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Effect of climatic factors on population dynamics of gram pod borer, *Helicoverpa armigera* (Hübner) in chickpea

Amogha[1]*, Usha[2], V.K. Mishra[3] and M. Soniya Devi[3]

[1]Department of Entomology, GKVK, UAS, Bangalore 560 065, Karnataka, India
[2,3]Department of Entomology, Rani Lakshmi Bai Central Agricultural University, Jhansi 284 003, U.P., India

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ABSTRACT

Helicoverpa armigera is major insect pest of chickpea which occurs during vegetative growth stage that continues to feed up to pod formation stage and responsible for drastic loss in the yield of chickpea. The optimum time to eliminate this pest is while it is in the early stages of its life cycle. This is conceivable if the pests come up can be predicted in advance. The best time to get rid of this pest is when it is still in early stages of its life cycle. If the appearance of pests can be anticipated in advance, this is plausible. In order to achieve this objective, an attempt was made to correlate the seasonal occurrence of pod borer, *H. armigera*, infesting chickpea with several meteorological variables. A study entitled population dynamics of gram pod borer *Helicoverpa armigera* (Hübner) on chickpea was carried out at agricultural research farm of Rani Lakshmi Bai Central Agricultural University, Jhansi during *rabi* season 2021-22. The first appearance of larval population of *H. armigera* was recorded during 7th standard meteorological week and reached its peak during 11th standard meteorological week while larval population started to decline during 13th standard meteorological week onwards. A positive correlation existed between the larval population density and maximum and minimum temperature. However, significant negative correlation showed between the larval population and morning relative humidity and evening relative humidity.

Key words : *Population dynamics, Chickpea, Pod borer, Helicoverpa armigera, Correlation*

Introduction

Chickpea *(Cicer arietinum* L.) is a major *rabi* pulse crop of India which is often grown on dry, heavy clouded soil. Chickpea is rich source of energy, protein, minerals, vitamins, fibre, and also contains potentially health-beneficial phytochemicals (Wood and Grusak, 2007). India ranks first in terms of area and production in the world. In India, chickpeas are produced on 10.91 million hectares of land, producing 13.75 million tonnes with an average productivity of 1260 kg/ha under irrigation condition in the years 2021–2022 (Source: Agricultural Statistics at a glance, Directorate of Economics and Statistics, Department of Agriculture and Cooperation). The gram pod borer *Helicoverpa armigera* (Hubner) (Noctuidae; Lepidoptera) is a major pest of chickpea. The pest is polyphagous in nature that known to feed on more than 100 plant species like cotton, tobacco, tomato, maize, sunflower and sorghum. The key factor to its pest status are its high reproduction rate, great mobility, voracious feeder,

([1]Ph D Scholar, [2]Assistant Professor, [3]Teaching cum Research Associate)

wide genetic diversity, and resistance to many insecticides. The caterpillar is the damaging stage. The typical damage symptom of the gram pod borer is presence of circular bore hole on the pods plugged with the head of the larva (Babu *et al.*, 2008). The single larva has the ability to destroy 30-40 pods in its lifetime. The ecological factors, temperature (14-45 °C), photoperiod (10-14 hrs), relative humidity (15-95%) coupled with optimum and intermittent rainfall were found to affect the population build-up, adult emergence and fecundity of the female moths of *H. armigera* (Tripathi and Singh, 1993). Hence an effort has been made to look into the relationship between incidence of pod borer infesting chickpea with various meteorological parameters.

Materials and Methods

A field investigation was conducted during *Rabi* season 2021-22 at Agricultural Research farm of Rani Lakshmi Bai Central Agricultural University, Jhansi to study the population dynamics of *Helicoverpa armigera* on chickpea. The chickpea variety RVG 202 was sown on 11th December 2021. All recommended agronomic practices were carried out including, hoeing, weeding, irrigation except insecticidal application was performed as and when needed. The gram crop was regularly monitored for occurrence of *H. armigera* from germination to pre-harvest stage of the crop. After their occurrence, the larval population of *H. armigera* was recorded at weekly interval in morning hours from chickpea plants at one-meter row length in control plots of size 5×5 m^2. Weekly meteorological data on temperature (minimum and maximum in °C), relative humidity (%), and rainfall (mm) were obtained from the Indian Grassland and Fodder Research Institute, Jhansi. Simple correlation analysis was used to determine the relationship between the number of larvae of *H. armigera* and meteorological variables using SPSS software.

Results and Discussion

The data recorded on larval population of *H. armigera* on chickpea during *Rabi* 2021-22 (Table 1 and Fig.1). It is evident from the data that the larval population occurred on chickpea throughout the growth phase, which found to be low at vegetative stage and high at pod development stage. The first appearance of larval population of *H. armigera* was recorded during 7th standard meteorological week (SMW), when maximum and minimum temperature was 25.8°C and 8 °C respecrively with morning and evening relative humidity of 87 and 46% respectively. The peak larval population was observed during 11th standard meteorological week (3.80 larvae/ meter row length) when maximum temperature, minimum temperature, morning humidity, and evening humidity was 35.2 °C, 16 °C,

Table 1. Population dynamics of *H. armigera* in chickpea during *Rabi,* 2021-22

Meteorological weeks	Days after sowing	Temperature (°C)		Humidity (%)		Rainy days	Mean larval population/ meter row length
		Max.	Min.	Mor.	Eve.		
51	7 DAS	22.9	4.4	88	61	0	0.00
52	14 DAS	22.3	8.4	90	65	1	0.00
1	21 DAS	20.9	7.7	91	71	2	0.00
2	28 DAS	19.2	10.4	91	71	1	0.00
3	35 DAS	18.3	5.8	91	72	0	0.00
4	42 DAS	19.9	7.6	91	71	1	0.00
5	49 DAS	26.4	7.3	89	59	0	0.00
6	56 DAS	24.0	7.5	88	47	0	0.00
7	63 DAS	25.8	8.0	87	46	0	0.60
8	70 DAS	28.0	11.3	84	46	0	1.00
9	77 DAS	28.5	11.3	84	45	0	1.20
10	84 DAS	30.0	12.6	81	44	0	2.47
11	91 DAS	35.2	16.0	80	38	0	3.80
12	98 DAS	38.0	17.4	79	38	0	2.67
13	105 DAS	38.8	16.8	76	34	0	1.87

Table 2. Correlation between larval population of *H. armigera* and abiotic factors on chickpea during *Rabi*, 2021-22

Larval population	Temperature (°C)		Relative humidity (%)	
	Maximum	Minimum	Morning	Evening
H. armigera	0.855**	0.872**	-0.875**	-0.782**

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

80%, 38% respectively. While the larval population started to decline on 13th standard meteorological week, when the maximum and minimum temeprature was respectively 38.8 ˚C and 16.8 ˚C and morning and evening relative humidity was respectively 76% and 34%. Rainfall has not ocurred after the appearence of larval population during the crop growing stage.

Correlation between larval population and weather parameter: Analysis of simple correlation coefficient between larval population and weather parameters *viz.,* temperature (maximum and minimum in °C) and relative humidity (morning and evening), revealed (Table 2) that the larval population of *H. armigera* showed significantly positive correlation with maximum temperature (r = 0.855) and minimum temeprature (r = 0.872). whereas significantly negatively correlated with morning (r = -0.875) and evening relative humidity (r = -0.782) respectively. The present result pertaining to incidence of *H. armigera* were in confirmation with Yadav and Jat (2009) who reported that the larval population was highest during the pod formation stage. The population of *H. armigera* on chickpea was positively correlated with maximum and minimum temperature. While relative humidity and rainfall had no effect on the population fluctuation. Similarly, Reddy *et al.* (2009) also showed significant positive correlation of *H. armigera* with both maximum and minimum temperature, the correlation coefficient being 0.82 and 0.71, respectively.

Conclusion

The initial larval population of *H. armigera* was recorded during 7th standard meteorological week and reached its peak during 11th standard meteorological week. The mean larval population was found positively correlated with maximum (r = 0.855) and minimum temperature (r = 0.872). However, mean larval population showed significant negative correlation with morning relative humidity (r = -0.875) and evening relative humidity (r = -0.782). The study of population dynamics of gram pod borer has been important in the development of basic insect ecology as well as in the understanding and management of this serious pest.

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Conflict of Interest: None.

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