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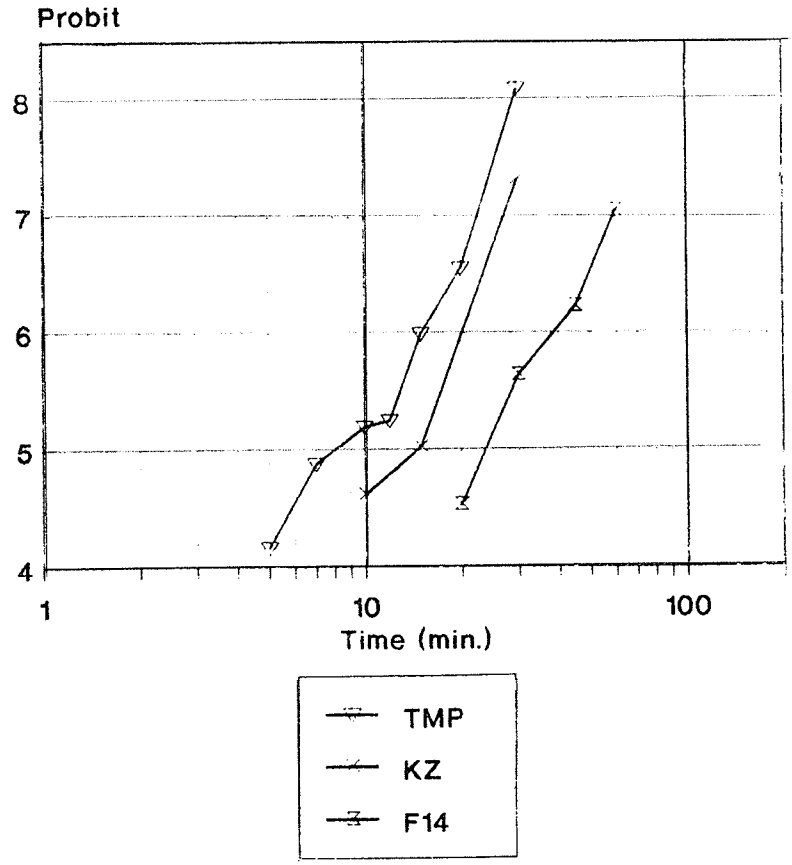

Fig. 1- Probit regression lines for KZ , TMP strains and F14 gerneration of An.stephensi , selected with propoxur

Table 1 - The probit regression line parameters of Propoxur selection on the adult females of *An.stephensi*

Strain / Generation	LT_{50}	Uper C.F. Lower C.F.	LT_{90}	Uper C.F.* Lower C.F.	X2 (d.f)
KZ	13.77	14.95 12.49	27.60	32.79 24.48	15.80 (2)
TMP	8.5	9.05 7.95	18.97	21.46 17.19	14.68 (5)
F1	12.77	14.49 11.38	49.69	72.86 38.11	124.68 (6)
F2	16.86	18.07 15.63	37.53	42.98 33.74	12.09 (4)
F3	23.41	24.82 21.95	47.39	52.48 43.62	6.97 (5)
F4	29.06	30.26 27.88	57.80	62.74 53.93	18.84 (5)
F5	36.94	38.48 35.37	64.95	70.09 60.99	8.53 (4)
F6	43.63	46.57 40.97	107.90	135.05 92.16	0.78 (4)
F7	34.74	37.85 31.28	101.00	122.94 87.66	33.13 (3)
F8	48.51	52.65 44.93	126.97	166.30 105.58	29.70 (4)
F12	19.37	21.38 16.79	34.06	38.42 31.18	2.17 (2)
F13	22.60	24.37 20.58	38.91	43.59 35.74	4.46 (2)
F14	24.30	25.90 22.66	43.13	48.73 39.34	2.00 (2)

* C.F. = Confidence limit

Figure 1 shows the regression lines for log time probit mortality of KZ,TMP and F_{14} generation. The LT_{50} and LT_{90} values for each line as well as the results of the statistical analysis are presented in table 1.

This low level of resistance tolernace is in agreement with the observations made on *An.albimanus* in 1972 , where only 2.8 X resistance was noticed , to propoxur , in 50 generations (2,3). However , this is in sharp contrast to the development of resistance in *An.stephensi* from Iran (5,6) and Pakistan (4) to malathion. In the two latter studies *An.stephensi* showed 4 X and 37X resistance in 5 and 15 generations , respectively.

However in order to maximize the opportunities for this adulticide to remain effective for as many years as possible , careful insecticide management is needed. As Brown has aptly stated " this is essentially achieved by proper economies in their use and by avoidance of the unnecessary blunting of compunds before their time ". Integrated control may relegate chemical control to its strong suit , namely a precision which can obtain immediate and thorough control in definite areas at planned times (1). The development of proper biological control method and the use of environmental sanitation should help to achieve this end.

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(2,3) , *An.sacharovi* Favre and *An.maculipennis* Meigen in Europe and *An.culicifacies* Giles in India and Oman (12).

During propoxur application , an investigation was made to determine the ability of *An.stephensi* to develop resistance to this insecticide as a major step for planning the future strategy of using chemical insecticides in malaria control programmes in south of Iran.

Materials and methods

Two strains of of *An.stephensi* were used in this study :

1) TM: a strain originated from Tomgoohar village , Minab , Hormozgan province (54, 04'E. longitude and 27,09'N. latitude) , where about 20 rounds of indoor residual spraying of propoxur was performed during 1977-1992 and which was colonized at the School of Public Health in 1986.

2) KZ: a strain originated from Kazeroun , Fars province (latitude 29,37'N and longitude 51,38'E) which has been maintained in an insectary since 1957. This strain has never had any exposure to organophosphorus , carbamate insecticides.

3) TMP: a subcolony derived from TM , which was submitted to propoxur selection.

Mosquito rearing , maintenance and the experimental procedure were carried out under controlled conditions of temperature ($26+1^0$c) and relative humidity (80-85%).

Susceptibility tests were carried out on adult females at 4-5 exposure times using about 100 mosquitoes for each exposure time. The sexes had been separated at the pupal stage. Selection pressure was conducted at the level of killing about 70-90% of adult females.

Results and discussion

Propoxur indoor residual spraying has been implemented in Minab , Hormozgan province for 14 successive years. In this area , *An.stephensi* is almost active throughout the year and is the major vector of malaria. This species is still susceptible to propoxur (9). Susceptibility tests on the adult females of *An.stephensi* collected from Minab showed LT_{50} of 5.9-8.45 minutes during 1984-1987.

Initially the parental strain (TMP) showed a LT_{50} of 8.5 minutes. Fourteen successive generations of propoxur selection on the adults resulted in 2.86 fold increase in tolerance that of the TMP strain and 1.76 fold that of the KZ strain.

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PROPOXUR SELECTION OF THE ADULTS OF *ANOPHELES STEPHENSI* FROM MINAB , SOUTH OF IRAN

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Key words: *Selection , propoxur , Anopheles stephensi , Iran*

Abstract

Anopheles stephensi is the main malaria vector in south of Iran. It has been known to be resistant to DDT , malathion and dieldrin. After appearance of resistance , the area was treated with propoxur , at the rate of 2 g/m^2 twice a year for 14 successive years. This species is still susceptible to propoxur. In order to forecast the possibility of development of propoxur resistance in *An.stephensi* , the females of this species were put under the pressure of propoxur for 14 generations in 1988.

Fourteen generations of propoxur selection on the adult females of *An.stephensi* resulted in an increase in LT_{50} from 8.5 minutes to 24.30 minutes, i.e. 2.86 fold increase in tolerance.

Introduction

Anopheles stephensi Liston is the chief vector of malaria in south of Islamic Republic of Iran and is known to be largely endophilic. Resistance to DDT was first recognized in this species in 1957 (11) and subsequently to dieldrin in 1960 (10) and to malathion in 1976 (7,8). During 1977-1992 , indoor residual spraying was carried out , 2 rounds per year in southern Iran , using propoxur (50% WP , 2 a.i g/m^2) , since 1993 lambdacyhalothrin (ICON 10% WP) has been substituted.

Resistance to carbamates has been observed in at least four malaria vector species world wide. These are *An.albimanus* Wiedemann in Central America

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