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Original Article

Evaluation for resistance in Kabuli chickpea genotypes against chickpea pod borer, *Helicoverpa armigera* (Hübner) (Lepidoptera: Noctuidae) under field conditions

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Abstract

The present study was carried out in a field trial at the Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad, to evaluate the susceptibility of ten advanced Kabuli genotypes and a check variety to chickpea pod borer (CPB), *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) during the year 2007. Genotypes CH 73/02, CH 76/02 and CC 121/00 were recorded as the most resistant against this insect pest. CH 72/02, CH 77/02 and CH 80/02 showed moderate resistance and CH 79/02, B 17/03, CH 65/02 and CH 60/02 the least resistance. CH 73/02 was highly resistant genotype showing the lowest pod damage (8.2%), decrease in damage (39.2%) and increase in grain yield (77.8%) over the check. The genotype, CH 60/02, was the least resistant showing 15.8% pod damage, 17.0% increased in damage and 53.3% decreased in yield over the check CM 2000. Results revealed that none of the genotype, was completely resistant against this pest, however, the genotypes which showed the high and moderate resistance and better yield as compared to the check had the valuable resistance attributes against CPB as in Kabuli type chickpea.

Keywords: Kabuli chickpea, *Cicer arietinum*, pod borer, plant resistant

1. Introduction

Chickpea (*Cicer arietinum* L.) is the most important grain legume crop, a major source of protein for the poor people of Pakistan. Its protein value ranges from 25.3 to 28.9% (Hulse, 1991). It is grown in 45 countries of the world and covers an area of 11 m ha with 9 million tones production (Anonymous, 1994). In Pakistan, it is mainly grown in rainfed and irrigated areas of the Punjab and covers an area of 1.11 m ha with a grain yield of 475 thousand tons (Anonymous, 2008). Kabuli chickpea is mainly grown in temperate and subtropical regions and it coveres nearly 10% of the total cultivation. The Kabuli type chickpea genotypes have bold seeds with creamy colour and are generally suitable for cultivation in well irrigated areas (Muehlbauer and Singh, 1987). Among the major yield limiting factors of chickpea, diseases and insect pests cause severe damage to the crop. Chickpea pod borer (CPB), *Helicoverpa armigera* (Hubner) (Lepidoptera: Noctuidae) is the most notorious pest of this crop and is one of the major limiting factors in its production the world over (Sharma *et al.,* 2005). CPB also causes yield losses in cotton, okra, tomato and in few other crops and vegetables (Saleem and Yunus, 1982). Yield losses due to CPB damage in chickpea may range from 70 to 95% (Prakash *et al.,* 2007). Its larvae causes serious damage to this crop during the fruiting stage, initially by appearing on new leaves then shifting to flowers, young shoots and finally entering the pods. A single larva can consume many pods before reaching the pupal stage. CPB has developed resistance against conventional insecticides as a result of their heavy use (Armes *et al*., 1996; Kranthi *et al*., 2002).

Development of cultivars with resistance to this pest

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could provide an effective approach in integrated pest management (IPM) to minimize the yield losses (Sharma *et al*., 2005). Studies have been conducted by many workers on screening of chickpea varieties for resistance and tolerance (Borikar *et al*., 1982; Dias *et al*., 1983; Tripathi and Sharma, 1984; Rashid *et al*., 2003 and Shafique *et al*., 2009. In integrated pest management, host plant resistance provides an effective tool for pest control as compared to other methods of control. Rajput *et al*. (2003) evaluated eight chickpea genotypes against CPB and observed that its larval population ranged from 1 to 50 larvae per plant, pod damage from 8 to 90% with grain yield from 23 to 1920 g per plot. The genotype, C-727 was found to be relatively resistant against CPB among the eight tested genotypes. Shafique *et al*. (2009) screened 13 advanced strains of Kabuli chickpea including a check and reported that pod damage ranged from 13.3 to 22.7% with grain yield from 274 to 855 g per plot on most and least susceptible strains, respectively. Efforts were carried out in the present study to screen advanced Kabuli chickpea genotypes against pod borer in a trial under natural field conditions keeping in view the importance of resistance in plants against insect pests in IPM.

2. Materials and Methods

The experiment was conducted at the experimental field area of NIAB, Faisalabad, Pakistan during the year 2007-2008. Ten advanced Kabuli chickpea genotypes developed by breeders of NIAB viz., B 17/03, CH 60/02, CH 65/02, CH 72/02, CH 73/02, CH 76/02, CH 77/02, CH 79/02, CH 80/02, CC 121/00 and a check CM 2000 were sown in November 2007 to screen for resistance against CPB. The experiment was laid out in a randomized complete block design (RCBD) with three replications. A distance of 30 and 15 cm between rows and plants was maintained, respectively. Each experimental plot consisted of four rows, each of 5 m length. To differentiate each experimental plot, two border rows of linseed were planted. Standard agronomic practices were adopted during the entire crop season according to the crop requirement under pesticide-free conditions. Weekly observations on pod borer larvae counts were recorded on randomly selected plants of one meter length from each row. At the harvest of the crop, pod damage was recorded in each replicate after counting the total number of pods and pods damaged by the pest from five randomly selected plants. Damage caused by CPB was calculated and converted into percent damage by using the following equation.

$$\text{Percent pod damage} = \frac{\text{Number of damaged pods}}{\text{Total number of pods}} \times 100$$

Temperature data were obtained from the meteorological observatory of the plant physiology section, Ayub Agricultural Research Institute (AARI), Faisalabad, located at the nearest place to the experiment. The crop was harvested and threshed and yield per plot was recorded. The collected data were statistically analyzed using analysis of variance technique following Steel *et al*. (1997) with MSTAT-C software programme and mean comparison was done by Duncan's multiple range test (DMRT).

3. Results and Discussion

The results regarding resistance among the chickpea genotypes against chickpea pod borer (CPB) *Helicoverpa armigera* (Hubner) on the basis of counts of larvae per meter row, percent pod damage and grain yield per plot and presented in Table 1 and 2.

3.1 Larval population

Larval population of CPB appeared on plants during the month of March when the temperature favored growth of the pest (Table 1). Population during March remained below the economic threshold level i.e., 1-2 larvae per meter length in all the genotypes including the check. During four weeks of March, the average maximum temperatures were 29.5, 31.4, 32.6, and 33.3°C while minimum temperatures were 14.6, 14.4, 15.5 and 17.7°C. The pest population of CPB increased with the rise in temperature from 1st to 3rd week of April. Average maximum temperatures during these weeks were 27.4, 33.2 and 34.0°C while, minimum temperatures were 16.3, 20.4 and 18.0°C. Mean larval population (number) on plants per meter row length during the first week of April was the highest (2.6) on CM 2000 and the lowest (0.66) on CH 76/02. A slight increase in temperature during the 2nd week of April, enhanced the larval population with the highest (3.0) larvae on CM 2000 and the lowest (1.00) on CH 79/02. In the third week of April, population ranged from 2.0 to 3.66 larvae per meter row length in all test genotypes. During April, the larval population was above the economic threshold level. At that time most of the pods were mature and CPB larvae have a non significant effect on pod damage. Here it is clear that none of the test genotypes was completely resistant to pod borer infestation. Dent and Pawar, (1988) reported that at low temperature (11°C), CPB was not observed. Results of present study confirmed the results reported by Anwar and Shafique, (1992) that the flowering and pod formation stages of the crop coincide with relatively high temperature (minimum 17°C and maximum 27°C), which is the optimum condition for rapid population build up of CPB. A range of 1.2 to 5.5 larvae per plant recorded by Wakil *et al.* (2005) supports the larval population found in the present results.

3.2 Pod damage

Data on pod damage (Table 2) indicate that the lowest damage (8.2%) of CPB was recorded near the maturity of crop in genotype CH 73/02 with 39.2% decrease in pod damage over the check, whereas, the highest damage (15.8%) was recorded in genotype CH 60/02 with 17% increase in damage over the check. Results of our study are contrary to those reported by Chhabra and Kooner, (1980) who recorded 0.5%

Table 1. Weekly mean larval population of CPB on Kabuli chickpea genotypes.

Genotypes	Observations during March, 2008				Observations during April, 2008		
	Week $_1$	Week $_2$	Week $_3$	Week $_4$	Week $_1$	Week $_2$	Week $_3$
B 17/03	0.33±0.33	0.33±0.33	1.00±0.00	1.33±0.33	2.00.57	2.00±0.57	2.33±0.33
CH 60/02	0.33±0.33	0.33±0.33	0.33±0.33	1.00±0.00	1.33±0.33	2.66±033	3.33±0.33
CH 65/02	0.66±0.33	1.00±0.00	1.00±0.00	0.66±0.33	1.66±0.33	2.00±0.00	3.33±0.29
CH 72/02	0.00	0.33±0.33	0.66±0.33	1.00±0.00	1.33±0.33	1.66±0.33	2.66±0.33
CH 73/02	0.00	0.33±0.33	0.66±0.33	1.00±0.57	1.33±0.33	1.66±0.33	2.33±0.33
CH 76/02	0.00	0.33±0.33	0.66±0.33	0.66±0.33	0.66±0.33	1.66±0.88	2.66±0.33
CH 77/02	0.66±0.33	0.66±0.33	1.00±0.00	1.33±0.33	1.33±0.33	2.33±0.33	2.66±0.33
CH 79/02	0.00	0.66±0.33	1.00±0.00	1.00±0.57	1.66±0.33	1.00±0.57	2.00±0.57
CH 80/02	0.33±0.33	0.66±0.33	0.33±0.33	1.33±0.33	2.00±0.57	2.33±0.33	3.00±0.57
CC 121/00	0.00	0.33±0.33	1.33±0.33	1.33±0.33	1.00±0.00	2.00±0.57	2.66±0.33
CM 2000 (Check)	0.66±0.33	0.66±0.33	0.66±0.66	1.33±0.47	2.66±0.33	3.00±0.00	3.66±0.33

Means±SE.

Table 2. Mean pod damage, grain yield and their difference (%) over check in Kabuli genotypes.

Genotypes	Pod damage (%)	Pod damage difference over check (%)	Grain yield per plot (g)	Grain yield difference over check (%)
B 17/03	13.9±0.62 ab	+2.9	512±44.8 ef	-26.7
CH 60/02	15.8±0153 a	+17.0	322±18.4gh	-53.3
CH 65/02	14.4±0.91 ab	+6.6	392±46.1 fg	-43.5
CH 72/02	10.3±0.69 cd	-23.6	686±73.3 cde	-02.3
CH 73/02	8.2±0.64 d	-39.2	1259±65.1 a	+77.8
CH 76/02	8.4±0.76 d	-37.7	985±90.1 b	+39.4
CH 77/02	13.2±0.45 b	-2.2	804± 80.0 c	+14.1
CH 79/02	10.3±0.75 cd	-23.6	197±8.4 h	-70.8
CH 80/02	12.6±0.64 bc	-6.6	807±54.0 c	+14.5
CC 121/00	9.6±0.56 d	-28.8	1119±86.9 ab	+58.2
CM 2000 (Check)	13.5±0.66 ab	__	703±95.5 def	__

Means sharing similar letters are statistically non significant at $P = 0.05$

infestation in resistant genotype and 30-40% infestation in susceptible genotypes using different lines. Our findings in the present study are in line to the results reported by Srivastava and Srivastava, (1989) who found CPB damage from 3.5 to 21.6% in different chickpea strains. Results reported by Ali *et al*. (1992) with CPB damage up to 20% on chickpea varieties are at par with our results. Our findings are in the line to the work of Shafique *et al*. (2008), who reported 13.3 to 22.7% pod damage by screening 13 Kabuli genotypes. Similarly Shafique *et al*. (2009) have reported 10.9 to 22.8% pod damage, which is agreement with our results.

3.3 Grain yield

Data regarding mean grain yield per plot (Table 2) indicate that the highest yield (1259 g) was recorded in genotype CH 73/02 with 77.8% increase over the check. A decreasing trend in grain yield was recorded in genotypes CC 121/00, CH 76/02, CH 80/02, CH 77/02, and having 1119, 985, 807, 804 g/plot, respectively difference of increased grain yield of +58.2, +39.4, +14.5 and +4.1% over check, respectively. The lowest yield (197 g/plot) was recorded in CH 79/02 with a 70.8% decrease in yield compared with the check. Grain yield in genotypes B 17/03, CH 60/02, CH 65/02 and CH 72/02 have attained 512, 322, 392 and 686 g/plot with 26.7, 53.3, 43.5 and 2.3% decrease, compared with the check, respectively. Our findings are in the line with the results reported by Shafique *et al*., 2008 who got 801 g/plot yield from the least susceptible Kabuli line, CH 75/02, among the thirteen tested strains of chickpea.

4. Conclusion

The present study concludes that genotype CH 73/02

is a highly resistant genotype, showing the lowest pod damage (8.2%) a decrease in damage of 39.2% and an increase in grain yield of 77.8% compared with the check while CH 60/02 is the least resistant having 15.8% pod damage, a 17.0% increase in damage and 53.3% decrease in yield over check CM 2000. High and moderate resistance shown by Kabuli genotypes in our study represent a valuable insect tolerance source that could be exploited by their direct release as a variety or by development of resistant germplasms by using them in hybridization.

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