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COMPARATIVE TOXICITIES OF FOUR WHO-RECOMMENDED LARVICIDES AGAINST LAB STRAIN OF *ANOPHELES STEPHENSI* IN IRAN, 1999

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Abstract

Investigation on the current response of *An.stephensi* larvae to four WHO recommended larvicides *viz.* malathion, temephos, chlorpyrifos and fenitrothion, were carried out in the laboratory in 1999. Diagnostic concentrations of pesticides only yielded 100% mortality with malathion. In contrast, levels of susceptibility to temephos, chlorpyrifos and fenitrothion were lower. Fenitrothion (0.125 mg/l), chlorpyrifos (0.025 mg/l) and temephos (0.625 mg/l) killed 72%, 90% and 87% of the population of *An.stephensi*, respectively. At the LC_{50} level the efficacies of chlorpyrifos and fenitrothion was higher than malathion and temephos. Relative toxicity of chlorpyrifos and fenitrothion was 6 and 24 time more than temephos and malathion. The findings of this study suggests that the diagnostic dose of organophosphate larvicides depend on time, location, strain and genetical background of resistance to insecticides, hence they can not be attributed to all species of *Anopheles*.

Introducation

Malaria has always been considered as the most important vector-borne disease in Iran due to its effect on the socio-economy of the populations. WHO recommends

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that malaria control receives of multilateral political support at different levels, is inserted into the health system of country, that there is anefficient community contribution and a necessary resource supplement (budget and expert staff). Our plan for control of malaria is in line with WHO recommendations. At the national malaria control strategies selective vector control against adult and larval stages is an attempt to reduce the man-vector contact and transmission of parasites to human.

Eight species of Anopheles including *An.stephensi, An.culicifacies, An.dthali, An.superpictus, An.maculipennis, An. pulcherrimus, An,sacharovi* and *An.fluviatilis* play important roles in malaria transmission in different parts of Iran. Among which *Anopheles stephensi* is known to be an important malaria vector in the Persian Gulf, the Middle-East and Indian subcontinent. As a result of the continuous application of insecticides in these regions, *An.stephensi* populations are known to be resistant to DDT (2,3,14), dieldrin (4,21) and malathion (6,7,8,9,11,12,13,18). There are as well some reports of pyrethroid resistance in *An.stephensi* based on laboratory selection (1,10,15,17). In the absence of any previous report on insecticide susceptibility of *An.stephensi* larvae in Iran, It was thought necessary to determine suceptibility in this species to WHO-recommended larvicides; malathion, chlorpyrifos, fenitrothion, and temephos.

Materials and methods

Larvae were tested with different concentrations of insecticides at the early 4th instar in a room with a temperature of 25 ± 1 °C according to the WHO method (20). Mortality counts were made after 24 hour exposure to the insecticide. In the analysis both dead and moribund larvae were considered as dead, and the alive larvea were scored separately. Only larvae of uniform size were considered during all of the tests. At each concentartion 200 mosquitoes representing individuals of 25 larvae were used at four interval occasions. Parallel control tests were done by adding 1 ml alcohol without insecticde in 249 ml of water. The percentage mortality was corrected with control using Abbots' formula. Dosage mortality regression lines were determined by the probit analysis method (5), using the probit 79 programme on an computre. Goodness off it of the points to a straight line were tested by Chi-square

analysis. A laboratory strain of *An.stephensi* named Tehran that is resistant to bo DDT and dieldrin at the adult stage and susceptible to all insecticides at the lar stage were used. This strain has been reared in our insectary for 400 generatio Different concentrations of alcoholic solutions of insecticides which is suppli by WHO in 50 ml bottles were used. Standard stock solutions of insecticides were follow:

malathion 781.25, 156.25, 31.25, 6.25 mg/l; temephos 156.25, 31.25, 6.25, 1.2 mg/l; fenitrothion 31.25, 6.25, 1.25, 0.25 mg/l and chlorpyrifos 6.25, 1.25, 0.2 0.05 mg/l.

In some cases lower logaritmic concentration of insecticides were diluted by addi required volume of alcohol solvent to the insecticide.

Results and discussion

The results of the studies on the efficacy of four organophospha larvicides; malathion, chlorpyrifos, temephos and fenitrohtion against larvea *An.stephensi* are shown in Fig. 1. Malathion at the diagnostic dose (3.125 mg/ yielded 100% mortality in the population. Lower mortality was obtained when they we tested with fenitrothion, chlorpyrifos and temephos. Diagnostic dose of fenitrothi (0.125 mg/l) caused 72% mortality. For chlorpyrifos (0.025 mg/l) and temephos (0.62 mg/l) the figures were 90% and 87%, respectively. In decreasing order of mortali at the diagnostic levels, fenitrothion was the least effective and malathion was t most toxic to the larvae of *An.stephensi*. Compartive toxicities of larvicides a shown in Fig. 2. The LC_{50} and LC_{90} is used to asses the relative toxicities pesticides. In order to find correlation between mortality and concentration probit-regression line parameters were calculated (5). The results are presented Table 1 and Fig.3. At the LC_{50} level fenitrothion exhibited lowest value (0.00 mg/l). The same figure can be seen by chlorpyrifos. A linear correlation was foun between the response of *An.stephensi* and the doses of insecticidess. The regressio lines of different insecticides are plotted in Fig.3. Results of X^2 test showed th response of *An.stephensi* to different insecticides statistically significant valu

indicating that proportions of the species differed in response and the response was not homogenous. In a study diagnostic doses of malathion, fenitrothion and temephos caused 61%, 84% and 100% mortality, respectively in the population of lab strain of *An.stephensi* in India (19), with high resistance to DDT, fenitrothion and malathion but were susceptible to temephos.

In view of these results, it can be concluded that diagnostic dose is flexible, and may vary in time and space. The effective management of resisatnce monitoring depends on understanding the genetical, biochemical and behavioural factors determining resistance in the mosquitoes.

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Table 1- Probit regression line parameters of *An.stephensi* to different larvicides

Insecticide	a	B±SE	LC_{50}±95% C.I	LC_{90}±95% C.I	$X^2_{(df)}$	P
Malathion	1.37	1.03±0.16	0.016 0.047 0.136	0.240 0.810 10.57*	46.2 (3)	<0.0001
Temephos	0.98	0.507±0.04	0.007 0.012 0.017	1.730 3.930 12.11*	6.63 (3)	<0.001
Chlorpyrifos	1.90	0.073±0.17	0.0005 0.0020 0.0620	0.014 0.142 0.290	37.03 (3)	<0.0001
Fenitrothion	1.25	0.47±0.11	0.0002 0.0020 0.0150	0.070 1.170 3.710	37.9 (4)	<0.0001

* not valid

a= intercept

B±SE= slope ±standard error

LC*50*±95% C.I= lethal concentration cause 50% mortality in population ± 95% confidence interval

LC*90*±95% C.I= lethal concentration cause 90% mortality in population ± 95% confidence interval

$X^2_{(df)}$= heterogeneity about the regression line with degree of freedom

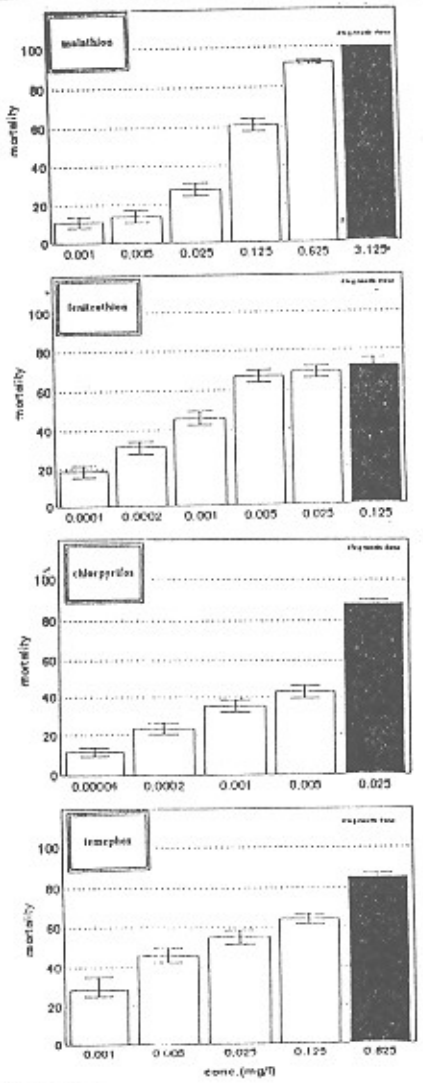

Fig. 1- The mortality of *An.stephensi* to different concentrations of larvicides

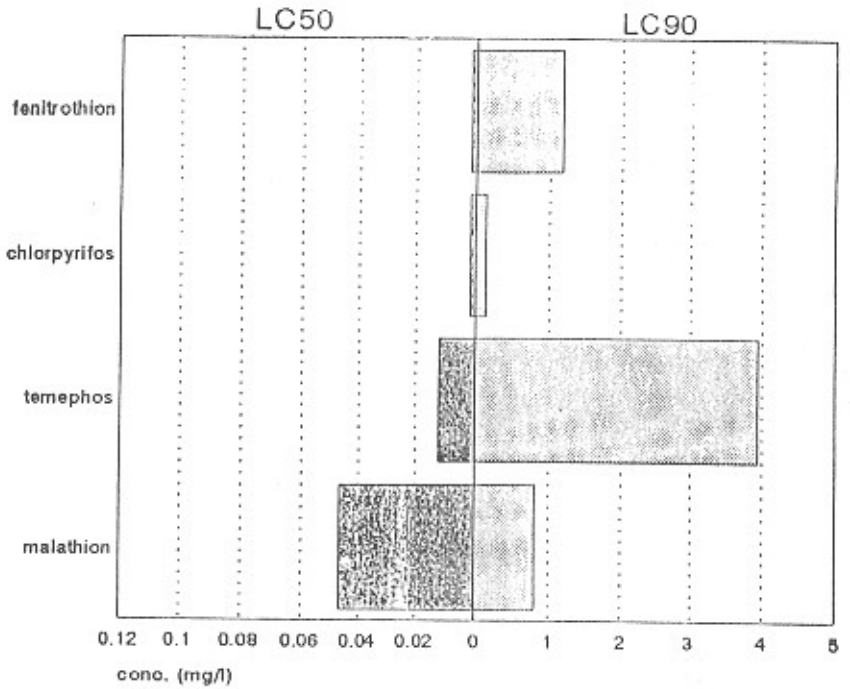

Fig. 2-Comparative toxities of different larvicides against *An.stephensi* larvae

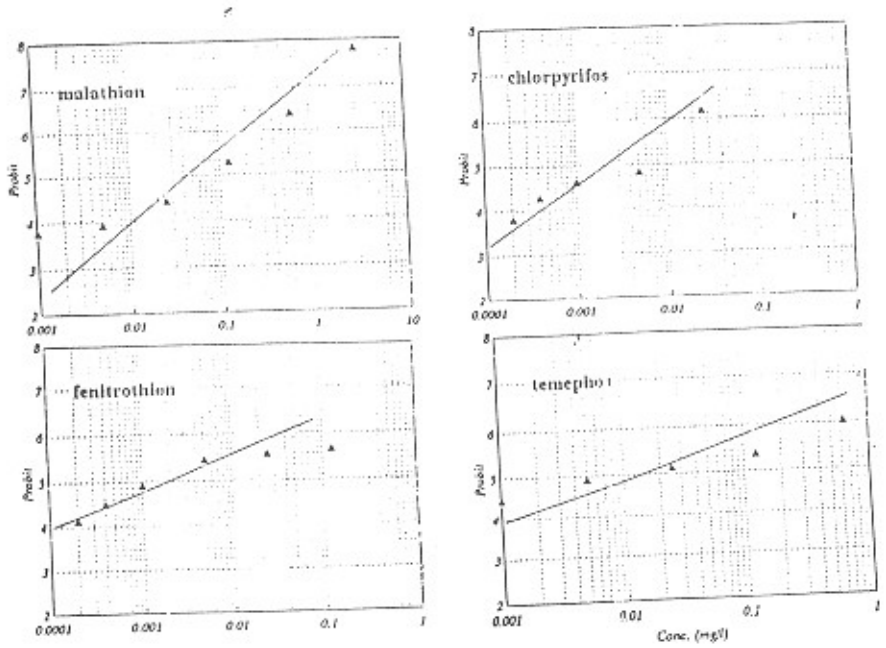

Fig. 3- Probit regression lines of *An.stephensi* to different larvicides

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