OPERATIONAL AND SCIENTIFIC NOTES

EVALUATION OF *BACILLUS THURINGIENSIS* VAR. *ISRAELENSIS* AND *BACILLUS SPHAERICUS* 1593 ON SRI LANKAN STRAINS OF LARVAL *CULEX QUINQUEFASCIATUS*

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INTRODUCTION

Bacillus thuringiensis var. *israelensis* (*B.t.i.* Serotype H-14, ONR 60A) and *Bacillus sphaericus* 1593, 2 aerobic spore-bearing bacilli isolated in Israel and Indonesia respectively, have demonstrated outstanding activity against a broad spectrum of mosquito larvae. The former has been shown to possess marked larvicidal activity against *Culex* sp., *Aedes* sp., *Anopheles* sp., *Uranotaenia* sp. and *Culiseta* sp. (Goldberg and Margalit 1977) and the latter predominantly, on *Anopheles* sp., *Aedes* sp., *Culex* sp., and to a lesser extent on other genera (Ramoska, Singer and Levy 1977). Their potential as entomopathogens has been demonstrated against mosquito larvae from Polynesia, Indonesia, West Africa, Egypt and India. However, similar studies have not been performed in Sri Lanka. This communication deals with the evaluation of the larvicidal efficacy of *B.t.i.* and *B. sphaericus* 1593 on Sri Lankan strains of *Culex quinquefasciatus* (the local vector of Bancroftian filariasis).

MATERIALS AND METHODS

PREPARATION OF BACTERIAL INOCULUM. The 3 cultures were obtained in the form of a pure dry powder.

SOURCE OF PATHOGENS: B. *thuringiensis* var. *israelensis*, supplied by Dr. Leonard J. Goldberg, Naval Biosciences Laboratory, Naval Supply Center, Oakland, CA 94625. *B. sphaericus* 1593 from Charles H. Schaeffer, Director, Mosquito Control Research Laboratory, University of California 5544 E. Air Terminal Drive, Fresno, CA 93727. The media employed for microbial growth, the preparation of the bacterial inoculum and insect trays have been described elsewhere (Wickremesinghe and Mendis 1980). Three trays containing 100 first instar larvae each were inoculated with bacterial suspensions yielding concentrations of 10^1—10^8 organisms/ml. for each experiment and mortality noted. Identical mosquito trays with similar volumes of normal saline served as controls. The experiments were repeated 6 times.

RESULTS AND DISCUSSION

The average results of these experiments are shown in Table 1. Number of larvae and volume of water employed for each tray were 100 and 1,000 ml. respectively.

It is evident that *B. thuringiensis* var. *israelensis* is an extremely effective larvicide on local strains of *Cx. quinquefasciatus* at a low concentration of 10^3 spores/ml, whereas *B. sphaericus* 1593 is surprisingly ineffective even at high concentrations. This may be due to the non-susceptibility of local strains of *Cx. quinquefasciatus* to the toxins of *B. sphaericus* 1593.

Although recent evidence suggests that *B. sphaericus* can multiply in dead insect larvae and be recycled in the insect milieu for some time (Hertlein and Hornby 1979) which would be advantageous in field application, *B. thurin-*

Table 1. Effect of *Bacillus thuringiensis* var. *israelensis* and *B. sphaericus* 1593 on Sri Lankan *Cx. quinquefasciatus* larvae.

B. thuringiensis var. *israelensis*		*B. sphaericus* 1593	
Spore concentration per ml	Per cent mortality	Spore concentration per ml	Per cent mortality
Controls	6	Controls	12
1.0×10^1	10	$1,0 \times 10^1$	14
1.0×10^2	35	1.0×10^2	10
1.0×10^3	100	1.2×10^3	16
1.0×10^4	100	1.0×10^4	15
1.2×10^5	100	1.4×10^5	18
2.2×10^6	100	1.4×10^6	20
2.4×10^7	100	1.0×10^7	20
2.2×10^8	100	1.2×10^8	24

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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)[1]

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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* (Oliogochaeta). In these studies, comparisons were not made with *Toxorhynchites* that had

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