AREA SCALE EVALUATION OF SUMITHION (OMS-43) FOR CONTROL OF ADULT ANOPHELINE MOSQUITOES IN MAMASSANI, KAZEROUN, SOUTHERN IRAN, 1972 *

N. Eshghy,**

A. Mesghali,***

Gh. Behbahani****

M. Motabar*****

ABSTRACT **A field trial evaluation of Sumithion (OMS-43) was carried out in the Mamasani area, Kazeroun, southern Iran, in order to evaluate the effectiveness of this insecticide for the control of adult anopheline mosquitoes.**

The technical difficulties encountered in the area and related to malaria were the resistance of A. stephensi to DDT and Dieldrin,

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** Kazeroun Research Station, Institute of Public Health Research, University of Teheran.

*** Malaria Eradication Unit, Fars Province, Malaria Eradication Organization, Ministry of Health.

**** Deprtment of Environmental Health, School of Public Health and Institute of Public Health Research, University of Teheran.

the exophilic and exophagic habits of A. d'thali, A. superpictus and A. fluviatilis and the ecology of the inhabitants.

Sumithion spraying, wdp, 2 g/m2, covered 57 villages with a population of 11,445.

One round of spraying was implemented in August at the peak of activity of A. stephensi. The effectiveness of Sumithion was evaluated by pyrethrum spray, exit trap, night bait and outdoor collections, as well as by age determination of female mosquitoes and biological evaluation.

Pyrethrum spray catches showed a remarkable reduction in indoor resting density of A. stephensi. Exit trap observations indicated 100% mortality within a 24-hour recovery period. The manbiting rate was reduced during th ecourse of collection. On the basis of the results obtained, it was concluded that Sumithion is an effective insecticide against anopheline mosquitoes and controls A. stephensi, under the conditions of this experiment, for about two months.

INTRODUCTION

After the development of resistance in *A. stephensi*, the main vector of malaria in the southern part of Iran, first to DDT (1957) and then to Dieldrin (1960), the strategy of the Malaria Eradication Programme in southern Iran was radically changed. Thereafter, various combined antimalarial measures were used and several potential antimosquito compounds (adulticides as well as larvicides) were evaluated under the prevailing conditions of the southern part of the country.

Comparative studies based on the effectiveness and cost benefit analysis have resulted in the utilization of Malathion as a suitable insecticide, substituting DDT and DLN and in some instances used in combination with these insecticides.

Malathion treatment, 50% wdp, 2 gs/m^2 (one to 3 rounds per annum, depending on the area), was implemented in 1968, and has resulted in the approximate control of *A. stephensi* on the littoral plain.(3) However, in the foothill and mountainous areas, where the activity of *A. stephensi* was reduced, other secondary vectors such as *A. d'thali, A. superpictus and A. fluvitalis* were still active.

Due to the exophilic tendency of *A. fluviatlis* and *A. d'thali* and the outdoor sleeping habits of the inhabitants, the transmission has not been completely interrupted. Malaria transmission usually occurs during 8 months of the year (April-December) with a peak during mid-August to mid October.

The frequency of application of Malathion may increase the possibility of development of tolerance of resistance of *A step-*

hensi. Therefore, making available other potential insecticides the control of mosquitoes or for replacing other compounds is ways of vital importance.

Sumithion is one of the new insecticides which has b used in field trials in Kisumu, Kenya. (2)

In order to assess the value of this insecticide under prevailing conditions of Iran, an operational study was carried in Mamassani area, Kazeroun, southern Iran, in 1972 (Map 1)

Objectives: The main objective of this trial was to assess the pact of insecticide treatment on the overall local anopheline po lation; special attendtion being given to *A. stephensi*, the m vector of the area. The evaluation of the effect of insecticide other confirmed vectors i.e., *A. d'thali, A. superpictus* and *A. viatilis* was also under consideration. Moreover, toxicological e luation of the compound was underway along with the entomo gical assessment (5) Motabar and Coll., in press.

Area of operation: The area is located on the southern slope the Zagros Mountains and has a sub-tropical climate. The av age maximum temperature is 40°C in July-August. The wint are mild and the temperature rarely drops below zero. The re tive humidity varied from 30-50% except on rainy days.

Ninety per cent of the dwellings are built of sun-dried bri covered with mud and 10% are built with ridged thatch roofs a mud brick walls.

Spraying Operations:

i. past-spraying experiences: From 1950-71, several residual ho sprayings were carried out in the area including:

10 rounds of DDT, 75% wdp, 2 g/m^2;

4rounds of Dieldrin, 50% wdp, 0.5 g/m^2; and

5 rounds of Malathion, 50% wdp, 2 g/m^2.

ii. *Present Operation*: One round of indoor spraying of OMS- at a dosage of 2 g/m^2 (technical grade) was carried out in t whole project area in August, 1972. The spraying covered 57 v lages with a total population of 11,445 inhabitants.

The percentage coverage in temporary and permanent sh ters was 99.6% and 96.1%, respectively. A summary of sprayi operations with OMS-43 in this area is given in Table 1.

EVALUATION

Entomological Evaluation: Five representative villages in t OMS-43 sprayed area and two villages in the comparison ar treated with Malathion* were chosen for entomological evaluatio

Pyrethrum spray collections were carried out at ten day intervals at eight fixed capture stations in each village.

Floor sheet collection. The number of dead mosquitoes found on sheets spread overnight on the floors of six sprayed shelters was counted at 10 day intervals.

Larval density was assessed by the counting of a number of dips. The third and fourth instar of larvae were identified, and the whole instar of larvae collected was counted for larval density.

Window trap collection. A total of 20 exit traps were installed in a number of sprayed houses (four window traps per village) and live specimens were observed for 24 hour mortality and examined at 10 days intervals.

Shelter pit collections. Twenty artificial pits (four pits per village) were established in OMS-43 sprayed villages and were examined at 10 day intervals.

Night-biting collections on human and animal bait were carried out at 10 day intervals in three villages treated with OMS-43. The collections during the hour after sunset, who caught all anophelines alighting on four villagers used as bait. An assessment of animal bait was conducted by one collecting from an ass and a cow.

Vector age determination was assessed by the ovary dissection of females collected in five OMS-43 treated villages by Detinova's method.(1)

Biological evaluation on various surfaces in treated houses with laboratory bred blood-fed *A. stephensi* females was carried out at weekly intervals. The WHO method (6) was used for the assessment of the residual deposit on sprayed surfaces.

RESULTS AND DISCUSSION

Coverage of the area with Sumithion resulted in a considerable decline in the population density of *A. stephensi.*

The density for *A. stephensi* decreased in five treated villages from 352.9 per shelter before spraying to 2.9, 11.4, 3.5, 4.2, 0.2 and zero in August and September (Table 2).

Pyrethrum spray collection of *A. stephensi* in forty dwellings totaled 14,119 before spraying operations. The number of empty blood-fed, half gravid and gravid females was 1167 (8.3%), 5820 (41.2%), 5339 (37.8%) and 1792 (12.7%), respectively.

During the three days after spraying, 119 *A. stephensi* were found in pyrethrum spray collections and the number of empty, blood-fed,half gravid and gravid females was 98 (82.4%), 10 (8.4%), 10 (8.4%) and 1 (0.8%), respectively (Table3). The decrease in indoor collections of *A. d'thali* after Sumithion applica-

tion was also considerable.

In two comparison villages sprayed with Malathion, the density decreased from 997.6 per shelter before spraying to 42.6, 9.3, 7.5, 6.1, 4.2, 18.1 and 19.8 in August, September and October (Table 4).

In pre-spray collections in 16 dwellings, 15,962 *A. stephensi* were captured and the number of half gravid and gravid females was 2837 (17.8%) and 3220 (20.1%), respectively (Table 5).

Durig August and September, a total of 65 *A. stephensi* and 213 *A. d'thali* were collected on sheets spread overnight on the floors in OMS-43 treated villages. Adequate exposure time is noticeable in the killing effect.

The main larval breeding places of *A. stephensi* are rise fields, canals and river banks.

Due to *rice season cultivation activity* in July, and the consequent extension of larval breeding place surfaces, a remarkable increase has been observed in the anopheline population in both OMS-43 trated and comparison villages treated with Malathion (Tables 2-4). Following OMS-43 application, a gradual reduction of the larval population is obtained.

Adult female collections were carried out in artificial pit shelters before and after Sumithion (OMS-43) application. Although *A. stephensi* as a species is quite endophilic, due to the numerous out-put of larvae, remarkable numbers of *A. stephensi* were collected in pit shelters. The maximum density was observed to be 21.8 per Pit three days after Sumithion application (Table 6).

A. d'thali, also known as an expohilic species, was collected with a maximum density of 49.3 per pit shelter.

Exit trap observations were carried out during the pre-spray period and a total of 25 *A. stephensi* and 507 *A. d'thali* females were colelcted, with an average mortality of 56% and 63.9%, respectivelv, after a 24-hour observation period (Table 7).

The indices of empty, blood-fed, half gravid and gravid females trapped were 14%, 16%, 12% and 58% for *A. stephensi* and 40.5%, 50.1%, 2.4% and 7% for *A. d'thali*, respectively.

After Sumithion application, the mosquitoes captured in exit traps were kept for observation, none of which survived for 24 hours. Among the collected mosquitoes no higher stages of blood digestion were seen.

During the pre-spray period, night-biting collections were conducted on human bait. The maximum man-biting rate of *A. stephensi* was observed to be 38.4 per bait per night.

The man-*A. stephensi* contact indices ranged between zero

and 16.6 per bait per night after Sumithion application (Table 8). No great number of *A. stephensi* bites were observed during the 80 days after spraying, with two exceptions where a total of 378 *A. stephensi* were collected with man-biting rates of 14.9 and 16.6 per bait per night 3 and 10 days after application. It may be mentioned that the inhabitants sleep outside during this period of the year and thus the catches wer emade almost entirely outdoors.

A few man-*A. d'thali* bites were observed during the course of study.

Animal night bait collections indicated a high percentage of mosquitoes captured from animals. The maximum rate of *A. stephensi* and *A. d'thali* was observed to be 213 and 133.7 per night bait before Sumithion application.

The animal-*A. stephensi* contact showed an average number of 27.1 and 24.3 bites per animal 3 and 10 days after application. Thereafter a definite reduction in biting rate was observed (Table 9).

In spite of a remarkable decline in *A. stephensi* biting indices the animal-biting rate of *A. d'thali* during the same period ranged between 1.7 and 61.5 per bait per night.

Apart from *A. stephensi* and *A. d'thali* a few *A. superpictus* were collected with a maximum rate of 5 per bait per night.

Ovary dissections carried out on 247 *A. stephensi* revealed an average parous rate of between 54.1% and 62.4%. Following sumithion spraying the parous rate of a total of 237 *A. stephensi* dissected dropped to between 3.5% and 9.8% (Table 10).

A total of 25 *A d'thali* were dissected with a parous rate of 76% in the pre-spray period. After spraying the average parous rate was observed to be between 22.8% and 39.5%.

The results of biological evaluation of the Sumithion effect within the 30 minute exposure period have shown a mortality rate of about 72.6% on mud walls up to 39 days after spraying; however by 102 days it had dropped to 8%. Wood bio-assays gave more than 70% mortality up to 95 days after spraying (Table 11).

Wall and roof bio-assays were carried out with a one hour exposure period. on mud, 74.5% and on wood, 100% mortality rates were observed for up to 88 days. After 109 days on mud and wood they had dropped to 51.3% and 83.8%, respectively (Table 11a).

A study was made by routine bio-assay on sprayed surface with Malathion as compared with Sumithion. With a 30 minute exposure period, the maximum morality was observed to be 68.5% on mud walls 11 days after spraying. Wood bio-assays gave more

than 70% mortality through 88 days after spraying (Table 12).

One hour bio-assay exposure on sprayed mud walls and wood roofs was recorded at 88 days after spraying with mortalities of 74.5% and 96%, respectively (Table 12a).

Susceptibility tests using the WHO technique were carried out on *A. stephensi*. The mortality rate, with 4% DDT concentration and oneto four hours exposure followed by a 24-hour recovery period, was observed to be between 0% to 1% and 8.9% to 12.9%, respectively.

With regard to 0.1% and 1% Fenitrothion (OMS-43) concentrations, the range of mortality after half an hour exposure followed by a 24-hour recovery period was observed to be between 0% to 2.0% and 99.2% to 100% respectively and with one hour exposure between 0.7% to 5.8% and 100%, respectively.

The range of mortality to 0.5%, 3.2% and 5% Malathion and half an hour exposure followed by a 24-hour recovery period was observed to be between 1.4% and 7.9%, 35.2% and 70.3% and 65.5% and 95.9%; with one hour exposure the mortality rate was 2,1% to 19.2%, 93.6% to 99.3% and 100%, respectively.

In conclusion, results obtained by entomological evaluation showed that Sumithion was effective in the control of *A. stephensi* until the end of transmission season (for more than two months.) The effect was observed not only on the anopheline indoor resting and larval population but also by outdoor resting, night bait collection and age determination of the vector (Table 13). The studies were performed at the peak of activity of *A. stephensi*. But in the case of other vectors species (*A. superpictus* and *A. d'thali*) the effect of insecticide was not so significant due to exophagic and exophilic habits of these species.

Further studies will give more detail on the effectiveness of this insecticide.

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TABLE 1. SUMMARY OF SUMITHION (OMS-43) SPRAYING OPERATIONS-MAMASANI , KAZEROUN, IRAN, 1972

Spraying period	General information			No.shelters		No.shelters sprayed				WDP kg used	* Labor/ day
	population	No. Households	No. Houses	Tempo-rary	Perma-nent	Tempo-rary	%	Perma-nent	%		
2-31.8.72	11445	2015	1885	1567	12257	1561	99.6	11779	96.1	4901.5	170/ 590

* 170 is standing for numbers of foremen and mixer .
590 is standing for numbers of spraymen.

TABLE 2. SUMMARY OF PYRETHRUM SPRAY COLLECTIONS AND LARVAL COLLECTIONS IN SUMITHION (OMS-43) TREATED VILLAGES -MAMASANI, KAZEROUN, IRAN , 1972

Month	Days after spraying	A.stephensi		A.dthali		A.superpictus		A.fluviatilis		Anopheline larvae number per 10 dip
		Number	Number per hut	Number	Number per hut	Number	Number per hut	Number	Number per hut	
May	pre-spray	0	0	0	0	0	0	0	0	0.2
		2	0.05	2	0.05	0	0	0	0	2
June	"	32	0.8	31	0.8	33	0.8	13	0.2	36.7
	"	40	1	46	1.1	7	0.2	2	0.05	31.8
July	"	350	8.7	189	4.7	44	1.1	0	0	21.7
	"	14119	352.9	837	20.9	0	0	0	0	52
August	3	119	2.9	35	0.9	0	0	0	0	34
	10	454	11.4	30	0.7	0	0	0	0	34.4
	20	140	3.5	104	2.6	0	0	0	0	15.1
September	30	168	4.2	216	5.4	0	0	0	0	21.9
	40	9	0.2	30	0.7	10	0.2	0	0	9.6
	50	0	0	14	0.3	4	0.1	1	0.02	6.6
October	60	3	0.07	24	0.6	5	0.1	0	0	5.9
	70	0	0	2	0.05	1	0.02	0	0	4.4
	80	0	0	2	0.05	0	0	0	0	5.5
November	90	0	0	1	0.02	1	0.02	0	0	2
	100	0	0	0	0	0	0	0	0	0.5

TABLE 3. RELATIVE OF BLOOD DIGESTION STAGES OF INDOORS COLLECTED OF A.STEPHENSI AND A.DTHALI IN SUMITHION (CMS-43) TREATED VILLAGES_ MAMASANI, KAZEROUN, IRAN, 1972

Month	days after spraying	A.stephensi						A.dthali					
		Blood digestion stages						Blood digestion stages					
		E	B.F	H.G	G	Total	Number per hut	E	B.F	H.G	G	Total	Number per hut
June	pre-spray	12 37.5%	17 53.1%	2 6.3%	1 3.1%	32 100%	0.8	9 29%	19 61.3%	3 9.7%	0	31 100%	0.8
	"	15 37.5%	17 42.5%	3 7.5%	5 12.5%	40 100%	1	17 37%	26 56.5%	2 4.3%	1 2.2%	46 100%	1.1
July	"	37 10.5%	128 36.6%	104 29.7%	81 23.1%	350 100%	8.7	32 16.9%	64 33.9%	74 39.2%	19 10%	189 100%	4.7
	"	1167 8.3%	5820 41.2%	5339 37.8%	1793 12.7%	14119 100%	352.9	229 27.4%	339 40.6%	123 14.8%	146 17.4%	837 100%	20.9
August	3	98 82.4%	10 8.4%	10 8.4%	1 0.8%	119 100%	2.9	23 65.7%	12 34.3%	0	0	35 100%	0.9
	10	368 81%	57 12.6%	14 3.1%	15 3.3%	454 100%	11.4	25 83.3%	5 16.7%	0	0	30 100%	0.7
	20	47 33.6%	92 65.7%	0	1 0.7%	140 100%	3.5	73 70.2%	31 29.8%	0	0	104 100%	2.6
September	30	88 52.4%	56 33.3%	14 8.3%	10 6%	168 100%	4.2	138 63.9%	63 29.2%	10 4.6%	5 2.3%	216 100%	5.4
	40	4 44.4%	5 55.6%	0	0	9 100%	0.2	18 60%	7 23.4%	1 3.3%	4 13.3%	30 100%	0.7
	50	0	0	0	0	0	0	10 71.5%	3 21.4%	0	1 7.1%	14 100%	0.3
October	60	1 33.3%	2 66.7%	0	0	3 100%	0.07	18 75%	4 16.7%	0	2 8.3%	24 100%	0.6

TABLE 4. SUMMARY OF PYRETHRUM SPRAY COLLECTIONS AND LARVAL COLLECTIONS IN COMPARISON VILLAGES TREATED WITH MALATHION -MAMASANI , KAZEROUN , IRAN ,1972

Month	Days after spraying	A.stephensi		A.dthali		A.superpictus		A.fluviatilis		Anopheline larvae
		Number	Number per hut	Number	Number per hut	Number	Number per hut	Number	Number per hut	number per 10 s dip
May	Pre-spray	0	0	0	0	0	0	0	0	0.6
	"	0	0	0	0	0	0	0	0	1.2
June	"	2	0.1	7	0.4	11	0.7	0	0	25.7
	"	35	2.2	4	0.2	7	0.4	0	0	10
July	"	175	10.9	52	3.2	3	0.2	0	0	13
	"	10806	675.3	1016	63.5	0	0	0	0	122.5
August	"	13563	847.6	1272	79.5	0	0	0	0	168.7
	"	15962	997.6	227	14.1	0	0	0	0	62.5
	5	682	42.6	24	1.5	0	0	0	0	22.7
September	15	149	9.3	0	0	0	0	0	0	25.5
	25	120	7.5	40	2.5	19	1.2	0	0	15.7
	35	98	6.1	37	2.3	4	0.25	0	0	11.7
October	45	68	4.2	9	0.5	3	0.2	0	0	5
	55	290	18.1	38	2.4	30	1.9	0	0	14.7
	65	317	19.8	6	0.4	7	0.4	0	0	8.5
November	75	66	4.1	2	0.1	8	0.5	0	0	7.3
	85	1	0.06	0	0	0	0	0	0	0
	95	0	0	0	0	0	0	0	0	0

TABLE 5. RELATIVE OF BLOOD DIGESTION STAGES OF INDOORS COLLECTED OF A.STEPHENSI AND A.DTHALI IN COMPARISON VILLAGES TREATED WITH MALATHION-MAMASANI, KAZEROUN, IRAN, 1972

Month	days after spraying	A.stephensi						A.dthali					
		Blood digestion stages						Blood digestion stages					
		E	BF	HG	G	Total	Number per hut	E	BF	HG	G	Total	Number per hut
June	pre-spray	1	1	0	0	2	0.1	3	4	0	0	7	0.4
	"	9 25.7%	19 54.3%	6 17.1%	1 2.9%	35 100%	2.2	0	4 100%	0	0	4 100%	0.2
July	"	23 13.1%	37 21.2%	53 30.3%	62 35.4%	175 100%	10.9	9 17.3%	15 28.9%	18 34.6%	10 19.2%	52 100%	3.2
	"	1544 14.3%	3213 29.7%	4448 41.2%	1601 14.8%	10806 100%	675.3	431 42.4%	291 28.7%	168 16.5%	126 12.4%	1016 100%	63.5
August	"	4605 33.9%	4378 32.3%	2602 19.2%	1978 14.6%	13563 100%	847.6	477 37.5%	387 30.4%	241 19%	167 13.1%	1272 100%	79.5
	"	3940 24.7%	5965 37.4%	2837 17.8%	3220 20.1%	15962 100%	997.2	42 18.5%	122 53.7%	42 18.5%	21 9.3%	227 100%	14.1
	5	388 56.9%	222 32.6%	48 7%	24 3.5%	682 100%	42.6	10 41.7%	14 58.3%	0	0	24 100%	1.5
September	15	50 33.5%	60 40.3%	28 18.8%	11 7.4%	149 100%	9.3	0	0	0	0	0	0
	25	22 18.3%	61 50.8%	26 21.7%	11 9.2%	120 100%	7.5	23 57.5%	17 42.5%	0	0	40 100%	2.5
	35	5 5.1%	52 53.1%	17 17.3%	24 24.5%	98 100%	6.1	11 29.7%	18 48.7%	3 8.1%	5 13.5%	37 100%	2.3
October	45	14 20.6%	25 36.8%	19 27.9%	10 14.7%	68 100%	4.2	7 77.8%	2 22.2%	0	0	9 100%	0.5
	55	27 9.3%	126 43.4%	80 27.6%	57 19.7%	290 100%	18.1	15 39.5%	14 36.8%	6 15.8%	3 7.9%	38 100%	2.4
	65	0	166 52.3%	88 27.8%	63 19.9%	317 100%	19.8	4 66.7%	2 33.3%	0	0	6 100%	0.4

TABLE 6. SUMMARY OF SHELTER PIT COLLECTIONS OF ANOPHELINES IN SUMITHION(OMS-43)TREATED VILLAGES-MAMASANI ,KAZEROUN,IRAN , 1972

Month	Days after spraying	A.stephensi		A.dthali		A.superpictus		A.fluviatilis	
		Number	Number per pit shelter	Number	Number per pit shelter	Number	Number per pit shelter	Number	Number per pit shelter
May	Pre-spray	-	-	-	-	-	-	-	-
	"	0	0	0	0	0	0	0	0
June	"	1	0.1	2	0.2	4	0.4	0	0
	"	8	0.5	5	0,3	8	0.5	3	0.2
July	"	46	2.3	91	4.5	15	0.7	0	0
	"	93	4.6	269	13.4	0	0	0	0
August	3	436	21.8	987	49.3	0	0	0	0
	10	173	8.6	637	31.8	0	0	0	0
	20	276	13.8	829	41.4	0	0	0	0
September	30	72	3.6	180	9	10	0.5	0	0
	40	13	6.5	83	4.1	15	0.7	0	0
	50	1	0.05	186	9.3	25	1.2	0	0
October	60	3	0.15	178	8.9	38	1.9	0	0
	70	0	0	81	4	50	2.5	0	0
	80	3	0.15	47	2.3	40	2	0	0
November	90	0	0	22	1.1	17	0.8	0	0
	100	0	0	0	0	0	0	0	0

TABLE 7 SUMMARY OF EXIT TRAP COLLECTIONS OF ANOPHELINES IN SUMITHION(OMS-43)TREATED VILLAGES MAMASANI,KAZEROUN,IRAN, 1972

Month	days after spraying	species	Total No. collected		after 24 hours observation		
			dead	alive	dead	alive	% mortality
	pre-spray	-	-	-	-	-	-
		-	-	-	-	-	-
July	"	A.stephensi	0	25	14	11	56
	"	A.dthali	0	507	324	183	63.9
August	3	A.stephensi	46	7	7	0	100
		A.dthali	198	24	24	0	100
	10	A.stephensi	14	13	13	0	100
		A.dthali	54	66	66	0	100
	20	A.stephensi	2	2	2	0	100
		A.dthali	52	38	38	0	100
September	30	A.stephensi	2	0	0	0	-
		A.dthali	31	31	31	0	100
	40	A.stephensi	1	1	1	0	-
		A.dthali	11	11	11	0	100
	50	A.stephensi	0	0	0	0	-
		A.dthali	3	5	5	0	100
October	60	A.stephensi	0	0	0	0	-
		A.dthali	3	6	6	0	100
	70	A.stephensi	0	0	0	0	-
		A.dthali	0	0	0	0	-
	80	A.stephensi	0	0	0	0	-
		A.dthali	0	0	0	0	-

TABLE 8. SUMMARY OF NIGHT BITING CATCHES ON HUMAN BAIT IN SUMITHION(OMS-43)SPRAYED VILLAGES MAMASANI, KAZEROUN, IRAN, 1972

Month	days after spraying	A.stephensi		A.dthali		A.superpictus	
		Number	Nr./bait/night	Number	Nr./bait/night	Number	Nr./bait night
July	Pre-spray	52	4.3	36	3	4	0.3
	"	461	38.4	13	1.1	0	0
August	3	179	14.9	8	0.7	0	0
	10	199	16.6	0	0	0	0
	20	24	2	8	0.7	0	0
September	30	25	2.1	0	0	1	0.1
	40	3	0.2	0	0	3	0.2
	50	1	0.1	2	0.2	1	0.1
October	60	0	0	0	0	0	0
	70	0	0	0	0	0	0
	80	0	0	0	0	0	0
	90	0	0	0	0	0	0
November	100	0	0	0	0	0	0

TABLE 9. SUMMARY OF NIGHT BITING CATCHES ON ANIMAL BAIT IN SUMITHION (OMS-43) SPRAYED VILLAGES-MAMASANI, KAZEROUN, IRAN, 1972

Month	days after spraying	A.stephensi		A.dthali		A.superpictus	
		Number	Nr./bait/night	Number	Nr./bait/night	Number	Nr./bait/night
June	pre-spray	-	-	-	-	-	-
	"	14	2.3	118	19.7	24	4
July	"	56	9.3	196	32.7	10	1.7
	"	1278	213	802	133.7	13	2.1
August	3	163	27.1	369	61.5	0	0
	10	146	24.3	134	22.3	0	0
	20	23	3.8	261	43.5	8	1.3
September	30	28	4.7	323	53.9	30	5
	40	2	0.3	44	7.3	13	2.1
	50	0	0	51	8.5	13	2.2
October	60	0	0	25	4.2	4	0.7
	70	1	0.17	16	2.5	2	0.3
	80	3	0.5	10	1.7	4	0.7
November	90	0	0	3	0.5	1	0.2
	100	0	0	0	0	0	0

TABLE 10 RESULTS OF OVARY DISSECTIONS OF COLLECTIONS OF ANOPHELINES IN SUMITHION (OMS-43) TREATED VILLAGES-MAMASANI , KAZEROUN , IRAN , 1972

Month	days after spraying	species	proportion parous	
			No. dissected	parous rate %
July	Pre-spray	A.stephensi	125	62.4
		A.dthali	25	76
	"	A.stephensi	122	54.1
August	3-10	A.stephensi	152	9.8
September	15-40	A.stephensi	85	3.5
		A.dthali	43	39.5
October	45-70	A.dthali	70	22.8

TABLE 11. RESULTS OF BIOASSAY EXPOSED 30 MINUTES TO SUMITHION (OMS-43) SPRAYED SURFACES- MAMASANI, KAZEROUN, IRAN, AUGUST-NOVEMBER, 1972

days after spraying	Mud surfaces (sorbent)		Wood surfaces (non sorbent)		All surfaces		control	
	No. tested	% 24h mortality	No. tested	% 24h mortality	No. tested	% 24h mortality	No. tested	% 24h mortality
4	289	96.9	301	100	590	98.5	61	0
11	301	95.7	302	100	603	97.9	61	0
18	304	92.1	300	100	604	96	61	0
25	302	87.7	300	100	602	93.8	57	0
32	292	83.5	298	100	590	91.8	59	0
39	303	72.6	303	99.6	606	86.1	59	0
46	297	63.3	301	98.6	598	81.1	58	0
53	296	46.9	298	95.3	594	71.2	58	1.7
60	299	40	299	93.9	598	67	60	0
67	309	35.2	304	92.1	613	63.4	60	0
74	303	32	307	91.8	610	62.1	61	1.5
81	303	27	305	89.8	608	58.5	60	0
88	149	19.4	151	84.1	300	52	62	0
95	152	11.2	150	71.3	302	41	61	0
102	150	8	148	67.6	298	37.8	63	0

TABLE 11 a. RESULTS OF BIOASSAY EXPOSED ONE HOUR TO SUMITHION (OMS-43) SPRAYED SURFACES- MAMASANI , KAZEROUN, IRAN, NOVEMBER 1972

days after spraying	Mud surfaces (sorbent)		Wood surfaces (non sorbent)		All surfaces		Control	
	No. tested	% 24h mortality	No. tested	% 24 h mortality	No. tested	% 24h mortality	No. tested	% 24h mortality
88	149	74.5	151	100	300	87.3	62	0
95	147	61.2	151	95.3	298	78.5	61	0
102	153	60.1	149	94.6	302	77.1	63	0
109	152	51.3	149	83.8	301	67.4	57	0

TABLE 12 a. RESULTS OF BIOASSAY EXPOSED ONE HOUR TO MALATHION SPRAYED SURFACES AS COMPARED WITH SUMITHION-MAMASANI, KAZEROUN , IRAN NOVEMBER 1972

days after spraying	Mud surfaces (sorbent)		Wood surfaces (non sorbent)		All surfaces		Control	
	No. rested	% 24h mortality	No. tested	% 24h mortality	No. tested	% 24 h mortality	No. tested	% 24h mortality
88	51	74.5	51	96	102	85.3	20	0
95	50	68	51	88.2	101	78.2	20	0
102	51	56.8	49	79.5	100	68	20	0
109	49	44.8	50	74	99	59.5	20	0

TABLE 12. RESULTS OF BIOASSAY EXPOSED 30 MINUTES TO MALATHION SPRAYED SURFACES AS COMPARISON WITH SUMITHION-MAMASANI, KAZEROUN, IRAN, AUGUST-NOVEMBER , 1972

days after spraying	Mud surfaces (sorbent)		Wood surfaces (non sorbent)		All surfaces		control	
	No. tested	% 24h mortality	No. tested	% 24h mortality	No. tested	% 24h mortality	No. tested	% 24h mortality
4	101	47.5	98	100	199	73.3	20	0
11	99	68.6	100	100	199	84.4	19	0
18	95	57.8	97	100	192	79.1	19	0
25	98	48.4	96	96.6	194	72.5	20	5
32	98	41.8	100	92	198	67.2	20	0
39	100	35	79	93.6	179	60.8	21	0
46	105	32.4	100	89	205	60	21	0
53	103	33	101	84	204	58.3	21	0
60	106	30.2	98	88.7	204	58.3	22	0
67	102	23.5	102	83.3	204	53.4	22	0
74	102	24.5	100	88	202	55.9	20	0
81	103	24.2	101	81.1	204	52.9	21	0
88	50	18	49	73.4	99	45.4	20	0
95	51	11.7	50	68	101	39.6	20	0

TABLE 13 SUMMARY OF ENTOMOLOGICAL EVALUATION ON A.STEPHENSI IN SUMITHION (OMS-43) TREATED VILLAGES - MAMASANI , KAZEROUN ,IRAN , 1972

Month	Days after spraying	Density per hut	% Gravid & half gravid	floor sheet (number dead)	Density per pit shelter	Exit trap mortality %	number/bait/night man	animal	Parous rate %	Bio-assay (all surface % 24 h mortality
May	Pre-spray	0	-	-	-	-	-	-	-	-
	" "	0.05	0	-	0	-	-	-	-	-
June	" "	0.8	9.4	-	0.1	-	-	-	-	-
	" "	1	20	-	0.5	-	-	2.3	-	-
July	" "	8.7	52.8	-	2.3	-	4.3	9.3	62.4	-
	" "	352.9	50.5	0	4.6	56	38.4	213	54.1	-
August	3	2.9	9.2	37	21.8	100	14.9	27.1	9.8	98.5
	10	11.4	6.4	16	8.6	100	16.6	24.1		97.9
	20	3.5	0.7	9	13.8	100	2	3.8		96
September	30	4.2	14.3	0	3.6	-	2.1	4.7	3.5	91.8
	40	0.2	0	1	6.5	-	0.2	0.3		86.1
	50	0	0	0	0.05	-	0.1	0		71.2
October	60	0.07	0	0	0.15	-	0	0		67
	70	0	0	0	0	-	0	0.17		62.1
	80	0	0	0	0.15	-	0	0.5		58.5
November	90	0	0	0	0	-	0	0		52
	100	0	0	0	0	-	0	0		37.8

Fig. 1. ANOPHELINE INDOOR DENSITY IN SUMITHION (OMS-43) TREATED VILLAGES-MAMASANI, KAZEROUN IRAN, 1972

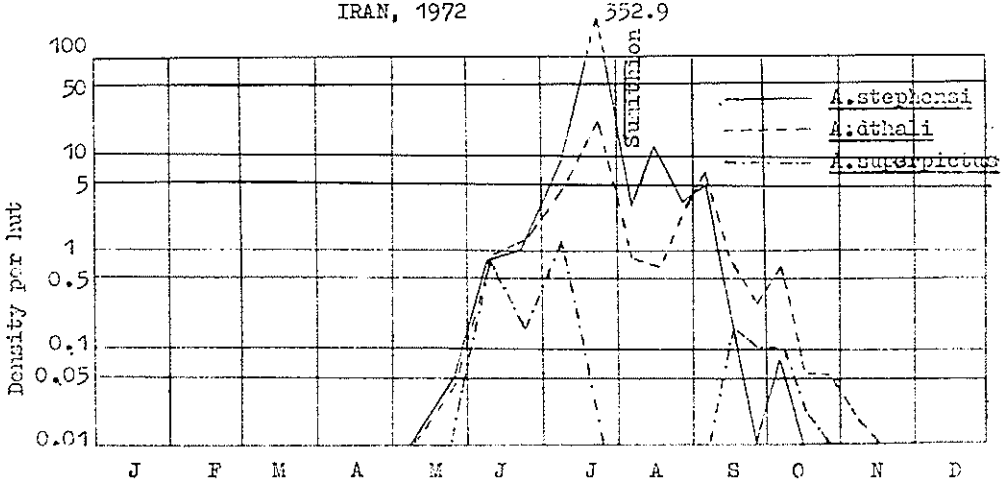

Fig. 2. COMPARISON OF INDOOR DENSITY OF A.STEPHENSI IN SUMITHION AND MALATHION TREATED VILLAGES-MAMASANI, KAZEROUN, IRAN, 1972

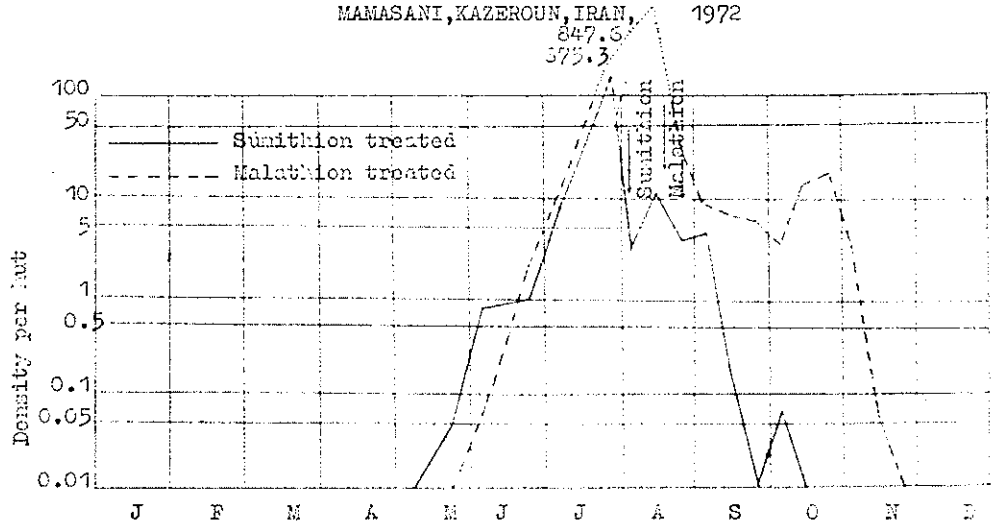

Fig. 3. SHELTER PIT COLLECTIONS OF ANOPHELINES IN SUMITHION (OMS-43) TREATED VILLAGES - MAMASANI , KAZEROUN , IRAN , 1972

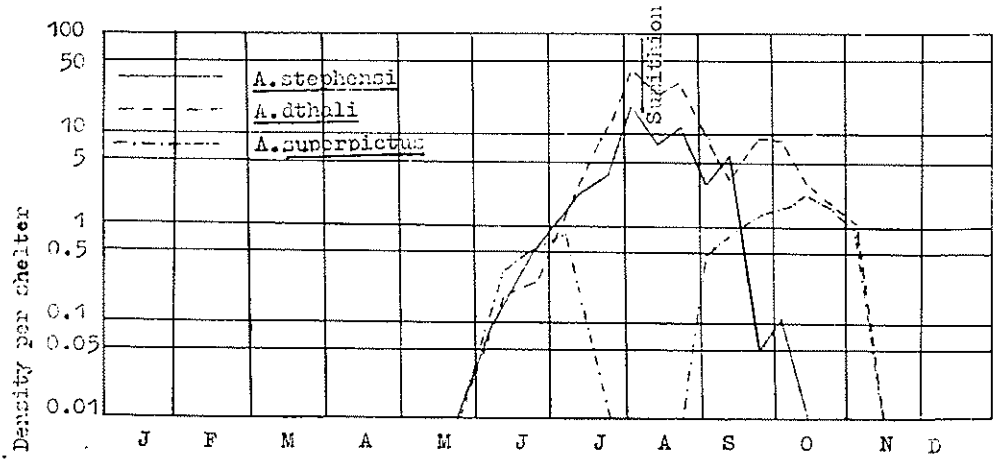

Fig. 4. NIGHT BITING CATCHES ON HUMAN BAIT IN SUMITHION (OMS-43) SPRAYED VILLAGES- MAMASANI , KAZEROUN , IRAN , 1972

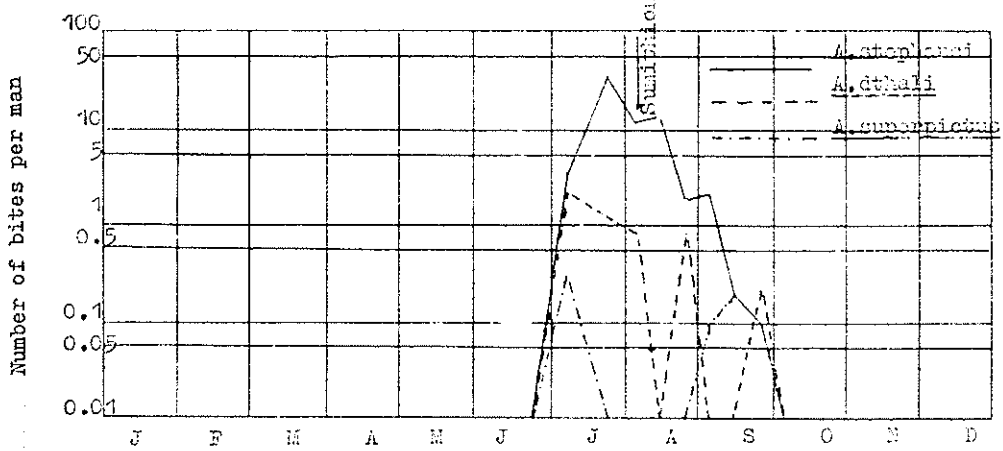

Fig. 5. NIGHT BITING CATCHES ON ANIMAL BAIT IN SUMITHION (OMS-43) SPRAYED VILLAGES MAMASANI, KAZEROUN, IRAN, 1972

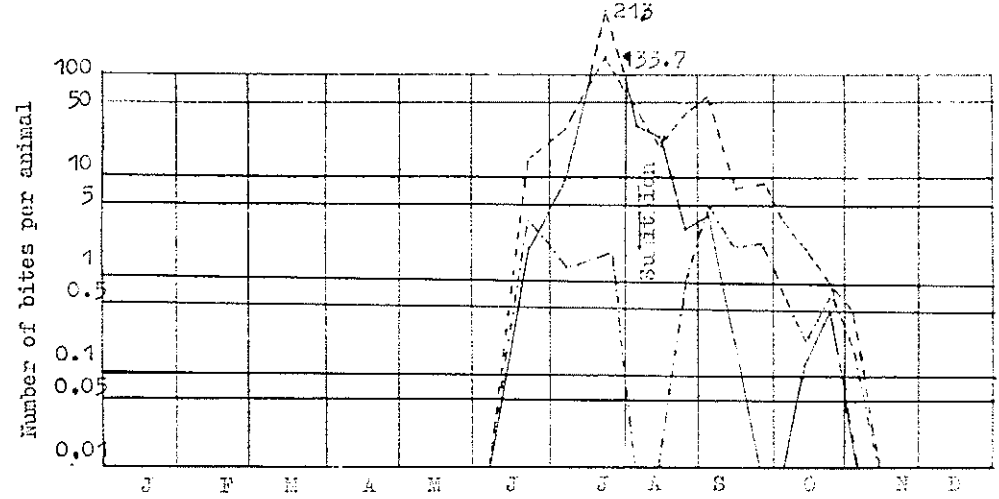

FIGURE 1

MAP SHOWING OPERATIONAL AREA TREATED WITH SUMITHION (OMS-43) AND MALATHION MAMASANI, SOUTHERN IRAN