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OBSERVATIONS ON THE BIOLOGY OF THE PULSE BEETLE *CALLOSOBRUCHUS CHINENSIS* (LINN.) INFESTING STORED PULSES

N.K. PANDEY AND S.C. SINGH
DEPARTMENT OF ZOOLOGY, A.N.S. COLLEGE, BARH (PATNA)-803213, INDIA.

A comparative study of the biology of *Callosobruchus chinensis* (Linn.) was made on urd and chickpea seed at 28 ± 2°C and 70 ± 5% R.H. An average of 70 eggs were laid by the famale. The maximum daily egg laying was observed on the first day of oviposition. The number of eggs laid per seed depended on the size of the pulse seed and the bruchid species involved. Incubation for the eggs was 4-5 days. The combined larval and pupal period averaged 20-days. Both the sexes occurred in almost equal numbers. There was no significant difference between the life span of two sexes and in the developmental period for eggs laid on successive days of oviposition. However, a significant difference in the mortality rate of such eggs was observed, than those laid on the first day showing the latest mortality. The eggs laid on the last day were usually non-viable.

INTRODUCTION

The life cycle of *Callosobruchus chinensis* (Linn.) has been reported by Rajak & Pandey (1965) and Raina (1970) on the seeds of the lobia (*Vigna cating*) and mung (*Phaseolus vulgaris*), respectively. But their findings are more specific. Being cosmopolitan in distribution, the beetle is reported to observe polymorphism (Utida, 1980) and multivoltinism (Southgate, 1980). All the varieties of different pulses have been reported to be infested by this beetle (Singh *et al.*, 1980). Here, to an appreciable extent the type of host is expected to play an important role in setting the pattern of life cycle of the pest due to a specific host-pest relationship. Scanty literature available on the bionomics of this bruchid, therefore, the present investigation of its life cycle especially reared on the seeds of pulses namely, *Vigna mungo* and *Cicer arietinum* which is commonly known as urd and gram, respectively in Patna District of Bihar, has been undertaken.

MATERIALS AND METHODS

On the proper identification when it was made sure that the collected insects were *Callosobruchus chinensis* (Linn.), a healthy culture of this species was maintained in the laboratory in earthen pots of 8" x 5.4" containing pulses at 28 ± 2°C and 70 to 75% R.H. Ten pairs of male and female adults were isolated as they emerged and each pair kept individually with 100 urd and chickpea seeds, to determine the total number of eggs laid by one female, eggs laid on each day and life span of adults. Eggs laid each day were kept separately in vials for hatch, larval growth and emergence of adults. The time required to complete the life cycle indicated the effect of parental age on the developmental period. The distinguishing characters noted during the present studies facilitate to identify the two sexes (Table I).

RESULTS AND DISCUSSION

Mating : Mating seems to be influenced by factors like types of food, temperature, relative humidity and the age of the two sexes. Adults were found to mate within an hour of their emergence from the seed. for mating the adults prefer to come on the surface layer of grains. this is perhaps in order to get free area for the purpose (Kuhni Kannan, 1919). The period of mating lasted 5-8 minutes in optimum conditions (30 ± 2°C; 70 ± 5% R.H.). Although one mating is found sufficient to ensure egg laying, adults were observed to mate several times.

Table I : Distinguishing characters of male and female of *C. chinensis*.

Features	Male	Female
Size	Average 2.5 x 2.0 mm small, broad	3.5 x 2.5 mm slightly bigger (narrow)
Antennae	Pectinate	Serrate
Elytera	1. With deep vertical & closed stripes 2. With light dark bands expanding laterally and tapering in the mid-dorsal line (usually two such bands)	1. Stripes present 2. No such transverse dark bands present
Pygidium	Broad, shiny area spreading over the lateral margins of posterior mid-dorsal & giving a shape of expanded inverted V.	Narrow, shiny area confined to the posterior mid-dorsal and giving a shape of closed inverted V.

Oviposition : On an average, laying of eggs by female started from 7-8 hours after mating when the temperature and relative humidity were maintained to optimum. After the eggs are laid, the female covers them for about 30 seconds during the time the secretion fastening the eggs to the seeds dries. Usually smooth holed seeds were selected for oviposition.

Usually 1-3 eggs were laid per seed althrough as many as 7 were found on a single seed while there were still a few seeds without egg. Utida (1942) reported on initial oviposition was at random. More eggs were laid on chickpea than urd seeds, the former being the larger and latter being smaller in size needed less space for development.

The egg : The freshly laid eggs are oval, planoconvex and broad anteriorly and narrow posteriorly. The colour of freshly laid eggs is translucent, milky white yellow tinge in the beginning but later becomes yellow.

Raina (1970) reported that *C. chinensis* females laid an average of 78 eggs, ranging from 63-90, over a period of 8 days. Howe & Currie (1964) noted an average of 45 eggs with a range of 20-64 at similar temperature and relative humidity conditions. Rajak & Pandey (1965) reported a range of 50-103 and Takasugi (1924) between 70-80 eggs at atmospheric conditions. It was also observed that maximum daily egg laying occurred in the first 24 hours, the number gradually dropped till the last day of oviposition. Hence, the fecundity of a single female of *C. chinensis* had been 30-110 eggs at the rate of 1-35 per day (Fig. 1)

Incubation and hatching : Hatching of the eggs was easily determined by observing them under a binocular microscope. The average incubation period for the eggs of *C. chinensis* was found to be 4-5 days at 30 ± 2°C and 70 ± 5% R.H. Percentage of hatching ranged from 90 to 95 for this beetle.

Larval and Pupal development : Life cycle of C. chinensis displayed a complete larval and pupal metamorphosis (Homometabolous), in simple life cycle, altogether for four larval instars and one pupal stage were observed.

First instar larva : This stage is hatched after 3 to 5 days of the incubation of the egg. This larval stage is very delicate, white in colour and measures on an average 0.50 mm in length and 0.20 mm in width. The first stage larva bears a large spine on either side of the first abdominal segment. A few small spines, usually arranged in two groups are also observed on the tergal plates of the pronotum (Van Embden, 1946). These spines appeared to help the larva in getting a hole on the egg shell while it used its mandibles to cut through the seed coat. By the action of mandibles, the first instar larva is able to make small tunnel into the seed and advance in the same where it feeds and grow. The tunnel thus assumes the inverted L-shape. After 2 to 5 days of active feeding life, the first instar larva moults into second instar larva (Fig. 1).

Second instar larva : The average measurement of this instar is 0.7 mm in length and 0.3 mm in width. The larva differes in several morphological details from the first instar larva. The madibles are more prominent and fixed at the tip of the anterior end. The general contour of the

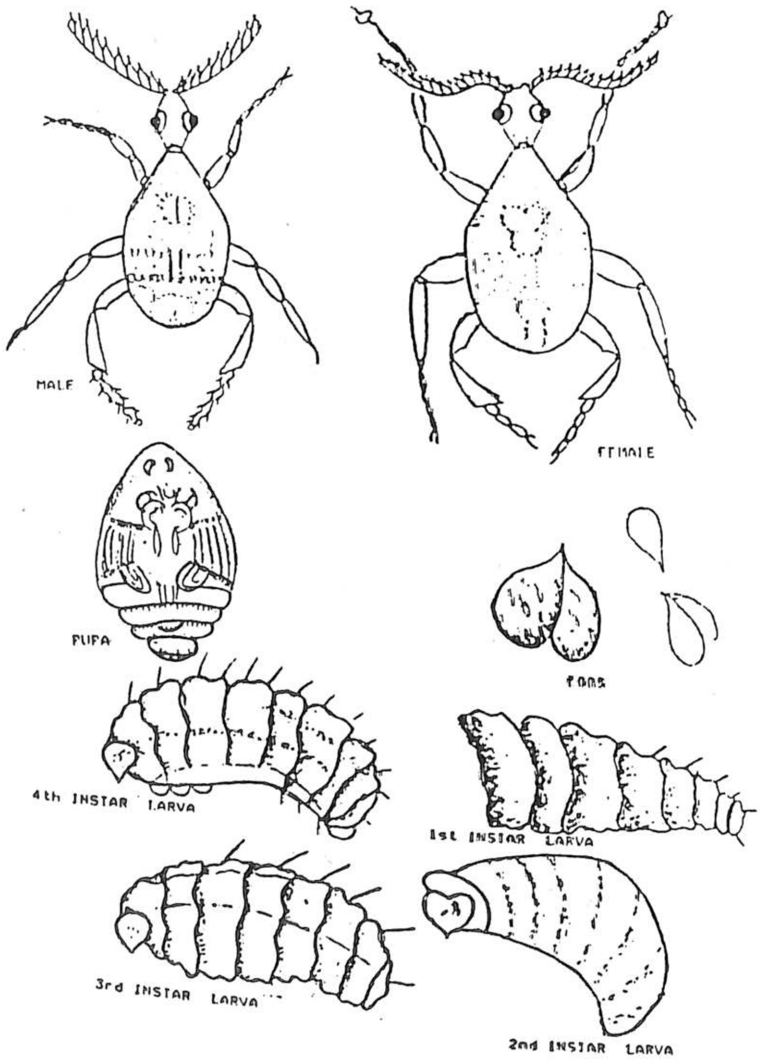

Fig. 1. Life cycle of *Callosobruchus chinensis* (Linn.).

body shows dorsal convexity. Both anterior and posterior end taper. Transverse circular annulations indicating the marking of segmentation of the larval body is more prominent in the second larval instar. After 3 to 5 days of massive feeding and growth, it moults into third instar larva.

Third instar larva : This stage exists in the tunnel of seed kernel. The average dimensions measures 0.80 mm in length and 0.35 mm in width. A few minute spine-like structures are found on the dorsal surface of the body. Prominent mandibles at the anterior end are present. The larval body assumes further dorsal convexity. this stage exists for 2 to 4 days after that it moults into fourth instar larva (Fig. 1).

Fourth instar larva : This is the final stage of the larval life. Its average size increased to 1.15 mm x 0.5 mm. General body surface shows more dorsal convexity. the rudiments of three pair of legs are visible. Mandibles become more developed. This stage exists upto 3 to 4 days after that it undergoes pupation. Before pupation, it chews a circular hole near the seed coat in such a way. that only a thin layer of testa is left intact. This gives the appearance of a 'window' or dark spot. This appearance of this dark spot is an indication of pupation (Raina, 1970).

Pupa : The pupation of the fourth instar larva occurs after 3 to 4 days. The pupal period lasts upto 6 to 9 days at optimum condition of temperature and relative humidity. During this period, recognization of the morphological structures occur in this stage. The head, thorax and abdomen are demarcated. The mouth parts, antennae and rudiments of third pairs of leg are well developed in the pupa (Fig.1).

Adult emergence : The adult beetle emerges out from circular 'window' already formed by the prepupation stage of the larva. If the pupation had occurred somewhere in the middle of the seed or the window was too small to let adult come out, it usually did inside the seed. The thin layer of the testa making the window is pushed off by the head of the adult. Thus, an exist is made for the emergence of the adult. The complete development of *C. chinensis* from egg to adult when reared on the seeds of gram (*Cicer arietinum*) and urd (*Vigna mungo*) at the similar temperature and relative humidity took an average ranging from 20 to 28 days. Raina (1970) reported that entire development period did not exceed 27 days for *C. chinensis* at similar temperature and relative humidity condition.

Developmental mortality : Mortality from egg to adult stage was found 24% in *C. chinensis*. It was observed in the seed from which adults did not emerge, that most of the mortality occurred in the egg and early larval stages. The highest mortality in the more advanced stages of growth was noticed. Similar observations were also made by Howe & Currie (1964) and Raina (1970).

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