

Original Article

Rapid Elimination of German Cockroach, *Blattella germanica*, by Fipronil and Imidacloprid Gel Baits

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Abstract

Background: Baits have become popular and effective formulations against urban insect pests. Compared with residual sprays toxic gel baits are used more and more frequently to control urban cockroach populations. The aim of this study was to investigate the usage of two commercially available fipronil and imidacloprid gel bait formulations against *Blattella germanica* field infested in Iran.

Methods: The study was carried out in an urban area at Tehran from March 2004 to September 2005. The 0.05% fipronil and 2.15% imidacloprid gel baits were placed continuously in 3 residential German cockroach infested units. Pre- and post-treatment cockroach density was assessed by visual count method.

Results: Pre- and post-treatment visual count of cockroaches in treatment and control areas, and percentage reduction in cockroach density in treatment areas in comparison to control areas was showed that density reduction was increased with the 0.05% fipronil and 2.15% imidacloprid gel baits in treated areas from 1st to 9th week in comparison to control area. After 60 days, German cockroaches eliminated completely from these areas.

Conclusion: These results show that fipronil and imidacloprid gel baits are highly effective in field German cockroach infested after insecticide spraying control failure German cockroach infested fields where spraying of pyrethroid insecticides failed to control the situation and confirm previous reports stating that avermectin and hydramethylnon are more effective than conventional insecticides in baits against cockroaches. Therefore, fipronil and imidacloprid gel baits are appropriate candidates for controlling German cockroach infested dwellings in Iran where control with other insecticides failed because of resistance.

Keywords: *Blattella germanica*, Fipronil, Imidacloprid, Gel bait, Elimination

Introduction

German cockroaches, *Blattella germanica* (L.), are the most common urban cockroaches found in houses and restaurants and remain one of the most economically and medically important pest. It is omnivorous and consumes a wide range of food types and may hitchhikes into the house on food material cartons, sacks of potatoes or onions, used furniture or appliances, beer cases, etc. Produce departments, pawn shops, nursing homes and other such places are

constantly fighting German cockroaches (as a general rule) and are notorious for being the source of residential infestations (Cochran 1999). It is proven or suspected carrier of the organisms causing diarrhea, dysentery, cholera, leprosy, plague, typhoid fever (Czajka et al. 2003) and viral diseases such as poliomyelitis (Prado et al. 2002). In addition, they carry the eggs of parasitic worms and may cause allergic reactions including dermatitis, itching, swelling of the eyelids and serious respiratory conditions. In addition to a major source of indoor allergens

and responsible for increased incidence of asthma (Roberts 1996, Eggleston and Luisa 2001, Katial 2003), there is emphasis to the need for the control of this insect pest.

Sanitation is a critical step in German cockroach control therefore water residues should be eliminated as many moisture sources as possible. All cockroach food sources should be eliminated.

Searching for new insecticides and new methods of insecticide delivery to control the heavy infestations of German cockroach continues as another important tool. Until recently, the control of German cockroach relied largely on sprays based on synthetic insecticides. With the development of baits, which can be selectively applied where the German cockroach live, the situation has now changed. Compared with residual sprays, baits take advantages of long residual activity, safer application and less environmental pollution.

Cockroach baits that are currently available include such formulations as granular, pelleted, containerized, pastes and gels, and have been improved due to their efficient non-repellant active ingredients, highly attractive and palatable food ingredients, as well as their high moisture content. Toxic gel baits are used more and more frequently to control urban cockroach populations (Appel 1990, Koehler et al. 1995, Cochran 1999). Gel baits can be selectively used in sensitive areas, such as premises used for the preparation of food, hospitals and kindergartens (Benson and Zungoli 1997). Gel baits have been the main method for German cockroach control in the United States for at least 5-8 yr (Harbison et al. 2003). Gel baits are proven to be convenient to use and highly effective to German cockroach control (Appel 1992, Ross 1993, Appel and Benson 1995, Kaakeh et al. 1997, Appel and Tanley 2000). When the active ingredient is incorporated into palatable bait, cockroaches readily consume a lethal dose from a single meal. Therefore,

baits were considered less likely to select for high-level cockroach resistance than insecticide sprays and other formulations.

Fipronil is a disruptor of the insect central nervous system via the GABA channel, acting with contact and stomach action. It blocks the GABA-gated chloride channels of neurons in the central nervous system, resulting in neural excitation and death of the insect. It is used against cockroaches, ants, termites, fleas, ticks, and mites in several formulations including sprays, baits, granules, dusts, and in flea and tick collars. It is the active ingredient in Frontline, Termidor, Maxforce ant gel, and various other brand names (Moschetti 2004).

Imidacloprid is an insecticide belonging to the chloronicotinyl class of compounds and its use as a new crop protection agent was first proposed in 1991 (Leicht 1993). Because it exerts its effects after oral ingestion, imidacloprid is also suitable for use in bait formulations (Londershausen 1996). Imidacloprid exerts no contact effects in gel form and does not vaporize into the surrounding atmosphere. This is of practical benefit, as it means there is no contamination of the environment by the active ingredient, and that the cockroaches must continue to have gel available to them until no more is being eaten. Imidacloprid generally has low toxicity to mammals (acute and chronic), birds, and fish. The low affinity of chloronicotinyl for vertebrate relative to insect nicotinic receptors is a major factor in their favorable toxicological profile. As to its performance: good reliable control, high selectivity, quick knock-down/protection and long residual activity are key features (Cox 2001).

The efficacy of toxic gel baits has been widely investigated, but their toxicity is generally estimated only from mortality rates (Scott 1991, Ross 1993, Kaakeh et al. 1997b). A number of laboratory studies have reported efficacy of fipronil and imidacloprid gel baits in control of cockroach infes-

tation but only a few field studies have been done so far. Nasirian et al. (2006) reported that the fipronil and imidacloprid gel baits completely killed the German cockroaches under laboratory conditions in ingested bait method (Nasirian et al. 2006). Very little field information is available about the efficacy and performance of fipronil and imidacloprid gel baits against field *B. germanica* infestation in Iran. The present study was thus conducted with the aim of evaluating the efficacy of two commercially available fipronil and imidacloprid gel bait formulations in the control of *B. germanica* field infested in Iran.

Materials and Methods

Study area and duration

The study was carried out in 4 residential units in an urban area at Tehran from March 2004 to September 2005. The residential units were located in different areas of Tehran. Of these 4 residential units, 3 were selected for treatment and 1 for control.

Sanitation

Field cockroaches infested were managed by controlling the availability of food, water, and hiding places. Food and water were not left out overnight and stored so as to deny access by the cockroaches. All spilled foods, including crumbs on the floor were cleaned up.

Trial procedure

The evaluated insecticide were imidacloprid gel bait 2.15%, Bayer AG Leverkusen, fipronil gel bait 0.05%, commercialized as Goliath, Rhone-poulenc Rhodic, Lyon, France.

Pre-treatment assessment in the field

In all residential unit included in the study following pre-treatment assessment was done:

Visual counts

The visual counts were done in the night after 24.00 h. The participant residential units were asked to close the residential units by 23.00 h and switch off the light. The lights were

switched on after 24.00 h and cockroaches were counted as they ran about hiding over tables, sink, cooking areas, etc. Light from a torch was thrown behind cabinets, storage areas and dish racks for counting the cockroaches. A 5 minute count of cockroaches was taken (Tilak et al. 2002). Visual counts more than 75, between 25 to 75, and less than 25 graded as severe, moderate, and mild infestations, respectively.

Insecticide treatment

The 0.05% fipronil and 2.15% imidacloprid gel baits (fipronil gel 0.05%, commercialized as Goliath, Rhone-poulenc Rhodic, Lyon, France and imidacloprid gel bait 2.15%, Bayer AG Leverkusen) were placed continuously in 3 residential units German cockroach infested. The fipronil and imidacloprid gel baits were placed simultaneously inside split, seams, under sink and in the soft drink lids as a container where no split exist and seams by linear or point application. The gel baits repeated periodically every week.

Post-treatment density

Post-treatment density was assessed by visual count method every week up to nine weeks, since it was found to be a better indicator of cockroach infestation. The visual assessment data in treatment and control residential units were considered for calculation of the percentage of reduction in cockroach infestation in residential units using the following formula of Mulla (Mulla 1971). % reduction = $100 - (C1/T1 \times T2/C2) \times 100$. Where, C1 is the number of cockroaches in control residential unit pre-treatment; T1 is the number of cockroaches in treatment residential unit pre-treatment; C2 is the number of cockroaches in control residential unit post-treatment; and T2 is the number of cockroaches in treatment residential unit post-treatment.

Results

The 0.05% fipronil and 2.15% imidacloprid gel baits were placed continuously in

3 residential units German cockroach infested. Pre- and post-treatment visual count of cockroaches in the treatment and control areas and percentage of reduction in cockroach density are presented in Tables 1 and 2. It was observed that 25.0, 23.6 and 26.5% reduction was achieved with the 0.05% fipronil and 2.15% imidacloprid gel baits in treated area 1, 2 and 3, respectively by 1st week in comparison to control area. Percentage reduction increased in the 0.05% fipronil and 2.15% imidacloprid gel baits treated areas 1, 2 and 3, 45.6, 53.0 and 51.8 percent, respectively by week 3 post-treatment and it was 100 percent by the end of week 9 post-treatment. After 60 d German cockroaches eliminated completely from these areas.

Discussion

Extensive use of insecticides has led to the development of resistance in German cockroach to a wide range of insecticides including organochlorines, organophosphates, carbamates and pyrethroids (Lee et al. 1996, Cochran 1997, Ladonni 2001, Nasirian et al. 2006b) and consequent control failures in some field populations have been reported

(Cochran 1989, Scott et al. 1990, Atkinson et al. 1991, Valles and Yu 1996, Dong et al. 1998, Valles 1999, Valles et al. 2000, Wei et al. 2001). Fipronil and imidacloprid are relatively new and act at new target sites, which are currently not affected by resistance than other previous insecticides that will be used for pest control especially against German cockroach.

These results show that fipronil and imidacloprid gel baits are highly effective in field German cockroach infested after insecticide spraying control failure with pyrethroid group insecticides and confirm the previous investigator reports that reported the avermectins (Cochran 1985), boric acid (Kocak 1990) and hydramethylnon (Mac Donald et al. 1987) are to be more effective than conventional insecticides in baits against cockroaches, and it will be suggested that fipronil and imidacloprid gel baits are highly effective in field German cockroach infested. Therefore, fipronil and imidacloprid gel baits are the appropriate candidates for controlling the infested German cockroach control failure dwellings of insecticide resistance in Iran.

Table 1. Cockroaches density estimation in control and treatment areas by visual assessment method

Duration	Visual count			Control area
	Treatment with fipronil and imidacloprid gel baits			
	Area 1	Area 2	Area 3	
Pre-treatment	115	214	189	138
Post-treatment (wk)				
1	95	180	153	152
2	68	125	95	145
3	39	75	68	103
4	25	36	29	136
5	17	25	18	175
6	12	10	13	204
7	8	5	7	193
8	3	1	2	169
9	0	0	0	139

Table 2. Comparison of reduced percentage of cockroach density in treatment versus control areas

Post-treatment weeks	Percentage reduction in fipronil and imidacloprid gel baits treated areas in comparison to control area		
	Area 1	Area 2	Area 3
1	25.0	23.6	26.5
2	43.7	44.4	52.2
3	45.6	53.0	51.8
4	77.9	82.9	84.4
5	88.3	90.8	93.6
6	92.9	96.8	95.1
7	95	98.3	96.8
8	97.9	99.6	99.1
9	100	100	100

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