

AEDES MOSQUITO SURVEILLANCE IN THE REPUBLIC OF VIETNAM

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INTRODUCTION

Dengue haemorrhagic fever has occurred yearly in the Republic of Vietnam since 1963, when an outbreak was confirmed serologically and clinically (Halstead *et al.*, 1965). More than 2,650 cases were reported in 1969. A large outbreak occurred in 1973, with 14,320 cases and 886 deaths. Out of a total of 51 provinces and cities, 26 had cases in 1972 and 41 in 1973. Except in the cities of Hue and Danang (Region I), the majority of cases have occurred in Regions III and IV including Saigon.

All four dengue serotypes were recovered from *Aedes aegypti* collected in Saigon and its vicinity, but none from 8,006 *Ae. albopictus* tested (Russell *et al.*, 1969).

Nation-Wide Survey

A WHO research grant was provided to the senior author for carrying out a nation-wide survey of *Aedes* mosquitoes in early 1971. Two localities (one urban and one rural) were surveyed in each province during the dry and rainy seasons by the single-larva-per-container collecting technique. Fifty houses were surveyed for each locality. Almost all the surveys were undertaken by the same team members.

Table 1 shows the number of containers per hundred houses positive with *Ae. aegypti* and *Ae. albopictus* in the urban and rural areas during the dry and rainy seasons in the period March 1971 to August 1973. For the former species, the indices of house, container

and Breteau, as well as the corresponding density figure, during the dry season are given in Table 1. It will be noted that the majority of the areas surveyed have very high density figure, 8 or 9, particularly in Regions III and IV. The Breteau index (number of water containers positive with *Ae. aegypti* larvae per hundred houses) of 858 obtained in the rainy season in the urban area of Go-Cong, a coastal area south of Saigon, is so far known as the highest world record. Brown (1973) made a review of computer survey of *Stegomyia* mosquitoes in which the highest Breteau index in the world was 590 obtained in Kharen Khoi, Thailand; the next, 558 in Si Racha, Thailand; and the third, 500 in Davao Philippines.

In Saigon, the house index of *Ae. aegypti* was 87% and 99% during the rainy and dry seasons, respectively, while during an early survey by Do-van-Quy (1965) this was only 42%. This is probably due to more rapid and extensive urbanization recently.

In Regions I and II, comparatively fewer water containers are kept in houses (about 2.5-3.5 per house), because most of the householders have their own wells. While in Regions III and IV, more containers per house (about 4-5) are noted. The most common water containers are jars (with a volume of 50, 100 and 150 liters) and the next gasoline drums (44 gallons), with an approximate ratio of 52:38%. In general, the indices in the urban areas are higher than in the rural areas (Table 1).

Table 1

Aedes Survey in Vietnam March 1971 - August 1973 (*Number of water containers positive with *Aedes* larvae per 100 houses).

Province	<i>Ae. aegypti</i>				<i>Ae. albopictus</i>				<i>Ae. aegypti</i> survey during the dry season			
	Urban		Rural		Urban		Rural		House index	Container index	Breteau index	Corresponding density figure
	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy				
REGION I												
Danang	266*	-	154	-	0	-	4	-	95	72	210	9
Quang-Ngai	122	76	4	66	0	12	0	2	64	24	63	6
Quang-Nam	140	-	212	-	0	-	0	-	93	63	176	9
Quang-Tin	130	154	132	208	0	0	0	0	80	52	131	8
Thua-Thien (Hue)	152	-	122	-	0	-	0	-	72	48	131	8
REGION II												
Binh-Dinh	34	-	54	-	0	-	0	-	35	26	44	6
Binh-Thuan	98	234	100	314	0	0	0	0	59	39	99	8
Cam-Ranh	126	66	72	110	0	0	12	4	62	43	99	7
Darlao	200	212	116	164	0	0	0	0	87	48	188	9
Khanh-Hoa	66	36	30	0	0	0	0	0	29	14	48	5
Kontum	96	126	40	54	0	0	8	0	46	35	68	7
Lam-Dong	174	210	178	236	6	0	4	4	79	50	176	8
Ninh-Thuan	130	52	60	120	2	0	0	0	51	31	95	7
Phu-Bon	260	108	124	72	0	18	0	28	85	47	192	9
Phu-Yên	-	160	-	258	-	0	-	0	-	-	-	-
Pleiku	194	126	56	64	0	0	0	0	69	30	125	8
Quang-Duc	186	148	88	16	0	54	0	6	89	41	137	8
Tuyen-Duc (Dalat)	0	6	126	222	0	118	0	0	37	12	60	6

Table 1 (Cont'd).

Province	<i>Ae. aegypti</i>				<i>Ae. albopictus</i>				<i>Ae. aegypti</i> survey during the dry season			
	Urban		Rural		Urban		Rural		House index	Container index	Breteau index	Corresponding density figure
	Dry	Rainy	Dry	Rainy	Dry	Rainy	Dry	Rainy				
REGION III												
Bein-Hoa	180	314	114	334	0	4	0	18	64	31	147	8
Binh-Duong	224	212	126	194	6	0	10	0	78	46	175	9
Binh-Long	-	410	-	414	-	6	-	12	-	-	-	-
Binh-Tuy	134	338	126	186	0	0	0	0	68	53	130	8
Cia-Dinh	240	654	662	332	0	0	0	0	79	62	451	9
Hau-Nghia	206	260	132	232	0	4	0	4	75	46	169	8
Long-An	-	388	-	476	-	0	-	0	94	61	303	9
Long-Khanh	130	270	98	188	0	0	4	4	61	43	111	8
Phuoc-Long	454	628	162	568	0	66	0	8	97	57	308	9
Phuoc Tuy	158	258	246	428	0	0	0	0	76	56	202	9
Saigon	456	304	304	194	0	2	0	6	99	63	380	9
Tay-Ninh	94	230	98	208	0	6	0	0	92	72	219	9
REGION IV												
An-Ciang	456	-	198	-	0	-	0	-	86	78	327	9
An-Xuyen	198	636	164	394	0	4	0	14	84	57	181	9
Ba-Xuyen	114	398	240	496	0	4	0	10	81	49	177	8
Bao-Lieu	222	456	248	482	0	0	0	2	95	70	235	9
Chau-Doc	142	186	220	284	2	0	0	0	86	59	181	9
Chuong-Thien	368	486	212	594	0	0	0	2	89	45	290	9
Dinh-Tuong	196	318	470	222	0	0	0	0	86	50	333	9
Go-Công	506	858	522	592	0	4	0	8	93	62	514	9
Kien-Giang	120	286	108	420	0	0	0	2	62	30	114	8
Kien-Hoa	198	362	220	396	0	0	2	0	89	47	209	9
Kien-Phong	316	380	100	236	0	2	0	6	70	49	208	9
Kien-Tuong	182	-	230	-	0	-	0	-	-	-	-	-
Pyong-Dinh	150	478	216	394	0	0	0	0	84	45	183	9
Sa-Deo	120	286	44	154	0	12	0	2	50	34	82	7
Vinh-Binh	364	544	498	356	0	10	4	0	100	84	450	9
Vinh-Long	172	300	296	326	0	6	2	0	71	49	234	9

Aedes MOSQUITO SURVEILLANCE IN VIETNAM

Remark: (1) (-): not yet surveyed.
 (2) - House index: per cent of houses infested.
 - Container index: per cent of water-filled containers infested.
 - Breteau index: number of positive containers per 100 houses.

Very few *Ae. albopictus* were found as shown in Table 1, even in the rural areas. Because of security reasons, the villages chosen as rural areas are located on the main road, 5-15 kilometres away from the cities. In these areas, few big trees and bushes are present. A survey made by Do-van-Quy and Tran-van-Mau (1968) in Saigon in 1966 showed the preference of *Ae. albopictus* breeding in outdoor artificial containers to tree holes, as 95% against 5%. The present survey revealed, however, only a negligible number of this mosquito. Probably due to more and more urbanization, *Ae. albopictus* has been replaced by *Ae. aegypti*. Experimental findings by Do-van-Quy and Tran-van-Mau (1968) showed that the presence of trees and bushes would favour greater breeding of *Ae. albopictus*.

Resistance to Insecticides

Ae. aegypti in Saigon was found to be resistant to DDT and dieldrin (Do-van-Quy, 1965). This was also observed in Danang (Region I) and Binh-Tuy and Binh-Long (Region III) by the national malaria eradication project in 1965-1966. Mouchet *et al.*, (1972) considered that *Ae. aegypti* collected in Danang was resistant to malathion (LC_{50} : 0.78 ppm) and those from Saigon have developed intermediate resistance (LC_{50} : 0.66 ppm).

DDT and dieldrin resistance in *Ae. albopictus* was quoted by Mouchet *et al.*, (1972) from the results of tests undertaken by Do-van-Quy in Saigon in 1963. Intermediate resistance of this mosquito to malathion was reported by Stasiak *et al.*, (1970)

Control Trial of *Ae. aegypti*

A small amount of Abate 1% sand granules was provided by WHO for the trial in a more or less isolated hamlet, Tan-Quy-Dong Village about 11 km from Saigon. A total of 62

houses were treated once, with an average of 15 houses per man-day. The average amount of Abate 1% sand granules used was 67 grams per house. Table 2 shows the control results. The effectiveness lasts at least three months. Due to a certain number of containers which were cleaned by the householders after treatment and newly-made containers which were not treated, the Breteau index could not be reduced to nil although it was much lower than that in the check area.

Table 2

Results (Breteau index) of control trial of *Aedes aegypti* larvae with Abate 1% sand granules at 1 ppm in December 1972 in Vietnam.

	Treatment area	Check area
Pre-treatment:	558	506
Post-treatment-		
one month:	12	256
two months:	31	225
three months:	37	216
four months:	145	269
five months:	135	200

In the treated area, most people were very pleased to observe the reduction of *Aedes* larvae by Abate. Only few householders were afraid of possible toxic hazards of the insecticide and complained of the bad odour of Abate for a few days after treatment. All these problems could be solved if a good health education is carried out before the application of Abate.

SUMMARY

Aedes mosquito survey was carried out in one urban and one rural areas for each province of the Republic of Vietnam during the dry and rainy seasons. Very high Breteau index (more than 200) of *Ae. aegypti* was

found in most of areas surveyed. *Ae. albopictus* was very rare. Both species have developed resistance to DDT and dieldrin and a certain degree to malathion. A small trial of Abate 1% sand granules for larval control gave very good results at least for three months.

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