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Biology of the *Callosobruchus chinensis* (L.) on Chickpea

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Abstract: In the present study we have investigated biology of the *Callosobruchus chinensis* (L.) on chickpea. The pulse beetle, *Callosobruchus chinensis* (L.) on chickpeas finished its life cycle in about a month. The incubation time was 4.5 days, the oviposition period was 7 days, and the larval and pupal periods were 18 days and 6.5 days, respectively. According to the study on the biology of *C. chinensis* on chickpeas the entire stage of development lasted 29.5 days. A solitary female laid an average of 84.15 eggs, with 89% hatchability rate.

Keywords: *Callosobruchus chinensis*, Chickpea, Oviposition, Lifespan, Hatchability, Larva, Pupa

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Introduction

With about 70% of the world's production, India is the leading producer of pulses. Compared to the global average of 857 kg/ha, India's average pulse productivity is approximately 652 kg/ha (Ready *et al.*, 2012). Proteins are the building elements that guarantee healthy growth and development of various bodily components, including hairs and bones. They also repair broken tissue. Pulses are the most widely accessible protein source for vegetarians (Singh and Mohan., 2018). Chickpeas (*Cicer arietinum* L.) is a prominent leguminous crop that is produced in the desert and rainfed regions worldwide, especially in places like India,

South Asia, West Asia, and Southern Europe, to satisfy the protein requirements of vegetarian diets (Mishra *et al.*, 2023). With almost 75% of the world's chickpea production, India is the world's top producer. Chickpea comprises 52-70% carbs and 18-22% protein. It provides a good amount of vitamins, minerals (calcium, phosphorus, and iron), and fat (4-10%). It also aids in decreasing cholesterol levels (Jaiswal *et al.*, 2019). These pulses suffer significant harm from pests. Beetles begin to infest field plants. There are five species of *Callosobruchus* known to exist in India. The three main species of pulse beetles are

Callosobruchus chinensis (L.), *C. maculatus* (F.), and *C. analis* (F.). They cause substantial pest problems for green gram, cowpea, lentil, black gram, and pigeonpea. During the six months (April through October) each year, the pest's growth can be seen (Singh and Mohan, 2018). *Callosobruchus chinensis* (L.), often known as the pulse beetle, is a highly damaging and widespread pest of stored legumes. The pulse beetle, *Callosobruchus* spp., is a significant primary pest (Mishra *et al.*, 2023). In the stores, the pulse beetles typically reach dangerous levels from July to August (Hosamani *et al.*, 2018). The productivity and market value of chickpeas is limited by insect pests, which are a major factor in the field and storage when tackling biotic problems (Jaiswal *et al.* 2019). In the present study we have investigated biology of the *Callosobruchus chinensis* (L.) on chickpea.

Materials and Methods

The present study on the biology of *Callosobruchus chinensis* was conducted in 2024 at the School of Entomology, Department of Zoology, St. John's College, Agra, Uttar Pradesh, India. The mother culture of the test insect, *C. chinensis*, was acquired from the Department of Entomology, Indian Institute of Pulse Research, IIPR, Kanpur, India to raise the culture in the lab. The chickpea seeds were procured from local granaries.

Test insect rearing

The original culture was kept at room temperature on disinfected seeds. 100 g of sanitized chickpea seeds, stored in a 500 g cylindrical transparent plastic jar (12 × 10.5 cm), were used to multiply the stock culture. Twenty pairs of *C. chinensis* adults that were 24 h old were released into a jar with 100 g of disinfected chickpea seeds and kept at room temperature. To investigate the biology of *Callosobruchus chinensis* on chickpeas, 30 g of cleaned chickpea seeds were stored in three small, clear plastic containers (8 × 5 cm), and three pairs of adults younger than 24 h were released into each container and kept at room temperature in July 2024. Seeds with a eggs were separated and stored in small glass vials to

make observations easier. Various biological factors were then monitored in a lab setting.

The developmental process was followed stage by stage, and the eggs were examined every morning using a magnifying lens. The infested grains were removed after incubation to measure the duration of the larval, pupal, and overall developmental phases and other parameters. Hatched eggs were opaque and white. To observe different biological stages, the seeds were cut and broken with a cutter and needle. The observation was done using a magnifying lens and microscope.

Results and Discussion

Egg

Females usually lay a single egg on a seed, but they may lay 2-16 eggs on a single seed. The eggs were oval and newly laid eggs were transparent and smooth. Hatched eggs were creamish-white in color and appeared hard.

Fecundity

The total number of eggs a single female lays is fecundity. The total number of eggs laid by a single female ranged from 55 to 80. This data is comparable to studies of Jaiswal *et al.* (2019) who reported that the average number of eggs laid by a single female was 84.15, ranging from 73 to 104 eggs per female on chickpeas. According to Mishra *et al.* (2023), the range of egg laying is 71–87 eggs per female during oviposition, with the mean number of eggs laid being 78.93 ± 4.83 eggs.

Hatchability

Hatchability is percentage of the number of hatched eggs out of 100. The rate of the hatching of eggs of *Callosobruchus chinensis* on chickpeas was 89%, similar to the 88% reported by Jaiswal *et al.* (2019) and 92% by Chakraborty and Mondal (2015).

Oviposition period

The oviposition period is from the beginning of egg laying to the stopping of egg laying (Limma *et al.*, 2022). In the present study the mean oviposition period was 7 days, ranging from 5-9

Table 1: Biology of *Callosobruchus chinensis* on chickpea

Stage	Time Duration (Days)		Average
	Min	Max	
Incubation period	4	5	4.5
Larval period	16	20	18
Pupal period	5	8	6.5
Total development period	26	33	29.5
Oviposition Period	5	9	7
Adult longevity (Female)	8	11	9.5
Adult longevity (Male)	6	10	8
Fecundity	55	80	84.15

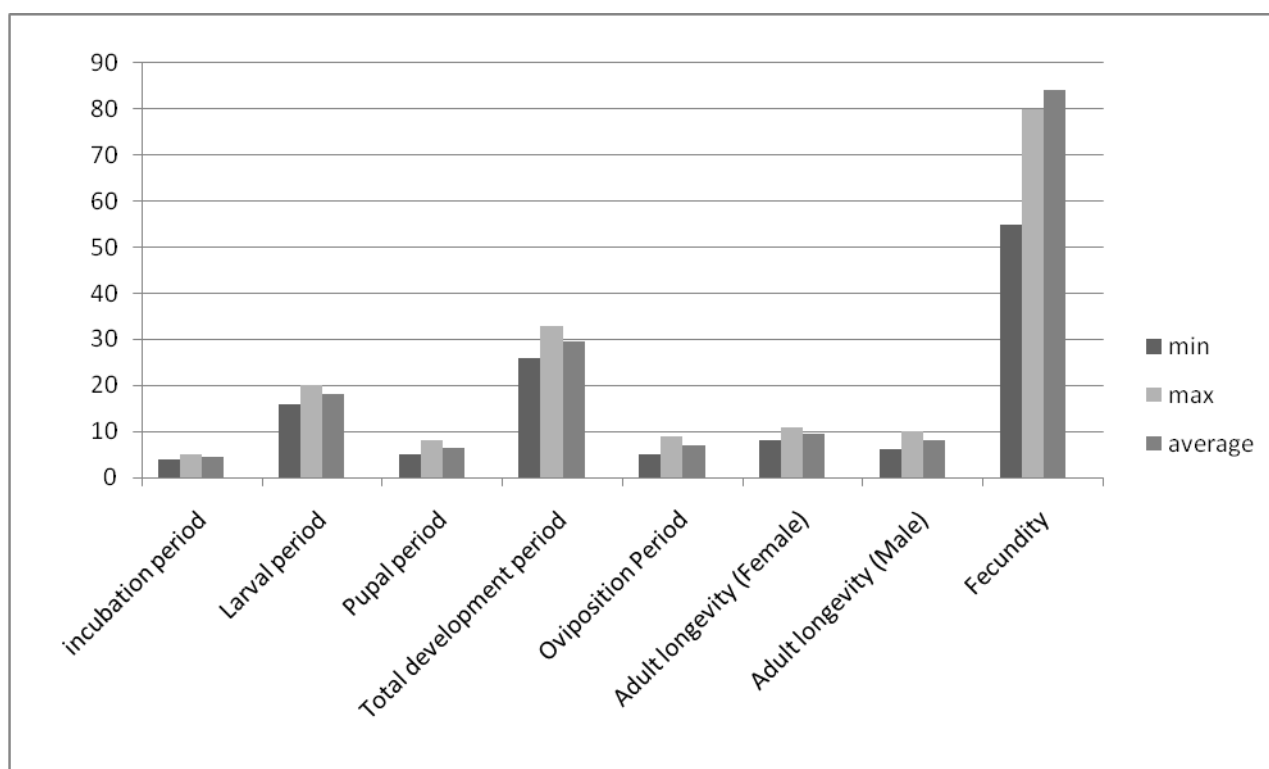


Fig. 1: Time period of different developmental stages of *C. chinensis* on Chickpea.

days. This is in close accordance with the mean oviposition period 8.1 ± 1.25 days and the range is 6–11 days on chickpeas reported by Jaiswal *et al.* (2019); an average of 7.76 ± 1.18 days and the range is 5–10 days reported by Singh *et al.* (2021); an average of 6.4 ± 1.14 days and the range is 5–8 days reported by Mishra *et al.* (2023); and an average of 5.80 days and the range is 5–7 days reported by Gopi and Singh (2020).

Incubation

Incubation is defined as the amount of time between egg laying and hatching (Limma *et al.*, 2022). In the foregoing study, *Callosobruchus chinensis* in chickpeas took 4–5 days to incubate (Table 1; Fig. 1), which is comparable to the 3–5 day incubation period, with an average of 4.15 ± 0.87 days reported by Jaiswal *et al.* (2019). Singh *et al.* (2021) reported the average as 5.16 ± 0.68 days, ranging from 4–6 days. Mishra *et al.* (2023) observed that the average days are 4.18 ± 0.23 with a range of 3–4 days. 4.6 ± 0.7 days with a range of 4–6 days have been reported by Augustine and Balikai (2019), and 4.10 days by Patel (2005).

Larva

The larva of the Bruchidae family is called a grub. Grub molts three times, has four instars, and is identified by the size of the grub and the casting of the head capsule (Sathish *et al.*, 2020). The larval period is from egg hatching to 4th instar larva (Limma *et al.*, 2022). In this study the average larval period was 18 days, with ranging from 16 to 20 days (Table 1; Fig. 1), which is similar to the result of 18–28 days, and the mean duration is 22.3 ± 3.06 days in chickpeas reported by Jaiswal *et al.* (2019); the average 18.2 ± 3.58 and the range is 14–23 days reported by Augustine and Balikai (2019); and the mean is 18.57 ± 1.95 day and the range is 16–21 days, examined by Mishra *et al.* (2023).

Pupa

The pupa is oval and the pupal chamber was built by the fourth instar grub at the end of the larval phase (Sathish *et al.*, 2020). In the present study

the mean duration was 6.5 days and the pupal period ranged from 5–8 days (Table 1; Fig. 1). This derives support from observations of Jaiswal *et al.* (2019) who noticed an average of 8.65 ± 0.87 days and a range of 7.10 days in chickpeas. Mishra *et al.* (2023) reported the average of 8.51 ± 0.17 days and the range is 8–9 days; whereas Hosamani *et al.* (2018) reported 7–8 days range with an average of 6 ± 0.39 days.

Total developmental time

Total developmental time is the time duration between the day of oviposition and the adult's emergence (Limma *et al.*, 2022). In this study it ranged from 26 to 33 days, with a mean of 29.5 days (Table 1; Fig. 1). This is comparable to 28 to 40 days, with an average of 32.85 ± 3.42 days, in the chickpeas examined by Jaiswal *et al.* (2019). Its life cycle span is 31.24 ± 3.92 days, as reported by Singh *et al.* (2021).

Adult Longevity

The period between an adult's emergence and death is known as adult lifespan (Limma *et al.*, 2022). In the present study the female's life span was 9.5 days with a range of 8–11 days, and the male's life span was 8 days with a range of 6–10 days (Table 1; Fig. 1). This is comparable to the average female life span of 10.15 ± 0.98 days with a range of 8–12 days and the male life span of 9.3 ± 1.08 days with a range of 7–11 days in chickpeas, as reported by Jaiswal *et al.* (2019). The male's life span was 6.62 ± 1.42 days with a range of 5–8 days and the female's life span was 7.53 ± 1.14 days with a range of 6–11 days, respectively as reported by Singh *et al.* (2021); life span of the female was 9.5 ± 1.58 day and range is 8–12 days and of the male is 8.3 ± 1.25 day and range is 7–11 days examined by Augustine and Balikai (2019). According to Mishra *et al.* (2023), the average life span for females is 9.10 ± 0.58 days with a range of 8–10 days, while the average life span for males is 7.2 ± 0.09 days with a range of 6–8 days. Singh and Mohan (2018) found that female longevity is 8.8 days and male longevity is 7.07 days.

According to research on the biology of *Callosobruchus chinensis* (L.) on chickpeas, the legume is the most favored host for this pest and can support several generations throughout the entire year. During the wet season, infestation is at its highest. The environmental conditions are more favorable in July and August compared to June. The study reveals that the developmental period was less than or equal to a month at room temperature. This is the optimum period of growth of the pest which causes huge damage to the seeds. According to the current study, farmers can be aware of the type and degree of damage the pulse beetle does to chickpea seeds kept at room temperature.

Ethical Statement

The authors confirm that all ethical issues have been dealt with the research ethics guidelines provided by the School of Entomology, Department of Zoology, St. John's College, Dr. B.R. Ambedkar University, Agra 282004, Uttar Pradesh, India.

Author Contributions

All authors participated equally in the specimen identification, research design and drafting of manuscript. The author (SG) collected and reared the insect and gathered the biological data. All authors have read and agreed to the published version of the manuscript.

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Conflict of Interest

The authors declare no conflicts of interest.

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