

Integrated Pest Management for the German cockroach (*Blattella germanica*) in selected urban communities

Gholam Hossein Shahraki*, Yusof Bin Ibrahim, Hafidzi Mohd Noor , Javad Rafinejad , Mohd Khadri Shahar

* Corresponding author: shahraki.gh@gmail.com



- The German cockroach, *Blattella germanica*, is the most common indoor species, especially in residential buildings in some countries such as Iran.

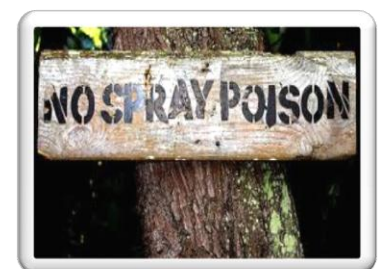
- Current control strategy which relies heavily on residual contact insecticides has resulted in the development of insecticide resistance or tolerance to all the major groups of insecticide (organochlorines, organophosphates, carbamates and pyrethroids) in field populations of this species.



- This situation has led to the application of more insecticide in an attempt to increase the number of insects killed.

- Because of the problems encountered, and in some cases the impossibility of eliminating the cockroach species completely, the concept of Integrated Pest Management as an alternative was recommended.

- In this approach, to reduce frequent application of harmful pesticide and target the pest species more accurately, and at the same time reducing the potential



for inducing resistance, a range of pesticides applied as bait have been developed.

- The strategy of IPM approach is based on: repeated monitoring, sanitation, educational programs, and the limited use of insecticides such as gel bait.



- Hence, a study was performed to evaluate the effectiveness of an IPM approach on German cockroach using hydramethylnon gel bait combined with vacuuming and educational programs in four study locations.

MATERIALS AND METHODS



- **Sticky traps** were used for monitoring cockroach populations in infested sites. The trap catch data were recorded weekly (i.e. after the 7-day trapping periods) over an 8-month period.

- **Siege Gel bait (hydramethylnon 2%)** in a 30 g tube was applied to IPM intervention locations. Siege had been calibrated (according to manufacturer's recommendation) to be applied at the rate of 0.5 g m²(10 droplets).



Study city (Yasuj, Iran)

Student dormitory; Housing complex;

Office; Hotel; Hospital;

- Inspected on **11 student dormitories** (comprising 386 residential units), **two different groups of staff housing complex** (comprising 46 apartment units), **two hospitals** (comprising 121 units), **one hotel** (comprising 17 residential units) and **22 official premises** located in South Western Iran,

showed sizeable German cockroach infestation for four study locations (two dormitories, one residential building and one hospital).

- Selected dormitories (G and I) were single dormitories comprised of 53 and 72 residential units and 250 and 220 occupants respectively. Selected residential building (House building F) comprised of 25 apartments and 186 residents. Furthermore, the hospital chosen for survey consists of 10 sections and 101 rooms.



- After injection of gel baits, an educational program was set up by putting up posters, handing out pamphlets, individual discussions and conducting informative lectures to students and other occupants in the intervention section on tactics of the IPM system. Sanitation using HEPA-filter equipped vacuum cleaners

was performed four times in treatment units.

RESULTS AND DISCUSSION

Among the total of 7,257 cockroaches trapped, *Blattella germanica* species was the most abundant, comprising **96.7%**. The other identified species in order of abundance were: the Turkestan cockroach (*Blatta lateralis*) (2.2%), the American cockroach (*Periplaneta americana*) (0.9%), the Brown-banded cockroach (*Supella longipalpa*) (0.07%), and the Oriental cockroach (*Blatta orientalis*) (0.03%). Progressive percentage reductions of weekly infestation rates are shown



in Figure 1. They indicated considerable reductions after two weeks of intervention. Slow action of siege[®] gel bait and the gradual impact of educational programs (to improve attitude of occupants about sanitation and exclusion) and vacuuming (to affect bait performance against cockroaches) were identified as effective factors contributing to the lag in infestation reductions.

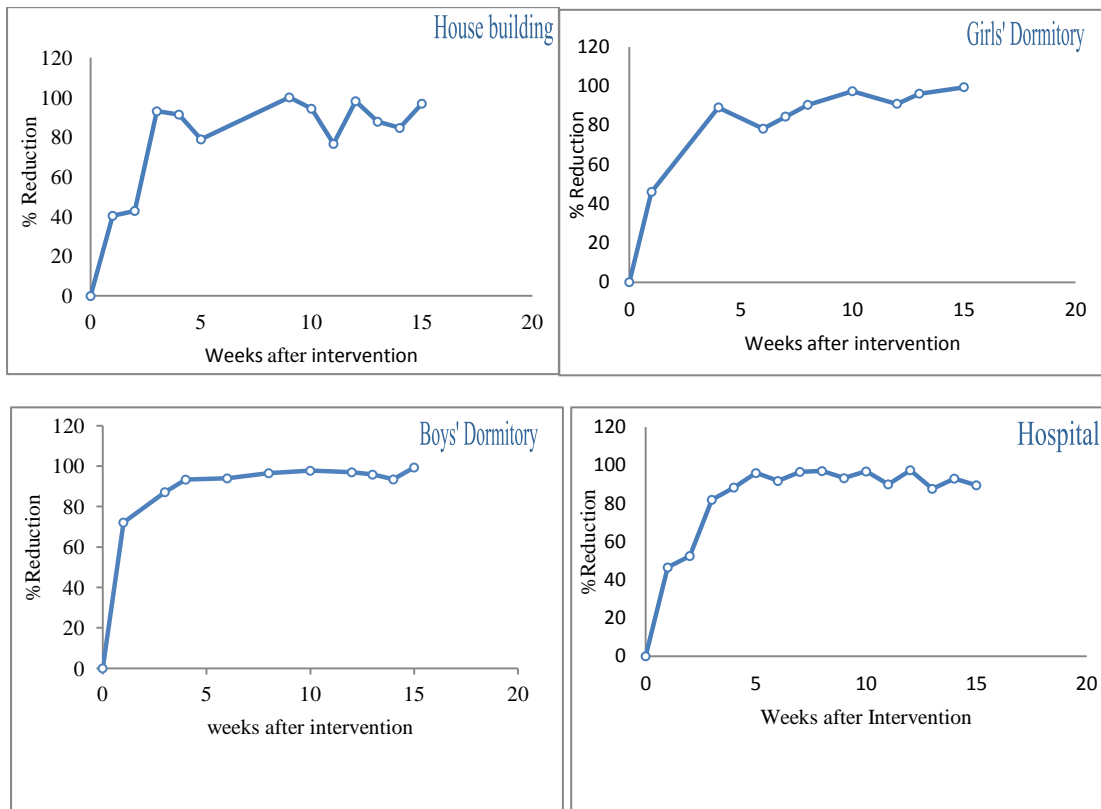
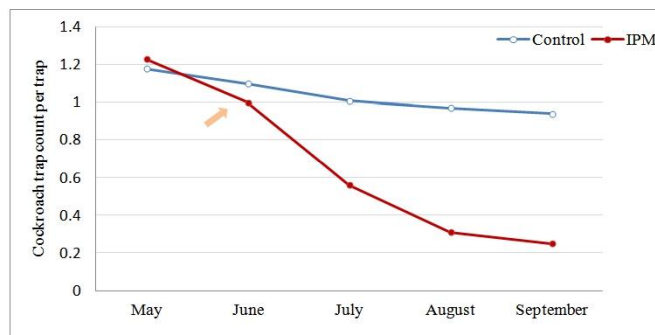


Fig.1: Mean of weekly percentage reductions of infestation rate throughout the IPM intervention for the three study locations.

Figure 2 illustrates the progressive reduction of infestation for five months after treatment (via transformed data before autumn).



* arrow shows start time of intervention

Fig. 2: Monthly mean of pre and post cockroach trap count at the Girls' dormitory

Table 1 shows significant reductions for mean cockroach trap counts (mean of post treatment weeks) after IPM intervention ($P < 0.05$) compared to control groups. Moreover, mean percentage reductions during post treatment weeks for all

study locations showed significant reductions ($P < 0.05$). Mean corrected percentage reductions (with effectiveness of control reduction) during a similar period treatment (15 weeks) are shown in Table 1. This shows that the mean of percentage reductions (corrected) for residential buildings during 15 weeks treatment was 76.8% and this was lower than the reduction in the hospital. However, there was no significant difference ($P > 0.05$) between mean of percentage reductions for the four locations.

Table 1: A total of German cockroach trap counts and followed corrected percentage reductions throughout the 15 weeks treatment period in the study locations

Study Locations	Treatments	Pre treatment (Mean)	Post treatment (Mean 15 weeks)	Corrected %reduction for mean post treatment*
Girls' dormitory G	IPM	16.69±6.2a	2.37±0.6a	72.11a
	Control	15.16±4.2a	7.72±2.19 b	
Boys' dormitory I	IPM	19.82±7.00c	1.47±0.46c	72.56a
	Control	12.1±4.32c	3.27±0.91d	
House building F	IPM	10.5±3.62e	1.5±0.41e	93.02a
	Control	3.58±0.72e	7.33±1.17f	
Hospital C	IPM	4.23±1.18g	0.44±0.24g	88.13a
	Control	3.80±0.77g	3.33±0.76h	

Means within column followed by the same letter are not significantly different at $P = 0.05$; * Kruskal-Wallis test; Corrected %Reduction by Mulla's formula (Mulla, 1971): $[100 - (\text{pre-control} / \text{pre-treatment} \times \text{post-treatment} / \text{post-control}) \times 100]$

Percentage recoveries after treatment for intervention units are shown in Table 2. All the remaining infested units (for premises) were in the low level of cockroach index and 67-100% recovery of infestation for premises (dormitories and house building) and 83% for hospital were recorded after treatment period. Low level of infestation is also a good level to achieve in IPM program and thus according to the scope of this study, percentage recovery for infested units of the premises improved by 100% after 15 weeks of treatment. High sensitivity of cockroach index for hospital and remaining infestation only for kitchen section (due to food debris) resulted in 83% recovery for this location. However removing this section from the analysis or calculation cockroach index for the kitchen section similar with other premises (dormitories and house building), improving recovery to 100% in achieving clean and low level of infestation.

Table 2: A total of corrected percentage reductions and percentage recoveries for IPM intervention during 15 weeks treatment period in the study locations

Study locations	No. of Sampling units	% Infested units	pre trap count (mean for intervention)	%reduction* (for mean post trap counts)	%Recovery of infestation**	Remaining infested units after treatment
Girls' dormitory G	53	72	16.69	72.11	100	Clean
Boys' dormitory I	72	72	19.82	72.56	94	Low ($1 < x \leq 3$ ck/trap)
House building F	25	60	10.5	93.02	67	Low ($1 < x \leq 3$ ck/trap)
Hospital	101	61	4.23	88.13	83	Moderate ($3 < x \leq 8$ ck/trap)

*corrected by Mulla's formula; ** for no. infested units to achieve clean level at post treatment week 15

The correlation between cockroach trap counts and weeks before and after treatment for intervention groups was simple linear with a specific negative slope for all study locations. However, there was no correlation between these data for the control groups of all study locations throughout the study period. Thus, the result showed that only the IPM treatment had a significant reduction (note the negative slope) in cockroach trap catch during the weeks of treatment.

Thus, an IPM approach using hydramethylnon gel bait together with educational programmes and sanitation (using vacuum) successfully reduced the German cockroach population to a clean level of infestation.