

Effect of Environmental factors on population incidence *Helicoverpa armigera* (Hubner) in Bengal gram.

S. A. Dwivedi*, Monu, S. K. Gharde and Vipul Kumar

School of Agriculture, Lovely Professional University, Phagwara Punjab

*Corresponding author Email: dwivedi.sunilkumar46@gmail.com

Abstract:

The population of Pod borer Helicoverpa armigera incidence was observed from eight standard weeks February (4th week) to the first week of May maximum population was observed in first week of May 14.7larvae/5plant. Minimum population was observed fourth week of May (20 SW) after that population start decline rapidly up to (2017-18) the pest appeared on the chickpea crop in January second week and maximum population observed in fourth week of April 14 larvae/5plant. The population was slightly decline first week of May (2018-19). Simple correlation studies to evaluate the instantaneous effect of the meteorological variables revealed that of the density independent factors (mini. & maxi temp, rainfall and R.H.) Temp. had played biggest role in pod borer population builds up. There was positive correlation between incidence of pest and temp and rainfall. There was no significant correlation between pod borer population and relative humidity. The correlation between pod borers with biotic factor (natural enemies) was not found significant.

Keywords: Pod borer, Population dynamics, Abiotic factors and Correlation.

Introduction:

Bengal gram (*Cicer arietinum* L.) is most important leguminous pulse crop that belongs to family Fabaceae, third most important grain legume crop in the world (Romeis et al., 2004), India ranks first in the production and consumption of chickpea in the world. Chickpea is important pulse crop as food, feed and fodder (Singh, 1997) It is a rich source of nutritional values in the diet of Indian people because of containing 22% of highly digestive protein, 60.2% total carbohydrates, 5.6% fat, 9.1% crude fiber and 3.1% ash. The mineral components are high in phosphorous (343mg/100gm), Iron (7mg/100gm) and Zinc (3mg/100g). it is mostly consumed in

from of a whole seed (boiled), decorated split cotyledons, dhal flour (besan) or some other product. Chickpea has additional value for farmer it with the help of root nodule fixing symbiotic nitrogen for improve productivity of soil.(Jerotich, 2013)The origin place of Bengal gram has is south-eastern Turkey, from where it spread throughout the world. (Pinto *et.al.*2017). Pulses are cultivated across the country with the maximum share coming from M.P. (24%), U. P. (16%), MH (14%), A. P. (10%), Karnataka (7%) and Raj. (6%) These states are contributing near about 77% of the total pulses production, while the remaining 23% is contributed by Gujarat, Chhattisgarh, Bihar, Orissa and other state. (Singh *et.al.*2018) chickpea accounted for more than 43% (7.06 MT) of the total pulses production (16.35 MT) in India and nearby 85% of total pulse exports from 2015 to 2016(Srivastava *et.al.*2017).

H. armigera is a prolific, widespread pest, feed on at least 180 plant species, spread across 47 botanical families (Kumar *et.al.* 2017) *H. armigera*(Hubner) (Lepidopteran: Noctuidae) is pest of many agricultural produce, like chickpea, cotton, pigeonpea, tomato, sorghum and cowpea also on groundnut, okra, peas, field beans and soybeans.(Pimparkar *et.al.* 2017 & Subramanian *et.al.*2006) It is mainly consumed on leaves, buds, flowers and young pods of the growing crop. Due to polyphagous, multi voltine, migratory behavior, high egg laying capacity easily developed resistance against available insecticidal doses, its became a difficult pest for management. (Sarwar *et.al.*2009)*Helicoverpa armigera* moth has pale reddish-brown with a prominent dot near the middle of the forewing. A larva has different colors changing from green, brown or yellowing. (Zahid *et.al.*2008)it caused maximum damaged on at time of pod formation stage (Lal *et al.*, 1985; Naresh & Malik, 1986)the impact of abiotic factors on lepidopteran insect population dynamics of the average Mini andMax. Temp, Mini and Max RH and Rainfall(Bhamare *et.al.* 2018)Its incidence appeared start from December second week and its peak period became during second week of January.Pest found active in the time period of fourth week of Dec. to third week of Jan. After that population decrease slowly and crop turned toward maturity. (Chataret.*al.*2010)Environmental factors creating stresses are the major constraints in enhancing the productivity of chickpea in India. Insect – pests and diseases are biotic bottlenecks in realizing its potential yield. Chickpea faces the attack of more than 60 insect-pests right from germination to maturity and also in storage (Shrivastava, 2003). According to Rahman, (1990) under suitable weather condition the damage of crop could

increase upto 90-95% due to present investigation was carried to found exact effect of weathers parameter on pod borer population.

Material and Methods:

The present study “Studies on population dynamics of chickpea pod borer, *Helicoverpa armigera* (Hubner) in relation to weather parameters ” were carried out on Student Research Farm, Domain of Entomology, School of Agriculture, Lovely Professional University, Phagwara, Punjab during 2017-18 and 2018-19. The research field is located at 31° 15' North latitude, 75° 32' East longitudes at 228 m above MSL. Trial was conducted in a RBD having nine treatments and three replication of chickpea variety USHA 362 having plot size 5x3m by maintaining spacing 45x10 cm.

Observation and data collection:

The observation was recorded from germination of crop till the harvesting of crop. Different pest population and natural enemies was recorded at weekly interval.

Two different methods were followed for the data observation of population method is visual count method (VCM) and Ground Cloth Shake method (GCSM). The time needed during each observation were conducted by properly counting them visually on the plant in the treatment of different randomly selected five plants in VCM and in GCSM, a white cloth sheet (1x0.5m) was stretched in between the rows and plants were shaken with hands to dislodge the larvae on to the sheet. After that, the number of larvae available on the sheet were counted and released on the same plant. Observation from each unit from different plots that replicated three times randomly taken every week and the time taken during each observation was recorded. Comparison of VCM with GCSM was done on the basis of mean number of larvae counted on five randomly selected plants. Relative Variation (RV), Time (min/hr.) took per sample and Relative Net Precision (RNP) values for two methods were compared to determine the efficiency and accuracy of sampling. (Snedecor and Cochran, 1967)

Formulae:

$$RV = \frac{SE(\text{Standard Error})}{X (\text{Mean number of larvae/sample})}$$

$$RNP = \frac{1}{RV \times \text{Time (mean hr.) taken/sample}}$$

Lower the RV and higher the RNP values, more accurate and efficient. Here, sample unit size of row length 3m so, using VCM were compared by calculating the mean, standard error and RNP values.

The data was collected at seven day interval from the field and recorded on basis of treatment and replication. The data collection was started at the flower initiation stage of chickpea crop in the field and continued up to maturity of the pods and harvest of the crops. The data were collected on chickpea crops by 5 plants randomly selected. Observations were recorded after every seven days from 7-9 am after that intensity of sunlight increase and larvae hide in vegetative portion of plants.

The recorded different pest populations of *Helicoverpa armigera* was correlated with abiotic and biotic factors. During the experiment, the crop was left untreated and pest population dynamics in relation to density independent factors (max. & mini. Temp., % RH during morning & evening, evaporation, wind velocity and rainfall) and biotic factor were like natural enemies Spider, Ladybird beetle, *Campoletis chloridae* etc. Observation on the pest population of *Helicoverpa armigera* were recorded at each meteorological week, from germination till maturity of the crop

Result:

Population incidence *Helicoverpa armigera* in Bengal gram (2017-18)

Population Incidence of pod borer was recorded from cropping season of chickpea crop during 2017-18 and 2018-19. The appearance larvae of this pest on chickpea crop along with meteorological observation during Rabi 2017-18 has been presented in Table-2. The data showed that the larval population of Pod borer first appeared eight standard week with an initial population of 0.75 larvae/5plants and continued till 20th standard week. There was gradual rise of *Helicoverpa armigera* larval population from 1.18, 3.09, 4.67 and 5.66 larvae/5plant during 9th,

10th, 11th and 12th standard week, respectively. The larval pest population attained its peak population with 9, 12.33, 11.44, 12.33 and 14.66 larval/ 5plants during 13th, 14th, 15th, 16th and 17th standard week, respectively. The corresponding mini and max temp were 25⁰C and 40⁰C, respectively while mini and max RH were 10 and 23% and average of rainfall of 5.71. The larval number declined gradually from 6.32, 2.46 and 0.11 during 18th, 19th and 20th standard week, respectively. (Table-1)

Table 1: Effect of abiotic factors on population dynamics of pod borer (2017-18)

SMW	Pod borer/5plants	Minimum Temp. (°C)	Maximum Temp. (°C)	Rainfall (mm)	Minimum RH%	Maximum RH%
47	0.0	11.5	25.0	0.0	15.5	34.0
48	0.0	12.1	24.9	0.0	15.4	32.9
49	0.0	12.1	21.7	2.7	29.7	60.7
50	0.0	12.7	24.6	0.0	22.1	38.7
51	0.0	10.7	22.7	0.0	24.1	46.3
01	0.0	7.6	19.7	0.0	30.0	57.3
02	0.0	7.1	21.0	0.0	28.0	50.3
03	0.0	8.0	22.1	0.0	28.1	53.4
04	0.0	6.9	18.7	6.9	38.3	72.0
05	0.0	9.9	23.4	0.0	29.4	57.7
06	0.0	8.4	22.3	0.0	23.6	47.3
07	0.0	10.6	22.1	7.1	41.4	70.7
08	0.8	13.1	26.6	8.5	30.3	64.1
09	1.2	14.7	27.1	1.5	33.3	65.3
10	3.1	14.6	29.7	0.1	21.4	49.7
11	4.7	15.9	32.6	0.1	14.1	34.1
12	5.7	15.7	31.7	3.1	19.1	46.6
13	9.0	19.0	34.3	0.9	14.0	38.4
14	12.3	18.4	33.6	0.8	18.6	43.6
15	11.4	20.6	34.4	1.0	16.6	41.0
16	12.3	22.3	35.7	0.2	12.6	34.0
17	14.7	25.3	40.3	5.7	10.1	23.3
18	6.3	26.7	39.1	8.3	15.6	35.0
19	2.5	26.1	39.0	6.0	17.6	34.0
20	0.1	28.3	40.9	0.7	10.3	22.1
21	0.0	29.0	43.7	0.0	5.3	9.3
Mean	3.23	15.73	29.19	2.06	21.69	44.65
Pearson Correlation	1	0.516**	0.579**	0.102	-0.479*	-0.340

Total observation	26	26	26	26	26	26
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SMW=Standard Meteorological Weeks, **Highly significant at 0.001% level, *significant at 0.05% level

The correlation coefficient of larval population of *Helicoverpa armigera* with prevailing weather parameters were find out and are presented in Table -1. Result showed that during Rabi 2015-16, larval population found non-significant having positive correlation with minimum temp ($r = 0.516$), maximum temperature ($r = 0.579$) and rainfall ($r = 0.102$). Whereas minimum relative humidity ($r = -0.479$), maximum relative humidity ($r = -0.340$) were found that non-significant negative correlation with larval population. (Table-1)

Incidence the population of *Helicoverpa armigera* in Bengal gram (2018-19)

Incidence of pod borer larvae on chickpea crop along with meteorological observation during Rabi 2018-19 has been given in Table-2. The values within table represent the larval population of pod borer first incidences second standard week having starting population 1.09 larvae/5plants and continued till 17th standard week. There was gradual rise of pod borer larval population with 3.33, 3.66, 4, 3.66 and 4.66 larval/plants during 3rd, 4th, 5th, 6th and 7th standard week, respectively. Whereas, the same larval population with less increasing 5, 4.66, 4, 5, 5, 6 and 7.33 larval/plants during the standard week are 8th, 9th, 10th, 11th, 12th, 13th and 14th standard weeks. The corresponding with mini and max temp were 22.57⁰C and 37.57⁰C, respectively while mini and max RH were 17.14 and 33.71% and average of rainfall of 5.1mm. The larval pest population attained its peak population with 12.88, 14 and 13.33 larval/5plant during 15th, 16th and 17th standard week, respectively. The corresponding minimum temperature and maximum temperature were 27.42⁰C and 41.28⁰C, respectively while minimum and maximum relative humidity were 9.85 and 18.28% and average of rainfall of 0.5mm, respectively. (Table-2) The correlation coefficient of larval population of *Helicoverpa armigera* with prevailing weather parameters were find out are shown in Table -2 final results showed that during Rabi 2015- 16, larval population had a non-significant positive correlation with mini temp ($r = 0.628$), max temp ($r = 0.583$) and rainfall ($r = 0.202$). Whereas minimum RH ($r = -0.040$), maximum RH ($r = -0.108$) were observed to have a non-significant negative correlation with larval population. (Table-2)

Table 2: Effect of abiotic factors on population dynamics of pod borer (2018-19)

SMW	Pod borer/5plants	Minimum Temp. (°C)	Maximum Temp. (°C)	Rainfall (mm)	Minimum RH%	Maximum RH%
43	0.0	18.8	31.0	0.0	19.5	37.5
44	0.0	18.6	28.9	1.7	29.3	57.1
45	0.0	16.1	28.0	0.0	17.0	36.9
46	0.0	16.6	27.3	3.0	20.9	40.9
47	0.0	15.3	27.3	0.0	19.1	40.1
48	0.0	14.3	26.0	0.0	22.3	47.3
49	0.0	12.3	22.9	1.2	24.1	49.9
50	0.0	11.1	21.0	8.4	29.6	56.1
51	0.0	8.9	20.7	0.0	23.0	43.9
52	0.0	6.9	19.1	0.0	24.7	42.6
01	0.0	9.6	18.3	3.0	39.7	56.7
02	1.1	9.3	19.7	14.8	39.1	62.1
03	3.3	9.6	19.9	32.5	44.4	62.9
04	3.7	7.7	16.9	36.0	52.4	78.9
05	4.0	9.0	18.6	4.2	47.3	75.7
06	3.7	10.9	18.6	47.4	57.1	83.4
07	4.7	11.3	20.7	60.9	64.9	89.3
08	5.0	11.3	20.6	31.4	61.7	88.3
09	4.7	10.4	19.0	47.3	58.3	88.0
10	4.0	11.9	22.3	10.2	48.9	78.4
11	5.0	12.6	24.4	0.3	47.3	79.6
12	5.0	15.0	26.9	11.5	35.0	62.3
13	6.0	19.9	33.9	0.0	22.1	46.0
14	7.3	22.6	37.6	5.1	17.1	33.7
15	12.9	25.0	38.0	0.6	15.1	25.4
16	14.0	22.0	32.6	34.1	28.0	53.4
17	13.3	27.4	41.3	0.5	9.9	18.3
Mean	3.61	14.22	25.22	13.82	33.99	56.83
Pearson Correlation	1	0.628**	0.583**	0.202	-0.040	-0.108
Total observation	27	27	27	27	27	27

SMW=Standard Meteorological Weeks, **Highly significant at 0.001% level, *significant at 0.05% level

Discussion:The population of Pod borer *H. armigera* incidence was observed from 8th standard week February (4th week) to the first week of May maximum population was observed in first week of May 14.7larvae/5plant. Minimum population was observed 4th week of May (20 SW) after that population start decline rapidly up to (2017-18) the pest appeared on the chickpea crop in January (2nd week) and maximum population observed in 4th week of April 14 larvae/5plant. The population was slightly decline first week of May (2018-19) this results get support from Ganai *et.al.*(2017) studies indicated highly significant positive association with immature stage of *H. armigera* and mean max temp (0.349) and mostly significant negative association between *Helicoverpa armigera* and mean relative humidity (-0.284). The non-significant effect was reported larval population of pod borer and mean relative humidity (-0.256) and mean mini temp had positive response on the larval population (0.404). Roshan *et.al.*(2018) studies indicated max and mini temp had a positive non-significant effect and rainfall, morning and evening relative humidity were observed to be non-significantly correlated with its larval pest population.Wakil *et.al.*(2010) A survey was conducted the temperature was positively correlated while relative humidity showed negative interaction with the larval pest populationsimilar result given by Saini *et.al.*(2017) ,Jakhar *et.al.*(2016) andBasavaraj *et.al.*(2013)*H. armigera* was significantly negatively correlated with RH ($r = -0.491$, $r = -0.533$) and mini temp ($r = -0.671$) It was similar with present my findings.

Conclusion:

The present research was concluded that maximum larval population were recorded first week of may and fourth week of April 14.7 and 14.0 larvae/5 plants with temp range 25-40 and 22 -32 °C simultaneously during both year, ETL was cross in the first week of April so management practices start from this period of time and increase the production of chickpea.

Future scope:

Present research investigation on incidence of *H. armigera* depended up on environmental factors particularly changing temp helpful to decided management practices start and increase production, so such type of work required in future.

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