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Chickpea Grains Resistance to Pulse Beetle, *Callosobruchus analis* (F.) (Coleoptera: Bruchidae)

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Abstract.- Grains of 22 chickpea genotypes were screened for resistance to pulse beetle, *Callosobruchus analis* (F.) under laboratory conditions (28±2°C and 60±5% R.H.). The results revealed that free choice oviposition by the beetle, adult progeny development, grain damage and weight loss' varied significantly ($P \leq 0.05$) among chickpea cultivars. Genotypes CM 3142-2/92, CM 88, CM 3142-3/92, CM72, and Pb91 harboured significantly lower number of eggs, adult progeny development, damage and grain weight loss indicating resistance to *C. analis.* The preference of the bruchid for host selection/oviposition seemed to be sensory to a larger extent as low number of eggs were laid on wrinkled and black grains genotypes. Various characteristics of chickpea for resistance to bruchids have been discussed.

Key words: Chickpea genotypes, grains, resistance, pulse beetle.

INTRODUCTION

Chickpea *(Cicer arietinum* L.) is the most important legume crop of Pakistan. It is considered as the best alternative to animal protein for poor masses of the country. During 2001 - 02, chickpea was cultivated on about 0.096 million hectares, producing about 673 thousand tonnes of grain with 701 Kg/hectare yield (MINFAL, 2003). Enhanced production and safe storage of chickpea grain is imperative to meet the requirements of teeming population. Bruchids *(Callosobruchus analis* (F.), *C. chinensis* and *C. maculatus)* are of significant economic importance as major insect pests of leguminous grains (Rehman, 1989; Hamed *et al.,* 1992; Khandwe *et aI.,* 1997; Shafique and Ahmad, 2002). During storage, high moisture content of grains (>12%), high temperature (25-35°C) and relative humidity (>60%) make the environment very conducive for proliferation of insect pests (Adams, 1998). As a result, beetles develop rapidly and inflict substantial losses to grains. Concerted efforts are needed to save the legume grains from this menace. Various options include application of insecticides / fumigants, biocontrol agents, biologically active plant materials (Rehman, 1989; Kharie *et al.,* 1992) and inherent resistance (Hamed *et al.,* 1988) in grains to insect pests.

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Resistant or less susceptible varieties are of particular interest for resource poor developing as well as developed grain exporting nations. Elite cultivars having good yields and acceptable storage characteristics are of worth exploitation as additional tool to grain protection strategies. Grains of promising chickpea genotypes were, therefore, screened for resistance to *C. analis* under laboratory conditions.

MATERIALS AND METHODS

The studies were carried out at Nuclear Institute for Agriculture and Biology (NIAB), Faisalabad during 2003. Twenty two chickpea genotypes (Flip 96-152C, PUSA-329, CM-439/92, CM-490/92, CM2090, CM3142-2/92, CM3142-3/92, CM3642/92, CM646/93, CM-1103/93, CM-72, CM-88, CM-98, C-44, Pb-1, Pb-91, Noor-91. Paidar 91, Bittle-98, Pb-99, Pb-2000, ICCV 95201) supplied by Mutation Breeding Division, NIAB, Faisalabad were screened for resistance to pulse beetle, *Callosobruchus analis* (F.) under laboratory conditions (28±2°C and 60±5% R.H.) The grains were cleaned and then preconditioned at 5°C for two weeks. The culture of *C. analis* was maintained on mungbean seed mixture in the laboratory. Seeds of mungbean showing "windows" (Credland, 1992) were separated from culture medium and kept in transparent plastic capsules (Zero No.). . The freshly emerged adults were paired in the test tubes and plugged with cotton. Mating started soon after paring (Southgate, 1979). Petri dishes having 60 grains (weighed) of each genotype were placed in a circle in the Perspex apparatus and mating pairs of beetles (1 pair/sample) were released in the centre for oviposition. The experiment was replicated 3 times. After 10 days the dead adults were removed and eggs laid (free choice) on grains were recorded. The grains with beetle eggs were kept in glass jars of 150 g capacity and covered with perforated tin lids till adult emergence (25 days). The emerging adults were taken out of grain jars and recorded daily upto 15 days. The damaged grains showing emerging holes were counted. The grain weight loss in each infested sample was recorded after sieving the frass. Per cent weight loss was determined using control samples. The data recorded were subjected to analysis of variance and significant means were compared using Duncan's new multiple range test at 5% level of significance. Coefficient of correlation (r) between different parameters were determined (Steel and Torrie, 1980).

RESULTS

The resistance of chickpea genotypes to pulse beetle, *Callosobruchus analis* (F.) was evaluated on the basis of free choice oviposition by the pulse beetle on grains, adult progeny developed from eggs laid, grain weight loss, damaged grains and shape and colour of grain. Parameters studied pertaining to resistance varied significantly ($\leq$ 0.05) in chickpea genotypes (Table I). The number of eggs laid by female beetle (32.00), adult progeny developed (12.33), grain weight loss (3.99%) and damaged grains (11.00) were lowest in genotype CM-3142-2/92 followed by CM-88, CM-3142-3/92, CM-72 and Pb-91 indicating resistance to *C. analis.* Contrary to that, eggs deposition, adult progeny development, grain damage and weight loss were high in Pb-1, CM-439/92, CM-490/92, CM-2090 and CM-1103/93 indicating susceptibility to pulse beetle. Grains of chickpea genotypes with wrinkled seed coat and black colour affected the beetle development and seemed to be less preferred than the smooth, plumpy and white colour seeds of chickpea cultivars.

Correlation between eggs laid and grain weight loss (r=0.459) was positive and significant. Similarly adult progeny emerged was positively correlated with grain weight loss (r=0.929) and grain damage (r=0.967). Correlation between grain weight loss and grain damage was (0.866) positive and significant. The correlations (r) between eggs laid by the beetle and adult progeny developed (r = 0.324) and between eggs laid and grain damage (r = 0.280) were positive but non-significant (Table II).

DISCUSSION

Literature survey indicates that varieties of a legume crop often differ in resistance to bruchids in time and space (Howe and Currie, 1964). Furthermore, parameters such as oviposition preference, insect progeny, grain damage, grain weight loss and physico-chemical characters of grains have been used to study varietal resistance/susceptibility to pulse beetles (Hamed *et al.,* 1992; Shafique and Ahmad, 2002).

Our study clearly showed that chickpea genotypes varied significantly for resistance to *C. analis.* Low adult progeny was produced in CM 3142-2/92, CM88, CM3142-3/92, CM72 and Pb-91 and hence less grain damage and weight loss was affected. However, no cultivar showed complete resistance to the insect. Genotypes Pb-91, CM439/92 CM490/92, CM-2090 and CM-II03/93 harboured large number of adult progeny consequently more grain damage and grain weight loss occurred to chickpea grains. The female beetle laid the lowest number of eggs on wrinkled seeds of CM 3142-2/92, however, it preferred to oviposit highest number of eggs on smooth and plumpy seeds of Pb-99, CM-98, CM-2090, C-44 and CM-II03/93. These observations are in line with the findings of Nawanze and Horber (1976), Mark (1982), and Singh *et al*. (1980a,c), who reported that ovopisition behaviour of pulse beetle might be affected by surface smoothness, plumpiness or wrinkling of the seed coat, size of seed as well as its odour.

Adult progeny development was lowest with minimum grains damage and grain weight loss in CM 3142-2/92, CM-88, CM 3142-3/92, CM-72 and Pb-91 even though eggs were laid on their grains. Their resistance, therefore, appears to be due to antibiosis to the eggs or larvae. Nawanze and

Table I.- Chickpea grains resistance to pulse beetle, *Callosobruchus analis* (F.).

Chickpea Genotypes	Eggs laid (Number)	Adults emerged (Number)	Grain weight loss (%)	Damaged grains (Number)	Grain	
					Shape	Colour
Flip 96-152 C	56.33 jk	36.67 fgh	11.81 g	41.33 d	S	W
PUSA 329	69.33 defg	40.67 e	13 .07 f	32.33 fg	S	B
CM 439/92	68.00 efgh	51.00 bc	16.22 c	49.67 bc	S	W
CM 490/92	55.33 jk	53.33 b	15.28 d	47.33 c	S	W
CM 2090	91.66 c	48.67 c	14.52 e	51. 00 b	S	W
CM 3142-2/92	32.00 m	12.33 I	3.99 0	11. 00 I	Wr	B
CM 3142-3/92	60.67 hij	14.33 I	6.08 m	18.33 j	Wr	B
CM 3642/92	76.67 d .	34.67 h	13.08 f	29.67 hi	S	B
CM646/93	64.33 efghi	31.33 i	10.03 ij	27.67 hi	S	B
CM 1103/93	85.67 c	44.00 d	18.79 a	36.67 e	S	B
CM-72	56.67 ijk	18.67 k	6.94 I	19.00 j	Wr	B
CM-88	49.33 kl	13.67 I	5.54n	12.67 kl	Wr	B
CM-98	99.33 b	40.00 ef	12.82 f	38.00 e	S	B
C44	87.33 c	28.00 j	9.85 j	27.33 i	S	B
Pb-1	61.67 ghij	58.33 a	17.08 b	54.00 a	S	W
Pb-91	69.33 defg	18.33 k	7.281	14.67 k	Wr	B
Noor-91	46.33 I	37.00 fgh	9.05 k	36.00 e	S	W
Paidar-91	81.33 de	30.67 ij	9.22k	30.00 gh	S	B
Bittle-98	63.00 fghij	38.33 efg	12.06 g	36.67 e	S	B
Pb-99	128.00 a	38.00 efgh	12.92 f	33.00 f	S	B
Pb-2000	65.33 efgh	36.33 gh	10.36 i	36.00 e	S	B
ICCV-95201	70.67 def	35.00 gh	10.87 h	32.33 fg	S	B

Means sharing similar letters in each column are non-significant ($P \leq 0.05$).
S = Smooth, Wr = wrinkled, W = White, B = black.

Table II.- Correlation coefficient (r) between different parameters of pulse beetle and chickpea genotypes.

Parameters	Adults emerged (Number)	Grain weight loss (%)	Damaged grains (Number)
Eggs laid (Number)	N.S. 0.324	0.459*	N.S. 0.280
Adults emerged (Number)	-	0.929**	0.967**
Grain weight loss (%)	-	-	0.866**

NS, Non significant; *, Significant at 5% level; **, Significant at 1% level.

Horber (1976) reported that differences in the seed coats of cowpeas affected oviposition and larval development of *C. maculatus.* The testa may be so thick that the newly hatched larva dies before it reaches the cotyledon, or the cotyledon may be poisonous. Sometimes the cotyledonous food is unpalatable or of poor nutritive quality (Janzen, 1977). Thus the larval development and adult progeny production is independent of oviposition and is greatly influenced by preferred host of good nutritive value. The oviposition on seeds may be affected by thick and hard testa of convex/wrinkled nature, while adult recovery is hampered by unpalatable physico chemical characteristics of grains i.e. antibiosis.

The resistant/tolerant genotypes of chickpea can certainly be helpful to reduce storage losses by bruchids and can be exploited by the breeders for the evolution of new varieties. The reaction of pulses after harvest to different insects should, therefore, be studied before recommending them for general cultivation. All efforts of breeders would be wasted if the high yielding varieties evolved by them are prone to insect infestation during postharvest storage. Postharvest storage studies, with special reference to insect attack, should be made a part of variety release proposal.

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