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Seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner in relation to abiotic factors in chickpea, *Cicer arietinum* L.

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Abstract
The field experiments entitled "Seasonal incidence of gram pod borer, *Helicoverpa armigera* Hubner relation to abiotic factors in chickpea, *Cicer arietinum* L." was carried out at Students' Instructional Farm of C. S. Azad University of Agriculture & Technology, Kanpur during *Rabi* 2017-18 and 2018-19. The initial incidence of larval population was observed 1.67 and 1.33 larvae/5 plants during the 49th and 50th SW, respectively. The population increased gradually and reached its peak on 6th and 7th SW with 12.67 and 11.67 larvae/5 plants, respectively. The correlation matrix for both years indicated negatively correlation with minimum r= -0.403 and r=-0.173 and maximum temperature r=-0.440 and r=-0.531 with larval population. However, positive correlation with relative humidity r=0.498 and 0.579 and rainfall 0.231 and 0.489, respectively.

Keywords: Chickpea, *Helicoverpa armigera*, seasonal incidence, abiotic factors

Introduction
Chickpea, *Cicer arietinum* L. is considered as "King of Pulses" and is commonly known as "Bengal Gram or *Chana*", belongs to family fabaceae. It is an important winter season soil fertility restorative legume crop and is grown globally as food source. It plays an important role in the vegetarian diet as a major source of protein. It is consumed as a green vegetable, *dal*, *chhole*, germinated breakfast food and powder to prepare sweets and many other relishing dishes. It's leaves are consumed both raw and cooked to take advantage of malic acid, citric acid, mineral matters and fiber, all of which are of medicinal value. The grain consists of 52-70 per cent carbohydrates, 18-22.2 per cent protein. Besides, it is a rich source of calcium, iron, vitamin C (green stage) and'B1'. Chickpea is grown over an area of 15.95 million ha in the world with a production of 15.51 million tonnes and productivity around 882 kg/ ha. In India, it is mostly grown under rain fed condition in heavy clay soils on 9.44 million ha with a production of 10.13 million tonnes & with an average productivity of 1073 kg/ha. Madhya Pradesh, Rajasthan, Maharashtra, Uttar Pradesh, Karnataka, Chhattisgarh, Andhra Pradesh, Gujarat and Jharkhand are the major chickpea producing states sharing over 95 per cent area. In Uttar Pradesh chickpea is grown on 0.57 million ha with production of 0.73 million tonnes with an average yield of 1272 kg/ha (Anonymous, 2019-20) [1]. Various factors responsible for low production and productivity of chickpea are poor genetic base, weeds, diseases and insect pests. The major insect-pests of chickpea are cutworm, *Agrotis ipsilon* Hufnagel, gram pod borer, *Helicoverpa armigera* Hubner, gram semilooper, *Autographa nigrisigna* Walker, aphid, *Aphis craccivora* Koch and tur pod bug, *Clavigralla gibbosa* Spinola (Sithanantham *et al*., 1984) [6]. Among these, the gram pod borer, *Helicoverpa armigera* Hubner is considered to the most serious insect pest causing on an average of 30-40 per cent damage to pods that can be increased up to 80-90 per cent under conducive environment. This insect damage the chickpea plants from seedling stage to crop maturity stage and its larvae can thrive on leaves, tender twigs, flowers and pods. After pod formation, the larvae bore into the pods and feed on the seed inside and cause considerable loss to seed yield. It's caterpillars feed on tender foliage and young pods by making holes in host and eat the developing seed by inserting the half portion of their body inside the pod. About 20-30 per cent of the chickpea yield can be reduced due to damage of pod borer (Sarwar, 2012) [4].

The population density of insect pests fluctuates when there is a change in weather conditions. Seasonal incidence is regulated by the abiotic factors such as temperature, rainfall, relative humidity, sunshine hours, wind velocity, etc. 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) [2].

Materials and methods

The experiment was laid out the study on seasonal incidence of gram pod borer in relation to abiotic factors were carried out during 2017-18 and 2018-19 at Students' Instructional Farm of C. S. Azad University of Agriculture & Technology, Kanpur. Chickpea variety KGD-1168 was sown in three plots of size 4.0 x 3.0 m during the first week of November with spacing 30 x 10 cm. The larval population of *Helicoverpa armigera* Hubner was counted five randomly selected plants per plot from first appearance to till harvest the crop.

Results and Discussion

The seasonal incidence of larval population of gram pod borer and its infestation on chickpea as well as effects of weather conditions on larval population infestation was studied. It is evident from the data presented in table-1 & Fig.-1 that the initial incidence of larval population during *Rabi* 2017-18 was recorded to the tune of 1.67 larvae/5 plants during the 49th SW. The minimum and maximum temperature prevailing during the initial infestation was 10.5 ^{0}C and 25.2 ^{0}C, respectively, while the average relative humidity was existed to the tune of 63.0 per cent during the study period. The larval population increased gradually and reached its peak on 6th SW with 12.67 larvae/5 plants. The minimum and maximum temperature prevailing during the period was 08.4 ^{0}C and 23.2 ^{0}C, respectively, and the average relative humidity was recorded in terms of 66.0 per cent. The larval population declined gradually and reached nil at 13th SW. The minimum and maximum temperature was recorded during this period was 17.5 ^{0}C and 36.0 ^{0}C, respectively, while average relative humidity was recorded 51.0 per cent. During the whole population study period rainfall was nil whereas in 4th SW a light shows was recorded i.e. 1.60 mm. The present findings are in accordance with Reddy *et al.* (2009) [3] recorded the larval populations started increasing and reached its maximum 12.97 mean larval population/plant during 4th week of March (12th standard week). The correlation studies between mean larval population and weather parameters revealed that the correlation of the larval population of H. *armigera* was found negative correlation with minimum (r=-0.403) and maximum (r=-0.440) temperature and positive correlation with relative humidity (r=0.498) and also with rainfall (r=0.231) during 2017-18. Observations were recorded to find out the effect of weather conditions on infestation of larval population on chickpea. The data presented in table-2 & Fig.-2 declared that the initial larval population during *Rabi* 2018-19 observed 1.33 larvae/5 plants during the 50th SW. The minimum and maximum temperature prevailing during the initial infestation was

Table 1: Seasonal incidence of gram pod borer, H. *armigera* during 2017-18.

SW	Period of Observation	Av. No. of larva/5 plants	Mean abiotic factors			
			Temperature (^{0}C)		Relative Humidity (%)	Rainfall (mm)
			Min.	Max.		
48	26 Nov-02 Dec	00.00	07.6	26.7	62	0.00
49	03 Dec-09 Dec	01.67	10.5	25.2	63	0.00
50	10 Dec-16 Dec	02.33	10.5	24.6	63	0.00
51	17 Dec-23 Dec	03.67	08.2	23.2	71	0.00
52	24 Dec-30 Dec	05.00	06.8	21.0	81	0.00
01	31 Dec-06 Jan	06.33	05.6	17.1	83	0.00
02	07 Jan-13 Jan	07.67	05.3	20.3	79	0.00
03	14 Jan-20 Jan	08.33	06.5	22.7	73	0.00
04	21 Jan-27 Jan	09.67	05.7	21.6	79	1.60
05	28 Jan-03 Feb	11.33	09.8	25.7	69	0.00
06	04 Feb- 10 Feb	12.67	08.4	23.2	66	0.00
07	11 Feb-17 Feb	10.67	11.2	24.3	71	0.00
08	18 Feb-24 Feb	09.33	12.1	30.3	63	0.00
09	25 Feb-03 Mar	08.67	14.6	30.7	65	0.00
10	04 Mar-10 Mar	06.00	13.9	30.5	54	0.00
11	11 Mar-17 Mar	04.33	15.7	33.5	45	0.00
12	18 Mar-24 Mar	02.67	16.4	34.1	46	0.00
13	25 Mar-31 Mar	00.00	17.5	36.0	51	0.00
14	01 Apr-07 Apr	00.00	18.1	36.2	50	0.00

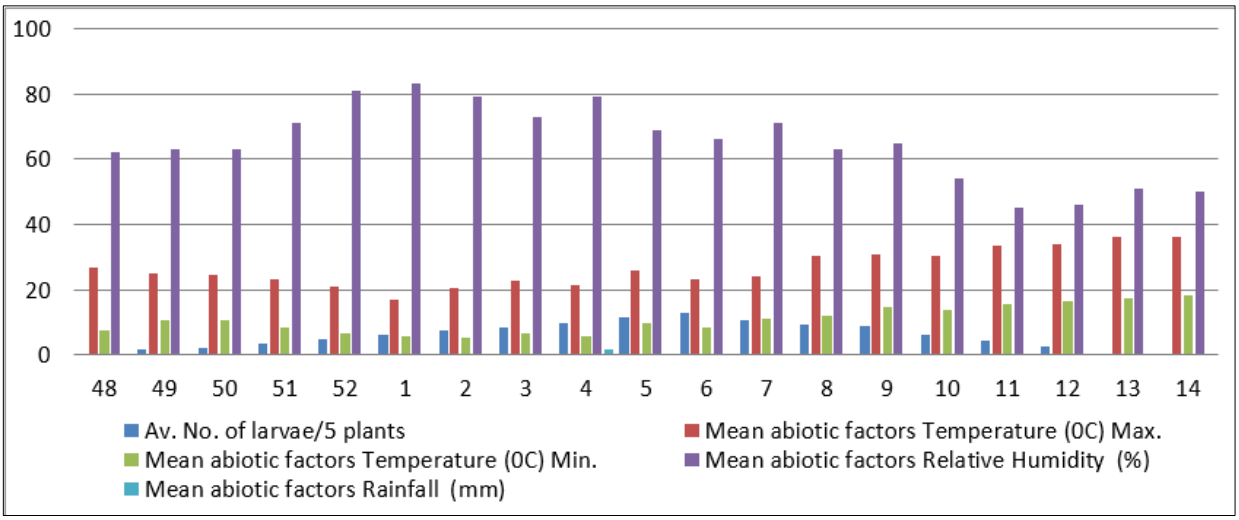

Fig 1: Seasonal incidence of gram pod borer, H. *armigera* during 2017-18.

Table 2: Seasonal incidence of gram pod borer, H. *armigera* during 2018-19.

SW	Period of Observation	Av. No. of Larva/5 plants	Mean abiotic factors			
			Temperature (^{0}C)		Relative Humidity (%)	Rainfall (mm)
			Min.	Max.		
48	25 Nov-01 Dec	00.00	11.6	26.6	66	0.00
49	02 Dec-08 Dec	00.00	8.8	24.8	63	0.00
50	09 Dec-15 Dec	01.33	8.3	22.9	68	0.11
51	16 Dec-22 Dec	02.00	5.3	22.5	61	0.00
52	23 Dec-29 Dec	03.33	4.6	21.1	60	0.00
01	30 Dec-05 Jan	04.33	7.3	22.4	68	0.00
02	06 Jan-12 Jan	05.67	7.6	21.4	45	0.00
03	13 Jan-19 Jan	07.00	6.0	23.1	61	0.00
04	20 Jan-26 Jan	08.67	10.6	19.6	72	1.90
05	27 Jan-02 Feb	09.33	8.3	21.3	67	0.00
06	03 Feb- 09 Feb	10.67	10.0	22.1	72	1.50
07	10 Feb-16 Feb	11.67	11.6	23.5	88	0.24
08	17 Feb-23 Feb	10.33	12.8	26.1	68	0.00
09	24 Feb-02 Mar	07.67	10.5	22.7	69	0.75
10	03 Mar-09 Mar	05.33	12.0	27.4	60	0.54
11	10 Mar-16 Mar	03.67	12.2	29.2	59	0.00
12	17 Mar-23 Mar	02.33	15.8	32.2	51	0.05
13	24 Mar-30 Mar	00.00	17.3	34.5	58	0.00
14	31 Mar-06 Apr	00.00	16.5	35.2	52	0.00

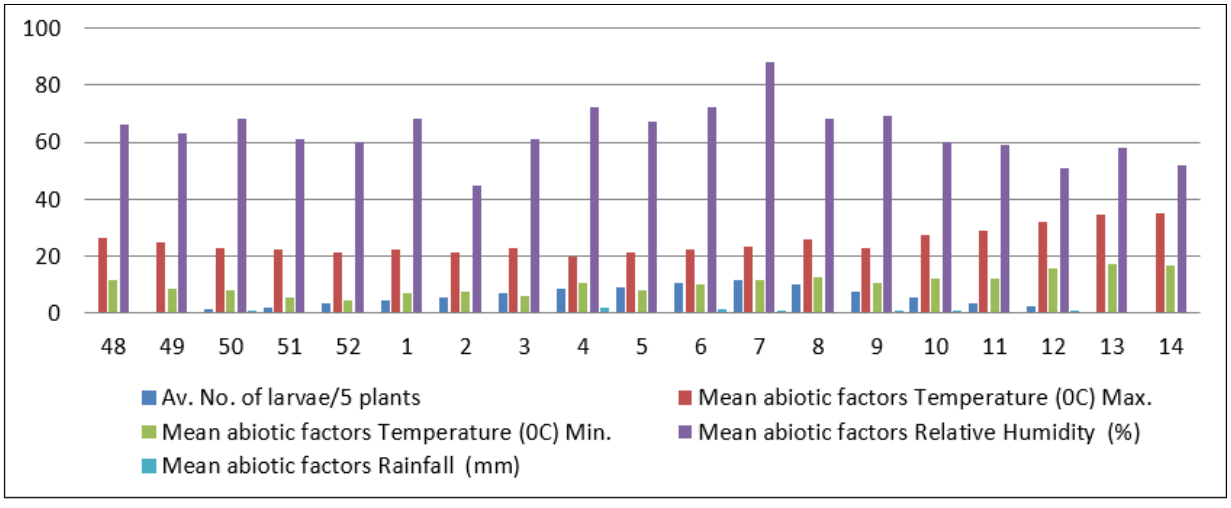

Fig 2: Seasonal incidence of gram pod borer, H. *armigera* during 2018-19.

8.3 ^{0}C and 22.9 ^{0}C, respectively, while the average relative humidity was observed 68.0 per cent and rainfall was 0.11 mm, recorded during the period. The larval population increased gradually and reached to peak on 7th SW with 11.67

larvae/5 plants. The minimum and maximum temperature prevailed during the period was 11.6 ^{0}C and 23.5 ^{0}C, respectively, and the average relative humidity was recorded 88.0 per cent, while rainfall was observed in terms of 0.24 mm. The larval population declined gradually and reached nil at 13th SW. The minimum and maximum temperature was recorded during this period was 17.3 ^{0}C and 34.5 ^{0}C, respectively, while average relative humidity was recorded 58.0 per cent and no rainfall was observed. The present findings are in collaboration with Shah and Shahjad (2005) [5] also reported that the pest population of H. *armigera* was low during 49th to 6th standard weeks but increased from 7th standard week onwards and declined again during 14th standard week. The correlation matrix indicated negative correlation for minimum (r= -0.171) and maximum temperature (r= -0.531) with larval population. The incidence of larval population positive correlation with relative humidity (r= 0.579) and rainfall (r= 0.489) during 2018-19.

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