

Efficacy of synthetic pyrethroid and propoxur aerosol in the control of German cockroaches (Dictyoptera: Blatellidae) in cookhouses

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Background & objectives: A field trial was carried out in cookhouses in an urban area to evaluate the efficacy of synthetic pyrethroid (0.02% deltamethrin + 0.13% allethrin) and propoxur aerosols (2%) in the control of German cockroaches (*Blatella germanica*).

Methods: A total of six cookhouses were selected by simple random sampling method (two each for the two insecticide treatments and two for control).

Results: It was observed that 89.36–87.8 and 77.95–59.74% reductions were achieved with propoxur and synthetic pyrethroid treatment respectively by first week post-treatment. The reduction in propoxur treated areas by eight weeks post-treatment was 82.98–76.13%, whereas the reduction in the same time period in synthetic pyrethroid treated areas ranged from 14.36% to an increase in density by a phenomenal 157.86% in one of the treated sites.

Interpretation & conclusion: The study reports the efficacy of propoxur aerosol (2%) treatment over synthetic pyrethroid (0.02% deltamethrin + 0.13% allethrin) in the control of cockroach infestation in cookhouses in urban area.

Key words Aerosol – *Blatella germanica* – cockroaches – control – propoxur – synthetic pyrethroid

Cockroaches are important pests because they spread filth and ruin food, fabrics and book-bindings. They discharge a nauseous secretion both from their mouths and from glands opening on the body which give a long-lasting, offensive cockroach smell to areas or food visited by them. Cockroaches move freely from building to building or from drains, gardens, sewers and latrines to human habitations. Because they feed on human faeces as well as human food they can spread germs that cause diseases^{1,2}. They are proven or suspected carriers of the organisms causing: diarrhea, dysentery, cholera, leprosy, plague, typhoid fever, viral diseases such as poliomyelitis³. In addition, they carry the eggs of parasitic worms and may cause

allergic reactions, including dermatitis, itching, swelling of the eyelids and more serious respiratory conditions. Cockroach infestations have been indicated as a major contributor to asthma throughout the world. Several studies have shown that large numbers of asthmatic patients are sensitised to cockroach allergens^{4,5}.

Heavy infestations of cockroaches can be effectively managed by chemical control measures (residual spray, aerosol, dust, baits, gels), followed by environmental management to deprive them of food and shelter⁶. Cockroaches have become resistant to commonly used insecticides⁷. The German cockroach is resistant

to several organochlorine, organophosphorus, carbamate and synthetic pyrethroid insecticides^{8, 9}. The present study was conducted with the aim of evaluating the efficacy of propoxur and synthetic pyrethroid aerosols in the control of German cockroaches in cookhouses.

Material & Methods

Study area & duration: The study was carried out in cookhouses in an urban area from September 2004 to March 2005. A total of six cookhouses were selected for treatment and control by simple random sampling method. The cookhouses were located in Armed Forces Establishment (Pune). Cookhouses selected were large in area and were separated from each other at far distance. Each cookhouse was having kitchen, dining hall, pantry and ration store. Pooled data were used for each cookhouse after estimating cockroach density in kitchen, dining hall, pantry and ration store.

Test chemicals: The insecticides evaluated were propoxur aerosol (2%) and synthetic pyrethroid aerosol (0.02% deltamethrin + 0.13% allethrin) available as ready to use aerosol dispenser.

Trial procedure: The trial was planned as a field study to evaluate the efficacy of the candidate insecticides in the control of German cockroaches in cookhouses. The study included the following:–

Complaints of residents regarding cockroach infestation: The individuals whose cookhouses included in study were briefed about the study to get their full cooperation and participation. Assurance of full participation was ensured before including in trial. They were given a performa which included their subjective assessment of cockroach problem. The response was either heavy infestation, light infestation or no cockroach seen. Cookhouses with heavy infestation were considered for inclusion in trial. The do's and don'ts to be followed post-treatment in the treated as well as the control cookhouses were explained to the concerned staff and it was ensured that the same were complied with during the entire trial period.

Pre-spray assessment in the field: In every cookhouse included in the study following pre-treatment assessment was done.

Visual counts: The visual counts were done in the night after 2200 hrs. The participant cookhouses were asked to close the cookhouses by 2100 hrs and switch off the entire light. The lights were switched on after 2200 hrs 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 five minute count of cockroaches was taken.

Trap count: Sticky traps were placed around the usual harbourages of cockroaches. Enough number of traps was placed to cover the suspected hiding sites in the study units. Cockroach traps were removed next morning to estimate the density.

Insecticidal spray: Propoxur aerosol (2%) and synthetic pyrethroid aerosol (0.02% deltamethrin + 0.13% allethrin) were sprayed in selected cookhouses at the infested sites and potential harbourages. No insecticide was sprayed in the control cookhouses.

Post-treatment density: Post-treatment density was assessed by visual count method every week up to eight weeks as it was found to be a better indicator of cockroach infestation. The visual assessment data in treatment and control cookhouses were considered for computation of percent reduction of cockroach infestation in the respective cookhouses. The percent reduction was calculated using following formula:

$$\% \text{ reduction} = \frac{\text{Pre-treatment density} - \text{Post-treatment density}}{\text{Pre-treatment density}} \times 100$$

Results

It was observed that the cockroach infestation in all the sites ranged from medium to high and the infesta-

tion was primarily of *B. germanica*. The pre-treatment density observation in various cookhouses by the two sampling techniques is presented in Table 1. It is observed that visual assessment method is superior to sticky trap method of density assessment and therefore, this method was chosen as the post-treatment sampling technique.

Table 1. Estimation of pre-treatment density of cockroaches by two different sampling methods

Sites earmarked for treatment/control	Sampling methods	
	Sticky trap	Visual assessment (5 min count)
Site-1 (Propoxur)	12	188
Site-2 (Propoxur)	9	82
Site-3 (Synthetic pyrethroid)	15	322
Site-4 (Synthetic pyrethroid)	10	159
Site-5 (Control 1)	8	89
Site-6 (Control 2)	12	171

Pre- and post-treatment visual counts of cockroach in treatment and control sites are presented in Table 2. The percent reduction in cockroach infestation with both the treatments is presented in Fig. 1. It was observed that 89.36 and 87.8% reduction was achieved with propoxur in treated site-1 and 2 respectively by first week, whereas cockroach density increased by 131.43 and 58.47% in control site-1 and 2 respectively. A higher percent reduction was observed in propoxur treated sites-1 and 2—94.68 and 92.68% respectively by second week and it was 82.98 and 76.13% by the end of eighth week post-treatment. Cockroach density increased by 249.43 and 61.4% in control site-1 and 2 and further increased to 304.49 and 104.67% of the pre-treatment level by eight weeks.

It was observed that 77.95 and 59.74% reduction was achieved with synthetic pyrethroid aerosol spray in treatment sites-3 and 4 respectively by first week. Percent reduction declined to 28.3% in treatment site-4, while cockroach density increased by 36.95% in treatment site-3 by second week. In treatment site-3, percent reduction further decreased to 31.6% by third

Table 2. Field evaluation of propoxur and synthetic pyrethroid aerosol spray in the control of German cockroaches

Time (in week)	Visual count					
	Treatment site			Control site		
	Site-1	Site-2	Site-3	Site-4	Site-5	Site-6
Pre-treatment	188	82	322	159	89	171
First week	20	10	71	64	206	27
Second week	10	6	441	114	311	276
Third week	13	5	221	361	313	314
Fourth week	14	6	250	375	315	330
Fifth week	14	12	260	390	330	335
Sixth week	25	14	280	395	340	340
Seventh week	30	15	290	400	350	345
Eighth week	32	16	295	410	360	350

Sites-1 & 2—Treated with propoxur (2%) aerosol; Sites-3 & 4—Treated with synthetic pyrethroid aerosol (0.02% deltamethrin + 0.13% allethrin).

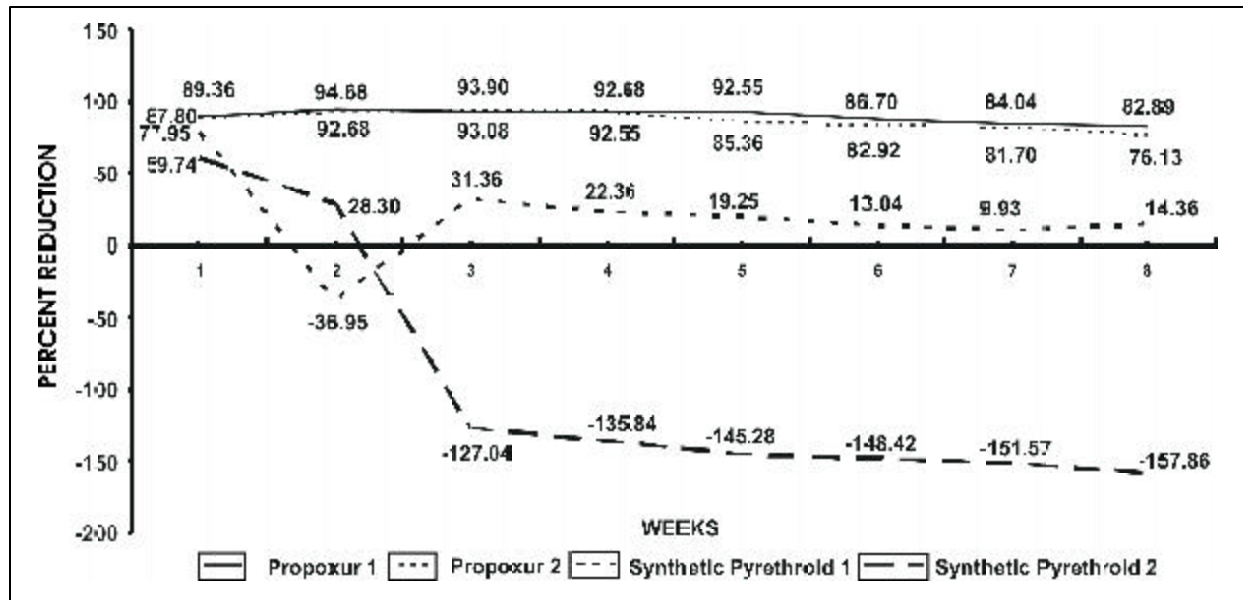


Fig. 1: The reduction (percentage) in cockroach infestation after treatment with propoxur and synthetic pyrethroid aerosol sprays

week and it was 14.36% by eighth week. Cockroach density increased in treatment site-4 to 127.04% by third week and increased further to 157.86% of pre-treatment by eight weeks post-treatment.

Discussion

Resistance has been reported amongst cockroaches to various group of insecticides such as organophosphates, carbamates and synthetic pyrethroids, when applied as residual spray and or topical application¹⁰. The efficacy of aerosols over conventional sprays against cockroaches is well documented¹¹. The aerosols have a better reach in the cracks and crevices, the usual harbourages for cockroaches than other spraying techniques. The aerosols in addition also exert a flushing effect on the cockroaches. Aerosol sprays containing a knockdown insecticide (propoxur and pyrethroid) are, therefore, more suitable for cockroach control. Aerosols can penetrate into small crevices and other enclosed, inaccessible cockroach hiding places so as to drive cockroaches out of their hiding places and thus shorten the time of kill. Aerosol application can cause a quick reduction in cockroach numbers.

The present study was conducted with the aim of evaluating the efficacy of propoxur and synthetic pyrethroid aerosols in the control of cockroaches in cook-houses. It was observed that the cockroach infestation in all the sites ranged from medium to high and the infestation was primarily of *B. germanica*. *B. germanica* has also been found to be the most dominant species in other studies as well¹².

The results in propoxur treated areas indicate a reduction of 89.36 to 87.36% by first week, 94.68 to 92.68% by second week and 82.98 to 76.13% by eighth week. The efficacy of propoxur aerosol in control of German cockroaches has been reported by other workers also in similar settings¹³. Their study reports a reduction of about 88% by first week followed by 91% reduction with propoxur aerosol by four weeks post-treatment. A reduction in cockroach infestation by 87% at the end of eight weeks post-treatment is comparable to the findings of our study.

Synthetic pyrethroid aerosol (0.02% deltamethrin + 0.13% allethrin) was not found effective in control of cockroaches in the present study. Resistance to deltamethrin in *B. germanica* has been reported in other

studies also^{14, 15}. The use of synthetic pyrethroids of the second type (viz. deltamethrin) against cockroaches has been recommended by workers because they can produce a higher insecticidal effect as well as irreversible knockdown¹⁶. However, in the present study the synthetic pyrethroid combination of deltamethrin and allethrin could not bring about the desired reduction in cockroach infestation. Propoxur is also known to cause greater Oothaecal detachment and reduced hatchability thereafter and therefore has a higher efficacy against cockroaches⁷. The study thus recommends propoxur aerosol treatment for effective control of German cockroaches in cookhouses in urban areas.

Acknowledgement

The authors wish to thank the staff of the various cookhouses under trial for their cooperation during the conduct of the trial and all the Health Assistants who assisted the workers for taking the readings in the night hours and also other technical help rendered from time-to-time.

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