

QUANTITATIVE LIFE-HISTORY OF BEAN PLATASPID; COPTOSOMA CRIBRARIUM (FABR.) (HETEROPTERA: PENTATOMOIDEA)

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Abstract. Laboratory experiments to determine the duration of eggs and larval stages of *Coptosoma cribrarium* Fabr.) in different seasons of the year were carried out for such informations should be useful from control point of view. Throughout the year, at room temperature, pre-oviposition period, incubation period, duration of various stages and mortality have been recorded.

Coptosoma cribrarium Fabr. has been known as a pest of bean in Indo-Pakistan subcontinent in general Aiyar¹ and in lower Sind in particular Ahmad and Moizuddin^{2,3,4} Both adults and larvae depend on the sap of bean plant and cause damage to flowers, twigs and stems of the plant. Sever attacks of larvae and adults are seen during the month of June to October. The abundance and built up in population during summer (Figs. 2-3) is probably for the high temperature. It is observed that the duration of days in egg hatching, and the period of moulting of instars for emerging into adults, become much shorter during summer. The life cycle is completed in 27-28 days in high temperature in contrast, to 59-60 days are taken in low temperatures. It has also been observed that female usually takes longer to emerge than the male. The ratio of the female in any observed ontogenic series is slightly greater in comparison to male.

Whereas kershaw⁵, Aiyar¹ and Cobben⁶ have made incomplete biological observations on various *Coptosoma* species giving only the structure of eggs and some of the instars, their inferences were all tentative without proper experiments and quantitative survey to support the inferences. Considering the above, the present work was undertaken.

Material and Methods

During the last three years sampling from various fields of bean plants (*Dolychos lablab*) in the Malir gardens near Karachi were continued and a successful colony was maintained in the nearby fields at Karachi University Campus. Biological studies were made throughout the year to know the effect of temperature on the duration of eggs and larval stages in laboratory at room temperature. Mean monthly temperature record is given in Table 1. The experimental material was derived from 5th instars. Newly emerged males and females were used for copulation. In one test tube only one pair was kept. Mating behaviour was noted and after the copulation was completed the female was separated. Pre-oviposition period, mode of oviposition,

incubation period and hatching period were recorded in time. To determine the duration of larval stages, individual larvae were separated from the cultured colony as soon as these were hatched and were kept in a separate test tube. Fresh leaves, twigs or fruits of bean plant were provided and changed daily. Exact time of moulting to first, second, third, fourth and fifth and to the adult was carefully recorded. Observations were taken once in 24 hours during the day time.

Observations and Results

Mating Behaviour. Mating takes place from end to end position. In laboratory adult males and females were found ready for copulation nearly 24 hours after emergence from fifth instar. Male initiates for copulation. The potential male moves around in search of female and when meets a female, swiftly moves round to seat on head to head position. Both remain seated motionless. Antennae of male begins to move slowly touching antennae and dorsum of head of female. The potential female responses and behaves in similar way. Male immediately turns round and comes in contact in end to end position and strikes the tip of abdomen of female. At this point female not only raises the tip of abdomen, but remains motionless holding the substratum tightly and the first valvifers are put wide apart. The male by touching the abdominal tip again and again locates the position for effective copulation.

Duration of copulation varies greatly ranging from a few minutes to 8 hours, but usually lasts for 1-2 hours. Copulation is repeated several times with the same couples or with members of other couples in one day. The copulation was also observed with gravid females. In case the female is not ready for copulation it tries to escape by pushing the male ahead or turning round to move outside. Male chases for a while and then gives up.

Pre-oviposition Period. In the present work pre-oviposition period has been defined as the time between copulation and the consequent oviposition after it. The pre-oviposition period was determined to be 3-5 days in summer (August and September). This is much

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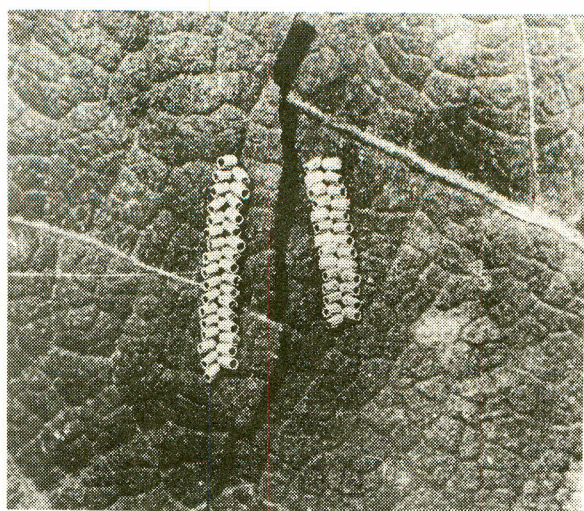


Fig. 1. Clusters of eggs of *C. cribrarium* on the ventral side of the leaf of bean plant (*Dolychos lablab*).

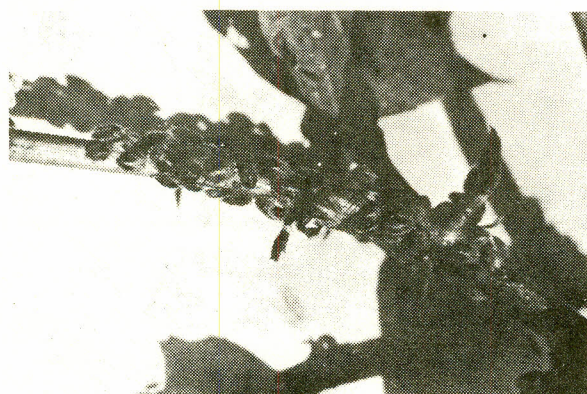


Fig. 2. Various stages of larvae of *C. cribrarium* feeding on stem and leaves of bean plant (*Dolychos lablab*) in the month of August, showing abundance.



Fig. 3. Various stages of larvae of *C. cribrarium* with a 5th stage immature in feeding position, on stem of bean plant (*Dolychos lablab*) in the month of August, showing abundance.

higher than the value determined by Aiyar¹.

Mode of Oviposition. The eggs are laid in a batch (Fig. 1), usually on ventral side of the leaves or on stem. The eggs are pressed down in alternated left and right symmetry in two rows in such a way that the posterior ends are touching each other. Small ochraceous pellets of irregular shape containing symbionts are also laid usually between 2-3 pairs of eggs. The eggs are cemented to substratum by white gelatinous liquid substance discharged during the process of egg laying. Time taken by a female to oviposit is noted to be 15-60 min. depending on the number of eggs in the batch. The number of eggs/ batch vary greatly from 12-38 eggs. A single female lays about 102 eggs in 4-5 batches in 2-3 days of time.

Eclosion of the Eggs. As the time approaches for eclosion the colour of the eggs changes to deep creamy, medially slightly swollen and glassy. The reddish eyes of the larvae at the anterior of the egg and the expansion and contraction are clearly visible through the transparent sculpture under binocular. It appears that the larva slowly strikes head on operculum which is provided with egg burster. The process is repeated rapidly and due to the pressure, the operculum is detached. The fore-side of the egg is the ventral side of the larva. The head of the larva slowly comes outside. The contraction and expansion of body and the movement of antennae and legs cause the larva to come out of the egg. In case the dorsum is stuck with yolk, vigorous movement of leg and antennae are seen to get free. Time taken by a single larva to emerge from an egg is noted to be 10-15 min.

Incubation Period. It is the time from the deposition of the eggs to the appearance of fully developed embryo, heralded by the appearance of the first free moving larval stage. In all 93 batches of eggs were kept under sufficiently precise observation to merit reporting and discussing. The results of 12 months are shown in Table 2. From these it could be concluded that the incubation period lies between 4-12 days depending on temperatures in different seasons. Averaging the means and adjusting the relevant standard deviation incubation period was calculated to be 5.64 ± 1.53 days.

Hatching Period. The hatching period i.e. the time when first free moving larva appeared to the end when most of them hatched is noted to be 2-6 hour depending on the number of eggs present in a batch. The day after the larva emerged, the unhatched dead embryos were counted, the seasonal fluctuations is given in Table 2. The over all proportion of eggs that hatched was 97.13%. The number of eggs that did not hatch, varies from batch to batch. The causes of unhatching are unknown.

Duration of Larval Stages. Table 3 shows mean duration of days of 190 individuals of I - Vth instars for 12 months. The figures of 7.29 ± 1.00 for 1st instar, 6.97 ± 0.56 for second instar, 7.00 ± 0.56 for third instar, 6.41 ± 0.85 for fourth instar, 8.33 ± 0.81 for

TABLE 1. TEMPERATURE AND HUMIDITY RECORD IN KARACHI

Year and Months.	Mean of daily		Highest	Lowest	Humidity % at	
	Maximum °C	Minimum °C	Maximum °C	Minimum °C	0800 hours.	1700 PST
1973						
October	35.00	20.38	38	16	65	45
November.	31.38	14.83	36	09	71	45
December.	26.00	11.61	29	07	67	37
1974						
January	25.8	10.2	29	07	62	35
February	25.9	10.6	29	04	52	26
March	33.1	18.3	36	13	73	36
April	33.6	22.1	38	18	77	52
May	34.7	25.2	40	22	77	63
June	34.4	26.7	44	23	70	58
July	33.4	27.1	37	26	75	67
August	32.2	26.0	35	23	77	68
September	33.3	24.9	41	23	80	63

TABLE 2 NUMBER OF HATCHED AND UNHATCHED (DEAD EMBRYO OR NON-HATCHED EMBRYO NOTED) EGGS AND INCUBATION PERIODS OF *C. CRIBRARIUM* IN LABORATORY.

Months	Average No. of eggs/batch	Total No. of eggs.	No. of eggs hatched	No. of eggs unhatched	Incubation period.
October	21.30	128	125	3	4.17 ± 0.41
November	24.92	324	321	3	7.00 ± 0.58
December	22.50	112	108	4	8.20 ± 2.39
January	19.00	95	90	5	9.80 ± 1.79
February	17.69	230	212	18	9.92 ± 0.86
March	20.00	120	114	6	8.00 ± 1.00
April	23.12	370	360	10	5.00 ± 0.63
May	27.16	163	161	2	4.17 ± 0.41
June	27.56	165	163	2	4.00 ± 0.00
July	23.83	143	141	2	4.67 ± 0.52
August	24.83	149	147	2	5.00 ± 0.00
September.	24.80	124	120	4	5.40 ± 0.55
Total.	—	2,123	2,062	61	—
Percentage of total.	—	—	97.13	2.87	—

fifth instar (male) and 9.17 ± 1.13 for fifth instar (female) were calculated by averaging means standard deviation. Analysis of the data gives the mean larval life of the male as 36.43 ± 9.56 and that of female as 37.39 ± 9.71 . The F-test indicates that the variance between the two sexes do not differ statistically ($P < 0.05$). The difference between the two was found by the T-test to be significant.

Summary of Duration of Various Stages of *C. cribrarium*

In Fig. 4 a composite picture is presented which displays graphically the time taken in each of the non-pherate stages up to the emergence of the last female. The batch of eggs was laid on 5th September 1974 in laboratory. These were found hatched on 5th day. Males completed emergence in 33-35 days and females in 34-36 days. Fig. 5 shows that the rate of emergence under the present conditions simply increases to a peak in both males and females and then declines.

It must be emphasized that these figures summarize the events that take place in the months of September and October when the temperature was high (Table 1).

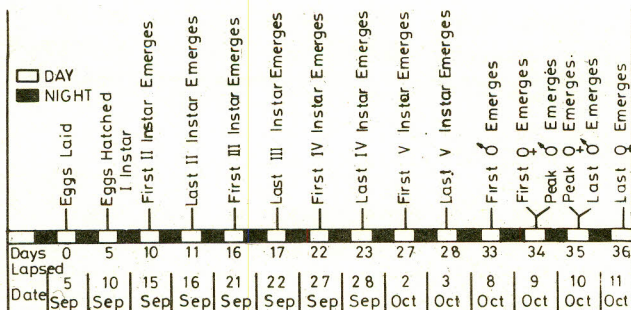


Fig. 4. Duration of various stages of *C. cribrarium* upto the emergence of last female.

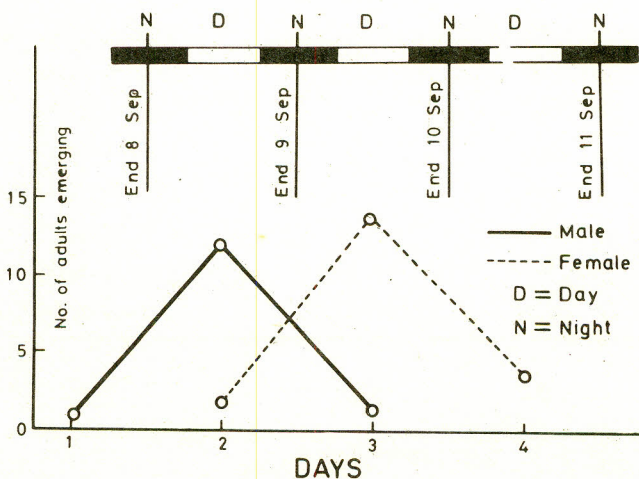


Fig. 5. Emergence of adults male and female *C. cribrarium*.

TABLE 3. DURATION OF LARVAL STAGES OF *C. CRIBRARIUM* IN LABORATORY.

	1st Instar.		2nd Instar.		3rd Instar.		4th Instar.		5th Instar. ♂		5th Instar. ♀	
	Min. days	Max. days	Min. days	Max. days	Min. days	Max. days	Min. days	Max. days	Min. days	Max. days	Min. days	Max. days
Oct.	5.29 ± 0.47	5	6	6.21 ± 0.43	6	7	6.14 ± 0.36	6	7	5.29 ± 0.83	4	6
Nov.	5.89 ± 0.57	5	7	6.82 ± 0.64	6	8	6.31 ± 0.48	6	7	5.81 ± 0.98	4	7
Dec.	8.16 ± 1.74	6	11	7.58 ± 0.69	7	9	8.11 ± 1.08	7	10	8.07 ± 0.80	7	9
Jan.	12.50 ± 1.99	14	17	9.00 ± 0.73	8	11	9.73 ± 0.70	9	11	10.06 ± 1.06	9	12
Feb.	14.57 ± 1.95	12	17	9.86 ± 0.86	9	11	10.08 ± 1.04	8	11	10.26 ± 0.87	9	12
Mar.	8.23 ± 2.17	6	12	6.53 ± 0.64	6	9	6.60 ± 1.23	5	10	6.60 ± 1.23	5	10
Apr.	6.10 ± 0.74	5	7	6.33 ± 0.49	6	7	5.58 ± 0.51	5	6	7.57 ± 0.53	7	8
May.	5.50 ± 0.52	5	6	6.27 ± 0.47	6	7	4.89 ± 0.78	4	6	6.60 ± 0.55	6	7
Jun.	5.42 ± 0.51	5	6	6.30 ± 0.48	6	7	5.00 ± 0.82	4	6	6.14 ± 0.35	6	7
Jul.	5.21 ± 0.43	5	6	6.29 ± 0.47	6	7	4.92 ± 0.79	4	6	6.17 ± 0.41	6	7
Aug.	5.28 ± 0.46	5	6	6.16 ± 0.37	6	7	5.24 ± 0.75	4	6	6.33 ± 0.52	6	7
Sep.	5.27 ± 0.46	5	6	6.33 ± 0.49	6	7	5.18 ± 0.73	4	6	6.29 ± 0.49	6	7
Mean	7.29 ± 1.00	.	.	6.97 ± 0.56	.	.	6.41 ± 0.85	.	.	8.33 ± 0.81	.	.

Discussion

Kershaw⁵ working on *C. cribrarium* in South China noted eight or more eggs in a row (thirty altogether being an average number) but did not mention the duration of larval stages and Aiyar¹ describing the life history of this species did not consider the seasonal effects on the duration of various instars. He also did not mention the number of observations made nor did he record the temperature when the observations were taken.

Aiyar¹ noted pre-oviposition period to be 4 to 7 hr, whereas, this period during the present study was observed to be 3-5 days during summer (August and September). It could be that gravid females brought from the field instead of virgin females were used by him. The above author also noted 10 - 40 eggs in a batch giving the commonest number to be 35, which is not only contrary to Kershaw⁵, but also to the present study (Table 2). In the present study a minimum of 12 and a maximum of 38 eggs were recorded in a batch and 22.91 eggs batch altogether being an average number. In a disturbed condition, number of eggs may be reduced.

Aiyar¹ noted incubation period to be 6 days contrary to 5.64 ± 1.53 days determined in the present work. The above author although tentatively noted the duration of larval stages to be 8, 6, 9, 9, 10 days for

first, second, third, fourth and fifth instars respectively, he unfortunately did not notice the differences in the duration of males and females of fifth instars. Present study reveals that there exists great variance in the duration of larval stages (Table 3). It is also obvious that the females spend a significantly longer time in the fifth instar than the period spent by the males. The mortality during the summer season was noted to be about 10% while in the winter season it was increased to about 25% probably due to severe climatic factors.

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