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Studies on biology of *Callosobruchus chinensis* (L.) on Chickpea seed in storage

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Abstract
Studies carried out in Laboratory condition on the biology of the pulse beetle, *Callosobruchus chinensis* (L.) (Coleoptera: Bruchidae) on the stored chickpea at department of Entomology, T.D. college, Jaunpur revealed that the insect completed one generation from July to September, 2017. The study on biology of *C. chinensis* on chickpea indicate 5.16 ± 0.87 days eggs incubation period, larval+ pupal period 25.17 ± 3.86 days. The adult life span for male was 6.26 ± 1.42 days where as for female 7.53 ± 1.4 days. The total developmental period was 31.17 ± 3.89 days. The pre-oviposition, oviposition and post-oviposition periods were on an average 7.39 ± 0.97 hours, 7.76 ± 1.18 days and 1.47 ± 0.57 days, respectively. The average egg laid by female was 200. The hatchability of eggs recorded as 92 per cent and sex ratio of male and female was 1:0.96.

Keywords: Biology of *Callosobruchus chinensis*, life span in chickpea

Introduction
Chickpea is the most important pulse crop of India and all Pulses are important food crops as they nourish mankind with highly nutritive food being rich source of high protein and several essential amino acids. Apart from being an important source of dietary protein for human being, the pulse crops are also important for the management of soil fertility through biologically nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture (Kannaiyan, 1999) [9]. As far as production is concerned, India ranks first in the world and contributes around 70 per cent (Anonymous, 2015) [2]. In Indian context, total pulse grown area is about 25.25 mh and production is only 16.47 mt (Directorate of economics and statistics, 2016). One of the major pulses cultivated and consumed in India, is chickpea and commonly known as Gram, Bengal gram or White gram. India is the major producing country for chickpea, contributing for over 75% of total production in the world and in Uttar Pradesh chickpea is cultivated in about 4.45 lakh hectare area with annual production of 2.98 lakh tones with productivity 669 kg/ha (Anonymous, 2016) [3]. It is an excellent source of protein and carbohydrate and its protein is of high quality as compared to other pulse crops (Ercan *et al*., 1995) [6]. It contains 18-22 per cent protein and 52-70 per cent carbohydrate. Apart from that it serves as a good source of energy (416 calories/100 gm), fat (4-10%), minerals (calcium, phosphorus, iron) and vitamins. It also helps in lowering the cholesterol level (Ali and Prasad, 2002) [1]. The production of chickpea is greatly hampered by both biotic and a biotic stresses and while addressing the biotic stresses, insect pests of chickpea play a significant role both in the field and in storage, limiting the chickpea production and market value. Pulse beetle, *Callosobruchus chinensis* (L.) is one of the most destructive and cosmopolitan pests of stored legume. It not only causes qualitative and quantitative losses but also reduce germination ability of seeds and it causes heavy losses to the tune of 10 to 60 per cent (Gupta and Kashyap, 1971) [7]. It is observed that up to 60 per cent of weight loss of the stored seed occurs due to pulse beetle (Golnaz *et al*., 2011) [8]. Due to infestation, seeds undergo biochemical alterations which results in the loss of various constituents of the seeds. The bruchid completes its entire immature life in individual legumes seeds, where they cause reduced germination potential, weight loss, seed infestation and also diminish the market as well as nutritional value of the commodity. Earlier, the biology of *C. chinensis* has been studied by many workers (Vyas and Motka 2005; Raina, 1970; Pokharkar and Mehta, 2011; Chakraborty and Mondal, 2015) [17, 12, 11, 5] and it is essential to control this pest at right stage of its infestation. Hence, a study has been carried out to understand the biology of *Callosobruchus chinensis* on chickpea in storage.

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Material and Methods

The biology of *Callosobruchus chinensis* was studied in the laboratory of Department of Entomology and Agricultural Zoology, T.D.P.G. College Jaunpur, U.P. during year 2017.

Test insect collection

To raise the culture in laboratory, the adult insect of *C. chinensis* were collected from local market than *C. chinensis*, was carefully separated by using Stereoscope binocular microscope on the basis of morphological character in Department of Entomology and Agricultural Zoology, T.D.P.G. College, Jaunpur. The chickpea seeds were procured from local market *i.e.* Sutahatti galla mandi, Jaunpur U.P.

Rearing of test insect

The initial culture was maintained on disinfected seeds at 30±1º C temperature and Relative humidity 70±5% in BOD incubator. Such stock culture again multiplied on 100 g disinfected chickpea seed kept in 1L cylindrical transparent plastic jar (20x15 cm). Twenty five pair of 1 day old adult of *C. chinensis* were released for egg laying in the jar containing 100 g disinfected chickpea seeds and maintained at 30±1º C temperature and 75% RH in BOD incubator. The seeds containing the eggs were collected and developmental stages have been observed during morning hours In order to facilitate the observations, seeds containing one egg were separated and kept individually in plastic vials (6.5x2.5cm) under laboratory conditions at fluctuating room temperature 29.38±0.66^0 C and RH 83.84±4.30 per cent.

Observations

Observation on developmental period were made by stage wise and the egg were observed under microscope daily in the morning 8 hr and evening 4 hr to till hatching. Due to destructive sampling, supplementary numbers of infested 100 grain samples have been taken for recording incubation period, larval and pupal periods. Observations on total developmental period, longevity of males and females, pre-oviposition, oviposition and post oviposition period were worked on 25 infested grain samples. For hatchability and sex ratio (Male: female) 184 eggs and 100 adults have been observed respectively.

Results and discussion

During the studies on various aspects of biology of *C. chinensis* under laboratory condition in BOD incubator at constant temperature 30 ± 1° C and 75% relative humidity on the duration of different stages recorded and described given below. The study on biology of *C. chinensis* was carried out on local variety of gram at laboratory condition during July to September 2017. During the study period and the duration of different stages were recorded (Table 1) and discussed below:

Incubation period and hatchability

In the present study incubation period of *C. chinensis* varied from 4 to 6 days with an average of 5.16 ± 0.68 day in seeds. This result are in agreement with the Pokharkar and Mehta (2011) [11], Rupesh Sharma *et al.* (2016) [13] and Patel *et al* (2005) who stated that incubation period as 4.00, 4.20 and 4.10 days respectively. Vyas (2004) [17] and Raina (1970) [12] also reported the incubation period of *C. chinensis* as 3.98 and 3.50 days, respectively; these are more or less similar with present findings.

In the present study the hatchability of eggs of *C. chinensis* was 92 per cent in chickpea. This result is in close association with the findings of Chakraborty and Mondal (2015) [18] who stated hatchability as 92.00%. Pokharkar and Mehta (2011) [11] and Raina (1970) [12] also reported the hatchability of *C. chinensis* as 92.00% and 94.00% respectively; these are more or less similar with present findings.

Table 1: Biology of Pulse beetle *C. chinensis* on chickpea *C. arietinum*

Stage	No. of grain samples observed	Duration in days (Except pre-oviposition period	
		Range	Average ± S.D.
Incubation period	100	4-6	5.16 ± 0.68
Larval + Pupal period	90	21-40	25.17 ± 3.86
Total development period	90	27-47	31.17 ± 3.89
Pre-oviposition period (hours)	25	5-9	7.39 ± 0.97
Oviposition period	25	5-10	7.76 ± 1.18
Post-oviposition period	52	1-3	1.47 ± 0.57
Adult longevity (Male)	25	5-8	6.26 ± 1.42
Adult longevity (Female)	25	8-11	7.53 ± 1.14

Hatchability	No. of eggs observed	No. of eggs hatched	Per cent hatchability
100	88		88
Sex ratio (Male: Female)	Adult observed	Sex development percentage	Sex ratio
100	Male: 53		1:0.88
	Female: 47		

Larval + Pupal period

In the present study the mean of larval and pupal period was 25.17 ± 3.86 days (Table 1). The larval +pupal duration was range from 21 to 40 days. Pokharkar and Mehta (2011) [11] also found similar results. Whereas Butani *et al.* (2001) [4] observed 19.77 days larval + pupal period of pulse beetle at 31.75 ^{0} C temperature and 57.07 relative humidity on different pulses.

Total Development period

In the present study the total development period on chickpea varied from 27-47 days with an average of 31.17 ± 3.89 (Table 1) day in chickpea under laboratory conditions. This result is in closed to the total life span was ranged from 31.24 ± 3.92 days. These results are in agreement with Pokharkar and Mehta (2011) [11]. Whereas Butani *et al.* (2001) [4] recorded total life span 25 to 28 days. Sharma *et al.* (2016) [13], Thakur and Pathania (2013) and Chakraborty *et al.* (2015) [18] who stated total development period as 33.30, 31.00 and 30.25 days respectively. These are more or less similar with present findings.

Pre-oviposition period

In the present study the results indicate that the mean of pre-oviposition period of *C. chinensis* on chickpea was 7.39 ± 0.97 hours. The range of pre-oviposition period was 5 to 9 hours in chickpea. This result is in close with the findings obtained by Chakraborty *et al.* (2015) [18], Vyas (2004) [17] and Pokharkar and Mehta (2011) [11] who stated pre-oviposition period as 6.36, 7.40 and 7.46 hours respectively. It is more or less similar with present findings.

Oviposition period

In the present study the results indicate that the mean of oviposition period of *C. chinensis* on chickpea was 7.76 ± 1.18 days. The range of oviposition period was 5 to10 days in chickpea. This result is in closed with the findings obtained by Rupesh Sharma (2016) [13] and Pokharkar and Mehta (2011) [11] who stated oviposition period as 8.20 and 7.88 days respectively. Vyas (2004) [17] and Verma and Anandhi (2010) [15] also reported the oviposition period of *C. chinensis* as 7.88, 8.00 days, respectively. It is more or less similar with present findings.

Post-oviposition period

In the present study the results indicate that the mean of post-oviposition period of *C. chinensis* on chickpea was 1.47 ± 0.57 day. The range of post- oviposition period was 1to 3 days. This result is in close proximity with the findings of Pokharkar and Mehta (2011) [11] and Vyas (2004) [17] and who stated post-oviposition period as 1.56 days and Rupesh Sharma (2016) [13] also reported the post-oviposition period of *C. chinensis* as 2.20, 2.80 days, respectively; it is more or less similar with present findings.

Adult longevity of male and female

In the present study mean of life span of female in chickpea was 7.53 ± 1.14 day while that of male was 6.26 ± 1.42 day. Longevity of females varied from 6 to 11 days in chickpea and that of male 5 to 8 days in chickpea. These result are quite similar to Pokharkar and Mehta (2011) [11] and it is also close with the findings obtained by Verma and Anandhi (2010) [15] and Vyas (2004) [17] who stated life span (male) as 9.60 and 9.76 days respectively. It is more or less similar with present findings.

Fecundity

The average eggs laid by female of *Callosobruchus chinensis* on chickpea were 77.8. These results are similar to Pokharkar and Mehta (2011) [11]. Such difference may be due to difference in food as well as environmental conditions.

Sex ratio

The sex ratio development of male was 51 per cent and female was 49 per cent and result showed that chickpea produced more males as compare to females, result is in 1:0.96. This result is in close proximity with the findings of Pokharkar and Mehta (2011) [11] who stated sex ratio as 1:0.96. Raina (1970) [14, 12] and Siddaraju (1994) [17] also reported the sex ratio of *C. chinensis* as 1:1.16 and1:1.16, respectively; it is more or less similar with present findings.

Conclusion

The study of biology provide information that chickpea is preferable host of *C. chinensis* and can complete several generation throughout the year and the maximum infestation occur during the month of July to September, where it causes maximum damage due to favorable environmental conditions. The study reveals that developmental period of the egg to adult was around a month or more than that during optimum period of growth the total developmental period is less than a month thus causing huge damage to seeds. Oviposition period, post oviposition period and male-female longevity is increased during the subsequent generation and that indicates about the adaptability of the beetle with the pulse. During unfavorable conditions depending on the food supply, temperature and humidity duration of developmental period may increase or decrease. Data pertaining from the experiments shows that the per cent hatchability increased during first generation and that indicates that the capability of the insect to increase the resource getting increased generation after generation. The current research prove that the way to provide awareness to the farmers about the nature and extent of damage caused by the pulse beetle in storage on Chickpea.

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