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SHORT COMMUNICATIONS

FINE STRUCTURE OF THE EGG CHORION IN TWO ANISOPTERAN DRAGONFLIES FROM CENTRAL INDIA (LIBELLULIDAE)

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The fine structure of the egg chorion in *Brachydiplax sobrina* (Ramb.) and *Orthetrum s. sabina* (Dru.), is described using the scanning electron microscope. The unwetted eggs of *B. sobrina* are bluish-green and spindle-shaped while those of *O. s. sabina* are oval and light brown in colour. The egg chorion is distinctly divided into an outer exochorion and an inner tough endochorion. The exochorion expands into a thick, sticky, jelly-like structure in water during oviposition, whereas the endochorion remains unchanged. The endochorion is thin and smooth in *O. s. sabina*, but in *B. sobrina* the undersurface of the endochorion is pitted and rough. The apical micropylar apparatus is composed of a sperm storage chamber (atrium) and a median projecting stalk, which possesses a pair of sub-terminal orifices. The atrium in *B. sobrina* is dome shaped with a tiny stalk whereas in *O. s. sabina* the micropylar apparatus is triangular with a longer stalk and a pair of almost apically placed orifices. Significant variations occur in the shape and size of the micropylar apparatus. The functional interrelationship of the micro morphological modifications in the chorionic structures is discussed.

INTRODUCTION

Scanning electron microscopic studies of the insect egg chorion have yielded important information of great taxonomic and functional significance (HINTON, 1981; MARGARITIS, 1985). In Odonata, however, such studies are confined to only a few species (MILLER, 1987; IVEY, et. al.,1988; BECNEL & DUNKLE, 1990; TRUEMAN, 1990; 1991; SAHLEN, 1995; MAY,1995), including five from India (ANDREW & TEMBHARE, 1992, 95, 96; ANDREW, 2002; ANDREW et. al., 2006).

The present work was undertaken to study the fine structure of post-oviposition changes in the egg chorion of the anisopteran, *Brachydiplax sobrina* (Rambur) and *Orthetrum s. sabina* (Dru.).

MATERIAL AND METHODS

Egg-laying female dragonflies were collected during the post-monsoon period (July-Sept, 2002-2005). The unwetted fertilized eggs were collected from the sub-genital plate by holding the wings flat and mimicking the dipping action or by passing a needle through the thorax which initiated egg shedding. Wet eggs were obtained by placing the abdominal tip in water containers to initiate egg shedding (ANDREW & TEMBHARE, 1995). Some eggs were also obtained by dissecting the oviduct and vagina. The exochorion of a few eggs was removed using fine tipped forceps or 10% KOH treatment (TRUEMAN, 1991). The eggs were processed for SEM by the methods described by ANDREW & TEMBHARE (1992, 1995).

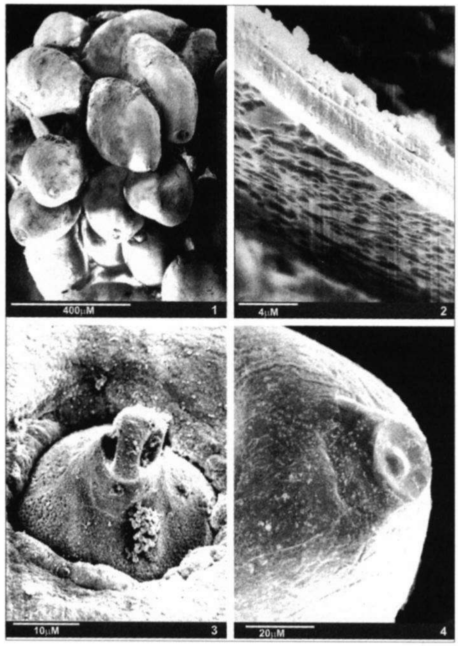
RESULTS

BRACHYDIPLAX SOBRINA (Figs 1-4). – The unwetted eggs collected from the subgenital plate of the female are small, bluish-green in colour and spindle shaped with linear dimensions of 360 ± 20 x 230 ± 15 µm. In water, the exochorion swells into a spongy, sticky, jelly-like structure and the eggs now measured 370 ± 20 x 270 ± 15 µm. The endochorion is tough and 4.5 µm thick. Its undersurface is pitted and rough. The micropylar apparatus is well differentiated from the exochorion by a circular depression (Figs 1, 3) which corresponds to the pedicel of the endochorion (Fig. 4). The micropylar apparatus is composed of a very large dome-shaped sperm storage chamber (atrium) about 55 µm in diameter and a micropylar stalk which is flat and short (10 µm), with a pair of large (7 µm in diameter) orifices (Fig. 3). The endochorionic circular pedicel is well developed. It is ridged with a central hump and is located just below the micropylar apparatus (Fig. 4).

ORTHETRUM SABINA SABINA (Figs 5-8). The unwetted fertilized eggs are oval, pale brown and lightly sticky with linear dimensions of 370 ± 25 x 260 ± 15 µm. In water, the exochorion swells into a spongy, sticky structure and the dimension of the egg changed to 385 ± 20 x 310 ± 15 µm. The endochorion is smooth and is 5 ± 2 µm thick (Figs 6, 7). It is devoid of articulations and bears a tiny apical pedicel. The micropylar apparatus is triangular, nipple shaped, with a diameter of 38 µm at the base. The micropylar stalk is 30 µm long with a pair of circular almost apical orifices which are 5.5 µm in diameter (Figs 5, 8).

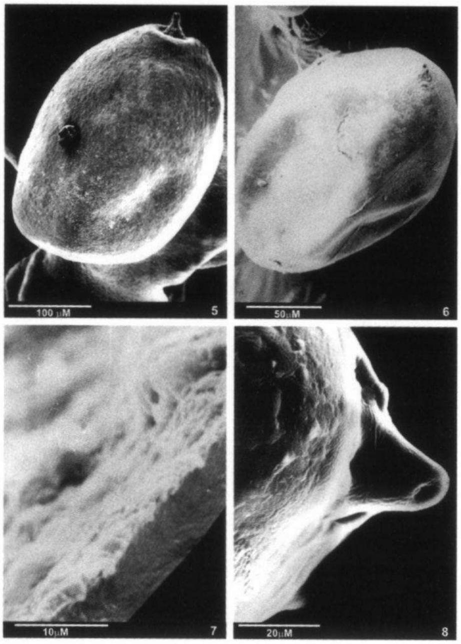
DISCUSSION

The libellulids *B. sobrina* and *O. s. sabina* exhibit an exophytic mode of oviposition where the eggs during oviposition extrude from the genital opening and accumulate under the ninth abdominal sternum on the sub-genital plate and are then washed-off by flicking the abdominal tip in the water, as reported for a large number of dragonflies (CORBET, 1999). In libellulids that exhibit an exophytic mode of oviposition, the eggs are generally oval/subspherical to facilitate quick sinking to avoid being consumed by fishes and other aquatic animals. Furthermore, these eggs can easily settle in small recesses in the substrate of the water body (CORBET, 1962). The exochorion of the libellulids *B. sobrina* and *O. s. sabina* exhibits typical libellulid fine morphological changes in water by swelling into a sticky spongy jelly-like mass (TRUEMAN, 1991; SAHLEN, 1995; ANDREW & TEMBHARE, 1996: ANDREW, 2002). The expanded thick exochorion protects the growing embryo and firmly anchors the egg. It further provides extended areas for tiny particles to stick to it and form a protective camouflage. The swelling in *B. sobrina* is comparative less then that observed in *O. s. sabina*. This is probably due to differences in the water body used for oviposition. *O. s. sabina* oviposits in shallow still water or slow moving roadside water puddles whereas *B. sobrina* oviposits in much deeper water bodies (MITRA 2006). SAHLEN (1995) observed that ions in the water and overwintering of eggs also affect the degree of expansion of the exochorion.



Figs 1-4. SEM micrographs of *Brachydiplax sobrina* (Rambur): (1) cluster of unwetted spindle-shaped eggs showing the apical micropylar apparatus; – (2) fractured section of the egg showing the pitted undersurface of the endochorion; – (3) side view of the micropylar apparatus showing the micropylar orifice on a short micropylar stalk; note the dome-shaped sperm storage chamber; – (4) egg without exochorion showing the ridged, conspicuous, circular pedicel with a prominent central hump.

The endochorion of exophytic eggs is generally unsculptured as found in *O. s. sabina*, but the undersurface in *B. sobrina* is pitted and rough. A sculptured outer surface of the endochorion has been reported in *Ladona deplanta* (IVEY et. al., 1988) and *Bradinopyga geminata* (ANDREW & TEMBHARE, 1996). The pedicel of the endochorion is well developed in both species studied but in *B. sobrina* it is projecting and heavily ridged with a central hump, as found in *R. v. variegata* (ANDREW & TEMBHARE, 1994). An endochorionic pedicle is observed in most of the libellulid eggs examined under the SEM (IVEY et. al., 1988;



Figs 5-8. SEM micrographs of *Orthetrum s. sabina* (Drury): (5) wetted egg showing expanded sticky exochorion and anterior micropylar apparatus; – (6) unwetted egg with the exochorion peeled off showing the smooth endochorion; – (7) fractured section showing the thin, tough endochorion; – (8) micropylar apparatus with a triangular stalk and almost apical micropylar orifice.

TRUEMAN, 1991; ANDREW & TEMBHARE, 1996) although SAHLEN (1995) did not observe the pedicel while studying libellulid eggs under the SEM.

SEM studies of the micropylar apparatus have disclosed an evolutionary pattern in Anisoptera, since a progressive reduction in the number of micropylar orifices is noticed from 14 in Pelaturidae to 2 in Libellulidae. This reduction requires less sperm material for fertilization and accelerates the rate of oviposition (IVEY, et. al., 1988). The micropylar apparatus is also used as an important taxonomic tool in the classification of closely related species of odonates (MAY, 1995).

In the present study, the dragonflies exhibit a typical 'libellulid' micropylar apparatus (TRUEMAN, 1991), but the large dome-shaped chamber and humped pedicel of *B. sobrina* is similar to that of *R. v. variegata*. The circular depression of exochorion around the micropylar apparatus is well developed in *B. sobrina* and a similar depression is found in the eggs of *R . v. variegata* and *Tramea virginia* (ANDREW & TEMBHARE, 1994; ANDREW, 2002). The flat and short micropylar stalk of *B. sobrina* is also unusual since most of the libellulids (excluding *T. virginia*) and *O. s. sabina* have cylindrical stalks (BECNEL & DUNKLE, 1990; SAHLEN, 1995; MAY, 1995; ANDREW & TEMBHARE, 1996; ANDREW, 2002). The micropylar stalk is modified in accordance with the shape and size of the fertilization pore of the vagina for rapid and efficient fertilization, as found in the libellulid, *T. virginia* (ANDREW & TEMBHARE, 1994).

In almost all odonates, the egg colour varies from yellowish brown to dark brown to black. K. Inoue (pers. comm.) observed bluish green eggs of *Macrodiplax cora* at Guam Island (USA) in the Pacific Ocean and *Hydrobasileus croceus* at Ishigaki Island in Ryukyu Archipelago, Okinawa prefecture, Japan. Thus *B. sobrina* is the third odonate species in the world to exhibit bluish green eggs and the first from the oriental region.

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