Biological Forum – An International Journal **17(1): 64-68(2025)**

ISSN No. (Print): 0975-1130
ISSN No. (Online): 2249-3239

Seasonal Incidence of *Helicoverpa armigera* (Hub.) on Chickpea in Relation to Abiotic Factors Semi-arid Region of Rajasthan

Rajkumar Bajya[1*], D.K. Bairwa[2], B.L. Jat[3], J.K. Bana[2], Akhter Hussain[3], S.L. Sharma[2], Laxman Singh Saini[1], D.R. Bajya[2] and Suman Choudhary[2]

[1]Ph.D. Scholar, Department of Entomology, SKNAU, Jobner Jaipur (Rajasthan), India.
[2]Assistant Professor, Department of Entomology, SKNAU, Jobner, Jaipur (Rajasthan), India.
[3]Professor, Department of Entomology, SKNAU, Jobner, Jaipur (Rajasthan), India.

(Corresponding author: Rajkumar Bajya)*

(Received: 07 October 2024; Revised: 20 November 2024; Accepted: 06 December 2024; Published online: 10 January 2025)
(Published by Research Trend)

ABSTRACT: The investigation on "Seasonal incidence of *Helicoverpa armigera* (Hub.) on chickpea in relation to abiotic factors semi-arid region of Rajasthan" were conducted at Agronomy Farm, S.K.N. College of Agriculture, Jobner, Rajasthan during two consecutive season *i.e. Rabi*, 2022-23 and 2023-24. During the investigation the incidence of gram pod borer, *H. armigera* in chickpea crop started from first and second week of December and reached to peak at second to third week of February, respectively during both year of study. The larval population of *H. armigera* had significant positive correlation with maximum and minimum temperatures and significant negative correlation with morning relative humidity.

Keywords: Chickpea, seasonal abundance, *H. armigera*, correlation, abiotic factors.

INTRODUCTION

Chickpea (*Cicer arietinum* L.) commonly known as Bengal gram, gram or *Chana* belongs to Leguminosae family. Globally, chickpea as the third most important pulse crop in term of production, following the common bean (*Phaseolus vulgaris* L.) and field pea (*Pisum sativum* L.) (Jukanti *et al*., 2012). India accounts for 75 per cent of the world chickpea production and consumption (Das *et al.*, 2017). Chickpea is a rich source of carbohydrates (60.7%), protein (21.5%), fat (6.0%) and contains essential nutrients such as niacin (B3), riboflavin (B2), pantothenic acid (B5) and vitamin C (Ahlawat and Om Prakash 1996; Jukanti *et al.*, 2012). Additionally, chickpea contains significantly higher levels of calcium and phosphorus compared to other legumes. In India, chickpea is cultivated over an area of 10.91 million hectares with an annual production of 13.75 million tonnes and a productivity of 1260 kg/hectare (Anonymous, 2022a). The major chickpea growing states are Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Andhra Pradesh, Karnataka, Chhattisgarh, Bihar and Jharkhand, contributing over 95% of the total production. In Rajasthan, chickpea is cultivated on 2.25 million hectares area, produced 2.65 million tonnes annually with productivity of 1177 kg/hectare (Anonymous, 2022b). Major chickpea growing districts in Rajasthan includes Kota, Sriganganagar, Chittorgarh, Alwar, Tonk, Jhalawar, Pali, Jaipur, Sawai Madhopur, Bikaner, Churu, Sikar and Hanumangarh contributing approximately 14 per cent of the total production. Despite its significance, the per availability of pulses is only 52.9 grams per capita per day or 19.3 kg per capita per year (Anonymous, 2017), far below the Indian Council of Medical Research (ICMR) recommended daily requirement of 104 grams (Anonymous, 2010). This shortfall is primarily due to various production constraints, including abiotic and biotic factors.

MATERIAL AND METHODS

To study the seasonal incidence of *H. armigera* on chickpea, the variety RSG-902 was sown on 28th October during *Rabi* 2022-23 and on 1st November during *Rabi* 2023-24 five plots of 2.4 × 2.0 m^2 size keeping row to row and plant to plant distance of 30 cm and 10 cm, respectively. All the recommended practices for raising the crop will be followed except for plant protection measures.

For this purpose the crop was left for natural infestation. The larval population of pod borer was recorded at weekly interval on one-meter row length at five spots selected randomly in each plot from the first appearance till harvesting of the crop in the early morning hours without disturbing the flora and fauna. The data recorded on larval population and meteorological parameters used for statistical analysis.

The simple correlation computed between the larval population of gram pod borer and weather parameters, *viz.*, maximum and minimum temperatures, relative humidity and rainfall, as per Karl Pearson's coefficient of correlation formula (Steel and Torry 1980).

$$r_{xy} = \frac{\Sigma XY - \frac{\Sigma X \Sigma Y}{n}}{\sqrt{\left(\Sigma X^2 - \frac{(\Sigma X)^2}{n}\right)\left(\Sigma Y^2 - \frac{(\Sigma Y)^2}{n}\right)}}$$

Where,

r_{xy} = Simple correlation coefficient

x = Variable, *i.e.* abiotic component.

(Maximum temperature, minimum temperature, relative humidity and total rainfall)

y = Variable, *i.e.* mean number of insect pests

n = Number of observations.

RESULTS AND DISCUSSION

The data recorded on larval population of gram pod borer, *H. armigera* in chickpea crop during *Rabi*, 2022-23 and 2023-24 have been presented in Table 1 & 2 and Fig. 1 & 2. The study of Seasonal incidence of *Helicoverpa armigera* and their correlation with abiotic factors is help to know the most susceptible stage of pests which, suitable control measures should be adopted to manage the pests. Further the study is also helpful to minimize the population of regular pests through changing the cropping pattern.

In the present investigation the incidence of larval population of gram pod borer, *H. armigera* in chickpea crop was commenced from the first and second week of December *i.e.* 50th and 49th SMW, which gradually increased and reached to peak (6.52 & 7.32 larvae/MRL) in the third week of February (8th SMW) and second week of February (7th SMW) in *Rabi*, 2022-23 & 2023-24 respectively.

The present study are conformity with that of Choudhary *et al.* (2024) conducted the population dynamics of *H. armigera* on chickpea. The incidence commenced from first and second week of December *i.e.* 49th and 50th SMW. Which, increased gradually and reached peak (6.4 and 5.2 larvae/ m row) in the third and second week of February (8th and 9th SMW).

Lal *et al.* (2013) noticed two peaks of the larval population of gram pod borer, (*H. armigera)* on chickpea. First peak during 49th meteorological week (SMW) with a maximum of 1.73 and 2.13 larvae per meter row length and second peak with 8.93 and 7.93 larvae per meter row during 8th and 9th SMW in 2003-04 and 2004-05, respectively which decreased sharply with maturity of the crop.

Likewise, Awasthi *et al.* (2003); Chatar *et al.* (2010); Shinde *et al*. (2013); Patel *et al.* (2015); Patidar *et al.* (2020); Bajya *et al.* (2022); Yadav *et al.* (2024); Kumawat *et al*. (2024) reported the incidence of *H. armigera* throughout the crop growth stages. The population appeared from second fortnight of November being minimum in second fortnight of December to first fortnight of January and peak during second fortnight of February to first fortnight of April depending on the climatic conditions.

The correlation studies revealed that the larval population had positive significant correlation with maximum and minimum temperatures (r = 0.528 and 0.572; $p<.05$) while, non-significant negative correlation with morning and evening relative humidity (r = -0.278: $p<.05$, r = -0.314; $p<.05$) and non-significant positive correlation with rainfall during *Rabi*, 2022-23. Likewise, the population of *H. armigera* had significant positive correlation with maximum and minimum temperatures (r = 0.539 and 0.562; $p<.05$) and significant negative correlation with morning (r = -0.578; $p<.05$) relative humidity while, non-significant negative correlation with evening relative humidity and non-significant positive correlation with rainfall during *Rabi*, 2023-24.

The multiple linear regression analysis explained 41.0 and 59.0 percent variation in *H. armigera* population due to combined contribution of abiotic factors during *Rabi*, 2022-23 and 2023-24, respectively. The step wise regression analysis explained 29.0 per cent significant variation in *H. armigera* population due to maximum temperature during Rabi, 2022-23 and 28.0 per cent significant variation in *H. armigera* population due to evening relative humidity during *Rabi*, 2023-24.

The present findings are conformity with that of Pandey *et al.* (2012) the larval population showed a significant positive correlation with minimum and maximum temperature (r = 0.621 and r = 0.643). In contrast, morning relative humidity exhibited a strong negative correlation (r = -0.760).

Shinde *et al*. (2013) reported positive correlation with both minimum and maximum temperatures and negative correlation with morning fully support the finding. Singh and Ali (2006); Yadav and Jat (2009); Malik *et al.* (2015) reported positive correlation of larval population with both maximum and minimum temperatures. Bajya *et al.* (2010); Meena and Bhatia (2014) reported positive correlation of larval population *H. armigera* with relative humidity.

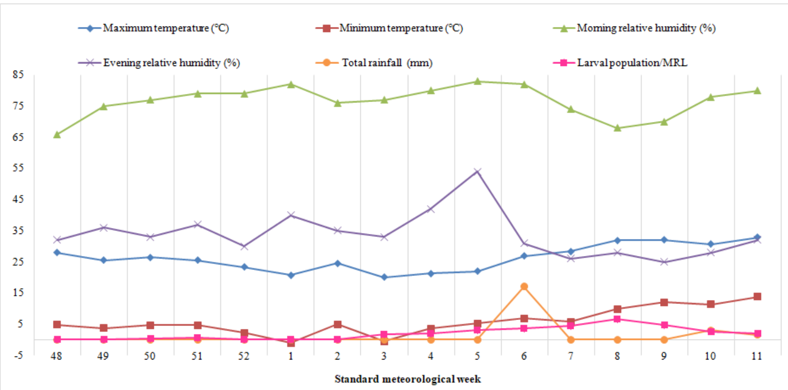

Fig. 1. Seasonal incidence of *H. armigera* on chickpea in relation to abiotic factors during *Rabi*, 2022-23.

Table 1 : Seasonal incidence of *H. armigera* on chickpea in relation to abiotic factors during *Rabi*, 2022-23.

Sr. No.	SMW#	Date of observation	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Larval population/MRL**
			Max.	Min.	Mor.	Eve.		2022-23
1.	48	26.11.2023	27.9	4.80	66	32.0	00.0	0.00
2.	49	03.12.2023	25.5	3.70	75	36.0	00.0	0.00
3.	50	10.12.2023	26.5	4.60	77	33.0	00.0	0.32
4.	51	17.12.2023	25.5	4.60	79	37.0	00.0	0.52
5.	52	24.12.2023	23.3	2.20	79	30.0	00.0	0.00
6.	1	01.01.2024	20.7	-1.00	82	40.0	00.0	0.00
7.	2	08.01.2024	24.5	4.90	76	35.0	00.0	0.00
8.	3	15.01.2024	20.1	-0.50	77	33.0	00.0	1.68
9.	4	22.01.2024	21.3	3.60	80	42.0	00.0	1.92
10.	5	29.01.2024	22.0	5.20	83	54.0	00.0	2.96
11.	6	05.02.2024	26.9	6.90	82	31.0	17.0	3.56
12.	7	12.02.2024	28.4	5.80	74	26.0	00.0	4.40
13.	**8**	19.02.2024	31.9	9.80	68	28.0	00.0	**6.52**
14.	9	26.02.2024	32.1	12.0	70	25.0	00.0	4.72
15.	10	05.03.2024	30.7	11.3	78	28.0	3.00	2.56
16.	11	19.03.2024	32.8	13.8	80	32.0	1.50	1.92

#SMW – Standard Meteorological Weeks; **MRL- meter row length

Table 2 : Seasonal incidence of *H. armigera* on chickpea in relation to abiotic factors during *Rabi* 2023-24.

Sr. No.	SMW#	Date of observation	Temperature (°C)		Relative humidity (%)		Rainfall (mm)	Larval population/MRL**
			Max.	Min.	Mor.	Eve.		2023-24
1.	48	26.11.2023	24.5	10.7	78.0	51.0	01.0	0.00
2.	49	03.12.2023	25.3	7.30	77.0	44.0	00.0	0.08
3.	50	10.12.2023	26.6	5.30	77.0	35.0	00.0	0.12
4.	51	17.12.2023	25.0	5.50	69.0	34.0	00.0	0.20
5.	52	24.12.2023	24.0	4.90	79.0	42.0	00.0	0.00
6.	1	01.01.2024	20.0	3.50	79.0	58.0	00.0	0.00
7.	2	08.01.2024	21.9	3.30	76.0	37.0	00.0	0.00
8.	3	15.01.2024	23.2	4.80	75.0	35.0	00.0	1.24
9.	4	22.01.2024	24.0	4.30	73.0	32.0	00.0	1.56
10.	5	29.01.2024	26.0	11.1	79.0	35.0	02.0	2.36
11.	6	05.02.2024	22.9	7.60	73.0	33.0	02.4	3.88
12.	**7**	12.02.2024	26.6	7.20	72.0	29.0	00.0	**7.32**
13.	8	19.02.2024	29.0	10.4	73.0	34.0	00.0	6.40
14.	9	26.02.2024	27.4	11.6	70.0	42.0	00.0	5.60
15.	10	05.03.2024	29.3	9.90	70.0	52.0	00.0	3.92
16.	11	19.03.2024	30.6	7.60	74.0	29.0	00.0	2.32

#SMW – Standard Meteorological Meeks; **MRL- meter row length

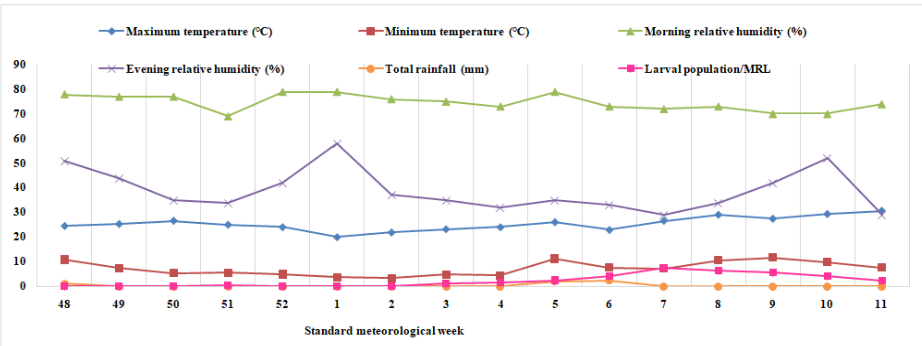

Fig. 2. Seasonal incidence of *H. armigera* on chickpea in relation to abiotic factors during *Rabi* 2023-24.

Table 3: Correlation coefficient between larval population of *H. armigera* on chickpea in relation to abiotic factors during *Rabi*, 2022-23 and 2023-24.

Larval population	Temperature (°C)		Relative humidity (%)		Rainfall (mm)
	Max.	Min.	Mor.	Eve.	
2022-23	0.528*	0.572*	-0.278	-0.314	0.225
2023-24	0.539*	0.562*	-0.578*	-0.328	0.076

* Significant at 5 per cent of significance

Table 4: Multiple regression models developed for larval population of *H.armigera* on chickpea during *Rabi*, 2022-23 and 2023-24.

Multiple linear regression equation ($Y= a + b_1X_1 + b_2X_2 + b_3X_3 + b_4X_4 + b_5X_5$)		R^2 value	
2022-23	2023-24	2022-23	2023-24
$Y= 21.92^a + (-0.36)\ T_{max} + (0.51)\ T_{min} + (-0.16)\ RH_{mor} + (-0.02)\ RH_{evn} + (0.11)\ Rf$	$Y= 26.78^a + (-0.18)\ T_{max} + (0.63)\ T_{min} + (-0.26)\ RH_{mor} + (-0.10)\ RH_{evn} + (-0.61)\ Rf$	0.411	0.598

a = constant

Table 5: Step wise regression models developed for larval population of *H. armigera* on chickpea during *Rabi*, 22-2023 and 23-2024.

Step wise regression equation ($Y= a +bX$)		R^2 value	
2022-23	2023-24	2022-23	2023-24
$Y= 0.746^a + (0.225)\ T_{max}$	$Y= 27.10^a + (-0.334)\ RH_{mor}$	0.296	0.280

CONCLUSIONS

The incidence of gram pod borer, *H. armigera* in chickpea study in early December, peaked in mid February. Significant positive correlations were observed between larval population and maximum and minimum temperatures and significant negative correlations were found with morning relative humidity.

FUTURE SCOPE

The findings of the current investigation on the seasonal occurrence of *Helicoverpa armigera* can significantly contribute to the development of targeted pest control strategies. By pinpointing the most vulnerable stages of these pests, it becomes possible to minimize the reliance on chemical pesticides. This approach helps create a safer environment that supports the growth of natural predators. Reducing pesticide use not only aids in the conservation of biological control agents but also enhances the effectiveness of natural pest management, particularly in controlling the larval populations of *H. armigera*.

Acknowledgement. The Head and Major guide, Department of Entomology, SKN College of Agriculture, Jobner, Jaipur allotted land and issued chemicals for partial fulfillment and financial supports. The authors are thankful to all the faculty members of Entomology Department; Dean, SKN College of Agriculture and the Director of Research for providing necessary facilities and encouragement.

Conflict of Interest. None.

REFERENCES

Ahlawat, I. P. S. and Prakash, O. M. (1996). Nutritional value of chickpea grains. Principles of agronomy and crops, pp. 43.

Anonymous (2010). Project coordinator's report of all India Coordinated Research Project on MULLaRP. IIPR, Kanpur, pp. 11.

Anonymous (2017). Agricultural Statistics at a Glance, 2016.

Anonymous (2022a). Agriculture Statistics. Reports of Directorate of Economics and Statistics, Department of Agriculture and Cooperation, Government of India, pp. 04.

Anonymous (2022b). Agricultural statistics at a glance 2018. Directorate of economics and statistics, Department of agriculture, co-operation and farmers welfare, ministry of agriculture and farmers welfare, Govt. of India, New Delhi.

Awasthi, A. K., Tiwari, R. B., Thakur, B. S., Shrivastava, D. K. and Chaure, N. K. (2003). Seasonal incidence of pod borer, *H. armigera* (Hub.) and yield losses in chickpea crop. *Journal of Entomological Research, 19,* 249-253.

Bajya, D. R., Monga, D., Tyagi, M. P. and Meena, B. L. (2010). Population dynamics of *Helicoverpa armigera* on chickpea, pigeon pea and cotton in correlation with weather parameters. *Annals of Plant Protection Science*, *18*, 223-282.

Bajya, R., Patel, Y., Garg, V. K. and Kumar, N. (2022). Effect of Weather Factors on Population Dynamics of *Helicoverpa armigera* Hubner (Noctuidae: Lepidoptera) in Chickpea. *Biological Forum - An International Journal*, *14*(4a), 242-245.

Chatar, V. P., Raghvani, K. L., Joshi, M. D., Ghadge, S. M., Deshmukh, S. G. and Dalave, S. K. (2010). Population dynamics of pod borer, *H. armigera* (Hub.) infesting chickpea. *International Journal of Plant Protection*, *3*(1), 65-67.

Choudhary, S., Deshwal, H. L. and Bana, J. K. (2024). Population dynamics of pod borer *H. armigera* on chickpea. *Indian Journal of Entomology*, *10*, 55446.

Das, A., Datta, S., Thakur, S., Shukla, A., Chaturvedi, S. K., Kumar, P. A. and Singh, N. P. (2017). Expression of a chimeric gene encoding insecticidal crystal protein Cry1A abc of *Bacillus thuringiensis* in chickpea (*Cicer arietinum* L.) confers resistance to gram pod borer, *H. armigera* (Hub.). *Frontiers in Plant Science*, *8,* 1423.

Jukanti, A. K., Gaur, P. M., Gowda, C. L. L. and Chibbar, R. N. (2012). Nutritional quality and health benefits of chickpea (*Cicer arietinum* L.): a review. *British Journal of Nutrition*, *108,* S11-S26.

Kumawat, S., Sharma, S. Kumari, H., Naga, B. L., Meena, R. K., Meena, S. K. and Arvind (2024). Population dynamics of *H. armigera* (Hubner) in chickpea. *Indian Journal of Entomology*, *10,* 55446

Lal, M., Singh, S. V., Singh, D. and Pal, B. N. (2013). Population fluctuations of *H. armigera* (Hub.) and *Campoletis chlorideae* and their relationship on chickpea. *Agriculture Sciences Digest*, *33*(1), 77-79.

Malik, R., Kumar, R., Prasad, C. S. and Rana, R. (2015). Seasonal dynamics of *H. armigera* (Hub.) on chickpea and relative abundance of larval parasitoid *Campoletis chlorideae* in correlation with weather parameters. *International Journal of Multidisciplinary Research and Advanced*, *1,* 1-6.

Meena, B. S. and Bhatia, K. N. (2014). Effect of weather parameters on population dynamics of gram pod borer (*Helicoverpa armigera*) in North West Plain Zone of Rajasthan. *Journal of Agrometeorology, 16*(2), 233-235.

Pandey, B. M., Tripathi, M. K. and Vijaylakshmi (2012). Seasonal incidence of *Helicoverpa armigera* (Hub.) on chickpea. *Annals of Plant Protection Science*, *22*, 190-239.

Patel, S. R., Patel, K. G. and Ghetiya, L. V. (2015). Population dynamics of pod borer, *H. armigera* (Hub.) in relation to abiotic factors. *An International e-Journal*, *4*(2), 163-170.

Patidar, D., Nayak, M. K., Jaiswal, S. K., Patel, K. and Patel, K. (2020). Seasonal variation of *H. armigera* (Hub.) population and their correlation with weather parameters under agro-climatic condition of Tikamgarh district, Madhya Pradesh. *International Archive of Applied Sciences and Technology*, *11*, 53-56.

Shinde, Y. A., Veeda, O. P. and Patel, B. R. (2013). Observed the larval population of *H. armigera* (Hub.) during *Rabi*, 2009-10 and 2010-11. *Current Biotica*, *7*(3), 222-227.

Singh, R. and Ali, S. (2006). Seasonal incidence of *H. armigera* (Hub.) and *Campoletis chlorideae* on chickpea. *Annals of Plant Protection Science, 14*(1), 234-235.

Steel, R. G. D. and Torry, J. H. (1980). Principles and procedures of statistics. Publication Mcgraw Hill Book Company, New York.

Yadav, S. K., Singha, D. R., Umraoa, R. S., Yadav, A. and Yadav, V., Yadav, G. (2024). Studies on seasonal incidence of gram pod borer, *H. armigera* (Hub.) on chickpea crop. *International Journal of Environment and Climate Change*, *14*(3), 349-354.

Yadav, S. R. and Jat, B L. (2009). Seasonal incidence of *H. armigera* (Hub.) on chickpea. *Journal of Insect Science* (Ludhiana), *22*(3), 325-328.

How to cite this article: Rajkumar Bajya, D.K. Bairwa, B.L. Jat, J.K. Bana, Akhter Hussain, S.L. Sharma, Laxman Singh Saini, D.R. Bajya and Suman Choudhary (2025). Seasonal Incidence of *Helicoverpa armigera* (Hub.) on Chickpea in Relation to Abiotic Factors Semi-arid Region of Rajasthan. *Biological Forum – An International Journal, 17*(1): 64-68.