

TOLERANCE OF *ANOPHELES STEPHENSI* TO MALATHION IN THE PROVINCE OF FARS, SOUTHERN IRAN, 1977¹

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ABSTRACT. *Anopheles stephensi*, the main vector of malaria in southern Iran, is resistant to DDT and dieldrin. Resistance to DDT was observed in 1957 and to dieldrin in 1960. The

development of double resistance in one of the main vectors in Iran posed a serious problem to the malaria eradication campaigns.

Malathion house spraying, 50% w.d.p., 2g/m², has been implemented in the province of Fars, 1-2 rounds per year, since 1968. In recent years, agricultural pesticides such as Perfekthion (dimethoate), Nexion (bromophos), Dimecron (phosphamidon) and carbamates as Carbaryl (sevin) are commonly used on a number of crops.

Tests carried out with malathion impregnated papers during 1975-77 showed tolerance of wild caught *An. stephensi* at different localities of the province of Fars, southern Iran.

INTRODUCTION

The development of physiological resistance to DDT and dieldrin in *Anopheles stephensi* Liston is probably the most serious technical problem encountered in the malaria eradication campaigns in southern Iran. Resistance to DDT was observed in 1957 and to dieldrin in 1960 (Mofidi et al. 1958, Mofidi 1960). Due to double resistance of *An. stephensi*, residual house spraying was discontinued from 1961 until 1967.

Malathion house spraying, 50% w.d.p. at the rate of 2g/m², has been implemented 1 to 2 rounds per year since 1968. The frequency of application of

malathion increased the possibility of development of resistance of *An. stephensi*. As the emergence of malathion resistance may have a reverse effect on malaria control in this area, the susceptibility level of *An. stephensi* to malathion has been checked regularly by the Kazeroun Medical Research Station.

In recent years, carbamates, notably carbaryl, perfekthion (dimethoate) and dimecron (phosphamidon) have come into use against date palm pests. Resistance to organophosphorous and carbamate compounds has been observed in *An. albimanus* in Central America (Georghiou 1972, Georghiou et al. 1972).

Susceptibility tests carried out in 1975-77 showed the field population of *An. stephensi* to be tolerant to malathion, in Borazjan, Kazeroun and Mamasani counties, province of Fars, southern Iran.

MATERIAL AND METHODS

All tests were carried out using a field population of adult female *An. stephensi* collected from indoor resting places between 06.00 and 08.00 hrs. The mosquitoes used were blood-fed and caught by aspirator tube. The method used in testing is that developed by the World Health Organization (WHO 1970).

Paper impregnated with malathion at concentrations of 3.2 and 5.0 percent was provided by WHO. For the control, impregnated paper with olive oil alone was used. The multiple exposure times were 15, 30, 60, 120, 240 min. The mosquitoes were transferred to clean holding tubes

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after exposure to the toxicant, and the percentage mortality determined 24 hr later.

The regression lines were derived from the mortalities obtained at different exposure times to the same concentration of insecticide.

RESULTS AND DISCUSSION

The susceptibility tests were carried out in different localities of the province of Fars, southern Iran. These localities are located 80 to 260 km north of the Persian Gulf. The base-line data collected just prior to starting malathion spraying for control of *An. stephensi* in Chelow village, Minab county, southern Iran (October 1964) showed that the discriminating dosage that kills 100% of this species was 3.2% malathion, 1 hr exposure, 24 hr recovery (Eshghy & Janbakhsh 1976).

Since 1968, all areas south of the Zagros mountain range went under a malathion and DDT spraying combination. In the regions where *An. stephensi* is the sole vector, only malathion spraying was done, while in the areas where *An. stephensi* is associated with other vectors such as *An.*

dthali, *An. fluviatilis* and *An. superpictus*, 1 or 2 rounds of malathion followed by 1 or 2 rounds of DDT were performed.

In tests carried out in April 1977 in the villages of Tol-kharaki and Chamdarvahi in Borazjan county, the percentage mortality with 3.2% malathion paper and 1 hr exposure was observed to be between 84.1–87.2%. With 5.0% malathion the mortality was between 98.1–98.9%.

In tests made in 1977 in the villages of Shah-davood and Rashedan-abad in Kazeroun county, with 3.2% malathion and 1 hr exposure the mortalities were observed to be between 55.3–88.6%. When the exposure time increased to 2 hr, the mortality rate increased to 95.8–100%. With the mosquitoes tested against 5.0% malathion the mortality rate after 1 hr exposure, 24 hr recovery was between 98.2–98.9%.

In tests made in the village of Kooshkak in Mamasani county, the percentage mortality with 3.2% malathion paper and 1 hr exposure was 76.9%; when the exposure time was increased to 2 hr, the mortality increased 98.9%.

In susceptibility tests carried out with 3.2% malathion papers, the LT50 was ob-

Table 1. Results of malathion susceptibility tests with 3.2% concentration on *An. stephensi* in the province of Fars, southern Iran, 1977

			% Mortality after 24 hours recovery						
Locality	Date	Spraying cycle	exposure period (minutes)						
			Control	15	30	60	120	240	LT50
Chamdarvahi (Borazjan)	April 77	15 DDT	1.9	5.7	51.4	87.2	100	—	29
		5 DL	(103)	(104)	(103)	(102)	(80)		
		9 MAL.							
Tol-kharaki (Borazjan)	May 77	15 DDT	1.9	5.7	34.4	84.1	100	—	35
		5 DL	(103)	(105)	(125)	(107)	(97)		
		9 MAL.							
Shah-davood (Kazeroun)	June 77	18 DDT	0	11.3	20.8	88.6	95.8	100	40
		7 BHC	(100)	(106)	(115)	(106)	(97)	(100)	
		9 MAL.							
Rashan-abad (Kazeroun)	July 77	21 DDT	0	4.2	28.2	55.3	100	—	37
		4 DL	(89)	(94)	(92)	(94)	(91)		
		11 MAL.							
Kooshkak (Mamasani)	July 77	21 DDT	0	9.1	45.7	76.9	98.9	100	34
		4/DL	(95)	(87)	(105)	(117)	(93)	(83)	
		11 MAL.							

The figures in parentheses represent the number of mosquitoes tested.

Table 2. Results of malathion susceptibility tests with 5.0% concentration on *An. stephensi* in the province of Fars, southern Iran, 1977

Locality	Date	Spraying cycle	% Mortality after 24 hours recovery					
			exposure period (minutes)					
			Control	15	30	60	120	LT50
Chamdarvahi (Borazjan)	April 77	15 DDT	0	9.2	85.1	98.9	100	25
		5 DL	(100)	(97)	(94)	(92)	(88)	
		9 MAL.						
Tol-kharaki (Borazjan)	May 77	15 DDT	1.9	16.1	78.3	98.1	100	20
		5 DL	(103)	(99)	(120)	(109)	(96)	
		9 MAL.						
Shah-davood (Kazeroun)	June 77	18 DDT	0	23.3	54.3	98.2	100	24
		7 BHC	(99)	(90)	(114)	(115)	(104)	
		9 MAL.						
Rashan-abad (Kazeroun)	July 77	21 DDT	0	8	53.3	98.9	100	28
		4 DL	(89)	(87)	(90)	(92)	(89)	
		11 MAL.						
Kooshkak (Mamasani)	July 77	21 DDT	0	16.6	70.8	100	100	25
		4 DL	(95)	(90)	(96)	(102)	(98)	
		11 MAL.						

The figures in parentheses represent the number of mosquitoes tested.

served between 29–40 min, and with 5.0% malathion paper, the LT50 was observed between 20–28 min (Tables 1–2).

To summarize, susceptibility tests performed on *An. stephensi* showed tolerance

to malathion in the field population, in the province of Fars.

With regard to the 0.1% propoxur, a study was made as base-line data in the localities which were under routine ob-

Table 3. Results of propoxur susceptibility tests with 0.1% concentration on *An. stephensi* in the province of Fars, southern Iran, 1977

Locality	Date	Spraying cycle	% Mortality after 24 hours recovery					
			exposure period (minutes)					
			Control	15	30	60	120	LT50
Chamdarvahi (Borazjan)	April 77	15 DDT	1.9	19	76	96.8	100	7
		5 DL	(103)	(100)	(92)	(95)	(94)	
		9 MAL.						
Tol-kharaki (Borazjan)	May 77	15 DDT	1.9	25	63.1	94.2	100	7.5
		5 DL	(103)	(108)	(114)	(105)	(99)	
		9 MAL.						
Shah-davood (Kazeroun)	June 77	18 DDT	0	19.1	55.3	95.2	100	7.5
		7 BHC	(99)	(115)	(103)	(106)	(100)	
		9 MAL.						
Rashan-abad (Kazeroun)	July 77	21 DDT	0	5.7	29.1	93.5	100	11
		4 DL	(90)	(105)	(103)	(93)	(95)	
		11 MAL.						
Kooshkak (Mamasani)	July 77	21 DDT	0	7.2	52.7	71.4	100	9.5
		4 DL	(95)	(110)	(110)	(105)	(112)	
		11 MAL.						

The figures in parentheses represent the number of mosquitoes tested.

servations in April-July 1977. The range of mortality after 0.5 hr exposure followed by a 24-hr recovery period was 100%. The LT50 ranged between 7-11 minutes (Table 3).

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