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REPORT ON THE EVALUATION OF BAYGON, 50% w/w (BAYER 39007, OMS-33, ARPROCARB) SHABANKAREH AREA, SOUTHERN IRAN, 1966

by

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INTRODUCTION

Since 1960, when the problem of resistance of An. stephensi to DDT and dieldrin paralyzed the whole process of the malaria programme in the southern part of Iran, some new insecticides have been evaluated in these problem areas by the Institute of Public Health Research in order to find a suitable insecticide for use in the malaria eradication programme.

Baygon 50% w/w WDP (OMS-33) a carbamate insecticide, which previously showed satisfactory results in the village scale trial carried out in Shabankareh area in 1964, was applied in a larger area scale trial in the same area in 1966.

In Shabankareh area, which is a typical representative of the problem areas of Southern Iran, 26 villages, with a total population of 6264 people, were selected for insecticide application of Baygon, and four villages with 375 inhabitants, situated on the border of the project area, were used for comparison. A sketch map of the project area is given in Appendix I.

Climate: The area has a long hot summer and short mild winter. The maximum temperature for the summer is 50°-52°C and in winter the minimum never drops below zero. The relative humidity varies from 30%-70%.

Type of houses: Approximately 60%-70% of all dwellings are made of sun-dried bricks and mud; the remaining 30%-40% are thatched huts.

I. HISTORY OF MALARIA CAMPAIGN IN THE AREA

A. History of spraying

From 1951-1956 this area was sprayed with DDT (2 g/m^2, one round a year to control malaria). Since 1956 the control has been shifted to the Malaria Eradication Programme (MEP). In 1957, when, for the first time An. stephensi developed resistance to DDT, it was decided to

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spray all southern parts of Iran, including this area, with dieldrin 0.5 g/m^2, two rounds a year. In 1959 An. stephensi was found to have resistance to both DDT and dieldrin, and in 1960 spraying was discontinued.

B. Transmission seasons

The duration of the transmission season in this area is considered to be eight-nine months, from early March to late November. Two peaks of transmission occur - the first in early summer and the second in the autumn. The highest peak of transmission is recorded in the second period, i.e. in October.

C. Brief entomological data

An. stephensi mysorensis is the main vector of the area with a high degree of resistance to DDT (1957) and dieldrin (1959).

The density of An. stephensi is lowest from January-April. In May it rises considerably, and reaches its highest level in June and July. At the peak of the hot season, i.e. the end of July and during the first part of August, there is usually a marked drop in the density, but increases again to a second peak in September, and October, followed by a gradual decrease to a minimum in February. Larval breeding places are usually stagnant water in palm groves, water pits along river beds and marshes. Adult mosquitos mostly rest in rooms and inhabited dwellings, particularly on hanging clothes, cotton, wool, straw mats, rather than on wall surfaces in spring and summer. This phenomenon reduces the desirable results expected from insecticide residual application. The mosquitos are found more frequently in stables and cow sheds from October-January where they rest mostly on or between thatch and straw ceilings and walls.

Susceptibility tests to organo-phosphorous insecticides (malathion and Baytex) were carried out on 1143 An. stephensi in Tol-Khoraki village in October 1965. The LC_{50} was 1.3 for malathion and 0.87 for Baytex.

An. d'thali is the second most common anopheline in Shabankareh. It is found in houses but is considered to be predominantly an outdoor rester. Its seasonal activity shows one peak in May and another in November. During the other months of the year its density is very low and it is rarely found inside premises. This species was recently found positive for sporozoites and thus is considered a local malaria vector.

An. superpictus is another vector of the area, with very low density, which is occasionally found in houses in the spring and autumn.

An. fluviatilis is considered a local vector but is found in low numbers in the area.

An. pulcherrimus, A. turkhudi and A. apoci are also present, but have no role in malaria transmission.

II. PRE-SPRAYING STUDY: Pre-spraying studies were carried out during the year 1965 (Table 1).

A. Entomological studies: Four villages were selected in the area, where spraying operations were to be performed, together with three villages in the comparison area. In the seven villages various entomological studies such as flit catch, larval checking as well as window traps, magoon traps and shelter pit collection, etc., were carried out daily in two villages and every fourth night in the others.

B. Parasitological surveys: Monthly malaria case detection was regularly performed in 30 villages under trial. Blood slides were taken from all 0-2 year-old children, previous positives, fever cases and suspected cases, and 20% of the remaining population, selected on random basis.

III. SPRAYING OPERATIONS

A. Operations: The area sprayed is about 20 x 15 km i.e. 300 km^2. The first round of house spraying was carried out with OMS-33, 50% WDP at a dose of 2 g/m^2. From the 11-27 April 1966 a total of 6231 permanent houses and two temporary shelters were treated in 26 villages, with 5506 inhabitants. The spraying team consisted of 14 spraymen, two mixers, two foremen, two squad leaders, and one chief of operations. Operations were carried out seven days per week for an average of seven hours per day. The amount of OMS-33 used was 1684 kg i.e. 300 g per capita. Hudson sprayers with nozzle tips 8002 were used, which were not changed during the spraying.

The second round of spraying was deliberately delayed until An. stephensi reappeared in the sprayed houses in numbers. During October 1966 insecticide of the same consignment as used in the first round was sprayed, using the same method and number of personnel. However, as it was intended to study the duration of the residual effect of different dosages, in the second round OMS-33 was sprayed at a rate of 1 g/m^2.

The number of premises sprayed during the second round was larger, due to the construction of temporary summer huts. Therefore, spraying operations lasted for 21 consecutive days, from the 4-24 October 1966; 954 kg Baygon 50% WDP was used (160 g per capita). A special team was directed to deal with summer huts which were constructed in the period between two rounds of spraying.

B. Safety precautions: The protective measures used comprised helmets with an extension to protect the neck, goggles, surgical-type masks, rubber gloves, hats, and rubber boots. The spraymen washed their faces and hands and changed their clothes before eating and resting, washed their face masks every day, and their uniforms whenever water was available, this being about once or twice a week.

IV. EFFICACY OF SAFETY PRECAUTIONS

A. Observations in spraymen: Two mixers developed symptoms such as headache, nausea, vomiting, tachycardia and abdominal pains one day after the start of spraying. They recovered after a day of rest and taking three tablets of Belladenal,[1] two tablets of prometazine theoslate (Avomin), three tablets of Ascorbic acid (500 mg), and sufficient amounts of liquid.

One of these two mixers and another sprayman had vertigo, vomiting, severe perspiration six days after first contact, but recovered after taking rest and the above-mentioned medication.

A fourth sprayman had diarrhoea and abdominal pains seven days after the start of spraying. He was treated by being given belladonna tincture and Iodochloroxyquinoleine (Entero vioform-Ciba) tablets.

B. Complaints among inhabitants of six treated villages: Six villages with a total population of 2523 inhabitants were selected at random, (from which 426 persons were examined for the blood cholinesterase activity). Among villagers under observation, 23 persons had light clinical symptoms a day after spraying their dwellings, as follows:

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[1] Each tablet contains 0.25 mg total Alkaloid of belladonna leaf and 50 mg phenobarbitone.

Eighteen persons (11 children and seven adults) with vertigo, headache and anorexia. They were treated by being given belladonna tincture and aspirin. Three adults also complained of the same symptoms, accompanied with severe perspiration, and two children developed itching.

V. ENTOMOLOGICAL EVALUATION

For determining the effect of the house spraying with OMS-33, entomological investigations were made in the same manner as in the pre-spraying phase, together with the determination of man-biting rate (method suggested by Garrett-Jones 1964) in seven selected villages. Four of these villages with 1215 inhabitants were in the sprayed area and three of them with 325 inhabitants in the comparison area.

A. Indoor-resting densities of anophelines were studied by means of total catch. Details are given in Table 2, for bi-weekly collections in eight rooms per village.

Immediately after the spraying the density of An. stephensi dropped to zero, and it could not be found in dwellings over a period of four months, while in the unsprayed comparison area An. stephensi increased to seasonal peak of 62,5 females per room (Table 2). The first An. stephensi reappeared in treated rooms during the fifth and sixth months after the spraying, but its density was only 0.34 during the last week of August, and 3.8 and 6.22 per room in September compared with densities of 46.1, 69.6 and 65.6 per shelter in the comparison unsprayed villages during the same period.

The effect of OMS-33 on An.d'thali was less pronounced. This species disappeared for two months only after the first spraying in the treated villages. Low, but increasing numbers were caught in treated villages from the third month on. The density in treated rooms ranged from 0.18 to 3.25 and in the control area from 0.0 to 15.7, during the third to the sixth month after spraying.

The anopheline larval density remained zero for a period of about two-and-a-half months after the first round of spraying and did not increase above one until the fifth month. In unsprayed villages larval density increased naturally and reached a maximum of 218 specimens per 10 dips in late September. Larval density at that time was about 15 per 10 dips in treated villages (Table 2).

B. Window-trap collections have been carried out by 22 traps (11 outlet, 11 inlet) in five villages (four treated and one untreated). In two villages (Barmak, sprayed and Cham Darwahi, unsprayed). The traps have been visited daily and in the others fortnightly. The collections were carried out in the early part of the morning.

During the 10 days immediately after spraying only a few An. stephensi and An. d'thali entered the inlet and outlet traps of sprayed houses which were being visited daily and all were killed. Thereafter no anophelines were collected in window traps during the four months after spraying. During this same four-month period, May through August, 1132 An. stephensi and 65 An. d'thali were captured in daily visited outlet and inlet traps in the unsprayed village.

In the fifth month after spraying both anopheline species reappeared in the traps of the sprayed village in low numbers, two An. stephensi and five An. d'thali being caught in inlet traps and six and 26 respectively in outlet traps. In the comparison village the corresponding figures were 192 An. stephensi and 18 An. d'thali in inlet traps and 213 An. stephensi and 132 An. d'thali in outlet traps (Tables 3 and 4).

C. Outdoor-resting densities of anophelines were observed in artificial pit shelters installed in treated and untreated villages. Resting specimens were collected from the pits early in the mornings. Daily collections were made in one sprayed and one unsprayed village with four pits in each. In the first month after spraying 74 An. stephensi were collected from the pits in the treated village, as against 611 in the comparison village. In the following four months the anophelines disappeared completely from the outdoor-resting shelters in the treated village, while they were continuously caught in the pits of the comparison village. In the sixth month after spraying the first An. stephensi (3) and An. d'thali (5) were recovered from the shelters in the sprayed village as compared with 81 and 155 specimens respectively caught in the untreated village (Table 5).

In addition, bi-weekly collections were carried out in eight pit shelters distributed in three other villages in the sprayed area. In these villages both An. stephensi and An. d'thali were present. In all of the six months after spraying, the number of the first species recovered was less than those in the comparison untreated village, but in the case of An. d'thali the catches sometimes were higher in the sprayed villages.

D. Man-vector contact was investigated by all night catches carried out bi-weekly in one sprayed and one unsprayed village. The collections were made by three mosquito catchers, who caught all anophelines alighting on six villagers during the period from dusk to sunrise. The villagers behaved in the usual local way. As the people in Shahbankareh slept outside their houses during this period of the year, the catches were made almost entirely outdoors. A few bites were recorded during the first month after spraying but no An. stephensi or An. d'thali were collected on human baits during the next three-and-a-half months after spraying. In the comparison village, biting An. stephensi were collected through this period but no An. d'thali were collected from human baits (Table 6).

Apart from An. stephensi there were only a few other anophelines caught in these night catches on human bait, i.e. four An. d'thali and four An. pulcherrimus in the sprayed village and four An. d'thali, four An. fluviatilis and two An. pulcherrimus in the control village.

E. Monthly dissection for age grouping of An. stephensi was carried on in May-July in unsprayed villages (no mosquitos were found in sprayed villages). The results showed that the parous/nulliparous ratio was 0.51, 0.92 and 0.7 during the three months in unsprayed villages.

F. Bio-assay

Bio-assay tests (WHO method) of blood-fed An. stephensi (Laboratory strain) for the evaluation of the duration of the residual effect of insecticide on sorbent and non-sorbent surfaces, were carried out on a basis of weekly tests in three treated villages. In each village a total of 20 tests were carried out, 10 on sorbent (mud) surface in one room, and 10 on non-sorbent (palm beams and mat) in another room. In addition, two tests for comparison were performed on non-treated outside surfaces. Fifteen mosquitos were utilized per cone, and thus a total of 66 cones with about 1000 mosquitos were used per week. The exposure time was 30 minutes. The long action of OMS-33 is indicated through numerous bio-assay tests which showed a total kill over a period of almost three months on sorbent and four months on non-sorbent surfaces. The combined mortality rate gradually dropped by the end of the fifth month, 144-146 days, after spraying, to 82.7% . Mortalities above 70% were maintained through 151 days after spraying for sorbent surfaces and through 171-174 days for non-sorbent surfaces. Bio-assay tests of walls retreated in October with 1 g/m^2 (treated in April with 2 g/m^2) gave 100% mortalities through 41 days (end of observations) for non-sorbent surfaces but less than 70% mortality after seven days on sorbent surfaces. The results obtained are given in Tables 7 and 8.

VI. PARASITOLOGICAL EVALUATION

Monthly surveillance has been continued after the spraying in 30 selected villages as in pre-spraying phase, and new positive cases have been carefully followed up for the case identification.

The results showed that there were few transmissions in treated villages from late June, and entomological observations showed that there is evidence that An. d'thali may be responsible for these, followed by An. stephensi (Table 9).

VII. SUMMARY AND RESULT

A. The area of investigation called Shabankareh is in the southern coastal plain of Iran, about 50 kilometers inland from the Persian Gulf.

B. The insecticide Baygon (OMS-33) 50% WDP was applied at the rate of 2 g/m^2 in April 1966, and 1 g/m^2 in October 1966.

C. The toxicological investigation carried out during the first cycle of operation (April) showed that the toxic effects among operators (spraymen, mixers, foremen) and inhabitants were light and no serious symptoms were observed.

For the treatment of complaints attributed to the insecticide only belladonna tincture was used, and no injection of atropine sulfate was needed.

D. Entomological surveys such as indoor flit catches, all-night collection of anopheline from human baits, outdoor resting places, survey and window-trap collections showed that An. stephensi (the main vector of malaria in subjected area) is totally reduced in the treated area; its density dropped to zero and no specimens were captured over a period of four months; while in the comparison area An. stephensi increased to a seasonal peak of 62.5/shelter.

The effect of OMS-33 on An. d'thali was less pronounced. It disappeared for about two months after the application of insecticide in the area, but gradually built up from the third month, the density in the treated room ranging from 0.18-3.25/shelter during three-six months after spraying.

E. Bio-assay tests showed that the residual effect of OMS-33 on both sorbent and non-sorbent surfaces is rather more promising than that of organo-phosphorus compound, giving 100% mortality up to 82 days, 76.2% mortality up to 145 days on sorbent surfaces and 100% mortality up to 110 days on non-sorbent surfaces after the application of 2 g/m^2.

F, The results obtained from monthly active case detection showed that a few transmissions of malaria occurred in the sprayed area although An. stephensi was under the control for most of the transmission period. There is some evidence that An. d'thali is responsible for maintenance of malaria in the area.

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TABLE 1. SUMMARY OF COLLECTION OF ANOPHELINES DURING 1965 PRE-SPRAY DATA

Month	Villages to be sprayed in 1966						Density of larvae[b]	Comparison villages						Density of larvae
	An. stephensi		An. d'thali		An. superpictus			An. stephensi		An. d'thali		An. superpictus		
	No.	Density[a]	No.	Density	No.	Density		No.	Density	No.	Density	No.	Density	
April	10	0.3	0	0	0	0	1.8	22	0.9	1	< 0.1	0	0	7.3
	80	2.5	7	0.2	2	0.06	12.3	87	3.6	9	0.4	2	0.08	19
May	86	2.7	24	0.8	46	1.47	8.5	176	7.3	68	2.8	65	2.7	29.3
	4 415	504.1	10	0.3	0	0	39.8	995	41.4	90	3.7	20	0.8	40.3
June	7 414	412.7	0	0	0	0	339.0	5 832	243.0	34	1.4	0	0	130.6
	7 249	324.1	0	0	0	0	275.6	10 171	568.0	0	0	0	0	282.3
July	4 023	116.1	3	0.1	0	0	330.8	5 033	262.4	12	0.5	0	0	87.9
	4 743	148.1	0	0	0	0	60.6	1 730	72.1	0	0	0	0	70.3
August	2 343	128.1	0	0	0	0	302.3	1 316	54.8	0	0	0	0	29.4
	428	15.1	9	0.3	0	0	30	517	24.4	9	0.4	0	0	28.7
September	1 547	87.8	0	0	0	0	47.5	1 564	65.1	0	0	0	0	80.1
	3 310	103.4	0	0	0	0	38.5	2 103	87.6	0	0	0	0	57.9
October	2 545	153.0	29	1.4	-	-	306.3	1 167	60.1	34	2.1	0	0	63.2
	878	45.6	110	5.6	-	-	81.5	1 278	66.9	71	3.6	0	0	99.3
November	546	20.9	99	4.8	0	0	40	1 637	107.8	275	17.3	0	0	80.3
	735	43.0	129	6.9	0	0	18	1 045	54.8	171	9	0	0	68.2
December	160	5.0	18	0.6	0	0	32.4	580	23.7	35	1.7	0	0	30.1
	146	7.9	12	0.4	0	0	20.3	509	20.3	30	1.3	0	0	16.3

[a] Average number per shelter.

[b] Density of larva per 10 dips.

TABLE 2. SUMMARY OF ANOPHELINE COLLECTIONS IN SPRAYED AND UNSPRAYED VILLAGES IN 1966

Month	Sprayed villages						Density of larvae	Unsprayed villages								Density of larvae
	An. stephensi		An. d'thali		An. superpictus			An. stephensi		An. d'thali		An. superpictus		An. fluviatilis		
	No.	Density	No.	Density	No.	Density		No.	Density	No.	Density	No.	Density	No.	Density	
January	178	5.6	9	0.3	1	<0.1	30.5	323	13.4	7	0.3	0	0	0	0	29.8
	44	1.4	1	<0.1	0	0	3.3	152	6.31	6	0.3	0	0	0	0	7.7
February	55	1.7	0	0	0	0	5.5	58	2.41	1	<0.1	0	0	0	0	5.5
	92	2.9	0	0	0	0	9.4	81	3.8	0	0	0	0	0	0	8.9
March	190	5.9	0	0	0	0	14	101	4.21	0	0	0	0	0	0	9.8
	252	7.9	0	0	0	0	23.5	172	7.1	0	0	0	0	0	0	17.3
April	645	20.1	48	1.5	5	0.2	107.2	228	9.8	28	1.1	0	0	0	0	137.0
	111	4.6	18	0.1	3	0.1	90.1	180	7.4	38	1.6	0	0	0	0	39.9
May	0	0	0	0	0	0	0	673	37.3	6	0.3	0	0	0	0	39.6
	0	0	0	0	0	0	0	1 521	52.5	7	0.4	0	0	0	0	130.6
June	0	0	0	0	0	0	0	1 126	62.5	28	1.6	0	0	0	0	170.0
	0	0	0	0	0	0	0	1 135	63	16	0.9	0	0	0	0	83.8
July	0	0	6	0.2	0	0	0	539	29.9	4	0.2	0	0	0	0	140.8
	0	0	13	0.4	0	0	0.9	768	42.6	0	0	0	0	0	0	36.4
August	0	0	11	0.3	0	0	0	193	10.7	0	0	0	0	0	0	29.3
	0	0	19	0.6	0	0	0.6	339	18.8	9	0.5	0	0	0	0	46.3
September	11	0.3	46	1.4	0	0	3.2	831	46.1	48	2.6	0	0	0	0	118.9
	118	3.8	72	2.3	0	0	14.9	1 254	69.6	185	10.3	0	0	0	0	218.2
October	178	6.2	100	3.3	0	0	14	1 181	65.6	113	6.2	4	0.2	7	0.4	176.2
	0	0	3	0.1	0	0	6.4	591	32.8	184	15.7	7	0.4	20	1.1	144
November	0	0	0	0	0	0	4.4	1 390	77	121	6.6	5	0.3	47	2.6	173.5
	0	0	0	0	0	0	1.4	623	33.1	54	2.8	0	0	19	1	52.3
December	0	0	0	0	0	0	2.2	14	0.7	2	0.1	1	0.1	14	0.7	1.7
	0	0	1	<0.1	0	0	0.0	11	0.5	0	0	0	0	3	0.1	2.5

TABLE 3. THE RESULTS OF DAILY ANOPHELINE COLLECTIONS FROM OUTLET AND INLET WINDOW TRAPS IN 1966

1966	Treated village (Barmak)				Untreated villages (Chamdarvahi)					
	Inlet (2)		Outlet (2)		Inlet (3)			Outlet (3)		
Month	An. stephensi M - F	An. d'thali M - F	An. stephensi M - F	An. d'thali M - F	An. stephensi M - F	An. d'thali M - F	An. fluviatilis M - F	An. stephensi M - F	An. d'thali M - F	An. fluviatilis M - F
April[a]	0 - 1	0 - 0	0 - 18	0 - 0	0 - 6	0 - 0	0 - 0	6 - 12	2 - 2	
May	0 - 6	0 - 3	0 - 0	0 - 0	122 - 162	3 - 8	0 - 0	3 - 20	1 - 2	
June	0 - 0	0 - 0	0 - 0	0 - 0	58 - 52	2 - 15	0 - 0	41 - 160	0 - 0	
July	0 - 0	0 - 0	0 - 0	0 - 0	30 - 78	0 - 12	0 - 0	56 - 144	1 - 7	
August	0 - 0	0 - 0	0 - 0	0 - 0	6 - 32	3 - 5	0 - 0	33 - 135	3 - 3	
September	0 - 2	1 - 4	2 - 4	6 - 20	33 - 159	7 - 11	0 - 4	54 - 159	17 - 115	0 - 4
October[b]	0 - 3 0 - 0	0 - 3 0 - 0	2 - 20 0 - 0	13 - 36 0 - 3	2 - 9	7 - 21	1 - 3	16 - 44	42 - 65	2 - 5
November	0 - 0	0 - 0	0 - 0	0 - 0	8 - 28	5 - 17	0 - 4	37 - 61	25 - 66	1 - 12
December	0 - 0	0 - 0	0 - 0	0 - 0	0 - 4	0 - 1	0 - 2	0 - 5	0 - 3	0 - 10

[a] First spray round 11-27 April.

[b] Second spray round 4-24 October.

TABLE 4. THE RESULTS OF BI-WEEKLY ANOPHELINE COLLECTIONS IN 12 (INLET AND OUTLET) WINDOW TRAPS OF TREATED HOUSES

Month	Species	Inlet			Outlet		
		Number of Anophelines M - F	% Mortality	Sella stages 1 - 2 - 3 - 4 - 5 - 6 - 7	Number of Anophelines M - F	% Mortality	Sella stages 1 - 2 - 3 - 4 - 5 - 6 - 7
April							
May	An. stephensi	2 - 3	100	2 - 1 - 0	1 - 2	100	1 - 1 - 0
	An. d'thali	0 - 0			0 - 1	100	0 - 1 - 0
June		0 - 0			0 - 0		
		0 - 0			0 - 0		
July		0 - 0			0 - 0		
		0 - 0			0 - 0		
August	An. stephensi	0 - 0			0 - 0		
	An. d'thali	0 - 0			0 - 2	100	0 - 0 - 1 - 0 - 1 - 0 - 0
September	An. stephensi	0 - 1	0.0	1 - 0 - 0	4 - 5	75	1 - 1 - 2 - 0 - 1 - 0 - 0
	An. d'thali	0 - 0		-	2 - 3	66.6	0 - 0 - 1 - 1 - 1 - 0 - 0
October	An. stephensi	0 - 0			3 - 7	57	2 - 3 - 1 - 0 - 1 - 0 - 0
	An. d'thali	0 - 0			1 - 7	43	1 - 3 - 2 - 0 - 1 - 0 - 0
	An. stephensi[a]	0 - 0			0 - 1	100	1 - 0 - 0
	An. d'thali	0 - 0			0 - 2	100	2 - 0 - 0
November	An. stephensi	0 - 4	100	2 - 0 - 0	0 - 0		
	An. d'thali	0 - 0			0 - 0		

[a] After second round of spray, 1 g/m^2.

TABLE 5. SUMMARY OF DAILY ANOPHELINE COLLECTIONS IN OUTDOOR SHELTERS - 1966

Month	Species Anopheles	Chamdarvahi untreated village (four pits)				Barmak treated village (four pits)				Other villages (eight pits)			
		No.	F	M	Density	No.	F	M	Density	No.	F	M	Density
April	stephensi	94	46	48	0.4	108	53	55	3.3				
	d'thali	15	8	7	0.1	43	27	16	2.2	-	-	-	-
						0	0	0	0				
May	stephensi	611	242	369	2.0	74	40	34	0.3	261	41	220	2.5
	d'thali	26	10	16	0.1	1	0	1		54	29	25	1.8
	pulcherrimus									2	2	0	0.1
June	stephensi	391	197	194	1.6	0	0	0		27	19	8	1.2
	d'thali	86	47	39	0.4	0	0	0	-	112	64	48	4.0
July	stephensi	113	54	59	0.4	0	0	0		10	6	4	0.4
	d'thali	26	16	10	0.1	0	0	0	-	9	8	1	0.5
August	stephensi	56	31	25	0.3	0	0	0		16	8	8	0.5
	d'thali	14	9	5	0.1	0	0	0	-	29	17	12	1.7
September	stephensi	181	112	69	0.9	0	0	0		27	17	10	1.6
	d'thali	279	163	116	1.3	0	0	0	-	29	12	17	1.7
	fluviatilis	6	6	0	0.1	-	-	-		-	-	-	-
October	stephensi	81	29	52	0.2	3	1	2		12	7	5	0.8
	d'thali	155	166	89	0.6	5	4	1	-	21	15	6	1.3
	fluviatilis	12	10	2	0.1	0	-	-		-	-	-	-
November	stephensi	192	114	78	1.0	0	0	0	-	10	3	7	0.2
	d'thali	120	71	49	0.6	0	0	0		5	3	2	0.2
	fluviatilis	38	29	9	0.2	-	-	-	-	0	-	-	-
December	stephensi	14	7	7	0.1	0	0	0	-	5	2	3	6.3
	d'thali	11	8	3		0	-	-	-	1	1	0	
	fluviatilis	8	7	1	-	-	-	-	-	1	1	0	

TABLE 6. SUMMARY OF NIGHT BITING COLLECTIONS ON HUMAN BAIT (SIX LOCAL PERSONS) IN TREATED AND UNTREATED VILLAGES

Month	Round of visit	Treated village (Barmak)			Untreated village (Chamdarwahi)		
		Number of mosquitos per bait		Temperature °C[a]	Number of mosquitos per bait		Temperature °C [a]
		An. stephensi	An. d'thali		An. stephensi	An. d'thali	
May	1	1.1	0.0	15 - 27	6.6	0	20 - 27
	2	1.5	0.16	21 - 32	6.3	0	24 - 31
June	1	0.0	0.0	20 - 32	4.5	0	22 - 23
	2	0.0	0.0	23 - 37	3.8	0	22 - 34.5
July	1	0.0	0.0	25 - 29	1.5	0	24 - 29
	2	0.0	0.0	32 - 33	1.1	0	27 - 33
August	1	0.0	0.0	26 - 34	0.5	0	27 - 34
	2	0.0	0.0	26 - 33	0.83	0	26 - 33
September	1	0.0	0.0	25 - 37.5	1.8	0	26 - 37
	2	0.33	0.16	24.5 - 34	3.16	0.33	24 - 34
October	1[b]	9	0.33	15 - 31	1.5	0.33	14 - 30
	2	0.33	0.0	14 - 30	0.66	0	14 - 30
November	1	0	0	14 - 17.6	0	0	14.2 - 19
	2	0	0	-	0	0	-

[a] Outdoor temperatures except for November which was indoor.

[b] Four A. fluviatilis were captured in the first round of October.

TABLE 7. THE RESULTS OF BIO-ASSAY TESTS IN THREE VILLAGES SPRAYED WITH 2 g/m^2 BAYGON INSECTICIDE

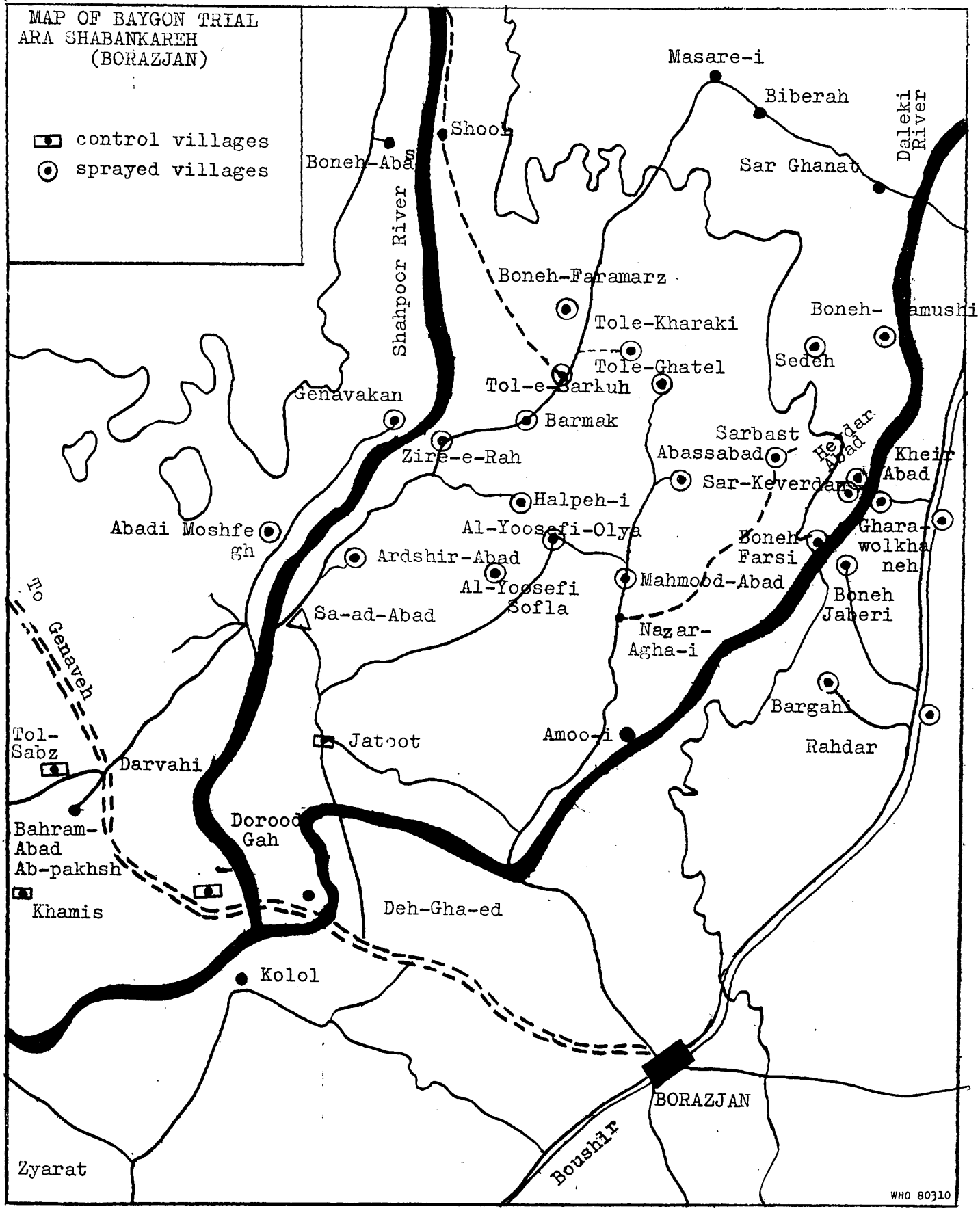
Month	Days between spraying and tests	Of mortality on sorbent surface %	Of mortality on non-sorbent surface %	Average	Mortality checks %
May	6 - 4	100	100	100	0
	11 - 13	100	100	100	0
	18 - 20	100	100	100	0
	27 - 25	100	100	100	0
June	32 - 34	100	100	100	0
	39 - 41	100	100	100	0
	35 - 55	100	100	100	0
	60 - 62	100	100	100	0
July	67 - 69	100	100	100	0
	74 - 76	100	100	100	0
	81 - 83	100	100	100	0
	88 - 90	99.7	100	99.9	0
August	95 - 97	99.3	100	99.6	0
	102 - 104	98.7	100	99.3	0
	109 - 111	96.8	100	98.4	0
	116 - 118	95.6	99.3	97.4	0
September	123 - 125	91.7	98.3	95	0
	130 - 132	88.8	96.6	92.7	0
	137 - 139	82.5	93.5	88.2	0
	144 - 146	76.2	89.2	82.7	0
October	151	70	86.1	78	0
	158	64.9	82.8	73.8	0
	165 - 167	56.7	81.9	69.3	0
	171 - 174	43.1	72.7	57.9	0
November	179	35.9	67.5	53.2	0
	186	32.9	65.5	49.2	0
	193	29.05	65	47	0
	200	24.6	64	44.3	0
	207	19.6	58.3	38.9	0

TABLE 8. THE RESULTS OF BIO-ASSAY TESTS IN THREE VILLAGES SPRAYED WITH 2 g/m^2 BAYGON IN APRIL AND 1 g/m^2 IN OCTOBER

Month	Period between spraying and tests	Mortality on sorbent surfaces %	Mortality on non-sorbent surfaces %	Total	Mortality checks %
October	6 - 7	77.7	100	88.5	0
November	13	67.1	100	83.55	0
	20	63.2	100	81.6	0
	27	62.6	100	81.3	
	34	59.3	100	79.65	0
	41	48	100	74	0

TABLE 9. THE RESULTS OF MONTHLY ACTIVE MALARIA CASE DETECTION IN BAYGON TRIAL AREA IN 1966

Month	25 Sprayed villages													Unsprayed villages											
	Total number of slides							0-2 years						Total number of slides							0-2 years				
	No. of slides	No. positive	% P.R.	Positive P.V	Positive P.F	Positive Mix	Fresh case	No. of slides	No. positive	Positive P.V	Positive P.F	Positive Mix	% P.R	Fresh case	No. of slides	No. positive	% P.R	Positive P.V	Positive P.F	Positive Mix	Fresh case	No. of slides	No. positive	% P.R	Positive P.V	Positive P.F	Positive Mix	Fresh case
April	1 411	20	1.4	2	18	-	-	328	5	1	4	-	1.5	-	267	-	-	-	-	-	-	51	-	-	-	-	-	-
May	1 168	22	1.8	5	17	-	-	335	7	2	5	-	2.1	-	382	9	2.4	4	5		3	96	2	2.2	1	1	-	1
June	1 221	45	3.6	30	15	-	2	321	6	5	1	-	1.8	-	246	14	5.7	7	7		5	58	4	1.6	3	1	-	-
July	1 213	128	10.5	99	29	-	13	296	19	16	3	-	6.1	-	235	27	11.5	19	8	-	3	62	6	9.6	5	1	-	-
August	1 161	114	9.8	95	19	-	9	278	14	13	1	-	5.03	1	218	20	10	17	3	-	-	60	6		5	1	-	-
September	1 049	92	8	53	39	-	2	266	12	6	6	-	4.5	2	184	12	3.7	9	3	-	-	53	2	-	2	-	-	-
October	1 192	180	15.9	81	98	1	7	292	32	18	13	1	1.9	5	240	18	7.5	11	7	-	1	69	2	2.8	2	-	-	1
November	1 246	212	16.9	64	147	1	-	286	27	7	20		9.4	-	266	42	15.7	26	16	-	3	71	6	8.4	5	1	-	-
December	687	84	12.2	27	57	-	-	160	10	2	8		6.2	-	133	24	18	14	10	-	2	27	5	18.5	4	1	-	1


MAP OF BAYGON TRIAL
ARA SHABANKAREH
(BORAZJAN)
control villages
sprayed villages
Masare-i
Biberah
Daleki River
Shool
Boneh-Aba
Shahpoor River
Sar Ghanat
Boneh-Faramarz
Tole-Kharaki
Boneh-
Tole-Ghatel
Sedeh
Tol-e-Sarkuh
Genavakan
Barmak
Sarbast
Abassabad
Zire-e-Rah
Kheir Abad
Sar-Keverdan
Halpeh-i
Abadi Moshfe gh
Al-Yoosefi-Olya
Ghara-wolkha neh
Ardshir-Abad
Boneh Farsi
Al-Yoosefi Sofla
Mahmood-Abad
Boneh Jaberi
Sa-ad-Abad
Nazar-Agha-i
Bargahi
Tol-Sabz
Jatoot
Amoo-i
Rahdar
Darvahi
Dorood Gah
Bahram-Abad
Ab-pakhsh
Khamis
Deh-Gha-ed
Kolol
BORAZJAN
Zyarat
Boushir
WHO 80310

APPENDIX I