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Screening of different germplasm of chickpea against pulse beetle (*Callosobruchus chinensis* L.) and its relationship with quality parameters

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ABSTRACT

Ten germplasm of stored chickpea were tested for their resistance against pulse beetle, *Callosobruchus chinensis* L. under laboratory conditions during the year 2013 and 2014 at the Department of Entomology, Narendra Deva University of Agriculture and Technology, Kumarganj- Faizabad. In above germplasm, the per cent seed moisture, per cent seed infestation, per cent seed germination and chemical composition of the seed were evaluated on the basis of their storage period before and after three months of storage. The results revealed that none of the germplasm was completely immune to the attack of C. chinensis. However, their response varied statistically significantly. Per cent infestation being main index of resistance, germplasm DCP 92-3 was found significantly highly tolerant and BG-256 least tolerant followed by NDG11-5, NDGK 98-8, NDG 93-1, NDG 97-1, IPC 2004-52, BG-362, BG 50-28 and NDG 12-1, were significantly susceptible. The co-efficient of correlation between per cent infestation with per cent moisture content, protein content and fat content was positive significantly, and per cent germination was negative significant.

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INTRODUCTION

Chickpea (*Cicer arietinum* L.) is the most important pulse crop in India. It provides high quality of protein and considered to be the best food for vegetarian population in India, South Asia, West Asia and Southern European countries (FAO, 2005). Seeds have about 20 per cent protein, 5 per cent fat and 55 per cent carbohydrate. The pulses have played a vital rule in the improvement of agricultural economy of different countries (Sarwar *et al.*, 2003 and Deeba *et a1.*, 2006). In our country, pulses continue to be in short supply; this calls for a review of agricultural policy at national level

with some change in emphasis and approach, through which the production of pulses can be greatly increased. Insects destroy at least 5 per cent of the world production of all cereal grains after they are harvested and while them are in storage, on the farms, in elevators or in warehouses. These losses consist of lowered weight and food value, insect adulteration, heating of grains, mould spoilage and low germination of seed. Pulse seeds suffer great damage during storage due to insect attack. Pulses are invariably infested with beetle and weevil in field and storage time (Adugeena, 2006).

Pulse beetle, *Callosobruchus chinensis* L. is a serious pest of stored grain products; it attacks mainly on the pulses, cereals and different types of grains. The damage due to this pest affects the germinative ability and nutritive value of the seed.

Storage insect pests are commonly controlled using chemical insecticides which, however, bear many drawbacks related to high cost, environmental pollution and food safety risks. Breeding legume crops to improve their resistance against storage insect pests, although having technical limitations is the best way of overcoming these disadvantages in an environment-friendly manner.

It is recorded that 55- 60 per cent loss in seed weight and 45.50 to 66.30 per cent 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 loss their germination capacity and become unfit for human consumption. In Africa, storage pests are estimated to cause 10 to 15 per cent losses and 23 to 80 per cent damage during 2–4 months of storage (FAO, 1994). In India, a loss of 15.33 to 17.00 per cent is recorded in chickpea storage against *C. chinensis* (Parameshwarappa *et al*., 2007). Especially small scale farmers lose a sizeable proportion of their harvested pulses which estimated to be 10 to 20 per cent for 3 to 6 months of storage (Khare, 1994). Present studies were undertaken to determine the susceptibility/ resistance response of chickpea germplasm against *C. chinensis* and to determine the correlation between different variable *i.e*. per cent moisture, per cent infestation, per cent germination and chemical composition *e.g.* protein, fat during storage period.

MATERIAL AND METHODS

Maintenance of insect culture :

To maintain the stock culture of *C. chinensis*, the sound and healthy chickpea grains were cleaned and sieved to remove the fractions of grains or insects if any. The grains were sterilized at 65±5^{0}C for 8 hours in order to eliminate both apparent and hidden infestation of insects and mites, if any. These grains were conditioned at least for a week in an incubator maintaining 28±2^{0}C and 65±5 per cent relative humidity to raise their moisture content. The adults of *C. chinensis* were obtained from godowns of seed processing plants of Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad for mass rearing and reared on already conditioned grains of chick pea in plain plastic jars of 5 kg capacity.

These jars were kept at a temperature of 28±2ºC and 65±5 per cent relative humidity. The adults so emerged from the culture were used for further experimentation.

Antibiosis test :

To the check resistance of different germplasm of chickpea against pulse beetle, ten germplasm namely NDG97-1, NDGK98-8, NDG11-5, NDG12-1, BG50-28, BG-362, IPC2004-5, BG-256, DCP92-3 and NDG93-1 were used. These germplasm were collected from Department of Genetic and Plant Breeding, Narendra Deva University of Agriculture and Technology, Kumarganj, Faizabad. The all ten chickpea germplasm were subjected to fumigation using Aluminium Phosphate (3g tab.) @ 1 tab. / 3 quintal disinfested before starting the experiment with seven days of exposure periods. Plastic jars were used as experimental units. In these jars, 500 g of each germplasm ware placed and 10 pairs of 1-3 days old beetles were released in each jar, the mouth of which was covered with muslin cloth and tight with help of rubber band. The jars were kept on racks at ambient condition in seed section Department of Entomology. The per cent moisture, per cent infestation, per cent fat and protein contents of each germplasm was calculated before and three months after experiment.

Per cent grain moisture :

Grain moisture content was calculated by randomly selecting 100 grain in each bag, were recorded with help of Steinlite Electronic Moisture Meter before and after 3 months of experiment.

Per cent grain infestation :

The per cent infestation of each cultivar was

calculated by separating healthy grains (without holes) from the sieved samples and was used for per cent infestation calculations using the formula :

$$\text{Per cent grain infestation} = \frac{\text{(Initial weight – Weight of sount grains)}}{\text{Initial weight}} \times 100$$

Per cent grain germination :

The germination tests were carried out according to International Rules of Seeds Testing (Anonymous, 1976). For assessing the germination of grains mixed with different materials and of untreated grains, a lot of 100 seeds were drawn from each replication and soaked in water for 24 hrs and then placed in petri dishes over a wet filter paper. These petri dishes were kept at a temperature of 28±2°C and the numbers of germinated grains were counted up to one week and the percentages of germination were calculated.

$$\text{Germination per cent} = \frac{\text{Number of seeds germinated}}{\text{Number of seeds kept for germination}} \times 100$$

Fat content :

Per cent fat content in chickpea grain was estimated by AOAC (1990). For this, 20 g grinded samples of grains were placed in Soxhlet extraction flask. Petroleum ether (B.P. 60-70°C) was poured in extraction flask. Sample was heated on water bath 80°C ±2°C. This process was repeated for 8-10 hours. Flask solvent was evaporated in at 50-60°C at water bath to get fat. The per cent fat was calculated as following formulae:

$$\text{Fat per cent} = \frac{\text{Weight of fat}}{\text{Weight of sample}} \times 100$$

Protein content :

Protein content in chickpea grain was determined by the Lowry's method (1951). One gram grinded sample was taken and homogenized in the presence of 10 ml of distilled water. The whole content was finally centrifuged at 5000 rpm for 15 minutes. The residue was discarded. Thereafter 1 ml supernatant was taken and mixed with 1 ml 10 per cent TCA. It was kept for 30 minutes at room temperature. Filter the whole content with the help of filter paper and reside was obtained was dissolve in 5 ml 0.1 N NaOH. 0.5 ml sample extract was taken in another test tube and volume was made up 1 ml with distilled water. Then 5 ml alkaline copper reagent was added and it was mixed properly. After 10 minutes, 0.5 ml folin's reagent was added and it was kept at room temperature to 30 minutes. Fillaly, colour intensity was recorded 660 nm on spectronic-20 against blank solution. Calculation was done by standard curve prepared from Bovine Serum Albumin solution and result was expressed as amount of protein in per cent of sample.

RESULTS AND DISCUSSION

Storage periods of chickpea seed (3 months) had a significantly difference on germplasm characters (% moisture contents, % infestation, % germination, protein and fat contents) as shown in Table 1 and 2.

Per cent moisture content :

The experimental result shows that there was a significantly different in the moisture content between chickpea seed germplasm during storage period (Table 1 and 2). The highest moisture contents were observed in NDG12-1 followed by BG50-28 and BG362 chickpea cultivar, whereas the lowest moisture observed on DCP92-3 before and after three months storage.

The moisture content of the seed was positively and significantly correlated with the per cent infestation, protein and fat content while with germination it was significant and negative. These results are comparable with those of Shaheen *et al*. (2006); Rizwana *et al*. (2011) and Saljoqi *et al*. (2015), reported that the moisture content of seed had significantly effect on the stored seed. The moisture content of the different cultivars should variations in storage period Aslam *et al*. (2006) reported correlation co-efficients between different variables showing highly significant values. Verma *et al*. (2011) found that the grain moisture contents were positively correlated with *C. chinensis* infestation.

Per cent infestation :

The result on per cent infestation caused by *C. chinensis* to seed of different germplasm varied significantly. The least per cent infestation was recorded in DCP92-3 and the highest infestation was recorded in NDG12-1, hence both these germplasm were designated as the most tolerant and susceptible germplasm, respectively. Germplasm BG50-28, BG362, IPC 2004-52 and NDG97-1 were comparatively susceptible. The germplasm NDG93-1 and NDGK-98-8 exhibited moderate response. The germplasm were regarded moderately resistant, the remaining germplasm such as NDG11-5 and BG256 (Table 1). The correlation carried

out between germination and per cent seed infestation was negative significant and protein, fat positive significant (Table 2).

In present study, the seed grains which were infested by *C. chinensis* did not germinate. There are many reports on *C. chinensis* feeding and infested to stored seeds. Shaheen *et al*. (2006) reported that insect infestation in stored chickpea seed reduced germination. Pokharkar and Chauhan (2010) observed maximum (81.60) per cent reduction in damage chickpea seeds against *C. chinensis*. Gatoria and Gill (2008) investingated that groth and development of pulse beetle, *C. chinensis* on kabuli and desi chickpea genotypes, lees seed damage in 49.99 per cent and higher 71.10 per cent infested seed.

Per cent germination :

The per cent germination of different germplasm due to feeding by *C. chinensis* varied significantly. The highest germination in BG256 before and after three months of storage period, least germination in DCP92-3 and NDGK98-8 was maintained the seed germination above seed certification standards after three months of storage and lowest in NDG93-1 and BG50-28 before and after three months of storage period, the correlation of per cent germination with protein, fat, moisture and infestation was significantly and negative.

The significant reduction in per cent seed germination during storage period similar reports of reduced germination of chickpea seed due to *C. chinensis* was reported by Nadaf and Singh (2014); Yadav and Pant (1975); Wadnekar *et al*. (1978) and Mandal and Konar (2004). Thus, this finding suggests more similar to that of Parameshwarappa *et al*. (2007), though the varieties included in this investigation are different one. Jha *et al*. (2009) found cultivar BG-267 to be highly preferred by pulse beetle and cultivar BG-256 least preferred.

Per cent protein content :

The protein content of different germplasm of chickpea seed after three months storage varied significantly, the highest protein content in NDG12-1 and NDGK98-8 while it was lowest in IPC 2004-52, respectively. The correlation of protein content with moisture, infestation and fat was significantly positive

Table 1 : Mean of per cent moisture content, per cent infestation, per cent germination, and chemical parameter of chickpea (protein and fat content) cultivars, before and after three months storage period

Treatments	Moisture		Infestation		Germination		Protein		Fat	
	Before	After	Before	After	Before	After	Before	After	Before	After
BG256	9.15	10.30	0.00	4.00	94.14	90.09	21.58	19.35	4.16	3.53
BG362	10.58	12.05	0.00	13.34	92.20	76.72	22.23	20.07	5.20	4.48
BG50-28	10.87	12.14	0.00	14.83	89.65	74.83	22.41	20.27	4.30	3.77
DCP92-3	9.05	10.05	0.00	3.44	90.38	86.78	20.49	18.54	4.32	3.83
IPC2004-52	10.19	11.91	0.00	11.72	90.87	78.18	19.53	17.69	4.25	3.81
NDG11-5	9.82	10.81	0.00	4.05	87.96	81.70	21.62	19.87	4.79	4.42
NDG12-1	10.95	12.23	0.00	16.10	93.31	75.16	23.55	22.10	5.32	4.97
NDG93-1	10.43	11.61	0.00	7.20	87.41	78.51	23.41	22.03	4.25	3.98
NDG97-1	10.36	11.33	0.00	10.12	88.74	77.36	22.45	21.15	4.30	4.08
NDGK98-8	9.96	10.79	0.00	6.28	92.28	85.11	23.53	22.38	5.15	4.95
S.E.±	0.21	0.13	0.00	0.64	0.78	1.45	0.35	0.44	0.20	0.23
C.D. (P=0.05)	0.61	0.39	0.00	1.90	2.33	4.29	1.04	1.30	0.60	0.69

Table 2 : Correlation

Parameters	Moisture	Infestation	Germination	Protein	Fat
Moisture	1				
Infestation	0.9333506	1			
Germination	-0.935300	-0.868650	1		
Protein	0.243465	0.197758	-0.26463	1	
Fat	0.251768	0.264738	-0.25519	0.651492	1

while with germination in was significantly negative.

The protein content of different germplasm should variations in crude protein (Table 2). Khattak *et al*. (1991) and Aslam *et al*. (2006) reported correlation co-efficients between different variables showing highly significant values. Shaheen *et al*. (2006) and Chandel and Bhadauria (2015) reported that the protein content are also responsible for the in addition to the main factors as per cent infestation and per cent moisture.

Per cent fat content :

The fat content of different germplasm of chickpea seeds after three months storage varied significantly. The highest fat content in NDG12-1 and lowest in BG256, respectively, the correlation of fat contents with moisture, infestation and protein was significantly and positive while with germination it was significant and negative. The fat contents of different germplasm showed significantly variations in chickpea seed during storage period similar reported in Siddiqa *et al*. (2013); Aslam *et al*. (2006) and Khattak *et al*. (1991).

Conclusion :

From the above results it may be concluded that highest per cent moisture contents, per cent infestation, fat content and initial protein content was obtained in NDG12-1, highest per cent germination, lowest fat content and highest protein content after storage was obtained in BG256 and NDGK98-8, lowest moisture content, infestation per cent was obtained in DCP92-3 and per cent germination in NDG93-1, BG50-28 and protein content in IPC2004-52 before and after chickpea seed storage.

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