

*giensis* var. *israelensis* is generally acknowledged to be the outstanding microbial candidate for the biological control of insect vectors of disease. This aerobic, spore-bearing bacillus which exerts its larvicidal effect by virtue of its crystalline Delta-endotoxin has the following outstanding properties. (a) Rapid toxicity (b) Activity on a broad spectrum of insect vectors at low concentrations (Vankova et al. 1978) (c) Innocuity to man and non-target animal species (Garcia and Goldberg 1978). Furthermore, large scale commercial production is imminent.

Filariasis is endemic in Sri Lanka and occurs predominantly in the southwestern coastal belt of the island. The aetiological agent is *Wuchereria bancrofti* and the vector is *Cx. quinquefasciatus*. The principal breeding sites of the vector are husk pits (coconut coir-making excavations in the soil), catch pits (holes which drain latrine water), trenches, marshes and wells which are readily amenable to treatment with spore suspensions. If field trials confirm these laboratory findings, *B. thuringiensis* var. *israelensis* would be a vital weapon in the control of filariasis in Sri Lanka.

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- TUBIFEX WORMS AS AN ALTERNATE FOOD FOR THE MASS REARING OF THE MOSQUITO PREDATOR TOXORHYNCHITES AMBOINENSIS (DOLESCHALL)<sup>1</sup>**
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- Mosquito predators in the genus *Toxorhynchites* have received much attention because of their potential use as a biological control agent against vector mosquitoes. Field trials have been recently performed with *Tx. amboinensis* (Doleschall) in Tahiti (Riviere and Pichon 1978) and in Fiji (unpublished) and with *Tx. rutilus rutilus* (Coquillett) in the United States (Focks et al. 1979, 1980). The main requirement for this type of field work is the mass rearing of *Toxorhynchites*. This in turn necessitates the mass rearing of prey larvae. Both of these activities are time consuming and expensive. A cheap alternate food source for *Toxorhynchites* would greatly improve its potential for use as a biological control agent.
- Successful attempts have been made using a non-living diet (Focks et al. 1978, Trpis 1979). However, because of a longer development period (3 to 7 fold), these methods are impractical for mass rearing programs.
- Breland (1949) successfully reared *Tx. rutilus septentrionalis* (Dyar and Knab) on living adult *Drosophila* while Holzapfel and Bradshaw (1976) reared the same species on a variety of other live food: first instars—*Artemia* (Crustacea), second and third instars—*Enchytraeus* (Oligochaeta) and fourth instars—*Tubifex* (Oligochaeta). In these studies, comparisons were not made with *Toxorhynchites* that had

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been fed with mosquito prey larvae to determine if the diet used had any effect on developmental time, survival etc.

In our rearing program of *Tx. amboinensis* in Fiji, the main obstacle was obtaining adequate numbers of prey *Aedes* and *Culex* larvae. In addition, it was usually difficult to provide an adequate amount of food which would last through the weekend. Once the prey had all been consumed (or emerged) *Tx. amboinensis* was highly cannibalistic. These problems were alleviated to a large extent when we started using *Tubifex* worms to supplement the diet of the third and fourth instars.

*Tubifex* worms are abundant in Fiji and can be easily found in large quantities in muddy drains. The mud is scooped up with a bowl or dipper, drained and brought back to the laboratory where it is placed in a conical pile in a large basin. We have kept *Tubifex* in this state for up to one month without any apparent adverse effects. As the mud dries, the *Tubifex* worms migrate towards the center. Eventually, when the soil has almost completely dried, a "ball" of worms is formed at the bottom and can be removed and stored in a small bowl of water until needed. *Tx. amboinensis* readily feeds on the *Tubifex* (Figure 1) and a mass of worms the size of a golf ball will keep approximately 100 *Tx. amboinensis* larvae fed for up to one week. The amount of labor involved is much less when compared to the prey larvae method.

A small experiment was set up to compare the developmental times and survival rates of *Toxorhynchites* larvae reared on *Tubifex* with those reared on field collected *Culex* and laboratory reared *Aedes* larvae. Sixty early third instar *Tx. amboinensis* larvae that had been reared on *Culex* and *Aedes* larvae were divided into 2 lots of equal numbers and placed into separate plastic trays (32 x 26 x 12 cm) which contained approximately 2 liters of water. One group of 30 larvae was fed on prey larvae while the other group was fed only on *Tubifex* worms.

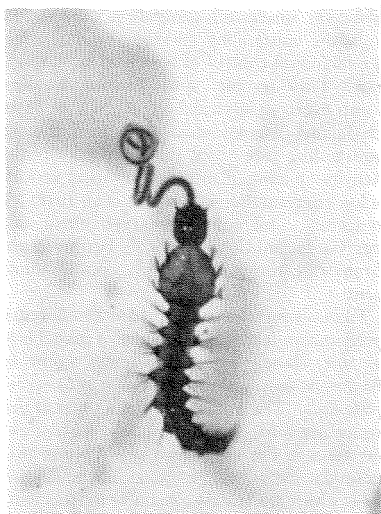


Figure 1. Feeding of a 4th instar *Toxorhynchites amboinensis* larva on a *Tubifex* worm in laboratory rearing.

A total of 5 replicates were set up on different days. The trays were inspected daily for mortality, pupation and emergence. The results, summarized in Table 1, show that although there was no difference in developmental time between the *Tubifex* and larvae fed groups, there was a large difference in the survival rates. Higher cannibalism may have occurred in the group fed mosquito larvae due to an insufficient number of prey. During the weekends, most prey larvae pupated and emerged and therefore, most of the food was depleted by Monday morning.

We have therefore shown that *Tubifex* worms are a very good alternate food for the mass rearing of *Tx. amboinensis*. Their use alleviates the need for rearing large numbers of prey

Table 1. Mean development time (egg to adult), percentage pupation and emergence of *Toxorhynchites amboinensis* reared from the third instar onwards on either prey larvae or *Tubifex* worms.

	Prey larvae			<i>Tubifex</i> larvae		
	Mean*	S.D.	No.	Mean*	S.D.	No.
Days to emergence	20	3	93	19	3	123
% pupation	69			85		
% emergence	62			82		

\* Mean of 5 replicates of 30 larvae each.

larvae to the third and fourth instars, lessens the time required for daily *Toxorhynchites* feeding and enables the accumulation and storage of food for immediate use when required.

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## FIELD EVIDENCE AGAINST TRANSOVARIAL TRANSMISSION OF FLANDERS VIRUS IN CONNECTICUT<sup>1</sup>

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Following the discovery of congenital passage of La Crosse virus in *Aedes triseriatus* (Say) (Watts et al. 1973) and Keystone virus in *Ae. atlanticus* Dyar and Knab (Le Duc et al. 1975), there has been a proliferation of field and laboratory studies designed to test the hypothesis of transovarial transmission of other mosquito-borne viruses. To date, workers in several laboratories have been successful in demonstrating this phenomenon in mos-

quitoes infected with members of 2 families of arboviruses: Bunyaviridae (bunyaviruses) (Watts et al. 1973, Le Duc et al. 1975, Christensen et al. 1978) and Togaviridae (flaviviruses) (Coz et al. 1976, Rosen et al. 1978, Aitken et al. 1979). It is the purpose of this note to present circumstantial evidence against the likelihood of transovarial transmission of Flanders virus (Rhabdoviridae) in *Culex restuans* Theobald and *Culiseta melanura* (Coquillett) based on field isolation attempts in Connecticut.

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Earlier studies (Main et al. 1979a) suggested that these 2 ornithophilic species, plus *Cx. pipiens* Linnaeus, were involved in enzootic cycles of Flanders virus in Connecticut, based on minimum field infection rates of 1:306, 1:465, and 1:435, respectively, over a 10-year period