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CASE STUDY:

Controlling Bed Bugs in Apartments

Researchers from Purdue University set out to determine just what's needed to perform successful bed bug treatments.

Bed bugs (*Cimex lectularious* L.) are notoriously hard to control. Their small body size, nocturnal behavior and potential for developing insecticide resistance make them difficult to detect and eradicate. A variety of chemicals are registered for bed bug control in the U.S., but these generally are not as effective as the old organophosphate or organochlorine insecticides that were banned for indoor use. Additionally, resistance development in bed bug populations may reduce the effectiveness of available insecticides. Successful bed bug elimination often requires several visits (Gangloff-Kaufmann et al. 2006).

Despite the wide attention placed on bed bugs, there are few reports on the effectiveness of bed bug control programs. To fill this research need, we carried out a study in a high-rise building in Indianapolis during May and June 2007. The amount of service time and insecticide used for control and the number of bed bugs were recorded biweekly for an eight week period. We believe the results will provide helpful information for pest management professionals, residents and housing managers in preparing their bed bug eradication programs.



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STUDY SITE. The study site was a 15-story building occupied mainly by elderly people. All units were one-bedroom apartments with bare floors. The bed bug infestations started on the 12th floor in late 2005. Thirty-seven residents had reported infestations as of May 2007. Insecticide sprays, steam machine applications, furniture removal and frequent washing of bedding materials were used by the pest control contractor and the residents attempting to control the bed bug infestations. Still, the problem continued and rapidly spread among the apartments in the building.

TREATMENT PROTOCOL. We identified eight infested apartments by visual inspection and resident survey in early May 2007. Immediately after examining the bed bug distribution, we placed the bedding materials in plastic bags and asked the residents to have them laundered. A box spring from one heavily infested apartment was discarded because there were numerous bed bugs inside the box spring. We also physically removed bed bug adults and large nymphs using forceps when only a few were found during the inspections.

Two people (Wang and Abou El-Nour) conducted the inspection and applied insecticides in each apartment. Suspend SC (0.038% deltamethrin) was applied to the bed area, mattresses, box springs and sofa using a 1-gallon B&G compressed air sprayer (see photo on page 68). Tempo 1% dust (cyfluthrin) was applied to the inner framework of couches and box springs, holes on bed frames, wall cracks and crevices, electric outlets and wall-baseboard conjunctions (see photo on page 70). The apartments were inspected at two, four, six and eight weeks after the initial treatment. During these visits, additional sprays (spot applications) or dust were applied to areas where live bed bugs were found. The residents were asked to launder their bedding materials at each visit if bed bugs were found in the apartments.

RESULTS. The average number of bed bugs found per apartment was 157 (range: 3 to 425) (see Table 1, page 68). Distribution of the bed bugs was as follows:

- Mattress and box springs: 85 percent
- Couch or sofa: 14 percent
- Other areas: 1 percent

The bed bug population dropped sharply after treatment. At the end of the eight-week period, two apartments still had bed bugs. The bed bug counts in these two apartments dropped from 303 to 6 (98 percent reduction) and from 255 to 2 (99 percent reduction), respectively. Among the six apartments where the populations



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One of the authors, Changlu Wang, uses a B&G compressed air sprayer to apply Suspend SC.

were eradicated, an average of two visits was needed before eradication. Eradication in these apartments was confirmed through interviews with residents and inspections.

The initial inspection and treatment by two technicians used an average of 43 minutes per technician (range: 23 to 64 minutes). The time varied according to the bed bug population levels and the amount of furniture. All apartments were relatively well maintained by residents. Most apartments had little furniture, making the control work easier.

Each apartment received a maximum of four sprays and three dust applications (including the initial application). The total amount of chemical applied included 395 grams of Tempo dust and 22.9 liters of Suspend SC (diluted solution). Twenty-nine man hours were used for the eight apartments during the course of the experiment. Compared to the amount of time spent for control, the cost of materials was minimal.

The residents were very satisfied with the thoroughness and results of the treatments. One resident declined the follow-up inspections. Six bed bugs were found in her apartment during the initial inspection. She

did not experience any bites after the initial treatment and refused further inspections.

DISCUSSION. Eradication of bed bug infestations in six apartments was achieved with insecticide applications and non-chemical methods. Considerable amounts of time and multiple visits were involved. The study results were consistent with that reported by Gangloff-Kaufmann et al. (2006).

According to the product label, we did *not* treat the whole mattress or box springs (unless heavily infested) to avoid leaving excessive residue on the bed (for safety and property damage reasons). Repeat treatments were focused on where live bed bugs were found during follow-up inspections. These additional applications were necessary because the bed bug hiding sites might have been missed during the initial inspection and treatment, or bed bugs had migrated from other locations.

Difficulties during the treatment occurred when the residents were not able to re-assemble the bed themselves. Ideally, the mattresses and box springs and the floor under the bed should be air dried before

Table 1. Bed bug counts and treatments in eight one-bedroom apartments in Indianapolis.

Week	Number of apartments with bed bugs	Average bed bug count	Treatment (Total amount)		
			Tempo dust (g)	Suspend SC (liter)	Technician time (hours)
0	8	157	294	14.9	11.5
2	7	21	91	5.7	6.1
4	6	3	10	0	4.6
6	4	3	0	1.1	3.8
8	2	1	0	1.2	3.2

re-assembling the bed. In several cases, we could not spray the floor under the bed or spray the mattress thoroughly because residents asked us to put the box springs and mattresses back into place right away.

Despite thoroughness during the treatments, we were not able to eradicate the bed bugs from two heavily infested apartments after eight weeks. One apartment received treatment at zero-, two-, six-, and eight-week intervals. The other apartment



Tempo 1% dust was applied to several areas, including electric outlets.

received treatment at zero-, two- and eight-week intervals. We suggest two reasons for the failure to eradicate the bed bugs. First, the bed bugs might have a certain level of resistance to deltamethrin and cyfluthrin (active ingredients in Suspend SC and Tempo dust, respectively) which made it difficult to eradicate heavy infestations. However, the resistance issue should not be enough to cause control failure. From the infestation history in the studied building, the bed bugs originated from a single source.

The successful bed bug eradication in six infested apartments indicates the bed bugs were still controlled by deltamethrin and cyfluthrin. A second possible reason for failure in eradication is that the treatment might not have covered all bed bug hiding places. Small numbers of bed bugs might have existed in the dressers, kitchens, bathrooms or closets. Results from these two apartments highlighted the need for continuous monitoring, frequent washing of bedding materials and other non-chemical methods to eradicate heavy infestations.

CONCLUSIONS. Successful eradication of bed bugs in apartments requires at least


two visits, expending considerable time in inspecting and treating the unit, and the use of a combination of various tools (chemical and non-chemical). Cooperation of the residents (e.g., frequent washing of bedding materials) and additional methods (e.g., discarding seriously infested furniture, removing clutter) will be needed for eradication of bed bugs in heavily infested apartments. 🦋

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Reference

Gangloff-Kaufmann, J., C. Hollingsworth, J. Hahn, L. Hansen, B. Kard, M. Waldvogel. 2006. Bed bugs in America: a pest management industry survey. *American Entomologist*. 52: 105-106.

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