SUSCEPTIBILITY OF *ANOPHELES SUPERPICTUS* TO INSECTICIDES IN IRAN[1]

N. ESHGHY, B. JANBAKHSH AND M. MOTTAGHI

Department of Environmental Health, School of Public Health, University of Teheran, P.O.Box 1310, Teheran, Iran

ABSTRACT. Susceptibility of adult female *Anopheles superpictus* Grassi to insecticides was studied in field surveys in different localities of Iran during 1971–74. Many parts of Iran had been treated with DDT inside houses, 4–12 rounds a year for malaria control. These tests were carried out in localities where the application of DDT had been withdrawn since 1968. The species was found to be susceptible to DDT, dieldrin, and malathion.

INTRODUCTION. In Iran *Anopheles superpictus* Grassi is widely distributed except in the area of the Caspian Sea and the Persian Gulf. It is the main vector of malaria in the Central Plateau of Iran, and an important vector in the mountainous areas south of the Zagros chain.

This species has shown behavior refractory to attack measures. In some part of Iran, particularly in Kermanshah in the west and Kashafrud, Khorassan, in the east, despite the anti-malaria campaign, transmission occurred. Adult females feed and rest outdoors and indoors.

The susceptibility level of *An. superpictus* to insecticides has been fully summarized by Brown and Pal (1971) who mentioned that this species was susceptible to all insecticides.

MATERIALS AND METHODS. The method used in testing was that developed by the World Health Organization for evaluating the susceptibility to insecticides of field populations of adult anophelines (WHO 1970). Paper impregnated with DDT in Risella oil at concentrations of 0.5, 1.0, 2.0 and 4.0%; dieldrin impregnated paper at concentrations of 0.05, 0.1, 0.2, 0.4 and 0.8%; and malathion impregnated paper at concentrations of 0.5, 3.2 and 5.0% were provided by WHO. For controls, papers impregnated with Risella oil alone were used.

All observed mortality was corrected by Abbott's formula when necessary. LC50's were estimated by plotting the dosage-mortality lines. The mosquitoes used were blood-fed *An. superpictus* which had been collected from human and animal shelters.

RESULTS AND DISCUSSION. The base-line value of LC 50 for DDT was 0.7%, being performed in the unsprayed village of Hajiabad in the Sabzevar area in northeastern Iran, in November 1955. (Janbakhsh et al. 1976).

In susceptibility tests performed on *An. superpictus* in the untreated villages of Beheshtabad and Dopolan at Ardel, in the Isfahan area, the LC50 of DDT was 0.68% and the LC50 of dieldrin 0.1% in August 1957. (Mofidi et al. 1958).

DDT has been applied as an adulticide for 15–20 years and, subsequently, dieldrin and malathion were used on the southern slopes and foothills of the Zagros range. The Central Plateau of Iran had been treated with DDT for malaria control inside houses, 4–12 rounds once a year, but the application of DDT has been withdrawn since 1968.

As table 1 shows, 9 villages in Kermanshah, Kurdestan, Isfahan and Khorassan which had been treated with DDT at the rate of 2g/m² once a year for 4–10 rounds, were checked during the last 4 years. The LC50 of DDT was found to be between 0.7–1.3% in DDT treated areas. Besides these 9 villages, in an additional number of

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Table 1. Results of DDT susceptibility tests on *An. superpictus* (1971–74) in Iran

Locality	Date	Spraying cycle	% Mortality after one-hour exposure, 24 hours recovery					
			Control	0.5	1.0	2.0	4.0	LC50
Sahneh (Kermanshah)	June 71	7.DDT	0 (95)	16.6 (102)	74 (98)	96.9 (99)	100 (100)	0.8
Songhor (Kermanshah)	"	6.DDT	0 (101)	21.2 (99)	65.3 (104)	94.2 (105)	100 (106)	0.85
Sarghaleh (Ghasr-Shirin)	"	7.DDT 3.MAL.	0 (100)	34 (100)	77.2 (101)	100 (102)	100 (103)	0.7
Mahabad (Kurdestan)	August 71	5.DDT	0 (71)	0 (68)	34.3 (67)	76.5 (64)	100 (67)	1.3
Sarney (Kermanshah)	August 72	6.DDT 4.MAL.	0 (127)	16 (131)	45 (127)	80 (137)	100 (138)	1.1
Deh-Mohammad (Tabas)	July 72	6.DDT	0 (101)	33.6 (101)	53 (85)	94.9 (99)	100 (101)	0.95
Kabood-Gonbad (Kalat-Naderi)	"	5.DDT	0 (91)	0 (58)	43 (58)	89.7 (88)	100 (108)	1.3
Jounaghan (Shahr-Kord)	August 74	10.DDT	0 (88)	4.5 (89)	26.2 (80)	92.1 (89)	100 (87)	1.15
Boojen (Isfahan)	"	4.DDT	0 (64)	9 (66)	39 (64)	95.5 (67)	100 (61)	1.1

The figures in parentheses represent the number of mosquitoes tested.

Table 2. Results of dieldrin susceptibility tests on *An. superpictus* (1971–74) in Iran

Locality	Date	Spraying cycle	% Mortality after one-hour exposure, 24 hours recovery						
			Control	0.05	0.1	0.2	0.4	0.8	LC50
Saghez (Kurdestan)	August 71	5.DDT	0 (87)	..	11.3 (79)	62.5 (75)	98.7 (82)	100 (82)	0.18
Gazaneh (Sanandaj)	"	5.DDT	0 (46)	..	9.5 (42)	62.8 (43)	97.8 (46)	100 (47)	0.19
Deh-Mohammad (Tabas)	July 72	6.DDT	0 (102)	3.1 (93)	38 (92)	100 (107)	100 (96)	..	0.12
Kabood-Gonbad (Kalat-Naderi)	"	6.DDT	0 (58)	4.6 (43)	86.1 (60)	100 (67)	100 (51)	..	0.07
Jounaghan (Shahr-Kord)	August 74	10.DDT	0 (96)	..	21 (86)	72.6 (87)	98.4 (88)	100 (82)	0.15
Broojen (Isfahan)	"	4.DDT	0 (90)	..	12.5 (78)	77.5 (76)	100 (70)	100 (80)	0.14

The figures in parentheses represent the number of mosquitoes tested.

Table 3. Results of malathion susceptibility tests on *An. superpictus* (1972–74) in Iran

Locality	Date	Spraying cycle	% Mortality after one-hour exposure, 24 hours recovery			
			Control	0.5	3.2	5.0
Sarney (Kermanshah)	August 72	7.DDT 4.MAL.	0 (131)	7 (128)	100 (135)	100 (101)
Jounaghan (Shahr-Kord)	August 74	10.DDT	0 (92)	10 (87)	100 (90)	100 (89)
Broojen (Isfahan)	"	4.DDT	0 (94)	12 (68)	100 (70)	100 (72)

The figures in parentheses represent the number of mosquitoes tested.

villages susceptibility tests were conducted in 1971–74. Studies showed the LC50 of DDT to be between 0.8–1.5% in DDT treated areas.

An. superpictus was tested against dieldrin and malathion in 1974–74. Tests carried out in 1971–74 showed the LC50 of dieldrin to be between 0.07–0.19%. The discriminating concentration that killed 100% of the mosquitoes tested was 0.8 and 3.2% of dieldrin and malathion respectively (Tables 2–3).

These studies showed, in spite of almost 4–12 years of DDT application on the Central Plateau and 2 years of dieldrin and, subsequently, the malathion application in mountainous areas south of Zagros chain, this species remained susceptible to these insecticides.

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