

Susceptibility of *Aedes aegypti* to Insecticides in Viet Nam

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Abstract

During 2000-2002, studies on the susceptibility of *Aedes aegypti* to insecticides were conducted at 22 places in 11 provinces and cities in four different regions of Viet Nam. *Aedes aegypti* was found susceptible to malathion, but resistant to DDT in almost all the study sites. It continues to be susceptible to the pyrethroid group of insecticides (permethrin, lambda-cyhalothrin, deltamethrin and alpha-cypermethrin) in many places in the North and Centre regions, but is resistant to these insecticides in many places in the South and Central Highlands in Viet Nam. However, the species was found highly and widely resistant to etofenprox.

Keywords: *Aedes aegypti*, pyrethroids, insecticides, Viet Nam.

Introduction

Insecticidal measures, especially in the outbreak-risk areas, are the most important for the control of *Aedes aegypti*, the main vector of DHF. Many insecticides of the group organochlorine (DDT), organophosphorous (fenthion, malathion and temephos) and pyrethroid (permethrin, deltamethrin, lambda-cyhalothrin, etc.) have been used for the malaria control programme and for *Aedes aegypti*. *Aedes aegypti* has been resistant to DDT since the early 1960s and cross-resistant to many insecticides of the pyrethroid and temephos groups in many countries, but is not yet resistant to malathion^[1-3]. When this species is resistant to the insecticides of the pyrethroid group, the organophosphorous ones could take their place^[4].

Both malaria and DHF were endemic in many mountainous, forested and coastal plain areas of Viet Nam where house spray and bednet treatment were applied for years. DDT was widely used before 1990 and later lambda-cyhalothrin, permethrin and deltamethrin^[5] were introduced. In 1999, *Aedes aegypti* was found resistant to DDT and some insecticides of the pyrethroid group in many places in Nam Bo (the South), Central Highlands, but not yet to malathion^[6]. This study provides more data on the susceptibility of *Aedes aegypti* to insecticides in different regions of Viet Nam.

Materials and methods

Time and study regions

During 2000-2002, studies were conducted at 22 places (located in 11 provinces and

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cities) – six places in the North, six in the Centre, six in the South and four in the Central Highlands.

Methods

The WHO standard bioassay tests (1998)^[7] were followed and the papers treated with DDT 4%, the control paper with OC (organochlorine control), malathion 5% and the control paper with OP (organophosphate control) and 5 insecticides of the pyrethroid group (permethrin 0.75%, lambda-cyhalothrin 0.05%, deltamethrin 0.05%, alpha-cypermethrin 30mg/m² and etofenprox 0.5%) with the same control paper PY (pyrethroid control).

The tests were done at a temperature of 25 °C ± 2 °C and humidity of 75-85%. The unfed, F1 mosquitoes, one or two days old – at least 150 mosquitoes for each insecticide, 100 for the test and 50 for the control, were used. Twenty-five mosquitoes were put in each test tube and the per cent mortality count was done 24 hours after the exposure. The mosquitoes in the resting tubes were then fed with glucose 10% in soaked cotton.

The susceptibility to the insecticides was evaluated on the following criteria:

- Mortality 98-100%: Susceptible to insecticide.
- Mortality 80-97%: Possibility of resistance to insecticide.
- Mortality < 80%: Resistant to insecticide.

Results

North

Of the six study places, *Aedes aegypti* was found resistant to DDT at five places and possibly resistant to DDT at one place; it was susceptible to malathion at five places and possibly resistant to this insecticide at one place. It was susceptible to all the tested insecticides of the pyrethroid group such as permethrin, lambda-cyhalothrin, deltamethrin and alpha-cypermethrin in at five places and the possibility of resistance to these four insecticides existed at one place. *Aedes aegypti* was resistant to etofenprox at four places and possibly resistant to etofenprox at two places (Table 1).

Table 1. Results of susceptibility tests on *Aedes aegypti* to insecticides in the North and Centre, Viet Nam

S. No.	Places	% Mortality						
		Permethrin 0.75%	Lambda- cyhalothrin 0.05%	Deltamethrin 0.05%	Alpha- cypermethrin 30mg/m ²	Etofenprox 0.05%	DDT 4%	Malathion 5%
1.	Thi Cau (Co) Bac Ninh (T) Bac Ninh (P)	100	100	100	100	68	57	100
2.	Phu Lang (Co) Que Vo (D) Bac Ninh (P)	100	100	100	100	92	94	100
3.	Cat Ba (S) Cat Hai (D) Hai Phong (C)	100	100	100	100	42	14	100

S. No.	Places	% Mortality						
		Permethrin 0.75%	Lambda- cyhalothrin 0.05%	Deltamethrin 0.05%	Alpha- cypermethrin 30mg/m ²	Etofenprox 0.05%	DDT 4%	Malathion 5%
4.	Niem Nghia (Co) Le Chan (D) Hai Phong (C)	91	92	94	95	92	21	100
5.	Ly Thai To (Co) Hoan Kiem (D) Ha Noi (C)	99	96 (200)	100	100	18	21	97.33 (150)
6.	Thinh Liet (Co) Thanh Tri (D) Ha Noi (C)	100	99	98	98	37	60	98
7.	Thach Phu (Co) Ha Tinh (T) Ha Tinh (P)	100	100	100	100	100	63	100
8.	Duc Tho (S) Duc Tho (D) Ha Tinh (P)	100	100	100	100	93	37.39 (115)	100
9.	Song Cau (S) Song Cau (D) Phu Yen (P)	100	100	100	98	51	4	100
10.	No. 6 (Co) Tuy Hoa (T) Phu Yen (P)	100	100	100	91	76	2	100
11.	Dong Luong (Co) Dong Ha (T) Quang Tri (P)	94	96	97	95	16	2	100
12.	Trieu Do (Co) Trieu Phong (D) Quang Tri (P)	100	100	100	100	86	11	100

No. 1 - 6 in the North

No. 7 - 12 in the Centre

Co: Commune; S: Small town; D: District; T: Town; P: Province; C: City

Figures in parenthesis indicate the number of mosquitoes tested

Central

Aedes aegypti was found resistant to DDT but was susceptible to malathion in all six places. It was susceptible to four insecticides of the pyrethroid group such as permethrin, lambda-cyhalothrin, deltamethrin and alpha-cypermethrin in five places and possibly resistant to them in one place, and resistant to etofenprox in three places, and

possibly resistant and susceptible to etofenprox at two and one places, respectively (Table 1).

South

Aedes aegypti was resistant to DDT at all six places; but susceptible to malathion at four places and possibility of resistance to malathion at two places; it was resistant to

permethrin and lambda-cyhalothrin at four places and the possibility of resistance to permethrin and lambda-cyhalothrin at two places. It also showed resistance to deltamethrin at one place and possibility of resistance to deltamethrin at five places;

resistance to alpha-cypermethrin at two places and possibility of resistance to alpha-cypermethrin at four places as well as resistance to etofenprox at all six places (Table 2).

Table 2. Results of susceptibility tests on *Aedes aegypti* to insecticides in the South and Central Highlands, Viet Nam

No.	Places	% Mortality						
		Permethrin 0.75%	Lambda - cyhalothrin 0.05%	Deltamethrin 0.05%	Alpha - cypermethrin 30mg/m ²	Etofenprox 0.05%	DDT 4%	Malathion 5%
1.	No. 6 (Co) Ben Tre (T) Ben Tre (D)	62	67	90	82	4	2	81
2.	Binh Thuan (Co) Binh Dai (D) Ben Tre (P)	94	90	97	92	53	20	100
3.	Binh Khanh (Co) Can Gio (D) Ho Chi Minh (C)	18	24	84	75	1	0	99
4.	Binh Trung Tay (Co) No. 2 (D) Ho Chi Minh (C)	96	93	97	96	20	11	95
5.	An Loc (S) Binh Long (D) Binh Phuoc (P)	79	56	84	96	1	0.8 (125)	90
6.	Tan Xuan (Co) Dong Xoai (T) Binh Phuoc (P)	8	28	19.33 (150)	25	7	2	99
7.	Plei Can (S) Ngoc Hoi (D) Kon Tum (P)	36	32	51	28	1	1	100
8.	Quyét Thang (Co) Kon Tum (T) Kon Tum (P)	57	61	66	47	1	1	100
9.	Buon Trap (Co) Krong Ana (D) Dak Lak (P)	5	11	41	40	0	6	97
10.	Thang Loi (Co) Buon Me Thuot (C) Dak Lak (P)	24	36	63	34	23	0	98

No. 1 - 6 in the South

No. 7 - 10 in the Central highlands

Co: Commune; S: Small town; D: District; T: Town; P: Province; C: City

Figures in parenthesis indicate the number of mosquitoes tested

Central Highlands

Aedes aegypti was resistant to DDT, permethrin, lambda-cyhalothrin, deltamethrin, alpha-cypermethrin and etofenprox at all four places in this region and susceptible to malathion at three places and showed possibility of resistance to malathion at one place (Table 2).

Discussion

Aedes aegypti was susceptible to malathion and resistant to DDT at almost all study places in Viet Nam. It was still susceptible to the four insecticides of the pyrethroid group (permethrin, lambda-cyhalothrin, deltamethrin and alpha-cypermethrin) in many places in North and Centre Viet Nam, but resistant to these insecticides in many places in the South and Central Highlands. These results

were not completely comparable with the observations made by Reiter and Gubler (1997)^[3], and Vu Duc Huong and Nguyen Thi Bach Ngoc (1999)^[6]. *Aedes aegypti* was possibly resistant to malathion in some places. This discrepancy in different regions was possibly due to the longer and more extended use of the insecticides of the pyrethroid group in malaria and dengue haemorrhagic fever control programmes and in agriculture in the Southern and Central Highlands. It is therefore suggested that the susceptibility tests should be conducted on all insecticides before use. Moreover, the cross-resistance of *Aedes aegypti* to insecticides belonging to the pyrethroid group should also be checked. *Aedes aegypti* was highly and widely resistant to etofenprox and further studies should be conducted in this context.

References

- [1] Yap HH, Cheng NL, Foo AES and Lee CY. Dengue vector control: present status and future prospects. *Kaoshiung J Med Sci*, 1994,10: 102-108.
- [2] World Health Organization. Dengue haemorrhagic fever: diagnosis, treatment, prevention and control. 2nd edn. Geneva: WHO, 1997: 48-59.
- [3] Reiter P and Gubler DG. Surveillance and control of urban dengue vectors. Dengue and dengue haemorrhagic fever. Colorado: CAB International, 1997: 425-454.
- [4] Kantachuvesiri A. Dengue haemorrhagic fever in Thai society. *Southeast Asian J Trop Med Public Health*, 2002, 33(1): 56-67.
- [5] Phan VT. Malaria epidemiology and malaria control in Vietnam. Medical Publishing House, Hanoi, 1996: 218-241 (in Vietnamese).
- [6] Huong VD and Bach Ngoc NT. Susceptibility of *Aedes aegypti* in south Vietnam. *Dengue Bulletin*, 1999, 23: 85-88.
- [7] World Health Organization. Report of the WHO informal consultation. Test procedures for insecticide resistance monitoring in malaria vector, bio-efficacy and persistence of insecticides on treated surfaces. Geneva: WHO, 1998. Document WHO/CDC/CPC/MAL/98.12: 1-43.