power microscopy was used to confirm all identifications. These were based upon the comb scales—those of *Ae. aegypti* bearing jagged denticles at the base of the apical spine, and those of *Ae. polynesiensis* being basally fringed. In April 1982, a similar record was made for the island of Vaitupu, a dozen larvae of each of the two species were identified.

One must ask, just *how* common a site for the now-circumtropical "domestic-container" breeding strain of *Ae. aegypti*, is that hollow core of the *Carica papaya* stem? Recollecting the World Health Organization's efforts to eradicate this mosquito from tropical American countries in the 1960's, when resurgences were blamed upon accidental reimportations from careless neighboring countries, one is tempted to wonder if, perhaps, there were slowly reconstituting populations based upon the minuscule overlooked percentage of the population in such cryptic "natural" and therefore ignored larval habitats as this? On discussing the question with colleagues at the joint meetings of the Entomological Societies of America, Canada and Ontario at Toronto (29 Nov.–3 Dec. 1982), one of us (M.L.) learnt from Dr. James E. Hudson of Letchworth, England, that in June 1982 he drew larvae (which were not specifically identified as those of *Ae. aegypti*) from the water-filled core of a papaya trunk at Paramaribo, Suriname. This was in the immediate proximity of his house, where *Ae. aegypti* was far and away the dominant mosquito.

The Tuvalu findings imposed a change in the integrated control methodology that was being planned. Clearly, the continuing production of *Ae. aegypti* from so cryptic a habitat (and it was clear that Tuvaluans were unlikely to welcome an edict to destroy their papaya trees, as part of the preliminary sanitation campaign aimed at source reduction of the DHF vector) was going to prejudice the success of what had been seen as an integrated control methodology based upon sanitation and several biocontrol approaches. These fears were confirmed when *Ae. aegypti* was also found to be breeding in the meter-long valves of giant clam (*Tridacna deresa*) shells on Funafuti, and even in half-coconuts (from which the "meat" had admittedly been scraped) on Vaitupu. The chances of survival of a decimated stock of *Ae. aegypti* seemed only too real, unless a residual chemical was applied to every household on the Phase 3 experimental atoll, Funafuti, in an attempt to kill adult *Ae. aegypti* continuing to enter dwellings, albeit in trivial numbers, following the exhaustive application of *Bacillus thuringiensis* serovar. *israelensis* (Teknar™, Sandoz Inc.) and Altosid™ (Zoecon's briquette version of the insect growth regulator, methoprene) to the island's total drinking water supply.

There is an intriguing aspect to all this which merits further consideration. The white sap that exudes from wounded papaya trees contains a protein-dissolving enzyme (papain) that acts, like pepsin, as a digestive aid (de Wit 1963). Could this be an attractant to ovipositing *Aedes aegypti*?

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EXPERIMENTAL LARVICIDES TESTED IN RICE FIELD PLOTS AGAINST *PSOROPHORA COLUMBIAE*[1]

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Two experimental compounds identified in preliminary laboratory studies as potential larvicides were tested against the rice field mosquito, *Psorophora columbiae* (Dyar and Knab). These were: Rohm and Haas RH-0994 (0-[4-[(4-chlorphenyl)thio]phenyl]0-ethyl S-propyl phosphorothioate) supplied as a 480 g AI/liter emulsifiable concentrate and FMC-45806 (cyano(3-phenoxyphenyl) methyl 3-(2,2-dichloroethenyl)-2,2-dimethyl cyclopropanecarboxylate) supplied as a 297 g AI/liter emulsifiable concentrate. In addition, temephos formulated in plastic ribbons and flakes for slow release (Environmental Chemical, Inc., Barrington, IL) was tested for long term larval control. This report covers studies that were conducted in 1980 at the Arkansas Agricultural Rice Branch Experiment Station in Stuttgart, Arkansas.

MATERIALS AND METHODS

Each test plot was approximately 6.1 × 6.1 m from levee center to levee center. Water was maintained at

[1] This paper reports the results of research only. Mention of a pesticide in this paper does not constitute a recommendation for use by the U.S. Department of Agriculture nor does it imply registration under FIFRA as amended. Also, mention of a commercial or proprietary product does not constitute an endorsement of this product by the USDA.

This study was conducted, in part, under the auspices of the USDA/CSRS and ARS Southern Regional Project S-122 (Biology, Ecology and Management of Mosquitoes in the Southern Region of the United States) sponsored by the Association of Southern Experiment Station Directors.

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an average depth of 10 cm on the 3.6 × 3.6 m growing surface and 23 cm at the low point of the levee ditch. The volume of water treated was approximately 3 m^3. The tests were conducted from July 17–25, 1980. At this time the rice was in the preboot stage.

The larvicides RH-0994 and FMC 45806 were tested at treatment rates of 27, 81 and 135 g AI/ha (0.1, 0.3, 0.5 g/plot). Three plots were used for each treatment rate. Temephos applied to 2 plots at the rate of 35 g AI/ha (0.13 g AI/plot, equivalent to label directions of 1 oz. EC/acre) was used as the comparison standard. Each larvicide was mixed in 2 liters of water and sprayed by hand.

The temephos plastic formulation contained 7.2% AI (w/w). The slow release ribbons were supplied in a treatment package containing 9 ribbons, each 40.6 cm (16 in) long and 1.3 cm (0.5 in) wide and 2 g in weight. Three treatment rates, 2 replicates each, of 5.2, 7.8 and 10.4 g AI/plot were tested by placing one package at each corner for the lowest rate. For the intermediate rate, 2 additional packages were placed in the growing area approximately equidistant from each other and from the corners. The highest rate was achieved by placing a package at the midpoint of each of the 4 perimeter ditches and 4 other packages in the growing area, each approximately equidistant from each other and from those in the ditches.

The flakes were irregularly shaped and each flake had a volume of approximately 3.4 mm^3. The flakes were evenly distributed by hand over the plots at the rate of 45, 95 or 180 g/plot (3.2, 6.8, 12.9 g AI). There were 2 replicates of each treatment rate.

Posttreatment bioassays were conducted in each plot at 24 hr, 48 hr, 5 days and 7 days. At the start of each bioassay 10 field-collected larvae of *Ps. columbiae* in late 3rd or early 4th instar were placed in a holding container in each plot. The containers were made from sections of white PVC irrigation pipe 37 cm long × 10 cm diameter. A nylon cloth screen of ca. 35 × 35 mesh covered the bottom; cheesecloth covers were attached after introduction of the larvae. Just above the bottom were three 1-cm diameter screened holes on opposite sides of the containers to facilitate water flow through the container. One container was attached to a stake in each plot at the junction between the rice and the open levee area. Mortality in the containers was recorded after 24 hr exposure.

RESULTS AND DISCUSSION

The results of the larvicide tests are presented in Table 1. The temephos standard at 35 g AI/ha was effective through 2 days posttreatment, but was ineffective when tested at 5 days posttreatment. In a previous test (Kottkamp et al. 1981) a temephos standard applied at the rate of 18 g AI/ha was effective through 7 days. The decreased effectiveness of this study was attributed to the unusually hot weather (mid-day temperatures ranged from 42–44°C) that occurred.

FMC-45806 and RH-0994 applied at a rate of 27 g AI/ha were equivalent in effectiveness to the standard. At 3X and 5X this rate, control periods were not extended for equivalent periods of time. However, the effectiveness of these 2 larvicides compares favorably with the standard and therefore warrants further testing.

The amount of temephos present in the lowest treatment rate used for the ribbons and flakes contained enough temephos for 40 and 25 retreatments, respectively. Based on a 3-day retreatment schedule, this number of retreatments would cover periods of 120 days and 75 days, respectively.

Despite treatment rates for ribbons and flakes of 40-80X and 25-100X the temephos standard, long term control was not obtained with either formulation. The lowest treatment rate with the ribbon was ineffective while the 2 higher rates failed between 2 and 5 days posttreatment. The flakes were more effective than the ribbon, providing complete control at the lowest treatment rate for the first 2 days posttreatment. Thus, 45 g of flakes were equivalent in control to 108 g of ribbon. The 2 highest treatment rates with the flakes were both effective 5 days posttreatment and partially effective at 7 days posttreatment.

Table 1. Effectiveness of larvicides against field-collected larvae of *Psorophora columbiae* in containers in 6.1 m x 6.1 m plots at Stuttgart, Arkansas, 1980.

Larvicide	Formulation	Treatment rate (g AI/ha)	No. plots	Percent control days posttreatment			
				1	2	5	7
		27	3	100	100	0	
FMC-45806	297 g/liter EC	81	3	100	100	57±6	0
		135	3	100	100	97±6	17±6
		27	3	100	100	27±45	
RH-0994	480 g/liter EC	81	3	100	100	73±38	0
		135	3	100	100	100	17±15
Temephos	Ribbons	1396	2	55±64	35±7		
	7.2%	2094	2	100	100	15±7	
		2792	2	60±56	100	50±56	5±6
Temephos	Flakes	870	2	100	100	30±42	
	7.2%	1740	2	100	100	100	75±21
		3479	2	100	100	100	65±35
Temephos	475 g/liter EC	35	2	100	100	5±6	
Control	—	—	2	0	0	0	0

Since the same plastic base was used for both ribbons and flakes, the main factor in the greater effectiveness of the flakes was probably the increased surface area. It is likely that the initial effectiveness was due to the release of the temephos present on the surface of the plastic base, while the lack of prolonged effectiveness was due to an insufficient migration of the temephos from the plastic matrix.

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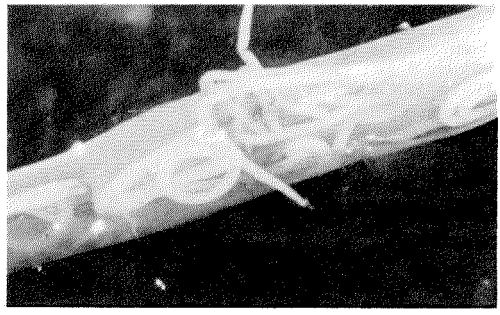

Fig. 1. *Romanomermis culicivorax* along leaf sheath and inside hollow portion of plant stem debris.

ASSOCIATION OF PLANT DEBRIS AND *ROMANOMERMIS CULICIVORAX*, A NEMATODE PARASITE OF MOSQUITOES

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The mermithid nematode, *Romanomermis culicivorax* Ross and Smith, has been studied extensively in the laboratory as a biocontrol agent of mosquito larvae. However, there still remain substantial gaps in our knowledge of the bionomics of this nematode under field conditions.

In studies to determine the depth of penetration by postparasites and adults of *R. culicivorax* in Louisiana soils, we unexpectedly encountered great difficulty in attempting to retrieve a predetermined number of nematodes from soil cores collected from fallow rice fields. The cores were established by forcing polyvinylchloride pipes (10 cm × 27 cm) into the soil and subsequently placing a known number of nematodes on the soil surface inside the pipes. The cores were left undisturbed for ca. 1 wk to allow the nematodes to penetrate into the soil. Following the exposure period, the pipes with the soil cores were removed from the field and taken to the laboratory. Each core was removed from the pipe and transversely sectioned along its entire length at 2 cm intervals. The individual portions were subjected to a soil washing process and strained through a series of graduated sieves.

Because of the consistently low percentage of retrieved nematodes, a closer examination was made of the soil and plant debris remaining in the sieves following the soil washing process. This examination revealed a substantial number of nematodes entwined among themselves and plant debris which inhibited their passage through the smaller mesh sieves. It was not uncommon also to find nematodes within the hollow portions of plant stems present in the soil samples. For example, a longitudinal incision was made along one side of a stem and several nematodes were removed. Nematodes were also found in other hollow stems as well as in between the interfacial spaces of leaf sheathes and stems (Fig. 1). After removal from the plant debris the nematodes were positively identified as *R. culicivorax*.

This is believed to be the first report associating *R. culicivorax* with plant debris in riceland soils. These initial observations indicated that hollow plant stems were used as harborage by some nematodes. It is not proposed that an obligatory relationship exists between *R. culicivorax* and plant debris or even that there is a possible association with living plant tissues. However, we want to alert other researchers to the difficulties that may be encountered if retrieval of nematodes from soil is involved in a proposed study.

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FIELD EVALUATION OF *BACILLUS THURINGIENSIS* VAR. *ISRAELENSIS* FOR CONTROL OF *AEDES TAENIORHYNCHUS* IN SALT MARSH POOLS[1]

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INTRODUCTION

Bacillus thuringiensis var. *israelensis (Bti)* was originally isolated from soil samples taken from mosquito-producing sites in Israel by Goldberg and Margalit (1977). Laboratory tests have shown the delta-endotoxin of *Bti* to be extremely toxic to mosquito larvae (de Barjac 1978, Garcia et al. 1980). Field data are limited, however, regarding the efficacy of

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