LURE AND KILL : AN UP-TO-DATE, ENVIRO-FRIENDLY COCKROACH CONTROL METHOD

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Abstract—Cockroaches settling down in various sanitary trade institutions, industrial establishments as well as in residential buildings may spread potential infectious diseases and allergy or – through their disgust provoking effect – may disturb people living or working there. As a consequence, regular control of these pests is a must. During the last decade, the fight against German cockroach (*Blattella germanica*) and Oriental cockroach (*Blatta orientalis*), the most common cockroach species in Central Europe, has gone through considerable changes and improvement.

Earlier pest controllers tried to eliminate cockroaches mainly by spray or dust formulations applied to the surfaces in large amounts. These methods remain usually ineffective, as the insecticides often have a repellent effect; in some cases, the insecticides get incrusted with fat or dust, or they are removed during cleaning soon. Such control methods have to be considered passive, since it is quite doubtful whether pests get in appropriate contact with the treated surface.

Demands to decrease wide-range use of pesticides in human environment and/or to apply formulations as little toxic to the environment as possible, have continuously increased recently. Therefore, in accordance with today's concept, we should attract the insects to the pesticide-free tools (traps) or insecticide containing baits (killing station, gel) instead of getting the insecticide to the insects. The essence of control consists in using the insecticide only on a restricted area and in small quantities.

As per the test results presented, for the control according to the lure and kill method are excellently suitable – among others – MEGFOG-LAK B sticky cockroach trap, PROTECT B cockroach killing station having – due to its synthetic pyrethroid content – a fast killing effect, as well as PROTECT B cockroach killing gel, all manufactured by Bábolna Bioenvironmental Centre.

INTRODUCTION

Cockroaches can be found in almost all places where mankind lives and the constant improvement in his living standards has offered these and various other pests even more favourable habitats. In Europe, the German cockroach (*Blattella germanica*) and the Oriental cockroach (*Blatta orientalis*) are the most common cockroach species. Recently, two other species originating from warmer climate countries have appeared and have caused problems more and more often; these are the American cockroach (*Periplaneta americana*) and the Brown-banded cockroach (*Supella longipalpa*). (Bajomi, 1984) This fact also supports the remarkable adaptability of cockroaches. Apart from temperature and relative humidity, appropriate hiding place is the main factor influencing the settlement of cockroaches (Bajomi and Elek, 1979). Cockroaches are omnivorous and not particular about their food; therefore, despite the improvements in general hygiene standards, they practically find food sources in all places where people live. The more and more spreading panel construction as well as central heating and exhaustion systems all provide excellent hiding places for cockroaches that favour their settling down and proliferation. (Bajomi and Elek, 1979)

From the body surface of the German cockroach and the Oriental cockroach, 40 different pathogenic microorganisms have been isolated. Considering that during their migration or their search for food cockroaches regularly visit decomposing waste, virulent mucus or faeces, and since their route is quite uncontrollable, they must be considered as potential transmitters of infectious diseases (Burgess, McDermott and Whiting, 1973; Burgess, 1981; Frishman and Alcasmo, 1977; Graffer and Mertens, 1950; Masters, 1960). Apart from this, with sensitive persons they may cause allergy; the fact that – especially in apartments – they provoke disgust by their pure presence can neither be neglected. For the above reasons, effective cockroach control is unavoidable (Bernton and Brown, 1964).

There are many factors that hinder effective protection against cockroaches. Cockroaches are extremely reproductive pests, especially at high temperatures. Their eggs are located in an ootheca well resisting to both the environment and most of the insecticides. Cockroaches are insects of

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hidden habitat avoiding light and mostly becoming active only in the dark. As they hide in small cracks and crevices in the daytime, it is diffucult to determine the site and level of infestation.

Whenever possible, cockroaches avoid insecticide-treated surfaces, as a result of repellency. Still – especially in the past but even nowadays – spraying of insect neuro-toxins (organophosphorous acid esters, carbamates, synthetic pyrethroids) onto the surfaces is considered the most widely used method in Europe. Repellency may be considerable especially in respect of synthetic pyrethroids. The residual insecticide applied to the surface is often washed off soon; if this is not the case, it gets covered by dust or fat what considerably decreases its efficacy. Apart from this, during application of residual insecticides on large surfaces – due to the outlined reasons and especially to unprofessional treatments – resistance to the insecticides may develop soon.

Taking into consideration that it is uncertain whether cockroaches will get in contact with the treated surfaces or not, cockroach control carried by the described general surface treatment or by zone spraying has to be considered as *passive* control method. The so-called fumigation carried out by DDVP may be a method more effective than passive control operations by residual insecticide spraying. DDVP is a toxic phosphorous acid ester (Oral LD_{50} value on rats: 56–80 mg/kg body weight) that presents hazards to both the client and the pest control operator. According to the latest statement of the U.S. Environmental Protection Agency, the carcinogenic effect of DDVP cannot either be excluded, therefore its use is not recommended. Cockroach control carried out by DDVP has a further inconvenience, as the client has to leave the treated premises for a longer time (Mueller, 1995).

If surface treatment with residual insecticide is completed by flushing out by natural pyrethrum or synthetic pyrethroid (tetramethrin, bioallethrin, bioresmethrin) having good flushing out effect, then contamination of cockroaches with the residual insecticide will increase considerably. The flushing out agent can be applied in several ways: mixed to the working solution containing the residual insecticide formulation or as a cold fog following the spraying. This latter method is substantially more effective, especially when carried out by a ULV generator producing 10–20 micron particles. The flushing out agent with such particle size is able to enter into the cracks and crevices where cockroaches hide, and will float in the air-space of the premises for a long time.

Both "fumigation" carried out by DDVP and residual spraying completed with flushing out agent may be considered as *active* cockroach control method. The use of flushing out agents represents a serious progress which increases the efficacy of cockroach controls considerably.

METHODS AND RESULTS

Taking into account the extreme prolificacy, the hidden habitat, the remarkable adaptability and the excellent hardiness of cockroaches, effective and successful protection – especially on the long run – can be achieved only by the application of up-to-date and integrated pest control (IPM) techniques (technologies). (Edwards, 1993)

The up-to-date cockroach control method must have an appropriate rapid effect, especially expected by the client. The method must remain effective for a longer period, in order not to bother the inhabitants, the clients with frequent reitered treatments. It is important that the insects should not become resistant to the applied insecticides soon. In recent time, it is more and more expected – especially in Europe and under the influence of the so-called 'green' movements – that the used insecticide formulations and application methods be the least possibly toxic to the environment and especially to the clients. Another demand in this connection is that instead of preventive and wide-range application of the insecticides they should be used only in restricted areas and for a limited duration in apartments and food-handling units (shops, restaurants, etc.). (Edwards, 1993; Jones, 1993)

Cockroach trap

The sticky traps with non drying glue contain some attractant, but contains no insecticide at all. When the attractant is appropriate, the traps are suitable for catching any cockroach species,

including also larvae in different developmental stages. Each trap remains effective for as long as 4–6 weeks, or even longer (when there is not much dust or if the trap does not fill up fast). The carton trap does not pollute the environment at all, and is made of 100 % degradable compunds, therefore it is fully acceptable in respect of environment protection.

The application of a good quality cockroach trap (large or small monitoring trap) makes it easy and sure to determine whether there is a cockroach infestation in a given place. If the traps indicate there is, it becomes possible to determine what species is/are causing the infestation, and the exact site and extent of infestation can also be localized, as can be determined its level, too (Bajomi and Guthy, 1981). In case of slight infestation, the problem can be solved by trapping in itself.

When applied prior to control, the trap allows to precise the place and extent of the necessary treatment; this permits to carry out aimed treatment and to use less insecticide which comes to save time and work, that is money (Bajomi, Kis-Varga and Bánki, 1993[4]; Bajomi, Kis-Varga and Bánki, 1993[5]). If used after control, the trap helps to check the efficacy of the work done, and – if necessary – the result can be improved by reitered aimed intervention. Use of the traps allows to follow up the effect of the treatment carried with Insect Growth Regulators (IGR), which only exert their effect over a longer period of time. Regular use and checking of the traps help to monitor the existence of pest-free state or emergence of re-infestation (Bajomi, Kis-Varga and Bánki, 1993[4]; Bajomi, Kis-Varga and Bánki, 1993[5]). Thus, the traps will provide a warning in time, before pest populations reach the critical level either in respect of economical or public health considerations. When the trap is used by the client (e.g. tenant, municipality, etc.), it can check the efficacy of the work done by the pest controller. Last but not least, the traps allow to eliminate infestation even in places where the use of insecticides is completely prohibited (premature baby wards in hospitals, zoo, etc.).

Use of pheromones seems to be quite obvious to lure cockroaches, this method having proved good in case of moths. The sex pheromones released by the female individuals are attractive to the males only, yet in public health the goal is to catch both individuals (Jones, 1993). Therefore, more favourable results could be achieved by using aggregation pheromones attracting both sexes. The relatively under-developed olfactory organ of cockroaches is a problem in both cases, thus the pheromones are only attractive from a short distance; therefore, use of food type attractants seems to be the most praticable solution. Food attractants lure various species in a satisfactory but different measure (Figures 1 and 2).

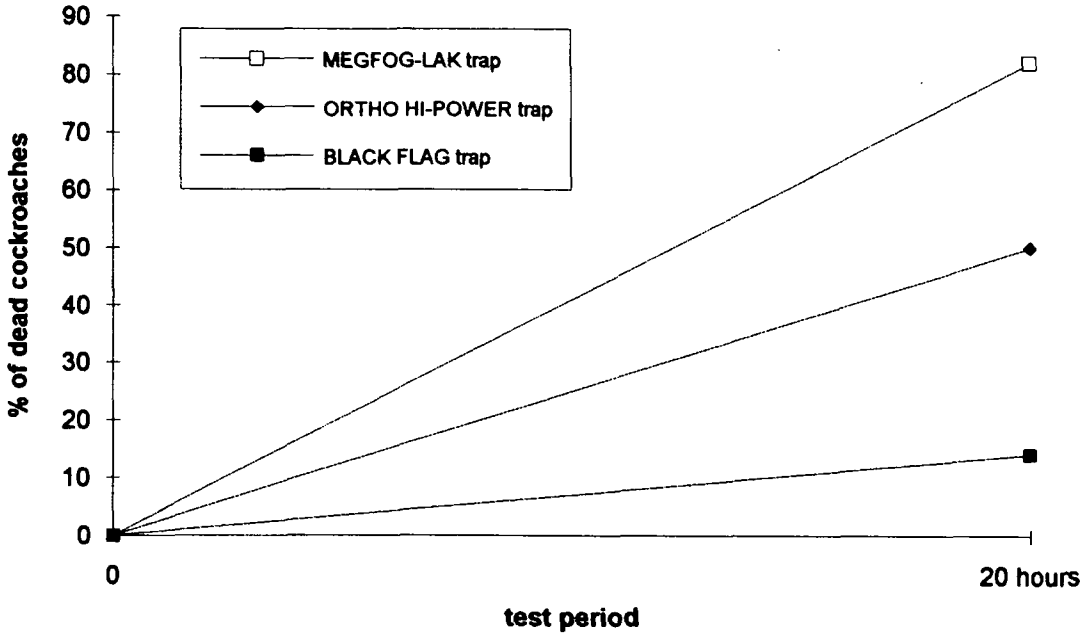
Cockroach killing station

The insecticide used in cockroach killing stations is a relatively fast killing active ingredient acting either as a stomach poison (hydramethylnon, chlorpyriphos, avermectin) or a stomach and contact poison (beta-cypermethrin). To attract cockroaches to the station, appropriate – practically food – attractants have to be used.

Laboratory and field experiences prove that the synthetically manufactured nature-like food attractant used in the attractant tablet of MEGFOG-LAK B cockroach trap can be excellently applied in the cockroach killing station, too. This attractant is so strong that it is able to overcome the repellency of synthetic pyrethroids like the third-generation beta-cypermethrin, which is the active ingredient of PROTECT B cockroach killing station, resulting in an excellent attracting and killing power against cockroaches of all species and developmental shapes (Figure 3).

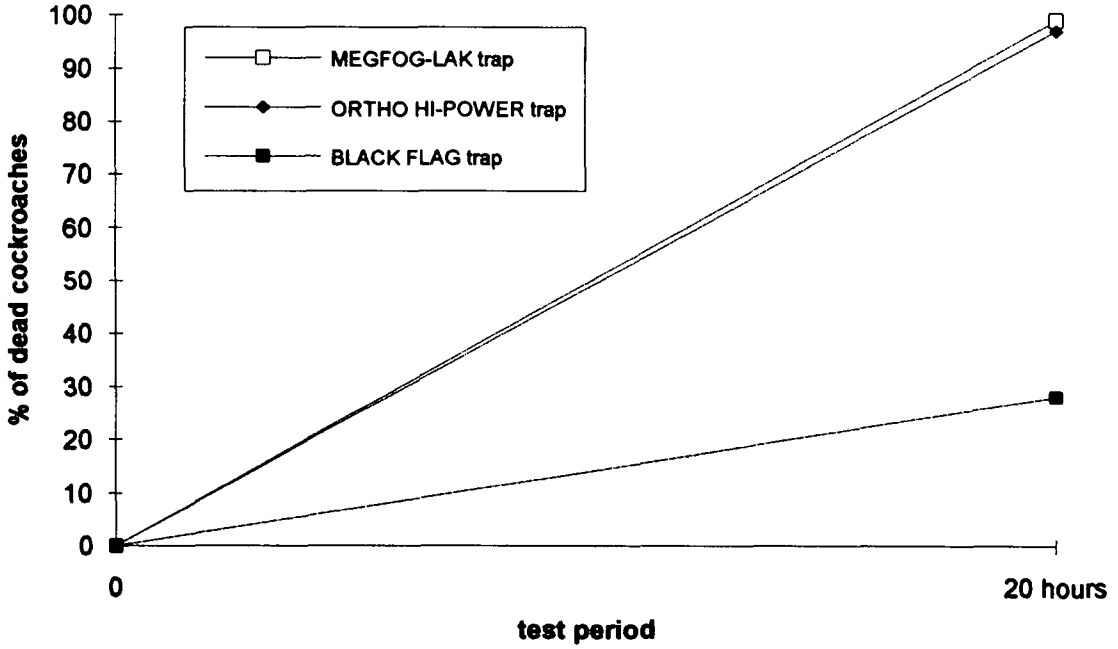
Apart from this, the killing active ingredient of PROTECT B cockroach killing station is completed with an Insect Growth Regulator (hydroprene), capable of being translocated, and thus able to regulate the development of cockroach population not entering into contact with the traditional insecticide. However, this principle has not been fully proved in practice yet.

A further advantage of the cockroach killing station is that due to the special solid plastic casing, neither children nor domestic animals have access to the insecticide itself. On the other hand, the plastic casing provides a good and lasting protection for the formulation. Thanks to the outstanding attractant and luring substances, the station is effective even in places where lots of alternative food are available for cockroaches. The cockroach killing stations are easy to use (due to their self-adhesive disc usually also on vertical or bending surfaces) and do not disturb clients.



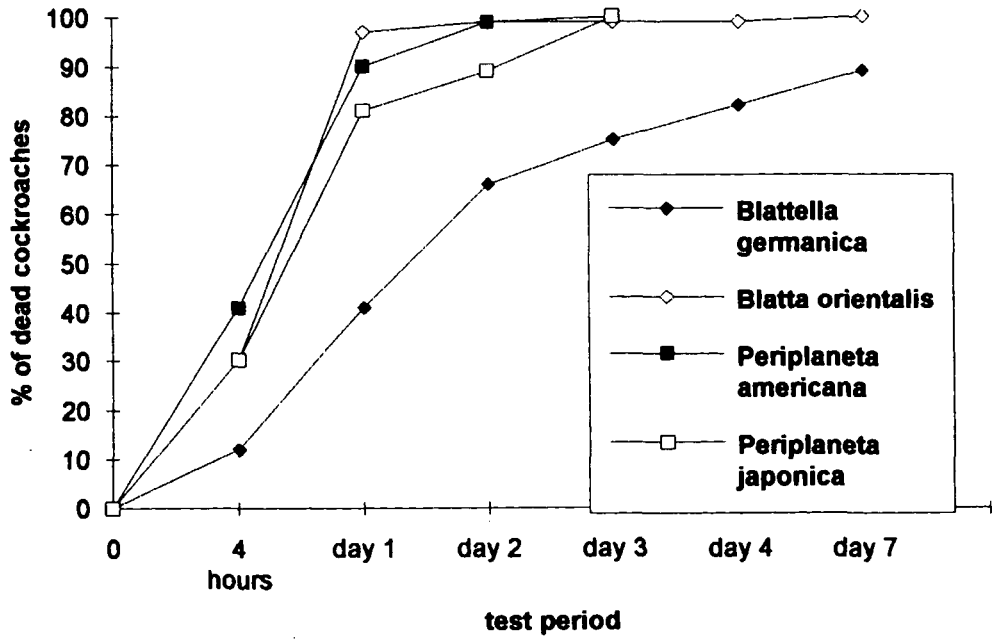
Test animal: *Periplaneta americana* (10 males, 10 females and 10 nymph)
Date of test: 1993
Test conducted by: McLaughlin Gormley King Company (USA). File No. C-2086-93
Test type: free choice
Test conditions: in 76×76×38 cm vessel, 27°C, relative humidity of 50%, 12 hour light/dark cycle.

Figure 1. Comparative biological efficacy test of cockroach traps (*Periplaneta americana*)



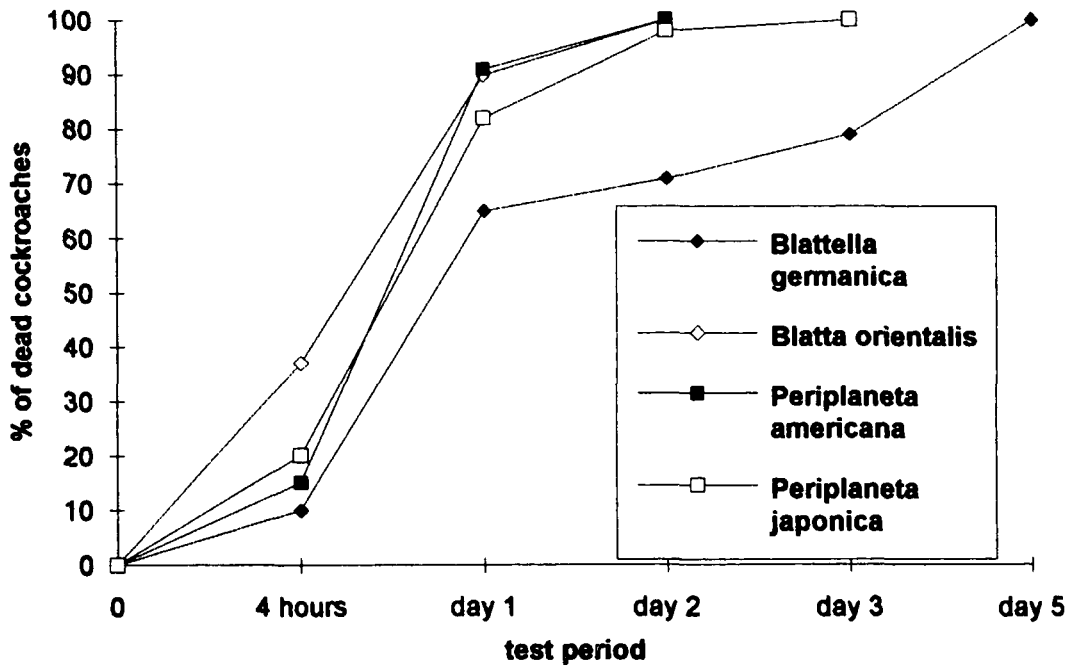
Test animal: *Blatta orientalis* (10 males, 10 females and 10 nymph)
Date of test: 1993
Test conducted by: McLaughlin Gormley King Company (USA). File No. C-2085-93
Test type: free choice
Test conditions: in 76×76×38 cm vessel, 27°C, relative humidity of 50%, 12 hour light/dark cycle.

Figure 2. Comparative biological efficacy test of cockroach traps (*Blatta orientalis*)



Date of test: 1993
Test conducted by: Bábolna Bioenvironmental Centre (Hungary)
Test type: free choice
Test conditions: in 80×60×20 cm vessel, with alternative harbourage and food. 25°C, relative humidity of 65%, continuous darkening

Figure 3. Biological efficacy test of PROTECT B cockroach killing station on different cockroach species



Date of test: 1993
Test conducted by: Bábolna Bioenvironmental Centre (Hungary)
Test type: free choice
Test conditions: in 80×60×20 cm vessel, with alternative harbourage and food. 25°C, relative humidity of 65%, continuous darkening

Figure 4. Biological efficacy test of PROTECT B cockroach killing gel on different cockroach species

Cockroach killing gel

The principle of application of cockroach killing gel – also containing insecticide and IGR active ingredient and attractant – is quite similar to that of cockroach killing station. The main difference between the two is that – when applied – in case of gel there is no plastic casing, the role of this being taken over by the cracks and crevices where cockroaches hide in and where gel has to be applied to. Similarly to the cockroach killing station, the gel has good attractivity to cockroaches, and preserves its efficacy for a longer period than sprays (Figure 4). In certain countries, the gel is available for control by both individuals and PCOs (Pest Control Operators). As regards Europe, common use is characteristic of controls by PCOs only.

PROTECT B cockroach killing gel contains the same active ingredients (beta-cypermethrine + hydroprene) and attractants as the cockroach killing station; as a result, its efficacy is similar, too.

Spray + attractant

Accepting and further developing the concept of lure and kill, in principle it is possible to treat only limited surfaces with the residual insecticide, and to lure cockroaches on these areas with the help of an appropriate attractant. Residual spot spraying can be carried out with any kind of residual insecticide, including also synthetic pyrethroids. As for lure, it can be done in two ways: either with the attractant tablet used, for example, in the cockroach trap or by adding one liquid attractant to the working solution containing the residual insecticide during application. This is a new concept being currently improved and tested in practice. If proves good, its use will allow quick and effective insecticide application on limited areas only.

SUMMARY

The application of lure and kill, a new, enviro-friendly cockroach control concept, together with the systematic use of traps enables us to determine the type, level and site of cockroach infestation both in terms of space and time. The use of traps as part of the system permits a monitoring during controls by PCO's that will allow to apply small quantities of insecticides only there and then where and when it is indispensable, instead of their preventive and wide-range use.

Even in this case, instead of getting the insecticide to the insects in some accidental way, we attract the insects to the insecticide (spray, gel) or to the control device (cockroach trap, cockroach killing station). The application of such techniques is not considered *passive,* but – due to their improved efficacy based on the attractant effect – are *active* control methods.

The application of integrated lure and kill method in practical cockroach control allows to improve the efficacy of control operations even in so-called 'hard areas', on the one hand, and to offer a solution that is more acceptable also in terms of environment protection, on the other.

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