A LARGE – SCALE MALATHION TRIAL IN THE BANDAR ABBAS AREA *

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ABSTRACT From October, 1964, a large-scale Malathion trial was carried ou in the Bandar Abbas area which covered 435 villages with a popu lation of 138,570. Until April, 1966, five rounds of Malathion, gm/m2, were performed. From 1967, the lowland area was spraye with two rounds of Malathion (March, August) and the highland with two rounds of Malathion (April, August) and two rounds o DDT (June, October).

The main vectors of the area are An. stephensi mysorensi (resistant to DDT and DLD) followed by An. fluviatilis and An dthali (predominantly in the highlands).

The results of entomological and parasitological evaluation

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up to 1969 were as follows: in lowland areas, 3 rounds of Malathion spraying are able to control the predominant vector — An. stephensi — and keep its density insignificant. In highland areas, due to the exophilic and exophagic tendency of the predominant vectors — An. fluviatilis and An. dthali — as well as outdoor sleeping habits of the local population, the complete interruption of transmission of malaria has not been achieved.

The Annual Parasite Incidence (API) in lowland areas, which was 42.9 per thousand in 1965, came down to 2.2 per thousand in 1969.

In highland areas, the API was reduced from 59.3 per thousand in 1965 to 11 per thousand in 1969.

INTRODUCTION

The development of resistance by *An. stephensi mysorensis*, the main malaria vector in the southern part of Iran, first to DDT in 1957 (6), and then to DLD in 1959(5), practically stopped the eradication of malaria in subsequent years.

In order to solve this problem, in 1958 the field research units of the Institute of Public Health Research, University of Teheran, started trials with new insecticides. In 1959 Malathion spraying was performed in Jiroft and in Shabankareh (Kazerun) areas and repeated in 1960 and 1963. Village-scale trials with Malathion showed that the residual effect of this insecticide is 6 weeks on non-organic surfaces and 12 to 16 weeks on organic surfaces. Subsequently the Malaria Eradication Organization and Institute of Public Health Research decided to carry out a large-scale trial in the Bandar Abbas region, which covers 435 villages with a total population of about 138,570.

DESCRIPTION OF THE AREA AND ADDITIONAL INFORMATION

The shahrestan of Bandar Abbas, which was included in the Malathion Pilot Project, is situated on the northern coast of the Oman Sea and the Persian Gulf facing the Gheshm and Hormoz Islands. It lies between 55°-45° East and 27°-28° North.

The pliot project area is comprised of 12 dehestans with 435 villages and a population of 138,570 (251 of the villages with a population of 57,635 are in the highlands and 182 of the villages with a population of 40,421 are in the lowlands). The Bandar Abbas port and the town of Minab were also included in the pilot project.

In the lowlands, malaria transmission occurs throughout most of the year with no transmission during two or three of the coldest months of winter. In the highlands, transmission occurs

from June to November with no transmission from December to May.

In the lowlands (littoral shore), about 70% of the human and animal shelters are made of organic matter. In the surrounding highlands only 40% of all the houses are made of organic matter. The rest are made of sun-dried bricks.

There are two periods during the year: a warm season from May to November and a temperate one from November to May.

The maximum temperature is about 46°C in June and the minimum is about 10°C in December. The rainfall was 82 mm in 1966 and 56 mm in 1967. The average annual rainfall is about 100 mm.

HISTORY OF MALARIA AND ANTI-MALARIA CAMPAIGN

For many years Bandar Abbas has been a malarious area and the disease has been prevalent there in hyperendemic form. Anti-malaria measures begun in 1950 and up to 1957 the area was under DDT insecticide coverage of wettable powder, 2 gm/m2, one round per year.

In 1957, *An. stephensi mysorensis* developed resistance to DDT, and thus all southern parts of Iran were sprayed with Dieldrin at 500 mg/sq. m., two cycles per year. In 1959, indication of resistance of *An. stephensi* to DLD was detected; consequently the second round of 1959 spraying was stopped in this area.

From October, 1964, to April, 1966, five rounds of Malathion spraying at 2 gm/sq. m. were performed (3).

From 1967, two rounds of Malathion were applied in March and August in the lowland areas (4). In the highlands, two rounds of Malathion were applied during April and August and two rounds of DDT during March and October. In this area the malaria vectors are *An. stephensi mysorensis, An. fluviatilis* and *An. dthali.*

METHODS AND TECHNIQUE

Four villages were chosen in hilly and littoral areas. Each village contained six permanent and two random capture stations. These capture stations were visited each fortnight, where floorsheet collection was made by the flitting method.

Shelter pit collections (7) were made from 5 shelter pits in a highland village and 5 shelter pits in a lowland village. The collections were made in the early morning every fortnight for 3 consecutive days. The average of 3 days collection from 5 shelter pits was considered as density per shelter pit.

Once every fortnight, human bait collections were performed in one highland village and one lowland village. In 1965 and 1966, these collections consisted of placing 2 field technicians in 3 different parts of the village. From 6 p.m. until 11 p.m. the technicians collected biting mosquitoes from each other, and from 11 p.m. until 5 a.m. for 2-hour periods, one technician collected biting mosquitoes from his partner and himself while the other technician slept. This colection was done outdoors where the people rested and slept at night.

In 1967 six local people were hired as bait and 2 field technicians collected biting mosquitoes from them. Each field technician worked with 3 hired persons.

The average number of biting mosquitoes collected from the 6 persons was considered as number of bites per person per night.

Six outlet window traps were placed in one highland village and six in a lowland village, and the traps were checked for 3 consecutive days every fortnight.

Mosquitoes were collected early in the morning and their Sella stages were recorded. They were then kept under observation for 24 hours to record their survival rate.

Mosquitoes collected alive during all studies (densimetry, shelter pits, window traps and night catches) were dissected by the Polovodova (8,9) and Detinova (1,2) methods in order to determine their physiological age. All those found with more than one dilatation were examined for infection rate by the dissection of their salivary glands and stomach.

Before starting the Malathion Pilot Project, the susceptibility level of the regions' vectors (*An. stephensi* and *An. fluviatilis*) was checked by the W.H.O. standard method (10).

During the execution of the project, the suceptibility level of the same vectors was checked every six months and no significant change was observed during this period (1964-1969).

Every 10 days, WHO standard bio-assay tests (WHO, 1963) were performed in 2 villages sprayed with Malathion, 50% w.p. 2 gm/m2, for estimation of the residual effect of Malathion w.p. on organic nad non-organic surfaces.

RESULTS

Effect of Malathion and DDT-Malathion spraying on the density of An. stephensi.

As was mentioned earlier, the first round of Malathion spraying was performed in October, 1964, which coincided with the end of the seasonal activity of this species. The effect of this

spraying was remarkable.

Until the next round of spraying, which was about fi months later, no *An. stephensi* were recorded in the selecte villages, although they were the most favourable ones in th area. Only in Chelow village, with almost 50,000 m2 of breedin places, was the density 0.14/ shelter 4 to 5 months after the initi spraying.

An. stephensi was under control at the intervals betwee the second and third, as well as between the third and fourt rounds of spraying. The maximum density was recorded fro Chelow (2.6 mosquitoes per shelter) when the interval betwee spraying operations was more than 3.5 months.

The fifth round of spraying was performed in March 1966, almost 6 months after the fourth round. The density wa zero during the interval between the fourth and fifth rounds i all villages except Chelow. In this village the density increase after four months and reached 17.5 mosquitoes per shelter befo the fifth round of spraying was started. The results of investiga tion of the five rounds of spraying showed that the build-up o density of *An. stephensi* started almost 3 months after each Mala thion spraying. The bio-assay tests on mud walls showed that aft two weeks 46% of mosquitoes were killed and after 3 weeks n kill was observed. The same tests performed on wood surface showed that after a 1-hour exposure 98% kill was observed unt 4 months after the spraying. However, *An. fluviatilis* and *An dthali* were recorded on walls and in outlet window traps 30-4 days after each spraying. The mortality rate of *An. stephensi* wa so high after each Malathion spraying (due to its endophilic ten dency) that it took more than three months for its next build-u and activity.

In March, 1966, Malathion was sprayed in this are followed by a DDT spraying in May.

Three months after the DDT treatment in the lowland (in September), the density of *An. stephensi* was 2.6 per shelte and in February after rainfall and development of breeding pla ces the density reached 25.8 per shelter.

At the beginning of March, 1967, this area was sprayed again with Malathion, at which time the vector density in Chelo was 129 per shelter and 15.5 in other villages. After this sprayin the area was left unsprayed until September, 1967, and durin this period the average density of *An. stephensi* was 0.7 with th exception of the village of Chelow, in which the density was 4 one month after the spraying. The collected mosquitoes were hel

24 hours for determination of survival rates and there was 55% mortality. The high density of Chelow was due to rainfall in February which increased the surface of breeding places as was mentioned earlier.

Direct anopheline collection at night on man was started in May, 1965, almost a month after the Malathion spraying, and was continued until December. No *An. stephensi* were present for three months after the spraying and from then on it never exceeded 0.5 bites per man per night. In the highland area only one *An. stephensi* was collected during the month of September and thus the man-biting ratio was 0.125 per man per night.

In 1966 the area was sprayed only once with Malathion and twice with DDT. *An. stephensi* was not found for more than 6 months and in the second half of August the biting ratio reached 2.5 bites per night per man, only one month after DDT spraying. In the highlands the ratio was 0.5 during September and November.

Indoor density, night bite collections and age-grouping dissections indicate that a malathion spray programme of 3 rounds per year is able to keep down the density of *An. stephensi*. Even in the exceptional village of Chelow, which has large breeding places and a high reproduction of anopheline mosquitoes, the proportion of mosquitoes of potentially dangerous age is very low.

In the lowland area, where the main malaria vector is *An. stephensi,* the annual parasite incidence was 42.9 per thousand in 1965 and in 1966, 1967, 1968 and 1969 it was respectively 5.2, 4.05, 1.7 and 2.2 per thousand. This picture shows a very significant reduction of API during the successive operational years, reaching 20 to 25-fold reduction for the years 1968-1969 as compared with 1965, i.e., the beginning of the Malathion Project.

In the highland area, the API was 59.3 per thousand, and during the following years of 1966, 1967, 1968 and 1969 it was respectively reduced to 24.4, 6.1, 10.2 and 11 per thousand, i.e., only 5 to 6-fold reduction for the years 1968-1969 as compared with 1965. This unusual highland picture shows that, in spite of intensified anti-malaria measures (two rounds of DDT and two rounds of Malathion spraying, treatment of all positive cases, introduction of Gambusia fish in active and potential breeding places, etc.), due to the exophilic and exophagic tendency of *An. fluviatilis* and *An. dthali* as well as outdoor sleeping habits of the local population during the transmission season, the transmission of malaria has not been interrupted.

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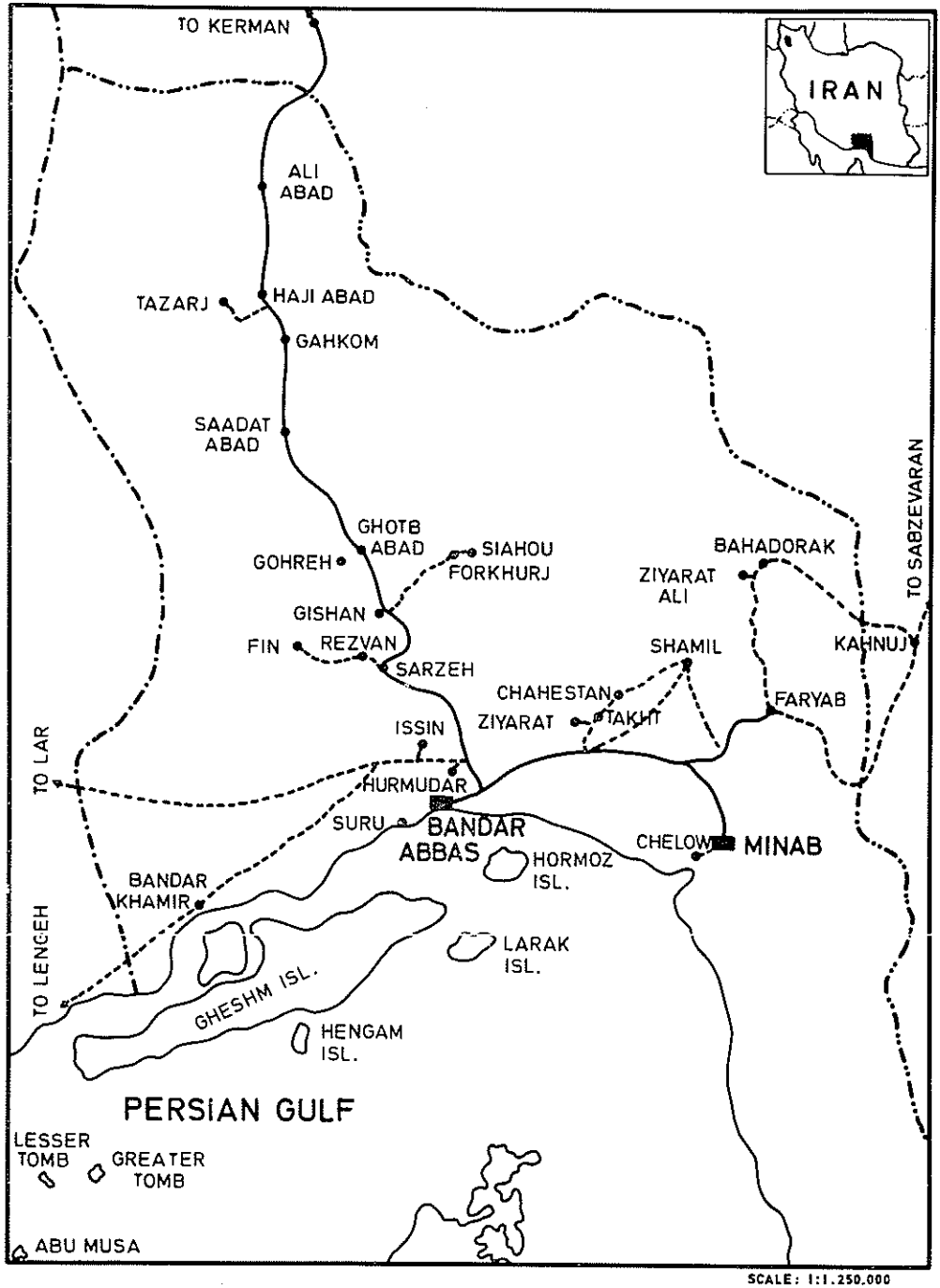

Map Showing Malathion pilot Project area