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DESCRIPTION, BIONOMICS AND PHYLOGENETIC DISCUSSION OF THE FIRST INSTAR LARVA OF *MEGACERUS CUBICUS* (MOTSCH.) (COLEOPTERA: BRUCHIDAE)

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Description, Bionomics and Phylogenetic Discussion of the First Instar Larva of *Megacerus cubicus* (Motsch.) (Coleoptera: Bruchidae)

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ABSTRACT: The first instar larva of *M. cubicus* is figured and described. Significant characters discussed are those of the ocellus, antenna, prothoracic plate, legs and chaetotaxy. A short discussion on the biological significance of egg characteristics is followed by concluding remarks concerning probable phylogenetic relationships among the tribes Megacerini, Bruchini and Bruchidiini.

Within the last decade larval descriptions and biologies have been published for representatives of all subfamilies within the family Bruchidae (Luk'yanovich and Ter-Minasyan, 1971; Pfaffenberger, 1979; Pfaffenberger and Johnson, 1976; Prevett, 1971; Teran, 1967). Supporting evidence is also forthcoming for the problematic subfamily Rhaebinae (Kingsolver and Pfaffenberger, in preparation). These contributions have provided considerable information, the majority of which has been used to strengthen an existent adult classification scheme.

Despite the progress at the subfamily level much work remains to be done with larvae to help clarify phylogenetic relationships at lower taxonomic levels. Such is the case with the present work. This is the first larval description and biological discussion of a member of the tribe Megacerini within the subfamily Bruchinae.

Megacerus cubicus (Motsch.)

BODY: (see fig. 1 in Pfaffenberger and Johnson, 1976) 0.25 mm wide by 0.8 mm long; cyposomatic; width greatest at meso-metathoracic segments tapering to minute 10th segment; cuticle white to light yellow without sclerotized, pigmented areas (excepting prothoracic plate on dorsum of prothorax); cuticle bearing organized pattern of long (primary) and short (secondary) setae. HEAD: (Fig. 1) 0.2 mm wide by 0.25 mm long; sclerotized; light to dark tan pigmentation; prognathous to hypognathous; dorsoventrally flattened; nearly quadrangular; proximal end may be deeply retracted into prothorax; full length, median, goblet-shaped, epicranial suture; pair of ocelli flanking distal ⅓ of each epicranial arm; large occipital foramen, together with mouthparts form venter of head capsule; point of articulation

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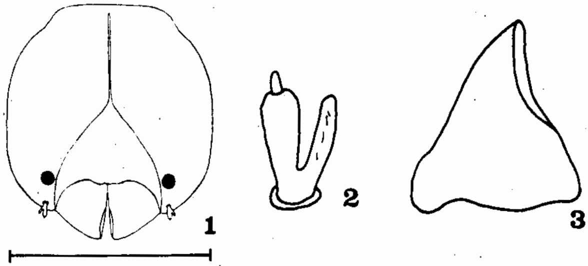
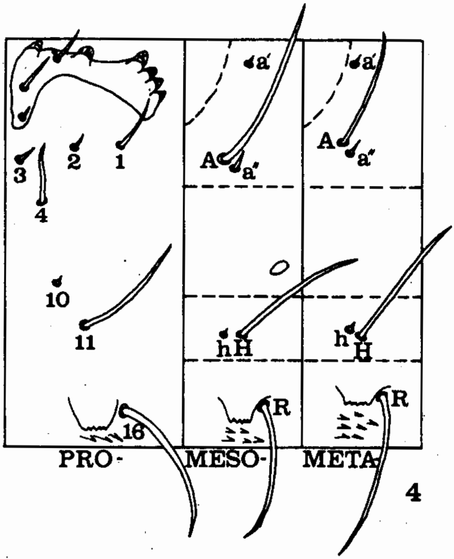
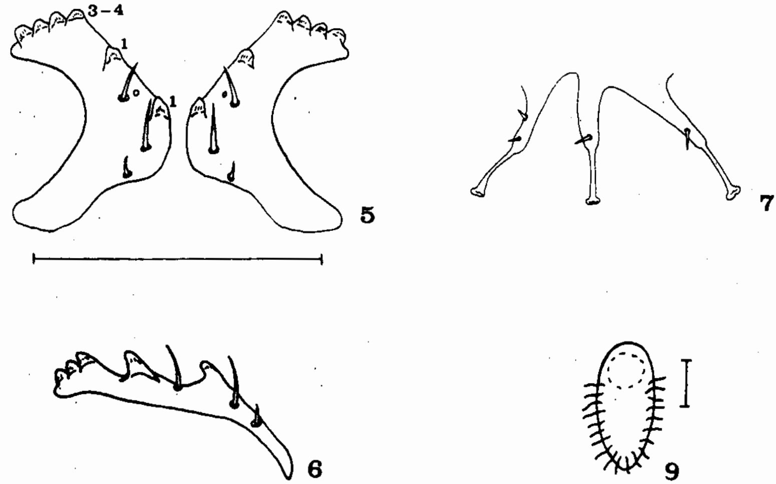




Figs. 1–4. *Megacerus cubicus*. 1. Anterior view of head capsule. 2. Antenna. 3. Monocondylic mandible. 4. Thoracic chaetotaxy. Scale line = 0.2 mm.

along ventral (distal) margin of occipital foramen. *Antenna:* (Fig. 2) located anterior to ocellus near junction of mandible and epicranial suture; single, bifid segment (may be second of 2 segments, see fig. 23, P in Pfaffenberger and Johnson, 1976); proximal segment telescoped into head capsule; median lobe of bifid segment longer and somewhat enlarged, with single, distally located, sensillum basiconicum. *Mandible:* (Fig. 3) monoconcylic; smooth molar surface; concave chewing surface. THORAX: (Fig. 4) without sclerotization except for pigmented, X-shaped plate on prodorsum (Figs. 5, 6); width greatest in meso- and metathoracic regions; prothorax without evident sutures; sutures dividing meso- and metathorax into prodorsal, postdorsal, spiracular, epipleural and sternal regions (Fig. 4). *Prothoracic plate:* (Figs.

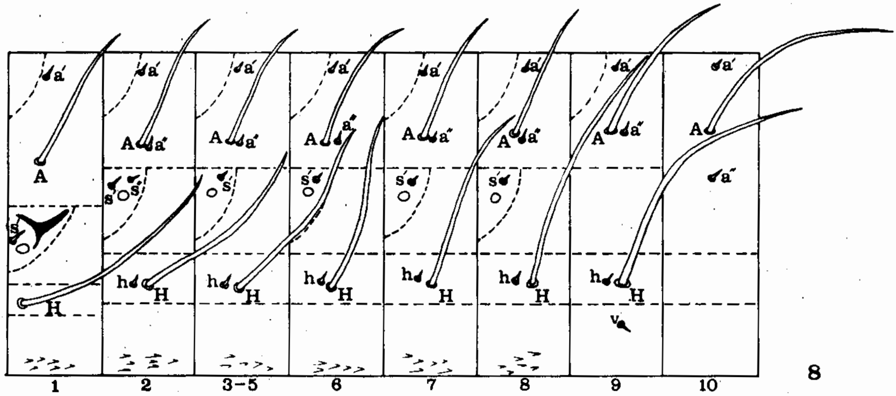


Figs. 5–7 and 9. *Megacerus cubicus*. 5. Anterior view of prothoracic plate, showing 1 + 1 + 3–4 tooth formula. 6. Lateral view of prothoracic plate. 7. Lateral view of thoracic appendages, showing flattened tarsus. 9. Ventral view of egg, showing circular emergence hole and row of radiating, anchoring filaments. Scale line = 0.2 mm.

5, 6) X-shaped; with 5–6 pairs of teeth; teeth arranged in 1 + 1 + 3 or 4 (see fig. 15, A in Prevett, 1971); plate with 3 pairs of setae; single seta and subtending sensory pore midway between teeth 1 and 1 along medial border of plate; 2 pair of equidistantly spaced setae located antero-medially to first median teeth; anteriormost pair of setae decurved and half as long as other setal pairs on plate. *Prothorax:* (Fig. 4, Table 1) with 7 setae, excluding those associated with the prothoracic plate; sternum bearing few posteriorly directed, sharp, sclerotized projections. *Mesothorax* and *metathorax:* (Fig. 4, Table 1) with reduced, asetiferous prodorsum; postdorsum with 1 primary

Table 1. Distribution of setae on *Megacerus cubicus*, first instar.

Segment	Prodorsum	Postdorsum	Spiracular area	Epipleuron	Hypopleuron	Sternum	Prothorax
Mesothorax		Aa'a"			Hh	R	1
Metathorax		Aa'a"			Hh	R	2
Abdomen							3
1		Aa'	s'		H		4
2		Aa'a"	s's"		Hh		10
3–8		Aa'a"	s'		Hh		11
9		Aa'a"			Hh	v	16
10		Aa'a"					



8

Fig. 8. *Megacerus cubicus*. Lateral view of abdomen, showing chaetotaxy.

(A) and 2 secondary (a′ a″) setae; mesoepipleuron with ovoid spiracle; meso- and metapipleural regions without setae; hypopleural areas with 1 primary (H) and 1 secondary (h) setae; sternum with 1 primary (R) seta and 2–3 transverse rows of sharp, sclerotized projection. *Legs:* (Fig. 7) 2-segmented; each succeeding pair of greater length; transverse distance between paired appendages increasing with each succeeding pair; distal segment bearing flattened tarsus; proximal segment of prothoracic appendage with pair of short, laterally located tactile setae, 1 distal and 1 medially located; proximal segments of meso- and metathoracic appendages bearing short, laterodistal, tactile seta. ABDOMEN: (Fig. 8, Table 1) prodorsa of segments 1–9 asetiferous; first postdorsum with 1 primary (A) and secondary (a′) setae; postdorsa 2–9 with 1 primary (A) and 2 secondary (a′ a″) setae; segment 10 without prodorsum, bearing primary (A) and 2 secondary (a′ a″) setae; spiracular area of segment 1 with elongate, tapered, blunt spine; segments 1 and 3–8 with 1 secondary (s′) seta; segment 2 with 2 secondary (s′ s″) setae; spiracles slightly oval; epipleuron of segments 1–9 asetiferous; epipleuron absent on segment 10; hypopleuron of segment 1 with single primary (H) seta; hypopleura of segments 2–9 with single primary (H) and secondary (h) setae; hypopleuron of segment 10 bare: sterna 1–8 with 3–4 irregular rows of posteriorly directed, sharp, sclerotized projections; sternum of segment 9 with mediolateral, decurved, secondary (v) seta; sternum of segment 10 bare.

EGG: (Fig. 9) about 0.6 mm long by 0.3 mm wide; elongate, oval with posterior taper; single, ventral row of numerous, radiating, anchoring filaments, securing posterior ¾ of egg.

MATERIAL EXAMINED: 15 first instar larvae, Mexico. 8 mi S Benjamin Hill, Sonora, from morning glory seeds (species unknown), collected by C. D. Johnson. Determined by association with reared adults.

Significant characters include the presence of a single ocellus on each side; deeply cleft, bifid antennal segment bearing enlarged sensillum basiconicum at end of largest of two lobes; 1 + 1 + 3 or 4 arrangement of teeth on prothoracic plate; absence of chaetotaxy between anterior arms of prothoracic plate; presence of setae Hh on meso- and metathoracic hypopleural legs 2-segmented, with flattened tarsus; each succeeding pair of legs of increasing length; presence of setae Aa'a" on abdominal segment 10; presence of s's" on second abdominal segment and s' on segments 1 and 3–8; presence of seta H on first abdominal segment and setae Hh on segments 2–9.

Biological Notes

According to Teran and Kingsolver (1977), adults frequent the flowers of plants belonging to the following three genera: *Argyreia* (Tribe Argyreieae), *Ipomoea* and *Merremia* (Tribe Convolvulaceae). They also observed that the pollenophagous adults copulate and oviposit upon the calyx or seed surface.

The egg expresses two unusual characteristics. It lacks the "typical" broad band of cement so often associated with the bruchid egg (figs. 45, 3 and 4 in Pfaffenberger and Johnson, 1976). It instead, possesses a single, partially circumscribing row of radiating fibers which closely resembles the egg of *Merobruchus julianus* (Horn) (see fig. 1 in Forister and Johnson, 1970). However, the radiating fibers completely encircle the egg of *M. julianus* (Forister and Johnson, 1970) whereas in *M. cubicus* the fibers are restricted to the posterior three-fourths of the egg.

According to Forister and Johnson (1970), the radiating filaments are highly adaptive especially when oviposition occurs on immature seeds. The females of *M. cubicus* appear to prefer ripe seeds as sites of oviposition, but they also occasionally oviposit upon immature seeds (Teran and Kingsolver, 1977). If the latter should occur, the radiating filaments would seem to undergo extension more easily upon the surface of an expanding seed than would a broad, flat, layer of cement. Therefore, successful seed adherence is much more likely.

The second noticeable difference is the posterior taper of the egg which also appears to have adaptive significance. When the larva prepares to eclose through the ventral surface of the egg it draws its abdomen forward. The resultant increase in hydrostatic pressure (Pfaffenberger and Johnson, 1976) swells the anterior end of the body thereby engaging the abdominal spine and short, secondary setae on the inner surface of the tapering chorion. The ensuing purchase provides sufficient leverage necessary for the larva to chew its way through the ventral surface of the egg and to escape.

Structures associated with the egg and larva are not only of biological significance but also represent important phylogenetic clues. Therefore, it is suggested that information of *M. cubicus* be compared to that available on other species (Pfaffenberger and Johnson, 1976; Prevett, 1971).

According to Teran and Kingsolver (1977), the first instar will eclose through the dorsal and/or ventral surface of the egg. However, those choria examined in this study indicate ventral eclosion (Fig. 9). Eclosion will occur upon the surface of the fruit or calyx and the larva will immediately penetrate the underlying seed. Since eggs may be oviposited singly or in multiples upon a host seed and since one larva matures within a single seed (Teran and Kingsolver, 1977), it appears as though larvae may be cannibalistic.

A more in-depth discussion of the biology of *Megacerus* sp. (including lists of host plants) is provided by Teran and Kingsolver (1977).

Phylogenetic Discussion

The tribe Megacerini belongs in the subfamily Bruchinae (Bottimer, 1968). According to Kingsolver (personal communication), of the four tribes within this subfamily, adult Megacerini appear to be more closely related to the adult Bruchini.

Major characteristics of the first instar of this species seem to support the placement of the tribe Megacerini within the subfamily Bruchinae. These characteristics do nevertheless expose some rather significant phylogenetic ties with the first instar larvae of the tribe Bruchidiini, especially with members of the genus *Bruchidius* (Prevett, 1971).

The prothoracic plate of *M. cubicus* strongly resembles that of *B. schoutedeni* (see fig. 26, G in Prevett, 1971). The fact that the teeth are arranged in a similar manner and that three pairs of setae are found upon the plate, rather than between the anterior arms, is highly significant. Moreover, the legs of *B. schoutedeni* and *M. cubicus* are two-segmented and bear a flattened tarsus (cf. figs. 25, C and E in Prevett, 1971). These weighted similarities seem to indicate a stronger affinity with the Bruchidiini than had been previously assumed.

These larval similarities merely suggest that a closer examination is needed of the assumed phylogenetic relationships among the adults. These assumptions are, however, based entirely upon first instar characteristics of a single species within the tribe Megacerini. Therefore, before sound recommendations can be made, characteristics of first and final larval instars of several species must be examined.

Acknowledgments

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