

Insec(tc)ure*:

Are you insecure about your insect cures?

A UT Urban IPM Lab Newsletter for the Pest Management Industry

Are bed bugs resistant to the management products I'm applying?

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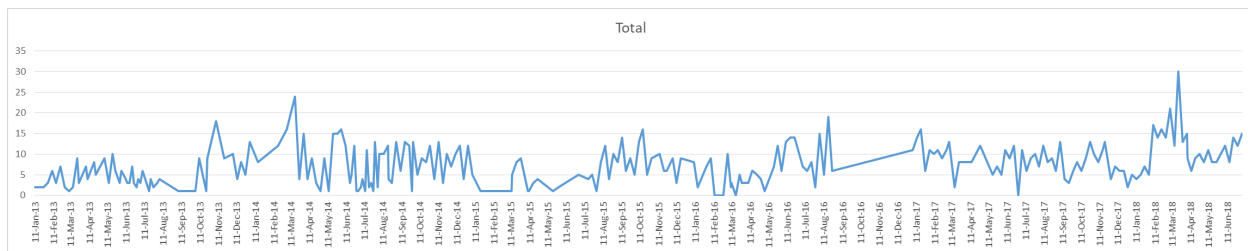


Figure 1. The number of apartments treated for bed bugs per service day from January 2013 to May 2018 in a Tennessee low-income high-rise for the elderly and disabled.

Above is a graph that indicates the number of bed bug treatments conducted from January 2013 – June 2018 in a Tennessee low-income high rise for the elderly and disabled. Ideally, you'd like to see the number of infested apartments decrease over time to lower levels and eventually to zero. But that's not what is happening here.

Let me explain the apartment's treatment protocol. Control methods consisted of mostly liquid pesticide applications. Residual liquid pesticides were sprayed into cracks and crevices and nonresidual applications were made to the bed and upholstered furniture for the first treatment. Follow-up treatments were every 1 to 2 weeks later if bed bugs were still present and consisted of nonresidual applications to the bed and upholstered furniture again. No nonchemical controls were used because the pest control company indicated they did not have the time to vacuum or steam. Resident could rarely afford a box spring and mattress encasement. Housing managers relied on resident reporting, or the pest management professional noting them during a quarterly general pest treatment, to approve a treatment. Occasionally we included this low-income high rise in a research study of a building-wide inspection - you can see from the peaks in the graph when our inspections occurred. Rooms adjacent to infested rooms were not inspected for bed bugs, but in the last couple of years, the common wall of the adjoining rooms may have been treated with a desiccant dust. Visual inspections determined the elimination of the infestation. Recordkeeping by the pest management professional (PMP) was inconsistent in some cases.

You can probably recognize some aspects of the protocol that could be tweaked. We discussed the benefits of vacuuming and steaming in last month's article. In the future, we'll discuss the advantages of and need for building-wide inspections and the most optimal method to use monitors. Today I'd like to describe the issues related to bed bug resistance to insecticides.

*Pronounced insect cure

Resistance to insecticides can occur when you repeatedly treat the same population with the same product or class of products. Over time, the treatment will not be as effective because generation after generation you are killing off the susceptible bugs and leaving behind those not susceptible to the treatment. In bed bugs, research has documented resistance due to increased enzyme activity to breakdown toxins, a mutation to a receptor, such as a sodium pump on a nerve cell, occurs so the insecticide or its metabolite no longer fit, or a thicker cuticle decreases the insecticide penetration into the bug. If you look through the literature, you'll notice that a Knoxville strain has exhibited tolerance to bifenthrin and chlorfenapyr and a high level of resistance to deltamethrin. To prevent or slow the development of resistance, we recommend rotating the class of insecticides applied. If you are unsure of an insecticidal class, you can look up the active ingredient in the IRAC chart at <https://irac-online.org/modes-of-action/>.

When bed bugs are resistant to dried insecticide residues on surfaces, it is necessary to spray the bed bug directly to kill it in a short time; which further emphasizes the need for a thorough inspection on treatment day. Because resistance is common in the US, you should assume the bed bugs you are treating are resistant unless you know otherwise. So, what if you want to know if the bed bugs you've been treating are resistant to your products? I wouldn't expect a PMP to use sophisticated equipment and analyses to find and compare the LD₅₀, LC₅₀ or LT₅₀ to determine resistance. But, you could use the ThermalStrike LightsOut Lab-In-A-Bag Pesticide Efficacy Kit (<https://www.protectabed.com/shop-all/lightsout-lab-in-a-bag-pesticide-efficacy-kit.html>, Figure 2), or create your own similar kit, to get an idea if the product is less effective than expected.



Figure 2 Components of the Lab-In-A-Bag Pesticide Efficacy Kit. Image:www.protectabed.com

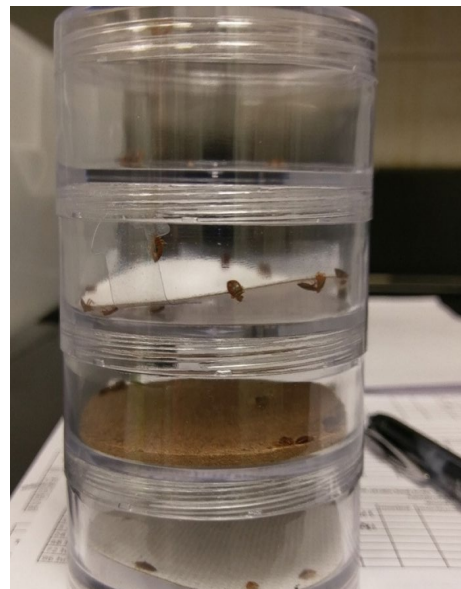


Figure 3. Each plastic chamber received a dried insecticide-treated surface and 10 male and 6 nymphal bed bugs. Image: UT E&PP

Jennifer Chandler and I decided to evaluate the lab-in-a-bag kit a few years ago. We were conducting building-wide inspections when we came across a heavily infested bed. You know what this looks like - the sides of the bed were nearly completely black from accumulated bed bug feces. So we placed a knee-hi stocking over the end of the hose of our 1-gallon shop vac, folded the ends over the tubing, attached the crevice tool, and proceeded to remove as many bed bugs as possible. The stocking containing bug was removed, tied in a knot and placed in a sealable plastic bag until we returned to the lab.

One of the most commonly used residual insecticidal sprays was a combination pyrethroid and neonicotinoid product applied for both bed bug and general pest control for at least the previous 18 months before this evaluation. We mixed it according to label directions in a hand-trigger spray bottle and applied it to both sides of three surfaces (Masonite wood, mattress fabric and chair fabric) until saturated – which required about three sprays. When dried, each surface

was placed into a different plastic chamber (Figure 3) and 10 males and 5 nymphal bed bugs were added. An empty plastic chamber served as a control. After 24 hours, a small piece of cardstock was added to the untreated control so bed bugs would have something to climb on; without it, they would flip over on their backs and appear dead. We used three containers per treatment. Each chamber was inspected at 0, 0.3, 1, 4, 8.5, 24, 47, 94, 118, 142, and 166 hours after bed bug introduction and the number of dead or abnormal bed bugs counted and recorded. In addition to the housing strain, we used the Harlan strain which has been maintained in various laboratories since 1973 and has not been exposed to insecticides since then. The Harlan strain is susceptible to most insecticides.

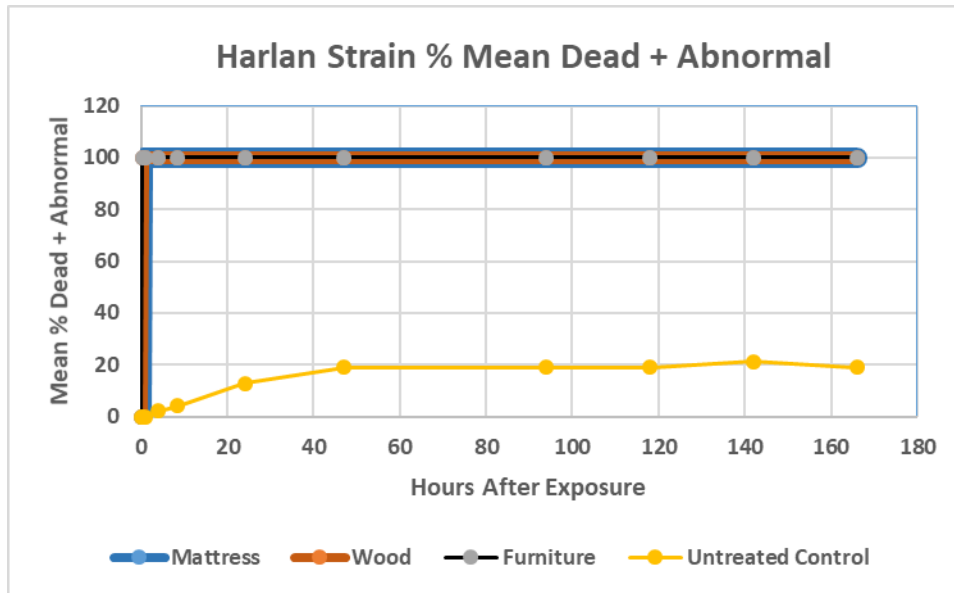


Figure 4. Average percentage mortality (dead and abnormal) of Harlan strain bed bugs due to exposure to a dried residual spray of a pyrethroid-nicotinoid combination product applied at label rates to three surfaces (Masonite wood, mattress fabric and chair fabric).

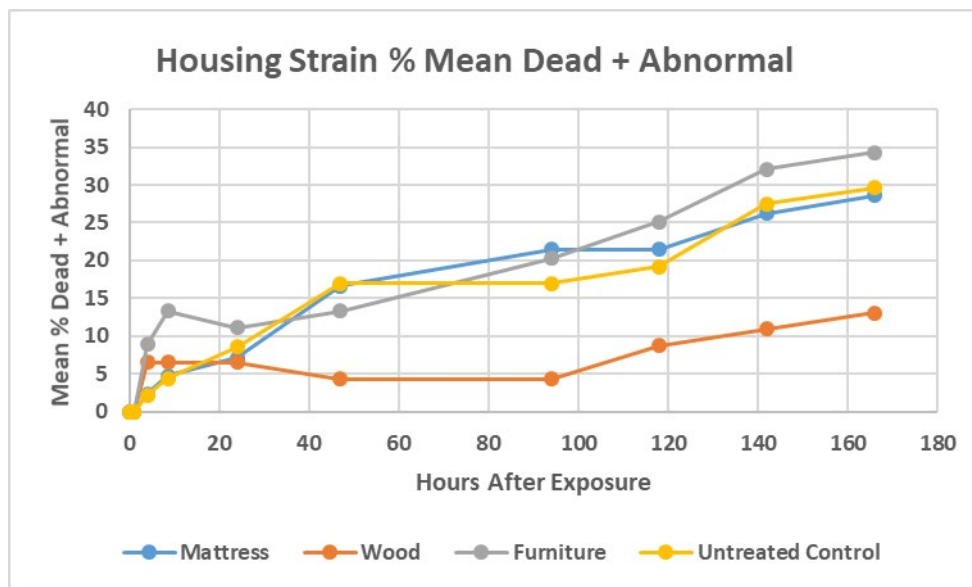


Figure 5. Average percentage mortality (dead and abnormal) of housing strain bed bugs due to exposure to a dried residual spray of a pyrethroid-nicotinoid combination product applied at label rates to three surfaces (Masonite wood, mattress fabric and chair fabric).

All **Harlan** strain bed bug males and nymphs **died within 20 minutes** of exposure to the dried combination product regardless of the surface it was applied on (Figure 4). At 166 hours, or nearly 7 days, after introduction to the chamber,

the greatest percentage of dead and abnormal housing strain bed bugs was 34% in the furniture material, followed by 30% in the untreated control, 29% in the mattress material and 13% in the Masonite wood (Figure 5). **You read that correctly; on the treated furniture material, at best, 1 in 3 housing strain bed bugs had died after being in constant contact with the treated surface for nearly a week!** One doesn't need to run sophisticated statistical analyses to see that the insecticide was less effective against the housing strain.

I purposely did not list the Trade Name of the product we tested. What fails to work on one strain may work on another. You can find examples of products that work slightly on one strain and not at all on others – even strains that occur in the same city. It will depend on the selection pressure, insecticide and otherwise, that have been imposed on these populations.

Unless you can document that your bed bugs are susceptible to the product(s) you are applying, a best management practice is to conduct an extensive inspection and to spray, vacuum or steam the bed bugs as they are discovered. A desiccant dust applied in a dry environment is a good supplement and one of the few effective residual treatments available to PMPs at this time.

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Precautionary Statement

To protect people and the environment, pesticides should be used safely. This is everyone's responsibility, especially the user. Read and follow label directions carefully before you buy, mix, apply, store or dispose of a pesticide. According to laws regulating pesticides, they must be used only as directed by the label and registered for use in your state.

Disclaimer

This publication contains pesticide recommendations that are subject to change at any time. The recommendations in this publication are provided only as a guide. It is always the pesticide applicator's responsibility, by law, to read and follow all current label directions for the specific pesticide being used. The label always takes precedence over the recommendations found in this publication.

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