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Shrutika R Nandalwar
P.G. Scholar, Entomology
Section, College of Agriculture,
Nagpur, Maharashtra, India

Dr. Jayashri D Ughade
Assistant Professor of
Entomology, College of Food
Technology, Yavatmal,
Maharashtra, India

Dr. VJ Tambe
Professor and Head,
Entomology Section, College of
Agriculture, Nagpur,
Maharashtra, India

Dr. BN Chaudhari
Associate Professor,
Entomology Section, College of
Agriculture, Nagpur,
Maharashtra, India

Dr. Sapana B Baviskar
Assistant Professor,
Agricultural Botany Section,
College of Agriculture, Nagpur,
Maharashtra, India

Ovipositional preferences of pulse beetle, *Callosobruchus analis* on different stored pulses

**Shrutika R Nandalwar, Jayashri D Ughade, VJ Tambe, BN Chaudhari
and Sapana B Baviskar**

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Abstract

An important storage pest pulse beetle, *Callosobruchus analis* (Fabricius) is causing considerable quantitative and qualitative losses in stored pulses. The present study was conducted during 2025-26 at Entomology Section, College of Agriculture, Nagpur, to evaluate the ovipositional preference of *C. analis* on eight stored pulses, namely chickpea (desi), chickpea (kabuli), green gram, black gram, red gram, turkish gram, lentil and cowpea. The experiment was conducted in a Completely Randomized Design (CRD) with three replications under no-choice and multiple-choice conditions at 10 and 12 percent grain moisture. Oviposition was recorded at 3 and 7 days after release of freshly emerged adults. Significant differences in egg laying were observed among the tested pulses under both moisture levels and test conditions. Green gram was the most preferred host, followed by cowpea, whereas lentil was consistently the least preferred host. Under multiple-choice conditions at 12 percent moisture, the highest oviposition was recorded on green gram (82.00 eggs/female) at 7 days, while the lowest was recorded on lentil (8.67 eggs/female). At 10 percent moisture, the same preference trend was observed, although overall egg deposition was reduced. The study demonstrated that not only the host pulse but also the grain moisture content significantly influenced the ovipositional preference of *C. analis*. The findings may be useful for identifying comparatively susceptible and less preferred pulses for better management of pulse beetle infestation during storage.

Keywords: *Callosobruchus analis* F., pulse beetle, ovipositional preference, green gram, chickpea, cowpea

Introduction

As a major source of dietary protein as well as the replacement of animal protein, pulses are an important food crop, popularly known as “poor man’s meat.” In Indian food system pulses occupy an important position which consumed in different forms. However, substantial losses mainly occur after harvest during various stages of storage, transportation and processing. In case of stored pulses, among the various factors responsible for deterioration, the major constraints are insect pests.

Pulse beetle (*Callosobruchus analis* F.) belonging to the family *Bruchidae* is an important insect pests of stored pulses. It is one of the major and widely distributed economically important pulses pest in storage. It attacks most of the stored pulses, including chickpea, green gram, black gram, pea, cowpea, lentil and pigeon pea (Aslam *et al.*, 2002) ^[1]. During the storage pulse beetle causes both quantitative and qualitative losses. Infestation results in the formation of bore holes on the grains, making the pulse grains hollow and unsuitable for consumption. It also reduces grain weight, affects seed viability, seed germination capacity and adversely affects the market value with nutritional losses of stored pulses. Many of the researches reported that, insect-damaged grains by pulse beetles may also increase the susceptibility to microorganisms. Singh *et al.* (1989) ^[15] reported that, moulds developing on insect-damaged grains may produce aflatoxins, highlighting the importance to maintain grain quality and safety by protecting stored pulses from insect infestation of pulse beetle.

Pulse beetles are difficult to manage due to their ability to multiply rapidly under favourable storage conditions with high reproductive capacity and short developmental period make the populations enable to build up within a short period (Seni and Mishra, 2022) ^[14]. Eker *et al.* (2018) ^[20] reported that, females attach eggs firmly to the seed coat which helps newly hatched larvae bore into the seed and complete their developmental period within the grains.

Corresponding Author:
Shrutika R Nandalwar
P.G. Scholar, Entomology
Section, College of Agriculture,
Nagpur, Maharashtra, India

Newly emerged adults can reproduce without requiring additional food or water and adapted to storage conditions (Credland, 1987) ^[5].

Since the larvae remain only within the seed after hatching it cannot move to another seed, host selection is very important for the female for successful development of progeny (Smith, 1986) ^[18]. The nutritional quality of the host pulses may also influence the development of pulse beetles (Nwosu and Ikodie, 2021) ^[12]. Mitchell (1975) ^[11] stated that female beetles tend to prefer high-quality host seeds of pulses for oviposition. Hence, the ovipositional behaviour of the female pulse beetle is particularly important as the eggs laid on pulse grains determine the subsequent establishment and development of the pulse beetle population in storage.

Therefore, to study the ovipositional preference of *C. analis* on different stored pulses is important for understanding host suitability and pest behaviour. Such information can help to identify comparatively suitable/preferred or less suitable/preferred pulses to pulse beetle. Hence, the present investigation was undertaken with the objective to investigate ovipositional preference of *Callosobruchus analis* on different stored pulses.

Material and Methods

The present investigation was conducted under laboratory conditions in Completely Randomized Design at Entomology laboratory of Entomology section, College of Agriculture, Nagpur, Maharashtra, India during 2025-26 with different eight pulses and three replications.

Collection of different pulses

The seeds of eight different pulses viz., desi chickpea (*Cicer arietinum* L.), kabuli chickpea (*Cicer arietinum* L.), green gram (*Vigna radiata*), black grams (*Vigna mungo*), red gram (*Cajanus cajan*), turkish gram (*Vigna aconitifolia*), lentils (*Lens culinaris*) and cowpeas (*Vigna unguiculata*) were obtained from local market of Nagpur (Table 1). The seeds were healthy, genetically pure, insect free, and disease-free. The seeds were further critically examined for removal of foreign material. The seeds were stored in plastic containers and appropriately covered with sterile, clean muslin cloth for future testing. The seeds were further critically examined and foreign material was removed from the lot. The seeds were stored in separate plastic containers (14 cm x 14 cm x 17 cm), properly covered with clean sterile muslin cloth for future testing.

Rearing technique of test insect

Adult pulse beetles (*Callosobruchus analis*) were obtained from the Entomology Section, College of Agriculture, Nagpur. The initial culture, collected from the University Godown, Dr. Panjabrao Deshmukh Krishi Vidyapeeth, Akola during the previous year's M.Sc. research, had been maintained on gram used as such for No-choice test experiment. To ensure host acceptability in multi-choice test, the available culture was multiplied separately on respective pulse treatment. For this purpose, 200 g of grains of each respective pulses were placed in separate large glass jars, and 10 pairs of adult beetles were released into each jar. The insects were reared for two generations on their respective pulse grains before being used in the experiment. The jars were covered with muslin cloth to provide proper aeration and prevent the escape of insects. The beetles were

allowed to mate and oviposit freely for seven days. After the oviposition period, the parent beetles were removed, and the grains containing eggs were retained in the same jars until adult emergence. One-day-old (0-24-hour-old) adults of the third generation were used for the experimental studies.

Identification of male and female

Male and female beetles were sorted out under simple microscope by their antennal characteristics, size and shape of the body (Halstead, 1963) ^[7].

Determination and Adjustment of grains moisture content

The pulse grains were procured from the local market and their initial moisture content was estimated. The pulses sample of 5 g accurately and subjected to oven drying at 105 °C for 4-6 hrs. oven dried samples were cooled in desiccators and weighed. The drying was repeated until the constant weight was obtained. The resultant loss in weight was calculated as per moisture content. The moisture content was then adjusted to 10 and 12 percent for conducting the experiment.

Table 1: percent moisture present in initial sample of different pulses procure from local market

Treatment No.	Store pulses	Initial Moisture (%)
T ₁	Chickpea (desi)	12.8
T ₂	Chickpea (kabuli)	10.2
T ₃	Green Gram	10.8
T ₄	Black Gram	10.5
T ₅	Red gram	10.5
T ₆	Turkish gram	8.2
T ₇	Lentil	9.5
T ₈	Cowpea	11.0

Methodology

The ovipositional preferential studies were conducted by using the pulse grains with 10 and 12 percent moisture by following the method of Karthik *et al.* (2023) ^[9] and Soumia *et al.* (2017) ^[19].

Multiple choice test: Eight equal compartments were made in the big size Petri plate by fixing strips of paper in a radial manner. Hundred grains from each pulse were kept in each compartment in a randomized manner at equal distance from the centre and five pair of newly emerged adult was released in the centre of petri plate. Eggs laid were counted on 3 and 7 days after the release of beetles in each pulse. The experiment was replicated three times in Completely Randomized Design.

No-choice test: Hundred grains from each pulse were kept in Petri plate separately. One pair of newly emerged adults was released in the Petri plate with single store pulse. Eggs laid were counted on 3 and 7 days after the release of beetles in each pulse. The experiment was replicated three times in Completely Randomized Design.

Statistical analysis

The experiment was laid out in a completely randomized design with eight treatment using different stored pulses. Three replicates of each treatment were maintained under laboratory condition. The ovipositional preference data were transformed into square root transformation and then

analysed with the help of one-way analysis of variance. When F values were found significant, then treatment means were compared by using critical difference values at 5% level of probability.

Results and Discussion

The ovipositional preference of *Callosobruchus analis* released on different pulses with 10 and 12 percent moisture was presented in table 2.

Host preference at 12 percent moisture

No-Choice Test

The highest oviposition was recorded in Green Gram (40.33 eggs) and at par with Cowpea with 36.33 eggs at 3 DAR and it was a most preferred group of pulse for oviposition by pulse beetle. Desi chickpea, red gram, kabuli chickpea and black gram was a moderately preferred group of pulses for oviposition by pulse beetle with 32.67, 31.67, 30.67 and 30.33 eggs at 3 DAR, respectively. The least preferred group for oviposition was lentil with 23.67 eggs and turkish gram with 29.00 eggs (table 1).

At 7 days of release of beetles, cumulative egg deposition expanded following the 3-day trend. Green Gram (T_3) sustained the maximum oviposition of 70.00 eggs (8.42),

followed by Cowpea (T_8) with 65.67 eggs (8.16). Lentil (T_7) remained the least preferred host with 40.67 eggs (6.45).

Multiple Choice Test

Multiple choice selections induced strong host discrimination. Green Gram was most preferred pulse with 47.67 eggs followed by cowpea (39.67 eggs) at 3 DAR of pulse beetle. Egg laying dropped on less-preferred hosts i.e. black gram, turkish gram and lentil received 10.00, 6.33 and 4.67 eggs, respectively. Moderately preferred group content chickpea desi, chickpea kabuli and red gram with 27.33, 26.67 and 23.33 eggs, respectively.

Preference discrimination widened further at 7 DAR of beetles. Green gram accumulated 82.00 eggs followed by cowpea accumulated 67.33 eggs. Conversely, female beetles actively less preferred lentil, turkish gram and black gram with 8.67, 11.00 and 17.33 eggs, respectively. Chickpea desi, chickpea kabuli and red gram were the moderately preferred pulses with 48.00, 45.67 and 40.00 eggs, respectively.

Higher grain moisture (12%) increases grain softness, metabolic activity, and seed coat elasticity, making it easier for females to attach eggs and for newly hatched larvae to bore into the seed coat (Eker *et al.*, 2018)^[20].

Table 2: Effect of different pulses on fecundity of pulse beetle at 12% moisture content.

Treatment	Treatment details	No choice (No. of eggs laid)		Multiple choice (No. of eggs laid)	
		3 DAR	7 DAR	3 Days	7 Days
T ₁	Chickpea (desi)	32.67 (5.80)*	56.33 (7.57)*	26.67 (5.16)*	45.67 (6.83)*
T ₂	Chickpea (kabuli)	30.67 (5.62)	52.67 (7.32)	27.33 (5.32)	48.00 (6.97)
T ₃	Green Gram	40.33 (6.42)	70.00 (8.42)	47.67 (6.97)	82.00 (9.11)
T ₄	Black Gram	30.33 (5.60)	52.33 (7.30)	10.00 (3.31)	17.33 (4.28)
T ₅	Red gram	31.67 (5.71)	54.67 (7.46)	23.33 (4.93)	40.00 (6.40)
T ₆	Turkish gram	29.00 (5.48)	49.67 (7.12)	6.33 (2.69)	11.00 (3.46)
T ₇	Lentil	23.67 (4.96)	40.67 (6.45)	4.67 (2.94)	8.67 (3.10)
T ₈	Cowpea	36.33 (6.11)	65.67 (8.16)	39.67 (6.38)	67.33 (8.28)
F Test		Sig	Sig	Sig	Sig
SE(m)±		0.11	0.11	0.087	0.082
CD at 5%		0.32	0.34	0.26	0.25
CV%		3.20	2.61	3.21	2.34

*Figures in parentheses are square root transformed values

Host preference at 10 percent moisture

Reducing grain moisture to 10% resulted in a consistent decline in overall fecundity across all host treatments while retaining the same host preference hierarchy (Table 3).

No-Choice Test

Green gram with 29.67 eggs followed by Cowpea (26.33 eggs) were the most preferred pulses for oviposition in no-choice test at 3 DAR of beetles. Moderately preferred group for oviposition was chickpea desi, red gram, chickpea kabuli, black gram and turkish gram with 23.00, 21.67, 21.33, 19.33 and 19.33 eggs, respectively. The lowest egg deposition was recorded on lentil with 15.00 eggs.

Cumulative highest eggs deposited reached 52.00 eggs on green gram and 46.33 eggs on cowpea at 7 DAR of beetles. Least preferred oviposition was recorded on lentil with 27.67 eggs. Moderately preferred group for oviposition was chickpea desi, red gram, chickpea kabuli, black gram and turkish gram with 40.33, 38.33, 37.67, 34.00 and 33.67 eggs.

Multiple Choice Test

Green gram and cowpea was highly preferred group of pulses received the maximum of 38.33 and 31.67 eggs. Substantial reductions were observed in least preferred group of pulses was black gram (8.00 eggs), turkish gram (4.00 eggs), and Lentil (2.67 eggs). Moderately preferred group of pulses included chickpea kabuli, chickpea desi and red gram with 30.67 eggs, 29.67 eggs and 26.00 eggs, respectively at 3 DAR.

At 7 DAR, least preferred hosts were lentil with 4.33 eggs, turkish gram (7.00 eggs) and black gram (13.67 eggs). Highest preference was concentrated on green gram, recorded 68.00 eggs and cowpea with 57.67 eggs. Moderately preferred hosts included chickpea kabuli (30.67 eggs), chickpea desi (29.67 eggs) and red gram (26.00 eggs).

Lower moisture (10%) hardens the seed coat, reducing tactile acceptability and slowing female oviposition rates.

The present study results are in confirmation with Singh and Swami (2023)^[16] who reported, cowpea, greengram,

pigeonpea and pea were the most preferred hosts for oviposition. These were followed by desi chickpea and Kabuli chickpea, while blackgram, soybean and red lentil received the lowest number of eggs. The highest number of eggs by *Callosobruchus maculatus* under no-choice conditions was laid on greengram (61.0±20.74) (Kavitha and Maheshvari, 2021) [10]. Rajkhowa *et al.* (2024) [13] recorded the highest oviposition and adult emergence (6.84 nos) in chickpea, whereas lentil recorded the lowest egg deposition under no-choice

conditions and no oviposition was observed under choice conditions.

The highest number of eggs was laid on greengram pods (17.50), followed by chickpea (14.33), cowpea (11.50), and blackgram (8.50) (Borthakur *et al.*, 2019) [3]. In the free-choice test, the highest egg density was recorded on cowpea (1.14 eggs per seed), followed by desi chickpea (1.07 eggs per seed) and Kabuli chickpea (1.01 eggs per seed) (Dwivedi *et al.*, 2020) [6].

Table 3: Effect of different pulses on fecundity of pulse beetle at 10% moisture content.

Treatment	Treatment details	No choice (No. of eggs laid)		Multiple choice (No. of eggs laid)	
		3 Days	7 Days	3 Days	7 Days
T ₁	Chickpea (desi)	23.00 (4.89)*	40.33 (6.42)*	16.33 (4.16)*	29.67 (5.54)*
T ₂	Chickpea (kabuli)	21.33 (4.72)	37.67 (6.21)	17.67 (4.32)	30.67 (5.62)
T ₃	Green Gram	29.67 (5.54)	52.00 (7.28)	38.33 (6.27)	68.00 (8.31)
T ₄	Black Gram	19.33 (4.51)	34.00 (5.92)	8.00 (2.89)	13.67 (3.83)
T ₅	Red gram	21.67 (4.75)	38.33 (6.27)	14.67 (3.95)	26.00 (5.20)
T ₆	Turkish gram	19.33 (4.51)	33.67 (5.89)	4.00 (2.22)	7.00 (2.82)
T ₇	Lentil	15.00 (3.99)	27.67 (5.35)	2.67 (1.91)	4.33 (2.29)
T ₈	Cowpea	26.33 (5.23)	46.33 (6.88)	31.67 (5.71)	57.67 (7.66)
F Test		Sig	Sig	Sig	Sig
SE(m)±		0.081	0.14	0.079	0.089
CD at 5%		0.25	0.42	0.24	0.27
CV%		2.95	3.91	3.47	2.97

*Figures in parentheses are square root transformed values

Green gram and cowpea feature smooth, convex seed coats and optimal grain dimensions, providing favorable physical and chemical stimuli that encourage maximum oviposition. Conversely, lentil seeds are small, flattened, disc-shaped, and possess a tough seed coat, while turkish gram and black gram present rough or coated seed surfaces. These physical attributes impede firm egg adhesion and act as antixenotic barriers to female beetles (Chakraborty *et al.*, 2015) [4]. The higher oviposition recorded on green gram in the present study was supported by Bista *et al.* (2025) [2], who reported the host pulse also had a significant impact on fecundity; cowpea produced the most eggs per female (78.45), followed by green gram (76.67), while black gram produced the fewest (59.50 eggs per female).

Conclusion

The evaluation of *Callosobruchus analis* across eight stored pulse species under both no-choice and multiple-choice testing conditions demonstrates a statistically significant variation in host choice and egg deposition preference.

Host Preference Hierarchy: The female pulse beetle exhibits a consistent oviposition preference order across the host species evaluated: Green Gram (T₃) > Cowpea (T₈) > Kabuli Chickpea (T₂) ≥ Desi Chickpea (T₁) > Red Gram (T₅) > Black Gram (T₄) > Turkish Gram (T₆) > Lentil (T₇) at 3 and 7 DAR across all tested moisture levels i.e. 10 and 12% moisture.

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