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FENTHION RESISTANCE IN *AEDES AEGYPTI* FROM SELECTION PRESSURE ON LARVAE

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ABSTRACT. Selection pressure applied to larvae of a field population of *Aedes aegypti* from the Villa Palmeras, Santurce section of San Juan, Puerto Rico resulted in the development of resistance to fenthion in the laboratory. After 9 filial generations of selection pressure, resistance occurred by a factor of 11 compared with the parents, by a factor of 18 compared with the Arecibo, Puerto Rico laboratory strain, and by a factor of 37 compared with the susceptible Fort Detrick laboratory strain. The LC_{50} values in parts per million were as follows: Fort Detrick laboratory strain, 0.004; Arecibo laboratory strain, 0.008; Villa Palmeras parents, 0.013; and Villa Palmeras selection F_9, 0.15.

Previous studies have shown that *Aedes aegypti* develops resistance to malathion in Puerto Rico (Fox 1973). In the search for a replacement, similar work needs to be done with candidate insecticides. The purpose of this research was to find out whether a Puerto Rican field strain would become resistant to fenthion after selection pressure on the larvae in the laboratory.

MATERIALS AND METHODS. In February, 1974, I collected larvae from water in cement flower vases in the "Cementerio San José" in the Villa Palmeras, Santurce section of the city of San Juan, Puerto Rico, reared them to adults, and designated this colony the "Villa Palmeras" field strain. Offspring of these specimens were used in the experiments. Survivors of the tests were saved for breeding and testing subsequent generations so that selection pressure with fenthion occurred on the parents and each of 9 filial generations. For comparing normal levels of fenthion susceptibility I used 2 laboratory colonies, the Fort Detrick strain and the Arecibo, Puerto Rico laboratory strain. Originally, the Fort Detrick strain came from the Communicable Disease Center, Savannah, Georgia in 1962, and the Arecibo, P.R. strain from specimens collected in 1969. To make the tests, I exposed for 24 hr about 20 4th stage larvae in 250 ml solutions in open half-pint cardboard containers and replicated the tests 4 times. The concentrations used, 0.005, 0.01, 0.025,

0.05, 0.1, 0.2, and 0.4 parts per million, were obtained by diluting World Health Organization fenthion stock solution (625 p.p.m.). To obtain selection pressure, I reared the survivors of the various concentrations tested. A 10-fold increase in the LC_{50} value of the Villa Palmeras field strain was the standard for resistance.

RESULTS. Table 1 gives the results of tests against the parents and 9 filial generations of the Villa Palmeras field strain. Table 2 shows the LC_{50}, LC_{90}, and LC_{95} values for the Fort Detrick laboratory strain, the Arecibo laboratory strain, and the Villa Palmeras field strain, while Figure 1 gives the dosage mortality relationships. Resistance ratios are in Table 3. Compared with the Fort Detrick strain, the Arecibo, P.R. laboratory strain showed less susceptibility to fenthion by a factor of 2. In the field, the Villa Palmeras, P.R. parent strain was less susceptible by a factor of 3. Five generations of fenthion pressure on the larvae of the Villa Palmeras strain resulted in a clear loss of susceptibility, and 9 generations of pressure elicited resistance by a factor of more than 11 compared with the parents, and a factor of more than 37 compared with the Fort Detrick laboratory strain.

DISCUSSION. The capacity to resist fenthion differs around the world. In India 20 generations of pressure increased the LC_{50} value from 0.003 p.p.m. to only 0.018 (Madhukar and Pillai 1970), while in

Table 1. Effect of selection fenthion pressure on 4th stages *Aedes aegypti* larvae of the Villa Palmeras, Puerto Rico field strain.

Generation	Percent mortality at concentration (p.p.m.)		
	0.01	0.025	0.05
Parents	34	89	100
F_1	15	74	100
F_2	8	61	95
F_3	4	40	83
F_4	ND	38	72
F_5	ND	13	56
F_6	ND	ND	63
F_7	ND	ND	54
F_8	ND	ND	25*
F_9	ND	ND	11†

ND=Not done.
* 0.1 p.p.m., 51%; 0.2 p.p.m., 100%.
† 0.1 p.p.m., 30%; 0.2 p.p.m., 63%; 0.4 p.p.m., 100%.

Table 3. Larval *Aedes aegypti* resistance to fenthion as shown by resistance ratios.

Strain	LC_{50} in p.p.m.	Resistance ratio
Arecibo Laboratory/ Fort Detrick	.008/.004	2.00
Villa Palmeras Parents/ Fort Detrick	.013/.004	3.25
Villa Palmeras Parents/ Arecibo Laboratory	.013/.008	1.63
Villa Palmeras F_9/ Villa Palmeras Parents	0.15/.013	11.54
Villa Palmeras F_9/ Arecibo Laboratory	0.15/.008	18.75
Villa Palmeras F_9/ Fort Detrick	0.15/.004	37.50

Table 2. Toxicity of fenthion to *Aedes aegypti* 4th stage larvae as shown by LC_{50}, LC_{90}, and LC_{95} values in parts per million and confidence limits in parentheses.

Strain	LC_{50}	LC_{90}	LC_{95}
Fort Detrick (Laboratory)	0.004 (.004–.005)	0.006 (.005–.007)	0.007 (.006–.008)
Arecibo, P.R. (Laboratory)	0.008 (.007–.009)	0.012 (.010–.013)	0.013 (.011–.016)
Villa Palmeras, P.R. (Field, Parents)	0.013 (.011–.015)	0.023 (.018–.029)	0.027 (.021–.035)
Villa Palmeras, P.R. (Selection, F_9)	0.15 (0.13–0.18)	0.40 (0.31–0.52)	0.53 (0.38–0.74)

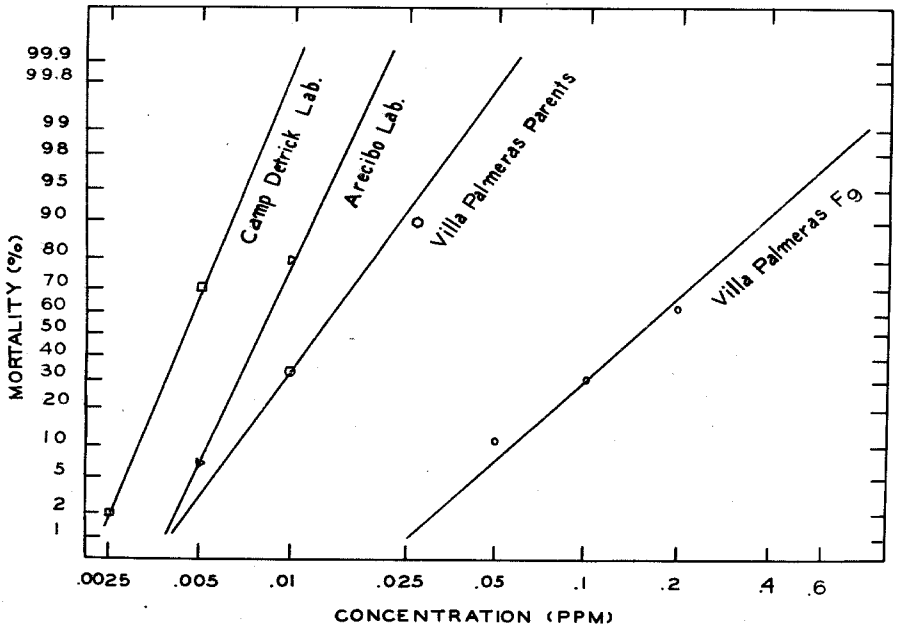

Fig. 1. Dosage-mortality relationships of fenthion and the larvae of strains of *Aedes aegypti*.

Puerto Rico, 9 generations of pressure increased the LC_{50} value from 0.013 to 0.15. Since high LC_{50} values have been reported from various places in the Caribbean Region (Brown and Pal 1971, Mouchet1967, Tinker, unpublished), a strong potential to develop resistance is to be expected in Puerto Rican populations. If fenthion were used for control of *Aedes aegypti* in Puerto Rico today, a 10-fold resistance could occur in about a year. But this and even higher levels might not be enough to nullify the effectiveness of fenthion as a larvicide.

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