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Post Ovipositional Changes in the Egg Chorionic Ultrastructure of the Dragonfly *Pantala flavescens* (Fabricius) (Insecta: Odonata: Anisoptera)

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ABSTRACT : The ultrastructure of the egg chorion of the dragonfly, *Pantala flavescens* (Fabricius) is described using the light and scanning electron microscope. The egg of *Pantala flavescens* is oval and the chorion is distinctly divided into an outer exochorion and an inner endochorion. The egg measures about 720 ± 20 × 530 ± 10 µm in unwetted condition. The endochorion is light yellow, but turns brown within a few hours in water. The exochorion which envelopes the endochorion as a thin covering which expands into a transparent thick, sticky, jelly-like structure when it comes in contact with water and therefore, the egg in wet condition bloats and measures 870 ± 20 × 550 ± 20 µm. The apically placed micropylar apparatus is nipple shaped, formed of a small sperm storage chamber (atrium) and a median projecting micropylar stalk. The stalk is of 'concave cone' type and possesses a pair of subterminal orifices. A circular groove demarcates the exochorion and the micropylar apparatus.

Keywords : Egg, Chorion, *Pantala flavescens,* Dragonfly.

INTRODUCTION

Pantala flavescens (Fabricius) is not only the most widespread dragonfly on the earth but is the most common libellulid dragonfly of the Indian subcontinent. It flies in large swarms with the monsoon winds and its arrival in the subtropics and tropics regions coincides with the Intertropical Convergence Zone. It is also recorded to migrate from India to Africa across the Arabian Sea. After mating, it flies in tandem and oviopsits in almost all types of shallow waterbodies including road side puddles and water accumulated on terrace of buildings (Corbet, 1999; Subramanian, 2005; Anderson, 2009). *Pantala flavescens* exhibits a typical exophytic mode of oviposition where the eggs during oviposition extrude from the genital opening, accumulate under the sub-genital plate and are then washed off by flicking the abdominal tip in water (Corbet, 1999).

In Odonata, the egg chorion is an extensively modified, dynamic structure with major taxonomic and phylogenetic significance (Corbet, 1999). The chorion not only provides protection and vital facilities to the developing embryo (Hinton, 1981; Margaritis, 1985) but also undergoes ultrastructural changes in the aquatic medium after oviposition (Miller, 1987; Andrew and Tembhare, 1992, 1995, 1996; Miller, 1987; Trueman, 1990, 1991; Sahlen, 1995; Andrew, 2002, 2009). Dragonflies are amphibiotic; the larvae are aquatic while the adults are aerial. The female odonates therefore lay eggs in or around the water body but exhibit various adaptations in their mode of oviposition. The shape of the egg and the ultrastructure of the chorion greatly modified in accordance with the mode of oviposition (Corbet, 1999, Miller 1985).

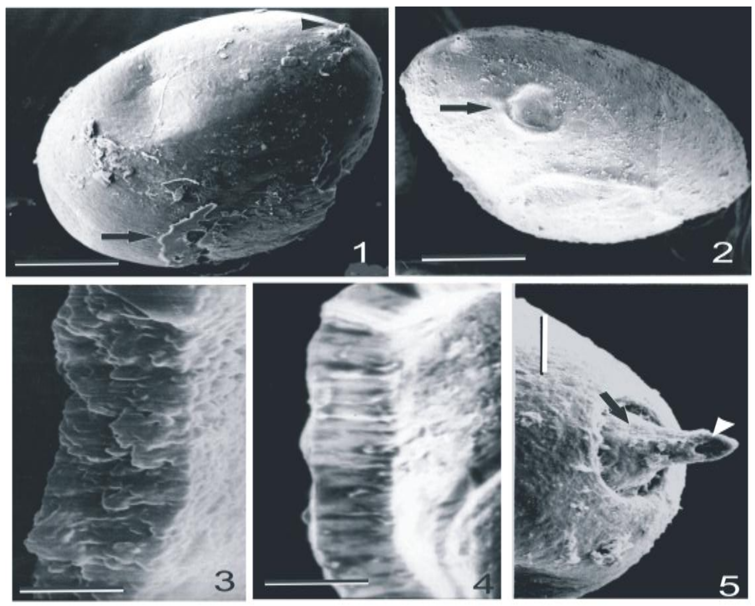
The studies on the ultrastructure of the egg chorion in Odonata is confined to only a few species (Miller, 1987, 1991; Miller & Miller, 1985; Trueman, 1990, 1991; Sahlen, 1995; May, 1995; Ivey et al., 1988; Becnel & Dunkle, 1990; Gaino et al., 2008) including some from the India subcontinent (Andrew & Tembhare, 1992, 1995, 1996; Andrew, 2002, 2009). The present work was undertaken to study the post ovipositional changes in the egg chorion of the dragonfly *Pantala flavescens* (Fabricius).

MATERIAL AND METHODS

Egg laying females were collected during the post monsoon period around the waterbodies of Nagpur city. The unwetted fertilized eggs were collected from the subgenital plate by holding the wings flat and by mimicking the dipping action or by passing a needle through the thorax which initiated egg shedding. Wet eggs were obtained by dipping the abdominal tip in water container to initiate egg shedding (Andrew and Tembhare, 1995). The eggs were dehydrated in ethanol, transferred to acetone, air dried, mounted on stubs, gold coated and examined under the JEOL 6380A scanning electron microscope. The nomenclature of Trueman (1991) is used to describe the various components of the egg.

RESULTS AND DISCUSSION

Freshly laid unwetted eggs of *Pantala flavescens* are pale yellow, oval/spheroid, slightly sticky and measure about 720 ± 20 × 530 ± 10 µm (Fig.1). The chorion is distinctly divided into an outer exochorion and an inner endochorion. The exochorion is thin transparent and smooth and forms a covering which can be easily detached from the endochorion. In water, the exochorion expands into a transparent, thick, sticky jelly-like structure and the egg bloats and measures 870 ± 20 × 550 ± 20 µm (Figs. 2, 3). The sticky exochorion of adjacent eggs fuse in wet condition to form an egg-mass. The endochorion is unsculptured, tough and about 6-8 µm thick (Fig. 4). It does not undergo any significant morphological change in water except for a change in colour from yellow to light brown within an hour and later darkens to dark brown. A micropylar apparatus is located at the anterior end of the egg and is well defined from the exochorion by a circular groove. The micropylar apparatus is nipple shaped 42 µm in length and has a diameter of 48 µm at the base. It is composed of a small basal sperm storage chamber (atrium) and a median projecting 24 µm long stalk, which is in the form of a concave sided cone (Fig. 5). The stalk possesses a pair of subterminal orifices (diameter- 6.5-7 µm). The sticky exochorion of adjacent eggs fuse in water to form an egg-mass.



Figs. 1-5. SEM micrographs of the eggs of Pantala flavescens: Fig. 1. Unwetted egg with partially removed exochorion. Note the thin, easily detachable exochorion (arrow), smooth endochorion and apical micropylar apparatus (arrow head) [bar = 80 µm]. Fig. 2. Wet bloated egg with spongy, soft (arrows) exochorion [bar = 120 µm]. Fig. 3. Section of the exochorion displaying spongy nature [bar = 5 µm]. Fig. 4. Section of endochorion showing compact nature without any reticulations [bar = 10 µm]. Fig. 5. Micropylar apparatus exhibiting a tiny atrium (arrow), cylindrical micropylar stalk with subapical micropylar orifice (white arrow head). Note the circular depression differentiating micropylar apparatus and exochorion [bar = 20 µm].

The egg of *P. flavescens* is oval/spheroid which is a common feature of libellulid exophytic eggs (Miller, 1985). This shape helps to facilitate quick sinking of the egg in the water body and to avoid being consumed by fishes and other aquatic animals. Further, these eggs can easily settle in small recesses on the floor of the water body. The exochorion of *P. flavescens* swells into a sticky spongy jelly-like mass in water. The expanded sticky exochorion not only protects the growing embryo but firmly anchors the egg to the substrate. It also provides an extended area for tiny particles to stick to it and forms a protective camouflage (Corbet, 1999). The swelling of the exochorion of *P. flavescens* is not as pronounced and thick as that of *Orthetrum s. sabina* and *Rhyothemis v. variegata* (Andrew and Tembhare, 1996; Andrew 2009). Variation in the expansion of exochorion is probably dependent upon the type of water body used for oviposition or might be a species specific characteristics (Andrew & Tembhare, 1990). According to Sahlen (1995), ions in the water and overwintering of eggs might have a major role in the degree of expansion of the exochorion. In *Synthemis regina* the exochorion is sculptured with conspicuous pattern of follicle cell impression, where as in *Nannophlibia risi*, faint outline of follicle cell impressions are found around the anterior pole (Trueman, 1991), in *P. flavences*, the exochorion does not exhibit any follicle cell impressions.

Although sculptured endochorion has been reported in *Landona deplanta* (Ivey *et al.*, 1988) and *Bradinopyga geminata* (Andrew and Tembhare, 1996; Andrew *et al.*, 2006) the endochorion of *P. flavescens* is unsculptured as reported in many libellulid dragonflies (Trueman, 1991; Andrew and Tembhare, 1996; Andrew 2009). The colour of the endochorion in majority of libellulid including *P. flavescens* changes from different shades of pale yellow to yellow-brown and gradually darkens to brown (Trueman,1991), but bright blue/green coloured endochorion is reported in some tropical libellulids like *Brachydiplax chalybea*, *Brachydiplax farinose* and *Brachydiplax sobrina* (Corbet, 1999; Andrew, 2009). The micropylar apparatus of *P. flavescens* is 'libellulid type' (Trueman, 1991; May, 1995), nipple shaped with a tiny atrium (sperm storage chamber) and a short stalk possessing a pair of apical micropylar orifices. Tiny atrium is also found in the eggs of *O. s. sabina*, *R. v. variegata* and *B. geminata* whereas the micropylar apparatus of *Tramea virginia* and *Brachydiplax sobrina* possess a large dome shaped atrium (Andrew and Tembhare, 1996; Andrew, 2002, 2009). The micropylar stalk is cone shaped in *B. geminata*, humped in *B. sobrina* and cylindrical in *Zyxomma petiolatum* (Andrew and Tembhare, 1995, 1996; Andrew 2009). The micropylar stalk of *P. flavescens* is the 'concave cone' type as reported in some american (May, 1995) and australian (Trueman, 1999) libellulids. According to Andrew (2002) the micropylar stalk is modified in accordance to the shape and size of the fertilization pore of the vagina. Corbet (1999) observed that there was a phylogenetic pattern of progressive reduction in the number of micropylar orifices from the most ancient family (Epiphlebiidae) having 12-14 to the most recent (*Libellulidae*) having only 2 micropylar orifices. Along with this reduction there is also a trend towards progressive clustering of micropylar orifices near the centre of the anterior pole of the egg culminating in two micropylar orifices located close to the tip of the micropylar stalk as found in *P. flavescens*. The micropylar orifices decrease follows a phylogenitic pattern, the most ancient families have a circular groove, demarcating the exochorion around the micropylar apparatus of *P. flavescens* has also been reported in the libellulid *T. virginia*, *B. sobrina* and *R. v. variegata* (Andrew and Tembhare, 1996; Andrew, 2002, 2009).

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