2. Title: Insecticide Tolerance Level of Mosquitoes in Thailand

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Objective: To determine the insecticide tolerance level of some of the medically important mosquito species in Thailand and to conduct periodic surveillance on the insecticide-susceptibility status of these species. Description: Insecticide susceptibility tests are performed using the adult and larval mosquito test kits developed by the World Health Organization. The methods used are standardized and the procedures are recommended by the Armed Forces Pest Control Board.

Progress: Urban areas in Loey Province were surveyed during May for Aedes aegypti breeding sites. The communities of Muang Loey, Wang Sapong and Chieng Khan were found to have A. aegypti indices of 100 (all houses examined had adults or larvae on premises). The index dropped markedly in smaller villages examined on the road between Muang Loey and Wang Sapong; the greater the distance from either town the lower was the incidence of aegypti. Since all of the buildings examined had been sprayed with DDT in 1961, 1962 and 1964 it was anticipated that the aegypti population had probably become resistant to that insecticide. Tests of larvae collected in Muang Loey indicated that the LC_{50} of DDT was 0.10 ppm or higher, while more than 50 per cent of the adults tested from that town survived one hour exposure to DDT concentrations of 4.0% (Table 3).

Susceptibility of the mosquito Culex gelidus to chlorinated hydrocarbons insecticides was determined in the laboratory. This species is commonly distributed over much of Thailand and has been implicated in that country and in Malaysia as a vector of Japanese encephalitis virus. Field collected larvae were obtained from the vicinity of Kasetsart University in the District of Bang Khen, Bangkok during November and December. Twenty-six larval tests were performed and the LC_{50} values obtained were 0.0120, 0.0220, and 0.0203 ppm for DDT, BHC, and Dieldrin, respectively. These values indicated that larvae of this species are susceptible to the three insecticides used in the tests. Since no insecticides have been used in the area where larvae were collected, these results should serve as base line data on the susceptibility of this species. Tests on the susceptibility of adults of this species to DDT were also initiated. Females of this species biting cattle at the Dairy Farm of Kasetsart University were collected for this purpose. Several tests were performed but due to mortality in some of the control series, additional trials will be carried on to provide enough data for the calculation of the LC values.

Attempts were also made to establish base line data on the susceptibility of Anopheles balabacensis (SMRL strain) to DDT. Eight tests were performed but further testing was postponed temporarily due to shortage of material subsequent to the build-up of a sub-colony at WRAIR.

Personnel of the department cooperated in field tests of new insecticides begun in May by Mr. Clifford Lofgren of the U.S. Department of Agriculture and Major John E. Scanlon, WRAIR. The susceptibility of female Aedes aegypti and Culex quinquefasciatus to six insecticides (Fenthion, Sumithion, Malathion, Naled, Baygon, Schering 34615) applied as thermal aerosols with a Swing Fog 11 aerosol generator were undertaken. The toxicities of 11 insecticides (Abate, Dursban, Fenthion, Sumithion, Shell SD-7438, Cela 1942, Cela 2225, Shell SD-8211, Malathion, Shell SD-8447 and Naled) for larval aegypti and quinquefasciatus were also tested. Results of these trials are reported elsewhere by Scanlon and others.

Table 3. Results of tests on the susceptibility of some mosquito species of Thailand to chlorinated hydrocarbons (1965 - 1966)

Species	Locality	Stage tested	Insecticide		
			DDT	BHC	Dieldrin
Aedes aegypti	Muang Loey	Larva	S	—	—
		Adult	R	—	—
Culex gelidus	Bang Khen, Bangkok	Larva	S	S	S

(S) susceptible; (R) resistant; (—) not tested.

Field trials of some of the more promising larvicides were continued. Tests were conducted for the determination of residual toxicity of three insecticides against larvae of Aedes aegypti in concrete water storage jugs. Abate, Dursban and Shell SD 8211 were used as emulsifiable concentrated at the rate of 0.1 and 1.0 ppm, 1.0 and 10 ppm, and 10 ppm respectively. A total of eighteen concrete water jugs (50 gallan capacity) were used, 3 for each treatment plus control. Each jug was filled with 45 gallons of water into which the required amount of the emulsifiable concentrate was added and well mixed. Fifty late third or early fourth instar larvae of insectary reared Aedes aegytpi were introduced once a week into each jug and checked for mortality 3 days later. If live larvae were encountered in any jug on two consecutive weeks, such a treatment was considered no longer effective.

Table 4. Comparative toxicity of three insecticides against Aedes aegypti larvae in concrete water storage jugs.

Insecticide*	Formulation EC	Treatment (p.p.m.)	Av. No. Weeks effective
Abate	(4 lbs/gal)	0.1	17.0
		1.0	> 23.0
Dursban	(4 lbs/gal)	1.0	5.3
		10.0	> 23.0
Shell SD 8211	(2 lbs/gal)	10.0	4.3

*Use of trade names is for identification purposes only and does not constitute endorsement by this Department.

Results showed that Shell SD 8211 gave the lowest effective residual action of only 4.3 weeks when used at the rate of 10 ppm and especially when compared with Dursban applied at the same rate (Table 4). When applied at a concentration of 1.0 ppm, Abate thus far gave a much longer residual effect (> 23 weeks) than Dursban which was effective for an average of 5.3 weeks. However, Abate at the low rate of 0.1 ppm gave the most effective residual toxicity lasting for an average of 17 weeks.

A similar test was conducted to determine the effects of water use or periodic volume fluctuation on the residual toxicity of Abate against Aedes aegypti larvae in the concrete water storage jugs. In this series, Abate was also applied as an emulsifiable concentrate at the rate of 0.1 and 1.0 ppm. Water was withdrawn from each jug at the daily rate of 5 gallons for three consecutive days. At the end of each week, 15 gallons of untreated water were added and mixed well in each jug before the larvae were introduced. This is the only way in which this test differed from the one previously described. Results indicated that despite the periodic water volume fluctuation and the subsequent dilutions upon additions of fresh water Abate maintained an effective residual toxicity for an average of 7.3 and 18.3 weeks when applied at the rates of 0.1 and 1.0 ppm. respectively.

Summary: Tests on the susceptibility of wild populations of Aedes aegypti from Muang Loey to DDT indicated that the larvae were susceptible while the adults were resistant to this insecticide. Baseline data on the susceptibility of Culex gelidus larvae to chlorinated hydrocarbons have also been established.

Among the three insecticides tested for residual toxicity against Aedes aegypti larvae in concrete water storage jugs Abate appeared most promising producing, at the low rate of 0.1 ppm, an effective residual action of 17 weeks. The latter was reduced to 7.3 weeks when the treatment was subjected to periodic volume fluctuations because of water usage.