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Population dynamics of major phototactic insect pests of chickpea ecosystem through light trap

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ABSTRACT

An investigation was carried out at Experimental Farm, JNKVV, Jabalpur (MP) during 2016 - 2017 to know the population dynamics of major phototactic insect pests using Jawahar light trap in chickpea ecosystem. The present study revealed that gram pod borer was first recorded during 45th SW in light trap. The activity period of *Helicoverpa armigera* was noticed from November 2016 to April 2017 with two distinct peaks during 13th and 14th SW. The highest peak was observed in 14thSW. Cutworm was first recorded during 46th SW in light trap. Three distinct peaks were observed during 4th, 12th and 16th SW with highest peak was observed in 12th SW. Tobacco caterpillar was also firstly recorded during 46th SW in light trap with one distinct peak during 13th SW. Further, the correlation studies revealed that maximum temperature, minimum temperature, sunshine, wind velocity, morning vapor pressure and evaporation showed significant positive correlation whilemorning relative humidity and evening relative humidity, showed negative correlation with *Helicoverpa armigera*, *Agrotis ipsilon* (Hufnagel) and *Spodoptera litura* (Fabricius) moth catches and statistically found significant except wind velocity which wasnon-significant against *Agrotis ipsilon* (Hufnagel). Rest of the weather parameters were found non-significant.

Key words: Chickpea, Insect pests, Light trap, Population dynamics.

INTRODUCTION

Light trap occupied important place as one of the oldest, traditional and indigenous technology of pest management for sustainable agriculture, which was very common practice in early decade of 20thcentury mostly for the control of nocturnal insect pests. The study of monitoring population dynamics of the insect pests through light trap is an important tool for Integrated Pest Managementall over the world. Many of the insect pests mostly nocturnal and few diurnal species are positively phototropic and are attracted towards light. Chickpea (*Cicer arietinum* Linn.) is a major winter pulse crop grown in India. Among the pulses, chickpea occupies 30 per cent of annual production in India. India stands first in terms of area and production of chickpea in the world. During last decade (2003-2012) about 66.78 per cent of the global chickpea area falls in India, corresponding to 65.97 per cent of global production with an average productivity of 838 kg/ha (FAO, 2012). Madhya Pradesh is the single largest producer of chickpea in the country accounting for over 40 per cent of the total national production. In Madhya Pradesh,during 2016-17, chickpea was grown in 30.76 lakh hectare area with a production 34.67 lakh metric tonsand an average yield was 1101kg/ha (Anonymous 2017).

Importance of chickpea in the state economy is well known due to its high production potential and suitability in climatic condition for its cultivation. Thus, there is a tremendous scope present for increasing chickpea area and production in the state for farmers' prosperity. Recently, Chickpea production is constrained by occurrence of several insect-pests which hampered the crop production in the state. Various noctuid insects of chickpea include *Helicoverpa*, *Agrotis* and *Spodopteraetc.* damage the crop and reduced 10-85% yield (Das, 1997). Thus, there is a great need for early detection and eco-safe control of these noctuid pest in chickpea crop. Similarly, study of monitoring pest population dynamics of the phototactic insect pests is important for effective management (Khadse, 2017), hence, we directed a research to monitor the population dynamics of phototactic insect fauna using light trap in chickpea ecosystem particularly in Jabalpur region of M.P. Although some work has been done on use of light trap against major pests but lesser information is available on population dynamics on phototactic insect fauna of chickpea ecosystem particularly in Jabalpur region of M.P. Thus, this study will provide population dynamics of major phototactic insect pests of chickpea which is theoretical basis for the sustainable management of chickpea pests.

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MATERIALS AND METHODS

The experiment was conducted at Experimental Farm, Jawharlal Nehru Krishi VishwaVidhalya, Jabalpur (MP) during November 2016 to March 2017. Jawahar light trap

model (developed by JNKVV) containing mercury vapor lamp (80 W) was used in present study. Seasonal activities of major insect pests were recorded on daily basis by operating the light trap throughout the *Rabi* season of 2016-17. Daily trap catch was converted into weekly total and mean per day per week (weekly mean/day) was calculated. Divisions of week were based on standard meteorological week described by procedure of Vaishampayan and Shrivastava (1977). Observations of weather data (maximum temperature, minimum temperature, sunshine, wind velocity, morning relative humidity, evening relative humidity, rainfall, morning vapor pressure, evening vapor pressure, evaporation and number of rainy days etc.) were recorded on daily basis from JNKVV meteorological observatory. The correlation coefficient between major insect pests and various weather factors was calculated by using the statistical correlation regression analysis in SAS 9.2 software (http:// support.sas.com/software/92/index.html).

RESULTS AND DISCUSSION

Early monitoring and detection insect pests population in a crop ecosystem is an approach for IPM module. Although, emergence of pest populations in an ecosystem are highly affected by climatic condition. Thus, correlation of weather data with population dynamics of emerge insect pest is an essential part for further forecasting and effective management of pest population in a crop. the present study was to attempt light trap intercepted the population dynamics of major phototactic insect pests of chickpea ecosystem and correlation of weather parameter. The observed and assessed finding of our investigation with every light trapped population is described here under following heads.

Gram pod borer (*Helicoverpa armigera*)

Gram pod borer was the major damaging pest and first recorded during 45th SW in light trap. The activity period of *Helicoverpa armigera* was observed from November to April with two distinct peaks during 13th and 14th SW (Fig 1). The highest peak was observed in 14th SW, during this period maximum and minimum temperature were 41.6°C and 21.6°C, respectively, whereas morning and evening relative humidity and vapor pressure were 39.1 per cent and 11.1 per cent and 9.7 mm and 7.3 mm, respectively. Further, sunshine, wind velocity, evaporation, rainfall and number of

Table 1: Correlation coefficient of weather factors on light trap catches of *Helicoverpa armigera* (Hubner), *Agrotis ipsilon* (Hufnegle) and *Spodoptera litura* (Fabricius).

Weather Parameter	*H. armigrera*		*A. ipsilon*		*S. litura*	
	r	Byx	r	Byx	r	Byx
Maximum temp. (°C)	0.762**	0.926	0.658**	0.992	0.668**	1.088
Minimum temp. (°C)	0.721**	0.726	0.564**	0.706	0.583**	0.786
Morning RH. (%)	-0.786**	-2.998	-0.532**	-2.495	-0.567**	-2.870
Evening RH. (%)	-0.595**	-1.537	-0.572**	-1.83	-0.598**	-2.064
Rainfall	-0.14 NS	-	0.004 NS	-	0.002 NS	-
Sunshine Hour	0.539**	0.177	0.525**	0.213	0.542**	0.238
Wind Velocity	0.628**	0.196	0.38	-	0.415*	0.172
Morning Vapor Pressure	0.462*	0.125	0.636**	0.211	0.630**	0.226
Evening Vapor Pressure	-0.26 NS	-	-0.257 NS	-	-0.305 NS	-
Number of Rainy Days	-0.08 NS	-	0.096 NS	-	0.117 NS	-
Evaporation	0.764**	0.395	0.612**	0.391	0.641**	0.442

*Correlation is significant at the 0.05 level, NS= Non – Significant.

**Correlation is significant at the 0.01 level.

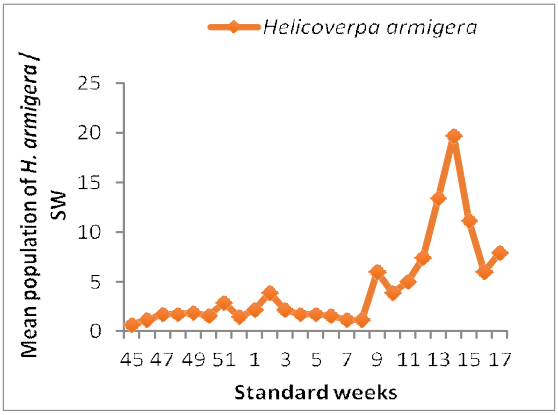

Fig 1: Mean population of *H. armigera* in light trap during 2016-2017.

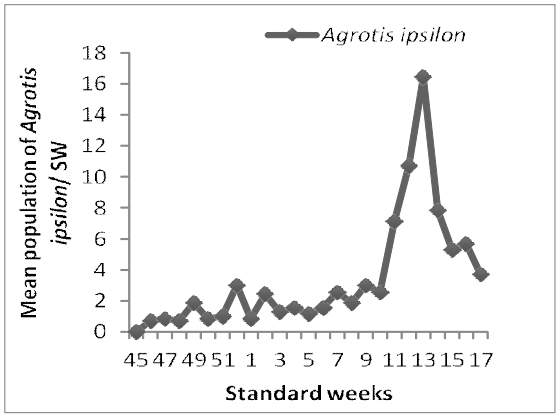

Fig 2: Mean population of *A. ipsilon* in light trap during 2016-2017.

rainy days were 10.1 hrs, 6.4 km/hrs, 9 mm, 0.00 mm and 0 rainy day respectively.Correlation studies revealed that maximum temperature (°C), minimum temperature (°C), sunshine, wind velocity, morning vapor pressure (mm) and evaporation, respectively showed significant positive correlation with moths catches, further morning relative humidity and evening relative humidity, showed negative correlation with moths catches and statistically found significant (Fig 4,5,6 & 7). Rests of the weather parameters were found non-significant (Table 1). Earlier, Choudhari *et al.* (1999), Nandgopal *et al.* (2006), Gao *et al.* (2010) and Baker *et al.* (2011) monitored dynamics of *H. armigera* moths with light traps from four locationsand found significance positive correlation between sunshine hrs and population build up.

Cutworm (*Agrotis ipsilon* Hufnagel):

The activity period of *Agrotisipsilon*Hufnagel was observed from November to April with three distinct peaks during 4th, 12th and 16th SW (Fig 2). Cutworm was first recorded during 46th SW, in light trap. The highest peak was observed in 12th SW, during this period maximum and minimum temperature were 33.8°C and 14.3°C, respectively, whereas

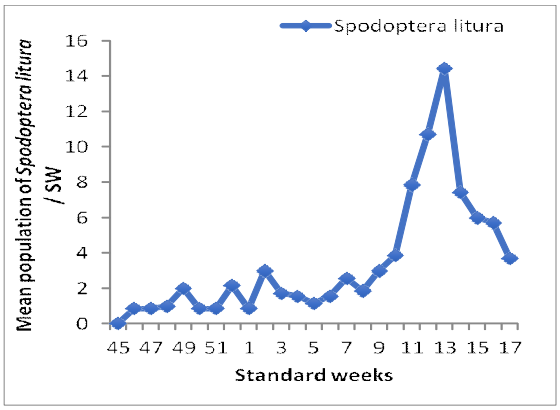

Fig 3: Mean population of *S. litura* in light trap during 2016-2017.

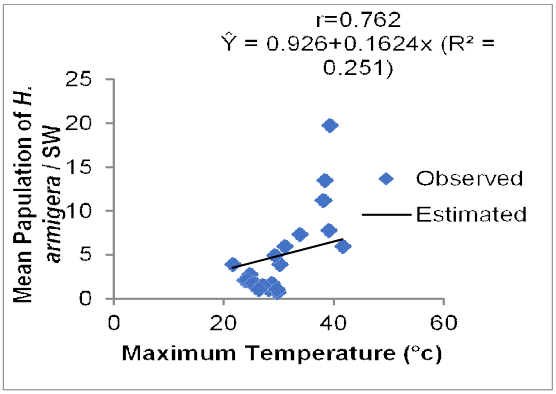

Fig 4: Regression of maximum temperature (°C) on *H. armigera* trapped in light trap.

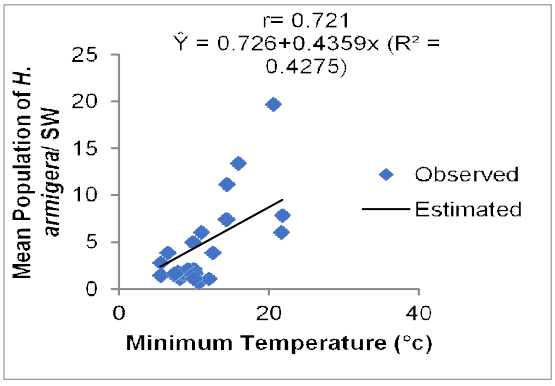

Fig 5: Regression of minimum temperature (°C) on *H. armigera* trapped in light trap.

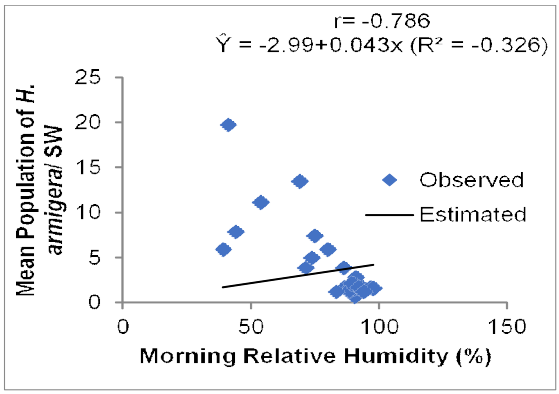

Fig 6: Regression of morning relative humidity on *H. armigera* trapped in light trap.

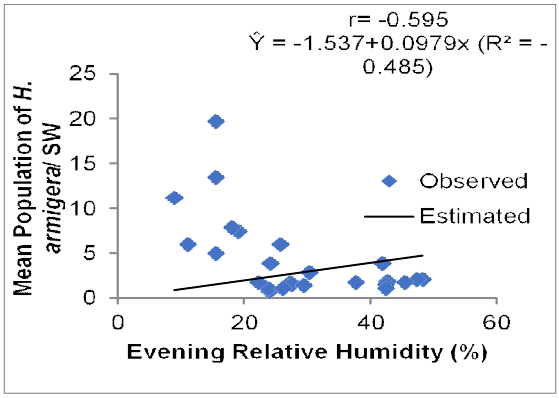

Fig 7: Regression of evening relative humidity on *H. armigera* trapped in light trap.

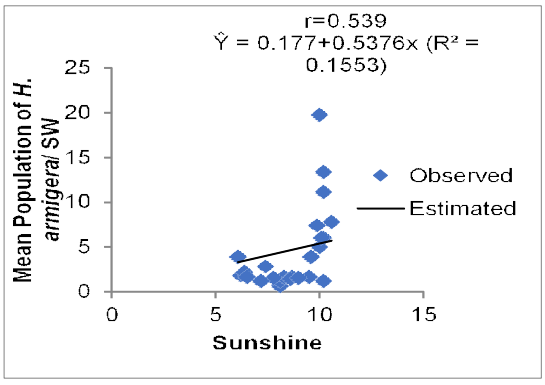

Fig 8: Regression of maximum temperature (°C) on *A. ipsilon* trapped in light trap.

morning and evening relative humidity and vapor pressure were 75 per cent and 19.1 per cent and 11.1 mm and 7.6 mm, respectively. Further, sunshine, wind velocity and evaporation were 9.9 hrs, 3.4 km/hrs and 5.27 mm, respectively. There was 2.8 mm rainfall during this week which occurred in 1 days.

Correlation studies revealed that maximum temperature (°C), minimum temperature (°C), sunshine, morning vapor pressure (mm) and evaporation respectively showed significant positive correlation with moths catches, further morning relative humidity and evening relative humidity, showed negative correlation with moths catches, and statistically found significant (Fig 8,9,10 & 11). Rest of the weather parameters were found non significant (Table 1). In contrast with the present findings, Bisht *et al.* (2005) studied the seasonal activity of cutworm through light trap catches and found that's the pest remained active from March to September and were not available from October to February.

Tobacco caterpillar (*Spodoptera litura* Fabricius)

It was first recorded during 46th SW in light trap. The activity period of *Spodoptera litura* Fabricius was observed from

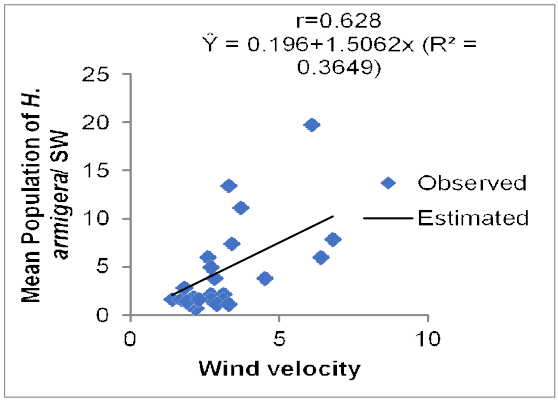

Fig 9: Regression of minimum temperature (°C) on *A. ipsilon* trapped in light trap.

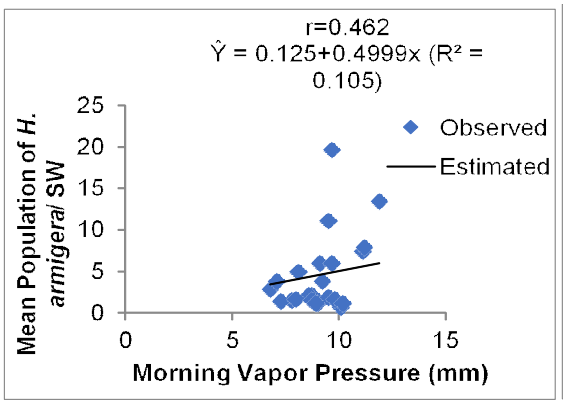

Fig 10: Regression of morning relative humidity on *A. ipsilon* trapped in light trap.

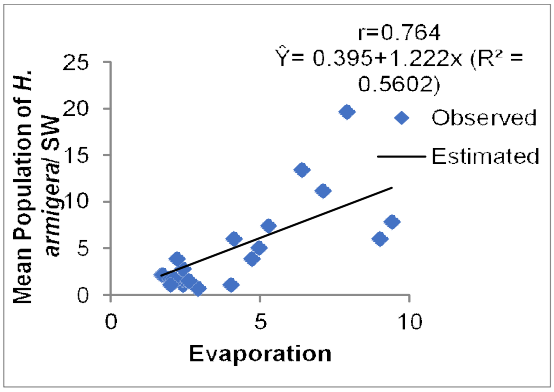

Fig 11: Regression of evening relative humidity on *A. ipsilon* trapped in light trap.

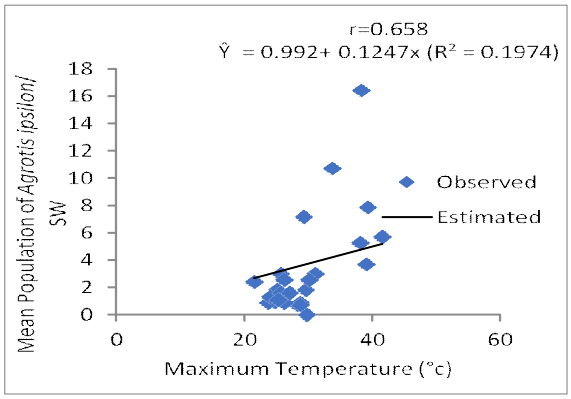

Fig 12: Regression of maximum temperature (°C) on *S. litura* trapped in light trap.

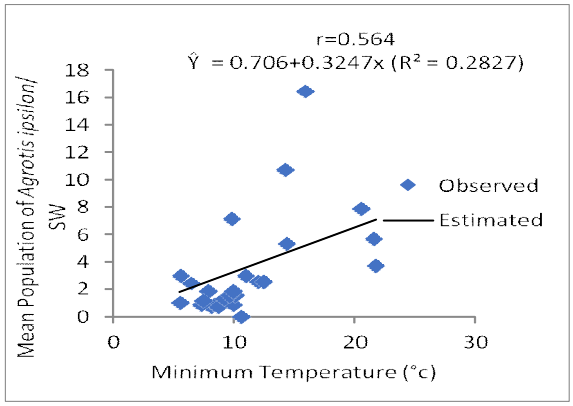

Fig 13: Regression of minimum temperature (°C) on *S. litura* trapped in light trap.

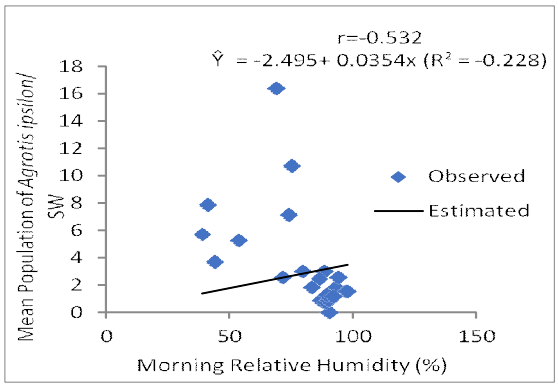

Fig 14: Regression of morning relative humidity on *S. litura* trapped in light trap.

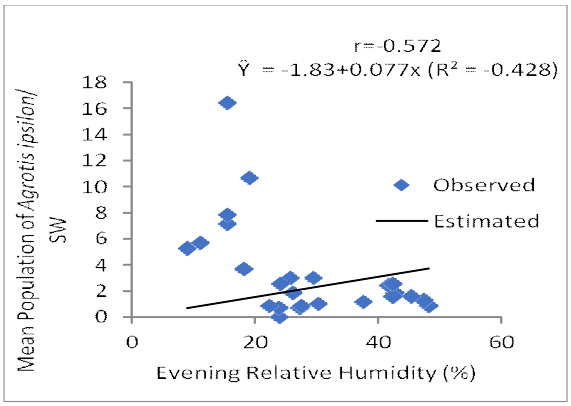

Fig 15: Regression of evening relative humidity on *S. litura* trapped in light trap.

November to April with one distinct peak during 13th SW (Fig 3).The highest peak was observed in 13th SW, during this period maximum and minimum temperature were 38.3°C and 15.9°C, respectively, whereas morning and evening relative humidity and vapor pressure were 69.1 per cent and 15.5 per cent and 11.9 mm and 7.9 mm, respectively. Further, sunshine, wind velocity and evaporation were 10.2 hrs, 3.3 km/hrs and 6.4 mm, respectively. There was no rainfall during this week. Population then sharply decreased from 14th SW and reached to its lower level in 17 SW in trap catches.

Correlation studies revealed that maximum temperature (°C), minimum temperature (°C), sunshine, wind velocity, morning vapor pressure (mm) and evaporation, respectively showed significant positive correlation with moths catches, further morning relative humidity and evening relative humidity, showed negative correlation with moths catches and statistically found significant (Fig 12,13,14 and 15). Rest of the weather parameters was found nonsignificant (Table 1). Xiaowei Fu *et al*. (2015) reported the *Spodopteralitura* Fabricius is a serious crop pest with a strong migratory ability. Majority of moths trapped in the autumn and moths had downwind displacement rather than randomly by heading toward their seasonally favorable direction.

CONCLUSION

The study on Light trap intercepted population dynamics of major phototactic insect pests of chickpea ecosystem showed that gram pod borer was first recorded during 45th SW in light trap. The activity period of *H. armigera* was observed from November to April with two distinct peaks during 13th and 14th SW. The highest peak was observed in 14thSW. Cutworm was first recorded during 46th SW, in light trap. The activity period of *Agrotis ipsilon* (Hufnagel) was observed from November to April with three distinct peaks during 4th, 12th and 16th SW. The highest peak was observed in 12th SW. Tobaco caterpillar was first recorded during 46th SW in light trap. The activity period of *S. litura* (Fabricius) was observed from November to April with one distinct peak during 13th SW. The highest peak was observed in 13th SW. Correlation studies revealed that maximum temperature (°C), minimum temperature (°C), sunshine, wind velocity, morning vapor pressure (mm) and evaporation respectively showed significant positive correlation and further morning relative humidity and evening relative humidity, showed negative correlation with H. *armigera*, *A.ipsilon* Hufnagel) and *S.litura* (Fabricius moths catches and statistically found significant. Except wind velocity no- significant against *A.ipsilon* (Hufnagel) rest of the weather parameters were found non-significant.

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