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Effect of environmental factors on pod damage percentage by gram pod borer (*Helicoverpa armigera*)

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Abstract
A field experiment was conducted during rabi season of 2017-18 entitled "Effect of environmental factors on pod damage percentage by gram pod borer (*Helicoverpa armigera*)" in saline alkaline soil of Narendra Deva University of Agriculture & Technology, Narendra Nagar (Kumarganj), Ayodhya (U.P.). The experiment consisted in R.B.D. of three replication and nine treatment combinations comprised with three varieties and three date of sowing *viz.*, sowing on Nov. 5th with temperature 23.8°C, Nov 15th with temperature 20.8°C and Nov. 25th with temperature 16.8°C and three varieties Uday (V_1), Pusa-362 (V_2) and Radhey (V_3). The results revealed that higher pod damage was recorded with all varieties in crop sown at November 25th followed by November 15th sown crop While lowest pod damage percentage was recorded in crop sown at November 05th. The highest pod damage percent among all varieties was recorded in Radhey followed by Pusa-362, while lowest pod damage percentage was recorded in variety Uday at each date of sowing.

Keywords: Chickpea, growing environment, Pod damage, *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) [2]. Chickpea is a good source of protein (21.1%), Carbohydrates (61.5%), Minerals (Ca, P and Fe) and Vitamins (C). Adjustment in sowing times is a good agronomical tool that could be employed to minimize the damage caused by insect pests. Pest appearance, population fluctuation, infestation rate and crop yield are very much dependent on sowing time. Although, *H. armigera* attack chickpea throughout the cropping growth, but damage caused during flowering and pod formation stage that results in substantial yield loss (Ahmad et al. 2016) [1]. Larvae of *H. armigera* start feeding up on the leave and pods whatever available soon after hatching. Generally, population peaks correspond to full bloom and pod formation stage of chickpea (Shah and Shahzad, 2005) [5]. The extent of damage inflicted by *H. armigera* to chickpea depends not only on number of larvae but also on the developmental stages of -crop (Tripathi and Sharma, 1984; Shah and Shahzad, 2005) [5]. Time fitted cultivation as a part of modern IPM is thus found indispensible to minimize *H. armigera* infestation (Nowinszky and Puskas, 2011, Muchhadiya *et al*. 2014) [4, 3]. Shah and Shahzad (2005) [5] reported that population of *H. armigera* flourished during second half of February and outbreak situations were found throughout March. One possible reason may be probably owing to optimum temperature and abundant food supply in the form of pods. In view of its seriousness, effect of time of sowing was studied on the infestation of *H. armigera* on chickpea. A single larva can consume 30-40 pods in its life time (Taggar and Singh, 2012) [7] and hence can cause 10-35 per cent reduction in pod yield (Singh *et al.*, 2004) [6].

Materials and Methods

The experiment was conducted during Rabi season 2017-2018 at Student's Instructional Farm of N. D. University of Agriculture & Technology, 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.

Percentage of pod damage:

The ten chickpea plants were randomly selected from each plots at 50% flowering of experimental crop till the maturity. Number of total pods including damaged pods were plucked and counted to calculate the percentage of pod damage by using following formula;

$$\text{Pod damage percentage} = \frac{\text{Number of damaged pods}}{\text{Total number of taken pods}} \times 100$$

Results and Discussion

Percentage of pod damage

Percentage of pod damage of chickpea during crop period as affected by dates of sowing and varieties. Pod damage percentage at 1st date of sowing *i.e.* 5th November in each varieties started from 50% flower initiation stage 5th standard met. week and continued up to at the time of harvesting (16th standard met. week). The pod damage percentage ranged between 5.3-12.6%, 9.3-15.0% and 12.3-20% in varieties Uday, Pusa-362 and Radhey respectively, during crop period. Higher pod damage percentage was recorded in 16th standard met. week at the time of maturity in all varieties *viz.* Uday (12.6%), Pusa-362 (15.0%) and Radhey (20%) respectively.

In the 2nd date of sowing (15th Nov.) presented in table-4.6 pod damage in each variety started from 50% flower initiation 6th standard met. week and continued upto at the time of harvesting (16th standard met. week) the pod damage percentage ranged between 7.0-13.3%, 10-15% and 13.3-21.6% in all varieties *viz.* Uday, Pusa-362 and Radhey respectively, during crop period. Higher pod damage percentage was recorded in 16th standard met. week at the time of maturity in all varieties *viz.* Uday (13.3%), Pusa-362 (15%) and Radhey (21.6%) respectively.

In the 3rd date of sowing (25th Nov.) in table-4.7 pod damage in each varieties started from 50% flower initiation 7th standard met. week and continued upto at the time of harvesting (16th standard met. week). The pod damage percentage ranged between 9.3-14.3%, 11.3-15%. and 14.3-23.3% in all varieties *viz.* Uday, Pusa-362 and Radhey respectively, during crop period. Higher pod damage percentage was recorded in 16th standard met. week at the time of harvesting in all varieties *viz.* Uday (14.3%), Pusa-362 (15.6%) and Radhey (23.3%) respectively. Similar finding were also reported by Ahmad *et al.* (2018).

In the case of pod damage percentage higher pod damage was recorded during third date of sowing in all varieties and in three varieties higher pod damage affected variety is Radhey followed by Pusa-362 and lowest damage was found in all stages in varieties Uday, due to higher affected of larvae (*Helicoverpa armigera*).

Table 1: Effect of environmental factors on pod damage percentage at 1st date of sowing (5th Nov.)

Observation date and month	S.M.W.	Temperature (^{0}C)		R.H. (%)		Sunshine (Hrs.)	Pod damage (%)		
		Min.	Max.	Mor.	Eve.		Uday	Pusa-362	Radhey
29Jan.-04Jan.	5	7.2	24.3	95.0	45.1	4.7	5.3	9.3	12.3
05 Feb.-11Feb.	6	8.1	24.3	86.7	34.8	4.6	6.6	9.6	13.0
12 Feb.-18 Feb.	7	10.7	24.7	91.7	52.7	3.5	7.3	10.0	13.3
19 Feb.-25 Feb.	8	11.8	28.7	88.8	45.8	6.5	7.6	10.3	14.0
26 Feb.-04Mar.	9	14.1	30.1	92.4	42.2	6.6	8.3	11.6	15.3
05 Mar.-11Mar.	10	12.3	31.1	91.0	38.5	6.6	9.6	12.3	16.6
12 Mar.-18 Mar.	11	13.7	32.8	81.7	34.8	7.1	10.3	12.6	17.0
19 Mar.-25 Mar.	12	14.2	34.2	83.4	25.7	7.1	10.6	13.0	17.3
26 Mar.-02Apr.	13	15.5	35.2	85.0	23.8	7.3	11.3	13.3	17.6
02 Apr.-08Apr.	14	18.7	35.3	81.0	35.0	7.3	12.0	14.3	18.6
09 Apr.-15 Apr.	15	18.3	35.4	74.0	32.4	7.1	12.3	14.6	19.3
16 Apr.-22 Apr.	16	20.4	39.2	63.2	20.5	7.9	12.6	15.0	20.0

Table 2: Effect of environmental factors on pod damage percentage at 2nd date of sowing (15th Nov.)

Observation week and date	S.M.W.	Temperature (^{0}C)		R.H. (%)		Sunshine (Hrs.)	Pod damage (%)		
		Min.	Max.	Mor.	Eve.		Uday	Pusa-362	Radhey
05 Feb.-11Feb.	6	8.1	24.3	86.7	34.8	4.6	7.0	10.0	13.3
12 Feb.-18 Feb.	7	10.7	24.7	91.7	52.7	3.5	7.3	10.6	14.0
19 Feb.-25 Feb.	8	11.8	28.7	88.8	45.8	6.5	8.0	11.0	15.3
26 Feb.-04Mar.	9	14.1	30.1	92.4	42.2	6.6	8.3	11.3	16.3
05 Mar.-11Mar.	10	12.3	31.1	91.0	38.5	6.6	8.6	11.6	17.0
12 Mar.-18 Mar.	11	13.7	32.8	81.7	34.8	7.1	9.3	12.3	17.3
19 Mar.-25 Mar.	12	14.2	34.2	83.4	25.7	7.1	10.0	12.6	18.0
26 Mar.-02Apr.	13	15.5	35.2	85.0	23.8	7.3	11.3	13.3	18.3
02 Apr.-08Apr.	14	18.7	35.3	81.0	35.0	7.3	11.6	14.0	19.0
09 Apr.-15 Apr.	15	18.3	35.4	74.0	32.4	7.1	12.0	14.3	20.3
16 Apr.-22 Apr.	16	20.4	39.2	63.2	20.5	7.9	13.3	15.0	21.6

Table 3: Effect of environmental factors on pod damage percentage at 3rd date of sowing (25th Nov.)

Observation week and date	S.M.W.	Temperature (^{0}C)		R.H. (%)		Sunshine (Hrs.)	Pod damage (%)		
		Min.	Max.	Mor.	Eve.		Uday	Pusa-362	Radhey
12 Feb.-18 Feb.	7	10.7	24.7	91.7	52.7	3.5	9.3	11.3	14.3
19 Feb.-25 Feb.	8	11.8	28.7	88.8	45.8	6.5	9.6	11.6	15.0
26 Feb.-04Mar.	9	14.1	30.1	92.4	42.2	6.6	10.3	12.0	16.6
05 Mar.-11Mar.	10	12.3	31.1	91.0	38.5	6.6	11.0	12.3	17.0
12 Mar.-18 Mar.	11	13.7	32.8	81.7	34.8	7.1	11.6	13.6	18.3
19 Mar.-25 Mar.	12	14.2	34.2	83.4	25.7	7.1	12.0	14.0	19.6
26 Mar.-02Apr.	13	15.5	35.2	85.0	23.8	7.3	12.6	14.3	20.0
02 Apr.-08Apr.	14	18.7	35.3	81.0	35.0	7.3	13.0	14.6	21.6
09 Apr.-15 Apr.	15	18.3	35.4	74.0	32.4	7.1	13.3	15.3	22.0
16 Apr.-22 Apr.	16	20.4	39.2	63.2	20.5	7.9	14.3	15.6	23.3

Conclusions

Higher pod damage was recorded with all varieties in crop sown at November 25th followed by November 15th sown crop While lowest pod damage percentage was recorded in crop sown at November 05th. The highest pod damage percent among all varieties was recorded in Radhey followed by Pusa-362, while lowest pod damage percentage was recorded in variety Uday at each date of sowing.

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