PRELIMINARY FIELD TRIAL FOR THE BIOLOGICAL CONTROL OF *AEDES AEGYPTI* BY MEANS OF *TOXORHYNCHITES BREVIPALPIS*, A PREDATORY MOSQUITO LARVA

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ABSTRACT. A preliminary field trial on the Caribbean island of St. Maarten demonstrated the feasibility of using a predator mosquito larva, *Toxorhynchites brevipalpis* as a biological control agent for *Aedes aegypti*. Sixteen days after the introduction of *brevipalpis* eggs into *aegypti* breeding containers, all of the 21 houses sampled no longer had *aegypti* breeding and the house index dropped to zero.

INTRODUCTION

The introduction of predaceous mosquito larvae of the genus *Toxorhynchites* as a means of bio-regulation of *Aedes scutellaris* was proposed by Buxton and Hopkins (1927). Pemberton attempted to introduce *Tx. inornatus* into Hawaii (Swezey 1930). Bonnet and Hu (1951) established a small laboratory colony of *Tx. brevipalpis* Theob. in Hawaii, and a total of 103 adults were released in a bamboo forest close to Honolulu. None of these releases was eminently successful as the numbers of introduced specimens were so insignificant. Muspratt (1951) suggested that the idea of using *Toxorhynchites* for this purpose should not be abandoned. He considered that their efficacy could be increased by large scale breeding in an insectary and subsequent release in large numbers at suitable times of the year, as a continuous measure. The W.H.O. East Africa Research Unit carried out a small *Tx. brevipalpis* release project in Tanzania in 1972, but this evidently was plagued with production problems and large scale releases were not accomplished.

Obviously large numbers of *Toxorhynchites* must be produced and multiple releases made, if the poor results of the past are to be overcome. It is imperative that successive floodings of the area with *Toxorhynchites* be undertaken, in order to upset the normal predator/prey relationship.

The island of St. Maarten, part of the Netherlands Antilles (Windward Islands), was chosen as a test site because of the *Ae. aegypti* population and the existence of house index data. The island is approximately 45 mi² in area, and is divided by a political (not physical) boundary, into the Dutch side of approximately 20 mi² and the French side of approximately 25 mi². The Dutch side has approximately 8000 inhabitants living in 3350 houses and the French side has approximately 4000 people living in 1500 houses. The rainfall averages 1132 mm with most of the rainfall occurring between August and November. Most houses depend upon rainwater for their water supply. In addition to cisterns, 50% of the yards contain drums for collecting rainwater. The average annual temperature is 26.9°C. The average annual relative humidity is 76%.

PURPOSE OF TRIAL

To achieve the goal of control of *Ae. aegypti*, it is necessary to transport or locally produce sufficient numbers of predators. It was impractical to transport thousands of adult mosquitoes, so it was decided to determine the feasibility of transporting eggs. After determining the breeding sites and distributing the eggs,

the next step was to observe the efficacy of the predator. No concerted attempt was made to determine if the predator became established or would spread. The field trial was limited in scope and preliminary in nature.

METHODS

At the Insect Control & Research, Inc. laboratory, we have established a colony of *Tx. brevipalpis* from specimens collected at a tire dump near Dar-es-Salaam, Tanzania (see Trpis & Gerberg, 1973). Techniques have been developed to mass rear this species and we have been able to collect 25,000 eggs in 1 day. Production of 10,000 or more adults per week can readily be accomplished. This requires rearing 2-5 million *Ae. aegypti* larvae per week, as food for the *Toxorhynchites* larvae and for stock cages.

An experiment was conducted to determine the feasibility of transporting eggs by air, from Baltimore, MD to St. Maarten, NA. Ten Thousand eggs were placed in 10 plastic 9 dram vials, in an insulated container containing an "Ice Pack." At the end of 48 hr in transit, the temperature had increased from 60°F to 70°F. Approximately 66 hr after oviposition, the 1st hatch was observed.

A house to house inspection was conducted in the Simpson Bay area of St. Maarten. Eggs were placed in all *Ae. aegypti* positive water containers. The number of eggs placed in each container varied from 10 to 500, depending upon the size of the container and extent of infestation. Approximately 6000 eggs were distributed.

Five days after the introduction of the eggs, 6 of the treated containers were sampled for the presence of predator larvae. One week later, a total of 21 houses of the 43 treated were thoroughly sampled and thereafter routinely checked. These houses had cisterns, metal drums or other containers that held water.

RESULTS AND DISCUSSION

Of the first 6 containers sampled, 5 were noted to have *Tx. brevipalpis* larvae. All of the 21 houses that were sampled 1 week after the introduction of eggs had *Tx. brevipalpis* larvae present. By the 16th day, all containers that had been treated with *Tx. brevipalpis* eggs were negative for *Ae. aegypti* and *Culex quinquefasciatus*. Subsequent inspections revealed that the numbers of *Tx. brevipalpis* larvae per container gradually decreased. This may have been due to cannibalism, as the food source had been eliminated. Six weeks after treatment, *Ae. aegypti* larvae reappeared in 1 container. Within 8 weeks first instar *Ae. aegypti* were found in other containers. Rainfall had been heavy, causing hatching of new *Ae. aegypti* eggs. As most of the *Tx. brevipalpis* had pupated by 6 weeks, it is possible that the newly hatched larvae may have been consumed during the 6 week period.

The house index (the percentage of houses or premises examined that are positive for *Ae. aegypti* larvae) in the experimental area had been 6.7% in October 1973. Treatment was then initiated, consisting of focal and perifocal spraying with fenthion WP (Baytex®) and the use of temephos (Abate®) granules. The house index was reduced to 2.9% by early December, but shortly after the index began to rapidly increase. Two weeks after the introduction of *Tx. brevipalpis* (the latter part of January) the index had dropped to zero. (See Table 1.)

CONCLUSIONS AND SUMMARY

It has been demonstrated that *Tx. brevipalpis* can be mass reared in sufficient quantities to be used as a bio-regulating method. It is feasible and practical to transport eggs by air. Eggs can be distributed and will hatch and larvae develop in the ecological climate existing in St. Maarten. Preliminary results indicate that it is possible to obtain a zero index of *Ae. aegypti* through container treatment with *Tx. brevipalpis*. It is anticipated that flooding of St. Maarten with *Tx. brevipalpis* eggs at 4 week intervals might well suppress and possible eradicate *Ae. aegypti*. It is theoretically possible to achieve similar

Table 1. Predator-prey relationship in 21 localities St. Maarten, N.A.

House No.	Days after introduction of eggs of *Toxorhynchites brevipalpis*											
	7 TAC	10 TAC	13 TAC	16 TAC	28 TAC	31 TAC	33 TAC	36 TAC	39 TAC	42 TAC	45 TAC	48 TAC
3/11 Tire Factory	TAC	TAC	TA	T	T	T	T	T	T	T	T C	T C
3/11/33	T C	T C						C	C	C	C	C
3/ 4/25	TAC	T	T			C	C	C	C	C	C	C
3/ 4/26	T C	T	T	T	C	C	C	C	C	C	C	C
4/ 5/ 5	TAC						C	C	C	C	C	C
4/ 5/ 8	T C						C	C	C	C	C	C
4/ 7/ 3	T C	T	T	T	T	T	T	T			C	C
4/ 7/18	TAC	T	T	T		C	C	C	C	C	C	C
4/ 7/19	TAC	T	T	T	T		C	C	C	C	C	C
4/ 7/21	TAC	T							C	C	C	C
4/ 7/22	T C	T	T	T						C	C	C
4/ 7/23	T C	T	T	T						A	A	AC
4/ 4/33	T C						C	C	C	C	C	C
4/21/ 5	T C	T	T	T	T	T C	T	T	T	T		C
4/22/14 Treehole	TAC	T				T C						C
4/23/21	T C	T				T C	C	C	C	C	C	C
4/23/22	T C									C	C	C
4/23/24	T C									C	C	C
4/23/ 4 Cesspool	TAC	TCA	TA	T	T	T C	T C	T C	T C	T C	T C	T C
4/22/30	T C	T						C	C	C		C
2/56/152	T C										C	C

T = Positive for *Toxorhynchites brevipalpis*
A = Positive for *Aedes aegypti*
C = Positive for *Culex quinquefasciatus*

results if a thorough insecticidal treatment is used, but from an environmental and health viewpoint, it is safer to use a predator species. For developing countries, this system has another advantage in that *Tx. brevipalpis* can be reared locally instead of importing insecticides. This is not to imply that pesticides are not useful in an *aegypti* program. However, other means should also be investigated.

There have been no indications of establishment of *Tx. brevipalpis* on St. Maarten. This may be considered appropriate as it is not necessarily desirable to establish this species and have it develop a balanced predator/prey relationship. Bioregulation would be most effective if the predator is used on a repeated basis at pre-determined intervals. This would provide an economically feasible control program with minimum environmental impact.

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NEW RECORDS OF MOSQUITOES IN SUFFOLK COUNTY, LONG ISLAND, NEW YORK

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ABSTRACT. Six mosquito species, *Aedes dorsalis* (Meigen), *Ae. flavescens* (Müller), *Orthopodomyia* sp., *Wyeomyia smithii* (Coquillett), *Anopheles barberi* Coquillett, and *An. walkeri* Theobald, were newly recorded during the period of 1971 to 1977 from Suffolk County, Long Island, N.Y. These records bring the mosquito list of the county to 37 species.

Suffolk County is the easternmost county in New York State. It is more than 80 mi. long and 20 mi. wide (about two-thirds of Long Island) and is surrounded by water except for the western boundry (Fig. 1). The mosquito situation in the county is significant due to the abundance of fresh, brackish and salt water breeding sites. The chance of mosquitoes migrating from outside Long Island to Suffolk County is almost nil. There is no possibility for such migration from the north across Long Island Sound (7–20 mi. wide) since the prevailing winds during spring and summer are mainly southwestern. The only migration would be from the west, New York City or Nassau County. Since Suffolk County serves as a summer resort area, consequently there is a possibility of mechanical introduction of mosquitoes from other localities by summer vacationists.

Mosquito surveillance is a major activity in the control program conducted by the Bureau of Vector Control, Department of Health Services. New Jersey and CDC light traps are operated to study the seasonal prevalence of the different species,