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Larval fluctuation of *Helicoverpa armigera* with reference to environmental factors in chickpea crop

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Abstract
A field experiment was conducted during rabi season of 2017-18 entitled "Larval fluctuation of *Helicoverpa armigera* with reference to environmental factors in chickpea crop." in sandy loam soil of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). The experiment consisted of nine treatment combinations comprised three varieties and three date of sowing viz., sowing on Nov. 5th with temperature 23.8 ºC, Nov 15th with temperature 20.8 ºC and Nov. 25th with temperature 16.8 ºC and three varieties Uday (V_1), Pusa-362 (V_2) and Radhey (V_3). Results reveal that the all three varieties under three date of sowing Peaks larval population of pod borer were recorded during 8th to 9th standard week. Highest larval population (5.50 larvae/plant) was recorded in crop sown at November 25th followed by November 15th sown crop while lowest in sown on November 05th, larval population increased with increase in temperature, maximum temperature from 25ºC to 35ºC increases the larval population, while minimum temperature from 10 ºC to 14 ºC indicate that larval population increased with increase in minimum temperature in all varieties.

Keywords: Chickpea, population dynamics, *Helicoverpa armigera*

Introduction
Chickpea, (*Cicer arietinum* L.) is one of the most important legume crop in the world and in the Asia region. Chickpea is the premier pulse crop of Indian sub continent. India is the largest chickpea producer as well as consumer in the world. Pulse occupies an unique position in Indian agriculture by virtue of its high protein content and its capacity to enrich the soil fertility through the mechanism of symbiotic nitrogen fixation. It is a super energy umbrella for the people as dietary protein for the livestock as green nutritious fodder and feed and for the soil as a mini nitrogen plant and green manure (Ali, 1988) [1]. Chickpea is a good source of protein (21.1%), Carbohydrates (61.5%), Minerals (Ca, P and Fe) and Vitamins (C). Among the various insects that attack chickpea crop, pod borer (*Helicoverpa armigera*) is the most damaging insect. It is quite prevalent in Asia, Africa, Australia and some other chickpea growing regions. As pod borer is a polyphagous insect that attacks on more than 182 plant species, the development of cultivars resistant or tolerant to *H. armigera* could be integrated in the pest management strategy particularly in the developing countries (Fitt 1989). Among different insect-pests of -chickpea in field gram pod borer *(H. armigera)* is serious pest which cause damage upto 20-50 % pod damage throughout the country (Anonymous, 1978), 16-18% at Almora in Uttaranchal, 16-22% in Orissa and it causes serious damage to the crop every year in Punjab (Atwal, 1991). The young larvae feed on the tender portion of leaves and shoots by scratch them. Grown up larvae consume leaf buds, whole leaf and flowers under severe infestation, the whole plant may get defoliated with the availability of pods, the third instars larvae make a hole in the pods and move inside to feed on grains, where as fully grown larvae feed after making a hole in the pods and thrusting its head, there in while keeping hind parts of the body outside. A single larva destroys about 30-40 % pods (Reed and Pawar, 1982) [5].

Materials and Methods
The experiment was conducted during Rabi season 2017-2018 at Student's Instructional Farm of N.D.U.A.&T., Kumarganj, Ayodhya (U.P.). Geographically, the experimental site is situated at 26º47 N latitude, 82º12 E longitude and at an attitude of 113 meters above mean sea

level (M.S.L.) in the North Indo-genetics plain. The site comes under sub-tropical climate and often subjected to extreme weather condition *i.e.* cold winter and hot summer. The experiment was conducted in Randomized block design (RBD). Nine treatment combinations comprised of three sowing date *viz.*, November 05 (D_1), November 15 (D_2) and November 25 (D_3) with three varieties *viz.*, Uday (V_1), Pusa-362 (V_2) and Radhey (V_3). The rate of fertilizer *viz.* nitrogen and phosphorus of 20 kg and 40 kg ha^{-1} recommended. Whole quantity of nitrogen and phosphorus applied at the time of basal application.

Population dynamics of *Helicoverpa armigera*:
Ten plants were randomly selected and tagged from each plots. Larval population of *Helicoverpa armigera* (Hub.) was recorded from weekly interval and pod borer larvae collected and counted and finally averaged.

Results and Discussion
Population dynamics of *Helicoverpa armigera* (Hubner)
Incidence of larvae of chickpea in respects to different environments and varieties. Larval activity in the 1st date of sowing *i.e.* 5th Nov. in each varieties started from 49th standard met. week and continued up to physiological maturity (13th standard met. week). The larval population of *H. armigera* ranged between 0.23-4.80, 0.43-4.83 and 0.43-5.43 in varieties Uday, Pusa-362 and Radhey respectively, during experimentation period. Peak larval population was found in 8th standard met. week (19-25 Feb.) in varieties, Uday (4.80) and in Pusa-362 (4.83) followed by 7th and 9th standard met. week. In Radhey variety peak larval population was found on 9th standard met. week (26Feb.-04Mar.) followed by 8th and 10th standard met. week and minimum was found on 49th standard met. week.
In 2nd date of sowing (15th Nov.) the larval population of *H. armigera* was recorded in 50th standard met. week and continued upto 13th standard met. week. The larval population of *H. armigera* ranged between 0.20-4.80, 0.43-4.80 and 0.63-5.43 in varieties Uday, Pusa-362 and Radhey respectively. Peak larval population was found in 8th standard met. week (19-25 Feb.) in varieties, Uday (4.80) and in Pusa-362 (4.80) followed by 7th and 9th standard met. week. In Radhey variety peak larval population was found on 9th standard met. week (26Feb.-04Mar.) followed by 8th and 10th standard week and minimum was found on 49th standard met. week.
In 3rd date of sowing (25th Nov.) the population of *H. armigera* was recorded in 51th standard met. week and continued upto 13th standard met. week. The larval population of *H. armigera* ranged between 0.23-4.83, 0.50-4.83 and 0.90-5.50 in varieties Uday, Pusa-362 and Radhey respectively, during experimentation period. Peak larval population was found in 8th standard met. week (19-25Feb.) in varieties, Uday (4.83) and in Pusa-362 (4.83) followed by 7th and 9th standard week. In variety Radhey variety (5.50) peak larval population was found on 9th standard met. week (26Feb.-04Mar.) followed by 8th and 10th standard met. week. Similar finding were also reported by Shan and Shahzad (2005) [6].
Insect react to external heat changes. The oviposition is held within certain temperature limits. Adult *H. armigera* larvae active during morning to mid-day when the sky is clear, sunshine is bright and temperature, relative humidity and rainfall is high the activity with reduction in light intensity and stops in the evening, weather played effectiveness during insect was appearance while due to high temperature and solar radiation degrade the efficiency of insecticides. Among these factor temperature, RH and BSS are more affected. Relationship between temperature, Relative humidity and bright sun shine and larval population of pod borer were developed. Minimum temperature was highly correlated than maximum temperature. The increase in Maximum temperature from 25 ºC to 33 ºC increases the larval population. While increase in minimum temperature from 11 to 14 ^{0}C indicates the increases larval population in all varieties. Increased in morning relative humidity from 82 to 92 % increases the larval population in all varieties. Evening relative humidity between 51 to 68 % recorded highest larval population of pod borer while further increase in evening relative humidity reduced the larval population. Morning relative humidity was highly correlated than evening relative humidity. Increase bright sunshine hrs. from 4 to 6.5 increases the larval population.

Table 1: Effect of environmental factors on incidence of larval population at 1st date of sowing (05th Nov.)

Observation date and month	S.M.W.	Temperature (^{0}C)		R.H. (%)		Sunshine (Hrs.)	Mean Larval population/plant		
		Min.	Max.	Mor.	Eve.		Uday	Pusa-362	Radhey
03 Dec.-09 Dec.	49	9.8	26.1	91.2	42.1	5.7	0.43	0.50	0.43
10 Dec.-16 Dec.	50	10.1	25.5	94.8	47.7	5.5	0.50	0.90	0.63
17 Dec.-23 Dec.	51	8.1	23.3	95.2	61.2	3.9	1.00	1.23	1.23
24 Dec.-30 Dec.	52	8.4	19.4	97.1	74.1	2.2	1.23	1.30	1.40
01 Jan.-07Jan.	1	4.7	15.1	97.5	74.1	0.6	1.80	1.50	2.10
08 Jan.-14 Jan.	2	5.2	13.8	97.8	77.8	0.5	1.10	1.93	1.80
15 Jan.-21 Jan.	3	4.8	21.8	97.8	50.4	4.1	2.00	2.83	2.33
22 Jan.-28 Jan.	4	5.9	21.3	96.7	53.0	4.1	1.73	3.00	2.00
29Jan.-04 Feb.	5	7.2	24.3	95.0	45.1	4.7	1.63	3.10	1.83
05 Feb.-11Feb.	6	8.1	24.3	86.7	34.8	4.6	2.83	2.83	2.10
12 Feb.-18 Feb.	7	10.7	24.7	91.7	52.7	3.5	3.93	3.53	3.83
19 Feb.-25 Feb.	8	11.8	28.7	88.8	45.8	6.5	4.80	4.83	5.23
26 Feb.-04Mar.	9	14.1	30.1	92.4	42.2	6.6	3.50	4.63	5.43
05 Mar.-11 Mar.	10	12.3	31.1	91.0	38.5	6.6	2.13	3.10	3.23
12 Mar.-18 Mar.	11	13.7	32.8	81.7	34.8	7.1	1.23	2.23	2.13
19 Mar.-25 Mar.	12	14.2	34.2	83.4	25.7	7.1	0.53	1.33	1.63
26Mar.-02Apr.	13	15.5	35.2	85.0	23.8	7.3	0.23	0.43	0.93

Table 2: Effect of environmental factors on incidence of larval population at 2nd date of sowing (15th Nov.)

Observation date and month	S.M.W.	Temperature (^{0}C)		R.H. (%)		Sunshine (Hrs.)	Mean Larval population/plant		
		Min.	Max.	Mor.	Eve.		Uday	Pusa-362	Radhey
10 Dec.-16 Dec.	50	10.1	25.5	94.8	47.7	5.5	0.53	0.60	0.63
17 Dec.-23 Dec.	51	8.1	23.3	95.2	61.2	3.9	1.20	0.90	1.23
24 Dec.-30 Dec.	52	8.4	19.4	97.1	74.1	2.2	1.23	1.30	1.40
01 Jan.-07Jan.	1	4.7	15.1	97.5	74.1	0.6	1.83	1.53	2.10
08 Jan.-14 Jan.	2	5.2	13.8	97.8	77.8	0.5	1.10	1.93	1.83
15 Jan.-21 Jan.	3	4.8	21.8	97.8	50.4	4.1	2.00	2.83	1.33
22 Jan.-28 Jan.	4	5.9	21.3	96.7	53.0	4.1	1.73	3.00	2.00
29Jan.-04 Feb.	5	7.2	24.3	95.0	45.1	4.7	1.60	3.10	1.83
05 Feb.-11Feb.	6	8.1	24.3	86.7	34.8	4.6	2.83	2.83	2.80
12 Feb.-18 Feb.	7	10.7	24.7	91.7	52.7	3.5	3.93	3.53	3.83
19 Feb.-25 Feb.	8	11.8	28.7	88.8	45.8	6.5	4.80	4.80	5.23
26 Feb.-04Mar.	9	14.1	30.1	92.4	42.2	6.6	3.50	4.63	5.43
05 Mar.-11 Mar.	10	12.3	31.1	91.0	38.5	6.6	2.13	3.13	3.23
12 Mar.-18 Mar.	11	13.7	32.8	81.7	34.8	7.1	1.23	2.20	2.13
19 Mar.-25 Mar.	12	14.2	34.2	83.4	25.7	7.1	0.53	1.33	1.60
26Mar.-02Apr.	13	15.5	35.2	85.0	23.8	7.3	0.20	0.43	0.93

Table 3: Effect of environmental factors on incidence of larval population at 3rd date of sowing (25th Nov.)

Observation week and month	S.M.W.	Temperature (^{0}C)		R.H. (%)		Sunshine (Hrs.)	Mean Larval population/plant		
		Min.	Max.	Mor.	Eve.		Uday	Pusa-362	Radhey
17 Dec.-23 Dec.	51	8.1	23.3	95.2	61.2	3.9	1.20	0.93	1.23
24 Dec.-30 Dec.	52	8.4	19.4	97.1	74.1	2.2	2.23	1.20	1.40
01 Jan.-07Jan.	1	4.7	15.1	97.5	74.1	0.6	1.83	1.53	2.13
08 Jan.-14 Jan.	2	5.2	13.8	97.8	77.8	0.5	1.13	1.93	1.83
15 Jan.-21 Jan.	3	4.8	21.8	97.8	50.4	4.1	2.00	2.90	1.40
22 Jan.-28 Jan.	4	5.9	21.3	96.7	53.0	4.1	1.73	3.10	2.00
29Jan.-04 Feb.	5	7.2	24.3	95.0	45.1	4.7	1.63	1.13	1.90
05 Feb.-11Feb.	6	8.1	24.3	86.7	34.8	4.6	2.90	2.90	2.83
12 Feb.-18 Feb.	7	10.7	24.7	91.7	52.7	3.5	3.93	3.60	3.83
19 Feb.-25 Feb.	8	11.8	28.7	88.8	45.8	6.5	4.83	4.83	5.23
26 Feb.-04Mar.	9	14.1	30.1	92.4	42.2	6.6	3.50	4.60	5.50
05 Mar.-11 Mar.	10	12.3	31.1	91.0	38.5	6.6	2.13	3.13	3.23
12 Mar.-18 Mar.	11	13.7	32.8	81.7	34.8	7.1	1.23	2.23	2.13
19 Mar.-25 Mar.	12	14.2	34.2	83.4	25.7	7.1	0.53	1.40	1.70
26Mar.-02Apr.	13	15.5	35.2	85.0	23.8	7.3	0.23	0.50	0.90

Conclusions

Higher larval population (5.50 larvae/plant) was recorded in crop on November 25th followed by November 15th sown crop while lowest in crop sown on November 05th. However, highest larval population were obtained in each date of sowing in variety Radhey followed by variety Pusa-362, while lowest larval population was recorded in variety Uday at each date of sowing.

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