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GENETIC DIFFERENCES FOR SUSCEPTIBILITY OF CHICKPEA TO BRUCHID BEETLE (*CALLOSOBRUCHUS CHINENSIS* L.) ATTACK

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Resistance of 39 chickpea varieties was assessed against *Callosobruchus chinensis* L. Rough, hard and wrinkled seed surface and thick seed coat showed non preference (resistance). Coefficients of phenotypic and genotypic variations were highly positively correlated with damaged seed and emergence hole. The finding can be used for hybridization to limit pesticide use.

Key words: *Callosobruchus chinensis*; Susceptibility, Emergence hole.

Introduction

Chickpea (*Cicer arietinum* L.) is an important crop among pulses in Pakistan as it occupies 75% of the total area (1.75 million hectare) under cultivation to pulses. Damage caused to stored chickpea by Bruchid beetle (*C. chinensis* L.) is important in terms of economic loss. Some investigations have been conducted to assess the comparative susceptibility and resistance on morphological basis of various legumes, including chickpea, to attack by bruchid beetles (*C. chinensis* L. and *C. maculatus* F.) [1-9]. In addition, some work on genetic parameters of resistance in chickpea to attack of these bruchids was done [10, 11]. The present investigation was undertaken to assess genetic differences for resistance in chickpea to attack of *C. chinesis* L. to identify sources of resistance/tolerance for incorporation in the chickpea so that reliance on poisonous chemicals could be reduced.

Materials and Methods

Stock cultures of *C. chinensis* were maintained in glasss jars on seeds of chickpea variety ILC 195. Twenty five undamage healthy seeds of each of the 39 chickpea varieties were used in the test.

One hundred and seventeen appropriate size cavities were made in thermopore sheet (1 square meter size with 5.0 cm thickness) to accommodate 25 seeds per cavity of each variety in 3 replications in a randomized fashion. An acrylic sheet was held on the thermopore sheet with the help of a wooden frame to form a chamber for providing about 3 cm space between the thermopore and acrylic sheet for free movement of the bruchids to choose and infest the genotypes. One hundred and seventeen pairs of *C. chinensis* (24-48 hrs. old) were released in the test chamber. The experiment was conducted under semi-dark conditions at $27 \pm 3°$ and 55-65% RH and terminated after completion of bruchid emergence. The data were recorded on the number of damaged seeds, the number of holes (emergence of adult bruchid), and also on the seed surface texture and seed coat thickness.

Kabuli type varieties had smooth, soft and thin (SST) seed coat while Desi types had rough, hard, wrinkled seed surface and a thick (RHWTK) seed coat.

Analysis of variance, genotypic and phenotypic correlations and broad sense heritability estimates were determined using methods of Singh and Chaudhary [12]. Mean values of seed damage and emergence hole were also subjected to Duncan's Multiple Range Test (DMRT).

Results and Discussion

Seed damage (susceptibility/tolerance of the varieties). Maximum seed damage 23.33 was noted in varieties FLIP 82-79 and FLIP82-9 with small, soft and thin seed coats which were significantly different from the varieties CM 107, KC 239, CM 369, CM 279, with rough, hard, wrinkled and thick (RHWTK) seed coat and PK 51709 and PK 51944 (small seeded) with rough, hard and thick (RHTK) seed coat (Table 1). Three main groups, varieties 1 - 8, varieties 9 - 34 and varieties 35 - 39 were identified as respectively highly susceptible and tolerant with respect to the level of damaged seed.

Number of holes (bruchid emergence or developmental support). The results (Table 1) based on this criterion clearly divided the varieties into two groups. Varieties 1 - 17 with smooth, soft and thin (SST) seed coat (susceptible), and varieties 18 - 39 with rough, hard, wrinkled and thick (RHWTK) seed coat (less susceptible/tolerant). Comparatively less bruchid emergence was observed in Var. PK 51709 and PK 51944. Values of phenotypic variances and coefficient of variation were greater than the corresponding genotypic values (Table 2), indicating the masking effect of environment. Broad sense heritability values were low (17.6 and 31.9%).

Correlation coefficient (genotypic) of damaged seeds with the number of holes was positive and highly significant (Table 3). The phenotypic correlation between these two characters was also positive and highly significant but lesser in magnitude as compared to the genotypic correlations.

Comparatively less seed damage was noted in desi types which confirms the observations record by Brewer and Horber

TABLE 1. MEAN VALUES AND RESULTS OF DMRT FOR DAMAGE PARAMETERS IN CHICKPEA.

S. No.	Seed surface	DMRT	Mean damaged seeds	Variety	Variety	Mean No. of holes	DMRT	Seed surface
1.	SST	A	23.33	FLIP82-79*	FLIP82-79*	82.00	AB	SST
2.	SST	A	23.33	FLIP28-9*	FLIP82-9*	96.69	A	SST
3.	RST	AB	23.00	AUG 1432	AUG 1432	63.00	ABCDEFG	RST
4.	SST	ABC	22.33	FLIP81-40*	FLIP81-40*	57.67	ABCDEFGH	SST
5.	SST	ABC	22.33	CM 1/79	CM 1/79	54.67	BCDEFGH	SST
6.	SST	ABC	22.00	X82TH91*	X82TH91*	71.33	ABC	SST
7.	SST	ABC	21.67	FLIP81-29*	FLIP81-29*	53.00	BCDEFGH	SST
8.	SST	ABC	21.67	X82TH152*	X82TH152*	69.67	ABCD	SST
9.	RST	ABCD	21.33	810277	810277	38.67	CDEFGH	RST
10.	RHTK	ABCDE	21.00	CM 1917	CM 1917	36.00	CDEFGH	RHTK
11.	SST	ABCDE	20.67	FLIP82-16 *	FLIP82-16*	52.00	BCDEFGH	SST
12.	RHWTK	ABCDE	20.67	810264	810264	36.67	CDEFGH	RHWTK
13.	RHWTK	ABCDE	20.67	PK 51881	PK 51881	33.00	CDEFGH	RHWTK
14.	SST	ABCDE	20.67	Y 2608*	Y 2608*	53.00	BCDEFGH	SST
15.	RHWTK	ABCDEF	20.33	CM 455	CM 455	34.33	CDEFGH	RHWTK
16.	SST	ABCDEF	20.33	KC 1266*	KC 1266*	66.00	ABCDEF	SST
17.	SST	ABCDEF	20.33	X82TH78*	X82TH78*	50.67	BCDEFGH	SST
18.	RHWTK	ABCDEF	20.00	810297	810297	32.67	CDEFGH	RHWTK
19.	RHWTK	ABCDEF	20.00	CM 439	CM 439	30.67	CDEFGH	RHWTK
20.	RHWTK	ABCDEF	19.67	810320	810320	28.67	DEFGH	RHWTK
21.	RHWTK	ABCDEF	19.67	CM 370	CM 370	31.33	CDEFGH	RHWTK
22.	SST	ABCDEF	19.33	KC 1276	KC 1276	41.33	BCDEFGH	SST
23.	RHWTK	ABCDEF	18.67	CM 1919	CM 1919	32.00	CDEFGH	RHWTK
24.	RST	ABCDEF	18.67	PK 51885	PK 51885	35.67	CDEFGH	RST
25.	RHWTK	ABCDEF	18.67	CM 39	CM 39	25.00	FGH	RHWTK
26.	SST	ABCDEF	18.33	X82TH149*	X82TH149*	68.00	ABCDE	SST
27.	SST	ABCDEF	18.33	Y 2614*	Y 2614*	45.67	BCDEFGH	SST
28.	SST	ABCDEF	18.33	KC 1270	KC 1270	39.00	CDEFGH	SST
29.	RHWTK	ABCDEF	18.00	CM 901	CM 901	27.67	EFGH	RHWTK
30.	RHWTK	ABCDEF	17.67	CM 837	CM 837	27.67	EFGH	RHWTK
31.	RHWTK	ABCDEF	17.33	CM 1918	CM 1918	34.67	CDEFGH	RHWTK
32.	RHWTK	ABCDEF	16.67	CM 159	CM 159	28.67	DEFGH	RHWTK
33.	RHWTK	ABCDEF	16.33	CM 1916	CM 1916	25.00	FGH	RHWTK
34.	RHWTK	BCDEF	16.00	CM 107	CM 107	21.00	GH	RHWTK
35.	RHTK	CDEF	15.33	PK 51709	PK51709	17.33	H	RHTK
36.	RHTK	CDEF	15.33	KC 239	KC 239	23.00	GH	RHTK
37.	RHWTK	DEF	14.33	CM 369	CM 369	24.33	FGH	RHWTK
38.	RHWTK	EF	14.00	CM 279	CM 279	28.33	DEFGH	RHWTK
39.	RHTK	F	13.33	PK 51944	PK 51944	17.00	H	RHTK

A category which shares common letters is non significantly different at the $P < 0.05$ level. SST = [(S) smooth, (S) soft and (T) thin.]. RHWTK = [(R) rough, (H) hard, (W) wrinkled and (TK) thick.]. * = Kabuli type.

TABLE 2. VARIABILITY AND HERITABILITY OF BRUCHID DAMAGE PARAMETERS IN CHICKPEA.

Characters	Genotypic variance	Genotypic coefficinet of variation	Phenotypic variance	Phenotypic coefficient of variation	Heritability
No. of damaged seeds	2.62	8.43	14.86	20.077	0.176
No. of holes	200.47	33.79	627.61	59.790	0.319

TABLE 3. GENOTYPIC (rg) AND PHENOTYPIC (rph) CORRELATION COEFFICIENTS BETWEEN THE TWO CHICKPEA DAMAGE PARAMETERS ($P < 0.01$).

		No. of holes
No. of damaged seeds	rg	0.9606 **
	rph	0.6582 *

[9] Podoler and Applebaum [1] and Gokhale [4] indicating inability of the larvae to penetrate rough, hard, wrinkled and thick (RHWTK) seed coat (antibiosis due to mechanical and physical factors). Nwanze *et al.* [7] also stated that bruchids can detect macroscopic differences in seed coat texture which may be responsible for their choice of varieties.

Varieties 1- 17 included mostly kabuli types which supported maximum bruchid development. Salunkhe and Yadhav [8] and Gupta and Mishra [2] reported similar findings for the kabuli varieties. Varieties 18 - 39 having rough, hard, wrinkled and thick (RHWTK) seed coat included desi type which supported less bruchid emergence (tolerance/tolerance) especially in case of varieties PK 51709 and PK 51944 (small seeded). Raina [3] stated that possible factor for resistance in chickpea may be due to very rough and spiny seed coat and Podoler *et al.* [1] observed that thickness of the seed coat seemed to be the only limiting factor on larval penetration.

The seed damage and emergence hole of the varieties corresponded with respect to the level of susceptibility. According to Nwanze and Horber [5] that small seeded varieties give development support to fewer individuals as smaller seeds contain less food material. The concept of resistance in small seeded varieties may therefore be pseudo resistance. In our case, the finding of these authors is not in agreement on the basis that the emergence holes in PK 51709 and PK 51944 corresponded the mean seed damage (15.33 and 13.33, respectively). Insufficiency of food material may lead to less adult emergence, but not leave the seed undamaged, as is the case in our study. These results are in close agreement with an earlier report of Afzal *et al.* [10] and Ahmed *et al.* [11]. Screening of chickpea varieties indicated that the surface texture of the seed carries factors of resistance (whether mechanical, physical and /or biochemical) limiting bruchid infestation. However, The material to be used in the breeding should combine both a size acceptable to the consumers as well as negative factors to check insect biomass.

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