RESISTANCE OF ANOPHELES SACHAROVI FAVRE TO DDT IN IRAN, 1973

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ABSTRACT

A. sacharovi, which is one of the main malaria vectors of the Palearctic region, is resistant to DDT in Greece (1949), Lebanon (1954), Turkey (1959), Syria and the U.S.S.R. (1972).

The first record of A. sacharovi resistance to DDT in Iran was given in 1959 from the Kazeroun area, followed by Izeh (1969) and Meshkin-Shahr (1970).

This paper urgently advises speedy measures to eliminate the present foci of DDT-resistant A. sacharovi, to distinguish the areas of spread around the foci and to proceed with the systematic checking of the susceptibility level of A. sacharovi in other areas of its distribution in Iran.

INTRODUCTION

Anopheles sacharovi was the first anopheline to develop resistance to DDT. Failure in the effect of DDT on A. sacharovi was first observed in southern Greece in 1949, when it was observed that adults of this species were resting in large numbers under road bridges, but were absent from sprayed houses and stables. In 1950, adults were observed remaining in houses and resting on sprayed

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walls (Georgopoulos, 1951). In 1952, control failure was observed within 4 weeks after spraying and the indoor population of A. sacharovi had returned to the unsprayed level (Livadas and Georgopoulos, 1953). Definite DDT resistance as well as Dieldrin resistance was observed (De Zulueta, 1959) in areas that had been sprayed 10 times with DDT and 5 rounds with Chlordane or HCH.

DDT-resistant populations of A. sacharovi have been reported from Lebanon (Garrett-Jones and Gramiccia, 1954), Turkey (De Zulueta, 1959), Syria (Orioni, 1972) and the U.S.S.R (Drobozian et al., 1972). In Yugoslavia, A. sacharovi has shown tolerance to DDT and there is no report of DDT resistance from Rumania, northern Iraq, Italy or Albania (Brown and Pal, 1971). A. sacharovi is distributed throughout the U.S.S.R., Italy, Sardinia, Corsica, Syria, Iraq, Austria, Cyrus, Turkey, Greece, Kazakstan, Lebanon and Jordan (stone et al., 1959). In Iran, A. sacharovi is partly scattered throughout Azerbaijan, the central area, the west and southwest and Fars Province. It is found in the northern area of Kerman Province, but not in Khorassan, Baluchestan and the Caspian Sea area.

As the emergence of insecticide resistance has great impact on the Malaria Eradication Campaign, evaluation of the susceptibility level of the anopheline vectors has been checked regularly by members of the Vector Control Unit, Department of Environmental Health, School of Public Health and Institute of Public Health Research.

In this paper, the history of A. sacharovi resistance in Iran as well as the results of susceptibility tests performed in Izeh (southwest) and Meshkin-Shahr (northwest) from 1969 to date are discussed.

MATERIALS AND METHODS

The method used in testing is that developed by the World Health Organization for evaluating the susceptibility of a field population of adult Anophelines (WHO, 1970). Paper impregnated with DDT in Risella oil at concentrations of 0.5, 1.0, 2.0 and 4.0%, Malathion-impregnated paper at concentrations of 0.5, 3.2 and 5.0%, and Dieldrin-impregnated paper at concentrations of 0.2, 0.4, 0.8 and 1.4% were provided by WHO. For the controls, paper impregnated with Risella oil alone was used.

The A. sacharovi were placed in tubes with untreated paper and allowed to remain there for one hour. Those insects which were not active were removed from the tubes. The mosquitoes were gently blown into the tubes with treated paper. Exposure
to the impregnated papers lasted one hour, two hours or four
hours as necessary, after which time the mosquitoes were blown
back into the tubes with untreated paper. The mosquitoes were
held in these for 24 hours; then a final mortality count was made.
During the holding period a pad of wet cotton wool was placed
on top of the tubes. The temperature and relative humidity
during the test period were recorded. All observed mortalities
percentages were corrected by Abbott's formula when necessary
(1925). LC50's were estimated by plotting the dosage-
mortality lines. The mosquitoes were collected from human and
animal shelters in Izeh, northern Khuzestan, in southern Iran, and
from Meshkin-Shahr in the northwest of the country.

RESULTS AND DISCUSSION

1. A spraying operation with DDT, at the rate of 2 g/m² against
two important vectors, A. stephensi and A. sacharovi, commenced
in Izeh area, Khuzestan, southwest Iran, in 1953. These insectici-
dide applications decreased the indoor population of A. sacharovi
to almost zero and adults of this species were collected in earth-
ware wheat containers at a very low density. By 1957, A. stephensi,
the main malaria vector, acquired resistance to DDT
(Mofidi et al., 1958). In 1958, the area was sprayed with Dieldrin
at the rate of 0.5 g/m² twice a year. In the following year A.
sacharovi disappeared from the sprayed area. By 1960, A. stephensi
acquired resistance to Dieldrin and the area was resprayed with DDT.
In 1967, because of the double resistance of
A. stephensi to DDT and Dieldrin, the area had gone under DDT
and Malathion application, twice a year with each insecticide.
However, A. sacharovi reappeared in houses in 1969, after 8 years
of spraying with DDT, 3 times spraying with Dieldrin and 2 times
with Malathion. In July 1969, susceptibility tests showed that
the LC50 for DDT had increased from 0.7% to 1.1%. In 1970,
1971, 1972 and 1973 the LC50's for DDT were 1.4, 1.4, 3.6 and
4% respectively. In 1973 when A. sacharovi was tested against
4% DDT at one hour exposure, after 24 hours recovery the mortal-
ity obtained was about 53%. When the exposure time was in-
creased to 2 hours, the mortality obtained was about 90%.

2. In Meshkin-Shahr, northwestern Iran, the area has
been under DDT application at the rate of 2 g/m² once a year
for 10-11 years. In August, 1970, A. sacharovi was found resis-
tant to DDT in one village (Mohamad-Bagloo). When this species
was tested again 4% DDT at one-hour exposure, after 24 hours
recovery the mortality rate was zero. When the time of exposure
was increased to 4 and 8 hours, the mortality rate remain-
the same level. The average density of *A. sacharovi* was 36 per room. In July, 1971, out of 31 villages investigated, susceptibility tests were performed in four villages. *A. sacharovi* was tested against 4% DDT. The mortality rate after one and four hours exposure was zero. The average density of *A. sacharovi* was recorded at 5 to 22 females per room.

In 1973, 26 villages in the same area were checked. In all villages we were able to catch *A. sacharovi* in human and animal shelters. The average density was about 10 to 26 per room. When *A. sacharovi* was tested against 4% DDT, after one and four hours' exposure the mortality rate was zero.

3. In 1959 in the Kazeroun area of southern Iran, which had been treated with DDT for 5 years, the mortality rate on 4.0% DDT paper was 35-40% in Dadin Bala and Polabgineh respectively. The area was sprayed with Dieldrin at the rate of 0.5 g/m², twice a year, in 1960-1961, and from 1967 to 1973 with Malathion at the rate of 2 g/m². After Dieldrin application, *A. sacharovi* disappeared from the area and has not reappeared up to the present time.

Taking into account the problems created in Turkey and Syria, etc. (Zahar, 1973), by the resistance of *A. sacharovi*, we should be aware of the potential danger and technical difficulties which the resistance of this vector could cause in Iran.

All possible measures should be taken in order to prevent the spread of existing areas of resistant foci and to facilitate their elimination.

A careful systematic checking of the susceptibility level of *A. sacharovi* in other areas where resistance has not been detected is also recommended.

CONCLUSION These investigations show that *A. sacharovi* is resistant to DDT in the northwest and southwest of Iran. The susceptibility tests carried out with Malathion and Dieldrin show that *A. sacharovi* is susceptible to both insecticides. In the northwest of Iran, the discriminating dosage that killed 100% of *A. sacharovi* tested for Malathion was 3.2% and for Dieldrin 1.6%. In the southwest, the discriminating dosage that killed 100% of *A. sacharovi* for Malathion was 3.2% and for Dieldrin 0.8%.


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<th>Area &amp; Location</th>
<th>Date</th>
<th>Time of Spraying</th>
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In Khuzestan Province, S.W. Iran

Results of DDT susceptibility tests on A. g. sacharovi adults
DOSAGE-MORTALITY REGRESSION LINES
FOR ADULTS OF A. SACHAROVI, IZEH AREA,
MAP SHOWING THE DDT RESISTANCE AREAS OF A. SACHAROV AND IT'S DISTRIBUTION IN IRAN