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Evaluation of Chickpea (*Cicer arietinum* L.) Germplasm for the Resistance to Gram Pod Borer, *Helicoverpa armigera* (Hübner) in Tarai Region of Uttarakhand

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A B S T R A C T

Screening of chickpea germplasm was carried out at Norman E. Borlaug Crop Research Centre, Pantnagar during winter season of 2017-18, with the objective of identifying the source of resistance to *H. armigera*. Observation recorded over a period of six weeks revealed that, the minimum mean egg (0.28 eggs/5 plants) and larval population (0.5 larvae/5 plants) were recorded on ICC372351. Minimum pod damage of 5.56 per cent was recorded on ICC372351, whereas the maximum grain yield of 1071.58 kg/ha was recorded on ICC3404. The germplasm *viz.* ICC4484 (3), ICC4260 (3), ICC244624 (3), ICC372351 (3) and ICC3089 (3) were rated as least susceptible based on pest susceptible rating.

Introduction

Chickpea, *Cicer arietinum* is one of the most important *rabi* pulse grown all over the world. India is the single largest producer of chickpea accounting for 65 per cent of the total production. In India Chickpea was cultivated in an area of 9.01 million hectares with a production of 7.58 million tonnes accounting for 34.3 per cent and 45.6 per cent of total pulse area and production (FAOSTAT, 2017). The production and productivity of chickpea has been drastically reduced by the biotic and abiotic stresses. Nearly sixty insect pest feed on chickpea, of which Gram Pod borer, *Helicoverpa armigera* (Hübner) is a pest of great economic importance in chickpea, and it is the major limiting factor in chickpea cultivation. In severe cases it causes about 75 to 90 per cent losses in seed yield (Sarwar, 2013), despite the application of costly insecticides. This pest alone reported to cause losses over Rs. 35000 million annually in India (Kumar, 2003). It has also developed high levels of resistance to several insecticides and in addition to the huge direct economic losses, deleterious effects of pesticides remain in the environment. Therefore, development of a cost effective and an environmentally friendly

approach like improvement of cultivars resistant to *H. armigera* is necessary. The resistant cultivars reduce yield losses due to insect pests, particularly under subsistence farming conditions in the developing countries. Therefore, the present research was undertaken to screen and identify the tolerant chickpea germplasm to *H. armigera.*

Materials and Methods

Eleven germplasm along with resistant checks (GL25016 and ICCL86111), susceptible check (ICC3137) and local check (PG186) were screened at Norman E. Borlaug crop research centre (NEB-CRC), G.B.P.U.A & T, Pantnagar, under natural field conditions during *Rabi* season of 2017-18. The germplasm were grown in plot of 2m x 3m with spacing of 10 x 30cm, in randomized block design with three replications. The germplasm were assessed in terms of egg and larval population per five plants at weekly interval from the date of first larval appearance till the maturity of the crop. Per cent pod damage from five randomly selected plants of each replicated plot and the final grain yield was also assessed at harvest stage. The pest susceptibility rating was calculated and graded as per the method given by Lateef and Sachan (1990).

Per cent pod damage =

$$\frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

Tukey's HSD test was used to compare differences among treatment means ($P<0.05$) using statistical package for social sciences (SPSS) Software, version 16.

Results and Discussion

The results pertaining to the mean egg and larval population per five plants, per cent pod damage, pest susceptibility ratings (PSR) and yield (kg/ha) of various germplasm screened for their reaction to *H. armigera* and the susceptibility ratings based on pest susceptibility ratios obtained from pod damage with respect to PG186 are presented below.

Mean egg population per five plants

The data on the number of eggs of *H. armigera* per five plants was recorded from the time of build-up of the insect population (8^{th} S.W.) to the maturity of the crop (13^{th} S.W.) are presented in the Table 1. During the 8^{th} S.W. maximum numbers of eggs (1.33 eggs/5 plants) in germplasm ICC2767 and no eggs in germplasm ICC4484, ICC4260, ICC3552, ICC372351, ICC3404 and ICC3089 were observed as against the check's PG 186 (0.67 eggs/5 plants), ICCL86111 (0.33 eggs/5 plants) and ICC3137 (0.33 /5 plants). A non-significant difference was observed between germplasm and their checks. Egg population during 9^{th} S.W. varied non-significantly from nil on ICC3552 and ICC372351 to the highest of 1.67 eggs/5 plants on ICC2767 as compared to 1.33 eggs/5 plants on check PG 186. A non-significant difference in egg population among the germplasm and their checks were observed during 10^{th} S.W. however, it ranged from 0.0 to 2.00 eggs/per 5 plants on germplasm as against 0.67 to 1.67 eggs/5 plants on check varieties. During the 11^{th} S.W. the population varied non-significantly from 1.00 to 2.67 eggs per 5 plants on germplasm as against 0.33 to 1.67 eggs per 5 plants on checks. Egg population during 12^{th} S.W. varied non-significantly from a minimum of 0.33 eggs/5 plants on ICC6263, ICC372351 and ICC3404 to maximum of 3 eggs/5 plants on ICC2767 as against 0.67 to 2.33 eggs/5 plants on check varieties. There was no egg population were observed during 13^{th} S.W. When overall mean egg population of *H. armigera* was considered there were non-significant differences among the test germplasm.

Table.1 Screening chickpea germplasm against eggs and larvae of *H. armigera* during 2017-18

Germplasm	Number of eggs of *H. armigera* per 5 plants							Number of larva of *H. armigera* per 5 plants						
	8th S.W.	9th S.W.	10th S.W.	11th S.W.	12th S.W.	13th S.W.	Pooled mean	8th S.W.	9th S.W.	10th S.W.	11th S.W.	12th S.W.	13th S.W.	Pooled mean
ICC4484	0^{a}	0.67^{ab}	0.33^{ab}	1^{ab}	1.333^{abc}	0	0.44^{ab}	0.67^{a}	0^{a}	1.33^{abc}	1^{abc}	2.67^{abcd}	0.67^{ab}	1.06^{abc}
ICC4260	0^{a}	1^{ab}	0.67^{ab}	0.67^{ab}	0.67^{ab}	0	0.39^{a}	0.67^{a}	1.333^{ab}	1.33^{abc}	1.33^{abc}	2.33^{abc}	1.33^{b}	1.33^{abc}
ICC2767	1.33^{b}	1.67^{b}	2^{b}	2^{bc}	3^{c}	0	1.57^{c}	1^{ab}	2.67^{b}	3.33^{c}	1.67^{abc}	4.67^{d}	1.33^{b}	2.433^{d}
ICC397375	0.67^{ab}	1.33^{ab}	0.67^{ab}	1.67^{abc}	0.67^{ab}	0	0.72^{ab}	1.33^{ab}	1.333^{ab}	1^{ab}	1.67^{abc}	1.33^{a}	1^{ab}	1.39^{bc}
ICC244624	0.33^{ab}	0.33^{ab}	0.67^{ab}	1^{ab}	1.33^{abc}	0	0.5^{ab}	2.33^{b}	1.333^{ab}	2.33^{abc}	0.33^{ab}	2.33^{abc}	1^{ab}	1.61^{cd}
ICC3552	0^{a}	0^{a}	0^{a}	2.67^{c}	0.67^{ab}	0	0.56^{ab}	0^{a}	0.67^{ab}	1.33^{abc}	2.33^{c}	3.33^{abcd}	1^{ab}	1.45^{bc}
ICC6263	0.33^{ab}	1.33^{ab}	0.67^{ab}	1.33^{abc}	0.33^{a}	0	0.55^{ab}	1^{ab}	1^{ab}	2.33^{abc}	0.67^{abc}	1.67^{ab}	1^{ab}	1.18^{abc}
ICC372351	0^{a}	0^{a}	0^{a}	1^{ab}	0.33^{a}	0	0.28^{a}	0^{a}	0^{a}	0.67^{ab}	0^{a}	2^{abc}	0^{a}	0.5^{a}
ICC3404	0^{a}	0.33^{ab}	4.33^{c}	1.67^{abc}	0.33^{a}	0	1.00^{abc}	1.33^{ab}	1.333^{ab}	1.33^{abc}	2^{bc}	2.67^{abcd}	0.67^{ab}	1.56^{bc}
ICC3089	0^{a}	0.33^{ab}	0^{a}	1^{ab}	1.33^{abc}	0	0.39^{a}	1^{ab}	1^{ab}	1.33^{abc}	0.67^{abc}	2.33^{abc}	0.33^{ab}	1.11^{abc}
ICC6938	0.33^{ab}	1.33^{ab}	0^{a}	0.67^{ab}	0.67^{ab}	0	0.39^{a}	1.33^{ab}	1.333^{ab}	2.33^{abc}	1.67^{abc}	2.33^{abc}	0.67^{ab}	1.61^{cd}
ICC3137	0.33^{ab}	1^{ab}	1.33^{ab}	1.33^{abc}	2.33^{bc}	0	0.89^{abc}	0.67^{a}	1^{ab}	2.33^{abc}	1.67^{abc}	4^{cd}	1^{ab}	1.78^{cd}
GL25016	0^{a}	0^{a}	0.67^{ab}	1^{ab}	1.33^{abc}	0	0.55^{ab}	0.33^{a}	1.333^{ab}	0.67^{ab}	1^{abc}	3^{abcd}	0.67^{ab}	1.16^{abc}
ICCL86111	0.33^{ab}	0.33^{ab}	0.67^{ab}	0.33^{a}	0.67^{ab}	0	0.44^{ab}	0.33^{a}	0.67^{ab}	0.333^{a}	1.67^{abc}	1.67^{ab}	0.67^{ab}	0.72^{ab}
PG186	0.67^{ab}	1.33^{ab}	1.67^{ab}	1.67^{abc}	2^{abc}	0	1.16^{bc}	1^{ab}	1^{ab}	2.67^{bc}	1.67^{abc}	3.67^{bcd}	1^{ab}	1.8^{cd}
SEm±	0.23	0.27	0.35	0.30	0.36	_	0.14	0.30	0.46	0.41	0.33	0.38	0.24	0.16
CD @ 5%	0.67	0.78	1.01	0.88	1.06	_	0.41	0.89	1.33	1.19	0.96	1.10	0.71	0.47

S.W.- Standard week *Means in a column followed by the same letter(s) do not differ significantly at the 5% level by Tukey's HSD test

Table.2 Per cent pod damage due to *H. armigera*, yield and pest susceptibility rating of chickpea germplasm during 2017-18

Sl.No	Germplasm	Per cent pod damage*	PSR	Category	Yield (kg/ha)
1	ICC4484	8.18^{bc}	3	LS	759.56
2	ICC4260	7.77^{b}	3	LS	912.72
3	ICC2767	15.99^{et}	5	LS	652.89
4	ICC397375	10.18^{c}	4	LS	958.62
5	ICC244624	9.72^{bc}	3	LS	987.42
6	ICC3552	13.87^{de}	4	LS	821.81
7	ICC6263	16.96^{f}	5	LS	943.58
8	ICC372351	5.56^{a}	3	LS	1016.29
9	ICC3404	10.17^{c}	4	LS	1071.58
10	ICC3089	9.88^{bc}	3	LS	936.45
11	ICC6938	12.87^{d}	4	LS	971.46
12	ICC3137	20.17^{g}	6	MS	623.38
13	GL25016	10.29^{c}	4	LS	671.84
14	ICCL86111	8.56^{bc}	3	LS	897.64
15	PG186	19.82^{g}			831.45
SEm±		0.418			
CD @ 5%		1.210			

LS-least susceptible, MS-Moderately susceptible*Means in a column followed by the same letter(s) do not differ significantly at the 5% level by Tukey's HSD test

Mean number of eggs per five plants varied from the lowest of 0.28 eggs/5 plants on ICC372351 to the highest of 1.57 eggs/5 plants on ICC2767 as against 0.89 eggs/5 plants (ICC3137) to 1.16 eggs/5 plants (PG186) on check varieties. Above results were well supported by the findings of Maurya (2007), who observed that the number of eggs varied from 0.3 to 2.9 / 5 plants.

The similar results were also observed by Brar *et al.,* (2015) who screened genotypes of chickpea against *H. armigera* and found that egg population varied from 2.30 to 15.74 per five plants. However, in the present study, the egg population varied from 0.28 to 1.57 /5 plants due to divergences in cultivars and change in the climatic conditions.

Mean larval population per five plants

The observations were recorded from 8th S.W. to 13th S.W. (maturity of the crop). The perusal data clearly indicated that the population kept on increasing till the maturity of the crop. During the 8th S.W. there was no larval population observed on ICC3552 and ICC37235. The maximum number of larvae (2.33 larvae/5 plants) was recorded on ICC244624. There was non-significant difference observed between germplasm and check. Whereas during the 9th S.W. the maximum number of larvae (2.67 larvae/5 plants) on germplasm ICC2767 and no larval population on germplasm ICC4484 and ICC372351 were observed as against 0.67 to 1.33 larvae/5 plants on check varieties. Non-significant differences were observed between germplasm and their checks. There was no

significant difference in number of larvae per five plants amongst the germplasm and their check during 10th S.W. However, it ranged from 0.67 larvae/5 plants on ICC372351 to 3.33 larvae /5 plants on ICC2767. During 11th S.W. larval population varied from 0.00 (ICC372351) to 2.33 larvae/5 plants (ICC3552) as against 1.00 to 1.67 larvae/5 plants on checks. Larval population during 12th S.W. varied non-significantly from the lowest of 1.33 larvae/5 plants on ICC397375 to the highest of 4.67 larvae/5 plants on ICC2767 as compared to 1.67 to 4 larvae/5 plants on check varieties. There was a non-significant difference in number of larvae per five plants between the germplasm and their check during 13th S.W. however, it ranged from nil on ICC372351 to 1.33 larvae/5 plants on ICC2767 and ICC4260. As soon as the pods start to mature, the decline in the larval population was observed. When overall mean larval population of *H. armigera* was considered there were non-significant differences among the test germplasm. Mean number of larvae per five plants varied from the lowest of 0.5 larvae/5 plants on ICC372351 to the highest of 2.43 larvae/5 plants on ICC2767 against 0.72 larvae/5 plants (ICCL 86111) to 1.8 larvae/5 (PG186) on check varieties. Above findings are in accordance with the studies conducted by Brar *et al.,* (2015) who recorded a larval population varying from 0.27 to 13.28 per five plants.

Per cent pod damage

Low pod damage was recorded due to unfavorable climatic conditions to *H. armigera* during 2017-18. The per cent pod damage by *H. armigera* on the germplasm significantly varied from 5.56 per cent to 16.96 per cent (Table 2). The minimum per cent pod damage (5.56) was recorded in germplasm ICC372351 which differed significantly from others. The germplasm ICC6263 (16.96) recorded maximum pod damage which was at par with ICC2767 (15.99) as against 19.82 per cent, 8.56 per cent, 10.29 per cent and 20.17 per cent in check varieties PG186, ICCL86111, GL25016 and ICC3137, respectively. These results are in agreement with the observations of Wakil *et al.,* (2005) who recorded pod damage varying from 12.71 per cent to 38.83 per cent in chickpea by *H. armigera.* Chandile *et al.,* (2017) also observed that the per cent pod damage varied from 4.94 to 10.14 per cent.

Grain yield

The grain yield of eleven test germplasm ranged from 652.89 kg/ha to 1071.58 kg/ha (Table 2). Significantly highest grain yield of 1071.58 kg/ha was recorded in ICC3404. In other germplasm *viz.* ICC4484, ICC4260, ICC397375, ICC244624, ICC372351, ICC3552, ICC6263, ICC3404, ICC3089 and ICC6938 recorded intermediate grain yield from 759.56 kg/ha to 1016.29 kg/ha. Significantly lowest grain yield of 652.89 kg/ha was recorded in ICC2767 which was at par with checks PG186 (831.45 kg/ha) and ICC3137 (623.38 kg/ha).

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