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The biology of pulse beetle, *C. chinensis* on stored mungbean

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Abstract
Callosobruchus chinensis is internal, primary and most devastating pest of stored pulses. The fecundity of female beetle was observed with an average of 78.93 ± 4.83 eggs per female and incubation period was observed 4.33 ± 0.97 days. The larval and pupal period varied from 20 to 23 days with an average of 21.73 ± 0.96 days. The oviposition and post oviposition period was observed with an average 7.93 ± 1.27 and 2.2 ± 0.67 days, respectively. The longevity of adult female and male beetle observed wih an average 8.8 ± 1.56 and 11.33 ± 1.98 days, respectively. The total life cycle of *C. chinensis* was 32.73 ± 2.96 days and the sex ratio of female and male beetle was 0.83: 1.21.

Keywords: Mungbean, pulse beetle, *C. chinensis*, biology

Introduction
Pulses are an important source of protein that forms a major constituent of vegetarian diet for urban and rural people of India. Among the pulse crops, mungbean, *Vigna radiata* (L.) is one of the most important and third most popular crop throughout South Asian countries including India. The major mung bean growing states in India are Rajasthan, Maharashtra, Madhya Pradesh, Tamil Nadu, Andhra Pradesh, Karnataka, Orissa, Bihar, Haryana and Uttar Pradesh [1]. In India, it is cultivated in an area of about 43.26 million hectares with total production and average productivity of 21.65 million tonne and 500 kg/ha, respectively [2]. Also these are playing important role in sustaining soil fertility by fixing atmospheric nitrogen through symbiotic relation with rhizobium, apart from human and animal nutrition. It contains 56.7 per cent carbohydrate, 24 per cent protein, 3.5 per cent fibre and 1.3 per cent fat.
The pulse crops are attacked by many insect pests. Among them, *Callosobruchus chinensis* L. (Coleoptera: Bruchidae) has got great economic importance [3] and also most destructive in legume seeds. The infestation begins in the field and continues in the store houses causing heavy losses. They cause both qualitative and quantitative losses. They deteriorate the quality of seeds by denaturing and decreasing the solubility of proteins. In badly damaged grains, endosperm is eaten by the grubs leaving only the thin outer covering or thin film or seed coat. Such infested grains are not only unfit for consumption but also useless as seed. The losses in pulses during post harvest handling and storage has been estimated about 8.5 per cent in India [4]. Maximum damage is caused in month of July to September.

Materials and Methods
The experiment was conducted at Department of Entomology, College of Agricultural CCSHAU, Hisar on mungbean variety MH 421 during August to September, 2018.

Maintenance of nucleus culture
For initiating the culture, the adults of *C. chinensis* were collected from infested mung bean seed from storage laboratory, Department of Entomology at College of Agriculture, CCSHAU, Hisar. The collected adults of pulse beetle were identified and released in the plastic container along with mung bean grains. The mung bean grains were sterilized at 55^0C for 4 hour to make them free from any infestation. The mouth of containers containing adults and mung bean grains were covered with muslin cloth and kept in B.O.D. The culture was maintained in B.O.D. at temperature ranges 30 ± 5 ^{0}C and relative humidity 75-80 per cent. For the development of beetle, fresh grains were provided periodically as and when required. In order to avoid the infections caused by the fungi and the other parasitic organisms, the culture was observed in routine. This culture was used throughout the period of investigation. Dead adult beetles were removed periodically.

For biological studies, 15 pairs of freshly emerged pulse beetle were released on 50 g mungbean grains of variety MH 421 in plastic containers (250 g capacity) separately and such types of 15 containers (replication) were maintained. Males and females were identified on the basis of body size i.e. female are larger in size as compare to male. In adult female, tip of abdomen is exposed by elytra while in male it is covered by elytra. Male have serrate type antennae whereas female have pectinate type antennae. The observation on different parameters like fecundity, incubation period, larval and pupal period, oviposition and post- oviposition period, sex ratio, adult emergence and adult longevity were taken.

Fecundity
The fecundity was observed daily by counting the eggs which were laid by each female pulse beetle on the mung bean grain till its death.

Incubation period
Incubation period was observed as the duration of time taken from egg laying to till hatching which was recognized by turning of egg to opaque due to the accumulation of bored material in the egg chorion.

Larval and pupal period
The period between hatching of eggs to the adults emergence from the grains considered as the combined larval and pupal period of the pulse beetle and the observations were taken till the emergence of adults.

Oviposition and post-oviposition period
The adult pulse beetle were allowed to mate in separate containers. Fifteen replications were maintained with one pair in each container with the mung bean grains to observe the oviposition and post-oviposition periods. The oviposition period was considered as the period between starting of egg laying to stoping of egg laying by female beetle and the post-oviposition period was the period between stoping of egg laying to death of female beetle.

Sex ratio and adult emergence
Oviposited grains were selected from plastic containers (mixture of pulse beetle and mung bean grains) and maintained three replications in Petri plates (each replication having 50 oviposited grains). Total number of emerged adults were counted and examine under binocular microscope to determine the sex ratio. Male and female were identified on the basis of body size, female are larger in size as compare to male. In adult female, tip of abdomen is exposed by elytra while in male it is covered by elytra. Male have serrate type antennae whereas female have pectinate type antennae.

Adult longevity
The longevity of the adults of *C. chinensis* was measured by collecting the freshly emerged female and male beetle from the stock culture and shifted in separate containers with mung bean grains. Fifteen such containers along with mung bean grains were maintained for each male and female beetle.

Measurement of developmental stages
For measurement of different developmental stages of *C. chinensis*, five seeds were taken from the lot and soaked overnight in water. On the next day, seeds were opened gently with a sharp knife and the instar that hatched was examined under zoom stereo microscope. The length and width of the grub was recorded using a micrometer.

Statistical analysis
The data observed to statistical analysis unser ANOVA technique at 1% lavel of significance. The data were shown in range and Mean± S.D. for bilogical study.

Results and Discussion
(A) Fecundity
The eggs of *C. chinensis* were planoconvex, oval in shape, smooth and translucent in appearance. The fecundity of a female beetle was varied from 71 to 87 eggs with an average of 78.93 ± 1.45 eggs. This result corporated with the results obtained by Pokharkar and Mehta [5] who reported fecundity as 77.8 eggs per female on stored chickpea. Singh and Kumari [6] observed the fecundity of pulse beetle was on an average of 70 eggs per female on stored pulses grain (cowpea and chickpea). Thakur and Pathania [7] also observed fecundity of pulse beetle was on an average of 97.33 eggs on black gram during June-July.

(B) Incubation period
The incubation period of *C. chinensis* was varied from 3 to 6 days with an average of 4.33 ± 0.88 days under laboratory conditions during the month of August-September. Varma and Anandi [8] reported that the incubation period of pulse beetle on mungbean seeds varied from 3 to 5 days with a average of 4.0±1.0 days. The current findings are in close agreement with those of Rana Kiran [9] who observed that the eggs were laid by female beetle singly on seeds.The freshly laid eggs were planoconvex and translucent and also reported egg hatching of pulse beetle varied from 3 to 5 days with an average of 3.8 ± 0.79 days on garden pea. Hoshmani *et al.* [10] reported that the incubation period of pulse beetle was varied from 4 to 5 days with an average of 4.0 ± 0.21 days at 28 to 33 °C temperature and 68 to 75 percent relative humidity on green gram.

(C) Oviposition and post oviposition period
The oviposition period under laboratory conditions varied from 6 to 10 days with an average of 7.93 ± 1.52 days and the post-oviposition period was ranged from 1 to 3 days with an average of 2.2 ± 0.38 days. The present findings are supported by Varma and Anandi [8] who reported that the oviposition period of pulse beetle was 8.0 ± 1.58 days and post oviposition period was 2.2 ± 0.84 days on mungbean grains. Singh and Borah [11] revealed that ovipostional period of pulse beetle was 4.8 ± 0.25 days and post-oviposition period was 1.4± 0.11 days.

(D) Larval + Pupal period
The larvae entered into the grain and the colour of eggs was changed due to accumulation of frass inside the eggs. The larvae were apodous, stout, c- shaped and yellowish-white in colour with black-coloured head. The pupa of beetle was light cream in colour and as the pupa aged their colour changed from light cream to dark brown. The various appendages were held close to the body (exarate type). The larval + pupal period ranged from 20 to 23 days with an average of 21.73 ± 0.86 days. The present findings are in agreement with Hoshmani *et al.* [10] who reported the total larval and pupal period of 19 to 27 days with an average of 12.0 + 7.0 days on green gram seeds at ambient laboratory conditions. But

present findings are contrary to Solanki and Mittal [12] who reported that the larval and pupal period was 16.4 days on green gram. The variations in period (larval and pupal) might be due to the conditions of laboratory under which the experiment was performed**.**

Table 1: Different developmental stages of *C. chinensis* on mungbean variety MH 421

Parameters	Range	Mean ±S.D.
Fecundity (No. of eggs/female)	71-87	78.93±4.83
Incubation period (days)	3-6	4.33±0.97
Oviposition period (days)	6-10	7.93±1.27
Post-ovipoaition period (days)	1-3	2.2±0.67
Larval+Pupal period (days)	20-23	21.73±0.96
Adult longevity female (days)	7-11	8.8±1.56
Adult longevity male (days)	8-14	11.33±1.98
Total life cycle (days)	30-37	32.73±2.96
Adult emergence (%)	81.33-98.79	92.1±5.45
Sex-ratio (F:M)	0.72:1.0-0.92:1.38	0.83:1.21

(E) Adult longevity

The newly emerged adults were 3-4 mm long and oval in shape. It is brownish coloured adults. The adult female longevity ranged from 7 to 11 days with an average of 8.8 ± 2.29 days while adult male longevity varied from 8 to 14 days with an average of 11.33 ± 3.68 days. Similar findings were observed by Varma and Anandi [8] who reported that adult longevity of female was varied from 9 to 12 days with an average of 9.6±1.14 days while for male it was varied from 9 to 14 days with an average of 11.0±1.87 days on stored mungbean. Patel *et al.* [13] reported that adult longevity of pulse beetle was varied from 8 to 14 days with an average of 11.75 days on greengram.

(F) Total Life cycle

The total life cycle of *C. chinensis* from egg to adult ranged from 30 to 37 days with an average of 32.73 ± 3.68 days. The current findings are in supporting with Patel *et al.* [13] who observed total life span of pulse beetle on greengram was varied from 28 to 38 days with a mean of 33.51 days. Tabu *et al.* [14] observed that the total life cycle of pulse beetle (egg to adult) was 25.3 days on chickpea

(G) Per cent adult emergence

The adults beetle emerging from the grains via the window which was made by the larvae on mungbean grains. It was observed that window on grains are circular in shape and pushed the window by head which comes out first from grains. The per cent adult emergence of *C. chinensis* was ranged from 81.33 to 98.79 with an average of 92.1 ± 5.45 per cent.

(H) Sex ratio

The current investigation revealed that the sex ratio (Female : Male) of *C. chinensis* was 0.83 : 1.21 showing that the dominance of males over females beetle. The present findings are supported by Porkhar and Mehta [5] also reported maximum male emergence as compare to females with sex ratio of 0.96:1.00.

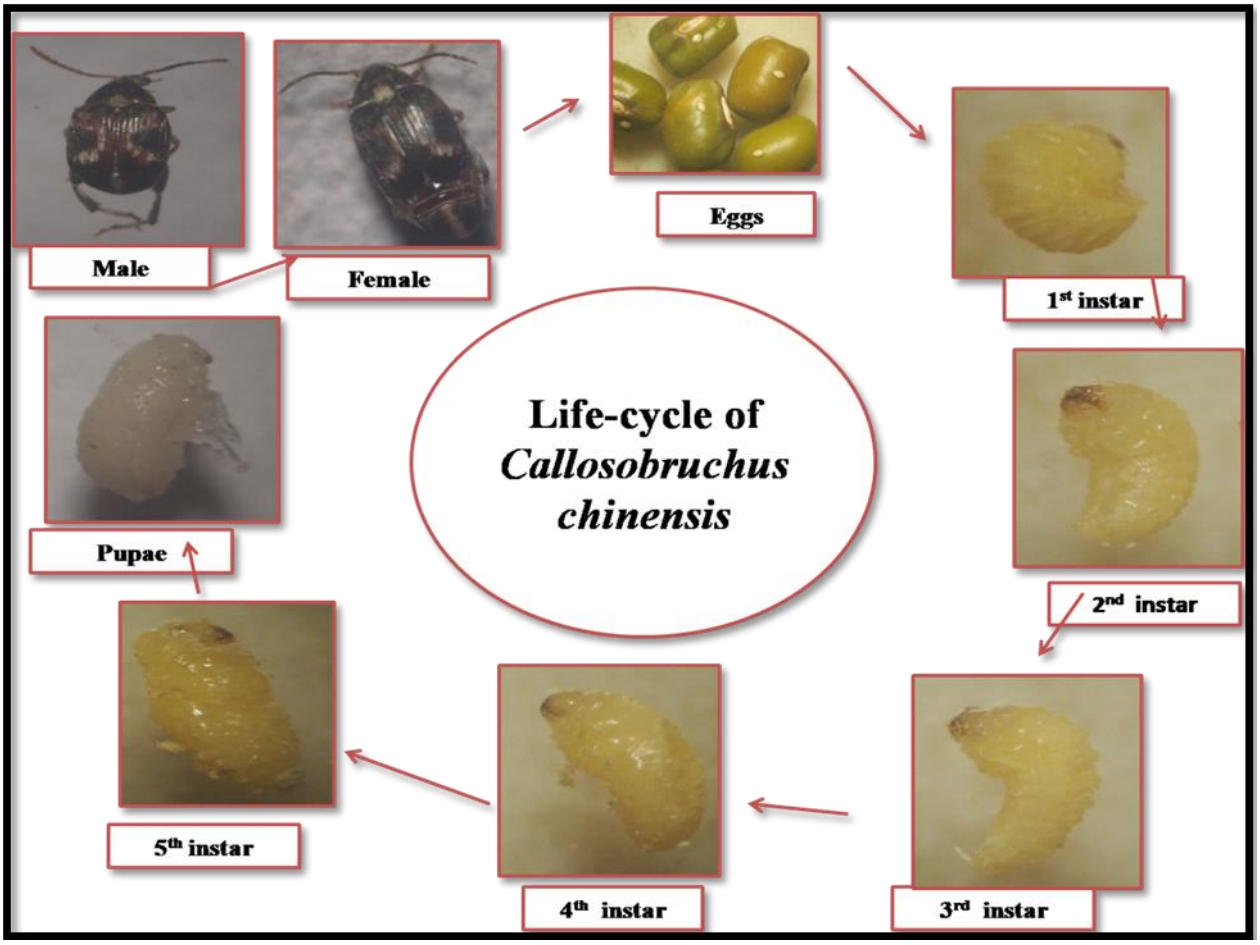

Fig 1: Life cycle of *C. chinensis* on mungbean grains

(I) Measurements of developmental stages of pulse beetle, *C. chinensis*

The length and breadth of first instar larvae of pulse beetle were smaller in size with an average of 0.76 and 0.44 mm, respectively (Table 2). The length of second larval instar was with an average of 1.25 mm and breadth was 0.82 mm. The average length and breadth of the third larval instar was 1.64 and 1.05 mm, respectively. The larvae remained inside the mungbean grains in "C" shaped position. The length and breadth of fourth larval instar was with an average of 2.25 and 1.51 mm, respectively. The mean length of fifth larval instar was 3.52 mm and breadth was 1.90 mm. The average length of the pupa was 3.96 mm and breadth was 1.22 mm. The female adults beetle measured avg. 4.25 length and avg. 1.51 breadth whereas male adult beetle length was avg. 3.88 and 1.17 and avg. 1.28 breadth. Similar findings were reported by Rana Kiran [9].

Table 2: Measurements of developmental stages of pulse beetle, *C. chinensis*

Life Stages		Measurement (mm)	
		Length	Breadth
Larvae	1st Instar	0.76* (0.72-0.83)**	0.44 (0.39-0.50)
	2nd Instar	1.25 (1.04-1.38)	0.82 (0.61-1.03)
	3rd Instar	1.64 (1.52-1.87)	1.05 (0.93-1.24)
	4th Instar	2.25 (2.07-2.98)	1.51 (1.19-2.01)
	5th Instar	3.52 (3.21-3.38)	1.90 (1.75-2.04)
Pupae		3.96 (3.82-4.09)	1.22 (1.23-1.37)
Adult	Female	4.25 (4.21-4.52)	1.51 (1.32-2.01)
	Male	3.88 (3.62-3.99)	1.28 (1.17-1.39)

*- Mean of three replication

**- Figure in parenthesis are ranged values

Conclusion

Current research is useful for farmers and extension worker of thestate for reducing pulse beetle, *C. chinensis* damage in stored conditions. It is also applicable for understanding biology of pulse beetle. Their infestation starts from field to storage so that it will help for the management purpose.

References

1. Soren KR, Patil PG, Das A, Bohra A, Datt S, Chaturvedi SK *et al*. Advances in pulses genomic research. Indian Institute of Pulses Research, Kanpur 2012, 17.
2. Anonymous. Agricultural Statistics at a Glance. Ministry of Agriculture and Farmers Welfare, Government of India, 2016-2017.
3. Southgate BJ. Biology of the bruchidae. Annual Review Entomology. 1979; 24:449-473.
4. Rahman A, Talukder F. Bioefficacy of some plant derivatives that protect grains against the pulse beetle, *Callosobruchus maculatus*. Journal of Insect Science. 2006; 6(1):154-158.
5. Pokharkar PK, Mehta DM. Biology of pulse beetle, *Callosobruchus chinensis* in stored chickpea. Progressive Agriculture. 2011; 11(1):34-36.
6. Singh SC, Kumari R. A study of the biology of *Callosobruchus chinensis* (Linn.) infesting stored pulses (grain legumes) in India. Indian Journal of Entomology. 2000; 62(4):319-322.
7. Thakur AK, Pathania M. Biology of Pulse beetle (*Callosobruchus chinensis*) and its management through Plant products on Black Gram (*Vigna mungo*). Star Journal. 2013; 2(1):18-21.
8. Varma S, Anandhi P. Biology of pulse beetle (*Callosobruchus chinensis* L Coleoptera: Bruchidae) and their management through botanicals on stored mung grains in Allahabad Region. Legume Research. 2010; 33(1):38-41.
9. Rana Kiran. Biology of Bruchid, *Callosobruchus chinensis* Linn. (Coleoptera: Bruchidae) on garden pea, *Pisum stivum.* Trends in Bioscience. 2014; 7(11):1078-1081.
10. Hosamani GB, Jagginavar SB, Karabhantanal SS. Biology of pulse beetle, *Callosobruchus chinensis* on different pulses. Journal of Entomology and Zoology Studies. 2018; 6(4):1898-1900.
11. Singh SK, Borah RK. Biology of pulse beetle, *C. chinensis* on pods of *Cajanus cajan*. Annals Agricultural and Biological Research. 2001; 6:35-37.
12. Solanki DK, Mittal DK. Biology of pulse beetle *Callosobruchus chinensis* in storage conditions in gram. International Journal of Agriculture Science. 2018; 10(7):5682-5686.
13. Patel VK, Chaudhuri N, Senapati SK. Biology of pulse beetle, *Callosobruchus chinensis* as influenced by feeding of different grain pulses. Agriculture Science Digestion. 2005; 25(4):254 -256.
14. Tabu D, Selvaraj T, Singh SK, Mulugeta N. Management of Azuki bean beetle (*Callosobruchus chinensis* L.) using some botanicals, inert materials and edible oils in stored chickpea. Journal of Agricultural Technology. 2012; 8(3):881-902.