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# LABORATORY EVALUATION OF INSECTICIDE GEL BAITS FOR CONTROL OF *SUPELLA LONGIPALPA* (DICTYOPTERA: BLATTELLIDAE)

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**Abstract** Five insecticide bait formulations have been evaluated for their attractiveness to adults of Brown-banded Cockroach, *Supella longipalpa* (F.) in laboratory trials. The gel formulations contained one of the following active ingredients (a.i.): hydramethylnon, imidacloprid, fipronil. Tests were carried out in plastic boxes (73 cm x 55 cm x 16 cm) in a climatic room (24° C; 60% RH), with 10 adults (5 males and 5 females). Every gel has been tested four times in presence of food source, water and cardboard shelter.

According to these tests, the attractiveness of gels decreased in the course of time; the majority of the adults have been killed in the first week than in the second and third ones. There were significant differences among the baits in their attractiveness to the Brown-banded Cockroach. The most effective gels were those with hydramethylnon and with fipronil 0.05%. After one week, more than 50% of the adults have been killed with tested hydramethylnon formulations and with fipronil 0.05% gel. In the following two weeks, the number of killed cockroaches has increased and in the test with hydramethylnon 2% formulation, the mortality rate was 100%. The formulation with fipronil 0.03% killed in three weeks about 50% of the adults. The worst gel was the one containing imidacloprid, which killed after three weeks less than 50% of the cockroaches.
**Key Words** *Supella longipalpa*, Brown-banded Cockroach, hydramethylnon, imidacloprid, fipronil.

## INTRODUCTION

The Brown-banded Cockroach *Supella longipalpa* (F.) was found for the first time in Italy, in domestic locations, in Genoa and Turin, in the year 1977 (Capra, 1977; Arzone, 1977). Then, this cockroach has widely spread in other cities, but at present it is not so common as *Blattella germanica* (L.), *Blatta orientalis* L. and *Periplaneta americana* (L.). *S. longipalpa* adults have a lifespan of 90-110 days at 30° C. A single female can produce a maximum of 20 oothecae. The postembryonal development takes about 55 days at 30° C, with 6-8 moults (Mallis, 1954). *S. longipalpa* is a domiciliary pest; it is possible to find it beneath tables, behind pictures and wallpapers where it feeds on the paste. It is used to harbour in furniture, bedding, cupboards and it seldom visits kitchens, except when it is in search of food. The wide distribution of Brown-banded Cockroach in apartments makes it very difficult to control (Cornwell, 1968).

The traditional control of cockroaches is based on the application of liquid formulations of pyrethroids, carbamates or organophosphates in or nearby infested harborages. This method is difficult to apply in case of *S. longipalpa*, because it is necessary to treat different areas in the room, with problems of pollution and the risk of damage to furniture and other points, where this insect prefers to glue the oothecae. The availability of the toxic baits use, in particular to control *B. germanica*, has significantly changed the way these pests are controlled. This change of strategies has been facilitated by the perception that the use of baits reduces the risk associated with insecticides in the domestic environment, including convenience and ease of use, discrete placement of the insecticide and minimal disruption to the customer during application (Lucas and Invest, 1993).

There are a lot of contributions on the evaluation of baits efficacy, on the attractiveness to males, females and nymphal stages of cockroaches and on the residual activity. These studies are especially about products available in different countries, with references to laboratory trials or field performance, mostly on the effectiveness of gels on *B. germanica* (Appel, 1992; Pospischil et al., 1999; Tanley and Appel, 1999; Nalyanya et al., 2001; Höbel and Royalty, 2002); few researches tested the attractiveness of this formulations on other species of cockroaches, in particular on *P. americana* and *B. orientalis* (Miller and Peters, 1999; Pospischil et al. 1999; Miller and Peters, 2002; Peters et al., 2002). Only a little number of works is about the palatability and effectiveness of gels on *S. longipalpa* (Pospischil et al., 1999; Nalyanya et al., 2001).

In Italy, in particular, we do not have studies about this topic. The aim of this work is to substantiate, with laboratory trials, the effectiveness of different commercial gel formulations on adults of *S. longipalpa*.

## MATERIALS AND METHODS

In these experiments it was used an insecticide susceptible strain of Brown-banded Cockroach *Supella longipalpa* (F.), reared in the laboratory of Istituto di Entomologia agraria, at the Università degli Studi di Milano (Italy) for 8 yrs, maintained at 25 ± 1° C and 65 ± 5% RH; water and dry crumbled crackers were provided *ad libitum*. Five 10/15-day-old adult males and five females have been used for all the tests. Cockroaches have been anesthetized with carbon dioxide to facilitate handling.

Five different gel baits have been tested with unbaited control: Maxforce® ultra, 1.8% hydramethylnon (Aventis); Siege®, 2% hydramethylnon (BASF); Goliath® gel, 0.05% fipronil (BASF); Maxforce® Gold Gel, 0.03% fipronil (Bayer); Solfac® Gel Scarafaggi, 2.15% imidacloprid (Bayer).

**Data analysis**

Insecticide gel baits have been tested in polyethylene arenas (73 cm x 55 cm x 16 cm) covered with a fine nylon net, to prevent cockroaches from escaping and to allow gas exchange. Water and food sources have been placed in two different corners of the arena; a drop of insecticide gel (0.06 ± 0.01g) has been placed at another corner, in front of the food, and pieces of corrugated cardboard were provided as harbourage at the last corner. Six arenas have been used; these were placed in a climatic room at 24 ± 1° C and 60 ± 3% RH. Anesthetized cockroaches were placed in the center of the arena and were allowed to acclimate for 1 day before the introduction of gel baits. Four replications were carried out for each gel.

The mortality rate was assessed daily for the first 3 days, then weekly for further 3 weeks. Dead cockroaches were not removed while the experiment was in progress.

The data have been elaborated with ANOVA and Duncan's *post hoc* test (SPSS for Windows 12.0). The results are expressed as a mean of dead adults ± $t_{student}$*SE (standard error).

## RESULTS

The results are shown in Table 1. In general, gels efficacy is higher in the first week because it has caused the death of many adults. After 1 day, only the fipronil 0.05% and imidacloprid gels were significantly different from control. In the following 2 days, fipronil gel 0.05% killed significantly more adults than the other gels (fipronil 0.03%, imidacloprid 2.15% and hydramethylnon 2%). Hydramethylnon 2% killed 100% of cockroaches after 3 weeks; a comparable result has been obtained using fipronil 0.05%. In our laboratory conditions, imidacloprid gel was the less effective to attract and kill *S. longipalpa* adults.

A statistical analysis (Table 2) shows that only in few cases there are significant differences between male and female mortality. In the following two days, fipronil 0.05% gel killed significantly more males than females; it is possible to observe other significant differences with hydramethylnon gels after 1 week and imidacloprid gel after 2 weeks. No significant differences between male and female mortality were observed with fipronil 0.03% gel.

Some females deposited oothecae during the tests and their hatching was observed (Table 3).

## DISCUSSION

The results indicate that some gels attract a significantly greater number of *Supella longipalpa* adults, but there is not always a correspondence with the results of laboratory trials carried out by other authors. In laboratory trials with *S. longipalpa*, Pospischil et al. (1999) observed a mortality rate of 100% of adults in 6 days, using a formulation of imidacloprid gel (2.15%) and rusk as alternative food. They used a higher amount of gel if compared to the quantity used in our trials, without specifying the number of adults for each test.

It is to highlight that in our test we have used the application rates indicated in presence of low-moderate infestations. Moreover, in our trials the gel baits have been placed in the arena in presence of alternative food, habitually used for rearing of *Supella longipalpa*. The results are then conditioned by the possibility that Brown-banded Cockroach could prefer usual food instead of tested gel baits. In presence of gel baits and usual food (that can be easily found in all infested houses) at the same time, it is impossible to obtain a significant reduction of population if the food is more attractive than the bait, as underlined in our results with imidacloprid. Nalyanya et al. (2001) highlighted a significant effect of bait type on the number of trapped adult males and females of

**Table 1.** Mean ± ($t_S$*SE) number of *Supella longipalpa* dead. Means followed by the same letter within a column are not significantly different (Duncan's test (P > 0.05)).

| | 1 day | 2 days | 3 days | 1 week | 2 weeks | 3 weeks |
|---|---|---|---|---|---|---|
| fipronil 0.05 % | 2.50±1.52 c | 4.75±0.59 c | 5.75±0.59 c | 7.25±1.48 c | 9.25±1.12 c | 9.50±0.68 cd |
| fipronil 0.03% | 0.75±1.12 ab | 2.00±2.35 ab | 2.25±2.94 ab | 4.75±2.61 b | 5.50±2.80 b | 5.50±2.80 b |
| imidacloprid 2.15% | 1.50±1.17 bc | 2.25±2.22 ab | 2.25±2.22 ab | 3.75±1.48 b | 4.75±0.59 b | 4.75±0.59 b |
| hydramethylnon 1.8% | 1.25±0.59 abc | 2.00±1.36 ab | 2.50±1.17 b | 6.75±1.12 c | 8.25±1.12 c | 8.25±1.12 c |
| hydramethylnon 2% | 0.50±0.68 ab | 3.50±2.04 bc | 4.00±1.92 bc | 8.25±1.12 c | 9.75±0.59 c | 10.00±0.00 d |
| control | 0.00±0.00 a | 0.00±0.00 a | 0.00±0.00 a | 0.00±0.00 a | 0.25±0.59 a | 0.25±0.59 a |

**Table 2.** Mean ± ($t_S$*SE) number of *Supella longipalpa* males and females dead. Means followed by the same letter are not significantly different (Duncan's test (P > 0.05)).

| | 1 day | | 2 days | | 3 days | |
|---|---|---|---|---|---|---|
| | males | females | males | females | males | females |
| fipronil 0.05 % | 1.75±1.12 b | 0.75±1.12 a | 3.25±0.59 c | 1.50±0.68 b | 3.25±0.59 d | 2.50±0.68 cd |
| fipronil 0.03% | 0.75±1.12 a | 0.00±0.00 a | 1.50±1.17 b | 0.50±1.17 ab | 1.50±1.17 abc | 0.75±1.76 ab |
| imidacloprid 2.15% | 1.00±0.00 ab | 0.50±1.17 a | 1.50±1.17 b | 0.75±1.12 ab | 1.50±1.17 abc | 0.75±1.12 ab |
| hydramethylnon 1.8% | 0.75±0.59 a | 0.50±0.68 a | 1.00±0.96 ab | 1.00±0.96 ab | 1.50±1.52 abc | 1.00±0.96 ab |
| hydramethylnon 2% | 0.50±0.68 a | 0.00±0.00 a | 1.75±1.48 b | 1.75±1.12 b | 2.25±1.12 bcd | 1.75±1.12 bc |
| control | 0.00±0.00 a | 0.00±0.00 a | 0.00±0.00 a | 0.00±0.00 a | 0.00±0.00 a | 0.00±0.00 a |
| | | | | | | |
| | 1 week | | 2 weeks | | 3 weeks | |
| | males | females | males | females | males | females |
| fipronil 0.05 % | 4.25±1.12 de | 3.00±1.35 bcd | 4.75±0.59 d | 4.75±0.59 d | 4.75±0.59 d | 4.75±0.59 d |
| fipronil 0.03% | 2.50±2.04 bc | 2.25±0.59 bc | 3.00±1.66 bc | 2.50±1.17 b | 3.00±1.66 bc | 2.50±1.17 b |
| imidacloprid 2.15% | 2.25±1.48 bc | 2.00±0.96 b | 4.00±0.96 cd | 2.75±1.12 b | 4.00±0.96 cd | 3.00±1.36 bc |
| hydramethylnon 1.8% | 4.50±0.68 e | 2.25±0.59 bc | 4.75±0.59 d | 3.50±0.68 bc | 4.75±0.59 d | 3.50±0.68 bc |
| hydramethylnon 2% | 4.75±0.59 e | 3.50±0.68 cd | 5.00±0.00 d | 4.75±0.59 d | 5.00±0.00 d | 5.00±0.00 d |
| control | 0.00±0.00 a | 0.00±0.00 a | 0.25±0.59 a | 0.00±0.00 a | 0.25±0.59 a | 0.00±0.00 a |

In laboratory trials, Brenner and Patterson (1989) observed that in presence of different baits *S. longipalpa* preferred Purina Cat Chow. Their results contradicted those reported in field tests by Adler (1985), who showed that a distiller's grain is a "highly specific" bait for this cockroach. All these data confirm the importance of the availability of alternative food sources, which could compete with baits in attractiveness of *S. longipalpa*.

The effectiveness of a.i. against this cockroach is proved; although the amount of available gel bait is an important element (Peters and Miller, 1999), the attractiveness of bait is probably the most considerable characteristic to control Brown-banded Cockroach quickly.

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