FIELD TESTS WITH DEET-TREATED WIDE-MESH NETTING AGAINST MIXED HEMATOPHAGOUS FLY POPULATIONS.[1]

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ABSTRACT. Deet, (N,N-Diethyl-m-toluamide), treated wide-mesh knotted cotton netting was evaluated for its repellent effectiveness against mixed field populations of mosquitoes, biting midges (*Culicoides* spp.) and phlebotomine sand flies during the rainy season in the Panama Canal Zone. Such netting proved effective against hematophagous flies for about 64 days, as determined by CDC mini-light trap collections. Results indicated that field use of bed nets made of deet-treated wide-mesh netting should offer effective temporary protection even under humid conditions.

INTRODUCTION

The use of repellent-treated netting against mosquitoes received attention at least as early as 1943 (Monchadsky et al.). Since then workers around the world have sought the best combination of repellent and netting for optimal effectiveness (Travis and Morton 1950, Dowling 1955, Saf yanova 1963). Tests with repellent-treated wide-mesh netting for protection against hematophagous flies have been conducted with promising results in the U.S. (Grothaus et al. 1972), and in Asia (Gouck and Moussa 1969). The advantages of wide-mesh netting over standard netting are numerous, including better ventilation and less weight (Gouck et al. 1971). Although other materials were repellent longer than Ent 22542 N,N-Diethyl-m-toluamide (deet) in earlier field tests (Grothaus et al. 1972), this compound was selected for evaluation in this study because of its availability and low cost.

During the rainy season in Panama, (June-November), mosquitoes reach their peak population densities. Biting midges (*Culicoides* spp.) and phlebotomine sand flies also become numerous in certain areas and constitute a serious nuisance and potential health hazard. These small flies can easily penetrate standard bed nets and the only protection is chemical treatment of nets or the use of body repellents. The purpose of this study was to determine the repellent effectiveness of deet-treated wide-mesh netting under humid field conditions.

METHODS AND MATERIALS

Wide-mesh knotted cotton netting, such as described by Grothaus et al. (1972), was impregnated with deet (Ent 22542) at the rate of 0.5 g repellent per g of netting. Netting was removed from sealed plastic bags, cut and stapled to light wooden frames, (45 cm × 45 cm × 90 cm). Frame bottoms were left open so that a CDC mini-light trap could be placed inside and retrieved. Once the trap was inside, the bottom net was drawn together and tied with a cord. To offer at least minimum protection to the light trap, a shallow metal cone roof was secured over the frame. Three frames were covered with treated netting, 2 with untreated netting and 1 was left uncovered to serve as a control (Figure 1).

All tests were conducted at Fort Kobbe within a grove of trees on the edge of Farfan Swamp in the Panama Canal Zone. Each trap was hung from designated tree limbs, 3–4 meters above the ground, and arranged so as to draw from both the swamp and forest without competing with other traps. Following each trap night all frame/traps were rotated 1

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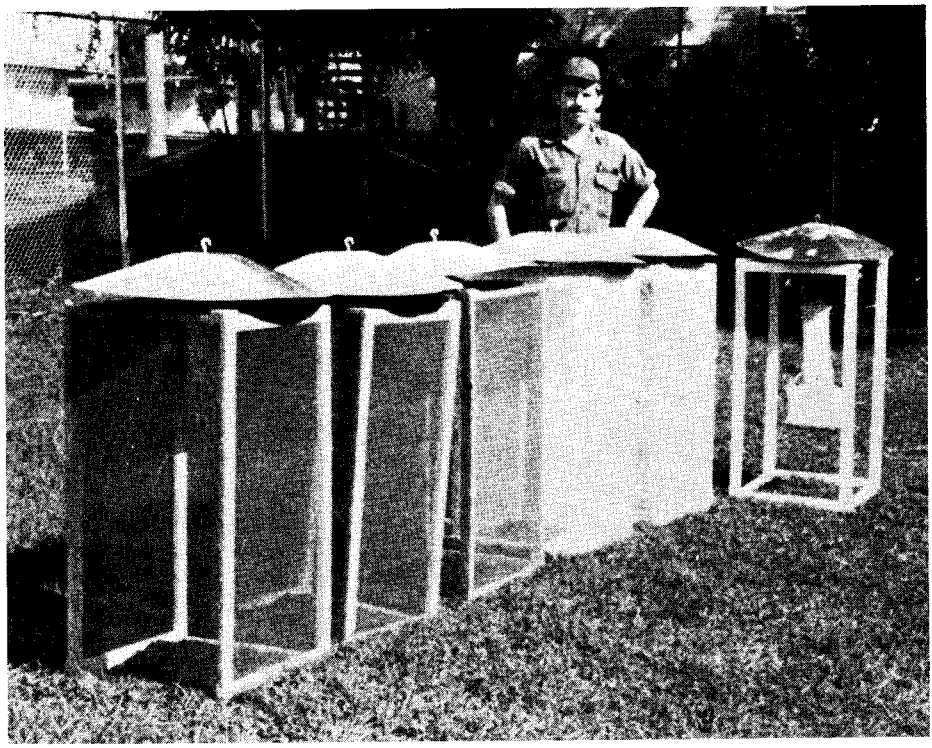

Figure 1. Wooden frames, equipped with protective metal roofs, on which knotted cotton, wide-mesh netting was attached. Three frames were covered with deet-treated netting, two with untreated netting and one was left uncovered to serve as a control. The control shows a CDC mini-light insect trap in place.

position so that none would have a more favored location.

Blocks of dry ice, suspended slightly above the frames, provided a source of CO_2 as an additional attractant. Depending on the dry ice supply, trials were made twice per week. Traps and frames were carried to the test site at 1700 hrs. and were retrieved at 0700 the next morning. All light trap collection bags were removed and their contents identified in the laboratory (Table 1). Netted frames were stored within a screen-enclosed porch next to the laboratory to await successive tests.

RESULTS AND DISCUSSION

The criterion for effective mosquito

Table 1. Biting Diptera collected in deet-treated wide-mesh netting tests in Panama Canal Zone.

		% of catch
Aedes	*angustivittatus*	0.5
	**serratus*	
	taeniorhynchus	1.0
Anopheles	*albimanus*	0.2
	**pseudopunctipennis*	
Culex		65.3
Culicoides	spp.	18.2
Deinocerites	*pseudes*	0.1
Haemagogus	**equinus*	
Mansonia	*nigricans*	0.1
	titillans	9.0
	venezuelensis	0.5
Lutzomyia	spp.	4.0
Uranotaenia	*lowii*	1.0

* Combined species constituted about 0.1% of total catch.

Table 2. Average numbers of biting Diptera collected and repellent effectiveness of deet-treated wide-mesh netting tests in Panama Canal Zone.

	Average No. Mosquitoes/Trap				Average No. Biting midges & Sand Flies/Trap				
Date	Treated Net	Non-Treated Net	Control	Percent Effective Treated vs. Untreated	Treated Net	Non-Treated Net	Control	Percent Effective	Rain-fall (Inches)
13 June	0	74.5	767	100	1.3	14.5	5	92	0.13
14 June	0	5.5	43	100	0	7.0	148	100	0
22 June	0	3.5	224	100	0	2.5	0	100	0.10
28 June	1.6	52.5	1256	97	1.6	44.0	39	97	0.09
29 June	0	11.0	39	100	0	6.0	8	100	0.09
6 July	6.7	120.0	1006	95	7.6	91.5	137	92	0.02
7 July	8.0	138.5	381	92	1.7	23.0	11	93	0.12
12 July	23.0	397.0	278	95	4.3	54.0	23	93	0
13 July	20.0	213.0	2551	91	24.0	42.0	103	43	0
19 July	1.6	158.0	2023	99	3.0	38.0	103	93	0.65
20 July*	0.3	7.0	50	96	1.4	15.0	9	91	0.13
26 July	1.4	60.5	170	98	0	1.5	5	100	1.60
27 July	2.3	49.0	117	96	1.6	17.5	21	91	0.14
2 Aug.	2.0	217.0	121	99	1.3	12.0	17	94	0
3 Aug.	3.0	48.5	234	94	1.3	20.5	22	94	0
9 Aug.	8.7	92.0	175	91	28.7	348.0	198	92	0.08
10 Aug.	0	7.0	163	100	1.3	14.0	6	91	0
16 Aug.	8.4	6.0	196	—	56.7	22.0	6	—	0.32
17 Aug.	4.0	18.5	26	79	192.0	159.0	28	—	0
									Total 3.47

* Aerial spray over test area conducted on 20 June at 0700 hours.

protection, as established by Gouck et al. (1967), is 90% reduction of mosquito passage through treated netting as compared to untreated netting, based on 2 successive tests. Deet-treated wide-mesh netting proved effective against mosquitoes, biting midges and sand flies for about 64 days (Table 2). It is noteworthy that even after an aerial application of malathion on the morning of 20 June, the ratio between test and control catches remained nearly the same. (Traps were not in the field during insecticide spraying.)

Although the recorded rainfall during the actual trap nights only totaled 3.47 inches, (Table 2), the netting was damp to soaking wet much of the time. This was largely due to the 23.81 inches of rain during the course of the test which drenched the netting during handling and also prevented the nets from completely drying in storage between test nights.

No offensive odors or allergic reactions were experienced by those in contact with the netting, including individuals who were sensitive to deet applied to the skin. In view that even standard mosquito netting often requires repellent treatment to offer protection against the smaller biting flies, treated wide-mesh netting would be even more desirable.

It is postulated that by placing treated wide-mesh netting bed nets in a plastic bag, or by tightly rolling them up after each use, the effectiveness of the repellent might be significantly extended.

These results indicate that the field use of deet-treated wide-mesh netting should offer effective protection, for a limited time, against mosquitoes, biting midges and phlebotomine sand flies even under humid conditions.

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