

# ACEPHATE AND AVERMECTINS FOR GERMAN COCKROACH CONTROL<sup>1</sup>

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## ABSTRACT

Acephate (1%), acephate (1%) plus 0.16% zinc ricinoleate (a deodorant) and 0.08% Tryfac 910-K® (a surfactant), and avermectins (0.02 and 0.1%) were applied in kitchens of single-family dwellings infested with *Blattella germanica* (L.). All gave control at 2, 4, and 8 weeks after initial application. There was no significant difference in control between insecticides or concentrations.

Key Words: German cockroach, *Blattella germanica*, Blattellidae, acephate, Orthene®, Avermectins.

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## INTRODUCTION

Avermectins, a new class of pesticides, have been isolated from the soil organism, *Streptomyces avermitilis* (Burg et al. 1979). Tested in the laboratory, they exhibited good control against selected insects, phytophagous mites, and plant-parasitic nematodes (Putter et al. 1981). Control of flour beetles (Ostlind 1979) and sarcoptic mange mites (Wilkins et al. 1980) has indicated a potential for use in indoor urban pest control. There are no published data on its effectiveness in controlling German cockroaches, *Blattella germanica* (L.). Acephate (Orthene®) has been proven effective for controlling German cockroaches by Ehrhardt and Dickens (1975), Grayson (1972), Gupta and Das (1974), Reiersen (1975), Wright (1982a, b) and Wright and Hillmann (1975, 1979). However, there exists a possibility of increasing its efficacy or improving some of its properties by the addition of selected adjuvants to the acephate concentrate. Reported hereafter are data on the efficacy of avermectins and acephate plus additives in control of German cockroaches.

## MATERIALS AND METHODS

Kitchens of 25 single-family dwellings, each with at least 25 visible German cockroaches, were used as test sites from September through November 1983. Cockroaches visually sighted in each kitchen, with the aid of a flashlight where necessary, were tallied prior to insecticide application and kitchens were assigned a sanitation grade based on Bennett's scale (1978) (Table 1).

<sup>1</sup> Dictyoptera: Blattellidae. Paper No. 9395 of the Journal Series of the North Carolina Agricultural Research Service, Raleigh, NC 27695-7601. Use of trade names in this publication does not imply endorsement of the products named or criticism of similar ones not mentioned.

Table 1. Sanitary rating scale (Bennett 1978).

Scale	Sanitary Condition
1. Fairly clean, not cluttered	Floors not very dirty, shelves and cupboards not cluttered, except for normal amount of content, no obvious piles of trash.
2. Fairly clean and cluttered	Floors fairly clean but may be cluttered with trash, clothes, etc. (nongarbage); cupboard filled with nongarbage articles.
3. Generally dirty, not cluttered	Floors generally dirty and/or greasy; cupboards dirty and not washed out for some time.
4. Generally dirty and cluttered	Floors generally dirty and piled with nongarbage trash, clothing, or small amounts of garbage; cupboards not washed out, dirty, and filled with nongarbage articles.
5. Severely dirty, not cluttered	Very dirty with garbage obvious; area very greasy and uncleaned in a long time; dead cockroaches obvious and not swept up.
6. Severely dirty and cluttered	Very dirty with garbage obvious and piled around, greasy areas filled with articles, trash, papers, etc. (which make counting difficult); dead cockroaches obvious and not swept up.

Solutions of 1% acephate prepared from a 97% soluble powder, or a mixture of 1% acephate, 0.16% zinc ricinoleate (a deodorant) and 0.08% Tryfac 910-K® (a surfactant), or Whitmire self-pressurized crack and crevice sprays of 0.02 (200 ppm) or 0.1% (1000 ppm) avermectins were applied to a dwelling.<sup>2</sup> Zinc ricinoleate was added to the acephate formulation as a possible deodorant, and the Tryfac 910-K was added to determine if it would influence efficacy through increased spreading-sticking on the surfaces. There were five dwelling replicates per insecticide, with insecticides randomly assigned to dwellings. Five untreated dwellings were used as untreated checks.

The acephate solutions were applied as per label directions with a 3.785-liter compressed air-sprayer equipped with a Multeejet® nozzle using 1.4 kg/cm<sup>2</sup> air pressure and the medium pin stream setting. Avermectins formulations, supplied ready-to-use in pressurized cans, were injected directly into cracks and crevices with a plastic injection tube.

Reinspections were made at 2, 4, and 8 weeks after initial application and spot retreatments with each insecticide applied where living cockroaches were observed. Measurement of the kitchen and amount of insecticide applied in the kitchen, converted to the amount applied per 50m<sup>2</sup>, enabled comparison between kitchens. Other rooms in the dwellings were treated with the insecticide in order to reduce the possibility of cockroach movement between rooms. Cockroaches in those rooms were not tallied.

<sup>2</sup> The acephate soluble powder, with an without additives, was furnished by Chevron Chemical Company, Ortho Division, San Francisco, CA 94119. Whitmire Research Laboratories, Inc., Saint Louis, MO 63122, supplied the avermectins as self-pressurized sprays with a liquid gas propellant system formulated specifically for crack and crevice applications.

## RESULTS AND DISCUSSION

Kitchen size (the total m<sup>2</sup> of floor and wall surfaces) ranged from 30 to 70 m<sup>2</sup>, with a mean of 48 m<sup>2</sup>. The amount of active ingredient applied in the initial treatment ranged from 0.02 to 17 g/50m<sup>2</sup> of kitchen floor and wall surfaces for all treatments. This variation was due to: (1) the different insecticide concentrations for acephate (1%) and avermectins (0.02 and 0.1%), (2) a tendency to use more insecticide with larger cockroach populations, and (3) increased amounts of insecticide applied in kitchens which contained more crack and crevice voids for cockroach shelter. Less insecticide was applied during retreatment ( $P = 0.01$ ) as only those areas with living cockroaches were treated. There was significantly ( $P = 0.01$ ) more 0.1% avermectins (a.i.) applied in the initial treatments than for the 0.02% formulation.

There were insufficient kitchens with sanitation grades of 1, 2, and 4 for correlation of cockroach population and sanitation. However, for kitchens assigned sanitation grades of 3 (7 rep's.), 5 (6 rep's.), and 6 (8 rep's) the number of sighted cockroaches were  $113 \pm 121$ ,  $184 \pm 106$  and  $636 \pm 512$ , respectively. There was no significant difference between total cockroaches for sanitation grades three and five; however, there was a difference ( $P = 0.01$ ) for these two levels alone or combined when compared to level 6 populations. These data are similar to results reported by Sherron et al. (1982), Wright (1979), and Wright and Dupree (1984) and indicate that control measures were less effective in houses with the poorest sanitation for these insecticides.

Pretreatment cockroach populations were significantly ( $P = 0.01$ ) reduced following insecticide applications (Table 2). Mean population reductions (%) for the insecticides ranged from 84 to 96, 85 to 99, and 94 to 99 at 2, 4, and 8 weeks after the initial treatment, respectively. The mortality was greater ( $P = 0.05$ ) at 8 weeks. German cockroach control in kitchens of single-family dwellings, NC 1983.

Insecticide*	No. live cockroaches in pretreatment counts†	Mean		
		% reduction of live cockroaches after week†‡		
		2	4	8
1.0% acephate	115 ± 81	90 ± 8	95 ± 5	98 ± 3
1.0% acephate plus§	547 ± 566	87 ± 7	90 ± 7	94 ± 6
0.02% avermectins	187 ± 118	84 ± 16	85 ± 15	97 ± 2¶
0.1% avermectins	582 ± 386	96 ± 3	99 ± 2	99 ± 1
Control#	70 ± 44	72 ± 50	85 ± 61	78 ± 82**

\* Five replications per treatment. Acephate applied as a water solution spray and avermectins as a Whitmire® self-pressurized crack and crevice spray.

† Mean and standard deviation.

‡ All insecticides gave significant ( $P = 0.01$ ) cockroach mortality. Waller-Duncan K-ratio T test.

§ Zinc ricinoleate (0.16%), a deodorant, and Tryfac 910-K (0.08%), a surfactant, added to the 1% acephate solution.

¶ Based on four replications; one family moved.

# Mean and standard deviation for the number of sighted cockroaches. Based on four houses, as one was deleted when the family removed furniture and debris harboring the cockroaches.

\*\* Based on three replications; one family moved.

weeks than at 2 and 4 weeks, which showed no significant difference. There was no statistical difference in mortality for the two insecticides, although the data appear to indicate that the 0.1% avermectins produced greater mortality than the 0.02%. There was no discernible change in smell to the applicator following addition of the zinc ricinoleate to the acephate formulation, nor was there any change in mortality following addition of the Tryfac 910-K surfactant. Cockroach tallies in one of the five untreated houses were reduced during the eight weeks due to the removal of debris and furniture which harbored many of the cockroaches by one tenant. This house was eliminated, leaving four untreated replicates. At eight weeks, one additional house was eliminated due to the family having moved.

These results indicate that the avermectins gave good control of German cockroaches in kitchens of single-unit family dwellings, and the properties of acephate, a good cockroach control insecticide, were not influenced by the addition of zinc ricinoleate, as a deodorant, and Tryfac 910-K, as a spreader-sticker.

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