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FIELD SCREENING OF SOME CHICKPEA GENOTYPES FOR THEIR RESISTANCE AGAINST GRAM POD BORER, *HELICOVERPA ARMIGERA* (HUBNER)

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ABSTRACT

Among 20 chickpea genotypes, a wide range of variation observed in *Helicoverpa armigera* larval population (0.99 to 2.02 larvae per plant), pod damage (4.37 to 10.50 per cent), damage rating (1.17 to 1.75), trichome number (105.4 to 279.6 per 0.25 cm^2) and grain yield (12.21 to 24.48 q per ha), respectively. The lowest larval population (0.99 per plant), pod damage (4.37 per cent), damage rating (1.17) and maximum trichome number (279.6 per 0.25 cm^2) as well as grain yield (24.48 q per ha) was observed in JG-11 which indicates that it is resistant against *H. armigera* compared to resistant check *i.e.* ICCL-86111, due to its virtue of genetic potentiality. While the maximum larval population (2.02 per plant), pod damage (10.50 per cent), damage rating (1.75) and lowest trichome number (105.4 per 0.25 cm^2) was observed in ICCV-95334, respectively; and lowest yield was recorded from the genotype, ICC-3137 (susceptible check) *i.e.* 12.21 q per ha . On basis of *H. armigera* larval population and pod damage, two chickpea genotypes *viz.*, JG-11 (0.99 larvae and 4.37 per cent per plant) and ICCV-97105 (1.15 larvae and 4.91 per cent per plant) were found to be resistant against *H. armigera*.

INTRODUCTION

Chickpea (*Cicer arietinum* Linn.) is the third most important food legume in the world after dry beans and field peas (FAOSTAT, 2008). India is the largest producer contributing up to 65 per cent of world chickpea production. Chickpea production has increased during the past 30 years from 6.5 million tons (1978-1980 average) to 9.6 million tons (2007-09) because of increase in grain yield from 630 to 850 kg per ha during this period (Sethi *et al.*, 2016). However, high yield is limited by the insect pests attacking chickpea. Among the insect pests, gram pod border, *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is the major constraint in production of crop worldwide (Sharma *et al.,* 2005; Kumar and Singh, 2014). *H. armigera* causes 50 to 60 per cent damage to the chickpea pods (Khare and Ujagir, 1977). Crop losses could reach up to 90 per cent if population is not managed properly (Lal, 1996). Currently, the application of chemical insecticides is the most common method of controlling *H. armigera* (Sharma, 2007). However, *H. armigera* is known to have developed resistance to almost all insecticides used for its control (Kranthi *et al.*, 2002). Thus, host plant resistance (HPR) remains as back bone of pest management system favorable to most agro-ecosystems (Sharma, 2007). Therefore keeping in view, the present investigation was carried out to screen 20 chickpea genotypes for their resistance against *H. armigera*.

MATERIALS AND METHODS

The field experiment was conducted at Research Farm, Agricultural Research Station, Badnapur (VNMKV, Parbhani), Maharashtra, India during *Rabi* 2014-15. A total of 20 chickpea genotypes were screened against gram pod borer, *H. armigera viz.*, 5034, ICC-14364, ICCL-86105, ICCV-07104, ICCV-07306, ICCV-08108, ICCV-09115, ICCV-92944, ICCV-97105, JG-11, DO-59, ICC-14872, ICCV-07112, ICCV-08107, ICCV-09103, ICCV-09118, ICCV-95334, ICCV-10 along with resistant and susceptible checks *i.e.* Cv. ICCL-86111 and ICC-3137, respectively. The experiment was laid in randomized block design (RBD) with three replications. Each genotype was sown in two rows of 3.0 m length with row to row and plant to plant spacing of 45 cm and 15 cm, respectively. All the recommended cultural and agronomic practices were followed homogeneously in all the genotypes to raise a good crop. None of the insecticide was applied to protect the crop from infestation of gram pod borer, *H. armigera*. The genotypes were closely examined at weekly interval commencing from germination to harvest. The number of *H. armigera* larvae and percent pod damage per plant was recorded on randomly selected five plants from each genotype at weekly intervals (Bhatt and Patel, 2001; Maurya and Ujagir, 2004; Singh and Yadav, 2006; Ghugal and Srivastava, 2015). Per cent pod damage was calculated by using following formula suggested by Kumar *et al.* (2013).

$$\text{Pod damage}(\%) = \frac{\text{Number of damaged pod}}{\text{Number of total pods}} \times 100$$

The genotypes were graded on basis of pods damaged by *H. armigera*. Grading scale was used to grade the genotypes are as follows (Sharma, 2014).

Grade	Pods damaged	Grade	Pods damaged
1	Less than 10 per cent	6	51-60 per cent
2	11-20 per cent	7	61-70 per cent
3	21-30 per cent	8	71-80 per cent
4	31-40 per cent	9	More than 80 percent
5	41-50 per cent		

The grain yield obtained from each genotype was recorded and worked out on hectare basis. Number of trichomes on a square disk of 0.25 cm^2 sized pod wall for 10 random pods of each genotype in each replication was recorded by using simple microscope at 25X magnification as per the method suggested by Girija *et al*. (2008). Thus the data obtained was subjected to statistical analysis for interpretation of results.

RESULTS AND DISCUSSION

The data on larval population of *H. armigera*, its pod damage, damage grade, trichome number and grain yield of different chickpea genotypes is presented in Table 1. All the genotypes indicated significant variation regarding larval population and pod damage as well as chickpea grain yield, respectively. The larval population of *H. armigera* varied from 0.99 to 2.02 larvae per plant on different genotypes under study during crop season *(Rabi* 2014). The least larval population of gram pod borer, *H. armigera* was observed on genotype, JG-11 (0.99 larvae per plant). This was followed by, ICCV-97105 (1.15 larvae per plant) and ICC-14364 (1.21 larvae per plant) having at par reaction effect with each other respectively. Whereas the genotype ICCV-95334 recorded highest larval population *i.e.* 2.02 larvae per plant and remaining genotypes *viz*., ICCL-86111 (1.32 larvae per plant), ICCL-86105 (1.38 larvae per plant), DO-59 (1.38 larvae per plant), ICCV-10 (1.42 larvae per plant), 5034 (1.51 larvae per plant), ICCV-07104 (1.52 larvae per plant), ICCV-08107 (1.52 larvae per plant), ICCV-08108 (1.58 larvae per plant), ICCV-09118 (1.63 larvae per plant), ICCV-92944 (1.67 larvae per plant), ICCV-07306 (1.70 larvae per plant), ICCV-09115 (1.71 larvae per plant), ICCV-09103 (1.76 larvae per plant), ICCV-07112 (1.82 larvae per plant), ICC-14872 (1.90 larvae per plant) and ICC-3137 (1.99 larvae per plant) were found to having intermittent larval population ranging from 1.32 to 1.99 larvae per plant, and having at par reaction with each other respectively.The results of present investigation in relation to larval population of *H. armigera* are in accordance with; Waqas *et al*. (2005), who reported that on basis of larval population, the genotype, 90261 appeared as susceptible (7.46 larvae per plant) and CM-4068/97 appeared to be resistant (2.12 larvae per plant), respectively. Ruttoh *et al*. (2013) reported that the mean larval density ranged from 0.15 to 1.20 larvae per plant. The genotypes, EC-583250 and EC-583264 had lowest larval density, while ICC-4973 and ICC-3137 had highest larval densities increased from 0.30 to 1.97 larvae per plant during flowering stage. Similarly, Gughal and Srivastava (2015) reported that *H. armigera* larval population at pod formation stage of unprotected condition was varied from 0.07 to 0.73 larvae per plant. The genotype, RSG-963 recorded significantly least larval population (0.07 larvae per plant) than other

Table 1: *H. armigera* larval population, pod damage, grade on basis of pods damaged, no. of trichomes and grain yield of different chickpea genotypes

Genotype	No. of larvae per plant *	Per cent pod damage**	Damage grade	No. of trichomes (per 0.25 cm^2)	Yield(q/ha)
5034	1.51 (1.42)	6.70 (15.05)	1.28	161.0	22.32
ICC-14364	1.21 (1.31)	5.23 (13.18)	1.23	238.6	23.21
ICCL-86105	1.38 (1.37)	5.80 (13.94)	1.23	228.2	22.80
ICCV-07104	1.52 (1.42)	6.53 (14.73)	1.30	149.0	20.92
ICCV-07306	1.70 (1.48)	7.74 (16.11)	1.38	154.0	17.88
ICCV-08108	1.58 (1.44)	6.92 (15.23)	1.32	167.8	18.44
ICCV-09115	1.71 (1.49)	7.96 (16.43)	1.42	144.4	17.48
ICCV-92944	1.67 (1.47)	7.40 (15.79)	1.38	135.4	17.93
ICCV-97105	1.15 (1.28)	4.91 (12.79)	1.17	271.6	23.60
JG-11	0.99 (1.22)	4.37 (12.11)	1.17	279.6	24.48
DO-59	1.38 (1.37)	5.88 (14.06)	1.41	208.2	22.72
ICC-14872	1.90 (1.55)	9.53 (17.95)	1.54	124.0	15.41
ICCL-86111	1.32 (1.35)	5.80 (13.94)	1.23	130.0	22.93
ICCV-07112	1.82 (1.52)	8.82 (17.26)	1.42	118.6	15.90
ICCV-08107	1.52 (1.42)	6.94 (15.23)	1.29	177.2	18.87
ICCV-09103	1.76 (1.50)	8.05 (16.43)	1.39	157.0	16.98
ICCV-09118	1.63 (1.46)	7.10 (15.45)	1.33	137.6	18.01
ICCV-95334	2.02 (1.59)	10.50 (18.91)	1.75	105.4	13.17
ICCV-10	1.42 (1.39)	6.02 (14.18)	1.24	170.2	22.60
ICC-3137	1.99 (1.58)	10.21 (18.63)	1.68	112.4	12.21
SE (m) ±	0.02	0.34	-	-	1.42
CD at 5%	0.05	0.99	-	-	4.11
CV%	2.21	3.87	-	-	12.66

*Figures of larval population in parenthesis are $\sqrt{x+0.5}$.;**Figures of percentage in parenthesis are angular transformed values.

genotypes *viz.*, ICCL-86111, DCP-92-3, ICCC-37 and L-550 *i.e.* 0.18, 0.22, 0.33 and 0.37 larvae per plant, followed by CRIL-2-82 (0.44 larvae per plant) and ICC-3137 (0.48 larvae per plant), respectively and maximum larval population was observed in genotypes of PBG-5, GPF-2 and CSJ-479 *i.e.* 0.51, 0.70 and 0.73 larvae per plant, which were at par with each other. The results from the present study also suggest that larval population of *H. armigera* varied from one genotype to another due to susceptibility and tolerance of twenty chickpea genotypes. While, Bhatt and Patel (2001) and Singh and Yadav (2006) reported maximum densities of *H. armigera* larval population ranges from 14.32 to 38.19 larvae per five plants on different chickpea cultivars *viz*., Chaffa, ICCV-10, Phule G-5, PG-81-1-1, GNG-465, BG-391, BG-273, DCP-92-3, BG-256 and JG-130, respectively. It may be due to host acceptance or susceptibility of chickpea cultivars against *H. armigera*.

The pod damage due to pod borer, *H. armigera* was ranged from 4.37 to 10.50 per cent during crop season. The pod damage was significantly lowest on genotypes, JG-11 (4.37 per cent) and ICCV-97105 (4.91 per cent) with at par reaction, respectively. The genotype, ICCV-95334 (10.50 per cent) recorded highest pod damage due to pod borer, *H. armigera*. All other remaining chickpea genotypes *viz*., ICC-14364 (5.23 per cent), ICCL-86111 (5.80 per cent), ICCL-86105 (5.80 per cent), DO-59 (5.88 per cent), ICCV-10 (6.02 per cent), ICCV-07104 (6.53 per cent), 5034 (6.70 per cent), ICCV-08108 (6.92 per cent), ICCV-08107 (6.94 per cent), ICCV-09118 (7.10 per cent), ICCV-92944 (7.40 per cent), ICCV-07306 (7.74 per cent), ICCV-09115 (7.96 per cent), ICCV-09103 (8.05 per cent), ICCV-07112 (8.82 per cent), ICC-14872 (9.53 per cent) and ICC-3137 (10.21 per cent) were having at par reaction with each other and found to having intermittent larval population ranging from 5.23 to 10.21 per cent respectively.

The results of present investigation in relation to pod damage are in accordance with; Ghugal and Srivastava (2015), who reported that under unprotected condition least pod damage was recorded in the genotypes, DCP-92-3, RSG-963, ICCL-86111 and GPF-2 *i.e.* 5.23, 7.68, 9.88 and 10.37 per cent, respectively, which were at par with the resistant check ICCC-37 (11.43 per cent), and maximum pod damage recorded in ICC-3137, PBG-5, L-550, CSJ-479 and CRIL-2-82, *i.e.* 14.28, 17.53, 19.61, 21.90 and 22.45 per cent, respectively and they were at par with each other. Shankar *et al.* (2014) reported that the pod damage was significantly lower on EC-583264, ICC-10393, ICC-12475, ICCL-86111, ICCV-10, RIL-20 and RIL-25 than in ICC-3137 (susceptible check), respectively. Jadhav *et al.* (2012) found that the pod damage within twenty genotypes tested, varied from 8.48 to 33.06 per cent. The genotype Phule G-105-14-1 recorded lowest pod damage of 8.48 per cent followed by Phule G-7104 (9.61 per cent). While the genotypes, Phule G-06302 and local Kabuli recorded maximum per cent pod damage of 30.04 and 33.04, respectively. Chandrakar *et al.* (2006) reported that the genotype, BRG-74 had the minimum pod damage of 6.64 per cent as compared to BG-1047, BGD-74, BGD-320, FG-344, H-97-67, H-97-71, H-93-106, IG-443, KW-109, RG-9210, RSG-798 and JG-74, respectively. Lateef and Sachan (1990) suggested that some of the chickpea lines suffered considerably less borer damage than others due to tolerance to pod borer. This has necessitated that need for selecting genotypes with greater ability to tolerate or recover from the pod borer damage (Lateef, 1985). Tingey (1981) reported that cultivars with tolerance mechanism of resistance have a great value in pest management as such cultivars prevent the evolution of new insect biotypes capable of feeding on resistant cultivars.

The trichome number on pod wall of different chickpea genotypes is ranging from 105.4 to 279.6 trichomes per 0.25 cm^2. The highest trichome number was recorded on JG-11 (279.6 per 0.25 cm^2) which recorded lowest larval population (0.99 larvae per plant) and exhibited least pod damage (4.37 per cent), respectively; while least number of trichomes was recorded on the genotype, ICCV-95334 (105.4 per 0.25 cm^2) which recorded highest larval population (2.02 larvae per plant) as well as pod damage (10.50 per cent) indicating that presence of trichomes is the most important factor for the resistance. With the increasing of trichome density, larvae may found difficult to feed on chickpea pods due to irritation caused by trichomes and their secretions (malic acids) as well as larvae may go away from host plant due to non-preferring ability.

The results of present investigation in relation to trichome number on pod wall are in accordance with; Girija *et al.* (2008), who reported that the tolerant genotypes *viz.*, ICCL-87315, ICC-506 and ICC-12479 with higher number of trichomes exhibited less percent pod damage, while susceptible genotypes *viz.*, Annigeri and ICCV-2 with lesser number of trichomes showed higher pod damage. Similarly, higher trichome density in resistant genotypes and lower trichome density in susceptible genotypes was also observed in cowpea by Veeranna and Hussain (1997). Also Shanower *et al.* (1997) found that in pigeonpea, increased density of trichomes on pod could reduce the damage due to pod feeding insects. The results from the present study also suggest that higher trichome density has a role in imparting resistance against chickpea pod borer, *H. armigera*.

The lowest grade recorded based on pod damage in all over crop season on chickpea genotypes JG-11 and ICCV-97105 *i.e.* 1.17 and highest grade recorded on genotype, ICCV-95334 *i.e.* 1.75 while, other genotypes recorded intermediate grades ranging from 1.23 to 1.68. The results of present investigation are in accordance with; Kumar *et al.* (2013), who reported that nine genotypes were found as tolerant genotypes with grade on rating scale 1 because of their pod damage (5.50 to 8.50 per cent) and these genotypes were DGP-15, GIG-0312, ICCL-87315, ICCV-7, RIL-115, ICC-29, ICC-12470, ICCV-10 and PG-23, respectively. Seven genotypes (DGP-15, GIG-0312, ICCL-87315, ICCV-7, RIL-115, ICC-29, ICC-12470, ICCV-10 and PG-23) shown pod damage from 20.00 to 23.00 per cent and rating scale 3, were placed under susceptible grade because they were at par with susceptible check (H-82-2), remaining 34 genotypes shown pod damage from 10.50 to 19.00 per cent with rating scale scored 2, were placed under moderately resistant grade. Similarly, Rai and Ujagir (2005) found that four genotypes (ICCV-93929, ICCV-9602, ICCV-96030 and ICCV-2) had resistance to gram pod borer with a pest damage score of 3 on a scale of 1-9 and on other hand, ICCV-10, ICCV-97115, ICCV-97119 and ICC-16381 proved tolerant, as they gain more seed yield than the others.

The maximum grain yield was obtained from JG-11 (24.48 q per ha) due to its genetic potentiality against least number of *H. armigera* larvae, which ultimately leads to lowest pod damage under the study. While the genotype, ICC-3137 was recorded lowest grain yield *i.e.* 12.21 q per ha due to its susceptibility against gram pod borer, *H. armigera*. All other remaining genotypes *viz*., ICC-14364 (23.21 q per ha), ICCV-97105 (23.60 q per ha), ICCL-86111 (22.93 q per ha), ICCL-86105 (22.80 q per ha), DO-59 (22.72 q per ha), ICCV-10 (22.60 q per ha), 5034 (22.32 q per ha), ICCV-07104 (20.92 q per ha), ICCV-08107 (18.87 q per ha), ICCV-08108 (18.44 q per ha), ICCV-09118 (18.01 q per ha), ICCV-92944 (17.93 q per ha), ICCV-07306 (17.88 q per ha), ICCV-09115 (17.48 q per ha), ICCV-09103 (16.98 q per ha), ICCV-07112 (15.90 q per ha), ICC-14872 (15.41 q per ha) and ICCV-95334 (13.17 q per ha) were shown moderate performance regarding grain yield ranging from 13.17 to 23.60 q per ha and having at par reaction with each other, respectively.

The results of present investigation in relation to chickpea grain yield are in accordance with; Maurya and Ujagir (2004), who reported that three chickpea entries *viz*., ICC-11180, ICC-2171 and ICC-11175 produced the highest seed yields (38.9, 38.9 and 33.3 q/ha), respectively. Ali and Mohamed (2014) reported that the cultivar Hawata gave the highest seed yield (1482 kg per ha) followed by Atmore (1276 kg per ha) and Shandi (1246 kg per ha), respectively. Ghugal and Shrivastava (2015) reported that the genotypes, CSJ-479, DCP-92-3 and GPF-2 recorded significantly higher grain yields *i.e.* 1923.67, 1372.68 and 1356.47 kg per ha, respectively due to lowest larval population, pod damage and were identified as less susceptible against the pest which were at par with the resistant check *i.e.* ICCC-37 respectively. The results from the present study also suggest that genotypes with higher trichome density, less larval population and minimum pod damage has a role in transmitting resistance against *H. armigera*, which leads to maximum grain yield.

From the present investigation, it can be concluded that the genotype, JG-11 showed overall better resistance against gram pod borer, *H. armigera* with low larval population, low pod damage and high grain yield, respectively due to its virtue of genetic potentiality and may be further utilized for development of varieties in breeding programme for benefit of the farmers.

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