

TABLE 3
THE MORTALITIES AND PROPORTION
OF UNFED MOSQUITOS IN A TREATED (UC-10584)
AND AN UNTREATED HUT

Month	Percentage of total catch					
	Treated hut (No. 11)			Untreated hut (No. 1)		
	Dead on floor	Dead in window-trap	Unfed	Dead on floor	Dead in window-trap	Unfed
1	82	14	39	0	37	66
2	57	17	48	0	18	58
3	16	24	54	0	27	41

39007 would be an effective residual insecticide in areas where houses are built almost entirely with wood or grasses.

The present trials with these two carbamate insecticides provide a subtle illustration of how the resting habits of *A. gambiae* at Magugu affect over-all mortalities in huts. Well over 90% of *A. gambiae* rest on the roofs of experimental huts, but when the

walls are lined with plywood at least 10% more mosquitos rest on the wall by day or night.* The high mortalities in hut 18 are thus not only due to the high toxic surface of the treated plywood, but also to its greater use as a resting-place.

Results have again shown that bio-assay exposure times have no simple relationship with the times that naturally entering mosquitos spend resting in a hut. For example, on the grass roof of hut 3, treated with UC-10584, bio-assay mortalities of 100% were still being inflicted after six months with exposure periods of only one hour's duration, while the over-all mortality to naturally entering mosquitos was only 58%.

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We wish to thank Assistant Field Officer Mr W. O. Obudho for the care with which he supervised collections of mosquitos in the experimental huts, and Mr P. O. Park and the staff of the Chemistry Department, Tropical Pesticides Research Institute, for determinations of the dosages of insecticide applied to the experimental huts.

* Tropical Pesticides Research Unit, *Progress report* No. 28, Arusha (unpublished).

Assessment of the Residual Toxicity to *Anopheles gambiae* of the Insecticides Sevin and Sumithion *

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The insecticides alpha-naphthyl-N-methylcarbamate (Sevin) and O,O-dimethyl-O-(3-methyl-4-nitrophenyl) phosphorothionate (Sumithion) received study in the form of bio-assays and trials in experimental huts at the Magugu Outstation of the Tropical Pesticides Research Institute, Arusha, Tanganyika, as part of the World Health Organization's programme of testing and developing new insecticidal compounds. The results presented in this paper are of trials made between March and July 1962.

Experimental methods

Two formulations of Sevin were studied, both made by Union Carbide Co. Ltd. The one contained 50% w/w technical product and the other, Sevin 85W, was an air-milled, microfine (2-10 μ), wettable powder containing 85% actual Sevin. Sumithion was also a water-dispersible powder, made by Farbenfabriken Bayer A.G., with 50% of the technical product. Five experimental huts were treated throughout by an Oxford Precision Sprayer at a nominal dosage of 2 g/m² and two at a nominal dosage of 4 g/m². The dosages applied to the huts were determined by chemical analysis of treated sample papers and ranged from 1.6 to 2.2 g/m² for the five huts and were 3.8 and 4.9 g/m² for the two treated

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with Sevin 50% water-dispersible powder. The method was in other respects the same as for previous studies,^a with additional observations on mosquito behaviour. Counts of mosquitos resting within the experimental huts were incorporated in the routine techniques to obtain data on densities of surviving mosquitos indoors.

Results

Bio-assays. The results of bio-assays in the experimental huts treated with Sevin 50% water-dispersible powder, Sevin 85W and Sumithion showed that the toxicities of all compounds were similar and persisted well on grass roofs, as shown by mortalities of 100% after five or 10 minutes' exposure, six weeks after application. The persistence of Sevin 50% water-dispersible wettable powder and of Sumithion was less on non-sorptive mud than on grass, as shown by mortalities of about 80% with 20 minutes' exposure, six weeks after application. All insecticides gave lowest persistence on sorptive mud, for even exposure periods of one or two hours did not give high kills six weeks after application, but Sumithion was rather more toxic than the Sevin compounds.

Mortality of naturally entering mosquitos. The results showed that the Sevin compounds were ineffective—i.e., killed less than 75% of mosquitos entering mud- or grass-roofed huts—during the first month after application of the insecticides. Sumithion, on the other hand, while similarly inadequate in a hut with a mud roof, showed no diminution of toxicity throughout the period of four months' observations in a hut with a grass roof, the mortalities remaining above 90% throughout this period. Observations in this latter hut were brought to an end only because of the sparsity of mosquitos in the dry season.

Effects of the insecticides on the behaviour of naturally entering A. gambiae. Experimental hut studies on Sevin 85W and Sumithion included observations on mosquito behaviour during the last seven weeks of the period of insecticide trials. Nearly all mosquitos that entered the Sumithion-

treated hut died indoors, thereby showing that the insecticide had no irritant effect causing increased egress of the mosquitos. On the other hand, the high proportion (70%) of surviving mosquitos in the window-trap of the hut treated with Sevin 85W, compared with the number indoors, indicated that a high proportion of the mosquitos entering the huts were irritated by, and escaped lethal contact with, the insecticide.

Discussion

The results of bio-assays in the experimental huts have shown that the Sevin compounds and Sumithion are similar to many other insecticides in the persistence of their toxicity for a longer period on non-sorptive than on sorptive mud, and even longer on grass.^a

Over-all mortalities among naturally entering *A. gambiae* have shown that the two Sevin compounds are unsuitable as residual insecticides and that Sumithion is probably an unsuitable insecticide for areas where huts are made of mud. Its undiminished toxicity in a grass-roofed hut suggests, however, that it would be an effective residual insecticide for areas where a high proportion of indoor-resting is on impermeable surfaces.

The results have again shown that bio-assay exposure times have no simple relationship with times that naturally resting mosquitos spend in a hut. A feature of interest in these present trials is that, although the results of bio-assays were similar in grass-roofed huts treated with the Sevin compounds and Sumithion, only the hut treated with Sumithion was extremely toxic to naturally entering *A. gambiae*. The explanation of this apparently anomalous situation appears to lie in the different effects of the insecticide on mosquito behaviour, the former insecticide being irritant and the latter non-irritant at the dosages employed in these trials.

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^a See the note by Smith & Hocking on page 273 of this issue.