

A Village-scale Trial of OMS-708 (Mobam) for the Control of *Anopheles gambiae* and *Anopheles funestus* in Northern Nigeria

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Trial area

The WHO *Anopheles* Control Research Unit No. 1 carried out a village-scale field trial of OMS-708^b to assess the residual effectiveness of this compound against the local malaria vectors *An. gambiae* and *An. funestus* during 1968. The trial area lies in Kujama District of Zaria Province in the North Central State in Northern Nigeria. This area comprises 4 villages (Zankoro, Gwarzo, Hayengada and Buruku), which are located along the Kaduna-Lagos road between 20 and 28 miles (32 km and 45 km), west of Kaduna. The land is fairly flat and the environmental conditions and topographical features are typical of the Guinea savanna area. Descriptions of villages prevalent in and around Kaduna have been given by Hannay^c and Service.^d

Spraying operations

Insecticide. Two drums of OMS-708 were received in May 1968. Representative samples of these were tested in the unit's laboratories for their physical and chemical properties according to the WHO Interim Specifications. The contents of both the drums had good free-flowing properties. The active ingredient content was slightly above the tolerance limit permitted for 80% water-dispersible powders. The suspensibility was high and there was no deterioration on accelerated storage.

After 10 weeks of tropical storage in Kaduna, no deterioration in the suspensibility or the active ingredient content was recorded in the formulation.

Field application. Spraying was carried out in the Zankoro-Gwarzo-Hayengada village complex for 4 consecutive days by 4 spraymen and 1 mixer. A total

of 453 houses and 405 other structures were sprayed, using 89.3 kg of the 80% water-dispersible powder. Prior to spraying the inhabited huts, unoccupied huts were sprayed for 2 days for the preliminary toxicological observations.

The formulation went into suspension readily without leaving any sediment or deposit in mixing tins or the filter gauges of the pumps. No significant erosion of the nozzle tips was observed to occur when up to 40 pump charges per nozzle were sprayed.

The final calculated dosage achieved was 2.1 g/m², and the total population living in the sprayed area was 731.

Toxicology. Toxicological observations were made during the spray observations^e and may be summarized by saying that during the spraying a few complaints were received from the spraymen of headache and skin irritation around the eyes and on the wrists. Pronounced inhibition of whole blood cholinesterase was shown at the end of the working day, but a considerable recovery was demonstrated by the following day. No complaints were received from the inhabitants of sprayed premises and moderate to pronounced depression of whole blood cholinesterase was demonstrated.

Entomological assessment

Entomological assessments as stated below were routinely conducted in the sprayed village of Gwarzo every 15 days. For comparison, the unsprayed village of Buruku about 5 miles (8 km) to the east of Gwarzo was assessed routinely once a fortnight.

Methods. The hut-resting densities of mosquitos were measured between 7 a.m. and 10 a.m. by

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^b Mobam (4-benzothienyl methylcarbamate).

^c Hannay, P. (1960) *Bull. ent. Res.*, 51, 45.

^d Service, M. (1963) *Bull. ent. Res.*, 54, 601.

^e Vandekar, M. & Wilford, K.: unpublished working document WHO/VBC/68.99. A limited number of copies of this document is available to persons officially or professionally interested on request to Distribution and Sales, World Health Organization, 1211 Geneva, Switzerland.

TABLE 1
EFFECT OF OMS-708 ON DENSITIES OF *AN. GAMBIAE* AND *AN. FUNESTUS*

Days after spray	<i>Anopheles gambiae</i>		<i>Anopheles funestus</i>	
	Average hut densities (pyrethrum-spray and exit-trap catches combined) ^a	Reduction (%) in density in relation to control	Average hut densities (pyrethrum-spray and exit-trap catches combined) ^a	Reduction (%) in density in relation to control
5	1.9 (30.3)	93.7	1.2 (9.1)	86.8
22	0.6 (7.7)	92.2	1.0 (3.5)	71.4
29	0.5 (11.0)	95.4	0.4 (7.9)	94.9
43	0.3 (6.0)	95.0	0.2 (7.2)	97.2
57	0.4 (7.6)	94.7	0.2 (10.8)	98.1
71	1.3 (10.4)	87.5	0.1 (11.2)	99.1
85	0.9 (15.2)	94.0	2.5 (31.1)	91.9
99	12.0 (16.2)	25.9	6.7 (27.3)	75.4
114	2.0 (16.9)	88.1	3.4 (76.1)	95.5
128	2.6 (7.0)	62.8	3.0 (33.8)	90.8
142	2.6 (8.5)	69.4	19.9 (87.5)	77.2
156	6.6 (7.6)	13.1	6.3 (27.6)	77.1

^a Figures in parentheses are for the unsprayed control village.

pyrethrum spray (0.2% concentration) in 10 catching-stations. The mosquitos were classified according to species, sex and abdominal stage.

Door exit-traps, made of mosquito netting on a wire-frame exit trap sewn to a heavy cloth, were used to determine the numbers of anophelines leaving the huts. The traps were fixed to the huts in the evening and were removed early next morning before the pyrethrum-spray catch. The mosquitos were differentiated according to species, sex and abdominal stage and the 24-hour survival rate was also noted.

Night biting rates were determined by making all-night biting catches, from 7 p.m. to 6 a.m., in the sprayed village with parallel biting catches in the unsprayed village on the same night for comparison. A team of 2 bait-collectors was posted inside each hut; they collected mosquitos from each other and from their own exposed limbs. Six to 8 bait-collectors were used in the sprayed village and 6 bait-collectors in the unsprayed control village. The mosquitos were identified the next day and were also dissected to distinguish the parous from the nulliparous, using the technique of Detinova or Polovodova depending on the stage of development of ovaries.

Bioassay tests were conducted every 15 days by the technique recommended by the WHO Expert Committees on Insecticides,^f using laboratory-bred *An. gambiae*. Selection of points at which to fix cones on the sprayed surfaces for bioassays was done according to the method described by Pant & Self.^g

The air-borne effect was also studied by the method reported by Pant & Joshi.^h

Results and discussion. The densities of *An. gambiae* and *An. funestus* as measured by pyrethrum-spray and exit-trap catches in the sprayed and control villages are shown in Table 1. It will be seen that up to 85 days after treatment the densities of these 2 species were very low. On the 85th day, however, the average density per hut (*An. gambiae* and

^f WHO Expert Committee on Insecticides (1963) *Wld Hlth Org. techn. Rep. Ser.*, 265, 139.

^g Pant, C. P. & Self, L. S. (1966) *Bull. Wld Hlth Org.*, 35, 709.

^h Pant, C. P. & Joshi, G. P.: unpublished working document WHO/VBC/68.108. A limited number of copies of this document is available to persons officially or professionally interested on request to Distribution and Sales, World Health Organization, 1211 Geneva, Switzerland.

TABLE 2
ABDOMINAL CONDITION OF *AN. GAMBIAE* COLLECTED BY PYRETHRUM-SPRAY AND EXIT-TRAP CATCHES
OF TRAPPED FED AND GRAVIDS IN OMS-708 SPRAYED AREA

Days after spray ^a	Pyrethrum-spray catches						Exit trap catches			
	Sprayed village			Unsprayed village			Sprayed village		Unsprayed village	
	No. of females	No. fed	No. gravid	No. of females	% fed	% gravid	No. of females	No. fed and gravid	No. of females	No. fed and gravid
5	2	1	0	200	52.5	47.5	17	0	103	51
22	2	2	0	47	66.5	31.4	4	1	30	18
29	0	0	0	82	90.2	9.8	5	4	28	11
43	1	0	1	21	76.2	23.8	2	1	39	29
57	0	0	0	41	65.8	34.2	4	3	35	28
71	0	0	0	49	91.8	6.2	13	8	55	29
85	2	1	0	66	83.3	13.7	9	4	86	62
99	11	10	0	68	86.7	11.9	109	84	94	45
114	1	1	0	67	92.5	7.5	19	18	102	72
128	4	2	0	42	80.9	19.1	22	12	28	24
142	2	2	0	51	91.2	7.9	24	18	34	10
156	36	30	4	53	83.0	13.3	30	23	23	17

^a Days on which tests were done in the unsprayed village do not always correspond exactly to those shown for the sprayed village under "Days after spray", but the period covered is the same and the difference is seldom more than 3 or 4 days.

TABLE 3
ABDOMINAL CONDITION OF *AN. FUNESTUS* BY COLLECTED PYRETHRUM-SPRAY AND EXIT-TRAP CATCHES
OF TRAPPED FED AND GRAVIDS IN OMS-708 SPRAYED AREA

Days after spray ^a	Pyrethrum-spray catches						Exit-trap catches			
	Sprayed village			Unsprayed village			Sprayed village		Unsprayed village	
	No. of females	No. fed	No. gravid	No. of females	% fed	% gravid	No. of females	No. fed and gravid	No. of females	No. fed and gravid
5	0	0	0	73	56.9	43.1	12	0	18	8
22	3	0	0	21	48.2	47.1	7	1	14	9
29	0	0	0	51	72.5	27.5	4	1	28	17
43	0	0	0	42	88.0	9.2	2	1	30	12
57	1	1	0	68	44.1	54.5	1	0	40	31
71	0	0	0	61	86.9	9.9	1	1	51	20
85	1	1	0	195	73.3	24.2	15	9	116	57
99	21	17	0	171	48.6	48.6	46	25	102	46
114	5	2	0	372	77.9	20.8	29	18	389	62
128	10	7	1	237	42.6	55.8	21	8	101	57
142	25	20	2	591	76.4	22.6	174	77	284	141
156	22	18	0	222	76.5	23.1	41	19	54	38

^a Days on which tests were done in the unsprayed village do not always correspond exactly to those shown for the sprayed village under "Days after spray", but the period covered is the same and the difference is seldom more than 3 or 4 days.

An. funestus combined) was 3.4; by the 99th day the average density per hut rose to 18.7.

Data relating to the abdominal stages of *An. gambiae* and *An. funestus* are shown in Tables 2 and 3. An increase in the number fed and gravid was observed after the 85th day.

As may be seen from Table 4, the biting rates of *An. gambiae* and *An. funestus* were low up to 94 days after spraying. On the 108th day, night biting collections yielded an average per bait of 6.6 *An. gambiae* and 7.25 *An. funestus* compared with 0.56 *An. gambiae* and 0.28 *An. funestus* on the 94th day.

Results of bioassay tests are given in Table 5. On mud surfaces, mortalities were higher than 70% up to 86 days and on thatched surfaces up to 73 days. On the 86th day there was a sharp fall in bioassay mortalities on thatched surfaces (45% compared with 92.0% at 73 days). On mud walls, mortality remained high at 78.1% on the 86th day but then fell to 52.5% and lower from 101 days after spray.

We may therefore conclude that OMS-708 is effective against *An. gambiae* and *An. funestus* in the Guinea savanna region of Northern Nigeria for approximately 3 months after spraying.

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TABLE 4
EFFECT OF OMS-708 SPRAY ON THE NIGHT BITING RATES OF *AN. GAMBIAE* AND *AN. FUNESTUS*

Days after spray	No. of baits	Density per bait ^a	
		<i>An. gambiae</i>	<i>An. funestus</i>
9	4 (6)	0 (13)	0 (6.0)
24	4 (6)	1.0 (20.0)	0.16 (8.0)
38	6 (6)	0.6 (8.3)	0.5 (7.8)
52	8 (6)	1.75 (22.0)	0.62 (6.0)
66	8 (6)	0 (5.1)	0.12 (8.5)
73	8 (-)	1.26 (-)	0.25 (-)
80	8 (6)	1.26 (25.8)	1.7 (18.3)
94	7 (6)	0.56 (12.8)	0.28 (18.0)
108	8 (6)	6.6 (31.5)	7.25 (46.3)
122	7 (6)	4.85 (18.3)	0.57 (27.0)
136	8 (4)	3.37 (25.75)	12.75 (51.25)

^a Figures in parentheses are for the unsprayed control village.

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TABLE 5
24-HOUR PERCENTAGE MORTALITIES OF LABORATORY-BRED AND FED *AN. GAMBIAE* EXPOSED FOR 30 MINUTES ON OMS-708 SPRAYED SURFACES IN VILLAGE HUTS

Days after spray	Sprayed surfaces		Unsprayed control surfaces	Temperature and relative humidity during exposure
	Mud walls	Thatched roofs		
2	100	97.1	0	24.4°C; 77 %
15	72.4	100	0	23.3°C; 78 %
31	60.0	100	0	25.0°C; 70 %
44	70.0	90.6	4.5	24.4°C; 92 %
58	70.5	100	0	26.7°C; 60 %
73	73.4	92.0	0	24.4°C; 83 %
86	78.1	45.0	0	24.4°C; 88 %
101	52.5	23.8	23.8	25.6°C; 80 %
117	50.0	41.8 ^a	8.7	26.1°C; 76 %
131	33.6	32.4	0	25.0°C; 96 %

^a Corrected.