A-5818
[1-4]

RESEARCH ARTICLE Indian Journal of Agricultural Research

Relationship between Weather Parameters and Incidence of Gram Pod Borer, *Helicoverpa armigera* on Chickpea

Keshav Mehra, Veer Singh

10.18805/IJARe.A-5818

ABSTRACT

Background: Chickpea, *Cicer arietinum* which is considered as a "King of pulses" get adversely affected by several biotic and abiotic stresses, out of which gram pod borer, *Helicoverpa armigera* (Hübner) is the major one. The damage caused by *H. armigera* starts from vegetative growth and continues till maturity of the crop. This pest is causes 25 to 70 per cent pod damage in chickpea but in favorable conditions pod damage goes upto 95 per cent.

Methods: Present study was carried out during, *rabi,* 2014-15 and 2015-16 at Research Farm, College of Agriculture, Bikaner (Rajasthan). Correlation coefficient was worked out with weather parameters such as temperature (maximum and minimum), relative humidity (maximum and minimum), rainfall and sunshine hours. Multiple linear forms of regression model were also used to assess the effect of the weather parameters on the incidence of pod borer.

Result: The studies revealed that peak larval population of gram pod borer was recorded in the second fortnight of February thereafter, population declined abruptly. The larval population of pod borer on chickpea occurred low at vegetative and flowering stages and high at pod formation as well as at grain developmental stages. The temperature (maximum and minimum) and sunshine hours had significant positive correlation with larval population during *rabi,* 2015-16. The maximum relative humidity showed significant negative correlation during *rabi,* 2015-16 whereas, minimum relative humidity showed significant negative correlation with larval population during both the seasons. The rainfall showed significant positive correlation during *rabi*, 2014-15.

Key words: Chickpea, Correlation, Gram pod borer, Population, Weather parameters.

INTRODUCTION

Chickpea, *Cicer arietinum* (L.) also known as gram or bengal gram belongs to the family leguminosae. It is one of the most important and remunerative pulse crop of *Rabi* season, grown around the world. Although all the pulses occupy a unique position in Indian agriculture as well as in the world but chickpea is considered as "king of pulses". The productivity of chickpea is adversely affected by several biotic and abiotic stresses, out of which gram pod borer, *Helicoverpa armigera* (Hubner) is the major one. The damage caused by *H. armigera* starts from vegetative growth and continues till maturity of the crop (Dhingra *et al.,* 2003). It is a very serious pest and has assumed the status of national pest in India because of its high fecundity, migratory behavior, cosmopolitan distribution, high adaptation to various climatic conditions and development of resistance to a wide range of insecticides (Gowda, 1996). Although it attacks chickpea throughout the crop growth, the damage caused during flowering and pod formation stages results in substantial yield loss. A single larva alone can destroy 30-40 pods before the maturity (Reed and Pawar, 1982). In Rajasthan, *H. armigera* caused 19-20 per cent reduction in grain yield of gram (Ameta and Thakar, 1988). The studies were undertaken to find out the correlation coefficient along with regression equation between pest population and key weather parameters to know the most favourable conditions.

Department of Entomology, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner-334 001, Rajasthan, India.

Corresponding Author: Keshav Mehra, Department of Entomology, College of Agriculture, Swami Keshwanand Rajasthan Agricultural University, Bikaner-334 001, Rajasthan, India.
Email: keshav.mehra35@gmail.com

How to cite this article: Mehra, K., Singh, V. (2021). Relationship between Weather Parameters and Incidence of Gram Pod Borer, *Helicoverpa armigera* on Chickpea. Indian Journal of Agricultural Research. DOI: 10.18805/IJARe.A-5818.

Submitted: 08-05-2021 **Accepted:** 19-11-2021 **Online:** 22-12-2021

MATERIALS AND METHODS

The experiment was conducted at Research Farm, College of Agriculture, Bikaner (Rajasthan) to study the relationship between weather parameters and incidence of *H. armigera* on chickpea, the variety GNG-1581 was sown on 15th October during *rabi,* 2014-15 and on 17th October during *rabi,* 2015-16 in a plot of 10 × 10 m^2. The row to row and plant to plant distance of 30 and 10 cm was maintained, respectively. Population of *H. armigera* was recorded at weekly intervals on chickpea. The observations on the incidence of *H. armigera* infesting chickpea were recorded by counting the larval population per meter row length from five randomly selected spots in the plot.

Correlation coefficient was worked out with weather parameters such as temperature (maximum and minimum), relative humidity (maximum and minimum), rainfall and sunshine hours. Following formula was used for calculating correlation coefficient.

$$rX_1Y_1 = \frac{\Sigma X_1 Y_1 - \frac{\Sigma X_1 \Sigma Y_1}{n}}{\sqrt{\left[\Sigma X_1^2 - \frac{(\Sigma X_1)^2}{n}\right]\left[\Sigma Y_1^2 - \frac{(\Sigma Y_1)^2}{n}\right]}}$$

Where,

rX_1Y_1= Simple correlation coefficient.

X_1= Independent variable *i.e.* abiotic component.

Y_1= Dependent variable *i.e.* pest.

n= Number of observations.

Multiple linear forms of regression model was also used to assess the effect of the weather parameters on the incidence of pod borer.

$$Y = a + b_1 X_1 + b_2 X_2 + \ldots\ldots\ldots\ldots\ldots + b_5 X_5 + Ui$$

Where,

Y = Larval population of *H. armigera*.

a = constant.

x_1 = Maximum temperature (°C).

x_2 = Minimum temperature (°C).

x_3 = Maximum relative humidity (%).

x_4 = Minimum relative humidity (%).

x_5 = Rainfall (mm).

x_6 = Sunshine hours (hrs).

Ui = Error term.

RESULTS AND DISCUSSION

Effect of weather parameters on the incidence of *H. armigera*

The data presented in Table 1 and Fig 1,2 revealed that the larval population of *H. armigera* first appeared in the third and fourth week of January during *rabi,* 2014-15 and 2015-16, respectively. Initially only 0.3 and 0.9 larva per meter row length (mrl) were recorded during *rabi*, 2014-15 and 2015-16, respectively. The present results are in agreement with those of Lal (1996), Reddy *et al*. (2009) and Dhaka *et al*. (2011), who reported activity of larvae of *H. armigera* during the months of January and February. The larval population increased gradually after appearance with the vegetative growth of the chickpea and attained its peak in the fourth week of February (5.8 larvae per mrl) during *rabi*, 2014-15 and third week of February (6.0 larvae per mrl) during *rabi*, 2015-16; there after, population declined abruptly. The results corroborate the findings of Gupta and Chandel (2008), Dhaka *et al.* (2011), Pandey *et al.* (2012), Sharma *et al.* (2012) and Shinde *et al.* (2013) who reported peak period of larval infestation in last week of February and beginning of March.

Correlation between weather parameters and larval population of *H. armigera*

The correlation studies (Table 2) revealed that during first year (*rabi,* 2014-15) the larval population showed non-significant positive correlation with maximum temperature and minimum temperature (r=0.022 and 0.163, respectively). These results corroborates with findings of Krishna *et al.* (2007), Gupta and Chandel (2008), Reddy *et al.* (2009), Sharma *et al.* (2012) and Mahawar *et al.* (2015), who reported positive non-significant correlation with larval population and temperature. During second year (*rabi,* 2015-16), the significant positive correlation was also existed between larval population and maximum and minimum temperature (r=0.884 and 0.898). Kulhari and Singh (2008), Pandey *et al.* (2012), Shinde *et al.* (2013) and Yadav *et al.* (2016) also computed significant positive correlation between larval population and temperature, which supports the present findings.

Maximum relative humidity showed negative non-significant (r=-0.110) and significant correlation (r=-0.761) with larva population during first and second year, respectively, while minimum relative humidity showed significant negative correlation during both the years (r=-0.588 and -0.582, respectively). The present finding confirms with the results

Table 1: Incidence of *H. armigera* on chickpea during *rabi,* 2014-15 and 2015-16.

SMW*	Month and week	Mean larval population per meter row length	
		2014-15	2015-16
3	January III	0.3	0.0
4	January IV	0.6	0.9
5	January V	1.3	1.8
6	February I	1.9	2.5
7	February II	2.7	4.1
8	February III	3.4	6.0
9	February IV	5.8	4.9
10	March I	4.1	3.7
11	March II	3.2	2.6
12	March III	2.1	1.2
13	March IV	0.8	0.6
14	April I	0.0	0.0

*SMW-Standard meteorological week.

Table 2: Correlation between larval population of *H. armigera* and weather parameters.

Abiotic factors	Correlation coefficient (r)	
	2014-15	2015-16
Temperature (°C)		
a. Maximum	0.022 NS	0.884**
b. Minimum	0.163 NS	0.898**
Relative humidity (%)		
a. Maximum	-0.110 NS	-0.761**
b. Minimum	-0.588*	-0.582*
Rainfall (mm)	0.807**	0.115 NS
Sunshine (hrs)	0.010 NS	0.868 **

*Significant at 5% level of significance, ** Significant at 1% level of significance, NS- Non-significant.

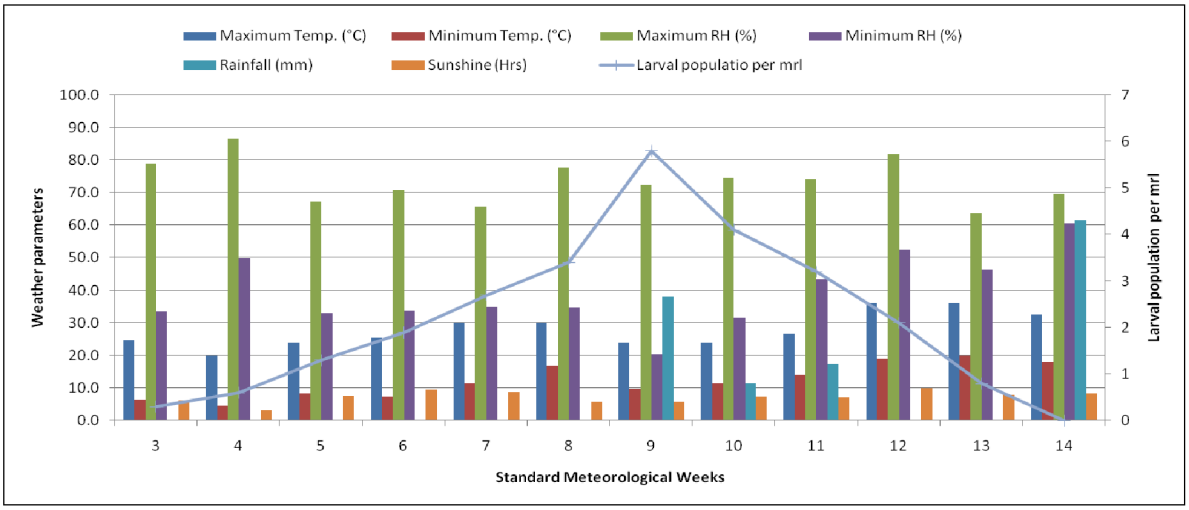

Fig 1: Seasonal incidence of *Helicoverpa armigera* on chickpea during *rabi*, 2014-15.

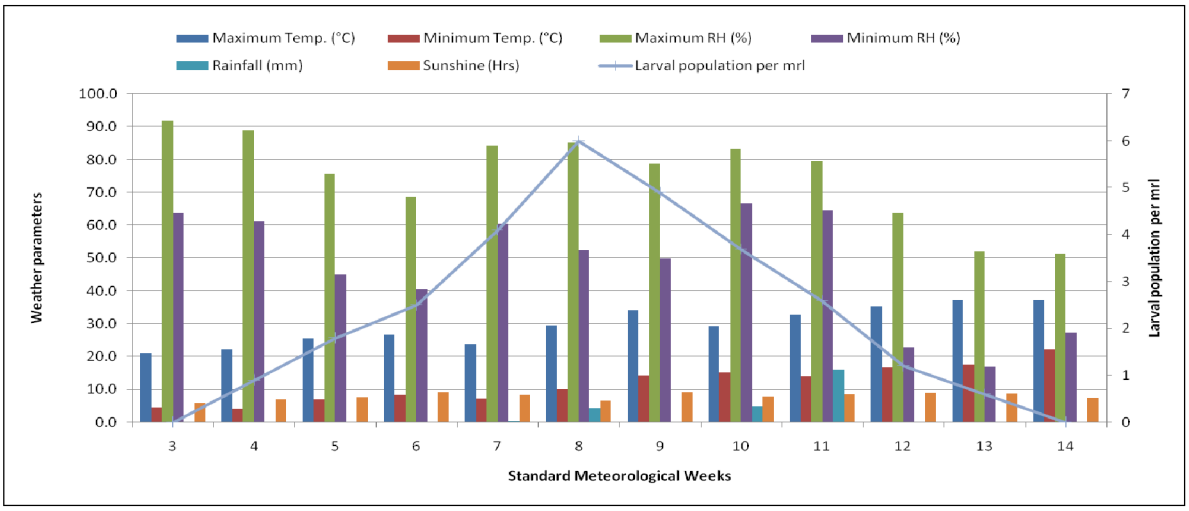

Fig 2: Seasonal incidence of *Helicoverpa armigera* on chickpea during *rabi*, 2015-16.

Table 3: Regression analysis between larval population of *H. armigera* and weather parameters.

Year	Regression equation	R^2	R
2014-15	$Y= 2.374-0.286T_{max}+0.390T_{min}+0.094RH_{max}-0.152RH_{min}+0.015RF+0.260SSH$	0.813	0.902
	$Y= 3.630-0.176T_{max}+0.328T_{min}+0.072RH_{max}-0.154RH_{min}+0.016RF$	0.777	0.882
	$Y= 5.798-0.247T_{max}+0.390T_{min}+0.056RH_{max}-0.143RH_{min}$	0.754	0.868
	$Y= 11.611-0.410T_{max}+0.355T_{min}-0.033RH_{max}$	0.240	0.489
	$Y= 8.733-0.390T_{max}+0.348T_{min}$	0.225	0.475
	$Y= 3.986-0.065T_{max}$	0.037	0.193
2015-16	$Y= -24.278+0.426T_{max}-0.168T_{min}+0.128RH_{max}+0.043RH_{min}-0.095RF+0.567SSH$	0.522	0.722
	$Y= -21.609+0.662T_{max}-0.367T_{min}+0.057RH_{max}+0.098RH_{min}-0.140RF$	0.472	0.687
	$Y= -18.194+0.458T_{max}-0.224T_{min}+0.113RH_{max}+0.023RH_{min}$	0.436	0.660
	$Y= -18.847+0.417T_{max}-0.171T_{min}+0.144RH_{max}$	0.432	0.657
	$Y= -1.390+0.227T_{max}-0.251T_{min}$	0.055	0.235
	$Y= 2.644-0.010T_{max}$	0.001	0.028

Where, Y= Larval population of *H. armigera*; T_{max}= Maximum temperature (°C); T_{min}= Minimum temperature (°C); RH_{max}= Maximum relative humidity (%); RH_{min}= Minimum relative humidity (%); RF= Rainfall (mm); SSH = Sunshine hours (Hrs).

of Pandey *et al.* (2012) and Sharma *et al.* (2012) they recorded negative non-significant correlation between larval population and relative humidity. Umbarkar *et al.* (2010), Wakil *et al.* (2010) and Mahawar *et al.* (2015) computed negative significant positive correlation with larval population and relative humidity; these findings are also supports present findings.

Rainfall showed significant and non-significant positive correlation (r=0.807 and 0.115) with larva populationduring first and second year, respectively. The present results corroborates with the findings of Gupta and Chandel (2008), Kulhari and Singh (2008) and Kumar *et al.* (2015), who also found positive non-significant correlation between larval population and rainfall.Sunshine hours showed non-significant and significant positive (r=0.010 and 0.868) correlation during first and second year, respectively. Mahawar *et al.* (2015) recorded positive non-significant correlation with sunshine hours and larval population which supports the present findings.

Regression analysis between larval population of *H. armigera* and weather parameters

The regression equation was computed by taking of larval population of pod borer as dependent variable and other weather parameters as independent variable. It was evident from the study that none of the weather parameters were alone responsible for larval population of pod borer on chickpea (Table 3). All weather parameters collectively accounted for 81.30 and 52.20 per cent variability in larval population of pod borer during 2014-15 and 2015-16, respectively.

ACKNOWLEDGEMENT

Authors are thankful to Department of Science and Technology, New Delhi for providing financial support. The authors are also thankful to the Dean, COA and Head, Department of Entomology, COA, Bikaner for providing necessary research facilities for conducting the experiment.

REFERENCES

Ameta, O.P. and Thakar, A.V. (1988). Assessment of losses due to insect pests of gram. Indian Journal of Applied Entomology. 2: 21-26.

Dhaka, S.S, Singh, G., Yadav, A., Mittal, V., Singh, D.V. and Singh, B. (2011). Seasonal incidence of the pod borers, *Etiella zinckenella* (Treitschke) and *Helicoverpa armigera* (Hubner) on vegetable pea in Meerut. Annals of Horticulture. 4(1): 89-94.

Dhingra, S., Kodandaram, M.H., Hegde, R.S. and Srivastava, C. (2003). Evaluation of different insecticide mixture against third instar larvae of *Helicoverpa armigera* (Hübner). Annals of Plant Protection Sciences. 11(2): 274-276.

Gowda, S. (1996). Comparative assessment of pyrethroid resistance in certain population of *Heliothis armigera*. Entomon. 16: 233-235.

Gupta, J.K. and Chandel, S.F. (2008). Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hubner) on chickpea. Indian Journal of Applied Entomology. 22 (2): 120-122.

Krishna, K., Kanaujia, K.R. and Kanaujia, S. (2007). Role of plant density and abiotic factors on population dynamics of *Helicoverpa armigera* (Hubner) in chickpea. Annals of Plant Protection Sciences. 15(2): 303-306.

Kulhari, G.L. and Singh, V. (2008). Seasonal incidence of *Helicoverpa armigera* (Hubner) on chickpea [*Cicer arietinum* (L.)]. Indian Journal of Applied Entomology. 22(2): 117-119.

Kumar, S., Singh, G., Singh, D.V., Rahul, S.N. and Kumar, S. (2015). Seasonal incidence of larval population of gram pod borer (*Helicoverpa armigera* Hubner) on chick pea in Meerut. Progressive Agriculture. 15(2): 259-262.

Lal, O.P. (1996). An outbreak of pod borer, *H. armigera* on chickpea in Eastern Uttar Pradesh. Journal of Entomological Research. 20(2): 179-181.

Mahawar, M.K., Chanu, N.Y., Nagar, R., Swaminathan, R. and Jain, H.K. (2015). Pod borer incidence and loss estimation in chickpea. Indian Journal of Applied Entomology. 29(1): 36-39.

Pandey, B.M., Tripathi, M.K. and Vijay, L. (2012). Seasonal incidence of gram pod borer *Helicoverpa armigera* (Hub.) on chickpea in Varanasi area. Journal of Experimental Zoology India. 15(2): 667-669.

Reddy, V., Anandhi, P., Elamathi, S. and Varma, S. (2009). Seasonal occurrence of pulse pod borer *Helicoverpa armigera* (Hubner) on chick pea at Eastern U.P. region. Agricultural Science Digest. 29(2): 60-62.

Reed, W. and Pawar, C.S. (1982). *Heliothis*: A Global Problem. In Proceedings of International Workshop on *Heliothis* Management. ICRISAT, Patancheru. 9-41.

Sharma, P.K., Kumar, U., Vyas, S., Sharma, S. and Shrivastava, S. (2012). Monitoring of *Helicoverpa armigera* (Hubner) (lepidoptera: noctuidae) through pheromone traps in chickpea (*Cicer arietinum*) crop and influence of some abiotic factors on insect population. IOSR Journal of Environmental Science, Toxicology and Food Technology. 1(5): 44-46.

Shinde, Y.A., Patel, B.R. and Mulekar, V.G. (2013). Seasonal incidence of gram caterpillar, *Helicoverpa armigera* (Hub.) in chickpea. Current Biotica. 7(1 and 2): 79-82.

Umbarkar, P.S., Parsana, G.J. and Jethva, D.M. (2010). Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hubner) on greengram. Legume Research. 33(2): 148-149.

Wakil, W., Ghazanfar, M.U., Kwon, Y.J., Qayyum, M.A. and Nasir, F. (2010). Distribution of *Helicoverpa armigera* Hubner (Lepidoptera: Noctuidae) in tomato fields and its relationship to weather factors. Entomological Research. 40(6): 290-297.

Yadav, P.C., Ameta, O.P. and Yadav, S.K. (2016). Seasonal incidence of gram pod borer, *Helicoverpa armigera* (Hubner) in chickpea. Journal of Experimental Zoology India. 19(1): 587-589.