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Evaluation of Arprocarb (OMS-33) for controlling Anophelines *

by

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INTRODUCTION

Among hundreds of new compounds which were tested in the WHO collaborative programmes for the evaluation of new insecticides, Arprocarb (OMS-33) showed promising results in various trials up to stage V.

An operational field trial of the stage VI was carried out in Shabankareh area, southern Iran in 1967, in collaboration with WHO to study and to evaluate the followings :

(i) To determine the biological effectiveness of the insecticidal residual deposit on the natural mosquito population ;

(ii) to establish the best and most economical field methodology of its application, and to determine the spraying hazards and precautionary measures required under the prevailing field condition ;

(iii) to assess the stability, consistency and suitability of the commercially produced compound ; and,

(iv) to verify the safety of the insecticide for spraymen under actual operational field conditions over a prolonged period of time, and to confirm its safety for inhabitants.

This paper essentially deals with entomological studies which determined the effectiveness of OMS-33, 50 % w.p.p. that was sprayed in two cycles of two gms. per sqm. as residual imagicide against the natural malaria vectors of the area.

Malariometric background :

The area has a long transmission season of about 9 months (March-December). *A. stephensi* (*mysorensis*) is the main proven vector of this area with two peaks of density (July and October). In 1957, *A. stephensi* was found to have developed resistance to DDT when dieldrin was substituted. In 1960, for the first time, *A. stephensi* was found in the area with dual resistance to DDT and dieldrin, and from 1960 spraying has been stopped in this area.

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The other confirmed secondary vectors are : *A. dthali, A. fluviatilis* and *A. superpictus.*

Operational background :

The trial area has been under DDT spraying (2 grs/sqm., one cycle per annum) during malaria control period (1951-57). At this time because of the development of resistance to DDT in *A. stephensi mysorensis,* the main vector of the area, the spraying was changed to DLN, 500 mg/sqm. two cycles per annum (1958-1960). In the autumn of 1960, *A. stephensi* became resistant to DLN, thus the spraying was stopped in the whole *A. stephensi* zone.

During 1963, a comparative village scale trial was carried out in 6 villages of the area for the evaluation of Fenthion, Arprocarb and Malathion in which Arprocarb was found to be a suitable and highly effective insecticide for controlling anophelines with a residual effect of 14-20 weeks as shown by spray sheet collection, window-trap catch, test hut, age determination and bio-assay tests.

During 1966, an area scale trial was carried out to evaluate the effect of Arprocarb (2 grs/sqm.) for controlling anophelines. The trials covered 26 villages with a total population of 6264 persons. The results of this trial based on indoor flit catches, all night collection of anophelines from human baits, outdoor resting places, survey and window-trap collections, and bio-assay tests showed that the residual effect of OMS-33 on both sorbent and non-sorbent surfaces is very promising, covering a period of 120 to 145 days.

1. METHODS AND MATERIALS

1.1. Zone and population.

The Shabankareh area of southern coastal Iran extends as a plain for approximately 300 square kilometers about 60 kilometers north of the Persian Gulf, 36 villages with about 12,000 population of this area were under programme.

The villages are composed of rather spacious family compounds each generally surrounded by a high wall. The muddy walls generally have about 40 to 50 cms. thickness, and are constructed of sun dried bricks which is made from a mixture of clay and finely chopped wheat straw. Family and animal rooms of mud brick construction extend out from the inside of these walls on one or more sides of the compound. Roof of date-palm trunk beams is supporting smaller interwoven palm fronds which are covered with mud. Other type of dwellings like *kumeh* (a human and animal shelter with date palm thatch roof, mud walls and open door) and *kapar* or summer hut constructed of stick frames and covered with date palm fronds.

The climate is considered sub-tropical with a rainless dry and hot summer of 26-46 °C. range of temperature and in other seasons temperature is seasonal and rain is occasional.

1.2. Method used for spraying.

The first round of spraying with OMS-33 50 % w.d.p. at the rate 2 gms/sq.m. (technical) carried out in 33 villages of 10,983 people from May 18 to June 30, 1967 and the second round of spraying at the same dosage was carried out in 31 of the same villages with 9,444 people between September 20 and October 8, 1967, after an interval of exactly four months since the first round.

1.3. Method of entomological evaluation.

The following entomological methods were undertaken in eight villages (five sprayed and three unsprayed) to evaluate various interacting factors :

(*a*) Spray sheet collections by flitting with pyrethrum in fixed and random catching stations (eight in each index village).
(*b*) Outdoor resting catches from established artificial shelters (six in each index village).
(*c*) Window exit-trap and floor sheet collections (three in each village) with 24-hour mortalities observation.
(*d*) Twelve-hour *night-catches* of mosquitos from human bait.
(*e*) The stages of blood digestion and ovary development of Anopheles females.
(*f*) Determination of parous rate and estimation of the longevity of female Anopheles.
(*g*) Determination of the level of susceptibility of wild caught mosquitos to OMS-33.
(*h*) Determination of the biting habits of *A. dthali* and *A. stephensi.*
(*i*) Tests for the air borne killing effect of OMS-33 using bio-exposure cages.
(*j*) Bio assays on various treated surfaces (using Lab. bred *A. stephensi*).

2. RÉSULTS AND DISCUSSION

2.1. Indoor Anopheles resting densities.

Observations made on the indoor resting Anopheles density showed that the figures for sprayed villages during the peak producing months of July and October were respectively 1.98 and 0.34, which was considerably lower in comparison to the figures for unsprayed villages (27.3 and 64.8 respectively). In fact the prespraying density of 4.20 for May is reduced by OMS-33 spraying to 0.07 in June and furthermore this density prevailed for 90 to 120 days, when it rose to 7.49 in September. This rising figure was again reduced to zero for the following four months after the second spraying cycle.

The respective indoor density figures of *A. stephensi,* the greatest contributor, were 23,4 and 37.2 in unsprayed villages for the months of July and November respectively. In contrast the corresponding figures for sprayed villages were 0.02 and 0.03. The first appearance of *A. stephensi* occurred 65-71 days after spraying in a village with the greatest potential for mosquito production.

The population of *A. dthali,* the second to *A. stephensi* in contributing to overall Anopheles density and with more exophilic tendency than the later species, was significantly under control for at least 90 days. Although this species was never absent during the days following the spraying but the density was always lower than one per shelter.

The other three Anopheles species, which their density is normally very low in this area, were under control in the period following the two cycles of spraying.

2.2. Outdoor Anopheles resting densities.

Three anopheles species of the area, i.e., *A. dthali, A. superpictus* and *A. fluviatilis* are known to be exophilic in varying degrees. The overall prespraying density of 3.08 per outdoor shelter in May 1967 was reduced to 1.15 at 3 to 28 days after spraying, which might be an indication that OMS-33 effects a reduction in the outdoor resting anophelines.

However, a review of the data for the eleven months from April 1967 to February 1968 indicates that in general the outdoor collections of Anopheles mosquito were very low and without great significant differences between sprayed and unsprayed areas.

2.3. Outlet window trap catches.

The 24-hour mortality was determined and those Anopheles mosquitos leaving habitations were identified and both compared in sprayed and unsprayed houses, during eleven months of observation of unsprayed versus OMS-33 sprayed villages respectively. *A. dthali* (196 VS 481 total) contributed most, *A. stephensi* (84 VS 5 total) secondly, and least *A. fluviatilis* (5 VS 15), *A. superpictus* (6 VS 23) and *A. pulcherrimus* (00 VS 00), to the mosquitos window-trapped.

In the unsprayed villages, the 24-hour mortality per cent of entrapped anophelines was zero. Contrastingly in OMS-33 sprayed villages the 24-hour mortality was 100 per cent up to 59 days, and 88 per cent up to 90 days after the first cycle of spraying, but dropped to 9 per cent between 90 to 131 days after spraying.

The results of window-trapping appear to indicate that fatal contact of Anopheles with OMS-33 acting as a residual and/or fumigant took place up to 90 days after spraying.

2.4. Floor sheet collections.

The finding of dead Anopheles on floor sheets indicates the likelihood that OMS-33 insecticidal contact was lethal to these mosquitos at least up to 123 days after spraying.

2.5. Night catches from human baits.

The observations were done outdoors as well as indoors, upon the prevailing human resting and sleeping habits. The man-malaria vector contact in unsprayed villages as compared to that of OMS-33 sprayed villages was found to be continually higher throughout June 1967 to January 1968. The man-Anopheles contacts in October-November and December were respectively 4.5, 2.8 and 2.5 per person in unsprayed villages, but in comparison, 0.8, 0.3 and 0.0 per man for the same three months, that is between 8 to 88 days after spraying.

A. stephensi, the primary malaria vector, was found feeding on man more than any other species and was most active during August to December 1967, especially in unsprayed areas. All the Anopheles mosquitos found in the Shabankareh area were found to feed on man and it appears that due to the presence of OMS-33 there was some modification in the man-vector contact of Anopheles, which of course influences malaria transmission.

2.6. Observations on the stages of blood digestion and ovary development.

It was found that in the 136 days after the 2nd spraying cycle, the number of females approaching the completion of their gonotrophic cycle as expressed in half gravid (7.1 %) and gravid (4.7 %) was significantly less in sprayed villages than in those unsprayed (corresponding figures were 26 % and 10.9 %) and this may be of some epidemiological significance. These finding were not similarly observed after the first cycle of spraying, nevertheless it should be noted that 60 days after spraying a significantly lesser percentage of Anopheles female were half-gravid and gravid in sprayed villages than in those unsprayed.

2.7. Studies to distinguish nulliparous from parous.

In unsprayed villages the parous to nulliparous ratios for *A. stephensi, A. dthali* and *A. fluviatilis* were within normal limits and also indicated that a greater number of these mosquitos as compared to those in sprayed villages were parous and therefore had oviposited at least once. Moreover the approximate longevity of these mosquitos determined from the nulliparous to parous ratios is longer in unsprayed villages than in those sprayed. This would suggest that the residual spraying of OMS-33 at 2 gm/m² shortened the average life span, was detrimental to oviposition and decreased a significant proportion of the malaria vector population which might have been at an epidemiologically dangerous age.

2.8. Bio-assay of OMS-33 insecticidal residue on surfaces.

The bio-assay test was conducted according to recommendation made by WHO. It was found that the OMS-33 imagicidal deposit maintained a high toxic effect on sorbent mud surfaces up to 126 days, giving a 60 per cent 24-hour mortality at this time and greater than 88 % kill up to 98 days after spraying. Thereafter between 132 to 161 days the 24-hour mortality was 48 %.

On non-sorbent wood surfaces, at 254 days after spraying the 24-hour mortality was 80 per cent. The adult control measure of spraying OMS-33 at 2 gms./sq.m. on habitation surfaces shows considerable promise.

2.9. Observations of airbone killing effect of OMS-33.

This insecticide has been noted to have an airborne killing effect after being applied on surfaces, therefore some limited observations were made to investigate this phenomenon which might be advantageous against domiciliary and peri-domiciliary malaria transmission.

A total of 9 cages of 50 mosquitos were used in each test of which 8 were installed in 2 sprayed rooms and one kept as control. Time of exposure was 60 minutes and time of holding 24 hours.

100 per cent kill took place in the two rooms up to 39 and 53 days after spraying.

The fumigant action of OMS-33 residues initially sprayed at 2 g/m², and under the particular environmental conditions of village structure existing in southern Iran, appears to be an advantage, provided that the physical properties that allow it to have such an action do not excessively reduce its residual action.

References

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