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Studies on the life cycle of pulse beetle (*Callosobruchus chinensis* L.) on chickpea and oviposition preference on different chickpea genotypes/ varieties

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Abstract
Total developmental period from egg to adult of *C. chinensis* (L.) was studied on chickpea (variety JG 12). It was observed that the average incubation period was 4.67 days, which varied from 3 to 7 days in which differences could be due to the impact of temperature and humidity. The larval pupal period varied from 26 to 29 days with an average of 27.0 days during the present studies with the larval period varied from 20 to 22 days and the pupal period from 6 to 7 days. The time taken by the beetle to complete total developmental period varied from 30 to 34 days (average: 31.66 days). Regarding adult orientation and oviposition preference of the pulse beetle (tested on 30 chickpea varieties/ genotypes), the genotype JG 11 X RVSSG 1 was found to be best host and the least preferred host was JAKI 9218.

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

Introduction
Pulse beetle (*Callosobruchus chinensis* L.) is a serious pest of stored grain products. It attacks mainly on the pulses. The male beetle has pectinate type of antennae while female has serrate type of antennae (Halstead. 1963) [5]. The damage due to this pest affects the germination ability and nutritive value of the seed. It is reported that 55- 60% loss in seed weight and 45 to 66% loss in protein content of pulses is due to infestation caused by this beetle (Faruk *et al*., 2011) [2]. In India, 15 to 17% loss is recorded in chickpea storage against *C. chinensis* (Parameshwarappa *et al*. 2007) [10]. Insect often cause extensive damage to stored grains and grain products, which may amount to 5-10% in the temperate and 20-30% in the tropical zone (Nakakita, 1998) [9]. Food grain losses are highly locality specific and high temperature and humidity usually favor the growth of loss causing organisms. In India; storage losses to various food grain commodities, stored for 6 months after harvest, have been estimated 2.5% due to insect pests alone. Both grubs and beetles are responsible for causing the damage. They complete their life cycle in 25-34 days during summer, whereas 40-50 days in winter (Ghosh and Durbey, 2003) [4].

Materials and Methods
The present study was conducted in the Department of Entomology, College of Agriculture, Jabalpur (M.P.) during 2018-19 to study the life cycle of the pulse beetle (*Callosobruchus chinensis* L.) on JG 12 variety of stored chickpea and oviposition preference on different chickpea genotypes/ varieties.

For a total developmental period of pulse beetle from egg to adult stage 50 gm seeds of chickpea were kept in a separate plastic jar and five pairs of freshly emerged beetles were released in each plastic jar. There are 3 replications. Eggs laid on each day will be kept in separate containers covered with muslin cloth. Observations were recorded for incubation period, larval & pupal period, total developmental period and growth index. The incubation period, larval and pupal period within the grain was recorded by gently splitting-open the whole grain with the help of the needle and forceps to observe the stage of insect under a stereo-zoom binocular. For testing the oviposition preference of *C. chinensis* hundred-gram seed of each genotype were taken and provided free choice condition to lay eggs. The observations were recorded by counting the number of eggs in each genotypes /varieties.

Results and Discussion
In present investigations, studies were carried out on the biological / life cycle of the pulse beetle on chickpea (variety JG12) and oviposition preference of pulse beetle *Callosobruchus chinensis* (L.) on different chickpea Genotypes/Varieties.

Biology / life cycle (total developmental period from egg to adult) of *Callosobruchus chinensis* in chickpea (JG 12) variety under forced condition
Observations were recorded for incubation period, larval & pupal period, total developmental period and growth index.

Development of bruchid: The developmental period required from egg to adult in the forced condition is presented in table 1.

Number of eggs: The data indicated that on an average 78.33 eggs were laid by a single pulse beetle female on 50 randomly selected chickpea seeds.

Egg period (incubation period): The data revealed that the average incubation period of pulse beetle was 4.67 days ranging from 3 to 7 days.
Larval period: The average larval period of pulse beetle was found to be 21 days.

Pupal period: The data indicated that the average pupal period of pulse beetle was 6 days.

Total developmental period: The average developmental period of pulse beetle was recorded 31.67 days (Table 1). The results of present investigation have been presented in the preceding chapters on Screening including oviposition behaviour, adult emergence, and total development period of chickpea variety/genotypes. These findings are discussed in this chapter and compared with the findings of other workers.

Table 1: Total developmental period from egg to adult in chickpea (JG 12)

S. No.	Stage of the Insect	Average Days ± S.D.
1	Egg periods	4.67±0.58
2	larval periods	21.00±1.00
3	Pupal periods	6.00±1.00
4	Total development period	31.67±2.08
5	Fecundity	78.33±7.64

* SD - Standard Deviation

Biology of *C. chinensis* was studied on chickpea (JG 12) under laboratory conditions during January 2019 to April 2019. It was observed that the average incubation period was 4.67 days, which varied from 3 to 7 days in which differences could be due to the impact of temperature and humidity. Earlier, Pokharkar and Mehta [11] (2011) reported the incubation period of *C. chinensis* ranging from 5.04 ± 0.69 days at room temperature on different pulses. Sharma [14] *et al*. (2018) observed average incubation period ranging from 4.2±0.2 days on chickpea. Average incubation period of 4 days by *C. chinensis* was also reported by Solanki and mittal [16] (2018) on chickpea seeds. Variations in 68 incubation period among different generations in different hosts have been reported by many workers, which were attributed to differences in temperature, relative humidity and host species. The larval pupal period varied from 26 to 29 days with an average of 27.0 days during the present studies with the larval period varied from 20 to 22 days and the pupal period from 6 to 7 days. Singh *et al*. (2017) [15] reported the larval-pupal period of 27.7 days in chickpea. While working the biology of *C. chinensis* on chckpea, Sharma *et al*. [14]., (2018) reported the combined larval and pupal period to be 21.3 ± 0.3 days, Hosamani [6] *et al*. (2018) had reported a comparatively shorter pupal period (12±7.0 days).
The time taken by the beetle to complete total developmental period varied from 30 to 34 days (average: 31.66 days) during the present study. Earlier, Thakur [17] *et al*. (2013) reported the total development period of pulse beetle to be average 34.5 days on blackgram. Hosamani [6] *et al*. (2018) also observed the average period for development from egg laying to adult emergence to be 29.0 days on chickpea. Jaiswal [7] *et al*. (2018) reported the total developmental period of 32.8± 3.42 days on chickpea.

Screening of different genotypes/varieties of chickpea for oviposition preference of *Callosobruchus chinensis*
The data were recorded by counting the number of eggs in each genotypes / varieties. The highest number of eggs were recorded on genotype JG 11 X RVSSG-1 (36.00 eggs) followed by JG12 x JG16-1 (27.67 eggs), JG 12 x JG 16-3 (26.33 eggs) and JG 130 (25.67 eggs) while lowest number of eggs were recorded on variety JAKI-9218 (2.33 eggs) followed by JG 1307 x ICC 7441 (3.00 eggs), JG 9605xICCV 06301 (7.00 eggs), and JG 12 (9.00 eggs) respectively (table 2 and fig.1).

Table 2: Oviposition preference of *C. chinensis* in free choice experiment.

S. No.	Genotypes /Varieties	Average No. of Eggs / 50 seed
1	JG 1307 x ICC 7441	3.00 (1.86)
2	JG74 x JG11551	18.00 (4.30)
3	ICC 15118	21.67 (4.71)
4	JG 74315-14	13.67 (3.76)
5	JG 11 x JG14	16.00 (4.06)
6	JG 12 x JG 16-3	26.33 (5.18)
7	ICC 96029 x ICC 11551	10.33 (3.29)
8	ICC 96029 x JG315	24.67 (5.01)
9	JG12 x JG16-1	27.67 (5.30)
10	JG 63 x ICC 4958	11.67 (3.48)
11	JG 9605 x ICCV 06301	7.00 (2.73)
12	JG 2016-1624	12.00 (3.53)
13	JG 26 x ICC 251741	18.00 (4.29)
14	JG 23 x ICC 251741	13.67 (3.75)
15	JG 11 x RVSSG 1	36.00 (6.04)
16	JG 63 x ICC 14407	18.67 (4.38)
17	ICC 552241 x JG 11	17.00 (4.18)
18	JG 2016-1	14.00 (3.81)
19	JG 36	23.67 (4.92)
20	JG 24	22.00 (4.74)
21	JAKI 9218	2.33 (1.57)
22	JG 12	9.00 (3.08)
23	JG 14	24.00 (4.95)
24	JG 130	25.67 (5.11)
25	JG 315	13.00 (3.67)
26	ICC 3137	23.00 (4.85)
27	ICC 4958	20.00 (4.52)
28	ICCL 86111	24.00 (4.95)
29	DCP 92-3	15.67 (4.02)
30	RVG 201	24.00 (4.95)
	S.Em±	0.13
	CD at 5%	0.37

***** Figure in parenthesis are transformed values

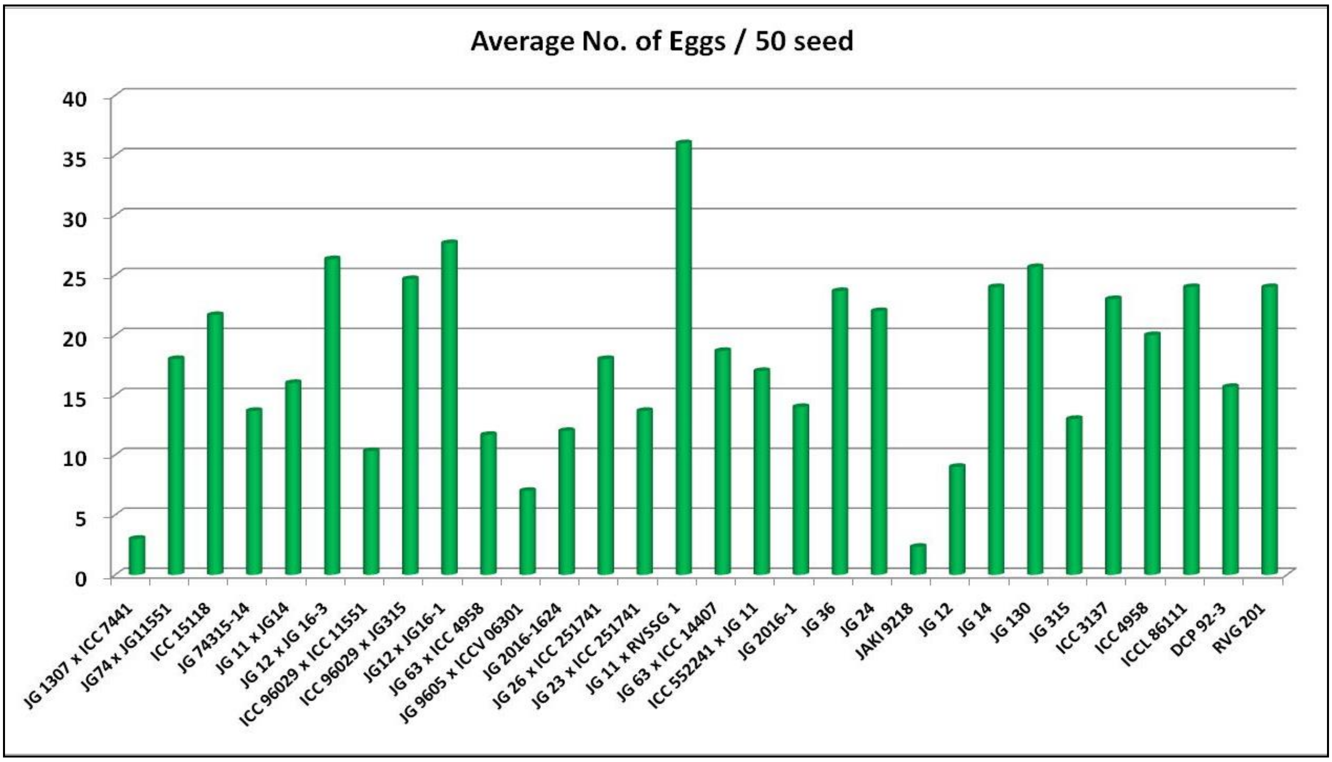

Fig 1: Average number of egg laying by *C. chinensis*

Preference for oviposition under free choice condition

Regarding oviposition preference recorded after release of the pulse beetle on different genotype JG 11 X RVSSG 1 was found to be best host and the least preferred host was JAKI 9218 at all the intervals. The reason for preference may be a smooth surface of seeds and somewhat bolder of the seeds.

Similar results have been obtained by, Raina [12] (1970) reported that *C. chinensis* female laid an average of 78 eggs, ranging from 63.90 over a period of 8 days and maximum number of eggs were laid on the first day of oviposition, similar results have also been observed by Ahmed [1] *et al*., (2003). They studied the reaction of pulse beetle on lentil, mungbean, chickpea and blackgram and observed that the highest (73.1) number of eggs was laid on chickpea, while the lowest (19.5) was in blackgram. Shaheen [13] *et al.* (2006) conducted the experiment on oviposition preference of *C. chinensis* in chickpea cultivars. The beetle showed a definite varietal response for oviposition depending upon the roughness and thickness of the seed coat. Mahor and Shrivastava [8] (2018) recorded significant differences on egg laying among different genotypes of chickpea ranging from 12.00 to 20.00 eggs.

Adult Orientation

For the development and adult emergence, JG 11 X RVSSG-1 proved to be the best host. Again JAKI 9218 was least suitable host for the development and adult emergence of C. *chinensis.* Similar results were obtained by, Shaheen [13] *et al.*, (2006) recorded maximum adults (5.07) in chickpea genotype Flip 97-192C, Mahor and Shrivastava [8] (2018) recorded that adult orientation on chickpea ranged from 5 to 9 adults with a minimum in JG 1 and maximum in JG 130. Galav and Bhowmick [3] (2018) observed maximum adult emergence from JG 24 and minimum in JG 32, respectively.

Conclusion

Total developmental period from egg to adult i.e. life cycle of *C. chinensis* was studied on chickpea (JG 12). The average incubation period was 4.67 days, which varied from 3 to 7 days. The larval + pupal period varied from 26 to 29 days with an average of 27.0 days during the present studies with the larval period varied from 20 to 22 days and the pupal period from 6 to 7 days. The time taken by the beetle to complete total developmental period varied from 30 to 34 days (average: 31.66 days).

Regarding oviposition preference, genotype JG 11 X RVSSG 1 was found to be best host for pulse beetle. The reason for preference may be smooth surface of seeds and somewhat boldness of the seeds. Variety JAKI 9218 was found least preferred host. For the development and adult emergence, the data recorded on 24, 48 and 72 hrs after release indicated that JG 11 X RVSSG 1 proved to be the best host and JAKI 9218 was least suitable host for *C. chinensis.*

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