Notes on the female reproductive system of the 
South African Citrus Psylla, Trioza erytreae (Del Guercio) 
(Homoptera : Psyllidae) 

by 

J. R. BLOWERS and V. C. MORAN 

Department of Zoology and Entomology, Rhodes University, Grahamstown

INTRODUCTION

The following is a morphological investigation, supplemented by histological data, of the female reproductive system of the South African Citrus psylla, Trioza erytreae (Del Guercio). Although studies of the female reproductive system have been made for several species of psylla (Witlaczil, 1885 cited by Imms, 1957; Awati, 1915; Weber, 1930) no work has been done on the reproductive system of T. erytreae. The present study has been made to fill this gap and it forms part of a wider biological study of this economically important insect.

MATERIAL AND METHODS

All animals used in this study were from a stock culture maintained in the laboratory. Material was fixed in either Bouin or Carnoy fixatives. The morphology of the reproductive systems was examined from whole mounts of the systems dissected out in alcohol after fixation, stained with borax carmine and mounted in glycerine.

For histological purposes the tissues were prepared in two ways. Either the whole abdomen was fixed, or the organs exposed by vivisection before fixation and stained with borax carmine to render them visible under the stereo-microscope. External genitalia were left intact to aid in handling the small and very delicate tissues. All tissues were dehydrated rapidly, half an hour in each alcohol, cleared in cedar-wood oil and embedded in 54°C paraffin wax. Sections were cut to a thickness of 6 μ. Mallory’s triple stain was used as described by Pantin (1964) which is a good differentiating stain while Mann’s methyl blue-eosin was used for nuclear differentiation.

THE FEMALE REPRODUCTIVE SYSTEM

The reproductive system of a three day old female Trioza erytreae (fig. 1a) comprises a pair of ovaries each with 25 to 30 ovarioles irregularly arranged at the distal end of each oviduct. The oviducts unite to form the common oviduct into which open a pair of tubular accessory glands. A single spermatheca is present ventral to the accessory glands and common oviduct, together with a thin-walled diverticulum of the vagina, possibly the bursa copulatrix. A spherical cement gland leads via a long cement duct to the distal portion of the genital chamber. This system is essentially similar to that of Psylla mali Schmidberger (Weber, 1930).
In the fifth instar nymph of *T. erytreae* (fig. 1b) all the organs present in the adult reproductive system are visible but the system is less developed and folded on itself. In the fourth instar nymph minute ovaries can be found but the reproductive system was not visible in the third stage nymph.

**The Ovarioles**

Each ovariole (figs. 2a and b) consists of a mass of densely packed nucleate cells, the germarium, which forms the apex of the ovariole and which lacks a terminal filament. Typical of the Hemiptera, the ovariole is of the acrotrrophic type, i.e. the cells providing nutrients to the developing oocytes are situated in the germarium and nutrients pass down to the oocyte by means of a nutritive cord of cytoplasm. In Hemiptera, the trophic cord usually extends from the centre of the germarium which is known as the trophic core. The trophic core was not visible in histological section of the ovarioles in *T. erytreae* and it is concluded that the nutritive cells in this insect are not concentrated in the centre of the germarium.

At emergence of the adult, oocyte development has progressed very little from the stage found in the fifth instar nymph, a single oocyte having started to develop (fig. 2a). As the oocyte enlarges and becomes surrounded by follicular cells, several small oocytes develop just below the germarium (fig. 2b). The number of follicles is small, normally two. By the third day after emergence a few eggs have reached maturity and these can be seen passing down the oviduct (fig. 1a). The period of three days required for the development of the first mature eggs correlates with the preoviposition period which has been found in this species. Van der Merwe (1941) quotes a preoviposition period which is normally from five to seven days and this is in general agreement with our findings (Moran & Blowers, 1967) where the normal preoviposition period was found to be three to six days.

**Cement Gland**

The cement gland (fig. 2c) comprises a single layer of large glandular epithelial cells in which a darkly staining secretion is visible. The material from the cement gland is secreted through a single pore in each cell into the lumen of the gland. Here the secretion forms a compact mass some of which is visible in the cement duct which has a distinct chitinous lining. Sections of the eggs and the leaf on which they were laid show that the secretion from the cement gland serves to secure the egg stalk in the leaf tissue. A similar gland is present in the aleurodids *Trialeurodes vaporariorum* (Westwood), the secretions of which fasten the egg to the leaf (Weber, 1931).

**Spermatheca, Bursa Copulatrix and Accessory Glands** (fig. 1a)

The spermatheca is a thin-walled organ with very large nuclei and although it has a large capacity for sperm storage it appears that more than one mating is required for the full complement of eggs to be laid. Bundles of sperm are clearly visible within this organ in the fertilized female. The bursa copulatrix is also thin-walled but has no visible contents in histological section. Weber (1931) names a similar organ in *Psylla*

---

**EXPLANATION OF FIGURES**

Fig. 1. The female reproductive system of *Trioza erytreae*. 1a. Lateral view of the system in a three day old adult. A single ovary only is figured. 1b. Ventral view of the system in a fifth instar nymph.
mali an accessory gland but no glandular function can be attributed to this diverticulum in T. erytreae as no glandular cells were found. The cellular structure of the tubular accessory glands is more suggestive of a glandular function, the cells have a deeply invaginated outer cell membrane. From this study, however, no definite function can be attributed to the accessory glands.

Eggs

The eggs are smooth and yellow in colour and each possesses a stalk or pedicel at its posterior end (fig. 3a) which is inserted into the leaf tissue when the egg is laid. A similar process was found in the eggs of P. mali by Lees (1916) and in members of the closely related family of Homoptera, the Aleurodidae, which Weber (1931) and Poinar (1965) maintain has a moisture absorbing function. The function of the egg stalk in T. erytreae, other than as a means of attaching the egg to the leaf, is not certain, but it is likely also to be used in water absorption. Circumstantial evidence is in favour of this suggestion.

Lees (1916) working on Psylla mali and Van der Merwe (1941) working on T. erytreae, observed that the eggs of these psyllids collapse and shrivel when the leaf on which they are laid is cut off and allowed to dry, and this has been confirmed in the present study of T. erytreae. Experiments were carried out in which dyes were introduced into young leaves on which eggs of T. erytreae had been laid. Neither aniline blue nor eosin were taken up by the eggs although dye did reach the area of the egg stalk and stained the cement in this area. It is possible however that the egg stalk is not permeable to these dyes.

A noticeable feature of the egg (fig. 3a) is a spherical mass of short rod-like, “symbiotic” organisms which form the mycetome. Most Homoptera, in all stages of the life cycle, harbour these allegedly symbiotic micro-organisms (Imms, 1957; Wigglesworth, 1965). Proft (1937, cited by Steinhaus, 1946) examined 22 species of psyllids and found “symbionts” to be present in all of them. In adults of T. erytreae the symbions are confined to specialized cells which form two large masses or mycetomes lying just anterior to the reproductive organs. Each mycetome is composed of a central syncytium and a border of mononucleate cells, the mycetocytes (fig. 3b). The symbions of the syncytium appear to differ from those of the mycetocytes both in shape and staining properties, the former staining blue with Mallory’s stain and the latter staining purple.

Transmission of the micro-organisms in psyllids takes place during oogenesis by invasion of the egg at the posterior pole as described by de Wilde (1964) in his review of insect reproduction. The micro-organisms infect the egg passing from a depression at the posterior end of the oocyte either between or through the follicular cells, and are released into the yolk cavity with the nutritive stream (de Wilde, 1964). Evidence from histological sections of the developing egg in the abdomen of T. erytreae indicate that a similar method exists in this insect.

It is well known that high temperatures have been used to kill the micro-organisms found in insects and this technique has been used as a tool for establishing the role of these micro-organisms (Cleveland, 1924; Wigglesworth, 1965). It has been esta-

---

EXPLANATION OF FIGURES

Fig. 2. Longitudinal sections through ovarioles and cement gland in Triozia erytreae. 2a. The ovariole directly after emergence of the adult female. 2b. The ovariole in a mature female showing several developing oocytes. 2c. The cement gland and part of the cement duct in the adult female.
Fig. 3. Longitudinal sections through the egg (3a) and the mycetome (3b) in an adult female of *Trioza erytrea*. 
blished by Moran & Blowers (1967) that high temperatures (approximately 8 hours per day at 32°C) have an adverse effect on *T. erytreae*, preventing eggs from hatching, inducing high mortalities in all stages and inhibiting ovarian development in the adult female. At these high temperatures the mycetome shows a clear change in colour from yellow to bright orange in the adults and eggs, and in the latter, moves from its normal position. It is tempting to suggest that the effects of high temperature on the microorganisms in *T. erytreae* are contributing to the adverse effects noted when this species is subjected to high temperatures.

**SUMMARY**

1. The structure and development of the female reproductive system of *Triozerytreae* (Del Guercio) was investigated by morphological and histological methods.
2. On emergence the female psyllid shows little ovarian development and development of the first mature eggs requires at least three days, which is the normal minimal preoviposition period in this species.
3. The morphology and possible function of the various organs in the reproductive system and that of the egg stalk and mycetome is discussed.

**ACKNOWLEDGEMENTS**

Grateful acknowledgement is made by J. R. Blowers for financial assistance from the South African Council for Scientific and Industrial Research, and by V. C. Moran for a research grant received from the Department of Agricultural Technical Services, Republic of South Africa.

**REFERENCES**


Manuscript received January 11, 1967.