

RESISTANCE OF ANOPHELES STEPHENSI LISTON TO  
MALATHION IN THE PROVINCE OF FARS, SOUTHERN  
IRAN, 1979<sup>1</sup>

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*Key words:* Iran, Anopheles Stephensi, Resistance

ABSTRACT

Anopheles Stephensi is an important malaria vector in southern Iran. This species developed resistance to DDT in 1975 and subsequently to dieldrin in 1960. Since 1968 this species has been under pressure of malathion house sprayin. 50% w.d.p., 2g/m<sup>2</sup>, 1-2 rounds per year.

Susceptibility tests carried out with malathion impregnated papers during 1979 showed that An. stephensi has acquired resistant to malathion too. With regard to the 0.1% propoxur, a study was carried out to obtain base-line data in the localities under routine observations and also the discriminating dosage that could kill 100% of An. stephensi.

The objective of the present paper is to summarize and discuss briefly the field investigations concerning insecticide resistance in An. stephensi.

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<sup>1</sup> This study was supported in part by funds from the School of Public Health and Institute of Public Health Research, University of Teheran, and partly by the Public Health Research Project of the Ministry of Health and Plan Organization.

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## INTRODUCTION

The development of resistance to chlorinated hydrocarbon insecticides by *An. stephensi*, the main vector of malaria in southern Iran, has created serious repercussions in mosquito control and eradication campaigns. 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 and then malathion was introduced to replace organochlorine insecticides.

Malathion house spraying, 50% w.d.p. 2g/m<sup>2</sup>, has been implemented 1 to 2 rounds Per annum Since 1968. The frequency of application of malathion increased the possibility of development of resistance of *An. stephensi* (Eshghy 1978). In recent years, agricultural pesticides such as perflorhion (dimenthoate), dimecron (phosphamidon) and carbamates as carbaryl (sevin) are commonly used on a number of crops.

Resistance to organophosphorous and carbamate compounds has been observed in *An. albimanus* in South and Central America (Georghiou 1972, 1973; Georghiou et al. 1972). In addition, resistance to one or more organophosphorous compound has been reported for *An. sacharovi* and *An. hyrcanus* in Turkey, for *An. messeae* in Romania, for *An. culicifacies* in Gujarat and Maharashtra States (India), (WHO, 1976).

In the laboratories of the School of Public Health and Institute of Public Health Research, Teheran University, an attempt was made to select resistance to malathion in *An. stephensi*. After 5 generations the LT50 with 3.2% malathion increased to 5 times that of the wild caught parents from mamasani, Kazeroun (Manouchehri et al. 1975).

Studies carried out on the resistance of *An. stephensi* to malathion in Bandar Abbas, southern Iran, 1975, showed that individual resistant to malathion are present in the field population of this species (Manouchehri et al. 1976).

Susceptibility tests performed on mosquitoes caught from different localities of the province of Fars, southern Iran in 1979, showed that field population of *An. stephensi* is resistant to malathion.

## MATERIALS AND METHODS

All the tests were performed with a field population of adult female An.stephensi collected from indoor resting places between 06.00 and 08.00 hr. The mosquitoes used were blood fed and caught by aspirator tube.

The testing method used was the one developed by the World Health Organization (WHO 1970). Four replicates of 20-25 insects were usually used for each concentration and exposure time. Standard WHO impregnated papers were used at the following concentrations: 4.0% DDT; 4.0% diel-drin; 5.0% malathion and 0.1% propoxur, together with the corresponding control papers. The multiple exposure times were 15, 30, 60, 120 min for malathion and 7½, 15, 30 and 60 min for propoxur.

Mosquitoes were held for 24 hr after exposure, when mortalities were recorded. Mortality percentages were corrected by the Abbott's formula when necessary. The LT50 and/or LC50 values were estimated graphically from the log-dosage-probit regression mortality line.

## RESULTS AND DISCUSSION

In 1979, a series of susceptibility tests were carried out on An.stephensi in the localities of **Tol-Kharaki** and **Chamdarvahi** (Borazjan country), **Shoa-es-saltaneh** and **Khoramzar** (Kazeroun county), **Dimemil**, **Jafar-abad** and **Kooshkak** (Mamassani county), in the province of Fars, southern Iran.

\*The average mortality rates for 4.0% DDT after 1 hr exposure and 24 hours recovery was between 4.1 and 5.1%. When exposure time was increased to 4 hr, the percentage mortality was between 8.2 and 24.3% (Table 1).

Susceptibility tests with 4.0% dieldrin concentration and 1 hr exposure revealed the mortality range of 18.7-31.8%. When exposure time was increased to 4 hr, the mortalities were observed to be between 34.3-55.2% (Table 2).

The base-line data collected just prior to starting malathion spraying, to control An.stephensi in Bandar - Abbas area, southern Iran (October 1964), showed that the discriminating concentration that killed 100% of this species was 3.2% malathion, 1 hr exposure, 24 hr recovery (Table

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and Janbakhsh 1976; Janbakhsh et al. 1976).

Since 1968, all areas south of the Zagros mountain range was treated with malathion, 1-2round per year. After almost 10 yr individuals resistant to malathion are present in the field population of An.stephensi in the province of Fars.

In tests made in 1979, with 5.0% malathion paper and 1 hr exposure, 24 hr recovery the average mortality rate was observed to be between 74.8-89.8%. The determination of LT50 values and interpretation of results based on time mortality was observed between 32-42 min (Table 3).

Table 1. Results of DDT susceptibility tests on An.stephensi in the province of Fars, southern Iran, 1979

Locality	Date	spraying cycle	Exposure time (hr)	% Mortality after 24 hr recovery	
				Control	4.0
Tol-Kharaki (Borazjan)	June 79	15 DDT 5 DL 13 MAL.	1	0 (94)	5.1 (98)
"	"	"	4	0 (94)	10.5 (95)
Chamdarvahi (Borazjan)	June 79	15 DDT 5 DL 13 MAL.	1	0 (98)	4.2 (95)
"	"	"	4	0 (98)	10.6 (94)
Shoa-es-sal taneh (Kazeroun)	July 79	23 DDT 4 DL 13 MAL.	1	0 (85)	4.2 (94)
"	"	"	4	0 (84)	24.3 (74)
Kooshkak (Mamasani)	July 79	23 DDT 4 DL 13 MAL.	1	0 (88)	4.1 (97)
"	"	"	4	0 (82)	8.2 (85)

The figures in parentheses represent the number of mosquitoes tested. DL = Dieldrin MAL. = Malathion

Susceptibility tests were carried out on An.stephensi with 0.1% propoxur paper, in order to obtain base line data in the localities which were under routine observations in July-August 1979. In this series of tests LT50's values was observed to be between 18-20 min and discriminating dosage that killed 100% of this species was 0.1% propoxur, 1 hr exposure, 24 hr recovery period (Table 4).

This it can be concluded that An.stephensi is strongly resistance to DDT, dieldrin, whereas resistance to malathion is not as strong in the field population of this species in the province of Fars, southern Iran.

Table 2. Results of dieldrin susceptibility tests on An.stephensi in the province of Fars, southern Iran, 1979

Locality	Date	spraying cycle	Exposure time (hr)	% Mortality after 24 hr recovery	
				Control	4.0
Tol-Kharaki (Borazjan)	June 79	15 DDT 5 DL 13 MAL.	1	0 (98)	23.4 (94)
"	"	"	4	0 (98)	34.3 (99)
Chamdarvahi (Borazjan)	June 79	15 DDT 5 DL 13 MAL.	1	0 (86)	20.2 (89)
"	"	"	4	0 (86)	37.7 (85)
Shoa-es-sal taneh (Kazeroun)	July 79	23 DDT 4 DL 13 MAL.	1	0 (85)	18.7 (83)
"	"	"	4	0 (84)	54 (74)
Kooshkak (Mamasani)	July 79	23 DDT 4 DL 13 MAL.	1	0 (88)	31.8 (92)
"	"	"	4	0 (82)	55.2 (76)

The figures in parentheses represent the number of mosquitoes tested.

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Table 3. Results of malathion susceptibility tests with 5.0% concentration on An. Stephensi in the province of Fars, southern Iran, 1979

Locality	Date	spraying cycle	% Mortality after 24 hr recovery Exposure period (min)					
			Control	15	30	60	120	LT50
Jafar-abad (Mamasani)	July 79	23 DDT 4 DL 13 MAL.	0 (93)	4.8 (105)	15.9 (94)	80.9 (89)	100 (99)	42
"	"	"	0 (90)	-	-	75.9 (204)	-	
Kooshkak (Mamasani)	July 79	23 DDT 4 DL 13 MAL.	0 (91)	14 (78)	44.9 (89)	87.1 (101)	100 (99)	32
"	"	"	0 (68)	-	-	88 (175)	-	
Dimemil (Mamasani)	July 79	23 DDT 4 DL 13 MAL.	0 (93)	11.4 (105)	24.8 (105)	89.8 (98)	100 (93)	36
Chamdarvahi (Borazjan)	July 79	15 DDT 5 DL 11 MAL.	0 (73)	-	-	74.8 (107)	-	
Khoramzar (Kazeroun)	August 79	16 DDT 5 DL 12 MAL.	0 (90)	5.4 (92)	31.5 (92)	86.9 (94)	100 (83)	35
"	"	"	0 (93)	-	-	89 (192)	-	

The figures in parentheses represent the number of mosquitoes tested.

DL = Dieldrin

MAL. = Malathion

Table 4. Results of propoxur susceptibility tests with 0.1% concentration on An. Stephensi in the province of Fars, Southern Iran, 1979

Locality	Date	spraying cycle	% Mortality after 24 hr recovery Exposure period (min)					
			Control	7½	15	30	60	LT50
Kooshkak (Mamasani)	July 79	23 DDT 4 DL 13 MAL.	0 (91)	14.9 (107)	19.1 (84)	98.9 (95)	100 (96)	20
Jafar-abad (Mamasani)	"	"	0 (95)	4.1 (97)	19.6 (102)	93.7 (92)	100 (98)	20
Dimemil (Mamasani)	"	"	0 (93)	6.6 (91)	22.8 (101)	90.6 (96)	100 (93)	19
Khoramzar (Kazeroun)	August 79	24 DDT 4 DL 14 MAL.	0 (96)	4.7 (105)	35.2 (105)	91.9 (87)	100 (89)	18

The figures in parentheses represent the number of mosquitoes tested.

DL = Dieldrin

MAL. = Malathion

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