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AEDES AEGYPTI SURVEILLANCE AND CONTROL TRIALS IN THE WESTERN PACIFIC REGION[1]

by

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[1] Background document for reference use at the Technical Discussions on "Control of Vector Mosquitoes of Dengue Haemorrhagic Fever".

CONTENTS

1. VECTOR MOSQUITOES

Usually, the occurrence of an outbreak of dengue fever/dengue haemorrhagic fever is associated with Aedes aegypti. Ae. albopictus is considered a secondary vector of dengue haemorrhagic fever in Singapore (Chan et al., 1971b) and most probably the vector of dengue in wild monkeys (Rudnick, 1967). Epidemiological observations have suggested that Ae. scutellaris served as a vector of dengue in Papua New Guinea (Mackerras, 1946) and Ae. polynesiensis in French Polynesia (Rosen et al., 1954). However, during the recent outbreak of dengue in Rabaul, Papua New Guinea, Ae. aegypti constituted 71% of all the mosquito larvae collected (Zigas & Doherty, 1973).

In Manila, the Philippines, where dengue haemorrhagic fever is highly endemic, Ae. aegypti has been found in great number and Ae. albopictus is totally absent (Basio & Azurin, 1972).

Over 14 000 cases of dengue haemorrhagic fever occurred in the Republic of Viet-Nam in 1973. Systematic surveys throughout the country revealed a very high density of Ae. aegypti, while Ae. albopictus was either absent or present in only a negligible number (Nguyen-Dang-Que, Dinh-van-Rung & Chow, 1974).

Based on experience in the Philippines, the Republic of Viet-Nam and certain other countries in the Western Pacific Region, as well as on findings in Bangkok, Thailand (Scanlon, 1966), it can be concluded that Ae. aegypti is the most important, if not the only, vector of dengue haemorrhagic fever. This paper will, therefore, deal mainly with Ae. aegypti.

2. ECOLOGY OF AEDES AEGYPTI

For ready reference, a brief review of the ecology of Ae. aegypti is given below.

Ae. aegypti breeds mainly in artificial water containers such as jars, drums, ant-traps, discarded tins, automobile tires, flower-pots, storage tanks, wooden boxes, etc. It can also breed in roof gutters, but rarely in plant containers. Its prevalence usually correlates with rainfall.

Its life cycle is 1-2 weeks. The eggs can withstand dessication for several months.

Man is the principal host. The mosquito bites principally by day, usually with two peaks - a minor one in mid-morning and a major one in late afternoon. A negligible number were found biting at night (Macdonald, 1956b). The feeding takes place mainly inside the house, where the mosquito usually rests. Its flight range is rather short, about a couple of hundred metres.

Probably because it is disturbed more often by human activity in the daytime, Ae. aegypti bites several persons before the completion of a gonotrophic cycle (Yasuno & Tonn, 1970). This would increase the chance of disease transmission.

3. VECTOR SURVEILLANCE METHODS

It is of the utmost importance to have basic information on the distribution and density of Ae. aegypti. A standardization of survey methods is necessary for global surveillance, and the following are recommended by WHO (WHO, 1972).

3.1 Larval survey

Examinations are made by the single-larva-per-container collecting method for the presence of larvae in water containers in the house and its surroundings. In small villages, every house can be examined, but in large villages and towns, at least 50 houses should be examined. The results should be expressed in the following indices:

"House index" - percentage of houses positive for the larvae.

"Container index" - percentage of water containers positive for the larvae.

"Breteau index" - total number of positive containers per 100 houses.

These are all estimates of frequency rather than numbers. The Breteau index, combining as it does both houses and containers, is the best of the single indices for estimating density.

3.2 Adult survey

This is undertaken by collecting the mosquitoes biting or landing on human bait over a period of time during the peak of the mosquito activities. The results can be expressed as number of female mosquitoes per man-hour.

3.3 Ovitraps

If the mosquito number is low, it may be detected by means of oviposition traps (ovitraps) and expressed as a percentage of ovitraps found positive. Ovitraps are set up for two to four days, the eggs laid are allowed to hatch and the larvae are identified.

The actual application of the above indices as applied to the transmission of yellow fever (WHO, 1971) may be cited for reference.

Areas in which the Breteau indices are less than five, house indices less than four, and container indices less than three are considered unlikely to promote the urban transmission of yellow fever by Ae. aegypti.

Areas where the Breteau indices exceed 50, house indices 35, and container indices 20, as well as where the biting collection exceeds two female mosquitoes per man-hour, are considered as involving a high risk of transmission.

4. RESISTANCE OF AEDES AEGYPTI TO INSECTICIDES

Ae. aegypti resistance to DDT and dieldrin is widely spread in South-East Asia and the Pacific area and has been noted in French Polynesia, the Khmer Republic, Malaysia and the Republic of Viet-Nam. Ae. aegypti has developed resistance to fenthion in the Khmer Republic, to malathion in the Republic of Viet-Nam and to both in Malaysia (Mouchet et coll., 1972).

Insecticide susceptibility test kits for mosquito adults and larvae may be ordered from WHO. Tests can be carried out on the spot or by sending the mosquito eggs to certain laboratories.

5. DISTRIBUTION OF AEDES AEGYPTI

WHO has undertaken a computer survey of Stegomyia mosquitoes on a global basis. A review was made of the distribution of Ae. aegypti in the Western Pacific Region (Chow, 1967). More systematic surveys, mainly by the single-larva-per-container collecting method, have been carried out very recently in this region. Annex 1 presents the up-to-date information available.

Ae. aegypti is widely distributed in most of the countries and territories. It has not been found in Hong Kong, Jpan, the Republic of Korea and New Zealand.

The Breteau index of 858 obtained in Go-Cong, a coastal urban area south of Saigon, Republic of Viet-Nam, is so far the highest known world record. An index of 500 in Davao, Philippines, is the fourth highest.

6. FIELD TRIALS OF LARVAL CONTROL

Successful field trials with Abate 1% sand granules at 1 ppm for the control of Ae. aegypti larvae have taken place in Bangkok (Bang & Pant, 1972). Similar experiments have been undertaken in certain countries and territories in the Region.

In Brunei, a large-scale application with the same insecticides at the same dosage, covering about 4000 houses with 17 600 water containers, revealed that the Breteau index of Ae. aegypti in Kuala Belait had dropped from 266 to 0. The amount of insecticide used per house per application was 24-58 grammes, at a cost of US$ 0.02-0.04. As a result of excellent public health education, there were no refusals to the application of the insecticide nor were toxic hazards noted. The above information was provided by the health authorities of the State of Brunei to the writer during his recent visits.

In the Republic of Viet-Nam, a small-scale trial was undertaken near Saigon. The average amount of insecticide used was 67 grammes per house. The effectiveness lasts at least three months (Nguyen-Dang-Que, Dinh-van-Rung & Chow, 1974).

A preliminary trial in Apia, Western Samoa, also showed that Abate 1% sand granules applied to empty gasoline drums (44 gal.) used as water containers controlled the breeding of Ae. aegypti for three months at a dosage of 1 ppm and for about two months at 0.05 ppm (report submitted by the entomologist of the WHO filariasis team).

7. WHO ACTIVITIES AND ASSISTANCE

In the Western Pacific Region, WHO has provided assistance in a number of ways, for example, by training national staff on the spot and assisting them in Aedes surveillance and control, by giving research grants under the Technical Contractual Agreement for Aedes survey, by holding seminars on mosquito-borne viruses, by providing

technical advice on ultra-low-volume (ULV) aerial spraying to stop an outbreak of dengue haemorrhagic fever, by co-ordinating with other agencies such as the South Pacific Commission on vector surveillance, etc.

WHO will conduct inquiries in countries and territories in the Region in order to prepare a list of available ULV insecticides, as well as ground and aerial spraying equipment. This is aimed at helping countries and territories to borrow or buy from a neighbouring country the supplies needed to stop outbreaks of dengue haemorrhagic fever.

It is hoped that national programmes on vector surveillance and control can be established with trained staff on a full-time basis. Up-to-date information on the distribution and density of Ae. aegypti may be transmitted to WHO for correlation and necessary action.

In summary, WHO is ready to provide technical assistance to countries and territories for the surveillance of Ae. aegypti and for the control of outbreaks of dengue haemorrhagic fever, if requested.

ANNEX 1

AEDES AEGYPTI DISTRIBUTION IN THE WESTERN PACIFIC REGION

American Samoa - No Ae. aegypti was present during the survey in 1965 (Chow, 1967), but it was found in 1972 by Dr D. Gubler of the University of Hawaii.

Australia - Ae. aegypti was present in Queensland during the survey in 1973 (report submitted to WHO by Dr E.N. Marks).

Brunei - According to the survey by the malaria project staff in 1973, Ae. aegypti has so far been found in only three urban areas.

British Solomon Islands Protectorate - No Ae. aegypti was found by the WHO entomologists in 1966 and in 1973, although Belkin (1962) mentioned its presence.

Cook Islands - Its presence in Rarotonga was mentioned by Belkin (1962), but no recent information is available.

Fiji - The Breteau index was 51 in Suva when surveyed by the city health personnel in 1972.

French Polynesia - It is well known that Ae. aegypti is widely distributed in Tahiti and other islands.

Gilbert and Ellice Islands - The Breteau indices of Ae. aegypti in Funafuti and Vaitupu in the Ellice Islands were 54 and 78 respectively, when surveyed by the entomologist of the WHO filariasis team in 1972.

Guam - It was noted that Ae. aegypti has disappeared since 1951. No current information is available.

Khmer Republic - The Breteau index of Ae. aegypti in Phnom-Penh was around 80, and in Battambang around 250, when surveyed by the malaria project in 1973.

Laos - Ae. aegypti is known to occur in the urban areas, but no systematic survey has been undertaken.

Malaysia - Ae. aegypti is established in most of the urban areas and is spreading into the rural areas. In Peninsular Malaysia, a systematic survey was done by Macdonald (1956a) and another, more recent one by the entomological staff of the Institute for Medical Research with a WHO research grant. Surveys in Sabah and Sarawak were assisted by a WHO consultant (Macdonald & Rajapaksa, 1972).

Nauru - The presence of Ae. aegypti was reported by Belkin (1962).

New Caledonia - Belkin (1962) also mentioned its presence.

New Hebrides - The Breteau index of Ae. aegypti in Ekipe was 163 when surveyed by the entomologist of the WHO filariasis team in early 1973.

Niue - Ae. aegypti was found for the first time in August 1972 by Dr T. Suzuki, entomologist of the WHO filariasis team.

Papua New Guinea - Ae. aegypti occurs in several coastal areas (Schoenig, 1972).

Philippines - An extensive survey in the different provinces was undertaken in 1969 with a WHO research grant. Ae. aegypti was present in all areas surveyed. In the Greater Manila area, this mosquito was found in a great number but Ae. albopictus was totally absent (Basio & Azurin, 1972).

Singapore - An intensive survey on Ae. aegypti and Ae. albopictus made by Chan et al. (1971a) showed that both species were common in the city, with Ae. aegypti being dominant.

Tonga - It is known that the species is common, although no systematic survey has been undertaken (Chow, 1967).

Trust Territory of the Pacific Islands - Ae. aegypti occurs in all districts of the Territory (Chow, 1967).

Wallis and Futuna Islands - The presence of Ae. aegypti in Uea was mentioned by Belkin (1962).

Viet-Nam - A WHO research grant was provided for a systematic survey in certain urban and rural areas throughout the country during the dry and rainy seasons from 1971 to 1973. Very high Breteau indices (over 200) were obtained in all the areas surveyed (Nguyen-Dang-Que, Dinh-van-Rung & Chow, 1974).

Western Samoa - The Breteau index in Apia was 25, when surveyed by the national health staff in April 1973.

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