Journal of Pharmacognosy and Phytochemistry

Available online at www.phytojournal.com

E-ISSN: 2278-4136
P-ISSN: 2349-8234
JPP 2018; 7(6): 464-467
Received: 28-09-2018
Accepted: 30-10-2018

Deepak Kumar Jaiswal
Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, BHU, Varanasi, Uttar Pradesh, India

SVS Raju
Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, BHU, Varanasi, Uttar Pradesh, India

Dinesh Kumar
Department of Zoology, Institute of Science, BHU, Varanasi, Uttar Pradesh, India

V Manju Vani
Department of Horticulture, Institute of Agricultural Sciences, BHU, Varanasi, Uttar Pradesh, India

Correspondence
Deepak Kumar Jaiswal
Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, BHU, Varanasi, Uttar Pradesh, India

Studies on biology of pulse beetle, *Callosobruchus chinensis* (L.) on stored chickpea under laboratory conditions

Deepak Kumar Jaiswal, SVS Raju, Dinesh Kumar and V Manju Vani

Abstract
Laboratory studies on the biology of the pulse beetle, *Callosobruchus chinensis* (L.) (Coleoptera: Bruchidae) on the stored chickpea revealed that the insect completed one generation from late march to first week of May, 2016. The study on biology of *C. chinensis* on chickpea indicated 4.15 ± 0.87 days incubation period, larval period 22.30 ± 3.06 days while pupal period was 8.65 ± 0.87. The adult life span for male was 9.30 ± 1.08 days where as for female 10.15 ± 0.98 days. The total developmental period was 32.85 ± 3.42 days. The pre-oviposition, oviposition and post-oviposition periods were 6.55 ± 0.94 hours, 8.10 ± 1.25 days and 1.85 ± 0.48 days, respectively. The average egg laid by female was 84.15. The hatchability of eggs recorded as 88 per cent and sex ratio of male and female was 1:0.88.

Keywords: Developmental biology, *Callosobruchus chinensis*, life span, fecundity and chickpea

Introduction
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 biological nitrogen fixation in soil and thus play a vital role in furthering sustainable agriculture (Kannaiyan, 1999) [8]. 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 (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 abiotic 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. 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) [7]. 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, 2004; Raina, 1970; Singh and Singh, 2017; Pokharkar and Mehta, 2011; Chakraborty and Mondal, 2016 and Mishra and Jena, 2015) [22, 14, 13, 9] 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* in chickpea.

Material and methods
The biology of *Callosobruchus chinensis* was studied in the laboratory of Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi during 2016.

Collection of Test insect

To raise the culture in laboratory, the mother culture of the test insect *C. chinensis* was obtained from local market, Department of Entomology and Agricultural Zoology, Institute of Agricultural Sciences, Banaras Hindu University, Varanasi. The chickpea seeds were procured from local market *i.e.* Susuwahi market near Banaras Hindu University, Varanasi.

Rearing technique of test insect

The initial culture was maintained on disinfected seeds at 30±1º C and Relative humidity 70±5% in BOD incubator. Prior to release, required amount of chickpea grains were disinfested by fumigation with aluminium phosphide (celphos) @ three tablets 9 (g) per tonne for 72 hours and then left in open for 24 hours to eliminate the hidden infestation and were conditioned. Fifteen pairs of one day old beetles from the initial culture were released in cylindrical jars measuring (25x15 cm) containing 500 g seeds. The jars were covered with muslin cloth and tied with rubber band and allowed to mate. The seeds containing the eggs were collected and developmental stages have been observed to assess the biology of the *C. chinensis.* In order to facilitate the observations, seeds containing one egg were separated and kept individually in plastic vials (4.5x2cm) and different biological parameters were studied under laboratory conditions.

Observations

Due to destructive sampling, supplementary numbers of infested grain samples (100) have been taken for recording incubation period, larval and pupal periods. After hatching, larva bore into the seed making egg shell empty and passed its larval and pupal stages inside the seeds only. Observations on total developmental period, longevity of males and females, pre-oviposition, oviposition and post oviposition period were worked out on 50 infested grain samples. For hatchability and sex ratio (Male: female) 100 eggs and 100 adults have been observed respectively. Fecundity of females has been observed by exposing 25 g of chickpea grain.

Results and discussion

During the studies on various aspects of biology of *C. chinensis* under laboratory condition, the duration of different stages recorded and described below. The study on biology of *C. chinensis* was carried out on local variety of gram at laboratory condition during March, 2016 to May, 2016. The average room temperature was 32.16 ± 1° C to 37.86 ± 1° C, while the relative humidity was 68.97 ± 2 to 62.23 ± 2 per cent during the study period and the duration of different stages were recorded (Table 1) and discussed below:

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	3-5	4.15 ± 0.87
Larval period	100	18-28	22.30 ± 3.06
Pupal period	100	7-10	8.65 ± 0.87
Total development period	50	28-40	32.85 ± 3.42
Pre-oviposition period (hours)	50	5-8	6.55 ± 0.94
Oviposition period	50	6-11	8.10 ± 1.25
Post-oviposition period	50	1-3	1.85 ± 0.48
Adult longevity (Male)	50	7-11	9.30 ± 1.08
Adult longevity (Female)	50	8-12	10.15 ± 0.98
Fecundity (egg/female)	20	73-104	84.15 ± 8.44

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	

Incubation period and hatchability

In the present study incubation period of *C. chinensis* varied from 3 to 5 days with an average of 4.15 ± 0.87 day in chickpea. This result is in close accordance with the findings obtained by Solanki and Mittal (2018) [18], Rupesh Sharma *et al.* (2016) [16] and Patel (2005) [5] who stated that incubation period as 4.00, 4.20 and 4.10 days respectively. Vyas (2004) [22] and Raina (1970) [14] 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 88 per cent in chickpea. This result is in close association with the findings of Solanki and Mittal (2018) [18] and Chakraborty and Mondal (2015) [4] who stated hatchability as 94.00% and 92.00% respectively. Pokharkar and Mehta (2011) [13] and Raina (1970) [14] also reported the hatchability of *C. chinensis* as 92.00% and 94.00% respectively; these are more or less similar with present findings.

Larval period

In the present study the larval period varied from 18-28 days and the mean duration of larval stage was 22.30 ± 3.06 day in chickpea. This result is in close accordance with the findings obtained by Solanki and Mittal (2018) [18] and Rupesh Sharma *et al.* (2016) [16] who stated larval period as 26.39 and 21.30 days respectively. Moreno *et al.* (2000) [10] and Venkate Gowda (1984) [21] also reported the larval period of *C. chinensis* as 31.84 and 32.80 days, respectively, these are more or less similar with present findings.

Pupal period

In the present study the pupal period ranged from 7-10 days with an average of 8.65 ± 0.87 day in chickpea. This result is in strong accordance with the findings obtained by Solanki and Mittal (2018) [18] and Moreno *et al.* (2000) [10] who stated pupal period as 6.82 and 7.08 days respectively. Ramesh (1993) [15] and Siddaraju (1994) [17] also reported the pupal

period of *C. chinensi*s as 7.40 and 8.68 days, respectively, these are more or less similar with present findings.

Total Development period

In the present study the total development period varied from 28-40 days with an average of 32.85 ± 3.42 day in chickpea under laboratory conditions. This result is in close accordance with the findings obtained by Rupesh Sharma *et al*. (2016) [16], Thakur and Pathania (2013) [19] and Chakraborty *et al.* (2015) [4] who stated total development period as 33.30, 31.00 and 30.25 days respectively. Siddaraju (1994) [17], EL-Halfway (1972) [5] and Patil (2007) [12] also reported the total development period of *C. chinensi*s as 28.20, 28.50 and 30.40 days, respectively, these are more or less similar with present findings.

Pre-oviposition period

In the present study the results indicate that the average pre-oviposition period was 6.55 ± 0.94 hours in chickpea. The range of pre-oviposition period was 5-8 hours in chickpea. This result is in close accordance with the findings obtained by Chakraborty *et al.* (2015) [4], Vyas (2004) [22] and Pokharkar and Mehta (2011) [13] who stated pre-oviposition period as 6.36, 7.40 and 7.46 hours respectively. Solanki and Mittal (2018) [18] and Verma and Anandhi (2010) also reported the pre-oviposition period of *C. chinensi*s as 9.60 hours; it is more or less similar with present findings.

Oviposition period

In the present study the results indicate that the oviposition period was 8.10 ± 1.25 day in chickpea. The range of oviposition period was 6-11 days in chickpea. This result is in close accordance with the findings obtained by Solanki and Mittal (2018) [18], Rupesh Sharma (2016) [16] and Pokharkar and Mehta (2011) [13] who stated oviposition period as 8.00, 8.20 and 7.88 days respectively. Vyas (2004) [22] and Verma and Anandhi (2010) also reported the oviposition period of *C. chinensi*s 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 post-oviposition period of C. chinensis was 1.85 ± 0.48 day with a range of 1-3 days. This result is in close proximity with the findings of Pokharkar and Mehta (2011) [13] and Vyas (2004) [22] and who stated post-oviposition period as 1.56 days. Solanki and Mittal (2018) [18] and Rupesh Sharma (2016) [16] also reported the post-oviposition period of *C. chinensi*s as 2.20, 2.80 days, respectively; it is more or less similar with present findings.

Adult longevity

In the present study average life span of female in chickpea was 10.15 ± 0.98 day. While that of male was 9.30 ± 1.08 day. Longevity of females varied from 8-12 days in chickpea and that of male 7-11 days in chickpea. This result is in strong accordance with the findings obtained by Solanki and Mittal (2018) [18], Verma and Anandhi (2010) and Vyas (2004) [22] who stated life span (male) as 9.60, 9.60 and 9.76 days respectively. Venkate Gowda (1984) [21], Moreno (2000) [10] and Rupesh Sharma (2016) [16] also reported the life span (female) of *C. chinensi*s as 9.89, 11.45 and 12.00 days, respectively; it is more or less similar with present findings.

Fecundity

In the present study average number of eggs laid by a single female 84.15 ± 8.44 which varied from 73-104 eggs per female in chickpea. This result is in close accordance with the findings obtained by Solanki and Mittal (2018) [18], Vyas (2004) [22] and Pokharkar and Mehta (2011) [13] who stated fecundity as 85.60, 80.60 and 77.80 eggs per female respectively. Venkte Gowda (1984) [21] and Rupesh Sharma *et al.* (2016) [16] also reported the fecundity of *C. chinensi*s as 92.20, 74.80 eggs per female, respectively; it is more or less similar with present findings.

Sex ratio

The result showed that chickpea produced more males as compared to females, resulted in 1:0.88. This result is in close proximity with the findings of Pokharkar and Mehta (2011) [13] who stated sex ratio as 1:0.96. Raina (1970) [14] and Siddaraju (1994) [17] also reported the sex ratio of *C. chinensi*s 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-October, where it causes maximum damage due to favourable 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. Ovipositional 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 crop. During unfavourable 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 percent hatchability increased during first generation and that indicates that the capability of the insect to exploit the resource getting increased generation after generation. The current research paves the way to provide awareness to the farmers about the nature and extent of damage caused by the pulse beetle in storage on Bengal gram.

Acknowledgement

The corresponding author is highly grateful to the University grant commission for providing financial assistance as UGC-RGNF fellowship for the present study.

References

1. Ali SI, Prasad R. Rabi pulses: chickpea, lentil, Lathyrus and French bean. In: R. Prasad (ed.), Textbook of Field Crops Production. New Delhi: Directorate of Information and Publication of Agriculture, Indian Council of Agriculture Research, 2002, 317-371.
2. Anonymous. Project Coordinator's Report. AICRP on Chickpea, IIPR, Kanpur, 2015, 36.
3. Anonymous. Project Coordinator's Report. AICRP on Chickpea, IIPR, Kanpur, 2016.
4. Chakraborty S, Mondal P, Senapati SK. Studies on biology of the pest beetle, *Callosobruchus chinensis* Linn. Infesting green gram. Current Biotica. 2015; 9(1):93-97.

5. EL-Halfawy MA, Nekhla JM, Isa NH. Effect of foodon the fecundity, longevity and development of southern cowpea weevil, *Callosobruchus maculatus*. Agric. Res. Rev. 1972; 50(1):67-70.
6. Ercan RH, Koksel A, Dag A. Cooking quality and composition of chickpea grown in Turkey. Gida. 1995; 20:289-293.
7. Golnaz S, Hasan M, Iman S. Insecticidal effect of diatomaceous earth against *Callosobruchus meculatus* (F) under laboratory condition. African Journal of Agricultural Research. 2011; 6(24):5464-5468.
8. Kannaiyan S. Bioresource technology for sustainable agriculture. Associated Publishing Company. New Delhi, 1999, 422.
9. Mishra SN, Jena BC, Guru BC. Biology of Pulse Beetle *Callosobruchus chinensis* in Storage Condition in Green Gram. International Journal of Science and Research. 2015; 4(8):1321-1323.
10. Moreno R, Duque GA, Cruz J, DE LA, Tróchez PA. Life cycle and hosts of C*allosobruchus maculatus* (Coleoptera: Bruchidae). Revista Colombiana de Entomologia. 2000; 26:131-135.
11. Patel VK, Chaudhuri N, Senapati SK. Biology of pulse beetle (*C. chinesis*) as influenced by feeding of different grain pulses. Agriculture Science Digest. 2005; 25(4):254-256.
12. Patil DR. Population build-up, varietal screening and management of pulse beetle (*Callosobruchus chinensis* L.) through botanical materials in stored chickpea. M. Sc. thesis (Unpublished). Junagadh Agricultural University, Junagadh, 2007.
13. Pokharkar PK, Mehta DM. Biology of pulse beetle, *Callosobruchus chinensis* in stored chickpea. Progressive Agriculture. 2011; 11(1):34-36.
14. Raina AK. *Callosobruchus* spp. infesting stored pulses (grain legumes) in India and a comparative study of their biology. Indian Journal of Entomology. 1970; 32(4):303-310.
15. Ramesh CV. Effectiveness of edible oils and chemicals as seedprotectants on bruchid infestation in soybean and their effects onseed quality and storability. M. Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore (India), 1993.
16. Sharma Rupesh, Devi Yadav S, Godara P. Biology of pulse beetle, *Callosobruchus maculatus* (F.) and its response to botanicals in stored pigeonpea, *Cajanus cajan* (L.) grains. Legume Research, LR-3807, 2016, 1-5.
17. Siddaraju R. Pulse bruchids control by using fumigants and their effect on seed viability, vigour and storability in cowpea [*Vignaunguiculata* (L.)Walp.], *M.Sc. Thesis*, University of Agricultural Sciences, Bangalore (India). 1994, 43-47.
18. Solanki Kumar D, Mittal DK. Biology of pulse beetle *Callosobruchus chinensis* in storage condition in gram. International Journal of Agriculture Sciences. 2018; 10(7):5682-5686.
19. Thakur AK, Mandeep Pathania. Biology of Pulse Beetle (*Callosobruchus chinensis*) and its Management through Plant Products on Black Gram (*Vigna mungo*). Science Technology and Arts Research Journal. 2013; 2(1):18-21.
20. Varma Anandhi SP. Biology of pulse beetle (*Callosobruchus chinensis* Linn, Coleoptera: Bruchidae) and their management on stored mung grains in Allahabad region. Legume Research: An International Journal. 2010; 33:38-41.
21. VenkateGowda N. Estimation of loss of stored soybean due to the bruchid, *Callosobruchus maculatus* (F.) and its biology, ecology and control. M.Sc. (Agri.) Thesis, University of Agricultural Sciences, Bangalore (India), 1984, 130.
22. Vyas HH. Biology, varietal screening and management of *C. chinensis* (Linneus) in stored cowpea. M. Sc. Thesis (Unpublished). Junagadh Agricultural University, Junagadh, 2004.