Pakistan Entomologist

Journal homepage: www.pakentomol.com

EVALUATION OF RESISTANCE IN LOCAL CHICKPEA VARIETIES AGAINST THE PULSE BEETLE, *CALLOSOBRUCHUS CHINENSIS* L. (COLEOPTERA: BRUCHIDAE)

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ARTICLE INFORMATION

Received: December 10, 2012
Received in revised form: June 17, 2013
Accepted: June 20, 2013

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ABSTRACT

The present research on the response of pulse beetle, *Callosobruchus chinensis* on five chickpea, (*Cicer arietinum* L.) varieties KK-1, KK-2, KC-98, Lawaghar and Sheenghar were conducted under laboratory condition. Two sets of experiment; no-choice test and free choice test were carried out in the Complete Randomized Design (CRD) with four replications. The results were evaluated on the basis of eggs laid/female, developmental period, total number of adults emerged, adult longevity of male and female, adult weight (mg), % adult emergence, percent grain damage and weight loss. Results of no-choice test revealed that none of the cultivar was completely resistant to *C. chinensis*, however, their response varied significantly. Taking weight loss as a standard parameter, cultivar Lawaghar (4 % weight loss) was significantly least susceptible, KK-2 (28%) and Sheenghar (31%) moderately susceptible while KC-98 (60%) and KK-1 (70%) were highly susceptible. The results of free-choice test also revealed that none of the cultivars was completely immune to the attack of *C. chinensis*. In free-choice test, variety Lawaghar also received significantly less number of eggs by *C. Chinensis*.

Keywords: Pulse beetle, *Callosobruchus chinensis*, chickpea, varietal resistance

INTRODUCTION

Pulses constitute major source of protein in the diet of people of developing countries. Pulses contain 20-30% of protein which is almost three times higher than cereals (Doharey *et al*., 1983). Major pulse crops grown in the country are chickpea, *Cicer arietinum* L.; lentil, *Lens culinaris.*; mung bean, *Vigna radiata* L.; mash, *Vigna mungo* L; and khesari, *Lathyrus sativus* L. In Khyber Pakhtunkhwa, chickpea is grown in the Southern areas, i.e., Karak, Bannu and D.I. Khan districts. It is traditionally grown on residual soil moisture after the rainy season in the months of October and November (Bashir, 1986).

Pulse beetle *C. chinensis* is one of the serious storage pests of Chickpea. *C. chinensis* has been reported to cause serious damage to pulses in Bangladesh, India and many countries of the world. It is cosmopolitan in distribution found in the countries where tropical and subtropical conditions prevail. It has a capability to infest not only cultivated host plants in the field but also in storage (Fahad, 2011). It is recorded that 55-60% loss in seed weight and 45.50 to 66.30% loss in protein content of pulses is due to infestation caused by this beetle (Faruk *et al*., 2011). In case of heavy infestation of grains by pulse beetle the grains lose their germination capacity and become unfit for human consumption. To reduce storage losses in pulses, usually some chemicals or fumigants are applied. The use of these chemicals not only increase input cost but also is health hazardous. Therefore, there is a need to search for some non-chemical methods. Investigating resistance source in the cultivable varieties is the best option in this regard. The present study is therefore planned to screen the five available cultivars for their resistance to pulse beetle *C. chinenis.*

MATERIALS AND METHODS

Varieties used for screening

Five varieties of chickpea which are presently under cultivation in pulses growing areas are selected for screening.

Cite this article as: Siddiqa, A., F. Perveen1, F. Naz and M. Ashfaque, 2013. Evaluation of resistance in local chickpea varieties against the pulse beetle, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae). Pak. Entomol., 35(1): 43-46.

These varieties are; KK-1, KK-2, KC-98, Sheenghar and Lawaghar.

Raising of *C. chinensis* culture

The culture of *C. chinensis* was maintained on a mung bean at 27±2 °C and 60±5% R.H with12:12 hr light: dark cycle for a number of generations in the laboratory.

Physio-chemical analysis of varieties

Morpho-chemical analysis of the candidate varieties was carried out to know the chemical composition of candidate varieties and their physical structure.

No choice test

In the no-choice test 50g of five chickpea varieties were placed in separate glass jars (10 x 5 cm). There were five chickpea varieties with five replications, each having a control. In this test the adults were confined to oviposit and develop on a single treatment.

Procedure

First the candidate varieties (KK1, KC-98, KK2, Lawaghar, and Sheenghar) were subjected to fumigation for two weeks so as to kill any pest already existing. Five pairs of newly emerged adults were released in glass jars (5x 10 cm) having 50 gram of each of five varieties. Jars were covered with muslin cloth, the rim of lid was held tightly on the jar so as to avoid the escape of pulse beetle and provide sufficient air. The insects were allowed to remain there for the purpose of egg laying till they died. The newly emeged adults were continued for next generation. The percent weight loss and percent grain damage were calculated by following the procedure of Khattak *et al*. (1987). Data on number of eggs oviposited, developmental period, adult longevity, total number of adults emerged, adult weight, % adult emerged, and % damage and percent weight were recorded.

The parameters were calculated by following formula:

%adult emergence= (Number of total adults emerged/total number of eggs laid) x100

Percent damaged grains= (Number of damaged grains/total number of grains) x100

% weight loss= weight of undamaged grains-weight of damaged grains/weight of undamaged grain.

Free choice test

In free choice test, complete choice was given to pulse beetle to oviposit on five chickpea varieties (KK1, KK2, KC 98, Lawaghar, and Sheenghar). For this purpose a plastic container measuring 2.5 x 2.5 x 35 cm was divided into 25 equal sections measuring 1 x 6.25 x 7 cm and in each section 5 grains of each chickpea varieties were placed randomly in each choice section. 20 pairs of newly emerged adults of *C. chinensis* were released in the middle of plastic container and covered with muslin cloth. The experiment was replicated five times. Data on number of eggs oviposited on each treatment, number of holes (number of adults emerged), percent adult emergence and percent damage grains were recorded.

Data analysis

The data recorded were subjected to statistical analysis by using statistics 8.1 for analysis of variance (ANOVA) for comparing the mean value and standard deviation (SD) to categorize varieties as resistant, susceptible and partially resistant.

RESULTSAND DISCUSSION

The results of present work revealed that the response of chickpea varieties varied against *C. chinensis*. Five chickpea varieties, i.e., KK1, KC-98, KK2, Lawaghar and Sheenghar were evaluated against *C. chinensis* under controlled laboratory conditions. All these varieties were different in grain size and chemical composition (Table 1, 2), their response varied significantly against *C. chinensis* infestation (Table 3). The response of observed grains pests to stored grain commodities depends upon multiple factors. The important ones are variety, insect pest species and grain size (Khattak *et al*., 1987). Within a variety there could be variations like texture, smooth or rough surface and chemical constituents of the grains (Khattak *et al*., 1987). The above results of our physical characters and chemical composition were closely related to the Khattak *et al*. (1991) results because there could be variation within a variety like texture, smooth and rough surface and chemical constituent of the grains.

No choice test

The data of No-choice test presented in Table (3) revealed that the beetle *C. chinensis* preferred KK-1 for ovipoition as (220) eggs were oviposited by *C. chinensis* , whereas KC-98 appeared to be the second most preferred variety as (159) were laid by the *C. chinensis* respectively. KK-2 and Sheenghar varieties were moderately preferred for oviposition as (123) of *C. chinensis* on these two varieties. Variety Lawaghar was least preferred as significantly lower number of eggs of *C. chinensis* (49) was observed on this variety. In other words variety Lawaghar performed better in test for the preference of oviposition by *C. chinensis.* These results of present research reveals that varieties with high protein content like KK-1 and KC-98 were more susceptible to pulse beetle (*C. chinensis*) than varieties with low protein content like Lawaghar. Our results are supported by Ashfaque *et al*. (2001) that varieties with high protein contents are highly preferred for oviposition by *C. chinensis* while varieties with low protein contents are least preferred for oviposition. However Khattak *et al*. (1991) are of opposite opinion. It might be due to different environmental conditions and other characters of the varieties used by them.

Table 1
Physical characteristics of candidate varieties.

Varieties	n* /50 gm	Seed/Grain Morphological characteristics (seed coat)
KK-1	261[a]	small in size, wrinkled, dark in color, hard texture
KK-2	226[b]	small in size, wrinkled, dark in color, hard texture
KC-98	181[d]	medium size, slightly round, light in color , hard texture
Lawaghar	178[d]	large size, round, more light in color, hard texture
Sheenghar	206[c]	medium size, slightly round, dark in color, hard texture

*n: Number of grains of five chickpea varieties:

Table 2
The chemical composition of five chickpea varieties.

		Chemical composition of five chickpea varieties					
Varieties	n*	% Moisture M±SD	% Ash M±SD	% Protein M±SD	% Fat M±SD	% Fiber M±SD	% Carbohydrate M±SD
KK-1	5	8.5±0.1[c]	2.9±0.01[a]	22.2 ±0.1[b]	4.4± 0.015[b]	8.4 ±0.01[a]	53.4 ±1.0[b]
KK-2	5	8.4±0.1[d]	2.6±0.1[a]	22.6±0.1[a]	4.2±0.001[c]	7.4± 0.1[c]	55.6 ±1.0[a]
KC-98	5	8.8±0.06[b]	2.8±0.01[b]	19.5±0.1[c]	4.2±0.001[c]	7.6±0.1[b]	57.1 ± 1.0[a]
Lawagher	5	8.3±0.1[d]	2.8±0.01[b]	19.2±0.1[d]	4.8±0.01[a]	7.7 ±0.1[b]	57.1 ± 1.0[a]
Sheenghar	5	9.2± 0.1[a]	2.6± 0.1[a]	18.7±0.1[e]	4.8± 0.1[a]	7.2± 0.1[d]	57.1 ±1.0[a]

Table 3
Number of eggs, developmental period, adult longevity, percent adult emergence, adult weight, percent grain damage and percent weight loss by *C. chinensis* on different chickpea cultivars.

Varieties	No. of eggs	No. of adults emerged	Develop-mental period (days)	Adult longevity (Days)	Percent Adult emergence	Adult Weight (mg)	Percent grain damage	Percent weight loss
	M±SD	M±SD	M±SD	M±SD	M±SD			
KK-1	220±43.9[a]	103±30.4[a]	31.8±0.45[c]	7.6±0.55	47±11.9 [a]	54±3.5 [b]	38±13.7 [a]	70± 0.3 [a]
KK-2	123±26.8[bc]	46±16.8[c]	33.0±0.0[b]	8.2±0.84	39±18.3 [a]	59±3.3 [a]	22±7.7 [b]	28± 0.28 [b]
Lawaghar	49±5.2[d]	60±20.5[b]	33.0±0.0[b]	7.6±0.54	36±11.1[a]	56±3.0 [ab]	35±10.7 [a]	60±0. 2 [a]
KC-98	159±14.3[b]	3±1.9[c]	33.0±0.0[b]	7.6±0.57	6±3.6 [b]	56±2.1 [ab]	1.7±1.1 [c]	4± 0.02 [c]
Sheenghar	88±35.3[c]	18±12.8[c]	33.0±0.0[b]	8.2±0.84	19±8.8 [b]	56±2.5 [b]	10±6.2 bc	31±0.10 [bc]

In the case of number of adults emerged of *C. chinensis,* the variety KK-1 was significantly higher (103) from KC-98 (compared 42 adults emerged). The KK-2, Lawaghar and Sheenghar were not significantly different in this parameter. Ahmad (1989) declared number of adult emergence is a suitable criterion for measuring varietal resistance than oviposition preference.

The percent grain damage by *C. chinensis* on candidate varieties was significantly different. Variety Lawaghar showed least damage for *C. chinensis* (1.7%) which was highly significant than other varieties KK-1 (36.8%), KK_2 (19.8%), KC-98 (33.5%), Sheenghar (7.9 %) respectively.

The percent weight loss by *C. chinensis* was found significantly different among candidate varieties. The KK-1 and KC-98 (weight loss 70% and 60% respectively) were significantly higher from KK-2 (42%). Lawaghar received significantly low percent weight loss (4.0%). This variety is followed by two other varieties KK-2 and Sheenghar. They had significantly low percent weight loss by *C. Chinensis.*

Free choice test

In free choice test (Table 4), the oviposition by specie *C. chinensis* had no significant difference on candidate varieties. However maximum number of eggs were oviposited on variety Sheenghar (47) followed by KK-2 (46), KC-98 (45), KK-1 (41) and Lawaghar (39). In other words variety "Lawaghar" performed better in test for the preference of oviposition by *C. chinensis*.

Percent grain damage by *C. chinensis* on candidate varieties was significantly different. Variety KK-1 received significantly minimum percent damage (52) than rest of the candidate varieties by *C. chinensis*; while variety KC-98 received significantly maximum percent damage (84). Other varieties received moderate percent damage by *C. chinensis* KK-2 (60), Lawaghar(72) and Sheenghar(80).

The above results revealed that none of the Chickpea cultivar is completely immune to *C. chinensis*; however varieties with hard, rough, thick and wrinkled seed coat proved to be more resistant than with those having soft, smooth and thin seed coat (Shaheen *et al*., 2006). Ahmad *et al*., (1993) observed that varieties with hard seed coat are not preferred by pulse beetle. The views of Janarthan (1973) and Johonson *et al*. (1990) are opposite and reported that physical factors are not associated with resistance of a certain cultivar. Riaz *et al*., (2000) found chickpea cultivar NCS-960003 partially resistant and NCS-960002 partially susceptible. Jha *et al*.(2009) found cultivar BG-267 to be highly preferred by pulse beetle and cultivar BG-256 least preferred.

Conclusion

In the light of this study it is recommended that varieties KK-2, Lawaghar and Sheenghar can be kept for long time storage while cultivars KK-1, KC-98 are not fit for long time storage. In case of long time storage of the later varieties, necessary measures for their protection against *C. chinensis* may be undertaken.

Table 4

Number of eggs, total number of adults emerged, percent adult emergence, and percent grain damage done by *C. chinensis* on different chickpea cultivars.

Varieties	n*	No. of Eggs	Total No. of Adults emerged	Percent adult emergence	Percent damage
KK-1	5	41±6.7	3±2.3	8±6.9	8±6.9
KK-2	5	46±8.8	3±2.2	8±4.6	8±4.6
KC- 98	5	46±3.2	6±2.9	13±6.2	13±6.2
Lawaghar	5	39±4.9	6±2.5	13±4.5	13±4.5
Sheenghar	5	47±11.4	4±1.0	10±3.5	10±3.5

REFERENCES

Ahmad, K., F. Khalique, I.A. Khan, M. Afzal and B.A. Malik, 1993. Variability in chickpea (*Cicer arietinum* L.) genotypes for resistance to *Callosobruchus maculatus* F. (Bruchidae). J. Stored Prod. Res., 25(3): 79-99.

Ahmad, K., F. Khalique and M. Afzal, 1989. Effect of agronomic factors on the incidence of *Helicoverpa armigera* (Hb.) and its parasite *Compoietis chloridae* (U.) in chickpea field. Pak. J. Sci. Ind. Res., 32(10): 694-697.

Ashfaque, M., S.K. Khalil and A. Zeb, 2001. Oviposition and development of Pulse beetle (*Callosobruchus maculates*) on M1 Seed of chickpea varieties. M.Sc. (Hons.) thesis, Department of Plant Protection, NWFP Agriculture University, Peshawar, Pakistan. Pp.135.

Bashir, A., 1986. Chemical control of gram pod borer *Heliothis armigera* (Hb) with different insecticides and resistance of chickpea cultivars against the pest. M.Sc. thesis, Entomology, Faculty of Agriculture, NWFP Agricultural University, Peshawar, Pakistan. Pp. 120.

Doharey, R.B., R.N. Katiyar and K.M. Singh, 1983. Ecotoxicological studies on pluse beetles infesting green gram. Bull. Grain Technol., 21: 110-114.

Fahad, A., 2011. Cryomazine concentration and host type effects on the biology of the southern cowpea weevil *Callosobruchus maculates*. African J. Microbiol. Res., 5(20): 3321-3326.

Faruk, K., I. Varol and M. Bayram, 2011. The effect of carbon dioxide at high pressure under different developmental stages of *Callosobruchus maculates* (F) hosting on chickpea. African J. Biotechnol., 10(11): 2053-2057.

Janarthan, R., 1973. A note on the relative susceptibility of seed of Dolichas Late Labe varieties to the pulse beetle *C. chinensis* L. (Coleoptera: Bruchidae). Bull. Grain Tech. 2 (1): 72.

Jha, A.N., C. Srivastava and J. Kumar, 2009. Host suitability of chickpea cultivars to *Callosobruchus chinensis* L. *and C. analis* F. Indian J. Entomol., 71(1): 72-76.

Johnson, Y.S., E. Thangara, K. Gunthilagaraj and T. Edward, 1990. Evaluation of chickpea genotypes for their resistance to the pulse beetle, *Callosobruchus maculatus* (F.) (Coleoptera: Bruchidae). Internat. Chickpea Newsl., (23): 19-20.

Khattak, S.U., K. Hamed, M.R. Khatoon and T. Mohammad, 1987. Relative susceptibility of different moongbean varieties of pulse beetle, *Callosobruchus maculatus* (F). J. Stored Prod. Res., 23: 139-142.

Khattak, S.U., M. Alam, S.K. Khalil and N. Hussain, 1991. Response of chickpea cultivars to the infestation of pulse beetle *Callosobruchus chinensis* (L). Pak. J. Zool., 23(1): 51-55.

Riaz, A., M. Aslam and N. Suleman, 2000. Evaluation of resistance in different chickpea strains to *Callosobruchus chinensis* (L) under laboratory condition. Pak. J. Biol. Sci., 3(6): 1033-1036.

Shaheen, F.A., A. Khaliq and M. Aslam, 2006. Resistance of chickpea (*Cicer arietinum* L.) cultivars against pulse beetle. Pak. J. Bot., 38(4): 1237-1244.