Alternative methods to insecticide control are being studied, although they may not be perfected for some time to come. Among these methods is the sterile-male technique, involving the release of males sterilized either through exposure to irradiation or by chemosterilants. Genetic control methods, introducing lethal genes into field populations or causing hybrid sterility or cytoplasmic incompatibility, are also under consideration.

Search is being made for pathogens or other biological agents which might be used to control *A. aegypti* either independently or, more likely, as part of an integrated control programme.

In order to utilize any of the preceding techniques, and, in fact, in order to undertake control in any new area, much research needs to be done on the biology of *A. aegypti* and closely related species.

The most fundamental method of controlling *A. aegypti* is to eliminate its breeding places. In most urban areas these are, for the most part, man-made. Often the provision of cheap, convenient piped water will reduce the necessity of storing water in small containers and concomitantly eliminate the larval habitats of the species. For many nations and cities, the development of such piped-water supplies is expensive and for the time being reliance must still be placed upon the use of effective insecticides.

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Insecticide-Resistance Studies on *Aedes aegypti* in Thailand *

JAMES M. NEELY [1]

Because of its role as a vector of haemorrhagic fever and dengue in Thailand, *Aedes aegypti* represents a major public health problem in that country. Insecticide-susceptibility tests carried out at the SEATO Medical Research Laboratory, using the WHO adult and larval test kits, indicate the presence of two DDT-resistant strains of *A. aegypti* in Thailand.

The first resistant strain was found in the city of Bangkok, where no large-scale DDT residual spray programmes have been carried out. Our tests indicated that the LD_{50} concentration of DDT for adults of this strain was 3.5%. No significant mortality was observed in larval stages of this strain reared in the presence of 2.5 ppm DDT.

The second resistant strain was located in the city of Pakchong, approximately 150 km north of Bangkok. Unlike Bangkok, Pakchong is a highly malarious area, and residual applications of DDT have been carried out in the city for the past two years. No significant mortality was observed from the Pakchong strain at any concentration of DDT, even when the exposure period was extended to 24 hours.

Aedes aegypti from the laboratory colony, which had been reared in captivity, yielded an LC_{50} of 1.0% when tested with DDT. All tests were conducted in accordance with WHO test procedures.

The appearance of presumptive insecticide tolerance in *A. aegypti* may have considerable effect on programmes for control of haemorrhagic fever. Further tests should be conducted on a large scale in Bangkok in order to determine the extent of the resistant strain of *A. aegypti* in the city. It is also suggested that no large-scale control programme be initiated in Bangkok until such tests have been conducted, regardless of the insecticide to be used.

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Report on a Pilot Study of *Aedes aegypti* Control in Bangkok *

SUJARTI JATANASEN [1]

A pilot project for the control of *Aedes aegypti* in Bangkok was started in March 1964, with the assistance of a WHO consultant.

Huay Kwang, a small community in the suburbs of Bangkok, was chosen as the pilot area because it is isolated and migration of *Aedes aegypti* into the

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area from non-control areas might be expected to be minimal. The community is a government housing project, with a population of 15 000 and comprising 1700 houses. The study was carried out by twelve full-time staff (one administrative medical officer, two sanitarians acting as squad leaders, eight *Aedes* operators and one draughtsman/clerk) and two part-time workers (one health educator and one entomologist).

After training of the personnel in the first two weeks of March 1964, a house-to-house inspection was undertaken to obtain the *Aedes* index, which was used as an indicator for evaluating the results of the control operations. The index obtained in March before the application of the insecticide was 85%.

Control operations began with residual spraying of DDT on all the inner surfaces of every house; a 75% DDT water-dispersible powder was used to make a 5% suspension, which was sprayed in such a way as to leave a deposit of 2 g per m^2 on all the treated surfaces. At the same time, all the water containers in every house were treated with a DDT suspension at a dose of 1 part of DDT per million parts of water.

After completion of the initial spraying operation, reinspection of all the houses in the study area was carried out every two weeks. At each reinspection all the water containers were resprayed perifocally, the interior and exterior of all breeding-sites and adjacent wall surfaces being treated with a 5% DDT suspension prepared from 75% DDT water-dispersible powder, irrespective of whether or not larvae were found in them.

The *Aedes* index dropped markedly: at the first round of reinspection the index was 4.5% and after the second round of reinspection and perifocal respraying it had fallen to 1.0%. From July to September the *Aedes* index was about 0.5%.

The results of the pilot study up to six months are satisfactory. There has been no spread of haemorrhagic fever inside the study area since the introduction of control measures against *Aedes aegypti*.

Thai Haemorrhagic Fever Control in Bangkok Municipal Area *

OPHAS DHAMVANIJ, CHEK DHANSIRI & UDOM TAINJAUNG

At the present time, Thai haemorrhagic fever is the most important infectious disease in Thailand. The disease appears predominantly in towns which have poor environmental conditions. Nearly 40% of the Bangkok municipal area may be considered slums, favouring the occurrence of haemorrhagic fever. The weather in Bangkok during the rainy season is also very well suited to the main vector of the disease, *Aedes aegypti*; almost every house has some places in which *A. aegypti* may lay their eggs.

The Bureau of Public Health of Bangkok Municipality has been responsible for carrying out the haemorrhagic fever control programme since the first epidemic, and improvements have been made in control every year. The present control methods are:

(1) Residual spraying: 8.5% DDT is applied everywhere that might constitute a suitable resting-place for *A. aegypti*.

(2) Health education: This is very well received and is focussed on two main aspects—(*a*) avoidance of exposure to mosquitos, especially during the day; and (*b*) elimination of all possible breeding-places of *A. aegypti*.

(3) Larviciding.

(4) Prompt concurrent disinsection of all premises in which cases have occurred.

The results of our work have been relatively good; it was not possible to stop the epidemics immediately, but the epidemic trend began to decline earlier than expected.

There is room for improvement of haemorrhagic fever control in Bangkok. Among the measures that might to advantage be adopted are: (*a*) the use of insecticides other than DDT in certain places; (*b*) improvement of the poor housing conditions; (*c*) the provision of an adequate piped-water supply throughout the city; (*d*) residual spraying of the whole city twice yearly; (*e*) continuous health education of the population by a variety of means; (*f*) prompt reporting of new cases; and (*g*) possibly the enactment of appropriate legislation.

* From the Bureau of Public Health, Bangkok Municipality, Thailand. Originally issued as document IR/Haem. Fever/Sem.1/WP/43.