(***Short Communication***)

Relationship of certain abiotic factors and the incidence of gram pod borer, *Helicoverpa armigera* (HUBNER) in chickpea at Pantnagar

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India is the largest producer and consumer of pulses accounting for almost 33% of world area. The chickpea marked a significant increase in area (9.96 million ha) for the year 2013-14 which is highest in last 10 years. Similarly, the chickpea production (9.92 million tonnes) also surpassed record with in the history of India since last 50 years (Anonymous, 2014). *Helicoverpa armigera* is a conundrum and one of the most dominant insect pests in agriculture, accounting for half of the total insecticides usage in India for protection of crops. The problem of this pest is magnified due to its direct attack on fruiting structures, voracious feeding habits, high mobility and fecundity, multivoltine nature, overlapping generations, nocturnal behaviour etc.; (Sarode, 1999). At the same time adequate ecological data is prerequisite for integrated pest management, which can therefore be enhanced after determining the seasonal abundance (Mathur *et al.,* 2003). There are many environmental factors which influence the insect pest populations (Lode and Sharma, 1993). Among them abiotic factors play a vital role in multiplication and distribution of insect pests. The knowledge on the seasonal incidence of gram pod borer will certainly found to be helpful in formulating the insect pest management strategies for *Helicoverpa armigera* at Pantnagar condition. Therefore, an attempt has been made to work out the effect of different abiotic factors on the seasonal incidence of pod borer, *H. armigera* in chickpea.

A field experiments were conducted at Crop Research Centre (CRC), G.B. Pant University of Agriculture and Technology, Pantnagar during, 2012-13 and 2013-14. The variety 'PG186' was planted in randomized complete block design in experimental plot of 5 x 4 m^2 with 10 cm plant to plant distance and 30 cm row to row distance during both the years. Chickpea crop was raised by following all the recommended agronomical practices except plant protection measures which enabled the build up of *H. armigera* in a pesticide free environment. The observation on egg and larval population was recorded on five randomly selected plants at weekly interval. The data on pest population were correlated with various weather parameters for working out the correlation coefficient. The SPSS 16.0 programme was used to work out the correlation between larval population and weather parameters. The data on maximum and minimum temperature, relative humidity, sunshine hours, rainfall and wind velocity were collected from the unit of meteorological observatory.

Seasonal incidence of chickpea pod borer H. armigera during 2012-13 and 2013-14: During 2012-13, the incidence of egg laying of *H. armigera* was marked on PG 186 from commencement of 11thSW (Table.1). The pest first appearance with an average of egg laying and larval population with mean 3.00 and 0.66, respectively per five plant in the 11thSW during that time the maximum-minimum temperature, morning- evening relative humidity (RH), rainfall and sunshine hrs, were 29.2^{0}C,12.8^{0}C, 88% (0712 am), 43% (1412pm), 13.4mm and 3.3 hrs, respectively. The maximum egg was recorded during 12th SW (19.00) with 29.9^{0}C, 15.2^{0}C, 88 % (0712 am) and 43% (1412am) for the maximum-minimum temperature, morning- evening relative humidity (RH). The peak level of larvae was ascertained during 15th S.W with mean 86.66 during which the abiotic factors were 36.9^{0}C, 17.9^{0}C, 68.2%, 22.8% and 9.36 respectively for maximum-minimum temperature, morning- evening relative humidity (RH) and sunshine hours. The population of both egg and larval population started to decline from 16th SW.

Table 1: Seasonal abundance of *H. armigera* on Chickpea during 2012-13

Std week	PG186		Temperature (° C)		RH (%)		Rain fall (mm) hours	Rainy days	Sun-shine
	Mean Eggs	Mean larvae	Max	Min	Morning	Evening			
11	3	0.66	29.2	12.8	88	43	13.4	1	3.9
12	19	0.33	29.9	15.2	88	43	0	0	2.5
13	13.33	13	30.5	14.5	88	38	0	0	2.4
14	8.33	87	32.9	14.8	79	24	0	0	10.36
15	3	86.66	36.9	17.9	68.2	22.8	0	0	9.36
16	0	2.66	34.7	18.2	60.7	28.3	1.2	1	9.43
17	0	1.33	35.5	19.6	63.7	31.1	0	0	9.33
Crop at maturity stage									

During second season of 2013-14, the population of *H. armigera* was appeared between 12thSW to 16thSW (Table.2). The seasonal incidence of *H. armigera* was commencement on chickpea started during 12thSW. The maximal egg was occurred during 13th SW (15.00) per five plants for which 31.2^{0}C, 14.8^{0}C, 87%, 32 %, and 7.6 hrs respectively for max and min temperature, morning-evening relative humidity (RH), and sunshine hrs. The maximal larval population was observed on 15thSW with mean 42.66 per five plants during that time the maximum-minimum temperature, morning- evening relative humidity (RH), rainfall and sunshine hrs, were 33.3^{0}C, 15.4^{0}C, 72%, 22%, 0.6mm and 9.4 hrs, respectively. The population of both egg and larval started to decline during 16th SW.

The influence of weather parameters on build up of insect pest populations *H. armigera* in chickpea variety PG186 by using simple correlation studies and are presented in (Table 3). During 2012-13, which, was revealed that, a significant negative correlation between larval population with evening relative humidity (r= -0.759**) whereas a non-significant positive relationship was found between larval population with maximum, minimum temperature and sunshine hours with (r=0.460); (r=0.036) and (r= 0.552), respectively. A non-significant negative relationship was found amid larval population with morning RH and rainfall of (r= -0.135); and (r= -0.316), respectively.

Table 2: Seasonal abundance of *H. armigera* on Chickpea during 2013-14

Std week	PG186		Temperature (° C)		RH (%)		Rain fall (mm)	Rainy days	Sun-shine hours
	Mean Eggs	Mean larvae	Max	Min	Morning	Evening			
12	1	2	28.7	14.2	83	39	0	0	7.9
13	15	14.33	31.2	14.8	87	32	0	0	7.6
14	13	36.33	32.5	15.1	82	31	2.2	1	10.4
15	3.66	42.66	33.3	15.4	72	22	0.6	1	9.4
16	0	20.66	32.5	15.4	75	29	10.2	2	7.4
Crop at maturity stage									

Table 3: Influence of weather parameters on the incidence of *H. armigera* on variety PG186

Year	Temperature (^{0}C)		Relative humidity (%)		Rainfall (X_5)	Sunshine hours (X_6)	Wind velocity (Km/hr) (X_7)
	Max. (X_1)	Min. (X_2)	7: 12 am (X_3)	14:12 pm (X_4)			
2012-13	0.460	0.036	-0.135	-0.759*	-0.316	0.552	-0.007
2013-14	0.904*	0.811	-0.599	-0.866	0.051	0.768	0.331

The regression equation developed to predict the incidence of larvae of *Helicoverpa armigera*- Y = 628.902 – 9.682 (RHE) + 5.108 (RF) + 2.284 (SSH) – 13.304 (WE) The regression equation revealed that the various abiotic factors were found to be most influencing factor, which contributed (R^2 = 0.825) 82.5 per cent variation in *H. armigera* larval population (Table 4). The regression equation was fitted to study the effectiveness of weather parameters indicated that for every 1 per cent increase in morning and evening relative humidity and for every one km/hr increase in wind velocity there would be decrease of -0.968, -13.304 number of larva population *H. armigera,* respectively. The other abiotic factors it showed, for every 1mm increase of rainfall , one hour increase in sunshine hour and a increase of 5.10, 2.28 number of larva population *H . armigera* respectively. During second season, 2013-14 the pod borer *H. armigera* was showed highly significant positive correlation was found (Table 3) with max temperature (r =0.904**) and a non-significant negative relationship was found amid larval population with morning and evening RH with (r=-0.599), (r=-0.866) respectively. A non-significant positive relationship was found between larval population with minimum temperature, rainfall and sunshine hours with (r=0.811), (r=0.051) and (r=0.768) respectively.

The regression equation was developed for second season to predict the incidence of larvae of *Helicoverpa armigera*, Y = - 66.484 - 0.019 (RF) + 5.663 (SSH) + 0.134 (WE).— The regression equation revealed that the various abiotic factors were found to be most influencing factor, which contributed (R^2 = 0.782) 78.2 per cent variation in *H. armigera* larval population (Table 4). The regression equation was fitted to study the effectiveness of weather parameters indicated that for every one km/hr increase in wind velocity and one hour increase in sunshine hour there would be increase of 5.63, 0.134 number of *H. armigera* larval population respectively. The other abiotic factors it showed, for every 1mm increase of rainfall there would be decrease of – 0.019 number of *H armigera* larva population

The present result pertaining to incidence of *H. armigera* were in confirmation with Singh and Ali (2006) have also recorded two peaks in the larval population of *H. armigera* throughout the crop season, first from 46 to 49th and second from 5 to 13th standard weeks. The studies on *Helicoverpa armigera* on pulse crop by Reddy *et al* (2009) revealed that, the incidence of the pod borer, *Helicoverpa armigera* in chick pea commenced from second week of February i.e. in the early part of 1st fortnight of February, with 0.05 mean larval population/ plant. The larval populations started increasing and reached its maximum of 12.97 mean larval population/plant during 4th week of March (12th standard week). Yadav and Lal (1988) also reported that the population of *H. armigera* on chickpea was positively correlated with minimum and maximum temperature and negatively correlated with average RH.

The present results of correlation with abiotic factors is cogent evidence with Reddy *et al.,* (2009) have reported that, the population has significantly positive correlation with both minimum and maximum temperature and the correlation coefficient being 0.71 and 0.82, respectively. The correlation coefficient of morning and afternoon relative humidity was -0.66. The rainfall and larval population showed positive correlation coefficient (0.03) but it was non-significant. The wind velocity and the sunshine hours showed positive non significant correlation with larval population. Chatar *et al.* (2010) observed that, maximum temperature exhibited highly significant negative correlation (r= -0.7514) with larval population of *H. armigera*, whereas, minimum temperature (r= -0.5771) and mean temperature (r= -0.6836) exhibited significant negative correlation. However, the pest population showed highly significant positive correlation with morning relative humidity (r= 0.7098), evening relative humidity (r= 0.7293) and mean relative humidity (r= 0.8063).

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Table 4: Regression between weather parameters and population of *H. armigera* on Variety PG186

Year	Regression Equation	R^2 value
2012-13	Y = 628.902 – 9.682 (RHE) + 5.108 (RF) + 2.284 (SSH) – 13.304 (WE)	0.825
2013-14	Y = - 66.484 - 0.019 (RF) + 5.663 (SSH) + 0.134 (WE)	0.782

Note: RHE: Relative humidity evening; RF: Rain fall; SSH: Sun shine hours; WE: Wind velocity

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