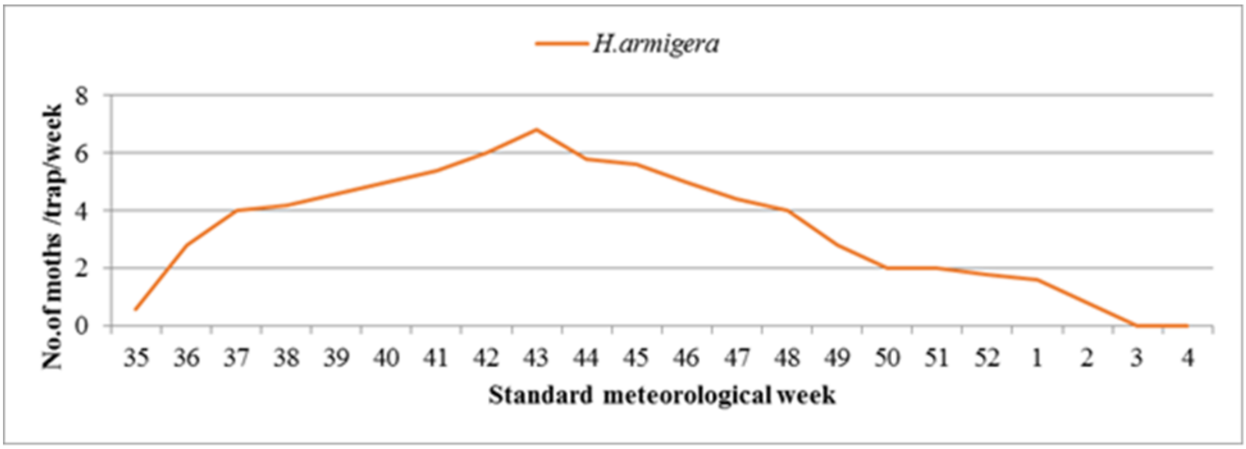

Fig 1: Weekly mean male moth of *Helicoverpa armigera* caught in pheromone trap in pigeonpea

Pheromone trap data when subjected to correlation and regression analysis, adult moth activity of *H. armigera* on pigeonpea was found significantly correlated with maximum temperature (r= 0.632),minimum temperature (r= 0.516) and evaporation (0.544), while morning relative humidity (r= -0.299),evening relative humidity(r= -0.296), rainfall (r= -0.052),rainy days (r= -0.018), sunshine hours (r=0.104) and windspeed (r= 0.146) were found non-significantly correlated (Table 2). The results were in accordance with the reports of [9, 10], who reported that peak moth activity had significant positive correlation with max. and min. temperature.

Larval population of *H. armigera* on pigeonpea was found significantly correlated with maximum temperature (r=0.474), windspeed (r= 0.487) and evaporation (r= 0.479), while morning relative humidity (r=-0.061),evening relative humidity (r= -0.329), rainfall (r= -0.095),rainy days (r= -0.111), sunshine hours(r= -0.038) and minimum temperature (r= 0.273) were found non-significantly correlated with larval population (Table 2). The results were in accordance with the reports of [11, 12], who reported that peak larval population of *H. armigera* had significant positive correlation with maximum temperature.

The results also indicated that *H. armigera* adult and larval populations were significantly correlated (0.831**) (Table 2).

The data on incidence of *H. armigera* adult and larval population was subjected to MLR analysis and the following equation was obtained (Table 3).

$Y= -65.45+2.10^{**} X_1-0.67 X_2+0.08 X_3+0.15 X_4+0.07 X_5-1.10 X_6-0.13 X_7+0.26 X_8-0.48 X_9$

$Y= -33.46+1.08^{**} X_1-0.57^{**} X_2+0.05 X_3+0.09 X_4+0.02 X_5-0.09 X_6-0.13 X_7+0.15 X_8+0.14 X_9$

The results showed that all the weather variables together contributed to the incidence of *H. armigera* adult population by 62.00 (R^2= 0.62) per cent which was in accordance with [13], who reported that all the weather variables together contributed to the incidence of *H. armigera* by 71.00 (R^2= 0.71) per cent. Whereas, all the weather variables together contributed to the incidence of *H. armigera* larval population by 74.00 (R^2= 0.74) per cent which was in accordance with [14], who reported that all the weather variables together contributed to the incidence of *H. armigera* by 80.7 (R^2= 0.807) per cent.

Table 2: Correlation matrix of *H. armigera* adult and larval population

	Adult population	**Larval population**
Adult population	-	0.831**
Larval population	0.831**	-
Maximum temperature	0.632**	0.474*
Minimum temperature	0.516*	0.273
Morning RH	-0.299	-0.061
Evening RH	-0.296	-0.329
Rainfall	-0.052	-0.095
Rainy days	-0.018	-0.111

Sunshine hours	0.104	-0.038
Wind speed	0.146	0.487*
Evaporation	0.544**	0.479*

Table 3: Regression coefficeints of *H.armigera* adult and larval population

Variable	REGRESSION MODEL	R^2
Trap catches Vs weather parameters	$Y= -65.45+2.10^{**} X_1-0.67 X_2+0.08 X_3+0.15 X_4+0.07 X_5-1.10 X_6-0.13 X_7+0.26 X_8-0.48 X_9$	0.62
Larval population Vs weather parameters	$Y= -33.46+1.08^{**} X_1-0.57^{**} X_2+0.05 X_3+0.09 X_4+0.02 X_5-0.09 X_6-0.13 X_7+0.15 X_8+0.14 X_9$	0.74

**significant at 1%
*significant at 5%
X_1= Maximum temperature; X_2= Minimum temperature; X_3= Morning RH; X_4= Evening RH; X_5= Rainfall; X_6= Rainy days; X_7= Sunshine hours; X_8= Wind speed; X_9= Evaporation

Conclusion
It was concluded from the above findings that farmer should be alert during last week of October to second week of November wherein the activity of the pest will be at its peak, which inturn coincides with flowering stage of the crop. It was also concluded that significant correlation exists between *Helicoverpa* population and maximum and minimum temperature; evaporation and wind speed. Further, all the weather variables together contributed to the incidence of *H. armigera* adult and larval population by 62.00 (R^2= 0.62) and 74.00 (R^2= 0.74) per cent respectively. Moreover, adult and larval population was found significantly correlated with maximum temperature and evaporation.

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