Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(2): 2307-2308
Received: 08-01-2018
Accepted: 09-02-2018

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Correlation between *Helicoverpa armigera* (Hubner) population and Weather factors in chickpea (*Cecer aratinum* L.)

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Abstract
The present investigations entitled "Studies on population dynamics and management of *Helicoverpa armigera* (Hubner) on chickpea using botanicals" was carried out at Students' Instructional Farm of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad during *Rabi,* 2016. revealed that *Helicoverpa armigera* population were noticed for the first time during 46th SW of 2016 and respective mean population were 0.33 larvae/plant. Mean population of *Helicoverpa armigera* showed non-significant negative correlation with minimum (-0.335) and maximum temperature (-0.220) and rainfall (-0.266) while RH showed non-significant with positive correlation (0.394).

Keywords: Gram**,** *Helicoverpa armigera*, Correlation and Weather Factor

1. Introduction
Chickpea (*Cicer arietinum* Linn. Leguminacae) is one of the most important *rabi* pulse crop of India. The world area of chickpea is estimated to be about 135.40 lakh ha^{-1} at global level with production and productivity of 131.02 lakh tonnes and 968 kg ha^{-1} respectively. In India, the area, production and productivity 59 mha, 77.03 million tonnes and 890 kg ha^{-1}, respectively (Annonymous 2016) [1].

Gram Pod borer *Helicoverpa armigera* is one of the major pest of gram. The pest starts its attack at early stage and become severe during maturity stage of the crop. The pest accounts for 90-95% of total damage. A single larva of *Helicoverpa armigera* can damage 25-30 pods of gram in its life time. It feeds on tender shoots and young pods. It makes holes in pods and insert its half body inside the pod to eat the developing seeds. The pod borers inflict heavy crop losses from seedling to maturity and the losses reach at its peak when the pods appear. The seed yield losses due to *Helicoverpa armigera* were 75-90% and in some places the losses were up to 100%. The yield loss in chickpea due to pod borer was reported as 10 to 60 per cent in normal weather conditions, while it was 50 to 100 per cent in favorable weather conditions, particularly in the state where frequent rain and cloudy weather is prevailing during the crop season. These losses can be reduced by the application of insecticides. In favorable conditions pod borer may cause 90-95 per cent of pod damage (Kumar *et al.,* 2017).

Helicoverpa armigera is a conundrum and one of the most dominant insect pests in agriculture, accounting for half of the total insecticides usage in India for protection of crops. The problem of this pest is magnified due to its direct attack on fruiting structures, voracious feeding habits, high mobility and fecundity, multivoltine nature, overlapping generations, nocturnal behavior etc., (Sarode, 1999) [7]. At the same time adequate ecological data is prerequisite for integrated pest management, which can therefore be enhanced after determining the seasonal abundance (Mathur *et al.,* 2003) [5]. There are many environmental factors which influence the insect pest populations (Lode and Sharma, 1993) [3]. Among them abiotic factors play a vital role in multiplication and distribution of insect pests.

Method and Material
To know the effect of abiotic variables on the population of *Helicoverpa armigera*, simple correlation analysis was carried out. The result of the analysis has been presented in (Table-2) and details have been given here as below:

Correlation observed between the *Helicoverpa armigera* population and abiotic parameters showed non-significant positive correlation with minimum and maximum temperature, relative humidity while rainfall had non-significant negative correlation.

Experimental Design and layout

The experiment was conducted on conceded ten treatments and laid out in a Randomized Block Design (RBD). Each treatment was allocated randomly in three replications. The unit plot size was 5 m ×4 m having 30 cm space between the blocks and 10 cm between the plots. Each plot contains two rows having 60cm distance between the row and that between plants was 30 cm.

Topography and climatic condition

The experimental site lies between 26.47^0 N latitude, 82.12^0 E longitude and 113 m above from the sea level in sub-tropical belt of the country with alkaline to normal soil. Mostly the rainfall is confined from July to September month. The weekly meteorological data obtained from the department of Agro-meteorology of the university have been mentioned in Table-1.

Table 1: Weekly meteorological data during *Rabi* season 2016-17.

S.W.	Temperature (^{0}C)		Rain fall (mm)	Relative Humidity (%)
	Min.	Max.		
40	25.7	34	9.8	76.6
41	21.8	32.7	25.3	74.5
42	17.9	32.8	0	68.1
43	16.3	32.4	0	64.9
44	14.1	31	0	65.4
45	12.7	29.7	0	67.2
46	11.8	29	0	67.4
47	11.8	27.3	0	67.4
48	12.2	25.8	0	79.9
49	11.7	19.2	0	86.6
50	9	19.5	0	86.9
51	7.5	23.2	0	74
52	10.6	20.1	0	84.1
1	10.2	18	0	88.2
2	4.9	20.1	0	66.3
3	5.9	22.4	0	68
4	9.1	23.7	16.8	76
5	8.2	21.9	0	80
6	8.4	24.5	0	69.3
7	9.9	25.7	0	70.3
8	11.1	27.9	0	63.9
9	11.5	28.8	0	57.8
10	12.3	27.8	0	62.4
11	10	29.4	0.7	56.8

Table 2: Correlation between *H. armigera* population and abiotic parameters during *Rabi*, 2016.

Insect	Temperature		Rainfall (mm)	RH (%)	Sunshine (hrs)
	Min.	Max.			
Gram pod borer	-0.335	-0.220	-0.266	0.394	-0.475*

The data of *Helicoverpa armigera* population on gram at the pre-treatment showed that mean population was homogeneous and non-significant between all the treatments (Table-2). The application of treatments (insecticides) was executed at ETL (3 eggs or 2 larvae/plant) which crossed at the 1st week of December (49th SW) on gram crop. Regular weekly recording selected plat of gram pod borer population was done from 50% flowering till harvested in the experimental field.

Results and Discussion

Correlation observed between the *Helicoverpa armigera* population and abiotic parameters showed non-significant negative correlation with minimum and maximum temperature and non- significant negative correlation with rainfall and negative significant correlation with sunshine.

The present finding are also accordance with the findings of Khorasiya *et al.* (2016) [2] who reported that direct and indirect effect of various abiotic factors on population buildup of *H. armigera* indicated that maximum temperature exerted very high negative direct effect (-1.14 to 8) while the morning RH registered positive (0.4842).negative high indirect effect was noticed of minimum temperature (-0.8909).

In present finding are in contrary with the finding of Singh *et al.,* (2015) [8] observed that temperature and rainfall had significant positive correlation maximum relative humidity and minimum relative humidity had significantly negative correlation and sunshine had no significantly effect on larval population of *Helicoverpa armigera*.

The present finding are also partial agreement with the findings Parmar *et al.,* (2015) [6] who reported Correlation coefficient of larval population with sunshine hours exhibited significantly positive correlation (r =0.55) on November 07 sown crop. Whereas, maximum temperature (r= 0.66) showed positively significant association with mean larval population.

The present finding are also partial agreement with the findings Lomash Kumar and Bisht, R. S (2013) [4] who reported that the larval population of the pest occurred throughout the growth period of crop with maximum at pod and grain formation stages. Maximum and minimum temperatures, sunshine hours and wind speed showed significant positive correlation with larval population whereas relative humidity and rainfall exhibited negative impact on larval population.

Acknowledgement

The authors are thankful to Department of Agricultural Entomology and Department of Agro-meteorology NDUA&T Kumarganj, Faizabad and entire faculty for providing necessary facilities for conducting the investigation and valuable suggestions during the course of investigation

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