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Varietal screening of black gram against *Callosobruchus* spp. and assessment of storage losses

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Abstract

A study was conducted to screen varieties of black gram against *Callosobruchus chinensis* (L.) and to determine the storage losses in black gram grains stored at farmer's level owing to infestation by *Callosobruchus* spp. in six district of Himachal Pradesh during 2008. The results revealed that among the six varieties screened against *C. chinensis*, the variety T-9 was observed to be most resistant with minimum growth index of 0.344 and longest grub development of 39 days. On the other hand Kullu-4 with maximum growth index of 1.058 and UG-218 with minimum grub development period of 31.33 days was found to be most susceptible to test insect. Further, maximum per cent of seed damage, weight loss and foreign matter with 18.4, 4.58 and 4.79 per cent was in district Kullu, while district Kangra suffered minimum per cent seed damage (1.61%) and minimum per cent weight loss (1.00%).

Key words: Black gram, *Callosobruchus* spp., varieties, storage losses.

Introduction

Among different pulses, black gram (*Vigna mungo* L.) is an important crop which has been observed to suffer storage losses owing to attack of insects pests. Pulse beetle *Callosobruchus* spp. continues to be an important pest of stored seeds of gram, cowpea, rajmash and black gram in various areas. In Himachal Pradesh, the bruchids *C. chinensis*, *C. analis* and *C. maculatus* cause infestation leading to huge losses in storage (Patnaik *et al.*, 1986). The adult beetles attack the leguminous pods in the field and deposit eggs on mature pods where from they are carried to the stored godowns following transportation. As a result of the attack, the endospermic portion of the seed is completely destroyed leaving only the seed coat. The seed thus losses its viability and rendered unfit for use. Various workers have studied seed damage and weight loss by *Callosobruchus* spp. infestation to different stored pulses (Ghosal and Senapati 2006 and Anandhi *et al.*, 2008). However, there is no available information with respect to hilly varieties regarding their susceptibility to pulse beetle. Various workers have evaluated varietal susceptibility of different pulses against *Callosobruchus* spp. (Dabi *et al.*, 1978, Singh and Sharma, 1980; Singh and Singh, 1990; Singh and Sharma, 2001; Jha, 2002 and Muhammad *et al.*, 2006). In view of the popularity of black gram in HP and damaging intensity of pulse beetle under traditional storage conditions attempt was, therefore, made to conduct studies at

farmer level on seed damage, weight loss by the pulse beetle during 2008-09. The response of *C. chinensis* to recommended black gram varieties for oviposition development and food consumption was also observed.

Materials and Methods

Screening of black gram cultivars against *C. chinensis*: Six cultivars of black gram viz. UG-218, Pant-U-19, PDU-1, T-9, Palampur-93 and Kullu-4 were screened for possible resistance against *C. chinensis* under laboratory conditions at Palampur. A sample of 50 seeds per variety was kept in plastic containers (5x5 cm) and three pairs of newly emerged (0-24 hr old) beetles taken from the uniparental laboratory culture were released in each container. The container were covered with muslin cloth and kept in a BOD incubator at 27 ± 2° C and 70 ± 5 per cent relative humidity. Each treatment was replicated thrice. Following 10 days of exposure period, observation was recorded on total number of eggs laid on a seed. Newly emerged adult were counted daily following 25 days of beetle release and removed from containers to prevent further breeding. The total developmental period (larval + pupal) and per cent emergence of adults was worked out. Forty days after beetle release, the seeds were weighted and total food consumed by the total insect was computed. The Growth index value for the insect for the different varieties was calculated according to the method of Singh and Pant (1955).

Assessment of storage losses to black gram at farm level against *Callasobruchus* spp.: Samples of black gram stored for nearly six months were collected from farmer's traditional storage structures during April-May 2008. Twelve developmental blocks (Table 1) were selected from six districts for sampling. Two representative samples of 300 g were drawn from each block and a total of 24 samples were collected. The samples were drawn with the help of tube sampler and brought to the laboratory for further studies. To compute seed damage and weight loss, a random sample of 25 g was drawn and calculations were done as per method given by Adams and Schulten (1978) and Haris and Linblad (1981). Observation on percentage of foreign matter (i.e. diseased seed, off seeds and stones etc.) was also recorded in the collected samples.

Table 1. Areas surveyed for the assessment of losses of stored black gram in six districts of Himachal Pradesh

Zone	District	Blocks
Zone 1	Sirmaur	Paonta Sahib, Nahan
	Una	Una, Gagret
Zone 2	Hamirpur	Nadaun, Sujanpur
	Kangra	Nagrota, Panchrukhi
Zone 3	Mandi	Mandi, Sundernagar
	Kullu	Kullu, Naggar

Results and Discussion

i) Screening of black gram cultivars against *C. chinensis* (L.): In this experiment six cultivars of black gram were evaluated for their preference to *C. chinensis*, maximum number of eggs were observed in cultivar PDU-1 (216.33 eggs/50 seeds). On cultivars UG-218, Pant-U-19, Palampur-93 and Kullu-4 on an average 183.67, 156.00, 153.00 and 127 eggs/50 seeds were recorded. Least preference for egg laying was there in cultivar T-9 (Table 2) with an average of 72.00 eggs/50 seeds. Although higher oviposition preference was seen on cultivar PDU-1, however survival to adult stage was relatively low (19.26%). Contrary to this, the survival to adult stage was higher on cultivar Kullu-4 (33.85%) and Palampur-93 (30.71%). On cultivars Pant-U-19 and UG-218 survival to adult stage was recorded to be 27.13 and 27.04 per cent (Table 2), respectively. Minimum survival (9.67%) to adult stage was recorded on cultivar T-9. Singh *et al.* (1980) also opined that preference for oviposition by *C. chinensis* is independent of development.

In present study, the adult emergence was maximum on cultivar UG-218 (49.67 adults/50 seeds) and in varieties PDU-1, Pant-U-19, Kullu-4 and Palampur-93 the adult emergence ranged from 41.67-47.00 adults/50 seeds. Minimum adult emergence was recorded in cultivar T-9 (9.67 adults/50 seeds). The total developmental period from egg to adult was found to be maximum in cultivar T-9 (39 days) and minimum (31.33 days) in cultivar UG-218 (Table 2). On cultivar Kullu-4, Palampur-93, Pant-U-19 and PDU-1, total developmental period was found within 32.00-34 days. Growth index value and food consumption was observed on single grub basis. Growth index and food consumption per grub (Table 2) was minimum in cultivar T-9 with a value of 0.344 and 0.0186 g, respectively. Maximum growth index value was calculated on cultivar Kullu-4 (1.058), where as food consumption per grub was maximum in cultivar PDU-1 (0.0584 g).

ii) Assessment of storage losses to black gram: During survey, three species of pulse beetle viz. *C. chinensis, C. analis, and C. maculatus* were found to infest the stored pulse seeds. Data presented in table 3 indicated that *Callosobruchus* spp. caused maximum seed damage (18.4%) in district Kullu and minimum (1.61%) damage were recorded in district Kangra. In districts Mandi, Sirmaur, Hamirpur and Una, the seed sample due to bruchid attack ranged from 1.64-7.71 per cent. In Uttar Pradesh, Ghosal and Senapati (2006) reported 17.2 per cent seed damage to stored black gram grains by *C. analis*. In adjoining Pakistan, *C. chinensis* has been found to cause 10 per cent seed losses to stored chickpea grains (Muhammad, 2004). These reports are in conformity with our findings. Likewise, the weight loss was observed to be maximum (4.58%) in the samples collected from district Kullu, while

Table 2. Ovipositional preference, larval development, growth index and survival to adult stage of eggs of *C. chinensis* on different cultivars of black gram

Cultivar	Seeds with eggs (%)*	Avg. no. of eggs per 50 seeds **	Avg. no. of adults per 50 seeds **	Survival to adult stage (%)*	Developmental period (Days)**	Growth index	Food consumed per grub (g)
Pant- U-19	100.00 (90.00)	156.00 (12.49)	42.33 (6.51)	27.13 (31.39)	33.00 (5.74)	0.822	0.0295
Palampur- 93	94.67 (76.65)	153.00 (12.37)	47.00 (6.85)	30.71 (33.65)	32.67 (5.71)	0.940	0.0296
Kullu- 4	98.00 (81.87)	127.00 (11.27)	43.00 (6.56)	33.85 (35.57)	32.00 (5.66)	1.058	0.0291
PDU-1	100.00 (90.00)	216.33 (14.71)	41.67 (6.45)	19.26 (26.03)	34.00 (5.83)	0.566	0.0584
UG-218	99.00 (84.26)	183.67 (13.55)	49.67 (7.05)	27.04 (31.33)	31.33 (5.60)	0.863	0.0436
T-9	86.67 (68.59)	72.00 (8.48)	9.67 (3.11)	13.43 (21.50)	39.00 (6.24)	0.344	0.0186
CD (P=0.05)	2.87	24.79	3.72	6.13	1.56		0.005
CV	1.68	9.21	5.39	12.54	2.62	8.670	8.850

* Figures in parentheses are angular transformed values
** Figures in parentheses are √x transformed values

Table 3. Assessment of losses in stored black gram in different districts of Himachal Pradesh

Area	District	Seed damage (%)	Weight loss (%)	Foreign matter (%)
Zone 1	Sirmaur	2.22 (8.57)*	1.39 (6.77)	2.02 (8.17)
	Una	7.71 (16.12)	3.04 (10.04)	0.91 (5.47)
Zone 2	Hamirpur	4.24 (11.88)	2.33 (8.78)	2.46 (9.02)
	Kangra	1.61 (7.29)	1.00 (6.16)	0.72 (4.87)
zone 3	Mandi	1.64 (7.36)	1.15 (7.06)	0.36 (3.44)
	Kullu	18.4 (25.43)	4.58 (12.36)	4.79 (12.64)
	Mean	5.97 (14.14)	2.24 (8.61)	1.88 (7.88)
CD (P=0.05)		2.823	1.702	1.046

*Figures in parentheses are angular transformed values

minimum weight loss (1.00%) occurred in district Kangra. The weight loss of stored black gram grains in Una, Hamirpur, Sirmour and Mandi districts was 3.04, 2.33, 1.39 and 1.15 per cent, respectively. Contrary to our observations higher weight loss of 8.7-18.38 per cent has been reported in stored black gram grains due to *Callosobruchus* spp. infestation in different parts of India (Dwivedi *et al.*, 1991; Muhammad, 2004; Ghosal and

Senapati, 2006 and Satya, 2005). This slightly higher weight loss may be because of differential ambient temperature prevailing at different locations. Among six districts, the samples collected from district Kullu were found to contain maximum percentage (4.79%) of foreign matter (i.e. diseased seed, off seeds and stones etc.) while minimum in samples collected from district Mandi (0.36%). Higher incidence of beetles in Kullu can be attributed to local variation in storage practices and tradition. In Kullu valley, farmer used traditional storage structures and the seeds were also not dried properly before storage. The *Callosobruchus* spp. infestation is generally higher if moisture content of grains is more than 12 per cent in storage (Khare, 1994). It is, therefore, imperative that the harvested pulse crop is adequately dried before storage at farmer's level. The moisture content should be 9-11 per cent and only properly dried grains should be stored in improved receptacles so as to minimize storage losses (Khare, 1994).

The cultivar T-9 was thus observed to have minimum preference for oviposition and development by bruchids. This was possibly due to its glabrous seed coat and comparatively low protein content when compared to other varieties. Under traditional storage condition this variety offered lower losses and could be safely selected for farm use in mid hills where it is presently being cultivated many farmers.

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