



# Varietal Screening of Stored Pigeonpea for Resistance to Seed Beetle, *Callosobruchus maculatus* (F.)

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**Abstract:** Ten varieties of pigeonpea were assessed for their relative susceptibility to seed beetle *Callosobruchus maculatus* (F.), in storage under no-choice and free-choice conditions during 2022-23. Under no-choice condition, the variety LRG 133-33 recorded maximum emergence (116.0 adults) and grain damage (62.67%), while LRG 467 had the least values for adult emergence and grain damage (56.33 no. and 32.33%, respectively). Under free-choice condition also, LRG 467 showed significantly higher level of resistance against seed beetle allowing very less emergence (50.33 adults) with minimum grain damage (34.67%) compared to other varieties. The resistance reaction of LRG 467 variety against *C. maculatus* was further confirmed in dual-choice test, wherein the number of adults emerged was lower (79) against LRG 133-33 (104). The seed beetle took slightly longer period for egg to adult emergence on LRG 467 (23.92 days) compared to LRG 133-33 (22.73 days) indicating the interference of some secondary metabolites in larval growth and development of the insect.

**Keywords:** Pulses, Storage insects, Bruchid, Relative susceptibility

Grain legumes play a pivotal role in ensuring nutritional security for the millions of Indian population, as they are rich in proteins, fibres and several essential nutrients, amino acids, minerals, and certain vitamins. India is the world's largest producer and consumer of a wide variety of grain legumes, hence they play an important role in Indian economy. Chickpea, pigeonpea, blackgram and greengram are the major grain legumes cultivated in Andhra Pradesh, and a total of 78 thousand tonnes of pigeonpea was produced from an area of 2.42 Lakh ha during 2022-23 (Division of Economics and Statistics 2023). Grain legumes are stored at various levels in various quantities for various purposes; sowing, consumption, processing, marketing etc., for shorter or longer duration, during which they suffer great damage due to insect attack. The cowpea weevil *Callosobruchus maculatus* (F.), is the most predominant destructive pest of stored grain legumes in Andhra Pradesh which can inflict huge losses in terms of quantity and quality (Harika et al 2023). Though insecticides were much relied for their control, reduced susceptibility of the bruchid populations to the commonly used insecticides malathion and deltamethrin (Sarada et al 2021) necessitated search for the alternative methods such as the use of modified atmospheres, hermetic packaging, plant powders etc (Swamy and Rao 2016, Swamy and Wesley 2017, Harika et al 2024). Nevertheless, a superior field performing variety, if susceptible to storage insect pests, often results in huge losses. Hence, development and use of resistant pigeonpea cultivars offers a simple, cheap and attractive approach for successful preservation of grain legumes from bruchid attack

in an environment-friendly manner (Kenei et al 2011). With this in view, experiments were conducted to know the relative susceptibility of pigeonpea varieties against seed beetle.

## MATERIAL AND METHODS

A total of 10 varieties of pigeonpea obtained from Regional Agricultural Research Station, Lam, Guntur, Andhra Pradesh were evaluated for resistance to seed beetle in storage under no-choice and free-choice conditions during 2022-23.

**Insect culture and bioassays:** Seed beetle, *C. maculatus* insects required for the experiments were cultured on pigeonpea grains obtained from freshly harvested crop and was maintained at ambient room temperature and relative humidity. Before their use in experiments, all the pigeonpeas were disinfested by fumigation with phosphine for seven days to remove inherent field infestations, if any. The moisture of test grains was ranged between 9.30 and 9.96 %.

**No-choice test:** Pigeonpea grains (40 g of each variety) were taken in plastic containers (200 ml capacity) and five pairs of freshly emerged *C. maculatus* beetles were released and secured with a lid. After allowing oviposition for five days, the adults were removed and data on number of eggs per 100 seeds were recorded. Subsequently, they were observed for the progeny emergence at 40 and 60 days after release of insects (DAR) and pooled to express as total number of adults emerged. The per cent grain damage was recorded at 60 DAR.

**Free-choice test:** Pigeonpea grains (20 g each) were taken in shallow cups and arranged in a circle in a wide plastic tray (l

× b × h: 45 cm × 45 cm × 10 cm) and a total of 100 seed beetles (mixed population) were released in the center to allow free movement of adults among the grains of their choice. The tray was closed with another tray of same size by keeping in reverse position and tightly securing with binder clips. The set up was kept undisturbed for five days to allow oviposition by the female insects, later the grains along with insects were transferred individually into plastic jars (200 ml). Data on number of eggs per 100 seeds at 10 DAR were recorded and allowed for subsequent development. The numbers of progeny adult emergence were observed at 30 and 45 DAR and expressed as total number of adults. Per cent grain damage was also recorded at 45 DAR.

**Dual-choice test:** The variety which showed maximum resistance to seed beetle in the above experiments was compared with another variety that showed susceptible reaction under dual-choice condition. For this, 100 grains of both pigeonpea varieties were taken in separate cups and placed in the insect cage (l × b × h: 20 cm × 15 cm × 15 cm), and 20 newly emerged beetles were released in the middle of two cups. Thus, six replications were set up. They were confined for 24 hours allowing oviposition by females. The insects were removed from the grains and transferred in to separate containers. Later after three days, individual single egg laden grains from each variety were collected and kept in glass vials. They were observed daily till the adult emergence to note the number of days taken for an egg to develop into adult stage. Thus, total number of adults emerged and the period from egg stage to adult emergence was recorded.

**Statistical analysis:** All the experiments were conducted at ambient conditions. Both no-choice and free-choice experiments were conducted by adopting completely randomized block design replicating thrice. The data were

suitably transformed and subjected to analysis of variance (ANOVA) using web-based agricultural statistics software package WASP 2.0 to test their significance.

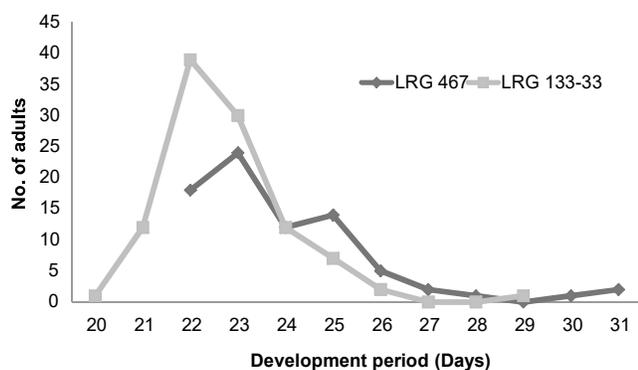
## RESULTS AND DISCUSSION

Under no-choice condition, though LRG 486 had the highest number of eggs (13.67) and LRG 52 had the least (1.0) per 100 grains and was reflected in adult emergence (Table 1). The variety, LRG 133-33 recorded maximum emergence (116.0 adults) and grain damage (62.67%), while LRG 467 had the least values for adult emergence and grain damage (56.33 adults and 32.33%, respectively). Under free-choice condition also, LRG 467 consistently showed significantly higher level of resistance against seed beetle allowing very less emergence (50.33 adults) with minimum grain damage (34.67%) compared to other varieties. However, LRG 133-33 recorded the maximum emergence (159.67 adults) that inflicted 62.67% grain damage. The resistance reaction of LRG 467 variety against *C. maculatus* was further confirmed in dual-choice test, wherein the number of adults emerged was lower (79) against LRG 133-33 (104). The seed beetle took slightly longer period for egg to adult emergence on LRG 467 (23.92 days) compared to LRG 133-33 (22.73 days) (Fig. 1) indicating the interference of some secondary metabolites in larval growth and development of the insect.

Satheesh et al (2021) also considered the parameters like growth index (GI), egg number and adult emergence for evaluating resistance in pigeonpea genotypes. Among different species of grain legumes tested, Mostafa et al (2023) observed longer developmental time of cowpea beetle fed on broad bean with the minimum immature survival rate, while Bidar et al (2021) observed longest

**Table 1.** Preference and development of seed beetle on different pigeonpea varieties

Variety	No-choice conditions			Free-choice conditions		
	Eggs (No.)/ 100 grains	Adult emergence (No.)	Grain damage (%)	Eggs (No.)/ 100 grains	Adult emergence (No.)	Grain damage (%)
LRG 52	1.0	67.67	34.0	34.33	86.33	47.67
LRG 105	3.33	95.33	50.67	37.33	144.67	66.0
LRG 133-33	5.33	116.0	62.67	53.33	159.67	71.67
LRG 223	1.33	97.33	45.33	38.0	115.67	50.33
LRG 454	6.0	87.33	39.0	37.0	125.33	68.0
LRG 467	2.0	56.33	32.33	24.0	50.33	34.67
LRG 471	6.67	88.0	42.67	35.0	90.33	45.67
LRG 486	13.67	79.33	36.33	31.67	129.33	65.0
LRG 492	4.33	89.33	44.67	38.33	107.67	65.33
LRG 499	5.67	74.0	38.67	30.0	115.67	66.33



**Fig. 1.** Pattern of seed beetle adult emergence on LRG 467 and LRG 133-33

developmental time on lentil. The chickpea varieties; NBeG 458, NBeG 47 and KAK 2 with thin seed coat and larger seed size recorded higher oviposition, adult emergence and grain damage (Swamy et al 2020). Pigeonpea genotypes having the traits like hard seed with less seed diameter and high proportion of seed coat are less preferred by the bruchids (Satheesh et al 2021). In contrast, a pigeonpea landrace namely IC 637089, though found moderately resistant to *Callosobruchus chinensis*, seed physical characters did not show any significant effect on any of the insect biological parameters indicating the role of biochemicals (Saravanan et al 2023). Chandel and Bhadauria (2015) reported that pigeonpea varieties; Jagarti, PUSA-33, ICPL-151, PUSA-84, UPAS-120 and Type 7 had significantly poor emergence of *C. chinensis* beetles and found it was positively governed by the test weight, hardness and moisture content of the seeds, though non-significant. However, the emergence of the adults was reduced by the increase in protein content in the seeds.

### CONCLUSION

Among the pigeonpea cultivars tested, LRG 467 with minimum adult emergence and longer developmental period is found resistant to seed beetle infestation. The exact factors offering resistance are to be further explored for better understanding of the resistance mechanism. In view of the storage losses due to seed beetle, any sort of resistance available in the varieties may be useful in

securing pulses seed and also as sources in crop improvement programme.

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