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## Biology of pulse beetle, *Callosobruchus maculatus* (Fab.) infesting cowpea

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### Abstract

Investigation was undertaken during January- May, 2021 to study biology and management of stored cowpea against pulse beetle, *Callosobruchus maculatus* (Fab.) at College of Agriculture, Pune. Studies on biology of pulse beetle, *C. maculatus* revealed that pre-ovipositional, ovipositional and ovipositional periods ranged from 3-9 hours with mean of 4.3 ( $\pm 0.70$ ) hours, 5-7 days with mean of 6.3 ( $\pm 0.94$ ) days and 1-3 days with mean of 2.4 ( $\pm 0.70$ ) days, respectively. Fecundity ranged from 49-62 eggs/female. Incubation period ranged from 3-5 days with mean of 5.4 ( $\pm 0.7$ ) and 8 ( $\pm 1.05$ ) days, respectively. Mean sex ratio (male: female) was 1:1.10. Total developmental period ranged from 22-26 days with mean of 22.9 ( $\pm 1.66$ ) days.

**Keywords:** Pulse beetle, cowpea, *Callosobruchus*, biology

### Introduction

Pulses are second most important crops next to cereals and are important component of human daily diet. Moreover, Pulses are rich in energy, proteins, vitamins, minerals and essential amino acids. Grain legumes are popularly known as pulses (Bharati *et al.*, 2017) <sup>[1]</sup> which contain 30-40 percent protein that is almost twice than cereals and hence, known as 'poor man's meat' (Hossain *et al.*, 2014) <sup>[2]</sup>. Annual weight loss in storage losses of pulses in India reported to be 55-60 percent and 45.5 to 66.3 percent loss in protein content of seed (Hosamani *et al.*, 2018) <sup>[3]</sup>. Pulse beetle, *Callosobruchus* spp (Chrysomelidae: Coleoptera) is an important primary pest and major constraint (Mounika *et al.*, 2021) <sup>[4]</sup>. Bruchid infestation leads to the development of secondary infection of fungi that produce mycotoxin due to which biochemical changes in seeds occur during storage and become unsuitable for human consumption. Moreover, the pest reduces germination potential and diminish market value (Augustine and Balikai, 2019) <sup>[5]</sup>. All the three species of pulse beetle (*C. maculatus*, *C. chinensis* and *C. analis*) are considered as important species infesting storage pulses in India, amongst, the former species is a key storage pest of cowpea (*Vigna unguiculata*) and its infestation leads quantitative and qualitative losses (Deshpande *et al.*, 2011) <sup>[6]</sup>. Generally, primary source of infestation starts from field wherein, adult female oviposits on pods and causes minor damage. Grubs penetrates pods and remain concealed within developing seeds as hidden infestation (Southgate, 1979) <sup>[7]</sup>. The damage caused by grub renders hallowing of seeds which in turn become unfit for human consumption and production of sprouts. Presence of round exit holes on seed surface indicates seed infestation. Therefore, with regards to its management aspect, understanding its biology becomes necessary.

### Materials and Methods

Laboratory experiment were undertaken during January to May, 2021 to study the biology of pulse beetle, *Callosobruchus maculatus* (Fab.) in stored cowpea at College of Agriculture, Pune. Rearing of pulse beetle were done in the laboratory condition. Test species, *C. maculatus* was procured from the seed technology laboratory, MPKV, Rahuri and nucleus culture was maintained on local variety of healthy cowpea seeds with 12 percent moisture content. The stock culture was maintained on cowpea as nutritional source within plastic jar admeasuring 13 cm  $\times$  10 cm with 1 kg seed capacity. Jars were kept in room temperature 27<sup>o</sup> to 30<sup>o</sup> C and 65 to 75 percent relative humidity.

Test species was identified under magnifying glass lens on the basis of morphological characters suggested by Khare, 1993 <sup>[8]</sup> and Bandaara and Saxena, 1995 <sup>[9]</sup>.

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For conducting studies on biology of the test insect, ten plastic vials (6.5 × 6 cm) containing 50 healthy seeds were placed in bottom of container. Single pair of freshly emerged adults of *C. maculatus* was released in each vials. Vials were covered with muslin cloth and fasted with rubber band and were kept in the BOD incubator at 27±5 °C temperature and 70±5 percent relative humidity. After a week, the released pair of dead adults was removed from container.

Pre-oviposition period was considered as a time taken from mating of female to initiation of egg laying on seed surface and it was recorded at an interval of 1 hour. Ovipositional period was computed on the bases of the period prevailing in between laying of first egg till the cessation of egg laying. Post oviposition was considered as time taken from cessation of egg laying to death of female. Fecundity of individual female was recorded daily till the death of female beetle. Incubation and hatchability was recorded as the time taken from egg deposition to hatching. Larval-pupal stage recorded after hatching, the first instar grub bores down inside the seed and passes further instars. The last instar, grownup grub forms circular translucent exit hole on seed surface and enters into pupal stage within the seed. Being completion of larval and pupal stage under the concealed conditions, it is difficult to observe the exact larval and pupal period therein (Chakraborty and Mondal, 2015) [10]. In separate set of experiment was constituted with ten vials for the study of adult longevity and sex ratio. In each vials, a pair of freshly emerged adults was released to record survival period in accordance with sexes. Total developmental period was computed for each of the life stages by considering the mean time taken from egg to emergence of progeny adult.

## Results and Discussion

Results on biology of pulse beetle, *C. maculatus* on stored cowpea was tabulated in table 1 on the bases of respective parameters.

### Life stages of *C. maculatus*.

Pre-ovipositional period of *C. maculatus* was found in the

range of 3 to 9 hours and mean period was observed as 4.3 (±0.70) hours. These findings are in agreement with that of reported by Chudasama (2015) [11] and Kopparthi (2019) [12]. Ovipositional period was observed in the range of 5 to 7 days and mean period of 6.3 (±0.94) days. These findings are in agreement with that reported by Sharma *et al.* (2016) [13]. Post-ovipositional period was recorded in the range of 1 to 3 days and mean period of 2.4 (±0.70) days. Similar observations have been made by Chudasama (2015) [11] and Kopparthi (2019) [12].

Fecundity of *C. maculatus* per female ranged from 49 to 62 eggs. Eggs were laid singly on seed surface with mean of 57.8 eggs (±4.15). The fecundity per female was reported to be 87.66 eggs. Incubation period was found in the range of 3 to 5 days with mean period of 4.8 (±0.42) days. Similar observations have been reported by Jadhav *et al.* (2015) [15] and Nisar *et al.* (2021) [15]. The hatching was ranged from 86.02 to 96.6 percent with mean period of 92.39 (±3.55) percent. These findings are more or less in the similar range that reported by Sharma *et al.* (2016) [13], Chudasama (2015) [11], Kopparthi (2019) [12] and Nisar *et al.* (2021) [15] reported as 95, 94.3, 91, 91 and 88.95 percent, respectively.

The hatching was ranged from 86.02 to 96.6 percent with mean period of 92.39 (±3.55) percent. Sharma *et al.* (2016) [13], Chudasama (2015) [11] and Kopparthi (2019) [12] observed the mean period as 22.9, 19.66 and 19.88 days, respectively, irrespective of prevailing room temperature and relative humidity.

Longevity of adult male and female ranged from 5 to 7 and 7 to 10 days with mean of 5.4 (±0.7) and 8 (±1.05) days, respectively. Mean sex ratio (M : F) was recorded as 1:1.10 and these findings are in confirmatory with the findings of Chakraborty and Mondal (2015) [10].

The computed total developmental period of *C. maculatus* was ranged from 22 to 26 days with mean of 22.9 (±1.66) days. The period was reported as 22 to 24 days by Jadhav *et al.* (2015) [15], Chudasama (2015) [11] and Kopparthi (2019) [12] which is more or less similar to present findings.

**Table 1:** Brief Biology of *Callosobruchus maculatus* on cowpea

SN	Life-stage	Range of period	Mean	S D
<b>Egg stage:</b>				
1	Pre-ovipositional period	3 to 9 h	4.3 h	±0.70 h
	Ovipositional period	5 to 7 days	6.3 days	±0.94 days
	Post-ovipositional period	1 to 3 days	2.4 days	±0.70 days
	Fecundity (eggs / female)	49 to 62 eggs	57.8 eggs	±4.15 eggs
	Incubation period	3-5 days	4.8 days	±0.42 days
	Hatching percentage	86.02 to 96.6 %	92.39 %	±3.55
<b>Larval and Pupal stages:</b>				
2	Larval-pupal period	20-25 days	23.6 days	±2.06 days
<b>Adult stage:</b>				
3	Longevity of adult male	5 to 7 days	5.4 days	±0.7 days
	Longevity of adult female	7 to 10 days	8 days	±1.05 days
	Sex ratio (male : female)	26.4- 26.9	1:1.10	±0.12
4	Total developmental period	22 to 26 days	22.9 days	±1.66 days

## Conclusion

Above studies on biology of *C. maculatus* shows that total developmental period from egg to adult was ranged in between 20-26 days. During this period, seeds were prone to serious damage from pulse beetle grubs. pre-ovipositional, ovipositional and post-ovipositional periods ranged from 3-9 hours, 5-7 days and 1-3 days, respectively. Fecundity varied

from 49 to 62 eggs/female depending on host availability, temperature, and relative humidity. Incubation period ranged from 3-5 days. Longevity of male and female ranged from 5-7 days and 7-10 days with mean of 5.4 and 8 respectively on the basis of availability of food supply. Mean sex ratio (male : female) was 1:1.10. As a result, current biological research indicates that necessary precautions should be taken during

the ovipositional stage to avoid significant damage from the pulse beetle.

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