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VILLAGE TRIAL ON FENITROTHION AGAINST ANTOPHELES ALBIMANUS IN EL SALVADOR, CENTRAL AMERICA

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VILLAGE TRIAL OF FENITROTHION AGAINST ANOPHELES ALBIMANUS IN EL SALVADOR, CENTRAL AMERICA[1]

by

Joseph R. Austin[2]

ABSTRACT

Fenitrothion, formulated as a 50% water-dispersible powder, applied as a residual treatment at the rate of 2 g/m^2 to houses in El Salvador, Central America, controlled DDT-resistant Anopheles albimanus adults for approximately four weeks on wood, thatch, pole, and tile surfaces. However, this period of residual activity was judged to be too short to test this material further in antimalaria programmes in the coastal problem areas of El Salvador.

Fenitrothion, (O, O-dimethyl O-(4 nitro-m-tolyl) phosphorothioate, OMS-43), is an organophosphorus insecticide which has undergone considerable study as a possible replacement for DDT in residual house spraying antimalaria programmes. In a village trial during 1963 with fenitrothion in Nigeria, Africa, Bar-Zeev and Bracha (1965) reported anopheline densities decreased to almost nil inside the treated village for the first six months after spraying. Mortality of anophelines captured in window traps in fenitrothion treated huts was high for seven months after treatment.

In El Salvador where vector resistance to DDT has caused serious problems for malaria eradication, a substitute insecticide for DDT has been sought for many years. In 1969, an entomological evaluation of fenitrothion was carried out in the village of El Zapotal, which is located in the eastern part of the country. The village is situated in a valley 65 metres above sea level near the foot of a low range of hills. The main Anopheles albimanus breeding source is south of the village and in very close proximity to the dwellings. It is of the "rainy-season" type, and for the most part is dry during the dry season. The rainy season in this area is usually from May to November with a range of 1725 to 2570 mm of rain during the year and a temperature range of 19.3°C to 37.2°C. There is extensive cotton-growing in the vicinity of El Zapotal.

Approximately five kilometres south in the same valley at an altitude of 62 metres another village, Playa Grande, was selected as a comparison village, although it was under routine DDT residual spraying. An untreated village was not available as the country has been under insecticide treatment for over 10 years.

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Most houses in both villages have grass-thatch or tile roofs with pole or other "open" type wall construction. Pole wall surfaces were found to be predominant in both villages.

Both villages had been routinely treated for several years previously by the Campaña Nacional Anti-Palúdica (CNAP) (National Malaria Eradication Programme) with DDT at 2 g/m^2. During the study period the control village was again treated with DDT when the six-monthly cycle came due, 2 June 1969. Prior studies had already indicated that there was no apparent effectiveness from DDT spraying when measured with present entomological evaluation techniques.

MATERIALS AND METHODS

Insecticide treatments - The test village (El Zapotal) was treated with fenitrothion 25 June by six spraymen furnished by the CNAP, utilizing conventional hand operated compression sprayers. Fenitrothion as a 50% water-dispersible powder (WDP) was applied to 83 houses by inside total coverage at a target dosage of 2 g/m^2 of the technical material. A total of 83 houses were treated using 87 kg of fenitrothion WDP.

It was noted that the insecticide at the time of spraying had an unpleasant odour. Several female occupants of the treated houses complained of a dizzy feeling and one complained of nausea and headache. In a toxicological study carried out in Southern Nigeria during 1963, Vandekar reported that fenitrothion was safe enough for extended field trials, providing precautionary measures including use of protective clothing and masks, washing after exposure and avoidance of treated surfaces contact by inhabitants be observed.

ENTOMOLOGICAL EVALUATION

Early morning resting densities - Ten "fixed point" houses selected throughout each village were searched bi-weekly by two men to a house using aspirators and flash-lights. The time spent was approximately 15 minutes to a house beginning at 0600 hours. The female A. albimanus specimens found were grouped into blood-feds, gravids, and unfeds. Counts were made of dead anophelines found in the houses and those females found alive were held for 24-hour mortality observations.

Exit trap densities and mortalities - Collapsible exit traps made of marquisette and metal frames were placed over the open wall spaces of a pole-type house in each village. They were fixed into position by 1800 hours and left in place all night. The following morning at 0600 hours the traps and the house were searched for live and dead anophelines. The live specimens were held for 24-hour mortality observations.

Fumigant tests - Due to the possibility of a fumigant action from the insecticide affecting the exit trap captures, special round wire cages (10 x 7 cm) containing 15 blood-fed A. albimanus each were placed inside the exit traps to measure any fumigant activity. One such cage was placed on each side of the house. Following the overnight exposures, the surviving mosquitos were transferred to clean cages and held for 24-hour mortality determinations.

Bio-assays of inside surfaces - Bi-weekly bio-assays of the main indoor surfaces were made using the World Health Organization (WHO, 1963) method with modifications. The removal of the mosquitos from the surface being tested was done by the use of CO_2 gas anaesthesia. There were 10 to 15 blood-fed females per testing chamber and the exposure period was 60 minutes. A special testing chamber was developed for the testing of the curved pole and tile roof surfaces. Two houses were selected for each type of surface to be tested and three testing chambers used per surface type. The main surfaces were wood, thatch, roofing tile, pole and adobe. The A. albimanus used were from corrals in the locality, or from one in nearby El Jocotal where there was a constant supply of A. albimanus known to be resistant to DDT. The test mosquitos were caught blood-fed the night prior to the bio-assay tests and held with cotton pads soaked in sugar water. The bio-assay tests were made starting at 0600 hours on the morning following the captures.

Susceptibility tests - In an effort to determine at least one of the causes of the poor results obtained with fenitrothion in the village spraying, susceptibility tests were conducted to evaluate the possible role of A. albimanus resistance to the insecticide. Before the arrival of the special fenitrothion impregnated papers supplied by WHO, an expedient technique was utilized for the susceptibility tests of A. albimanus in the study area. Plywood panels of 30 x 30 cm covered with kraft paper were sprayed with calculated dosages of the insecticide. The day following treatment the panels were bio-assayed with the WHO testing chamber. Three "cones" were used for each concentration, with from 10 to 15 blood-fed females per chamber, using a 60-minute exposure period. The exposed A. albimanus were removed from the testing chambers with the use of CO_2 and held for 24-hour mortality observations.

After the arrival of the fenitrothion impregnated papers from WHO, tests were done with the local El Zapotal A. albimanus strain from the corral. Similar checks were made with the DDT-resistant colony maintained at the Central America Malaria Research Station in San Salvador and a strain collected from an additional corral (Hacienda Nueva) where there has been little or no agricultural insecticide usage. The exposure period in all tests was 60 minutes.

DDT susceptibility tests, using the WHO procedure, were done employing four tubes with WHO 4% DDT impregnated papers and a control, using an exposure period of 60 minutes. The mortality reading was made at 24 hours in all tests.

RESULTS

Early morning resting densities - A series of three of these early morning captures were made prior to treatment, with a mean capture varying between 2.5 to 4.4 live A. albimanus per house (Table 1). The first week after the fenitrothion treatment no live mosquitos were found but an average of 1.4 dead females per house were encountered. By week 2, an average of 5.8 females were found per sprayed house, with 4.0 of these dead. The captures on post-treatment week 4 gave 3.9 live and 2.8 dead mosquitos per house. Beginning with week 4 the A. albimanus morning resting densities recalled or exceeded pretreatment levels, and by week 5 there was a marked decline in the mortalities obtained.

Similar captures were made in 10 "fixed point" houses of the comparison village, Playa Grande (Table 2). The mosquito densities appeared higher in Playa Grande from the outset and during the nine-week period covered in the study the house-resting densities averaged 3.8 to 10.6 A. albimanus females per house. Only in week 4 were any dead females found in any of the houses.

Indoor and outdoor night-biting counts and corral counts were made in both villages to determine general overall population trends during the test period. These counts indicated a general population increase during the first two weeks after the fenitrothion treatment, a subsequent decline to about pretreatment levels, and another increase on week 9.

Exit trap densities and mortalities - The only post-treatment capture of this type that gave 100% mortality was at the end of one week. The others on weeks 4, 6, and 8 gave 33, 50, and 40% mortalities, respectively. From 85 to 100% of the total female mosquitos encountered after treatment inside the house and in the traps were collected in the traps (Table 3).

During the post-treatment weeks 1, 2, 5 and 8 in the DDT sprayed Playa Grande, like captures in house 34A gave lower mortalities of 0 to 12% but with similarly high numbers (73 to 100%) escaping into the traps (Table 4).

Fumigant tests - The fumigant action of fenitrothion was relatively low - only 18% mortality of the caged mosquitos exposed overnight in the exit traps at the end of the first post-treatment week (Table 3), and no mortality on subsequent exposures.

Bio-assays of inside surfaces - With a one-hour exposure period on week 3, when the first post-treatment tests were done in El Zapotal (Table 5), satisfactory 24-hour mortalities were obtained with fenitrothion only on wood (80%), thatch (92%), and roof tile (77%). By the fifth week all test mortalities were between 0 and 32% and subsequent tests showed a further decline in mortalities.

All bio-assay tests done on the DDT-treated surfaces in the comparison village of Playa Grande indicated 25% mortality on wood and less on all other surfaces tested.

Susceptibility tests - The WHO susceptibility tests indicated a high DDT-resistant strain of *A. albimanus* present in the study area and comparison area (and also in the vicinity of El Jocotal, which served as a collection site for some of the mosquitos used in the bio-assay tests). This resistance (mortality less than 5% in all cases) accounted for the lack of effectiveness of the DDT spraying in Playa Grande.

In the preliminary susceptibility tests with the emergency technique using fenitrothion, one-hour exposures of the mosquitos collected from the Zapotal corral to dosages as high as 0.031 g/m^2 produced no mortality. Additional tests using higher concentrations produced the following 24-hour mortalities: 29% with residues of 0.062 g/m^2, 73% with 0.125 g/m^2, 97% with 0.25 g/m^2 and 100% with 0.5 g/m^2.

On receipt of the special fenitrothion-impregnated papers from WHO several comparison tests were made with *A. albimanus* from Zapotal, the DDT-resistant colony in San Salvador, and a non-agricultural zone of the country (Hacienda Nueva). The results are summarized in Table 6.

The results of these tests indicated that the Hacienda Nueva and the DDT-resistant colony strains were more susceptible to fenitrothion than *A. albimanus* from El Zapotal. A mortality of 90 and 100%, respectively, was obtained in the Hacienda Nueva and colony mosquitos with the 1.6% concentration which resulted in only 8 and 30% mortalities in two tests with the El Zapotal strain. The indicated resistance to fenitrothion in the mosquitos from El Zapotal may be due to the long years of usage of various different classes of insecticides in the nearby cotton fields. Methyl parathion, with a molecule similar to fenitrothion, is widely used in cotton-growing areas of the country.

CONCLUSIONS

Considering the rapid decline in the mortalities in the residue bio-assay tests, the quick return by week 4 of the house-resting densities, the low mortalities in the house and exit-trap captures, and the indicated resistance to fenitrothion in the susceptibility tests, it was concluded that this insecticide would not be useful for residual spraying of houses as an antimalaria measure in the coastal problem area of El Salvador.

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REFERENCES

Bar-Zeev, M. & Bracha, P. (1965) A village-scale trial with the insecticides carbaryl and Folithion in Southern Nigeria, Bull. Wld Hlth Org., 33, 461-470

Vandekar, M. (1965) Observations on the toxicity of carbaryl, Folithion and 3-isopropylphenyl N-methylcarbamate in a village-scale trial in Southern Nigeria, Bull. Wld Hlth Org., 33, 107-115

World Health Organization (1963) Insecticide resistance and vector control, Thirteenth report of the WHO Expert Committee on Insecticides, Wld Hlth Org. techn. Rep. Ser., No. 265, 227 pp.

TABLE 1. EARLY MORNING CAPTURES OF A. ALBIMANUS INSIDE 10 HOUSES TREATED WITH FENITROTHION (EL ZAPOTAL, 1969)

Date	Week	Houses positive	A. albimanus females			
			Total		Total	
			Alive	Dead	Alive	Dead
29 May	-4	8	27	0	2.7	0
5 June	-3	8	44	0	4.4	0
25 June	0	9	25	0	2.5	0
25 June	0	Houses treated with fenitrothion at 2 g/m^2				
1 July	1	5	0	14	0	1.4
8 July	2	9	18	40	1.8	4.0
23 July	4	9*	35	25	3.9	2.8
29 July	5	6	22	2	2.2	0.2
12 August	7	9*	41	8	4.5	0.9
26 August	9	7	64	1	6.4	0.1

* Nine houses searched
Alive = survived 24 hours after capture
Dead = found dead or captured alive and died within 24 hours.

TABLE 2. EARLY MORNING CAPTURES OF A. ALBIMANUS INSIDE 10 "UNTREATED" HOUSES (PLAYA GRANDE, 1969)

Date	Week	No. houses positive	A. albimanus females			
			Total		Total	
			Alive	Dead	Alive	Dead
27 May	-1	7	64	0	6.4	-
2 June	0	Locality treated with DDT at 2 g/m^2				
4 June	0	8	78	0	7.8	-
1 July	4	9	102	12	10.2	1.2
7 July	5	8	106	0	10.6	-
31 July	8	10	73	0	7.3	-
14 August	10	10	73	0	7.3	-
28 August	12	10	38	0	3.8	-

Alive = survived 24 hours after capture
Dead = found dead, or captured alive and died within 24 hours.

TABLE 3. EARLY MORNING CAPTURES OF A. ALBIMANUS INSIDE A TREATED HOUSE AND IN EXIT TRAPS (EL ZAPOTAL, 1969)

Date	Week	House No.	A. albimanus females			% mortality in fumigant test
			Total	% mort.	% in traps	
18 June	-1	259 A	147	10	82	-
25 June	0	Locality treated with fenitrothion				
1 July	1	259 A*	56	100	91	18
23 July	4	317	9	33	89	0
5 August	6	262	22	50	100	0
19 August	8	262	20	40	85	-

* House abandoned by occupants following this test, requiring a change in houses for further evaluation.

TABLE 4. EARLY MORNING CAPTURES OF A. ALBIMANUS INSIDE AN "UNTREATED HOUSE" AND IN EXIT TRAPS (PLAYA GRANDE, 1969)

Date	Week	A. albimanus females		
		Total	% mort.	% in trap
2 June	0	Locality treated with DDT		
2 July	4	95	3	73
9 July	5	125	1	84
31 July	8	26	0	100
21 August	11	25	12	96

TABLE 5. PERCENTAGE MORTALITY OF FIELD COLLECTED A. ALBIMANUS 24 HOURS AFTER EXPOSURE TO FENITROTHION AND DDT RESIDUES (EL ZAPOTAL (FENITROTHION) AND PLAYA GRANDE (DDT), 1969)

Week after fenitrothion	Insecticide	Surface							
		Wood	Thatch	Poles	Mud	Tile	Adobe	Palm	Control
0*	Fenitrothion	17	2	2	-	5	4	-	0
	DDT	8	3	4	3	1	-	3	1
3	Fenitrothion	80	92	51	-	77	1	-	0
	DDT	-	-	-	-	-	-	-	-
5	Fenitrothion	26	17	32	-	28	0	-	0
	DDT	25	3	4	5	3	-	7	1
7	Fenitrothion	22	9	5	-	17	10	-	2
	DDT	17	7	5	6	4	-	18	2
9	Fenitrothion	23	3	1	-	6	1	-	0
	DDT	3	2	1	6	0	-	8	1

* DDT - resistant colony strain used in 0-week tests.

TABLE 6. PERCENTAGE MORTALITY OF A. ALBIMANUS FEMALES 24 HOURS AFTER EXPOSURE* TO WHO FENITROTHION-IMPREGNATED PAPERS, 1969

Date	Mosquito source	Concentration				
		.025%	.1%	.4%	1.6%	Control
25 July	Zapotal	7** (100)	2(75)	1(100)	30(100)	9(75)
21 July	Colony	0** (50)	0(45)	68(50)	100(66)	13(45)
5 August	Zapotal	--	--	0(100)	8(100)	0(50)
5 August	Hcda. Nueva	--	--	9(77)	90(80)	0(50)

* Following a 60-minute exposure to impregnated papers.

** Corrected mortalities.

() Number of A. albimanus used.