



Biology of *Callosobruchus chinensis* in stored Pigeon Pea (*Cajanus cajan*) in Muzaffarpur, Bihar, India

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Abstract

Pigeon pea (*Cajanus cajan*) commonly known as Arhar, is the major pulse crop cultivated all over India. Pulses are important high protein foods for the vegetarian & good nutritious sources of vitamins and minerals too. But it suffers high percentage of damage during storage when compared to other grains because they are highly prone to pulse beetle infestation. Among major pests, *Callosobruchus chinensis*, is a catastrophic pest of various pulses like arhar, moong and chana. Before spreading infestation may begin from the fields. The growth and developmental stages of pest include eggs, larvae, pupae and adults. The total development period varied slightly different during season of the year. The wt & size of grain also influences the no. of eggs deposited by the female pulse beetle Present work was done to observe the biology of the pulse beetle on pigeon pea in laboratory on eleven different parameters. The results indicate that the average pre-oviposition period was 6.50 ± 00.70 hours, the oviposition period was 6.80 ± 1.04 days, and the post-oviposition period was 2.60 ± 0.52 days. The incubation period averaged 4.90 ± 0.86 days. Each female laid an average of 92.70 ± 11.34 eggs, of which 80.50 ± 08.61 successfully hatched. Percentage egg hatchability was 87.05 ± 04.08 . The total larval period averaged 15.10 ± 1.67 days, while the pupal period averaged 6.00 ± 0.93 days. The complete life span was completed within 32–40 days in females and 31–36 days in males. These findings are significant not only for understanding the developmental biology of the pulse beetle but also for devising effective control strategies.

Keywords: Pulse beetle, biology, life cycle, arhar, *Callosobruchus chinensis*, stored grain pest.

Introduction

In Bihar, pulses are important economically crops, because of their rich protein content and are rich of vitamins & other nutrients such as calcium and iron, for poor, who can't bear animal proteins¹. Pigeon pea (*Cajanus cajan* Linn.) is widely grown in India because it is good sources of protein commonly known as arhar. It plays an important role in diet. It comes next ranking after chickpea. Pigeon pea contains rich source of protein 20-22%, crude fibre 9.8-13%, fat 1.2%, 65% carbohydrate, ash 3.9-4.3% and minerals, such as phosphorus 163-293, potassium 1845-1941, magnesium 113-127, sodium 11.3-12.0 (mg/100g dry matter)^{2,3}. Arhar engaged 4.04 million hectares gross cropped area under pulses contributing 22 percent of the national pulse production (2.65 million tonnes)⁴. Globally, it is produced on area of 5.40 million hectares of total productivity of 4.49 metric tonnes and 829 Kilograms per hectare⁵.

The farmers usually store the seeds after harvest of pulse crops, throughout the year. During storing the pulse seeds, are liable to the attack the insect pests. *C. chinensis* (Linn.) is known as a major harmful pest among all pulse beetle of pigeon pea in storage⁶. Female beetles begins infestation first in the field where deposits its eggs on the surface of the host grains or green

Pods. These infested seeds are carried to storage and serve as an eminent source for infestation on healthy seeds. As soon as the egg hatches, the larvae bore into seed and eat the inner cotyledon or contents of the grain. Both larval and pupal period are completed inside the grain and mature adult emerges out through a circular exit hole. The present study focuses on the primary storage infestation of pigeon pea by *C. chinensis*. Oviposition takes place by insect pest where first interact between host plants and insect pests. For successful population built-up and high infestation, a successful oviposition is necessary.

This study of biology will be helpful to better understand against reducing their attack. The purpose of this research was to investigate its biology to help plan effective pest management. The studies on biology of *Callosobruchus chinensis* has been investigated by many researchers by different pulses⁷⁻¹⁴. The challenges associated with controlling the internal feeding pulse beetle, specifically the ineffectiveness of contact insecticides and the impracticality of fumigation in resource-limited rural settings highlight the need for alternative approaches. Consequently, plant materials emerge as the most promising and effective agents for grain protection.

Materials and Methods

The Studies of biology of *C. chinensis* was observed under controlled condition, & represent during June- August, 2025. The pure culture of the beetle was maintained in glass jar of 1/2 kg capacity⁸. Pigeon pea (*Cajanus cajan*) was purchased from local market of Gola Road, Muzaffarpur, Bihar. 100g per jar of pigeon pea was taken in 10 separate glass jars (Figure-1). 6 to 8 newly hatched beetle were kept in each jar of pigeon pea. Opening of jar were tie with muslin cloth and fixed each mouth of container with plastic rubber. After egg laying, we kept eggs separately in separate glass jars for further observations. Adult beetle was removed after death of adult beetle from the jar and total no of eggs laid by a single female on host grains was calculated. Each day the eggs were transferred to separate containers and the opening of jars covered by using muslin cloth.laid were kept in separate containers and mouth covered with muslin cloth (Figure-2 to 6).



Figure-1: Experimental setup

All observations of 10 jars were noted on 11 parameters individually, Pre-oviposition, oviposition, Post-oviposition, egg laying period, total number of eggs laid by a single female, total number of eggs hatched, percentage egg hatchability, larval period, pupal period, adult longevity of both male and female, total life span in male and female and represent in the form of mean and standard deviation along with the stage of min-max. Data obtained were analysed statistically in randomised design.

Results and Discussion

The result obtained is shown in (Table-1) confirms high reproductive potential and successful emergence. Pre-oviposition period was found to be short which means that female was reproductively mature soon after its emergence and have high mean fecundity with 92.70 ± 11.34 egg per female and hatchability rate is 82.02-96.42%. Among all mature stages larval stage has highest duration in the pest life cycle. Which is

because of larva is the only feeding stage in the life cycle of pest and it accumulates energy reserve for metamorphosis and reproduction. A significant difference in adult longevity among male and female were observed with females having a little extended (approx. 2 days) life span than males which appear to be evolutionary significant to facilitates to oviposition period and ensuring maximum eggs are laid. These findings were supported by other workers also.

The fecundity (egg laying) of a female beetle in present study ranged from 79.00-110.00 with the mean of 92.70 ± 11.34 number of eggs. These results are similar of Ravindra (1998) report. He reported 5.51 days of average mean incubation period with a range of 5 to 6 days¹⁵. Singh and Kumari (2000) also reported 70 eggs per female the fecundity of pulse beetle in storage condition pulses grain (cowpea and chickpea)¹¹. Fecundity of pulse beetle was observed by Thakur and Pathania on average of 97.33 eggs of pulse beetle on *Vigna mungo* (black gram) during June- July¹⁶.

Table-1: Life cycle parameters of *C. Chinensis* on *Cajanus cajan* (Pigeon pea).

Parameters	Mean \pm Standard Deviation (n=10)
Pre-oviposition (in hours)	06.50 \pm 00.70 (06.00-07.00)
Oviposition/Egg laying period (in days)	06.80 \pm 01.04 (05.00-08.00)
Post-oviposition	02.60 \pm 00.52 (02.00-03.00)
Incubation period (in days)	04.90 \pm 00.86 (04.00-06.00)
Total number of eggs laid/female	92.70 \pm 11.34 (79.00-110.00)
Number of eggs hatched	80.50 \pm 08.61 (69.00-92.00)
Percentage egg hatchability	87.05 \pm 04.08 (82.02-96.42)
Larval period (in days)	15.10 \pm 01.67 (12.00-17.00)
Pupal period (in days)	06.00 \pm 00.93 (05.00-07.00)
Adult longevity of male (in days)	07.60 \pm 00.95 (06.00-09.00)
Adult longevity of female (in days)	09.60 \pm 01.51 (07.00-12.00)
Total life span in Female (in days)	35.60 \pm 02.58 (32.00-40.00)
Total life cycle in Male (in days)	33.60 \pm 01.84 (31.00-36.00)

The current result of the incubation period of *C. chinensis* was ranged 4-6 days whereas average mean of 04.90 ± 00.86 days was recorded, which is dissimilar with the findings of Thakur and Pathania who observed incubation period ranging from

6.33-10.33 days¹⁶. The current report are similar with the Varma and Anandhi report. A/C to them 3-5 days observed the incubation period on mung bean seeds of pulse beetle, whereas average mean was 4.0 ± 1.0 days¹⁷. Minor differences may be slightly observed due to the temperature & seed texture, relative humidity as well as moisture content of the grains and variety of the host grain etc. Quazi reported incubation period to be 5-8 days which is different from my observation¹⁸. Maximum incubation period up to 6 days had been reported by Singh et al.¹⁹ and Augustine and Balikai²⁰.

The oviposition period ranged from 5-8 days with 06.80 ± 01.04 days of average mean and post-oviposition period varied from 2-3 days with average mean of 02.60 ± 00.52 days. The current results of oviposition was agree with report of Varma and Anandi who noted 08.00 ± 01.58 days oviposition period whereas 02.20 ± 0.85 days post-oviposition period was on mung bean grains¹⁷. The findings of oviposition period by Singh and Borah was 4.8 ± 0.25 days whereas post-oviposition period was 1.4 ± 0.11 days¹². Which is dissimilar of current finding. Numbers of eggs hatched was 69-92 eggs with average mean of 80.50 ± 08.61 eggs which is similar of Tania et al. findings, who observed 97.07 to 93.79 percent of percentage adult emergence of pulse beetle in dissimilar mung varieties²¹. This results was also similar to Chakraborty et al. results²². The current findings of mean of larval period was 15.10 ± 01.67 days which ranged from 12-17 days. This observation is almost similar to the findings of Hosamani et al²³. Augustine and Balikai reported 14-23 days' larval period in cowpea which is dissimilar of this finding. The pupal period was 5-7 days with average of 06.00 ± 00.93 days which is slightly different from Thakur and Pathania observation who reported 7-9.33 days in black gram. Pupal periods on black gram was 7-9 days recorded by Kumari et al. and Singal and Borah whereas mean value recorded 7.2 ± 0.18 days on Pigeon pea, respectively^{9,12}.

Adult longevity of male was 6-9 days with average mean of 07.60 ± 00.95 days while adult longevity in female was 7-12 days with average mean of 09.60 ± 01.51 days respectively. These results were similar findings of Ravindra's observation. He observed 7 days the adult longevity on cowpea, which is similar to the present findings. Male longevity as 06.01 ± 00.13 days were observed by Chakraborty and Mondal²². Limma et al. and Jaiswal et al. found that the male longevity was 7.10 ± 1.02 days which ranged from 6-9 days and 8.80 days which ranged between 7 and 11 days, respectively^{24,25}. Augustine and Balikai found that the female longevity was 09.50 ± 01.58 days which ranged between 8-12 days²⁶. These current observations were slightly equal to the results obtained by Chakraborty and Mondal²² and Raina⁸ who found it to be 9.13 and 9.44 days respectively.

Total life span in female was 32-40 days while total life span in male was 31-36 days respectively. The current findings are in agreement with Patel who recorded 28-38 days total life span of pulse beetle on green gram while average mean of 35.51 days²⁷.

Total life cycle was recorder by Tabu et al. was 25.3 days and Ravindra also reported life cycle to be 28.65 days on cowpea²⁸. These findings was agreement with present observation.

The adult beetle emerging from the grains were 82.02-96.42% with an average of 87.05 ± 04.08 percent. Gokhle recorded that adult emergence was 96.62% of *C. chinensis* on cowpea and on pea it was 73.35%; whereas Kumari et al. reported 46.77% adult emergence in blackgram^{29,9}.



Figure-2: Infected seeds.



Figure-3: eggs.



Figure-4: larva.



Figure-5: Pupa.



Figure-6: Adult.

Conclusion

This study of the life cycle of pulse beetle, *Callosobruchus chinensis* L, has provided valuable insights and showed that the species have reproductive efficiency with a quick life cycle. It showed high fecundity with larval stage as most dominant phase in the life cycle for control. Thus, this is valuable for farmer for minimising loss in storing conditions and suggested that it should be applied on only larval stage before the peak feeding period is reached. Hence the study contributed for understanding the biology and behaviour of this pest which is important for developing efficacious pest management strategies to ensure food security and minimize crop damage.

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