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Biology of pulse beetle (*Callosobruchus chinensis* L.) on chickpea (*Cicer arietinum* L.)

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Abstract
The laboratory study on the biology of the pulse beetle, *Callosobruchus chinensis* (L.) (Coleoptera: Bruchidae) on the stored chickpea were conducted and results revealed that the insect completed one generation from first week of July to second week of August, 2022. Incubation period, larval period and pupal period was 3.67±0.06, 20.33±1 and 6±1 days respectively. The adult life span for male was 9.30±1.08 days where as for female was 10.15±0.98 days. The total developmental period was 32± 2.06 days.

Keywords: Chickpea, *Callosobruchus chinensis*, biology, life cycle, pulse beetle

Introduction
Chickpea (*Cicer arietinum* L.) is an important annual pulse crop in the genus Cicer (Family: Leguminosae, Fabaceae) that is also known as "Garbanzo bean" or "Bengal gramme" (Gaur *et al.*, 2010) [5]. After *Pisum sativum* L. (field pea) and *Phaseolus vulgaris* L. (common bean), it is the world's third-largest food legume producer (Grasso *et al.*, 2022; Rasheed *et al.*, 2021) [6, 13]. It contains 416 calories per 100 g of chickpea (Shrestha, 2001) [16], as well as protein (18-22%), carbohydrate (52-70%), fat (4-10%), minerals (calcium, phosphorus, iron), and vitamins (Ali *et al.*, 2002) [1]. Insect pests are a major constraint in pulse production, causing severe losses both in the field and during storage (Mookherjee *et al.*, 1970) [8].
Chickpeas were grown on approximately 10.91 million hectares in India. The country achieved a record harvest of 107 Lakh tons at a productivity level of 1086 kg/ha. Madhya Pradesh has contributed a significant 28 per cent of total chickpea cultivated area and 34 per cent of total gramme production in the country, ranking first in both area and production, followed by Maharashtra (20% and 18%), Rajasthan (19% & 18%), and Karnataka (10% & 6%) (Anonymous, 2021) [2].
The main pest of stored pulses is the pulse beetle. In India, there are 117 bruchid species classified into 11 genera. (Arora, 1977) [3]. Out of that, three bruchid species *C. chinensis*, *C. maculatus*, and *C. analis* are frequently found in India, according to Raina (1970) [12]. Among that, most destructive species are *C. maculatus* and *C. chinensis*, which affect nearly every edible legume, including mungbean, pigeon pea, black gramme, cowpea, chickpea, and lentil. They are found throughout the world, including Australia and Oceania, Europe, Asia, Africa, and America (Rees, 2004) [14]. The larvae eat inside the pulses after boring into them, which lowers the commercial value and germination (Booker, 1967) [4]. *C. chinensis* has been found to cause a loss of 15.33 to 17.00 per cent in chickpea storage in India (Parameshwarappa *et al.*, 2007) [10].

The study of *C. chinensis* biology is critical for controlling this pest during its infestation. It aids in the identification of pulse beetle life stages and the specific stage at which infestation begins. Given these benefits, the current study was designed to investigate the biology of *C. chinensis* on chickpea.

Materials and Methods
Chickpea seeds of variety Digvijay were obtained from Central Store, Seed Cell, MPKV, Rahuri. The initial culture of pulse beetle was obtained from the Seed Entomology Laboratory, Seed Technology Research Unit, MPKV, Rahuri. Experiment was carried out at room temperature of 28-33 °C and relative humidity of 68 to 75 per cent under laboratory conditions. Identification key given by Raina (1970) [12] was used for identification of *Callosobruchus* spp.

Identification of *C. chinensis* L.

The culture of *C. chinensis* L. was collected from local go downs and carefully identified by using magnifying lens. Morphological characters are different in *C. chinensis* and *C. maculatus*, therefore *C. chinensis* L. was identified based on morphological characters. In *C. chinensis* elytra looks pale brown with median dark marks and entire posterior part of elytra is dark in colour. Along the side margins of abdomen have distinct patches of course white setae. Female and male bruchids were identified by its size, antennae and elytra.

- **Size:** Females are slightly larger than male and males are smaller in size compared to female.
- **Antennae:** Short serrate antennae in female. Males have long pectinate type of antennae.
- **Elytra:** Dark spots were noticed on elytra in females and abdomen is partially covered by elytra. In Males, abdomen is fully covered by elytra and black markings were noticed.

Rearing of *C. chinensis*

For stock culture of pulse beetle *C. chinensis*, chickpea variety, Digvijay, was used as nutritional source. *C. chinensis* were collected in 15 x 10 cm with 1 kg capacity glass jar containing chick pea 500 gm as rearing medium and was maintained in incubator at temperature of 30 °C and 70% relative humidity (RH). Releasing 10 pair of freshly emerged adult beetles (0-24 hours) in a glass jar, mouth of container was covered with muslin cloth on the top tied with rubber band to facilitate aeration. Periodical removing of infested grains and refill with fresh un infested healthy seeds for the development of beetles in order to maintain uniform and uniparental culture throughout the study period.

Biology of *C. chinensis* on chick pea (*Cicer arietinum*) was studied under the laboratory condition with respect various parameters like oviposition period, fecundity (number of eggs laid on per seed), incubation period, larval period, pupal period. Total development period and adult longevity was studied. Those parameters were analysed statistically by using complete randomized design given by Panse and Sukhatme (1954) [9].

Results and Discussion

In the experiment of biology of pulse beetle number of eggs was recorded at temperature range of 28 °C to 33 °C and relative humidity of 68 to 75% under laboratory conditions.

The average incubation period of pulse beetle was 3.67 days with the range of 3 to 7 days. There was 4 larval-instars. The larval period varies from 20 to 25 days with an average of 20.33 days. The data indicated that the average pupal period of pulse beetle was 6 days and observation was recorded the pupal period was seen 6-7 days. The average developmental period of pulse beetle was recorded 32 days with the range of 31-34 days. The average fecundity was recorded to be 74.33 eggs/ female. These results are in similar with the Jaiswal *et al.* (2018) [7] and Patel *et al.* (2021) [11] who stated that incubation period as 4.15 days and 4.67 days respectively. Sathish *et al.* (2020) [15] who stated that the larval period varies from 20-25 days. Patel *et al.* (2021) [11] recorded the pupal period was seen 6-7 days in both cases which are matched with present studies. Patel *et al.* (2021) [11] and Singh *et al.* (2021) [17] who stated the both studies the total development period of pulse beetle is in the range of 31 to 34 days.

Table 1: Study on biology of pulse beetle, *Callosobruchus chinensis* on chick pea

Stage of the Insect	Mean ± S.D	Range (days)
Fecundity /female	74.33±0.05	70-78
Egg period	3.67±0.06	3-7
Larval Period	20.33±1	20-25
Pupal period	6± 1	6-7
Total development period	32± 2.06	31-34

Conclusion

Since the infestation starts in the field and continues through storage, an understanding of the biology of the beetle is essential for efficient management. The study demonstrates that *C. chinensis* prefers chickpeas as a host, allowing for several generations annually. Maximum damage is caused during the peak infestation period of July to October, which also happens to coincide with favourable environmental conditions. The development time from egg to adult varies, according to this research. Significant seed loss results when it falls below one month during ideal growth periods, even though it can exceed one month in less favourable circumstances. Remarkably, increased ovipositional, post-ovipositional, and male-female longevity are seen in subsequent generations, suggesting adaptation to the pulsing crop. Unfavourable circumstances such as scarcity of food, temperature swings, and low humidity can also affect how long a beetle takes to develop.

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