

DDT Residual Spray Control of Sandflies in Panama^{1,2}

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In many places in Panama, particularly along the Caribbean coast, sand-flies, *Culicoides*, appear in tremendous numbers and constitute a nuisance of major proportions. The bite of these insects produces a sharp stinging sensation. *Culicoides furens* Poey, the dominant species, has been shown by Buckley (1934), in St. Vincent, B.W.I., to be infected in nature with developing larvae of the filarial worm *Mansonella ozzardi* (Manson). These sandflies are so small that they readily pass through the 16 or 18 mesh wire screening ordinarily provided for mosquito protection. The usual means of protecting persons from the bites of these insects in screened buildings has been to paint the screens with a non-volatile oil which collects dust and lint, thus reducing the

size of the screen apertures. This method provides only indifferent protection. When the apertures are sufficiently reduced in size to exclude sandflies effectively, the screens are so clogged that there is no longer free passage of air.

Several experiments were performed to determine the effectiveness of painting screens and selected portions of buildings with 5 per cent DDT in kerosene, as a means of local sandfly control and to evaluate the possibility of excluding sandflies from screened quarters. These experiments were conducted on the San Blas coast of Panama at an Army outpost. The cooperation and assistance of the surgeon and personnel of the 554th Signal Aircraft Warning Battalion and particularly of Pfc. Edwin W. Iossi is gratefully acknowledged. Sample lots of specimens of sandflies biting in these tests were all identified as *Culicoides furens* Poey by Sr. Marcelo Gallardo, entomologist of the Campaña Antimalarica of Panama.

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² The author was a member of a unit of Sanitary Corps officers assigned to the Tropical Disease Control Section of the Surgeon General's Office stationed at the Gorgas Memorial Laboratory, Panama.

³ Paid Paper.

In establishing biting rates, subjects stripped to the waist and the number of bites sustained on the trunk, head, and upper extremities was recorded for a 15-minute period. Subjects on which biting rates were determined were white continental troops. While the sandflies bite throughout the day when the wind is not too strong, the biting rates are apparently highest about dusk and dawn. Biting rates in the following experiments were all taken between 5:00 P.M. and 6:30 P.M.

The buildings in and around which the experiments were performed were all within a radius of 150 feet. The area is 800 feet from the nearest tidal mangrove swamp breeding place, and at an altitude of 175 to 180 feet. The control for all experiments was the same *i.e.*, the biting rate out-of-doors beside an oil house in the lee of the prevailing wind, where a consistently high biting rate had previously been observed. The control station was located 125 feet from the guard shed used in experiment 3 and 150 feet from the main building in which were located the orderly room, barracks and mess hall used in the other experiments.

While the biting rate used as the control is not strictly comparable with the rates in various of the other stations used in the experiments, it does serve to establish that throughout the period of the investigation an abundant sandfly population was present in the area at all times.

EXPERIMENT 1.—DDT treatment of orderly room screens. An orderly room was selected with screens which had been oiled some months previously. The apertures of the screens were considerably reduced by an accumulation of dust and lint. The biting rate inside this room on 10 successive evenings (February 22 to March 3, 1945) averaged 34 bites per 15 minutes. The screens were then brushed clean. The biting rate for the following 10 successive evenings (March 7 to 16, 1945) averaged 60 bites per 15 minutes. The control biting rate during this period averaged 183. On March 17 the screens of the orderly room were painted with 5 per cent DDT in kerosene. The biting rate for the following 12 days (March 17 to 28, 1945) was zero, while the control rate for this period varied from 114 to 345. After March 26, 1945 biting rates at both the orderly room and the control station were taken thrice weekly, on Monday, Wednes-

day, and Friday evenings. The results of these observations over a period of 91 days after the DDT treatment are shown in table 1.

The effectiveness of the DDT treatment is at once apparent. Appreciable biting by *Culicoides* in the orderly room occurred only after about 50 days had elapsed since treatment. Even after 3 months the biting rate reached a point only about one-ninth as high as that before treatment. The control biting rate during the period of this experiment shows some fluctuation, but is rather consistently high, indicating that there was no general reduction of sandflies in the area.

EXPERIMENT 2.—DDT treatment of barracks screens. In this experiment an entire barracks was used. The barracks was of typical open type construction used in the tropics; with three sides open to the air except for the mosquito protection afforded by wire mesh screens. The annoyance from *Culicoides* to sleeping men in this large room was somewhat mitigated by the presence of several large electric fans. In the air current from these fans few sandfly bites were sustained. To secure data on biting in this barracks all electric fans were turned off 5 minutes before biting rates were determined. The average biting rate taken on 5 evenings between March 7 and 16, 1945 was 21. The control biting rate out-of-doors, taken on the same 5 evenings, averaged 150. The screens of this barracks were painted with 5 per cent DDT in kerosene on March 17 and 18, 1945. The biting rates for the subsequent 90 days are given in table 2.

It will be seen that a moderate degree of control was effected. It appears that while there is a substantial reduction in the numbers of *Culicoides* biting in the barracks, the treatment is considerably less effective than in the orderly room (Experiment 1). An appreciable rise in the biting rate seems to appear after about 50 days, which is consistent with the residual effect obtained in experiment 1.

The biting sustained in the barracks even after treatment with DDT may be due in part to two factors. First, the treatment of so large an area as the screens around the entire barracks may have been less thorough than that of the relatively small orderly room. Second, the men at this outpost work on staggered shifts so

Table 1.—Residual effect of 5 per cent DDT in kerosene applied to screens of orderly room.

DATE (1945)	NO. DAYS AFTER APPLICA- TION OF DDT	BITING RATE (<i>Culicoides</i>)	
		In Orderly Room	Out-of- Doors (Control)
Screens Dirty			
Feb. 22 to March 3	—	34 (av.)	No data
Screens Cleaned			
March 7 to March 16	—	60 (av.)	183 (av.)
Screens Painted with 5 Per Cent DDT in Kerosene			
March 17	1	0	174
18	2	0	114
19	3	0	129
20	4	0	345
21	5	0	270
22	6	0	156
23	7	0	180
24	8	0	150
25	9	0	210
26	10	0	160
28	12	0	195
30	14	4	225
April 2	17	0	270
4	19	1	240
6	21	0	225
9	24	0	210
11	26	1	240
13	28	0	195
16	31	1	285
18	33	0	160
20	35	0	165
23	38	1	225
25	40	0	309
27	42	—	—
30	45	0	33
May 2	47	1	160
4	49	2	159
7	52	4	204
9	54	6	249
11	56	5	222
14	59	8	240
16	61	11	285
18	63	9	270
21	66	7	273
23	68	8	309
25	70	5	255
28	73	4	234
30	75	7	288
June 1	77	5	255
4	80	5	243
6	82	7	231
8	84	6	210
11	87	6	255
13	89	8	225
15	91	7	240

that they are constantly entering and leaving the barracks. There was ample

Table 2.—Residual effect of 5 per cent DDT in kerosene applied to screens of barracks.

DATE (1945)	NO. DAYS SINCE APPLICA- TION OF DDT	BITING RATE (<i>Culicoides</i>)	
		In Barracks	Out-of- Doors (Control)
Untreated			
March 7 to March 16	—	21 (av.)	150 (av.)
Screens Painted with 5 Per Cent DDT in Kerosene			
March 21	4	2	270
23	6	2	180
25	8	2	210
26	9	0	120
28	11	2	195
30	13	3	225
April 2	16	2	270
4	18	3	240
6	20	2	225
9	23	3	210
11	25	4	240
13	27	2	195
16	30	5	285
18	32	1	160
20	34	1	165
23	37	3	225
25	39	0	309
27	41	—	—
30	44	0	33
May 2	46	0	160
4	48	1	159
7	51	3	204
9	53	4	249
11	55	4	222
14	58	5	240
16	60	8	285
18	62	6	270
21	65	5	273
23	67	7	309
25	69	6	255
28	72	7	234
30	74	9	288
June 1	76	10	255
4	79	9	243
6	81	7	231
8	83	6	210
11	86	8	255
13	88	9	225
15	90	6	240

opportunity, therefore, for ingress of sandflies through the frequently opened doors.

EXPERIMENT 3.—*DDT treatment of guard shed.* A screened guard shed was selected for this experiment. This structure was about 8 feet square with the lower half of painted wood and the upper half of screen. The biting rate inside the guard shed was established over a 19 day period. The exterior woodwork was

Table 3.—Summary of DDT treatment of guard shed for protection from *Culicoides*.

OBSERVATION PERIOD (1945)	AVERAGE BITING RATE (<i>Culicoides</i>)	
	In Guard Shack	Out-of-Doors (Control)
Untreated		
March 7 to 26 (19 days)	34	189
Exterior Woodwork Painted with 5 Per Cent DDT in Kerosene		
March 28 to April 29 (33 days)	17	226
Screens Painted with 5 Per Cent DDT in Kerosene		
April 30 to June 15 (47 days)	19	230

then painted with 5 per cent DDT in kerosene and the biting rate for the next 33 days determined. The screens were then painted with 5 per cent DDT in kerosene and the biting rate recorded for the following 47 days. The results of this test are shown in table 3.

While there was some reduction in the number of sandfly bites sustained in this guard shed, the DDT failed to give adequate protection when applied either on the exterior woodwork or on the screens. There was no reduction in number of bites on the several evenings immediately after the DDT treatment of the wood, but the number of bites was reduced about two-thirds for 4 days after the screens were painted with DDT. We know that DDT in oil solution has a relatively low effectiveness on oil painted surfaces (particularly when the paint is fresh) but we are unable to explain the failure of the DDT on the screens of this guard shed, in contrast to the success obtained in experiments 1 and 2.

EXPERIMENT 4.—*DDT treatment of mess-hall area.* This experiment was designed to determine whether local out-of-doors protection from *Culicoides* could be obtained by spraying possible resting

Table 4.—Summary of DDT treatment of mess-hall area for protection from *Culicoides*.

OBSERVATION PERIOD (1945)	AVERAGE BITING RATE (<i>Culicoides</i>)	
	Beside Mess-hall	Out-of-Doors (Control)
Untreated		
March 9 to April 29 (52 days)	19	211
Walls etc. Sprayed with 5 Per Cent DDT in Kerosene		
April 30 to May 14 (15 days)	13	181

places near the human attractants. The area selected was immediately outside a mess hall where personnel waited in line, directly alongside the building, before meals. The outside wall of the mess hall, the overhanging eaves and other adjacent surfaces within a radius of about 30 feet, were sprayed with 5 per cent DDT in kerosene. The results are summarized in table 4.

There was no effective reduction of the sandfly annoyance with this treatment. The average number of sandfly bites in this area during the preliminary study period of 52 days had been 19. The evening of the day this area was sprayed, April 30, the number of bites dropped to 4, but there was little residual effect as the average number of bites for 15 days following treatment was 13.

CONCLUSIONS.—The several experiments reported here give some evidence that the treatment with 5 per cent DDT in kerosene of the wire mesh screens used to exclude mosquitoes from screened quarters will provide a good measure of protection from the bites of sandflies as well, although the results obtained in one experiment (No. 3) were quite unsatisfactory. No effective local out-of-doors protection from sandfly bites was afforded by spraying possible resting places within a radius of 30 feet.—8-18-47.

LITERATURE CITED

- Buckley, J. J. C. 1934. On the development, in *Culicoides furens* Poey, of *Filaria* (= *Mansoniella*) *ozzardi* Manson, 1897. Jour. Helminthology, 12(2): 99-118.