The Description of the Eggs of *Toxorhynchites moctezuma* (Diptera: Culicidae) from Trinidad, West Indies With notes on other eggs.

by

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ABSTRACT. A description of the eggs of *Toxorhynchites moctezuma* is presented, accompanied with photographs using both light and electron microscopy. Field observations on the oviposition behavior of this species are also described. In addition, the eggs of five *Toxorhynchites* species are compared and three photographed.

INTRODUCTION

Previously, Mattingly (1969) has described the eggs of *Toxorhynchites brevipalpis* Theobald, *Tx. rutilus* (Coquillett) and *Tx. splendens* (Weidemann) and reviewed the work of various earlier descriptions of *Toxorhynchites* eggs (Muspratt 1951, Breland 1949, Michener 1947, Green 1905, Banks 1908, Paine 1934, Newkirk 1947 cited by Mattingly 1969). Subsequently, descriptions of the egg morphology of *Tx. brevipalpis* and *Tx. rutilus* (Lamb and Smith 1980), *Tx. ambionensis* (Steffan et al 1980), *Tx. splendens* (Furumizo and Rudnick 1978) and *Tx. brevipalpis* (Trpis 1972) were reported using photographs rather than drawings but no comparative study based on the egg morphology has been conducted.

Recently, the eggs of *Tx. moctezuma* Dyar and Knab were received from E. S. Tikasingh from the Caribbean Epidemiology Centre, Trinidad and from field collections made during the University of Dundee Trinidad Expedition. This afforded us the opportunity of describing the eggs of *Tx. moctezuma* and also comparing the distinguishing features present on *Tx. brevipalpis, Tx. ambionensis* and *Tx. moctezuma* egg surfaces. The nomenclature used in the description of these eggs follows that of Harbach and Knight (1980).

DESCRIPTION OF THE EGG

The eggs of *Tx. moctezuma* are white when newly laid but as chorionic development progresses, the eggs' color changes from white to light yellow within an hour, thereafter changing to slightly pinkish-brown and finally grey prior to hatching. The measurements of the length of the eggs varied from 0.765 to 0.790mm in length, with the mean being 0.777 $\pm$ 0.001mm (N=10). The width of the

egg varies from 0.530 to 0.565mm, with the mean width being 0.548± 0.001 (N=10) at the broadest point.

The egg is ovoid in shape and covered with a granular substance forming small chorionic tubercles relatively sparsely distributed over all regions of the eggs with distinctly larger tubercles near the anterior polar specialized area (see Plate 1). The micropyle apparatus measures 0.05mm across with a gently raised micropylar disc, but no distinguishable corolla present. A similar observation was made by Mattingly (1969) while working with *Tx. theobaldi*, a synonym of *Tx. moctezuma* (Heinemann 1984, in litt. to E. Tikasingh).

On hatching the *Tx. moctezuma* eggs split transversally and more or less equatorially, but dehiscence is incomplete.

FIELD OBSERVATIONS ON OVIPOSITION

Toxorhynchites moctezuma like all other members of the genus lay eggs singly while performing a characteristic oviposition flight. On first approaching the oviposition site the female starts a looping flight about 16-20cm above and slightly to the side of the container. She then gradually descends, still looping until, just before oviposition, she may be only about 2cm above the water surface. Oviposition is achieved during an exaggerated downward loop at the bottom of which the egg is projected onto the water surface. The number of eggs laid within the same container varied from 1 to 4 eggs (Chadee et al 1987, O'Malley 1986).

Studies conducted on the diel oviposition periodicity in the field have shown that *Tx. moctezuma* laid between 12.00 to 18.00 hours with a major peak occurring between 14.00 and 16.00 hours (Chadee et al 1987). However, in a follow-up study using a different collection technique, a slightly different oviposition pattern was observed with a 13.00 hours (suntime) peak. This variation in the oviposition peak may be attributed to early morning rains which occurred during the Chadee et al (1987) study (Chadee unpublished data, O'Malley 1986). Between ovipositions, females have been observed resting on the leaves of saplings of *Lecythis zapucajo* at the Simla Research Station, Trinidad and more recently have been seen feeding on flowering plants in Trinidad, W. I. (see Plate 1G).

In the field the types of containers patronized by ovipositing *Tx. moctezuma* ranged from natural to artificial containers. Heinemann et al (1980) reported the collection of *Tx. moctezuma* immatures in bromeliads, treeholes and in some artificial containers. The artificial containers used include water drums (60%), cans (18%), tires (16%), basins (4%) and buckets (2%) (Chadee 1985). Because *Tx. moctezuma* females use artificial containers and have been found co-habiting in numerous oviposition sites with *Aedes aegypti* Linn., this species has been considered as a suitable candidate for biological control trials by augmentative release (see Chadee 1985, Chadee 1986).

DISCUSSION

Table 1 compares the similarities and differences in the shape of the egg, the length and width of five *Toxorhynchites* species based on actual measurements and observations found in the literature. From the length and width measurements (see Table 1) many of the species cannot be clearly distinguished and this may not be a useful tool in the separation of these egg species. However, on examination of the electron micrographs it is clear that significant morphological differences exist on the exochorion of the three species examined (see Plate 1). The results of this study suggest that, based on both light and electron miocroscopy useful diagnostic features can be discovered to aid in mosquito egg taxonomy.

From the photographs in Plate 1 and Table 1 it can be seen that all the *Toxorhynchites* eggs described herein are of a similar shape except that *Tx. brevipalpis* which possesses a "crown like" micropylar apparatus. The uniqueness of *Tx. brevipalpis* eggs extends also to the position they assume with respect to the water surface and walls of the containers in which they have been laid. All the other eggs studied possess a strong hydrophobic exochorion which enables them to lie horizontally on top the surface of the water. These eggs, therefore tend to move down the meniscus of the water in the container causing clumping of eggs in the middle (Furumizo and Rudnick 1978, Riviere et al 1978). Although the eggs of *Tx. brevipalpis* are buoyant, only the micropylar apparatus surrounding the micropyle is hydrophobic. This keeps the micropyle clear of water, while the rest of the egg remains vertical below the water surface. The buoyancy of the *Tx. brevipalpis* eggs takes them up to the sides of the meniscus and they are therefore normally found near the side of a container.

The significance of the positioning of the *Toxorhynchites* eggs with respect to the water surface has so far not been addressed. It seems probable that it is partly to do with reducing the risk of egg predation. Certainly, floating on top of the water surface or, in case of *Tx. brevipalpis* eggs, near to the walls of a container, would make the eggs less conspicuous to an aquatic predator.

The eggs of *Tx. brevipalpis* are also unique here in their mode of dehiscence. While the dehiscence pattern of the eggs *Tx. moctezuma, Tx. ambionensis* and *Tx. splendens* (Mattingly 1969) occurs more or less equatorially, *Tx. brevipalpis* dehiscence is apical and incomplete.

The changes in color found during the egg maturation of *Tx. moctezuma* noted during this study has also been observed for *Tx. splendens* (Furumizo and Rudnick 1978). It is possible that these changes might be used as an indicator of when eggs have been laid in the field. However, before this could be done, one would have to determine the effect of temperature and humidity on egg maturation in the species of *Toxorhynchites* being studied.

It should be noted that none of the eggs described during this study have the ability to withstand desiccation.

Table 1. Comparison of the five *Toxorhynchites* egg species showing their similarities and differences in shape, and in their length and width measurements.

Species	Shape	Length (mm)	Width (mm)	References
Tx. ambionensis	ovoid	0.566 ± 0.05	0.444 ± 0.04	Present study
Tx. brevipalpis	barrel	0.476 ± 0.02	0.311 ± 0.01	Trpis 1972
Tx. brevipalpis	-	0.604 ± 0.06	0.361 ± 0.05	Lamb & Smith 1980
Tx. brevipalpis	barrel	0.563 ± 0.01	0.349 ± 0.02	Present study
Tx. moctezuma	ovoid	0.777 ± 0.01	0.548 ± 0.01	Present study
Tx. rutilus	-	0.783 ± 0.02	0.531 ± 0.04	Lamb & Smith 1980
Tx. splendens	rugby ball	0.700	0.400	Furumizo & Rudnick 1978

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Plate 1. Showing the differences in the egg morphology of *Toxorhynchites ambionensis*, *Tx. brevipalpis* and *Tx. moctezuma*.

A. Whole egg morphology of *Tx. brevipalpis*
B. Characteristic shape of the exochorion of *Tx. brevipalpis*
C. Whole egg morphology of *Tx. ambionensis*
D. Characteristic shape of the exochorion of *Tx. ambionensis*
E. Whole egg morphology of *Tx. moctezuma* (eggs preserved in formalin)
F. Characteristic shape of the exochorion of *Tx. moctezuma*
G. Adult *Tx. moctezuma* feeding on a flowering plant in Trinidad, W. I. (Photo courtesy K. G. Preston-Mofham)