Bed bug product efficacy under the spotlight

PART 2

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This article is the second of a two part series exploring the efficacy of insecticides currently registered in Australia for bed bug control. The first article *(Professional Pest Manager Feb/Mar 2009 p.14)* examined products applied via direct topical application, while in the investigations herein, the products were examined by surface residual application.

Both studies were undertaken against the Common bed bug, *Cimex lectularius*.

As noted previously the different treatment methods were selected because, in urban pest control, insects are generally exposed to insecticides by two main means: contact directly from spray, and/or contact while walking on treated surfaces. The former method aims for a direct kill, whereas the latter provides for protection over time.

The products evaluated in the earlier topical trials were again tested and are listed in table 1 (*refer Professional Pest Manager Feb/Mar 2009 p.19*). These products encompass all the classes of currently registered insecticides for use against bed bugs and include most products that are routinely used by pest managers today.

Residual assay methodology

The bed bugs were from a colony maintained at Westmead Hospital, with the founder specimens derived from a 2004 infestation in Sydney.

The residual trials were conducted on 9cm filter paper.

The products were diluted to the maximum label rate and 1.2ml added to the filter paper, which wetted the paper completely without producing any excess. This is comparable to the label directions of applying diluted product to the point of run off.

The filter papers were allowed to dry for 24 hours and adult bed bugs of mixed sex added.

For each product, 10 bed bugs per replicate were tested and there were two replicates for a total of 20 bed bugs treated. Readings of mortality were taken every hour for the first six hours, and then at 24 hour intervals thereafter. Replicates for each compound were pooled and a percentage cumulative mortality determined. Control mortality was determined by combining all the control replicates. ▷

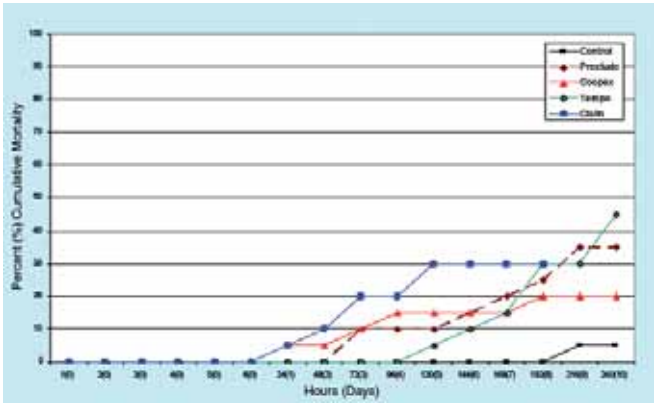

Figure 1: Cumulative mortality over time for the Common bed bug, *Cimex lectularius*, following exposure to an insecticide treated surface for the products Cislin, Coopex EC, Preclude, Tempo and the control.

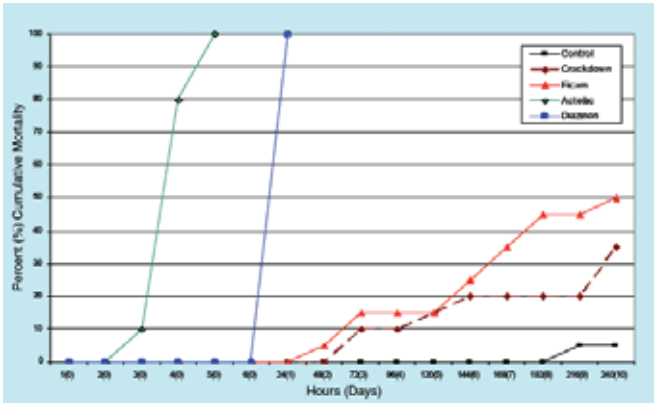

Figure 2: Cumulative mortality over time for the Common bed bug, *Cimex lectularius*, following exposure to an insecticide treated surface for the products Actellic, Crackdown, Diazinon, Ficam and the control.

Results – Residual application

The results are presented above in Figures 1 and 2.

In summary, Actellic produced a complete kill within five hours and Diazinon likewise within 24 hours. For the other products, mortality was much slower and gradually increased from 24 hours post application. However, 100% mortality was never achieved.

After ten days, the percent mortality for the other products in descending order were; Ficam (50), Tempo (45), Cislin (38), Crackdown (35), Preclude (35) and Coopex (20). Control mortality was 5%.

Discussion

The results with both the topical and residual experiments demonstrated some common characteristics: namely that the organophosphates (OPs) produced a complete kill in both experiments within 24 hours, whereas the carbamate, synthetic pyrethroids (SPs) and the natural pyrethrum failed to achieve complete mortality even ten days post exposure by either methodology.

There were, however, some differences between the two experiments. In the topical trials, the synergised 4th generation SP (Crackdown, which has the synergist piperonyl butoxide) yielded 95% mortality at ten days and appeared much more efficacious than all the other SPs and the carbamate. This is in stark contrast to the residual trial where Crackdown performed similar to the other non-OP products.

It must be noted that for the topical trials, a very defined but small dose was placed directly on the insects. In controlling a real bed bug infestation, it would be expected that the amount of insecticide that makes contact with the insect is far greater, as areas are often literally flooded and even those poor performing products may produce a moderate topical kill.

What the topical trial has provided is a direct comparison of products and a demonstration of quite varying efficacies.

Generally, topical application experiments are not undertaken and our trials have shown that residual experiments alone will provide an incomplete data set in efficacy experiments. Thus, if the only choice for a bed bug treatment was an SP, then greater success of eradicating the infestation is likely with a synergised 4th generation product.

The obvious question would be, "Why use the SPs when the OPs are so effective?"

In fact, our laboratory has now tested the residual activity of Actellic and found that it still kills all bugs within 24 hours post exposure after 16 weeks of aging the treated surface!

However, the OPs have an unpleasant odour which is unacceptable in the commercial and domestic market. These products also contain various solvent hydrocarbons that can cause staining on some surfaces, especially fabrics. Therefore some have use limitations.

For example, on the label for Actellic it states "Do not apply to carpets, mats or soft furnishings", which means this

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Figure 3: Bed bugs often show typical signs of stress following exposure to a lethal dose of insecticide, this includes 'hunchbacking'.

Figure 4: Another sign of insecticide exposure is the back arching.

product cannot be used in the eradication of many bed bug infestations.

Despite this concern, there are circumstances when the OPs could be employed, such as in extreme infestations whereby discarding infested belongings rather than disinsecting them is the only logical economically viable option. Also, OPs could be employed in premises which remain unoccupied for some time, such that the odour can dissipate.

The results achieved with the carbamate was somewhat unexpected, as a survey of professional pest managers in 2006 (Doggett and Russell, 2008) found that Ficam was one of the most successfully employed insecticides and no control failures where reported with this product. Perhaps there are other factors that may contribute to this insecticide being better in the field situation, such as a lack of repellency, and this warrants further investigation.

The experiments show that the Sydney bed bug strain has a high level of resistance to the carbamates and SPs. It is unknown how widespread is this resistance in Australia, although investigations in the US have found resistance in disparate bed bug populations across that country (Romero *et al.* 2007).

Considering that treatment failures are common here, it would be prudent to assume that most infestations comprise insecticide resistant bed bugs and need to be treated with a high degree of diligence.

It is now clear that insecticide resistance has been a major factor in the resurgence of bed bugs. But, what does all this mean for pest managers?

Unfortunately, the vast majority of products registered for bed bug control comprise the SPs and carbamates and, as noted above, the OPs cannot generally be routinely used. Thus, there is a limited arsenal of products available against bed bugs and most are not very effective, so it is not surprising that treatment failures are common.

As a result, in a bed bug treatment a lot of insecticide must be applied, which increases application costs and potential safety risks. The products must be targeted carefully directly at bed bugs and the residual action can not be replied upon. This makes the inspection absolutely critical, since failure to identify harbourage will inevitably lead to treatment failure.

The Code of Practice for the Control of Bed Bug Infestations in Australia (Doggett 2007) encourages best practice in the eradication of bed bug infestations. To ensure that the document is current, the information presented herein will be incorporated into the draft third edition, which will be available mid-year from www.bedbug.org.au. ■

REFERENCES

Doggett S.L. (2007). A Code of Practice for the Control of Bed Bug Infestations in Australia. 2nd Edition. Department of Medical Entomology & The Australian Environmental Pest Managers Association, Westmead Hospital, Sydney. 56pp. ISBN 1740800974.

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Romero A., Potter M.F., Potter D.A. and Haynes K.F. (2007). Insecticide resistance in the bed bug: a factor in the pest's sudden resurgence? Journal of Medical Entomology, 44: 175-178.