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Biology of pulse beetle (*Callosobruchus chinensis* L.) on different varieties of chickpea (*Cicer arietinum* L.)

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Abstract
The laboratory experiments were conducted to study the biology of *Callosobruchus chinensis* Linnaeus on different varieties of chickpea *viz*., Digvijay, Phule Vikram, Phule Vikrant, BDN-9-3, ICCV-3137, ICCCV-3137, BDN-797 and ICCL-86111 under laboratory conditions at the Post Graduate Laboratory, Department of Agril. Entomology, College of Agriculture, Latur during 2022-2023. The significantly highest mean incubation period (6.13 days) was observed on BDN-9-3 and the shortest (4.84 days) in ICCL-86111. The significantly percent egg hatchability was found to be highest on ICCL-86111 (87 percent) while lowest on BDN-9-3. The significantly highest larval-pupal duration was noticed on BDN-9-3 (26.26 days) and the shortest on ICCL-86111 (24.12 days). The significantly highest adult emergence (75.00 percent) was observed on Phule Vikrant and the lowest in BDN-9-3 (50 percent). The significantly maximum adult longevity of male and female was registered in BDN-9-3 (10.00 days) and Phule Vikram (12.91 days). The significantly lowest longevity of male was observed in Digvijay (8.87 days) and the lowest of female in ICCCV-3137 (9.98 days). The highest sex ratio was registered in BDN-797 (1:1.34) and the lowest in Phule Vikram (1:1.02 and Phule Vikrant (1:1.02).

Keywords: Chickpea, varieties, pulse beetle, *Callosobruchus chinensis*, biology

Introduction
Chickpea (*Cicer arietinum* L.) is an essential annual pulse crop that belongs to the genus Cicer (Family: Leguminosae, Fabaceae) and is also recognized as "Garbanzo bean" or "Bengal gram" (Gaur *et al*., 2010) [5]. It is the third-largest food legume produced worldwide, after *Pisum Sativum* L. (field pea) and *Phaseolus vulgaris* L. (common bean). (Rasheed *et al.*, 2021, Grasso *et al*., 2022) [14, 6]. It has a good source of energy i.e. 416 calories/100g of chickpea (Shrestha, 2001), along with protein (18-22%), carbohydrate (52-70%), fat (4-10%), minerals (calcium, phosphorus, iron) and vitamins (Ali, *et al*., 2002) [2].
One of the major constraints in production of pulses is the insect pests which inflict severe losses both in the field and storage (Mookherjee *et al*., 1970) [10]. Pulse beetle is the major pest of stored pulses. There are 117 species of bruchids in India, classified into 11 genera (Arora, 1977) [3]. Raina (1970) [13] reported that three species of bruchids *viz*.,
C. chinensis, *C. maculatus* and *C. analis* are commonly found in India. The *C. maculatus* and *C. chinensis* are the most destructive and attack almost all edible legumes, including mungbean, pigeon pea, black gram, cowpea, chickpea, and lentil, and are cosmopolitan in distribution, encompassing Australia and Oceania, Europe, Asia, Africa, and America (Rees, 2004) [16]. The larva bore into the pulses and feed inside which causes reduction in germination and commercial value (Booker, 1967) [4]. In India, a loss of 15.33 to 17.00 percent is recorded in chickpea storage due to *C. chinensis* (Parameshwarappa *et al*., 2007) [11].
Exploring the biology of pulse beetles across various chickpea varieties will aid in distinguishing resistant and susceptible strains. This will ultimately help us to identify sources of chickpea resistant to pulse beetle.

Materials and Methods
Chickpea seeds of different varieties were obtained from Agril. research station Badnapur, VNMKV, Parbhani and from Pulse Research Center, MPKV, Rahuri. The seeds were sterilized in hot air oven. Twenty-five freshly emerged adults of *C. chinensis* were confined in jars containing 100 g of chickpea seeds and mouth of jar was cover with muslin cloth. The jars were maintained at room temperature and relative humidity for four weeks. After four weeks, freshly emerged adults were used for conducting the experiment.

Study of biology of pulse beetle, *C. chinensis* was carried out under laboratory condition on chickpea varieties. Four pairs of one to two days old adults of *C. chinensis* were released for egg laying in rounded plastic jar containing grains of each variety under study. The seeds containing eggs of each variety was collected in the morning. One egg was kept on each grain, while others were removed with the help of needle. Such one hundred grains with eggs were kept individually in plastic vials (6.5 cm x 2.5 cm) under laboratory condition. The observations were recorded on hatching of eggs, incubation period, larval-pupal period, percent adult emergence, adult longevity and sex ratio daily in the morning.

Results

The mean incubation period, egg hatching percentage and larval-pupal period varied significantly on different varieties of chickpea. (Table 1) The highest incubation period was observed on BDN-9-3 (6.13 days) and it was at par with Digvijay (6.11) and BDN-797 (6.08 days). Significantly shortest incubation period (4.84 days) was noticed in ICCL-86111. The percent egg hatchability was found to be significantly highest in chickpea variety ICCL-86111 (87 percent) however, it was at par with on ICCCV-3137 (86 percent) and ICCV-3137 (85 percent). The lowest egg hatchability (71 percent) observed on chickpea variety BDN-9-3 but it was also at par with Phule Vikrant (78 percent). The shortest mean larval-pupal duration of *C. chinensis* was observed on chickpea variety ICCL-86111 (24.12days). The highest larval-pupal duration was noticed on chickpea variety BDN-9-3 (26.26 days) and it was at par with Phule Vikrant (26.23 days).

The percent adult emergence of *C. chinensis* varied significantly when reared on different varieties of chickpea (Table 2). It revealed that the highest adult emergence (75.00 percent) was observed on Phule Vikrant and it was at par with ICCL-86111 (72 percent) and Phule Vikram (71 percent). The lowest adult emergence was recorded in BDN-9-3 (50 percent). More no. of females than males emerged from all the entries of chickpea The highest male emergence was recorded in Phule Vikrant (37.00 percent) which was at par with ICCL-86111 (35 percent) and Phule Vikram (35 percent). The highest female emergence was observed in BDN-797 (39 percent) which was at par with Phule Vikrant (38 percent) and ICCL-86111 (37 percent). The highest sex ratio of *C. chinensis* was registered in BDN-797 (1:1.34) followed by BDN-9-3 (1:1.17), ICCCV-3137 (1:1.12), whereas the significantly lowest sex ratio was observed in Phule Vikram (1:1.02) and Phule Vikrant (1:1.02).

The adult longevity of male and female *C. chinensis* varied significantly when reared on different chickpea varieties (Table 3). The highest adult longevity of male *C. chinensis* was registered in BDN-9-3 (10.00 days) and Phule Vikrant (10.00 days) followed by ICCV-3137 (9.92 days) and the lowest were observed in Digvijay (8.87 days). Maximum adult longevity of female was recorded in Phule Vikram (12.91 days) followed by BDN-9-3 (12.15 days), Phule Vikrant (12.00 days) and the minimum were noticed in ICCCV-3137 (9.98 days), the result indicates that a females lived longer than males on all the varieties.

Table 1: The mean incubation period, percent egg hatch and larval-pupal period of *C. chinensis*

Chickpea variety	Mean incubation period (days)	Percent egg hatch	Larval-pupal Period (days)
Digvijay	6.11	83 (65.64)	25.52
Phule Vikram	5.30	82 (64.89)	25.20
Phule Vikrant	5.16	78 (62.02)	26.23
BDN-9-3	6.13	71(57.41)	26.26
ICCV-3137	5.11	85 (67.21)	25.19
ICCCV-3137	5.15	86 (68.02)	25.10
BDN-797	6.08	82 (64.89)	25.43
ICCL-86111	4.84	87 (68.86)	24.12
S. E. ±	0.05	1.17	0.08
C.D. at 5%	0.17	3.40	0.23
C.V. (%)	2.41	3.22	0.72

*Figures in parentheses indicate arcsine transformed values

Table 2: The percent adult emergence and sex ratio of *C. chinensis*

Chickpea variety	Percent adult emergence			Sex ratio
	Male	Female	Total	
Digvijay	31.00	34.00	65.00	1:1.09
	(33.83)	(35.66)	(53.72)	
Phule Vikram	35.00	36.00	71.00	1:1.02
	(36.27)	(36.86)	(57.41)	
Phule Vikrant	37.00	38.00	75.00	1:1.02
	(37.46)	(38.05)	(60.00)	
BDN-9-3	23.00	27.00	50.00	1:1.17
	(28.65)	(31.30)	(45.00)	
ICCV-3137	33.00	36.00	69.00	1:1.09
	(35.06)	(36.86)	(56.16)	
ICCCV-3137	31.00	35.00	66.00	1:1.12
	(33.83)	(36.27)	(54.33)	
BDN-797	29.00	39.00	68.00	1:1.34
	(32.58)	(38.64)	(55.55)	
ICCL-86111	35.00	37.00	72.00	1:1.05
	(36.27)	(37.46)	(58.05)	
S.E ±	0.47	0.48	0.68	
C.D at 5%	1.37	1.41	1.96	
C.V. (%)	3.44	3.09	2.27	

*Figures in parentheses indicate arcsine transformed values

Table 3: Adult longevity of *C. chinensis* L. in different varieties of chickpea

Chickpea variety	Male	Female	Mean
Digvijay	8.87	10.92	9.95
Phule Vikram	8.98	12.91	10.94
Phule Vikrant	10.00	12.00	11.01
BDN-9-3	10.00	12.15	11.16
ICCV-3137	9.92	11.00	10.49
ICCCV-3137	9.00	9.98	9.50
BDN-797	8.00	10.00	9.13
ICCL-86111	9.00	11.00	10.03
S.E ±	0.02	0.03	0.11
C.D at 5%	0.08	0.11	0.32
C.V. (%)	0.71	0.77	2.43

Discussion

The present studies are in agreement with findings of Patel *et al*. (2021) [12] who reported that incubation period of pulse beetle was 4.67 days ranging from 3 to 7 days in chickpea varieties whereas Singh *et al.* (2021) [18] reported that incubation period was 5.16±0.87 days on chickpea seed in storage. Ahmad *et al*. (2016) [1] reported that incubation period of *C. chinensis* on 11 varieties of chickpea seeds varied from 5.33 to 7.00 days with an average of 6.27 days. Kumar and Kumar, (2018) [7] revealed that hatching percentage of eggs of *C. chinensis* on gram variety GJ-16 varied from 66.00 to 82.00 percent with an average of 74.95±5.50 percent. Jaiswal *et al*. (2018) [7] recorded that the hatchability of eggs of *C. chinensis* was 88 percent on the stored chickpea. Kamble *et al*. (2016) evidenced that highest percent egg hatching was observed on grains of PG-5 (97.34 percent) while it was lowest on Vijay (89.51percent). Singh *et al.* (2021) [18] evidenced that larval-pupal period was 25.17±3.86 days on chickpea seeds in storage. Patel *et al*. (2021) [12] reported that larval and pupal period of pulse beetle in chickpea varieties was 21 days and 6 days respectively. Kumari *et al*. (2023) [9] reported the highest adult emergence *C. chinensis* in C1022 (76.22%) and the lowest in C1088 (59.14%) on chickpea genotypes. Reddy *et al.* (2021) [15] revealed that adult emergence was recorded on ICC3137 (34.93%) and the lowest on ICCV07108 (14.63%) on chickpea genotypes. Singh *et al*. (2021) [18] and Jaiswal *et al*. (2018) [7] revealed that chickpea produced more males as compared to females. Present findings were in agreement with the Singh *et al.* (2021) [18] who revealed that longevity of male was 6.26±1.42 days and in case of female it was 7.53±1.4 days on chickpea seeds in storage. Jaiswal *et al*. (2018) [7] revealed that longevity of females varied from 8-12 days and that of male 7-11 days in chickpea.

Conclusion

Based on the current study on growth and development of *C. chinensis* on different varieties, it can be concluded that BDN-9-3 was the least susceptible to *C. chinensis* compared to all other varieties used in the study.

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