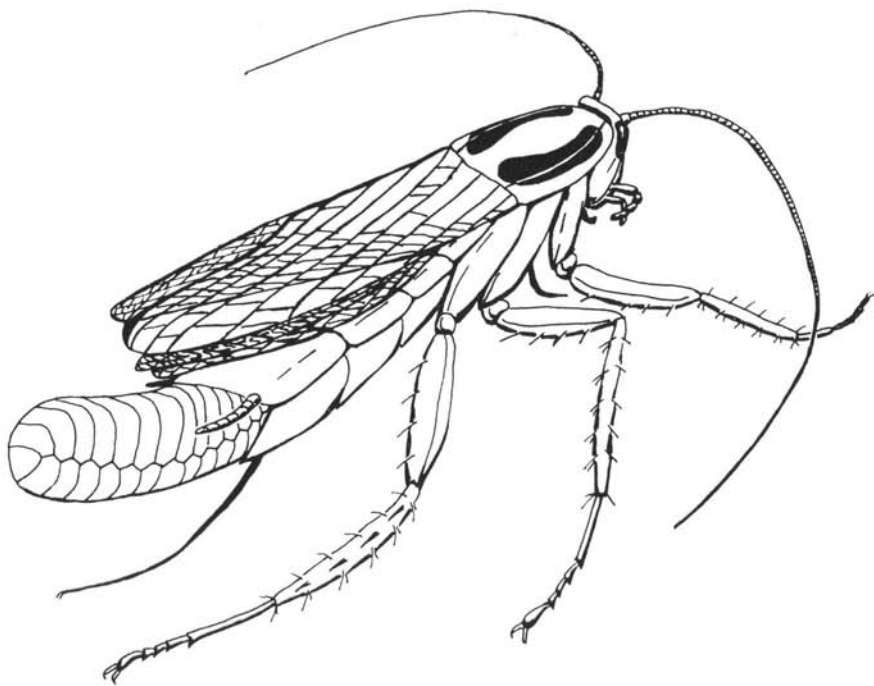


COCKROACH PROOFING

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in Urban Housing and Food Service Carts**

R. C. MOORE



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Introduction

The German cockroach, *Blattella germanica*, is the most important household insect present throughout the year in the United States (Mampe 1972). Infestations in densely populated inner-city areas of Connecticut are serious. A survey taken in 1970, in six New Haven public housing projects, revealed that 60% of the apartments were infested; of these, 18% were classified as very heavily infested (New Haven, Department of Health, 1970). As people move from infested housing into new low and moderate income housing, they often bring cockroaches with them. If cockroach prevention measures could be taken during construction of a building, they might be safer, more effective, and more economical than present techniques.

Several materials provide the lengthy residual activity needed for cockroach proofing. Dri-die® and Drione® have been reported to be effective against at least 50 species of arthropods, including seven species of cockroaches (Tarshis 1964). Ebeling *et al.* (1965, 1967, 1969) and Tarshis (1964), reported on successful use in California of inorganic dusts such as Dri-die 67, Drione, and boric acid for cockroach proofing. Dri-die (95.3% amorphous silica gel and 4.7% ammonium fluosilicate), is a nonabrasive, highly sorptive desiccant dust. It kills by absorbing a portion of the thin protective lipid layer of the cuticle, causing cockroaches to lose water at a lethal rate. Drione is a mixture of Dri-die (38.12% amorphous silica gel and 1.88% ammonium fluosilicate), pyrethrins (1.0%), and piperonyl butoxide (10%). Drione also acts as a desiccant, but the addition of pyrethrins makes it more toxic than Dri-die, and causes it to kill roaches more rapidly (Ebeling 1971).

Cockroaches are repelled by Dri-die and Drione (Ebeling *et al.* 1966, Moore 1972), thus treated areas become less attractive as harborages and breeding places. These same authors have shown that boric acid, which acts as a stomach poison, has been very effective against cockroaches because it does not repel them. Moore (1972) showed that small amounts of Dri-die 67 or Cab-O-Sil M-5 (99% SiO₂), mixed with boric acid, increased the toxicity of boric acid with little or no increase in repellency.

Baygon® (2-iso Propoxyphenyl-methylcarbamate) 2% roach bait, after having been aged for 101 days, continued to kill more than 90% of the cockroaches exposed in laboratory tests (National Communicable Disease Center, 1971). Baygon 2% roach bait, followed by a 1.1% Baygon spray, was used successfully by Moore (1971) to reduce infestations in occupied urban apartments.

Cockroaches are not only a problem in urban apartments, but are sometimes abundant in hospitals as well. Unique problems in hospitals are infestations in the insulation of electrically heated food carts and in cracks and crevices of other utility carts used in food service. These carts usually are fogged monthly with pyrethrum, but this method of cockroach control has been unsatisfactory.

In this study, boric acid, Dri-die, boric acid plus Dri-die, boric acid plus Cab-O-Sil and Baygon bait, were placed in apartments under construction or prior to occupancy to determine their effectiveness in preventing cockroach infestations. Drione was evaluated for control in electrically heated food carts and utility carts used in a hospital cafeteria.

Materials and Methods

Four buildings under construction in a low and moderate income housing project in New Haven were selected for evaluation of inorganic dusts. In building A, with 21 apartments, 11 units were treated with boric acid plus 0.1% Cab-O-Sil M-5; the remaining 10 units were treated with boric acid plus 0.1% Dri-die 67. In building B, 15 units were treated with Dri-die 67 alone. Boric acid alone was used in building C. The nine apartments in building D were not treated. Technical grade boric acid powder (Mallicrodt Chemical) was passed through 16-mesh window screen, before the silica materials, 0.1% Dri-die (FMC Corporation) or Cab-O-Sil (Cabot Corporation), were added. The materials were thoroughly mixed using a motorized mixer.

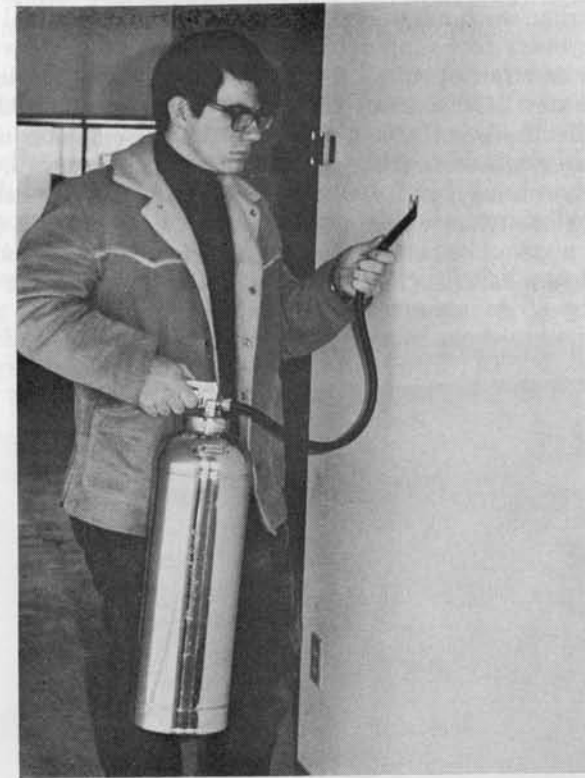


Figure 1.—Applying dust into wall voids using a pressurized blower.

All apartment walls surrounding the kitchen, bathrooms, and utility room were treated (Fig. 1) by blowing dust between the walls with a modified pressurized fire extinguisher (Neil A. MacClean Co.) as described by Ebeling *et al.* (1967). Some difficulties were experienced when applying either boric acid or Dri-die alone. After standing several days, boric acid powder became packed and lumpy. This caused clogging in the hose of the pressurized duster. Clogging was prevented by screening and then sifting the boric acid as it was being added to the duster. Dri-die or Cab-O-Sil are anti-caking agents which prevented lumping of the boric acid. While most of the Dri-die applied in wall voids will adhere to treated surfaces, some of it tends to float around excessively because it is extremely light. This is especially true when it is applied in open areas such as cabinet tops or under appliances.

The construction of the buildings studied was especially suited for this treatment. Dust could be blown throughout the wall-space through a single opening, such as an electrical outlet, because metal studs with a 4" opening every foot supported the wallboards. In walls without electrical outlets or other openings, a ¼" hole was drilled in the wallboard to inject the dust. Other areas treated with the pressurized duster included: 1. the basement area through which all common utility pipes ran; 2. the area where heating pipes entered wallspaces; 3. false areas under kitchen cabinets; and 4. enclosed soffit areas above cabinets. Several weeks before tenants began to move in, a hand duster (Getz gun) was used to treat other cabinet and closet areas and also under and behind kitchen appliances (Fig. 2). Approximately 5 lbs. of boric acid



Figure 2.—Applying dust or bait using a Getz-gun hand duster.

dusts and 2.5 lbs. of Dri-die were applied per apartment. After tenants moved into the buildings, the treatments were evaluated by monthly inspections using a pyrethrin aerosol spray to flush cockroaches into the open.

Two formulations of Baygon 2% roach bait (Chemagro Chemical Co.) were tested in the laboratory and in the field. Bait A was formulated by the manufacturer using technical grade Baygon. Bait B used 50% wettable powder. The efficacy was determined by confining cockroaches to 1 cc deposits in plastic dishes as described by Moore (1972), and calculating the $KD_{50\%}$ (knock-down dose for 50%). Repellency was tested by giving cockroaches a choice between darkened

areas containing bait, and untreated lighted areas (Moore 1972) with food and water. The numbers of living and dead cockroaches in the darkened, baited area were recorded at 24 hr. intervals.

Field tests with Baygon 2% roach bait were conducted in 30 newly constructed apartment units in New Haven. Half were treated with each bait formulation several weeks before tenants moved in. The bait was formulated as "crevice-sized" particles which could easily be applied with a Getz gun. Treated areas included those under and behind appliances, under radiators, in kitchen cabinet corners, on utility room and closet shelves, in sink cabinets, and in cracks, voids, and other enclosed areas. Wall voids were not treated. Particular attention was given to baiting false areas in and under kitchen cabinets because these provide excellent harborage for cockroaches. Between ½ and 1 lb. was applied per apartment. Monthly evaluations were made using the pyrethrin flushing technique.



Figure 3.—Applying Drione dust to insulation of electrically heated food carts using a Centra-bulb duster.

Two types of carts were treated in a state hospital facility. Twenty-five electrically heated food carts and 10 utility carts were treated with Drione dust (FMC Corporation). The tops of the food carts were removed and the dusts were applied to the insulation with a Centra-bulb duster (Fig. 3). Approximately 2 oz. of Drione were used per cart. Ten utility carts (5 large and 3 small metal carts, 1 large and 1 small wooden cart) were also treated using an aerosol can containing Drione. The dust was sprayed on under surfaces of the shelves and into all crevices. Monthly evaluations were made with pyrethrins.

Table 1

Areas of the apartments where cockroach infestations were most frequently found.

Treatment	No. apts.	% of sites infested			
		Kitchen	Bathroom	Utility Room	Closets
Boric acid (BA)	4	75	25	25	0
Dri-die	2	100	50	50	0
BA + 0.1% Dri-die	3	67	33	33	0
BA + 0.1% Cab-O-Sil	8	100	63	25	25
Untreated	5	100	60	0	40
Totals	22	91	50	23	18

Results

Boric acid-silica dust treatments. Results are given only for apartment units which were occupied for the entire first 6 months evaluation period. The kitchen was the most frequently infested site (Table 1). As shown in Table 2, boric acid or Dri-die alone, or boric acid plus 0.1% Dri-die were the most effective. This was true following 6 monthly inspections and also at the end of 18 months. In occupied units treated with these dusts, the infestation rate never exceeded more than 20%. In units treated with boric acid plus 0.1% Cab-O-Sil, 30-50% were infested after 6 months and 60% were infested after 18 months. At least half of the untreated units were infested when inspected the first time. No more than 13 cockroaches were flushed out during any inspection of a treated building, even after 18 months (Table 2).

Table 2

Effectiveness of boric acid-silica dusts for controlling German cockroaches when buildings were treated during construction.

Treatment	No. apts.	No. infested apts after						No. cockroaches flushed in apts. after					
		1 month	3 months	6 months	18 months	1 month	3 months	6 months	18 months				
Boric Acid (BA)	10	0	1	1	2	0	1	1	1	1, 5			
Dri-die	10	1	2	0	2	10	3, 7	0	0	4, 13			
BA + 0.1% Dri-die	10	0	2	1	1	0	1, 2	1	1	2			
BA + 0.1% Cab-O-Sil	10	3	5	3	6	1, 6, 8	1, 2, 2, 3, 9	6, 10, 10	6, 6, 6, 8, 11, 13				
Untreated	6	2	3	3	5	1, 10	1, 2, 5	12, 22, 36	1, 3, 26, 52, 72				

Baygon bait treatments. Two formulations of Baygon 2% roach bait were evaluated in the laboratory (Table 3). When cockroaches

Table 3

Efficacy of two formulations of Baygon bait for German cockroaches when confined with bait or in a choice situation.

Baygon bait Formulation	KD ₅₀ when roaches confined with bait (minutes) ^a	% kill after roaches initially placed in choice boxes (days) ^b					
		1	2	3	7	9	18
A	59.4	36.7	58.3	75.0	83.3	88.3	91.7
B	34.3	25.0	56.7	65.0	83.3	86.7	88.3
Untreated	None	0		0		3.3	8.3

^a 3 replicates of 10 adult male German cockroaches.

^b 3 replicates of 20 adult male German cockroaches.

were confined with the bait, it took 34 minutes for 50% to be knocked down with formulation B, and 59 minutes with formulation A. In the choice situation, 83% were killed in 7 days with either formulation. After 18 days, about 10% were still alive.

The results given in Table 4 show that live cockroaches were not entering darkened baited areas as frequently as the unbaited area. These observations indicate that cockroaches may have been repelled by the bait.

Table 4

Percentage of German cockroaches in the dark area of choice boxes treated with Baygon bait formulation.

Baygon bait Formulation	% live insects in dark area on day				
	1	2	3	7	9
A	10.5	32.0	20.0	10.0	14.3
B	15.6	19.2	23.8	20.0	12.5
Untreated	43.3	71.7	58.3	77.6	84.5

Numbers of roaches in newly constructed apartments treated with Baygon bait formulations are shown in Table 5. Two of the 15 newly constructed apartment treated with Baygon bait, formulation A, were infested after 3 and 6 months. In units treated with formulation B, one was infested after 3 months and three after 6 months.

Table 5

Effectiveness of two formulations of Baygon bait for controlling German cockroaches when buildings were treated prior to occupancy.

Baygon bait Formulation	No. apts.	No. infested apts. after		No. roaches flushed after	
		3 months	6 months	3 months	6 months
A	15	2	2	1, 12	6, 25
B	15	1	3	3	1, 4, 25

Drione dust treatments in food carts. The application of Drione dust to electric food cart insulation reduced the numbers of roaches in the carts by 98% after 1 month (Table 6). It continued to control at approximately this level for 5 months. In utility carts treated with the aerosol, roaches were reduced by 76% after 1 month and by 95% after 3 months.

Table 6

Effectiveness of Drione dust for controlling German cockroaches in electrically heated food carts and other utility carts.

Treatment	Initial No. roaches (carts)	% reduction after		
		1 month	3 months	5 months
Drione dust	135 (25) ^a	97.8	98.5	96.3
Drione aerosol	210 (10) ^b	76.2	95.2	—

^a Electrically heated food carts.

^b Utility carts.

Discussion

These field tests show that application of dusts such as Dri-die, Cab-O-Sil or boric acid and Baygon bait to apartments under construction were a successful control measure. There are several advantages to treating buildings during construction or before occupancy: 1. Insecticides are safer to apply when units are uninhabited; 2. treatments can be more thoroughly applied to areas such as cabinets or closets because they are empty; 3. tenants are not present to interfere with the applicator; and 4. dust or bait may keep cockroaches brought in by tenants from getting established.

Drione dust applied to food and utility carts successfully reduced roaches. It might be advantageous to treat these carts during construction. Applications of Drione dust to the insulation of other electric appliances such as stoves, refrigerators or freezers might also be effective in reducing cockroach infestations.

Dusts and baits are normally used as secondary or back-up treatments for residual sprays, but these data shows these materials can be used as the primary control measure. Dusts have a longer residual life than sprays, they penetrate deeper into cockroach harborages, and brief contact with the dust leaves a lethal deposit on roaches. Baygon bait, because of its "crevice-size," can be applied directly to the insect harborage.

Acknowledgment

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