

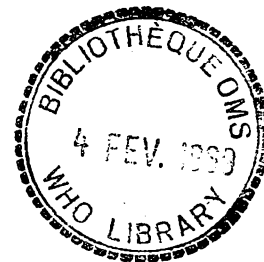


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A FIELD TRIAL USING DICHLORVOS IN  
MAMASANI AREA, KAZEROUN, SOUTHERN IRAN. 1965-1966<sup>1</sup>

by

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Introduction

The aim of this study was to determine the efficiency of the fumigant effect of dichlorvos (2,2-dichlorovinyl-dimethylphosphate, DDVP, OMS-14) in interrupting malaria transmission, and the duration of its fumigant effect under the conditions in Southern Iran.

Village scale and field trials using this insecticide have previously been reported for Upper Volta (Escudié & Sales, 1963, Quarterman et al., 1963, Mathis et al., 1963 and Funckes et al., 1963), Southern Nigeria (Gratz et al., 1963), Haiti (Schoof et al., 1966 and Cavalié & Limousin, 1966) and Northern Nigeria (Foll et al., 1965, Pant & Foll, 1965, and Foll & Pant, 1966).

The area chosen in Iran usually has a long transmission season of eight months (April - December). The main malaria vector of the area is Anopheles stephensi mysorensis. The other confirmed secondary vectors are: A. fluviatilis, A. superpictus and A. d'thali.

The season of activity of A. stephensi extends from May to December and maximum density is observed in the month of August. The larval breeding places are rice fields, canals, and river banks. This species is resistant to DDT and dieldrin. (Mofidi, 1962).

A. superpictus and A. fluviatilis are active mainly in the spring and autumn respectively. The larval breeding places of these two vectors are pits along spring rivulets, and river beds with little vegetation, near the villages.

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The study was undertaken in seven villages in the Mamasani area, which is representative of the problem regions of the southern slopes of the Zagros mountains. (Map 1)

These villages, with a total population of 1669, were geographically isolated in the north, south and west, from the neighbouring villages, and were treated with dichlorvos in 1965. In three of the seven villages, with a population of 1307, the application of dichlorvos was continued in 1966, but in the four others treatment ceased in 1965 due to shortage of dispensers. Three other villages, with a population of 580, with similar conditions as mentioned above, were used as comparison areas in 1965, and two of them, with a population of 232, were used in the same way in 1966.

The area has a sub-tropical climate. The summer is long and hot with a maximum temperature of over 45°C. The winter is moderate, with an average minimum temperature of 5°C and rarely drops below zero. The relative humidity usually is about 20-40% except on rainy days.

Wind, the principal factor influencing ventilation in dwellings, varies in velocity, duration and direction during the day and night, and usually blows from the west and north.

Most dwellings are built of unbaked mud bricks and some are plastered with mud. They usually have one staircase, but occasionally two. Each consists of one room, a stable, a store-room. About 10% of the dwellings consist of thatched huts (kumeh) with mud brick walls about one metre high.

#### 1. Operations

Ventilation studies were carried out as a preliminary study to ascertain whether or not the local conditions are suitable for using the residual fumigant technique and also to determine the number of dichlorvos dispensers required for each type of shelter.

The ventilation rates were determined by the method reported by Bracha (1963) in a ventilation study in mud huts in southern Nigeria using the hypochlorite-tolidine filter-paper technique of Lidwell & Lovelock (1946).<sup>1</sup>

The greatest amount of ventilation was observed to be in corridors (13% of total number of rooms). Because of the wide range of ventilation in different types of dwellings, the average amount of space recommended per vaporizer varied according to the type of dwellings. For example, one vaporizer was considered to be sufficient for assuring a reasonable concentration of dichlorvos vapour for 21 m<sup>3</sup> in stores (the least ventilated rooms), 15 m<sup>3</sup> in stables and living rooms of normal size, 12 m<sup>3</sup> in large stables and living rooms, and 7 m<sup>3</sup> in thatched huts and entrances (the most ventilated rooms).

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<sup>1</sup> This study was carried out by Mr L. Donegan, Tropical Products Institute, London, with two chemists and staff of Institute of Public Health Research.

MAP 1

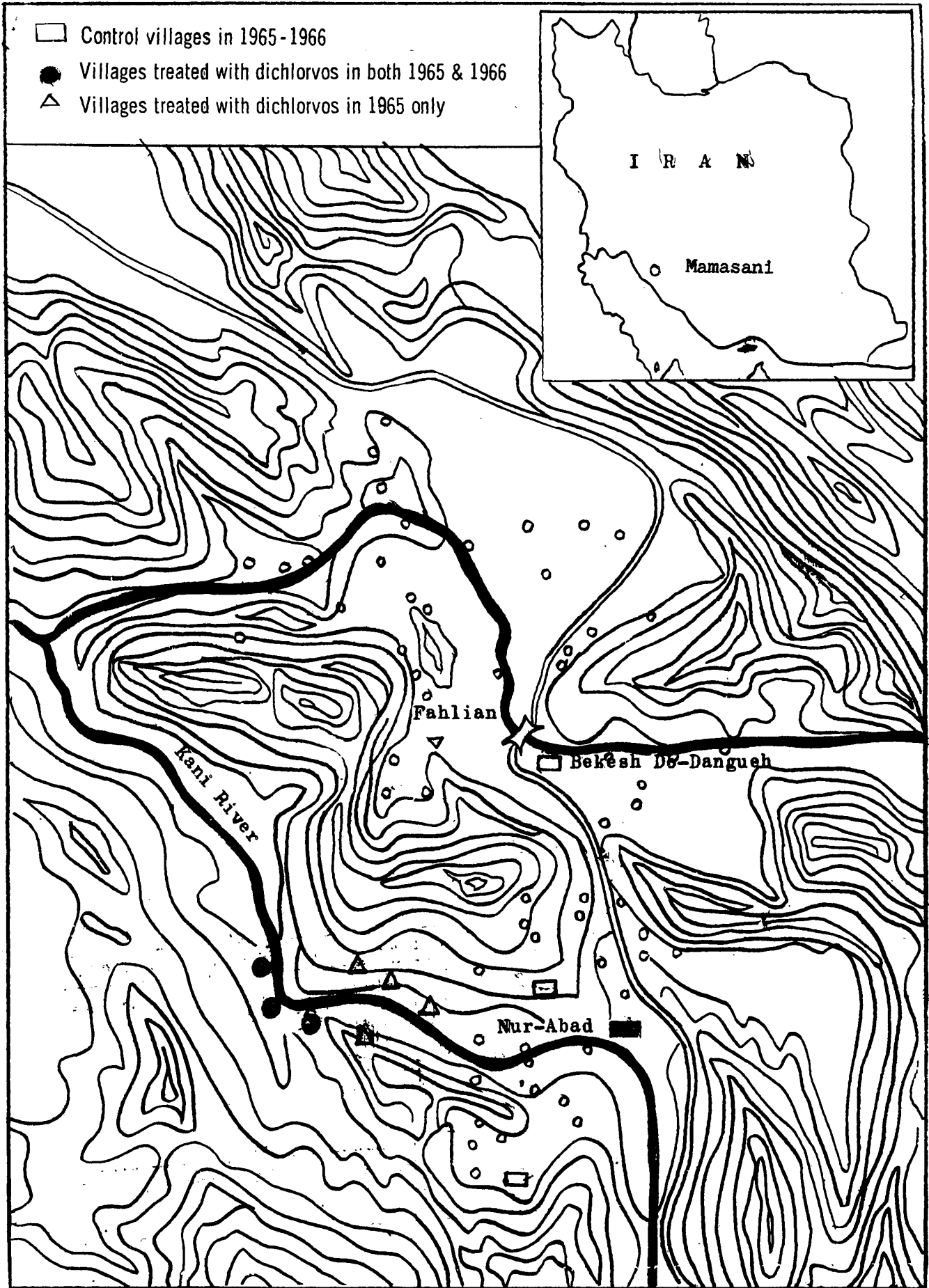




TABLE 1. RESULTS OF THE MEASUREMENT OF VENTILATION IN VARIOUS TYPES OF SHELTERS

Type of room	Position of doors and windows	Range of ventilation (Per cent. of volume changed in one hour)
Average living room	One door, without windows with ventilation holes	13.5 - 25.5
Large living room	Two doors and one or more windows with ventilation holes	25 - 42.5
Average mud stable	One door, with few ventilation holes	17.5 - 35
Store-room	One door, usually closed	12 - 22
Mud thatch hut (living or stable)	One door with thatched roof	27 - 62
Summer hut	One door with roof made of rush mat	35 - 119
Corridor, entrance	Two doors, opposite each other	39 - 117

Dichlorvos dispensers used in the trial were solid resin strips (produced by the Shell Chemical Company). The strips were 26 cm long, 0.50 m thick, and 6.3 cm wide. Each one weighed about 100 g, and contained not less than 20% of dichlorvos and associated compounds. There was a small hole at one end to facilitate hanging.

Coverage of the seven villages with dichlorvos dispensers was started in the middle of July 1965, when the population density of A. stephensi had reached a high peak. The last replacement dispenser was placed on 15 November and dichlorvos coverage is considered to have lasted 5-1/2 months, until the end of December 1965.

In the following year, 1966, the application of dichlorvos started on 10 May at the beginning of the season's activity of A. stephensi, and application of dispensers continued till September. The programme was then terminated because of shortage of dispensers.

5348 dispensers were used in the first round of coverage in July 1965 in 1755 roofed dwellings, of a total volume of 65 739 m<sup>3</sup>. When the results of bio-assay tests showed any failure in killing effects, the concentration of dichlorvos vapour was immediately increased in all dwellings of that type by adding dispensers as necessary. During July until December 1965 another 4934 dispensers were used for these additional applications.

In the following year, 1966, a total of 3787 dispensers were applied in 1236 shelters of a total volume of 47 979 m<sup>3</sup>. This application was carried out at the beginning of the transmission season (10-15 May) in three villages. An additional 2200 dispensers were used in different shelters according to bio-assay test results during the trial period from May to August.

## 2. Evaluation

### 2.1 Entomological evaluation

The "total catch" method was used for the entomological assessment in the trial as follows:

Pyrethrum spray collections were carried out at two-weekly intervals in eight to 12 fixed catching stations of different types (room, stable, store and other shelters mainly made of palm leaves) in each of the treated and untreated villages.

Window trap collection. A total of 44 window traps (22 outlets, 22 inlets) were installed in the treated and untreated villages in the first year (1965). In one treated village the traps were examined daily; in the others once every two weeks. In 1966 the traps of one treated village and one untreated village were examined daily.

Floor-sheet collection. The number of dead mosquitos on sheets spread overnight on the floors of six sprayed houses (fixed stations) in the treated villages were counted at fortnightly intervals.

Shelter-pit collections. During the first year, four artificial pits were examined daily in one treated village, and 19 pits in six other villages were examined every other week. During the trial in the following year, 1966, a total of 20 pits were examined in three treated and two control villages. (Four pits per village.)

Night biting collections were carried out after placement of dichlorvos dispensers from dusk to dawn in two villages (one treated and one control village) by a team of six insect collectors. Six local men were hired as baits. Each collector was responsible for collecting all the mosquitos biting one bait-man, and these mosquitos were identified according to species. This study was repeated twice per month, in one treated and one control village. Because of the outdoor sleeping habits of the inhabitants from August until the middle of November, night biting collections were made outdoors during that period. However, from late November to the end of December, when the people were sleeping indoors, the night catches were made inside the dwellings.

### 2.2 Biological evaluation

On the basis of results obtained from two dichlorvos field trials in Nigeria (Gratz et al., 1963, Pant & Foll, 1965), a bio-assay cage test method was designed for biological evaluation of dichlorvos in different types of dwellings in the trial area. This method consisted of: exposing approximately 50 laboratory-bred blood-fed A. stephensi females in a mesh cylindrical iron cage 10 x 16 cm in size to dichlorvos vapour by hanging the cages in the treated shelters for a period of six hours. Two cages were placed in each room, one near the ceiling and the other one near a wall about 60 cm above the floor. The cages were filled with mosquitos in the laboratory very early in the morning, and immediately carried to the field in a well-ventilated wooden box to be ready for test about 0600 hours. At about noon, the cages were collected from dwellings and carried to the holding room in the same box. The mortality was counted at the end of 24 hours.

Since the ventilation in the various dwellings in the trial area was quite different (from firmly closed store-rooms to open thatched huts) in each test village, 12 shelters of different types (living room, stable, kumeh, summer huts, house entrance and corridor) were selected for test stations.

These shelters were representative of the conditions existing in the villages. In each village, one room, one stable, and one thatched hut were chosen as control stations. In two villages the test stations were fixed, throughout the trial period. In other villages they were selected among the dwellings by random sampling on the day of the test. The tests were to be done weekly, on three days a week; two days in the fixed villages in the fixed test stations, and one day in turn in random selected stations in one of the villages under trial.

If the 24-hour mortality of these tests was below 70% for any type of shelter, vaporizers were added to all dwellings of that type, to increase the insecticidal action.

### 2.3 Parasitological evaluation

Monthly epidemiological surveillance was carried out in the villages under trial from April 1964 (pre-insecticide investigations) till the end of the programme. Parasite surveys consisted of mass blood collection from all inhabitants present in the village at the time of blood collection. Special attention was paid to infants from 0-2 years old, particularly to those under six months, fever cases and suspected cases.

### 3. Results and discussion

Coverage of the area with dichlorvos resulted in considerable decline in the population density of A. stephensi. The density decreased in seven treated villages from 794 mosquitos per shelter (before coverage) to 158, 85, 22, 7, and 1.2 in August, September, October, November, and December 1965 respectively. The next year the dichlorvos dispensers were applied at the time of the beginning of activity of A. stephensi (May), and the population density remained low in treated villages until the end of August, when the effectiveness of the insecticide was decreasing because of the shortage of dispensers. Thereafter the population of mosquitos increased in the dwellings of the treated villages. In control villages the density of mosquitos was normally high throughout the breeding season in 1965 and 1966 (Tables 2 and 3).

As a result of dichlorvos vapour present in dwellings, there was a considerable reduction in the resting A. stephensi density in the treated villages, but it never dropped to zero. The same reduction was observed for other anopheline species in the areas (A. superpictus, A. fluviatilis and A. d'thali).

A remarkable decline has been observed in anopheline larvae density in the treated villages, compared to the control villages, but the density did not drop to zero during the breeding season. (Tables 2 and 3)

The results of surveys in outlet traps in 1965 showed that among the anopheline mosquitos which had entered the dwellings and were entrapped on leaving, an average mortality of 49%, 58%, 13% and 57% respectively, occurred for A. stephensi, A. fluviatilis, A. superpictus and A. d'thali respectively. Of the mosquitos collected from outlet window-traps 87% were determined as Sella stage 1 and 2, and of the remainder 11% and 2% were in stages 3 and 4 respectively. No higher stages were seen. In the traps of control villages all different Sella stages of females were found. Among the mosquitos collected from inlet window-traps the mortality figures were 49%, 47%, 100% and 41% for A. stephensi, A. fluviatilis, A. superpictus, and A. d'thali respectively.

The results obtained from window trap collections in 1966 were observed to be similar to those mentioned above, but from the end of August when the additional application of insecticide was stopped, the mortality rate decreased because of low concentration of dichlorvos vapour in dwellings.

TABLE 2. RESULTS OF PYRETHRUM SPRAY COLLECTIONS AND LARVAL COLLECTIONS IN DICHLORVOS-TREATED AND UNTREATED VILLAGES IN 1965

MONTH	Seven villages treated with dichlorvos									
	<u>A. stephensi</u>		<u>A. fluviatilis</u>		<u>A. superpictus</u>		<u>A. d'thali</u>		Anopheline larvae number per dip	
	Number	Density	Number	Density	Number	Density	Number	Density		
April	8	0.1	0	0	41	0.6	0	0	3	
May	311	5	19	0.3	1 634	25	136	2	15	
June	1 913	29	36	0.5	2 409	36	1 290	19	25	
July	3 825	58	59	1	746	11	2 427	37	30	
August	{ *	52 388	794	204	3	268	4	21 272	322	589
	{ **	10 451	158	0	0	33	0.5	8 762	133	270
September	5 653	85	4	0.1	38	0.6	4 067	62	27	
October	1 451	22	0	0	196	3	672	10	10	
November	444	7	106	1.6	66	1	158	2.4	5	
December	79	1.2	53	0.8	5	0.1	0	0	0.6	

MONTH	Control villages									
	<u>A. stephensi</u>		<u>A. fluviatilis</u>		<u>A. superpictus</u>		<u>A. d'thali</u>		Anopheline larvae number per dip	
	Number	Density	Number	Density	Number	Density	Number	Density		
April	0	0	0	0	27	1	0	0	4	
May	129	4.5	9	0.3	652	25	93	4	14	
June	457	18	13	0.5	551	21	252	10	17	
July	1 258	48	36	1.4	196	7.5	660	25	22	
August	{ *	10 590	407	8	0.3	17	0.7	3 728	143	194
	{ **	19 060	733	9	0.3	30	1.2	10 078	388	311
September	23 247	894	1	0.03	107	4	11 752	452	436	
October	9 906	550	0	0	36	2	2 138	119	341	
November	1 724	96	15	0.8	20	1	245	14	29	
December	307	17	50	2.8	1	0.05	0	0	15	

\* Before application of DDVP  
 \*\* After application of DDVP

TABLE 3. RESULTS OF PYRETHRUM SPRAY COLLECTIONS AND LARVAL COLLECTIONS  
IN THREE DICHLORVOS-TREATED VILLAGES AND TWO CONTROL VILLAGES IN 1966

MONTH	Three villages treated with dichlorvos								Anopheline larvae number per dip	
	<u>A. stephensi</u>		<u>A. superpictus</u>		<u>A. fluviatilis</u>		<u>A. d'thali</u>			
	Number	Density	Number	Density	Number	Density	Number	Density		
January	0	0	0		0		0		0	
February	0		0		0		0		0	
March	0		0		0		0		0	
April	1	0.06	0	0	0	0	0	0	0	
May	{ *	11	0.36	45	1.5	0	0	33	1.1	0.06
	{ **	15	0.5	68	2.2	0	0	20	0.66	0.86
June		24	0.4	79	1.3	2	0.03	98	1.6	1.2
July		59	0.98	152	2.5	4	0.07	489	8.1	1.5
August		297	4.9	77	1.2	0	0	1 562	26	1.8
September		265	4.4	132	2.2	0	0	1 234	20.5	21
October		34	0.5	213	3.5	10	0.16	435	7.2	7.8
November		51	1.01	66	1.1	37	0.61	42	0.7	1.5
December		0		0		0		0	0	0

MONTH	Control villages								Anopheline larvae number per dip	
	<u>A. stephensi</u>		<u>A. superpictus</u>		<u>A. fluviatilis</u>		<u>A. d'thali</u>			
	Number	Density	Number	Density	Number	Density	Number	Density		
January	38	1.1	0		5	0.15	0		2	
February	0		0		0		0		0	
March	0		0		0		0		0	
April	0	0	2	0.25	0	0	0	0	0	
May	{ *	3	0.18	8	0.5	0	0	0	0	0
	{ **	17	1.2	48	3.2	0	0	21	1.5	0.25
June		24	0.75	50	1.5	0	0	76	2.3	1.6
July		179	5.5	105	3.2	0	0	404	12.6	2.3
August		306	9.5	89	2.4	0	0	652	20.3	24.2
September		297	4.9	94	2.9	14	0.43	967	30.2	42.2
October		573	17.9	111	3.4	22	0.75	263	8.2	12
November		549	17.1	61	1.8	0	0	28	0.86	1.3
December		6	0.18	3	0.9	0		0		0

\* Before application of DDVP

\*\* After application of DDVP

Shelter pits surveys resulted in an average density of 64, 47, 7, 0.9 and 0 A. stephensi per pit in the treated villages for the months of August to December 1965 respectively.

The densities in 1966 are shown in Table 4.

TABLE 4

	Density per pit in treated villages			Density per pit in untreated villages		
	<u>A. stephensi</u>	<u>A. superpictus</u>	<u>A. d'thali</u>	<u>A. stephensi</u>	<u>A. superpictus</u>	<u>A. d'thali</u>
April/66	0	0	0	0	0	0
May/66	0	0.08	0.3	0.7	2.2	1.2
June/66	0.1	1.3	1.9	1.2	3.0	6.2
July/66	0.4	1.8	10.5	5.3	1.3	6.5
Aug./66	10.5	1.0	47.5	33.1	1.0	18.6
Sept./66	0.7	2.4	9.7	0.3	4.6	9.6
Oct./66	0	5.0	4.8	10.1	5.3	4.0
Nov./66	0	1.7	0.2	5.0	1.5	0.2

The results of ovary dissections carried out on 1781 anopheline mosquitos of vector species in 1965, and 1026 in 1966 showed that the percentage of females of dangerous age for A. stephensi and A. superpictus was 1.5% and 2.2% respectively before insecticide application and both dropped to zero after the first treatment in 1965. Table 5 shows the proportion porous for the two mentioned vectors.

TABLE 5. PROPORTION POROUS

		<u>A. stephensi</u>		<u>A. superpictus</u>	
		Before application of dichlorvos	After application of dichlorvos	Before application of dichlorvos	After application of dichlorvos
1965	Control village	0.21	0.26	2.1	-
	Treated village	1.73	0.1	1.22	0.36
1966	Control village	-	0.78	-	0.38
	Treated village	-	0.08	-	0.39

The average number of bites received per night per individual for A. stephensi, A. superpictus and A. d'thali during night biting observations is indicated in Table 6.

TABLE 6. AVERAGE MAN-BITES PER NIGHT

	Treated villages			Untreated villages		
	<u>A. stephensi</u>	<u>A. superpictus</u>	<u>A. d'thali</u>	<u>A. stephensi</u>	<u>A. superpictus</u>	<u>A. d'thali</u>
Aug./65	16.5	0.83	1.16	99	0.5	1.8
Sep./65	5.48	0.15	0.15	30.25	0.08	0.65
Oct./65	2.0	0.08	0.08	7.45	0.28	0.45
Nov./65	0.08	0	0	3.35	0	0.35
Dec./65	0	0	0	0	0	0
Apr./66	0	0	0	0	0	0
May/66	0	0	0	0	0	0
June/66	0	0	0.2	0	0	0
July/66	0	0	2.85	0	0	0.75
Aug./66	0	0	1.12	20.12	0	1.12
Sept./66	0	0	0	8	0	1.8
Oct./66	0	0	0	8.1	0	0.05
Nov./66	0	0	0	0	0	0

Neither A. stephensi nor A. superpictus were caught attempting to bite man in treated villages in 1966. In 1965 the results showed a definite reduction in anopheline man-biting rate in the treated villages due to insecticide presence, but biting continued through the transmission season. However, comparison of the parasite rates in the treated and control villages indicate that even for endophilic species such as A. stephensi, as well as other vectors, the killing effect of the insecticide could not cut the chain between man and the vectors (Table 7). No significant decline was observed in the parasite rates during the period of insecticide coverage and the number of new cases observed in the treated villages, particularly amongst infants (0-2 years), was almost the same as in the untreated villages (Table 8).

The results of biological evaluation of the fumigant effect have shown that the value and the duration effect of dichlorvos vaporizers are directly related to the type of dwellings as well as the amount of ventilation, so that in the least ventilated rooms such as store-rooms insecticide vaporizers kept their killing effect (mortality on caged mosquitos more than 70%) up to a period of about 13 weeks, while in most ventilated dwellings such as summer huts, house entrances and corridors, the dispensers lost most of their effect after a period of one to three weeks (mortality dropped to much less than 70%).

TABLE 7. MONTHLY PARASITE RATE IN TOTAL BLOOD COLLECTION IN THE TREATED AND CONTROL VILLAGES IN MAMASANI AREA (1964-1966)

Month	Parasite rate in 1964 (pre-insecticide survey)		Parasite rate in 1965		Parasite rate in 1966	
	Village to be treated next year	Village to be a control next year	Treated villages	Control villages	Treated villages	Control villages
January	-	-	4.8	2.6	6.0	5.7
February	-	-	4.0	0	4.5	4.1
March	-	-	2.3	0	-	-
April	4.7	0	3.3	1.3	9.3	4.4
May	6.2	1.8	7.7	2.6	3.2	4.9
June	11.4	0	10.0	2.5	3.8	4.0
July	21.4	13.9	16.6	10.1	3.3	2.9
August	21.1	10.2	20.3	13.5	1.0	1.0
September	29.0	4.8	12.3	6.0	3.7	1.9
October	34.7	10.7	10.2	7.2	4.5	3.3
November	21.5	11.5	10.5	7.8	4.8	5.3
December	12.7	5.2	9.1	5.6	3.5	1.0

TABLE 8. RESULTS OF BLOOD SLIDE EXAMINATION IN AGE-GROUP 0-2 YEARS

During the years of 1965-1966

	Year 1965						Year 1966				
	Total slides	Positive slides	P. vivax	P. falciparum	Parasite rate	Total slides	Positive slides	P. vivax	P. falciparum	Parasite rate	
Village under dichlorvos coverage	Before insecticide application	402	41	0	10%						
	After insecticide application	281	29	0	10.3%	428	13	13	0	3.2%	
Control villages	Before insecticide application in dichlorvos area	184	11	0	5.9%						
	After insecticide application in dichlorvos area	112	6	4	5.3%	140	6	6	0	4.2%	

Table 9 shows the duration of effectiveness of dichlorvos dispensers in different types of dwellings in the area.

TABLE 9. DURATION OF EFFECTIVENESS OF DICHLORVOS DISPENSERS

Type of shelter	Duration of killing effect of dichlorvos vaporizers (above 70% mortality on caged mosquitos)
1. Store-rooms and other firmly closed dwellings	13 weeks
2. Living rooms, of normal size, usually having one door and several ventilation holes	8 weeks
3. Small stables having one door and several ventilation holes	8 weeks
4. Large living rooms, having two doors, two windows or more	5 weeks
5. Large stables having two or more entrances, which are usually open	5 weeks
6. 'Kumeh'; huts with mud walls and thatched roofs	5 weeks
7. 'Kapar'; huts made entirely from thatch or palm leaves	3 weeks
8. House entrances and corridors	1 week

SUMMARY

A field trial on evaluation of dichlorvos vaporizers (resin strips) was carried out in the district of Bekesh, Kazeroun, southern Iran, in order to evaluate the effectiveness of this fumigant insecticide in interrupting malaria transmission, with a view to its more general use in the large southern problem areas. The trial area consisted of 10 villages (seven treated and three control) with a population of 2244 in the year 1965. In the year 1966 insecticide coverage was continued in three villages, with a population of 1307. A total number of 10 282 and 5987 dichlorvos vaporizers were used in 1755 and 1236 shelters in treated villages, during the years of 1965 and 1966. The first placing of all the vaporizers was completed on 27 July 1965 at the peak of transmission season, and the last placement in that year finished on 15 November, and started again on 10 May 1966 at the beginning of the breeding season the next year and was completed at the end of August.

Before the insecticide coverage, pre-spraying studies consisting of collection of malarionetric data in the area, geographical reconnaissance house volume measurements and determination of air change rate in dwellings were carried out. The effectiveness of dichlorvos insecticide was assessed by using various entomological techniques such as, determination of indoor and outdoor adult anopheline density, as well as larval density, age composition of female mosquitos, window-traps and floor sheet collections, etc. Biological studies (fumigation, bio-assay tests) were also made to determine the duration of fumigation

effect of this insecticide using laboratory-bred (DDT and dieldrin resistant) Anopheles stephensi. Also, monthly blood collections of the entire human population in the experimental area were performed and some epidemiological factors were also studied.

On the basis of the results obtained, it was concluded that dichlorvos dispensers applied at the rate used in this trial, did not satisfactorily control the natural population of malaria vectors, (mainly A. stephensi) either in the first year of treatment when the insecticide applications were started at the peak of mosquito density, nor during the next year when the area was covered by the insecticide from the beginning of the mosquito breeding season. Also, according to the results of monthly surveillance in malaria case follow-up, corroborated by various entomological data, it was clearly shown that malaria transmission was not interrupted in the dichlorvos treated villages. It is also considered, that while the use of dichlorvos in higher dosages is not economical, there is no assurance that even higher dosages of this insecticide would successfully do the job under the conditions of such areas, with well-ventilated dwellings, outdoor resting and biting habits of the vectors, and the number of species of vector anophelines with different characteristics.

#### RESUME

Un essai pratique d'évaluation des vaporisateurs à dichlorvos (bandes de résine) a été effectué dans le district de Bekesh, au Kazrun (sud de l'Iran) pour permettre de déterminer si cet insecticide fumigant était capable d'interrompre la transmission du paludisme, et si l'on pourrait en généraliser l'emploi dans les vastes zones difficiles du sud. La zone désignée pour l'essai en 1965 comprenait 10 villages (7 traités et 3 non traités servant de témoins) totalisant 2244 habitants. En 1966, la couverture insecticide a été maintenue dans 3 de ces villages comptant 1307 habitants. Au total, 10 282 vaporisateurs à dichlorvos ont été utilisés dans 1755 habitations en 1965. Pour 1966, les chiffres étaient de 5987 vaporisateurs répartis dans 1236 habitations. La première mise en place de tous les vaporisateurs a été achevée le 27 juillet 1965, au plus fort de la saison de transmission. La dernière mise en place s'est achevée le 15 novembre. L'année suivante, les opérations ont commencé le 10 mai, au début de la saison de reproduction, et se sont terminées à la fin d'août.

Avant l'opération de couverture, l'on avait procédé à divers travaux : collecte des données paludométriques de la région, reconnaissance géographique, mesures volumétriques des maisons et détermination du taux de renouvellement de l'air dans les habitations. L'efficacité de l'insecticide au dichlorvos a été évaluée à l'aide de diverses techniques entomologiques comme la détermination de la densité anophélienne adulte dans les maisons et en plein air, la détermination de la densité de larves et de la composition par âge de la population de moustiques femelles, la collecte par pièges de fenêtres et sur draps, etc. Des études biologiques (fumigation et essais biologiques) ont également été faites pour déterminer la durée d'effet de la fumigation de cet insecticide sur des Anopheles stephensi élevés en laboratoire (résistants au DDT et à la dieldrine). On a aussi effectué des prises de sang mensuelles sur tous les habitants de la zone d'expérimentation, et étudié quelques facteurs épidémiologiques.

A la lumière des résultats obtenus, on a pu conclure que les diffuseurs de dichlorvos, utilisés dans la proportion choisie pour l'expérience, n'avaient assuré l'élimination de la population naturelle des vecteurs du paludisme (principalement A. stephensi) ni pendant la première année, où les applications d'insecticide avaient commencé au moment de la plus forte densité anophélienne, ni pendant la deuxième année, où l'opération avait été entreprise dès le début de la saison de reproduction des moustiques. De même, les résultats de la surveillance mensuelle (contrôle suivi des cas de paludisme), corroborés par diverses données entomologiques, ont clairement montré que la transmission du paludisme n'était pas interrompue dans les villages traités. Par ailleurs, alors que l'emploi de dichlorvos à plus fortes doses serait coûteux, rien ne prouve qu'il donnerait parfaitement satisfaction dans les conditions propres aux zones visées : habitations bien aérées, vecteurs se reposant et piquant à l'extérieur, et nombre des espèces vectrices, qui présentent des caractères différents.

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