Effect of Weather Factors on Population Dynamics of *Helicoverpa armigera* Hubner (Noctuidae: Lepidoptera) in Chickpea

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ABSTRACT: The field experiment on population dynamics, of gram pod borer (*H. armigera*) on chickpea was conducted at the JNKVV, College of agriculture Ganj Basoda. During Season rabi 2020-21. The results showed that the larval population of *H. armigera* was first observed 48th SMW (0.20 larval/mrl) which increased gradually and attained a peak larval population on 8th SMW (3.80 larvae/mrl). The weather condition prevailed in this week is Thereafter, the population declined from 9th SMW with average population of 3.30 (larvae/mrl) which gradually decreased with 3.0 & 2.82 & 2.25 in 10th and 11th and 12th SMW, respectively. The correlation analysis between gram pod borer with weather parameters indicated that maximum temperature (r=0.581) had significant positive correlation with gram pod borer, while minimum temperature (r = 0.287) shows positive non-significant and maximum relative humidity (r = - 0.593) showed significant negative correlation, whereas minimum relative humidity (r = - 0.347) and rainfall (-0.283) showed non-significant negative correlation with gram pod borer.

Keywords: Chickpea, Population dynamics, *Helicoverpa*, Weather factors, Relative Humidity, Temperature.

INTRODUCTION

The chickpea (*Cicer arietinum* L.) is a prominent legume crop in the Fabaceae family. Ninety percent of the world's chickpea output comes from Asia, (Ahmed and Awan 2013). This legume supplies larger amounts of calcium and phosphorus than other legumes and contains more calcium than whole cow's milk (120 mg/100 g) (Lamesgen, 2021). In India, it is cultivated in an area of 10.17 million hectares having an annual production of 11.35 million tonnes and productivity of 1116 kg/ hectare (Anonymous 2020a). In India particularly, in the states of Madhya Pradesh, Uttar Pradesh, Rajasthan, Bihar, Haryana, Maharashtra and Punjab. Rajasthan is one of the major states which occupies 2.6 million hectares area with production of 26.60 lakh tonnes and 1080 kg/hectare productivity (Anonymous 2020b). The chick pea growing districts in Rajasthan are Churu, Jhunjhunu, Hanumangarh, Sri Ganganagar, Ajmer, Sikar, Jaisalmer, Jaipur, Bikaner etc. Chickpea area, production, productivity in India 9.44/million hacter, 10.13 m/ton, 1073 kg/hac. and Madhya Pradesh 3.43/million hacter, 4.61 m/ton, 1344 kg/hac (Source-Agriculture at a Glance 2019. Directorate of Economics and Statistics, Department of Agriculture Cooperation & Farmers Welfare, Govt. of India, New Delhi) Chickpea production is strongly influenced by insect pests. The average loss from pod borer damage on chickpeas is from 25 to 30 per cent, and in some cases, despite numerous rounds of

insecticide application, the crop may be totally lost (Sarwar *et al.*, 2009). *Helicoverpa armigera* is a severely polyphagous pest which feed over 182 plant species, including cotton, maize, tobacco, pigeon pea, chickpea, and tomato, among many others (Gowda *et al.,* 2005). Chickpea production losses due to *H. armigera* ranged from 75 to 90 percent, with certain places having losses of up to 100 percent (Jeyarani *et al.*, 2010). *H. armigera* larvae, which feed on the host plant's growth points and reproductive organs, can harm up to 40 pods in a single feeding cycle. It destroys the floral buds, blooms, and young pods of the growing crop (Khan *et al.*, 2009). Therefore, in order to design a superior pest management model for the crop in this region, the present research study was undertaken to know the population dynamics of *H. armigera* larvae in relation to weather factors, under chickpea field conditions.

MATERIALS AND METHODS

The study was conducted during Rabi season 2020-21 at research field of College of Agriculture, Ganjbasoda. A popular variety of Chickpea JG-12 was sown with spacing 30 × 10 cm spacing and 0.2 hec. Plot size. All the normal agronomical practices recommended for the region were follower for raising the crop. No plant protection measure will be taken throughout the crop season. During the experiment, the crop was left as untreated in the experiments, 2nd in star larval

population of *H. armigera* were counted as per linear meter row.

Method of observation. The observations on population dynamics of gram pod borer were recorded at twice in a week (Standard Metrological Week) on randomly selected per meter row length at 10 sites from the first appearance of the pest and continued till maturity of the crop. The data thus, collected were computed and subjected to statistical analysis.

At the same time, observations on weather parameters *viz.* minimum and maximum temperature, morning and evening percent relative humidity, total rainfall per week, total rainy days per week, wind velocity (kmph) and sunshine hours per days were recorded daily. Standard meteorological Week (SMW) average of all the data collected for the pest, weather factors were calculated before statistical analysis. The data thus, collected were computed and subjected to statistical analysis. All the possible correlations and regression were worked out.

RESULTS AND DISCUSSION

Population dynamics of pod borer (*Helicoverpa armigera*) in chickpea. Showed that the first appearance of *H. armigera* was recorded during 48th SMW when larval population was observed 0.20 larvae/meter row length and maximum and minimum temperature, were 28.42°C and 12.14°C respectively, relative humidity during morning and evening was 83% and 33% respectively. The larval population increased to 0.50 larvae/mrl during next week (49th SMW) when maximum and minimum temperatures were 31.50°C and 12.71°C, respectively with 82% morning and 41% evening relative humidity. The population of *Helicoverpa* larvae was suddenly sharp increased and reached at its peak during 8th standard meteorological week (23 February to 01 March) being 3.80 larvae/mrl. During this week, maximum and minimum temperatures were 29.56°C, and 13.57°C and morning and evening relative humidity was 78% and 42% respectively. After next SMW declined of larval population is due to increase of maximum and minimum temperature, which was optimum range of temperature for higher growth rate of larval population. After that decline trend was observed from 9th SMW and 10th SMW (3.30 larvae/mrl & 3.00 larve/mrl) and reached its lowest level during 11th & 12th SMW (2.82 larvae/mrl & 2.25 larve/mrl) when maximum & minimum temperature were 34.50°C and 34.42°C & 28.18°C and 18.42°C respectively and relative humidity was 71% & 62 (morning) and 33% & 24% (evening).
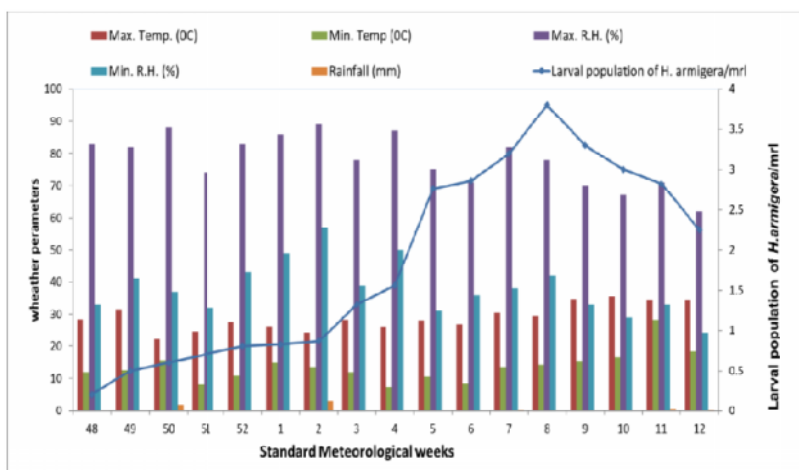
Fig. 1. Population dynamics of pod borer (*Helicoverpa armigera*) chickpea in relation to weather factor.

Correlation coefficient the larval population of pod borer (*H. armigera*) with different weather factors. The correlation studies revealed that the correlation (r =0.581) larval population of *H. armigera* maximum temperature was found positive significant and minimum temperature was positive non-significant (r = 0.287). The Maximum relative humidity had significant negative correlation with larval population of *H. armigera* is (r = -0.593) and negative but very weak correlation between *H. armigera* larval population with minimum relative humidity and rainfall (r = -0.347, and - 0.283 respectively. were also found to be non-significant.

Table 1: Correlation coefficient the larval population of gram pod borer (*H. armigera*) with weather factors.

Particulars	Larval population of *H. armigera*/mrl	
	Correlation coefficient (r)	t-calculated
Maximum temperature	0.581*	2.76
Minimum temperature	0.287	1.16
Maximum relative humidity	-0.593*	2.85
Minimum relative humidity	-0.347	1.43
Rainfall (mm)	-0.283	1.14

* Significant at 5% level; t-tabulated= 2.13

Regression Equation pod borer population with Maximum Temperature. The Regression equation of maximum, temperature with larval population of *H. armigera*/mrl. is showed in Fig. 2 indicated that regression coefficient value between the Pod borer population and Max Tem clearly indicated that 32.19 % change in pod borer population were affected by maximum temperature. The regression equation showed that a unit change in maximum temperature has exerted an influence on the pod borer population was increase in 0.162 mrl.
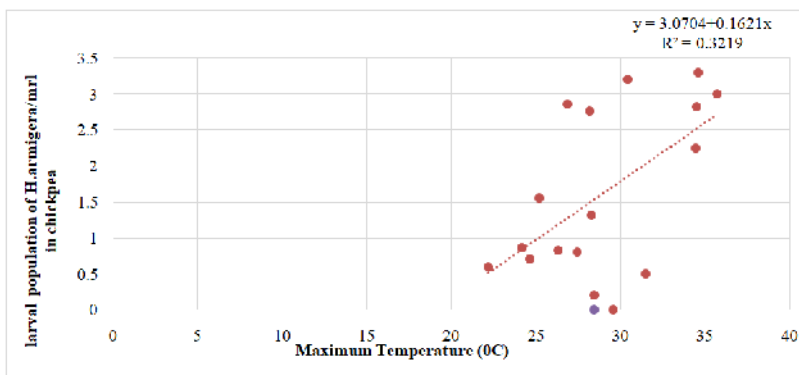
Fig. 2. Regression of maximum temperature with larval population of *H. armigera* /mrl.

Regression Equation pod borer population with maximum relative humidity. The Regression equation of maximum relative humidity with larval population of *H. armigera*/mrl. is showed in Fig. 3 indicated that regression coefficient value between the Pod borer population and Max. Tem. clearly indicated that 37.20 % change in pod borer population were affected by maximum relative humidity. The regression equation showed that a unit change in maximum relative humidity has exerted an influence on the pod borer population was increase in 0.089 mrl.
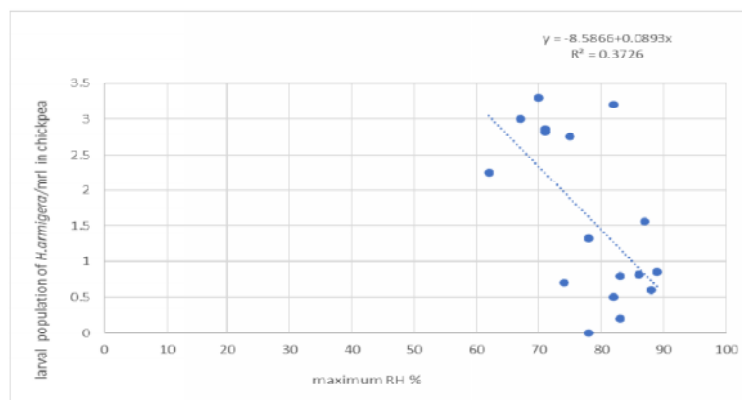
Fig. 3. Regression of max. RH % with larval population of *H. armigera*/mrl.

The *H. armigera* (Hubner) was found for the first time in the 48th Standard Meteorological Week (1st week of December) and remained till the 12th Standard Meteorological Week (last week of March). According to Chatar *et al*. (2010), *H. armigera* first appeared in the fourth week of November. This conforms to the current findings. During the 9th SMW, the pest reached its peak activity (4.80 larvae/meter row length) (26 February to 04 March). When in the morning and evening, the maximum and minimum temperatures were 33.29 °C and 13.000 C, respectively, with relative humidity levels of 80 percent and 25 percent. On chickpea, Lal *et al*. (2013) investigated two peaks of the larval population of the gram pod borer, *H. armigera*. The first peak occurred during the 49th meteorological week (smw) with a maximum of 1.73 and 2.13 larvae per metre row length, and the second peak occurred during the 8th and 9th SMW in 2003-04 and 2004-05, respectively, with 8.93 and 7.93 larvae per metre row, which decreased sharply with crop maturity. Patel *et al*. (2015) studied chickpea pod borer (*H. armigera* Hub.) population dynamics in relation to abiotic factors. According to studies, the pest actually started in the second week of November and remained till the fourth week of February, with peak activity in the first and second weeks of December. The correlation study showed a significant negative relationship between *H. armigera* larval population and evaporation (-0.551). There was no significant correlation between the larval population of *H. armigera* and maximum temperature, evening relative humidity, evening vapour pressure, or wind speed.

Piece of advice for Further Analysis. Analyses on the population dynamics of *H. amigera* in chickpea should be conducted over a larger period of time in order to determine the pest's status and the ideal ability to implement management approaches. A light trap monitoring scheme for the gram pod borer (*H. armigera*) should be implemented.

Plate 1 and 2: Larvae of *H. armigera.*

CONCLUSION

The field experiment on population dynamics, of gram pod borer (*H. armigera*) on chickpea was conducted at the JNKVV, College of agriculture Ganj Basoda during Rabi 2020-21. The results showed that the larval population of *H. armigera* was first observed 48th SMW (0.20 larval/mrl) which increased gradually and attained a peak on 8th SMW (3.80 larvae/mrl). Thereafter, the population declined from 9th SMW with average population of 3.30 (larvae/mrl) which gradually decreased with 3.0 & 2.82 & 2.25 in 10th and 11th and 12th SMW, respectively. The correlation analysis between gram pod borer with weather parameters indicated that maximum temperature ($r=0.581$) had significant positive correlation with gram pod borer, while minimum temperature ($r = 0.287$) shows positive non-significant and maximum relative humidity ($r = -0.593$) showed significant negative correlation, whereas minimum relative humidity ($r = -0.347$) and rainfall (-0.283) showed non-significant negative correlation with gram pod borer.

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