Bed Bugs: The Perfect Insect for IPM
(Integrated Pest Management)

- Inspection / Identification / Monitoring
- Evaluation / Recommendations / Education
- Treatment / Documentation / Follow-up
Bed Bug Program Strategies

1. Have a written plan of attack, a specific program for Bed Bugs...
   – Inspection / Identification / Monitoring
   – Evaluation / Recommendations / Education
   – Treatment / Documentation / Follow-up
2. Make and agree on a plan of action...
3. Communicate that program modifications may be needed as new information unfolds
4. Educate & train the client & victims of the infestation
5. Follow-up and be proactive
Inspection & Monitoring

1. Visual
2. Canine
3. Monitoring Devices
Sculptured Ceiling in Bedroom
Visual Inspections for BBs

• Bedding
  – Seams and Tufts of mattresses
  – Box spring (remove decorative fabric)
  – Cracks and crevices of the headboard, footboard, and bed frame
  – Pillows & pillow cases
  – Bed covers, sheets and mattress covers
  – Decorative items for beds

• Structure
  – Cracks and crevices
  – Wall fixtures; such as pictures, lights, etc.
  – Wall voids
  – Loose wallpaper
  – Baseboards & decorative trim
  – Window & door casings
  – Electrical & switch plates
  – Attics & crawl spaces
  – Heating elements
  – Pipe chases
Visual Inspections for BBs

• Furniture & cabinentries
  – Outside, inside and underneath (remove decorative fabrics)
  – Disassemble elements furniture

• Electronics and decorative items
  – TVs, computers, clock radios, etc.
  – Bookshelves, planters, pictures, etc.
What About the Dogs?
Canine Inspection

• What we want them to do...
  – Indicate on Live Bed Bugs and viable eggs, but not on feces, cast skins and dead Bed Bugs
    • 95% positive rate
  – Indicate on Bed Bugs and not other structural pests such as cockroaches and termites
    • 97.5% positive rate (field study)
  – Detect viable Bed Bug eggs
    • 90%

Indicating
Advantages & Disadvantages of Canine Inspection

Advantages

– BB dogs are trained to alert on one single viable egg, nymph, or adult.
– Increased accuracy – A certified BB dog team will be accurate almost always above a 95% rate.
– Canine inspection is faster and therefore can cover much more area than human inspectors.

Disadvantages

– The BB dog is only as good as the handler has been trained.
– Dogs can sometimes have “off days” and are subject to cold viruses and illness just like humans.
– Dogs can be distracted by other odors and chemical compounds in a structure
– Cost for a canine inspection for a single home may be prohibitive.
Night Watch Biosensory Monitor

$400
Bed Bug Beacon
$50
CLIMBUP™ Insect Interceptor

$60
CLIMBUP™ Insect Interceptor
Monitoring Devices

Advantages
- Fairly small and non-invasive.
- One time cost.
- In heavy to medium infestations, confirmation is usually pretty quick.
- Can be used for long periods of time after the removal of an infestation as a proactive way to monitor for reinfesting BBs.

Disadvantages
- May be of poor quality, or have no reliable test data to support capture claims.
- Many variables exist for these kinds of products. Placement and proximity to BBs is very important for some of these devices to work.
- Not always pet and child proof.
- Can be cost prohibitive, especially if they’re untried and do not work.
## Monitoring Traps

### Passive Monitoring Methods
- Climbup Interceptors
- Homemade Vaseline/Tape

### Active Monitoring Methods
- Bedbug Beacon
- NightWatch
- Homemade Dry Ice

<table>
<thead>
<tr>
<th></th>
<th>Climbup Interceptors</th>
<th>Homemade Vaseline/Tape</th>
<th>Bedbug Beacon</th>
<th>NightWatch</th>
<th>Homemade Dry Ice</th>
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<tbody>
<tr>
<td>Cost</td>
<td>$60</td>
<td>$10</td>
<td>$50</td>
<td>$400</td>
<td>$15</td>
</tr>
<tr>
<td>Ease of Setup</td>
<td>Moderately Easy</td>
<td>Moderately Easy</td>
<td>Easy</td>
<td>Easy</td>
<td>Somewhat Difficult</td>
</tr>
<tr>
<td>Ease of Use</td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
<td>Easy</td>
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<tr>
<td>Requires Replenishment</td>
<td>No</td>
<td>No</td>
<td>Yes</td>
<td>Yes</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety</td>
<td>Excellent</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
<td>Ok</td>
</tr>
<tr>
<td>Accuracy</td>
<td>Ok</td>
<td>Ok</td>
<td>Good</td>
<td>Good</td>
<td>Good</td>
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</table>
“Education should be at the core of any (Bed Bug) treatment program so all stakeholders understand that Bed Bugs exist, how to avoid them, how to recognize signs of an infestation and what to do if an infestation is suspected.”

Rick Cooper, BCE
Cooper Pest Solutions
Education Essentials

• Basic Identification and Biology of Bed Bugs
• Sanitation
• Cultural Practices
• Non-chemical methodologies that help prevent, detect and manage BBs
• Treatment Recommendations
Treatment Strategies

• Non-Chemical Methods
  – Physical Removal
    • Vacuuming, brushing...
    • Removal of infested items
  – Exclusion
    • Mattress covers
  – Traditional Insecticide Treatments
  – Heat (steam & dry)
  – Cryogenics (cold)
  – Fumigation (lethal gas)
  – Controlled Atmospheres
    • $\text{CO}_2$, $\text{N}_2$
Mattress and Box Spring Encasements
Traditional Insecticide Treatments
Traditional Insecticide Treatment

Advantages

– Certain products provide a residual effect that maintains control for an extended period of time.
– Applications may be periodic in nature to lessen the chance BBs can re-establish.
– Cost effective for beginning or small BB infestations.

Disadvantages

– Not all living areas and items can be treated with all insecticides.
– Cost are high because of the slow methodical nature and man-hours of the job.
– Residents that have sensitivities to insecticides may not be able to have this type of treatment.
– Poor choice of insecticide chemistry or application by the PMP (missed treatment areas) can result in failure.
If Bed Bugs have one vulnerability - it’s elevated temperature.

~Dr. Mike Potter, University of Kentucky
How Heat Kills Insects

• Dehydration (loss of water through the cuticle)
• Unfolding of Protein molecules and entanglement
• Physiological damage
## Temperatures Required to Kill Bed Bugs

Table 1. Mean percentage of initial knockdown and mean percentage of 24-h mortality (SE) among bed bug adults exposed to five different temperatures for varying lengths of time.

<table>
<thead>
<tr>
<th>Temp (C) (F)</th>
<th>Time (min)</th>
<th>% knockdown</th>
<th>% mortality</th>
</tr>
</thead>
<tbody>
<tr>
<td>(49) 118.4</td>
<td>1</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>(47) 116.6</td>
<td>2.5</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>(45) 113.0</td>
<td>3.5</td>
<td>100</td>
<td>83</td>
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<tr>
<td>(43) 109.4</td>
<td>25</td>
<td>100</td>
<td>100</td>
</tr>
<tr>
<td>(41) 105.8</td>
<td>100</td>
<td>100</td>
<td>100</td>
</tr>
</tbody>
</table>

1. Time versus Temperature Study
2. Threshold behavior and subsequent movement of bed bugs in response to increasing temperatures through conduction.
3. Threshold behavior and subsequent movement of bed bugs in response to increasing temperatures through convection.
4. Rate of penetration of lethal heat through mattresses, upholstered furniture, exterior walls and other structural elements in two habitat types (apartment, house).

<table>
<thead>
<tr>
<th>Temperature</th>
<th>Time (minutes)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Adults</td>
</tr>
<tr>
<td>113</td>
<td>90 min</td>
</tr>
<tr>
<td>118</td>
<td>2 min</td>
</tr>
<tr>
<td>122</td>
<td>0 min</td>
</tr>
</tbody>
</table>

Kells, Stephen A. Key findings on bed bug behavior at lethal & sub-lethal temperatures. University of MN. www.thermalremediation.com
Steam Heat Treatment

Steam

Advantages

– Good for small areas where BB are infesting.
– A useful tool where most or all insecticides are not labeled for use, such as bedding.
– Good mortality of all BB stages providing the application is performed well.
– Leaves behind no insecticide residue. Good technology for bedding, etc.

Disadvantages

– Steam cools on contact and may not have the desired temperature to kill eggs if used improperly.
– May not reach hidden insects and eggs in deep cracks and crevices.
– Very slow methodical application subject to applicator error.
– Leaves behind no insecticide residue when they’re sometimes needed.
Dry Heat Treatment

Dry Heat

Advantages

– Heat expands (it moves/transfers in several ways) to cooler areas.
– Kills all stages of BBs.
– Excellent choice where: 1) the population is high, 2) the infestation area is cluttered, 3) has many places where BB can hide and lay eggs, and 4) where insecticides cannot be used.
– Tenants can re-enter the treatment area shortly after the heat treatment is complete.
– Controlled temperatures will not damage electronics.

Disadvantages

– Can damage items that have low melting points such as: candles, chocolate, etc.
– Many items must be removed and then replaced after the treatment is made. This increases the chance of reinfestation if inspections of returning items are not made.
– Fire alarm and sprinkler systems must be protected from accidental trigger.
– May require insecticides to be applied in certain areas where temperatures do not reach mortality levels.
– Depending on the thermal equipment used, there may be restrictions for the size of the area to be treated.
– May be cost prohibitive if the number of infested units (for example, multi-level apartments) is high.
Why Structural Heat Treatment?
Extensive Populations!
Heat Treatment Generator
Heat Treatment Equipment
Heat Treatment Preparation
The End (Probably Not)
Acknowledgements

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Cryogenic (Cold) Treatment

Cryogenic (Cold) Treatments

Using cold to kill BBs will work under certain conditions. Because cold does not expand to make the surrounding area also cold, its penetrating capabilities are severely limited.

Advantages

- Mobility of the applicator is good
- Good contact-kill mortality for all BB stages when exposed to freezing.
- No residue after application.

Disadvantages

- The potential to damage surfaces when cold is applied is greater.
- Will not penetrate into deep BB harborages.
- Will damage electronics and like devices on contact.
- Slow methodical application increases man hour costs.
- No insecticide residue after application.
Fumigation

**Advantages**
- 100% mortality of all stages of BBs when used properly.
- Penetrates all cracks, crevices and voids of a structure.
- Very few items need to be removed from the treatment area.
- Costs may be overall less for multi-dwelling situations (as compared to insecticide and heat).

**Disadvantages**
- Costs for this service are very high and requires specialized technical expertise.
- Extensive preparation to the structure.
- No insecticidal residue left behind to keep BBs from reinfecting the structure in the future.
- Cannot use this treatment technique for a single unit of any multi-dwelling type of structure.
- Occupants must be vacated for a period of time, usually 48-72 hours.
Oh! Say can you see...
any bed bugs on me?
If you do, take a few...
cause’ I got them from you!