WHITE LARVA, A MUTANT IN THE MOSQUITO *TOXORHYNCHITES BREVIPALPIS* THEOBALD[1]

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ABSTRACT. A recessive mutant is described in *Toxorhynchites brevipalpis*. The mutant, white larva (*wl*), exhibits complete penetrance, segregates independently of sex, and can be determined in the larvae and pupae of both males and females.

INTRODUCTION

The genus *Toxorhynchites* of the family Culicidae is found world-wide from 40°N latitude to south of the edge of the southern tropics (Horsfall 1955). The genus comprises at least 65 species and 5 subspecies (Knight and Stone 1977; Belkin 1977). The potential value of the predaceous larvae of members of this genus as biological control agents of other mosquitoes has been stressed by many authors. Trpis (1973) states that larvae of *Tx. brevipalpis* may be at least as effective in the control of mosquito larvae as the larvivorous fish *Gambusia affinis*. It is of some importance that genetic information be accumulated for this species, since it is potentially a useful biological control tool. This paper describes the mutant "white larva" and its mode of inheritance. To the best of the authors' knowledge, this is the first mutant to be described for this species.

MATERIALS AND METHODS

The mutant white larva (*wl*) was first isolated in 1971 from a colony of *Tx. brevipalpis* maintained at the laboratories of Insect Control and Research, Inc., Baltimore, Maryland. This colony originated from collections made in an automobile dump in Dar es Salaam, Tanzania. Pure-breeding wild type and white larva (*wl*) strains were established by inbreeding. These strains were designated TOXY-WILD and TOXY-WL respectively.

Rearing methods used were generally similar to those described by Trpis and Gerberg (1973) for *Tx. brevipalpis*. Rearing was in an insectary room with a temperature of 27±2°C and ambient RH. Since the larvae of *Tx. brevipalpis* are cannibalistic, the freshly hatched larvae were separated and reared individually in small baby food jars (diameter 44mm, vol. 100 ml) containing 50 ml of water. Larvae of *Eretmapodites quinquevittatus* and/or *Aedes aegypti* were given to each *Tx. brevipalpis* larva as food. Pupae were sexed and placed individually in emergence cups made from pint-size cardboard containers. Upon emergence virgin females and males were selected for the experimental crosses. All experimental crosses, as well as colony maintenance, were conducted in cages measuring 28 cm wide × 30 cm deep × 44 cm high. Adult *Tx brevipalpis* were provided with 10% sucrose solution and/or fresh apples as a food source.

RESULTS AND DISCUSSION

DESCRIPTION. The normal larval color in *Tx. brevipalpis* is mahogany-red on the dorsal half with the ventral surface a greyish-white. This is in effect countershading. The newly hatched larvae are colorless. They turn greyish-white, then

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the dorsal surface turns reddish-brown during the late 1st and 2nd instars and darkens progressively until the very deep mahogany-red is attained in the 3rd and 4th instars. Microscopic observation suggested that the color was concentrated in particles in the fat bodies, and that the increase in the intensity of color with age was due to an increase in the number of particles. It is postulated that these particles may represent a metabolic by-product. These pigmented particles are also visible in the fat bodies between the sclerites of the pupae.

It is interesting to speculate on the possible adaptive significance of the counter-shading produced by the pigment distribution. In counter-shading if the darkest part faces toward the source of light, and the lightest from it, the body's own shadow so balances the color scheme that the outlines become dissolved (Portmann 1959). This would appear to be the case with *Tx. brevipalpis* where the dark pigmented surface is dorsal towards the light. The counter-shading would make the *Tx. brevipalpis* less visible to their prey as they float near the surface of the water waiting to snatch the prey. Also, the dark upper surface may help to make the *Tx. brevipalpis* larvae less visible to their predators against the dark background of the breeding sites. The counter-shading produced by the pigment distribution could have a definite selective advantage.

The mutant white larva (*wl*) is greyish-white to light pink on the dorsal half of the larvae with the ventral surface the same as in the normal. When newly hatched the *wl* larvae are colorless and then turn greyish-white. By the 4th instar the dorsal half of the larva may be a very light pink instead of the normal mahogany-red. Microscopic examination shows that the color is in particles in the fat bodies. It is postulated that the color change in the mutant is due to a change in the normal metabolic product that produces the mahogany-red in the normal larvae. The light pink particles are also visible in the fat bodies between the sclerites of the *wl* pupae. No morphological differences were noted between adults from the normal (TOXY-WILD) and *wl* (TOXY-WL) strains. The mutant shows complete penetrance. Figure 1 compares a normal and a white larva mutant of *Tx. brevipalpis*.

F_1 progeny from reciprocal crosses between wild type (TOXY-WILD) and white larva (TOXY-WL) were normal, indicating that *wl* is recessive. It was noted in the experimental crosses, as well as in the colony maintenance, that wild type females had excellent egg production with good hatch while the white larva females produced few eggs with poor hatch, regardless of whether the respec-

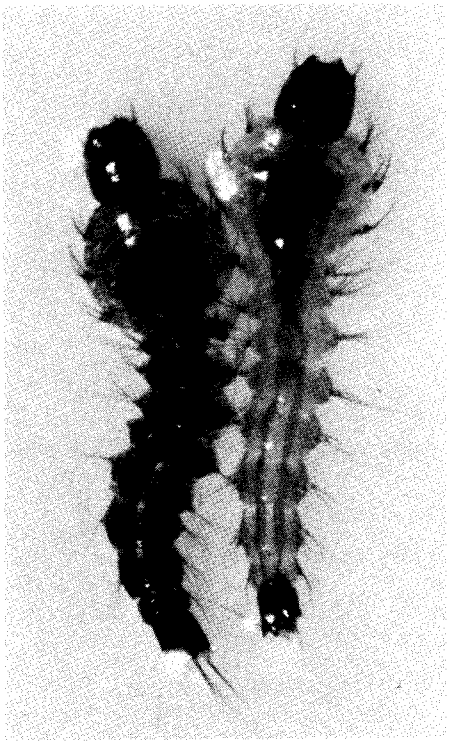

Fig. 1. Normal *T. brevipalpis* larva (left) and white larva (*wl*) mutant (right).

Table 1. Segregation of white larva (*wl*) in F_2 progeny.

P_1 Cross			F_2 Phenotypes			
Female		Male	+ Male	+ Female	*wl* male	*wl* female
Toxy-Wild	X	Toxy-Wl	29	32	10	3
Toxy-Wl	X	Toxy-Wild	No offspring produced			

tive females were inseminated by a wild type or white larva male.

LINKAGE. Table 1 gives the data obtained from crosses between F_1 individuals (approximately 4 pairs/cross) from reciprocal crosses. The detection of linkage, together with an examination of the concomitant segregation ratios, is easily carried out by means of a X^2 analysis (Bailey 1961). Such an analysis of X^2 for the F_2 progeny data is given in Table 2. The data indicate that *wl* is segregating independently of sex.

Table 2. Analysis of X^2 for F_2 Data.

Components	X^2	D. F.	Probability
Segregation for sex	0.2162	1	.70–.50
Segretation for +, *wl*	2.1802	1	.10–.05
Joint segregation	2.5946	1	.20–.10
Total	4.9910	3	.20–.10

Interestingly no F_2 progeny were obtained from the matings of white larva (TOXY-WL) females x normal (TOXY-WILD) males. The reasons for this are not known.

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