The response for both concentrations of Dursban 4E were the same as for the water controls; neither concentration flushed or knocked-down the test insects within the 1-h observation period. Within each of the other 3 insecticides, a decrease in the concentration caused an increase in the time to flush or knockdown the test insects. XRM 4322 gave the fastest flush of 50% of the test insects, followed by Decis EC and Demon WP. However, XRM 4322 gave the slowest flush of 90% of the test insects; Decis EC had the fastest FTso followed closely by Demon WP. Decis EC would seem to be the best flushing agent as assessed by this procedure. Decis EC also gave the most rapid knockdown of the test insects, followed by Demon WP. XRM 4322 gave very poor knockdown of the test insects.

| Treatment          | FT50 (min) | FT90 (min) | KT50 (min) | KT90 (min) |
|--------------------|------------|------------|------------|------------|
| Control            | 100 (0)    | 100 (0)    | 100 (0)    | 100 (0)    |
| Dursban 4E (0.5%)  | 1.2 (0.5)  | 24.0 (42.6)| 86.3 (27.5)| 100 (0)    |
| Dursban 4E (0.22%) | 1.4 (0.5)  | 66.3 (45.0)| 100 (0)    | 100 (0)    |
| XRM-4322 (0.5%)    | 4.0 (0.7)  | 9.0 (2.7)  | 10.0 (3.2) | 21.0 (13.4)|
| XRM-4322 (0.25%)   | 5.4 (2.6)  | 16.0 (4.2) | 28.0 (4.5) | 37.0 (18.9)|
| Decis EC (0.1%)    | 9.0 (2.2)  | 16.0 (4.2) | 28.0 (4.5) | 54.0 (5.2) |
| Decis EC (0.05%)   | 12.0 (2.7) | 46.0 (31.1)| 57.0 (6.7) | 84.0 (21.9)|

Data presented are the mean (standard deviation) from 5 replicates of 10 insects.

*Time (min) necessary to flush 50% (or 90%) of the insects from harborage.

*Time (min) necessary to knockdown 50% (or 90%) of the insects in the test.

*Expressed as % chlorpyrifos in aqueous solution, the % pyrethrins and piperonyl butoxide can be calculated from % AI in concentrate.

**SINGLE-FAMILY DWELLINGS:**

German cockroach, Blatella germanica (L.)

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SELF-PRESSURIZED, ENCAPSULATED SPRAYS FOR GERMAN COCKROACH CONTROL IN SINGLE-FAMILY DWELLINGS, 1985: Field evaluations were made in single-family dwellings infested with at least 25 visible German cockroaches/kitchen to compare the efficacy of 6 self-pressurized, encapsulated insecticide formulations against a standard nonencapsulated chlorpyrifos spray. Visually-sighted German cockroaches were counted, with flashlight illumination where necessary, in each kitchen prior to insecticide application. Items in cabinets were removed during the counting procedure to provide clear access for insecticide application. Preapplication counts were performed from August through November 1985, followed immediately by treatment, with additional inspections, and retreatments where living cockroaches were sighted, at specified intervals. All sprays were injected into cracks and crevices with a plastic application tube in keeping with label instructions. Six single-family dwellings (replicates) were treated/formulation, except for 1 formulation, where 12 single-family dwellings were used. The 12 dwellings were treated with 1 formulation to allow comparisons of mortality following an initial application only versus an initial application plus reapplications at specified intervals when living cockroaches were observed. The amount of insecticide applied/kitchen was determined by weight. Other rooms were treated with the same formulation, but the number of cockroaches was not counted and the quantity of spray applied was not measured. Floor and wall surfaces of the kitchen were combined for the kitchen area (m²). Analyses were calculated on percent reduction of cockroaches (pre-versus postcounts for each house) using a general linear models procedure and the Goodnight [1982] Waller-Duncan K-ratio t test for variables.

The wall and floor areas in the kitchens ranged from 27 to 75 m² with a mean of 58 m². The active ingredient applied in the initial application and during reapplications ranged from 0.5 to 8.9 g and from 0 to 3.2 g, respectively, for 50 m² of kitchen floor and wall surfaces. Smaller quantities of chemical were used in the reapplications because of high mortalities following initial application in many of the dwellings. All treatments and single versus periodic applications gave significant (P < 0.01) control for at least 8 wk. However, cockroach populations had increased dramatically in 5 kitchens at 8 wk, necessitating control with a different insecticide. Control efficacy with a single application of 0.5% encapsulated chlorpyrifos only was no different from that of an initial application and reapplications where living cockroaches were sighted. Some adult German cockroaches exposed to nonsynergized pyrethrum sprays and collected while showing intoxication symptoms recovered, a trait previously reported. Moribund females carrying oothecae also recovered, with subsequent nymphal emergence from the oothecae. Adult German cockroaches (including egg-case-carrying females) that had been treated with synergized pyrethrum did not recover, nor was any nymphal emergence from cases observed. Repellency following application of the pyrethrum formulations to cracks and crevices was noted as cockroaches emerged from these sites. They remained exposed on the walls for at least 2 wk, and had returned to the crevices and cracks by 4 wk. Retreatment of cracks and crevices produced the same pattern. This movement appeared more prevalent in houses with temperatures over 30°C.
### EVALUATION OF POTENTIAL INSECTICIDES FOR CONTROLLING GERMAN COCKROACHES, 1986:

Field tests were conducted to determine the relative effectiveness of self-pressurized sprays containing 1 or 2 concentrations of cyfluthrin or 1 concentration of an avermectin bait or dust-type baits of avermectins, boric acid, or fenoxycarb. MaxForce™ (hydramethylnon) bait and a self-pressurized spray of 0.5% chlorpyrifos, both labeled for cockroach control, were used as standards. Dry baits were applied with a Getz™ or Controlbulb™ duster. MaxForce was used as sold to homeowners; the self-pressurized formulations were applied as supplied by Whitmire Research Laboratories, St. Louis, Mo. All formulations were applied to cracks and crevices, except the MaxForce bait stations, which were attached to kitchen surfaces as directed by the label. Single-family houses located in Sampson County, N.C., served as test sites. Only houses with a minimum of 25 cockroaches sighted in a preliminary survey of the kitchen were used. Visual counts in the kitchen before the initial application and at specified intervals afterward determined the percent reduction in cockroach populations. The amount of insecticide for kitchen applications was recorded. No additional MaxForce stations were placed in the MaxForce test houses after the initial application. Other rooms in all test houses were treated, but cockroach numbers and amount of insecticide applied were not measured. Each formulation was replicated 5 times. Analyses were calculated on percent reduction of cockroaches (pre- versus postcounts for a house) using a general linear models procedure and the Goodnight [1982] Waller-Duncan K-ratio t test for variables. The combined wall and floor surfaces in the kitchens ranged from 35 to 90 m² with a mean of 55 m². The active ingredient applied in the initial application and during reapplications ranged from 0.007 to 4.2 g and from 0.0 to 1.4 g, respectively, for 50 m² of kitchen floor and wall surfaces. Smaller quantities of insecticide were used for the reapplications because partial cockroach control had resulted in most of the dwellings.

All treatments, except that involving the fenoxycarb bait, which is an insect growth regulator, gave significant ($P < 0.01$) control at 2 wk. Several adult cockroaches in the fenoxycarb-treated houses had curled wings, indicating that the growth regulator was being incorporated into the population and that cockroach population reduction should occur within several months. However, due to the large populations and dissatisfaction of the families, a standard cockroach control insecticide was applied at 2 wk. These houses were discontinued. At 4 wk, cockroach populations in the kitchens treated with the 1.0% boric acid bait were reduced an average of 32%, with several houses still containing large populations. Therefore, all houses treated with boric acid were discontinued and treated with a standard cockroach control insecticide. All other formulations gave significant ($P < 0.01$) control at 4 and 8 wk. Upon completion of the test, the Maxforce bait containers were opened. Many of the containers contained no bait, even though label recommendations as to the number to be placed per unit area were followed. The lack of bait in containers could have influenced the low percentage of cockroach reduction in several kitchens and suggests that additional containers may need to be placed in rooms with large cockroach populations.

| Treatment and concentration (%) | Avg. pretreatment count | Avg. % reduction* |
|---------------------------------|-------------------------|-------------------|
|                                 | Avg. | 2 wk | 4 wk | 8 wk | 12 wk | 16 wk |
| Avermectins dry bait            | 0.05 | 226  | 99a  | 99a  | 99a  | —    |
| Avermectins self-pressurized bait | 0.0025 | 102  | 76b  | 95ab | 97a  | 97a  |
| Cyfluthrin self-pressurized spray | 0.1 | 502  | 85ab | 90ab | 86a  | 86a  |
| Cyfluthrin self-pressurized spray | 0.2 | 361  | 91ab | 97ab | 91a  | —    |
| Boric acid dry bait             | 1.0  | 128  | 48c  | 32c  | —    | —    |
| Fenoxycarb dry bait            | 2.0  | 330  | 18d  | —    | —    | —    |
| MaxForce bait                   | 1.65 | 108  | 75b  | 84b  | 85a  | 85a  |
| Chlorpyrifos self-pressurized spray | 0.5 | 485  | 89ab | 96ab | 95a  | 95a  |

*Numbers within the same time frame followed by different letters were significantly different ($P < 0.01$; Waller-Duncan K-ratio t test).