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LABORATORY STUDY OF THE MATING BEHAVIOR, EGG BIOLOGY, AND IMMATURE STAGES OF *LESTONOCORIS KARACHIENSIS* (PENTATOMIDAE: PENTATOMINAE: LESTONOCORINI) AND ITS RELATIONSHIPS[1]

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Abstract. Studies on the biology and immature stages of *Lestonocoris karachiensis* on *Barlaria prionotis* were carried out in the laboratory. No member of the tribe Lestonocorini, to which this unique pentatomine belongs, is known with respect to complete life cycle and immature characters, etc. A key to the immature stages is given. The egg and immature characters are compared with those of representatives of other pentatomine tribes. The period for the complete life cycle was 30–45 days at 18–39 °C and 50–85% RH.

Previous workers have given comprehensive accounts of eggs and/or immature stages of representatives of different pentatomine tribes, but neither the biology nor the characters of the egg and the immatures of the Lestonocorini are known in the literature to date. The present work was undertaken to fill this gap. Herein, the mating behavior, egg biology, and immature stages of *Lestonocoris karachiensis* Ahmad & Mohammad on the plant *Barlaria prionotis* L. are described and keyed and the immature characters are compared with those of representatives of other pentatomine tribes (Ahmad 1978, 1980) to evaluate these characters at generic and tribal levels.

MATERIALS AND METHODS

Adults were collected from Karachi University Campus from the host plant *Barlaria prionotis* L. (Acanthaceae) by sweeping and beating. Laboratory studies were initiated in April and continued until late in November. Extreme highs and lows in temperature retarded the rate of growth and sometimes heavy mortality occurred, as noted in an earlier paper by us (Ahmad & Mohammad 1982).

Field-collected adults were taken to the laboratory with 1 pair each kept in a breeding chimney containing shoots of the host plant (*Barlaria prionotis* L.). The rearing data were taken with the following parameters: 13 h/day, 11 h/night, 18–39 °C, and 50–85% RH. In all, 25 observations were made of hatching and molting of each stage (Table 1). Drawings were made through a Leitz binocular microscope with an eyepiece graticule; representatives of eggs and of each stage were set in

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TABLE 1. Duration of life cycle of *Lestonocoris karachiensis* on the basis of 25 observations.

	DAYS TO HATCH (MEAN)	RANGE*
Egg	3–6 (4.04)	4.04 ± 0.32
1st instar	4–5 (3.88)	3.88 ± 0.31
2nd instar	3–5 (3.04)	3.04 ± 0.38
3rd instar	6–9 (5.56)	5.56 ± 0.73
4th instar	8–12 (7.88)	7.88 ± 0.84
5th instar	6–8 (4.08)	4.08 ± 0.69
Total time	30–45 (34.32)	34.32 ± 2.27

* At 99% confidence limit.

glycerine on cotton. A slide micrometer was used to measure eggs and structures of immatures. Means and ranges were calculated at 99% confidence limit, using standard statistical procedure (Table 2) based on 5–10 specimens, number subject to availability. Length was measured from the tip of the clypeus to the tip of the abdomen; width of head was measured between the outer margins of the compound eyes; humeral width was measured at the widest areas of the protergum, and greatest width was measured across the 4th and 5th abdominal segments.

MATING BEHAVIOR, EGG BIOLOGY, AND IMMATURE STAGES OF *LESTONOCORIS KARACHIENSIS*

Copulation

During mating, the male extends the pygophore, rotates it in all directions and approaches the female from behind. Mounting is accomplished with a little difficulty; the male first rides on the back of the female, holding her with his fore legs and finally the copulation takes place in an end-to-end position. Copulating pairs do not separate on being disturbed. Copulation duration is 1–2 days. When separated, the pair does not copulate again and remains almost inactive for a period of time.

Egg biology

Oviposition takes place 12–30 h after copulation. Eggs are laid on spines, leaves, and flowering buds of the host plant in clusters of 6–18, arranged in such a way that those of any one row neatly fit into the angles between eggs of adjacent rows. The egg clusters (Fig. 1, 2) are cemented by a thick, gluey, white crystalline secretion.

Eight field-collected females deposited a total of 372 eggs in 13 days. The number of eggs per female and the duration of the oviposition period during the month of November was as follows: (1) 40 eggs from 12–15 November; (2) 39 eggs from 14–17 November; (3) 42 eggs from 17–20 November; (4) 49 eggs from 15–19 November; (5) 35 eggs from 16–19 November; (6) 110 eggs from 14–20 November; (7) 32 eggs from 21–25 November; (8) 25 eggs from 24–25 November. The number of eggs deposited per day ranged from 16–25, $\bar{x} = 14.44$.

TABLE 2. Range of measurements of different stages of *Lestonocoris karachiensis.*

	INSTAR				
	1ST	2ND	3RD	4TH	5TH
Total length	1.40 ± 0.11	2.06 ± 0.05	3.68 ± 0.21	5.58 ± 0.33	6.22 ± 0.09
Length of head	0.39 ± 0.05	0.57 ± 0.03	0.75 ± 0.02	0.82 ± 0.01	0.91 ± 0.04
Width of head	0.52 ± 0.02	0.66 ± 0.02	0.84 ± 0.05	1.19 ± 0.06	1.32 ± 0.03
Humeral width	0.62 ± 0.05	1.02 ± 0.04	1.62 ± 0.09	2.52 ± 0.04	2.52 ± 0.05
Abdominal width	0.85 ± 0.07	1.14 ± 0.04	1.97 ± 0.07	3.34 ± 0.08	4.20 ± 0.06

Position of embryo. The position of the embryo inside the egg and the function of the egg burster at the time of hatching were as observed by Abbas & Ahmad (1980). The shape of the egg burster differs; the period of hatching is noted below.

Incubation. The incubation period ranged from 4–10 days, $\bar{x} = 7$ days. Ten to 15 min is needed by a 1st immature stage to emerge from the egg.

Egg hatching. Different clusters of eggs hatch at varying intervals of time, but all eggs within a cluster hatch simultaneously. Over 75–85% of the eggs observed hatched.

Egg parasitization. Out of several hundred batches observed during the present studies, 35–37 eggs in 2 batches (with a maximum of 42 eggs in each) were parasitized by *Elasmus* sp. (Hymenoptera). The parasitized eggs turned black; the emerged parasites were reared to the adult stage.

Description of egg (Fig. 3–5)

Length 1.08 ± 0.02, width 0.02 ± 0.01, smooth, covered with crystalline secretion, sides straight; elongate, tuber-shaped and of uniform width throughout length; gelatinous white, color gradually changes to light brown; pseudoperculum round, flat; chorion hyaline, entire; 12 micropyles around crown, 6 visible dorsally and 6 visible ventrally, vertex of head of embryo with sclerotized triradiate egg burster (Fig. 3–5) with a median, bluntly pointed raised process.

Descriptions of immature stages

First instar (Fig. 6). Bright red to dark red except head (excluding clypeus), antennae, pro-, meso- and metanotum, and legs dark ochraceous; clypeus, anterior margin of prothorax, lateral margins of pro-, meso- and metanotum, epicranial suture, laterocephalic margins, and abdomen albidus; abdomen with bright red pigmentations; body suboval; head somewhat quadrate, slightly broader than long; clypeus much longer than paraclypei; antenniferous tubercles slightly visible from above; antennae 4-segmented, 2nd and 3rd fused, almost equal in length, 4th longest; ratio of antennal segments 0.10:0.10:0.12:0.34; labium robust, reaching at least to 5th abdominal segment; ratio of labial segments 0.10:0.40:0.10:0.30; mesonotum longer than pro- and metanotum, each notum broader than long, ecdysal cleavage line running through center of each notum, posterior margin more or less convex; abdomen subrounded; scent glands present between segments 3 and 4, 4 and 5, 5 and 6, 1st pair oval, indistinct, 2nd and 3rd pairs somewhat quadrate and dark ochraceous with a small dark pair of tubercles, only slightly visible; legs thickly punctate and with stiff hairs, tarsi 2-segmented, 2nd and 3rd not yet separated.

Second instar (Fig. 7). Color and shape similar to 1st instar; 1st antennal segment shortest;

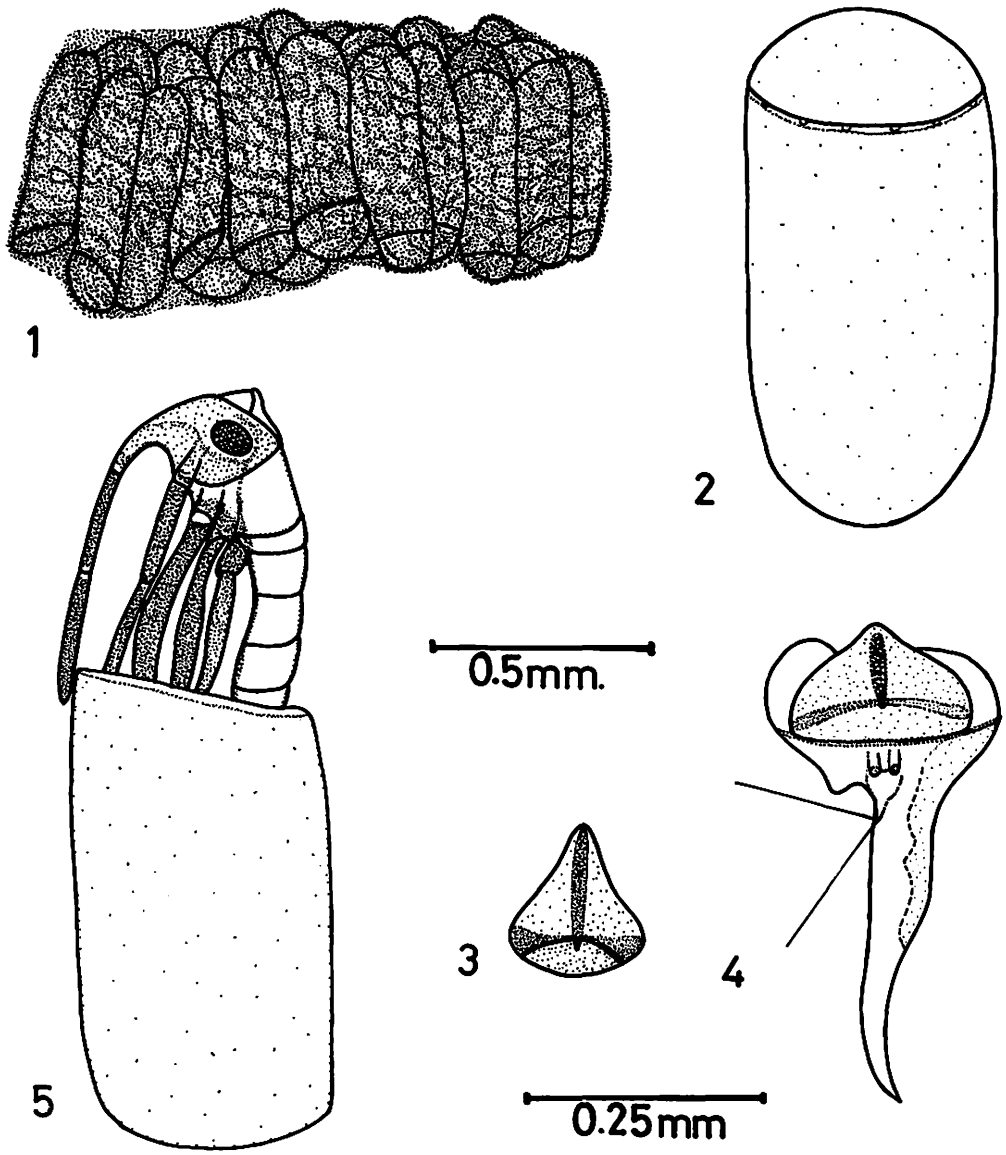

FIG. 1–5. *Lestonocoris karachiensis.* **1,** egg cluster; **2,** dorsal view of egg; **3,** egg burster; **4,** egg burster and embryonic membrane; **5,** egg with 1st immature stage emerging, following opening of pseudoperculum.

ratio of segments 0.10:0.22:0.30:0.50; labium at most reaching to 4th abdominal segment, ratio of labial segments 0.30:0.45:0.20:0.30; posterior margin of each notum sinuate, other characters same as in 1st instar; all abdominal characters same as in 1st instar except a light yellow U-shaped band present around dorsal scent glands from mesothorax to caudal end of abdomen; legs similar to those in 1st instar.

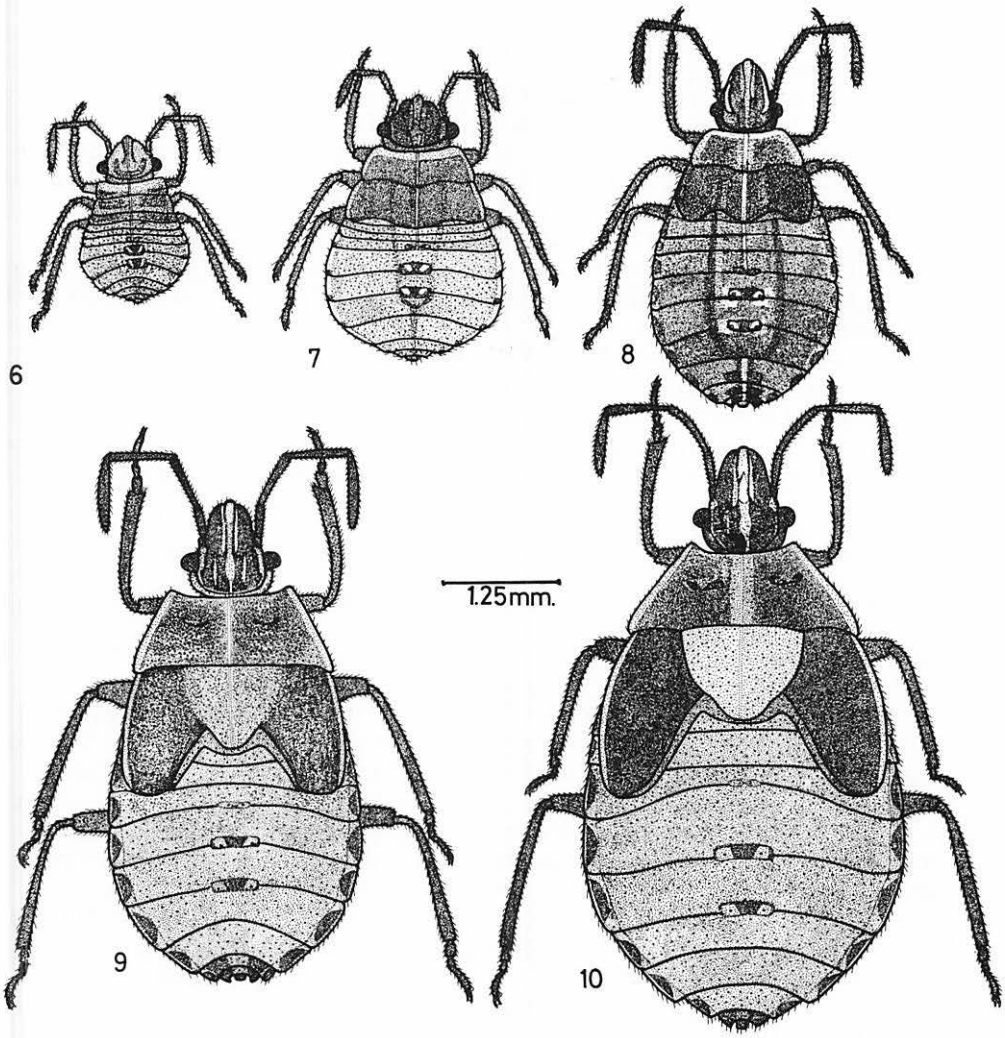

FIG. 6–10. Immature stages of *Lestonocoris karachiensis*: **6,** 1st instar; **7,** 2nd instar; **8,** 3rd instar; **9,** 4th instar; **10,** 5th instar.

Third instar (Fig. 8). Reddish ochraceous; body elongate-oval; head nearly as long as broad; clypeus a little longer than paraclypei; antenniferous tubercles distinctly visible from above; ratio of antennal segments 0.30:0.40:0.40:0.60; labium reaching to 3rd abdominal sternum; ratio of labial segments 0.12:0.72:0.30:0.40; posterior margin of prothorax deeply sinuate; humeral angles convex and subacute; meso- and metanotal wing pads present, reaching to 1st abdominal segment; mesonotum showing slightly early development of scutellum; abdomen elongate oval, 7th, 8th, and 9th abdominal segments with dark ochraceous patches; other characters similar to those in 2nd instar; legs similar to those in 2nd instar.

Fourth instar (Fig. 9). Ochraceous with black punctures, except clypeus, inner margins of paraclypei and eyes, lateral margins of pronotum and mesonotal wing pads yellow; antennae

and legs dark ochraceous; head slightly broader than long; clypeus and paraclypei almost equal in length, 2nd antennal segment slightly longer than 3rd; ratio of antennal segments 0.35: 0.70:0.60:0.80; labium slightly passing beyond hind coxae; ratio of labial segments 0.50:0.80: 0.40:0.60; anterior pronotal angles subacutely developed, posterior margin truncated, humeral angles appearing as somewhat rounded pads, a slight sign of calli present, meso- and metanotal wing pads reaching to 3rd abdominal segment; scutellum more prominent than in preceding stage; abdomen unicolorous with red pigmentation; 1st, 2nd and 3rd abdominal scent glands with tubercles, latter distinctly visible, markings on connexiva distinct; legs similar to those in 3rd instar.

Fifth instar (Fig. 10). Color similar to that in 4th instar; body broadly oval; head much broader than long; clypeus and paraclypei equal in length; clypeus medially raised; ocelli present, 2nd antennal segment much longer; ratio of antennal segments 0.35:0.80:0.60:0.80; labium reaching to hind coxae; ratio of labial segments 0.70:0.90:0.40:0.70; pronotum 3× broader than long, lateral margins weakly serrate, calli distinct; scutellum well developed, meso- and metanotal wing pads reaching to ¾ of 3rd abdominal segment; abdomen broadly oval; all other features similar to those in 4th instar except tubercles of abdominal scent glands and markings of connexiva more prominent; hairs on tibiae more condensed and 3rd tarsal segment present.

KEY TO THE IMMATURE STAGES OF *LESTONOCORIS KARACHIENSIS*

1. Length not exceeding 2.70 mm; bright to dark red; body suboval; scutellum and metathoracic wing pads not developed 2
   Length more than 3.10 mm; reddish to dark ochraceous; body elongate to broadly oval; scutellum and metathoracic wing pads present 3
2. Very small in size, length not exceeding 1.70 mm; 1st, 2nd, and 3rd antennal segments almost equal in length; labium reaching to 5th abdominal segment ..... 1st instar
   Comparatively larger in size, length distinctly more than 1.70 mm; antennal segments not as above; labium at most reaching to 4th abdominal segment ..... 2nd instar
3. Head nearly as long as broad; clypeus at least a little longer than paraclypei; 2nd and 3rd antennal segments equal in length; labium reaching to 3rd abdominal sternum; meso- and metanotal wing pads extending only to 1st abdominal segment; calli not yet developed ..... 3rd instar
   Head at least slightly or much broader than long; clypeus almost equal to paraclypei; 2nd antennal segment either slightly or much longer than 3rd segment; labium reaching to or slightly passing beyond hind coxae; meso- and metanotal wing pads reaching to or extending beyond 3rd abdominal segment; calli present 4
4. Body elongately oval; head slightly broader than long; 2nd antennal segment only slightly longer than 3rd; clypeus flat; ocelli absent, lateral margins of pronotum smooth; meso- and metanotal wing pads not extending beyond 3rd abdominal segment ..... 4th instar
   Body broadly oval; head much broader than long; 2nd antennal segment much longer than 3rd; clypeus medially raised; ocelli present; lateral margins of pronotum weakly serrate; meso- and metanotal wing pads reaching to or extending beyond 3rd abdominal segment ..... 5th instar

DISCUSSION

The eggs and immatures of *L. karachiensis* of the tribe Lestonocorini share characters with members of other pentatomine tribes: a triradiate egg burster, the sequence of development of wing pads, the presence of 3 pairs of dorsal abdominal

scent glands, and labium that decreases in length in successive immature stages (Puchkov & Puchkova 1956, Southwood 1956, Decoursey & Essalbaugh 1962). However, much elongated tubular eggs with parallel lateral margins, distinctly visible dorsal and ventral micropylar processes, and prominently developed humeral lobes in almost all immature stages isolate the present lestonocorine species from the entire subfamily Pentatominae.

Eggs are deposited in 2 or 3 rows, their pseudoperculum flatly rounded, the micropylar processes arranged in a circle; the immature stages are elongate-oval. These characters relate *L. karachiensis* to members of the tribe Aeliini Stål (Ahmad et al. 1985), but *karachiensis* differs from aeliine species in the color of the eggs that, unlike the yellowish green eggs of the Aeliini, are gelatinous white when freshly laid and turn to light brown.

The small number of micropylar processes on eggs of lestonocorines and halyines (12–13) described here and in Southwood (1956) contrast with the large numbers on eggs of other Pentatominae (30–70) and show a somewhat primitive status (Cobben 1968: 265). A thick, white, sticky crystalline secretion and distinctly visible micropylar processes (not remarkably elongate) support this conclusion. However, prominently developed humeral lobes with light yellow U-shaped bands around the dorsal abdominal scent gland plates in the 2nd and 3rd immature stages of *L. karachiensis,* give indications of its being an advanced taxon insofar as suitability for some particular habitat [as noted by Ahmad et al. (1985)].

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