

## Laboratory evaluations on the repellency of deet against two cockroach species *Blattella germanica* Linne and *Periplaneta fuliginosa* (Serville)\*

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**Abstract:** The repellency of deet (N, N-diethy-*m*-toluamide) against two domiciliary cockroach species, *Blattella germanica* Linne and *Periplaneta fuliginosa* (Serville) was evaluated by a choice test in the laboratory. The results showed that good to excellent repel effect against adult *B. germanica* lasted for 3 weeks or 2 months when the dosage of 2.5 g/m<sup>2</sup> or 5 g/m<sup>2</sup> of deet was treated respectively, while against adults and old nymphs of *P. fuliginosa*, only 5 g/m<sup>2</sup> of the chemicals was effective for 1/2 month.

### Introduction

Effective, safe and long-lasting repellents would be of great practical value in keeping cockroaches out of households, food and drink-vending machines and food establishments due to the necessity to minimize or eliminate the use of insecticides. Although such chemicals have been synthesized and investigated (Schwarz et al., 1970<sup>1)</sup>, 1971<sup>2)</sup>, McGovern et al., 1974<sup>3, 4)</sup>, 1975<sup>5)</sup>), unfortunately their candidate compounds are still under development and have not been available until recently. Deet is known to be one of the most effective repellents for many biting arthropods but the evaluations on cockroaches are not yet established.

The present paper deals with its repellent effect against two domiciliary cockroaches, *Blattella germanica* and *Periplaneta fuliginosa*, especially concerning with effective dosage and residual effect.

### Materials and Methods

The cockroaches used in this test were taken from the stock colonies which have been maintained at our laboratory at a temperature of 25±1°C and 16 hours light per

day. One hundred adult males and 100 adult females of the German cockroaches or 30 adult males, 30 adult females and 30 large nymphs of smoky-brown cockroaches were transferred into a tin container (120×120 cm, 20 cm in height) provided foods (Oriental Rat Food MF) and water in the dishes. Eight shelters were also placed in the container at regular distance along the floor edge (see Fig.). Each shelter was made out of 10 cm squares of 0.3 cm plywood stacked one above two other pieces separated by small tacks placed into the bottom of each square so that a 0.4 cm (German cockroach) or 0.6 cm (smoky-brown cockroach) void was formed for cockroach harborages between the squares. As the cockroaches might uti-

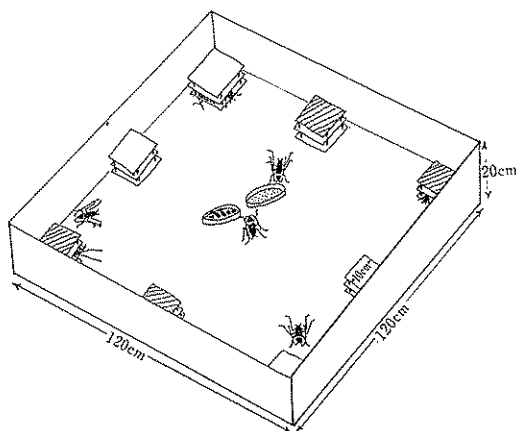


Fig. Container used in the test and position of the shelter, food and water

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lize the particular shelters or site, the shelters were rotated day by day in turn and the numbers of cockroaches concealed in the shelters were counted on a daily basis. In order to establish the preference to specified shelters or site, a preliminary test was carried out. The results showed that there was significant difference in the numbers of cockroaches among the shelters but not among the sites. Thus, eight shelters were divided into two groups so that the total number of cockroaches concealed in each group became almost the same, then the chemicals were used to treat one group. An acetone solution of deet was sprayed over five surfaces of each shelter except the bottom at a rate of 0.5 g, 2.5 g or 5 g/m<sup>2</sup> and control shelters were treated only with acetone. One night later, the shelters were set again in the container. Cockroaches in each shelter were counted once a day for 4 days. After that the shelters were kept in the room under normal environmental conditions for a few months and occasional tests were repeated until the compound lost its repellency.

### Results and Discussions

#### The repellency of deet against the adult

German cockroach, *B. germanica*, was shown in Table 1.

The ratio of individuals which were found inside the shelters ranged from 80.6% to 95.1% on average and the remainders were found in and around food and water sites or open space outside the shelters, showing female cockroaches aggregate in a shelter and not males. With the treatment of 0.5 g/m<sup>2</sup> of the chemicals, a total of 291 (171 ♀, 120 ♂) cockroaches were observed in the treated shelters and 441 (211 ♀, 230 ♂) were observed in the untreated shelters during the period of one to four days after treatment. At this dosage, as the effectiveness of these chemicals did not seem to last for a longer period, observation was not continued afterwards. In 2.5 g/m<sup>2</sup>, most of the insects were not concealed in the treated shelters within three weeks after treatment. After two months of treatment, however, a considerable number of individuals were found in treated shelters and no significant difference between the treated and untreated shelters could be recognized. In 5 g/m<sup>2</sup>, an excellent repellency was shown for two months.

The effect against smoky-brown cockroach is shown in Table 2. This species seemed to utilize the shelters slightly less than the

Table 1 The repellency of deet against adult *B. germanica*

Dosage (g/m <sup>2</sup> )	Period after treatment (day)	Total number of insects concealed in the shelters*						Percentage of concealed insects (%)
		treated			untreated			
		♀	♂	total	♀	♂	total	
0.5	1- 4	171	120	291	211	230	441	91.5
2.5	1- 4	0	1	1	426	322	748	93.6
	21-24	2	10	12	359	314	673	85.6
	64-67	96	101	197	242	206	448	80.6
	92-95	150	174	324**	239	181	420**	93.0
5.0	1- 4	0	0	0	350	345	695	86.0
	20-26	1	0	1	359	314	673	84.3
	63-67	2	3	5	343	313	659	83.0
	90-93	127	133	260	267	234	501	95.1

\* Total number observed once a day for 4 days

\*\* no significant difference ( $\alpha=0.05$ )

Table 2 The repellency of deet against *P. fuliginosa*

Dosage (g/m <sup>2</sup> )	Period after treatment (day)	Total number of insects concealed in the shelters*								Percentage of concealed insects (%)
		treated				untreated				
		♀	♂	N	T	♀	♂	N	T	
2.5	1-4	1	0	0	1	83	110	98	291	81.1
	16-19	40	41	29	110**	56	68	77	201**	86.4
5.0	1-4	0	0	0	0	105	115	110	330	91.7
	16-19	30	14	14	58	65	90	89	244	83.9
	29-32	36	41	46	123**	75	74	53	202**	90.8

\* Total number observed once a day for 4 days

\*\* no significant difference ( $\alpha=0.05$ )

N=nymph T=total

German cockroach. Tsuji and Mizuno (1973)<sup>6)</sup> have reported that the adults and old nymphs showed a marked trend to reject each other. Considering the exclusive nature of adult and the old nymph concerning the smoky-brown cockroach, there might not have been enough space for concealment concerning this species. With treatment of 2.5 g/m<sup>2</sup> and 5 g/m<sup>2</sup> of the chemicals, the efficiency of deet against the smoky-brown cockroach was from 1 to 4 days and 16 to 19 days after treatment, respectively.

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#### Deet のチャパネゴキブリ及びクロゴキブリに対する忌避効力

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Deet (N, N-diethyl-*m*-toluamide) のチャパネゴキブリ成虫及びクロゴキブリ成・幼虫に対する忌避効力を検討した。10cm 角のベニヤ板を3枚重ねたシェルターを、容器(120×120cm, 高さ20cm)の周辺部8か所に等間隔に配置し、その半数に薬剤を処理して潜伏場所として利用するゴキブリ数を観察した。両シェルターの利用数の差から有効処理濃度、効力持続期間の検討を行った。その結果、チャパネゴキブリに対しては、5 g/m<sup>2</sup> 処理で処理後2か月間、2.5 g/m<sup>2</sup> 処理では3週間後まで高い忌避効力を維持したが、0.5 g/m<sup>2</sup> 処理での効力は低かった。また、クロゴキブリに対しては、その効力は相対的に低く、2.5 g/m<sup>2</sup> 処理で直後のみ、5 g/m<sup>2</sup> 処理で2週間有効であった。