Bed Bug Basics – Identification, Prevention, Control

Dr. Susan C. Jones
Professor of Entomology
The Common Bed Bug
(Cimex lectularius)
Hemiptera: Cimicidae

- Insects (true bugs)
- Temporary external parasites
- Feed only on blood
- Prefer to feed on humans
- Alternate hosts: rodents, bats, birds, pets (cats, dogs, etc.)

Not caused by bad housekeeping!!
BED BUGS CAN HAPPEN TO ANYONE!
Bed Bugs Make Their Way To the Americas

- Bed bugs are not native to the Americas
- Introduced by the early colonists
- Sailing ships had severe bed bug infestations
- Early 18th century--severe bed bug problems in the English colonies and Canada
1940s
“Live Better Through Chemistry”

DDT and other synthetic insecticides with long-lasting residual were very effective in controlling bed bugs.

late 1940s – early 1950s
Bed bugs developed resistance to DDT
Worldwide Resurgence of Bed Bugs Since Late 1990s

Aumenta la presencia de chinches en Barcelona
Las empresas de control de plagas descarten su desaparición, han incrementado las actuaciones contra estos insectos en...

SPAIN

Montréal: épidémie de punaises de lit confirmée
mardi 26 octobre 2010 à 18H38

ENGLAND

Bedbugs invade London's smartest hotels

From The Times
April 14, 2004

Bedbugs eat into tourism

Bernard O'Riordan in Sydney
The Guardian, Wednesday 6 April, 2004 01:47 BST

AUSTRALIA
The Most Bed Bug-Infested Cities in the U.S. 2012

Chicago Replaces Cincinnati As Orkin’s Number One Bed Bug City

Bed bug business up more than 32 percent nationwide

1. Chicago (+1)
2. Detroit (+1)
3. Los Angeles (+2)
4. Denver
5. Cincinnati (-4)
6. Columbus, Ohio
7. Washington, D.C. (+1)
8. Cleveland/Akron/Canton (+5)
9. Dallas/Ft. Worth (-2)
10. New York (-1)
11. Dayton, Ohio (+4)
12. Richmond/Petersburg, Va. (-2)
13. Seattle/Tacoma (+14)
14. San Francisco/Oakland/San Jose (-2)
15. Raleigh/Durham/Fayetteville, N.C. (+4)

2013

Cincinnati ranks No. 1 in list of calls to an extermination company as top bedbug infested cities

1) Cincinnati
2) Philadelphia
3) Detroit
4) New York
5) Columbus
6) Los Angeles
7) Dallas
8) Chicago
9) Houston
10) Baltimore
FIGURE 5. WHICH OF THE FOLLOWING PESTS DO YOU CONSIDER MOST DIFFICULT TO CONTROL?

- Bed Bugs: 76%
- Ants: 17%
- Cockroaches: 6%
- Termites: 1%
Some Reasons For the Resurgence of Bed Bugs

- International travel and commerce
- Housing with high tenant turnover
- Pesticide use has changed
  - Pesticide bans
  - Failure to re-register insecticides
  - Baits to control ants & cockroaches
- Insecticide resistance
## Non-pyrethroid Insecticides For Use Against Bed Bugs

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</tr>
<tr>
<td><strong>Chlorfenapyr</strong>&lt;br&gt;(halogenated pyrrole)</td>
<td>Phantom® SC&lt;br&gt;Phantom® PI</td>
</tr>
<tr>
<td><strong>Acetamiprid + bifenthrin</strong>&lt;br&gt;(neonicotinoid + pyrethroid)</td>
<td>Transport® Mikron&lt;br&gt;Transport® GHP</td>
</tr>
<tr>
<td><strong>Thiamethoxam + λ-cyhalothrin</strong>&lt;br&gt;(neonicotinoid + pyrethroid)</td>
<td>Tandem®</td>
</tr>
<tr>
<td><strong>Dinotefuran + diatomaceous earth</strong>&lt;br&gt;(neonicotinoid + silica dioxide)</td>
<td>Prescription Treatment&lt;br&gt;Alpine® Dust&lt;br&gt;Alpine® PI</td>
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INTEGRATED PEST MANAGEMENT (IPM) FOR BED BUGS:

Correctly identify the pest

+ Conduct a thorough inspection

+ Use sanitation measures

+ Apply insecticides to targeted sites
LIFE CYCLE OF THE BED BUG

(Cimex lectularius)

Note: These images depict bugs with a partly digested blood meal.

Adult (male & female)
~0.26 inch (6.5 mm) long
Takes repeated blood meals; life span ~1 to 1½ yrs

Egg
~0.04 inch (1 mm) long
Glued in place

1st stage nymph
~0.06 inch (1.5 mm) long
Takes a blood meal then molts

2nd stage nymph
~0.08 inch (2 mm) long
Takes a blood meal then molts

3rd stage nymph
~0.1 inch (2.5 mm) long
Takes a blood meal then molts

4th stage nymph
~0.12 inch (3 mm) long
Takes a blood meal then molts

5th stage nymph
~0.18 inch (4.5 mm) long
Takes a blood meal then molts

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Dr. Susan C. Jones & Benjamin R. Diehl
How to recognize if it’s a bed bug

Shape and Size

• Beak-like mouthparts
• Oval shaped body
• Body flattened (unfed) to swollen (recently fed)
• Adults: ~1/4 to 3/8 inch long
• Youngest nymphs (immature bugs) are tiny (<1/10 inch long)
How to recognize if it’s a bed bug

Color

- Youngest nymphs:
  - almost colorless (unfed)
  - crimson (recently fed)

- Older nymphs and adults:
  - various shades of brown (unfed)
  - reddish brown (fed)
Adult Bed Bugs

Female

Male
Bat Bug
(Cimex adjunctus)

Bed Bug
(Cimex lectularius)
IDENTIFICATION SERVICES

Ohio State University Pest Diagnostic Clinic

• Fee for identification services ($20 per insect sample)
• ID wide variety of insects, arthropods, plant diseases, etc.
• Online submission form: http://ppdc.osu.edu

614-292-5006
Some Basics of Bed Bug Management

- Early detection and treatment are very important.
- Bed bug control typically is much faster and less expensive when the infestation is detected early.
**LIFE CYCLE OF THE BED BUG (Cimex lectularius)**

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  ~0.26 inch (6.5 mm) long
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**Total developmental time (egg to adult):**

- 21 days @ 86°F
- 120 days @ 65°F

Note: These images depict bugs with a partly digested blood meal.

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Life History Characteristics Show That Bed Bug Numbers Can Quickly Increase … (Early Detection and Treatment are Very Important)

- **Eggs**
  - Glued in place
  - 1 – 12 eggs / day / female
  - A single female can produce ~150 eggs
  - Hatch in 6 – 17 days

- **Nymphs (immature bugs)**
  - Five nymphal stages
  - Require a blood meal in order to grow

- **Adults (males & females)**
  - Require repeated blood meals
  - Can live 12 – 18 months
  - Can survive months of starvation
Survivorship During Starvation for *Cimex lectularius* L.

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Received: 09 February 2011; in revised form: 20 April 2011 /; Published: 11 May 2011

Test conditions: 79-80 °F (~26.5 °C) 69% RH

Abstract: Four bed bug strains (*Cimex lectularius*) with different levels of pyrethroid resistance were evaluated to determine their ability to survive extended periods of starvation. First instar bed bugs of all strains were the most vulnerable to starvation (13.8–36.3 days mean survival time). Fifth instars and adults survived the longest during starvation (41.5–142.6 days). Significant differences in survivorship during starvation were observed between resistant and susceptible strains of bed bugs. Overall, all immature and adult stages of the resistant bed bug strains had significantly shorter survival times than those of the susceptible strains (*P* < 0.05).
BED BUG HABITS

- Cannot fly
- Can walk very fast
- Typically hide during the day in dark, protected sites (esp. cracks & crevices)
- Prefer fabric, wood, and paper surfaces
- Can cling tightly to surfaces
Bed bugs are very good hitchhikers!

Bed bugs can be moved from one place to another by hiding in:

- luggage
- furniture
- bedding
- backpacks, purses, briefcases
- clothing
- ...
Bed Bugs Hiding in Luggage
--Bed Bug Hitchhikers—in walker & wheelchair

Photos courtesy of General Pest Control Co.
Bed Bug Hitchhikers in shoe tread
How do bed bugs travel?

- Hitchhiking
- Walking
  - down a hallway after dropping off an item
What **shouldn’t** you do for a bed bug problem?

Typically, you shouldn’t dispose of furniture.

- Bed bugs will fall off the furniture as you are moving it, hence spreading the problem.
- Infested furniture usually can be treated.
- Bed bugs can quickly infest replacement furniture.
- Items placed on the curb often are picked up and reused, thereby spreading bed bugs to other households.
How do bed bugs travel?

- Hitchhiking
- Walking
  - down a hallway after dropping off an item
  - from an infested room to new territory
  - from one apartment to another via pipes, electrical wires, cables, …
In multi-family housing, bed bugs readily spread to units that are adjacent, below, and above the infested unit.
Bed Bug Feeding Habits

- Typically feed at night
- Locate their host using cues such as carbon dioxide, heat, and odor
Recognizing Bed Bug Bites

- Skin reactions (avg = 7 of 10 people)
  - Redness
  - Welts
  - Itching
- Resemble bites from other insects & arthropods
- Typically no red spot at the center (such as with fleas and black flies)
- Typically occur on exposed skin
  - Neck and face; shoulders and arms; back; etc.
- Rarely occur on the palms or soles (such as with scabies mites)
- Often occur in rows or groups
- Confirmation based on finding bed bug evidence
Health Effects from Bed Bugs

- Skin reactions in 7 of 10 people
  - Redness
  - Welts
  - Itching
- Secondary bacterial infections
- Anemia
- Asthma
- Anaphylactic shock
- Psychological effects
- Sleeplessness
- Agitation
- Anxiety …
Bed bugs are a pest of significant public health importance!

http://www.cdc.gov/nceh/ehs/Publications/Bed_Bugs_CDC-EPA_Statement.htm
http://www.epa.gov/pesticides/bedbugs/
Bed bugs also are responsible for severe economic hardships.

**Fig 9.** What was the average amount your residential customers (single family homes) spent treating bed bugs in 2012?

- 15% spent under $500
- 67% spent $501–$1,500
- 15% spent $1,501–$3,000
- 3% spent over $3,000
Recognize the telltale signs of bed bugs!

- Black fecal spots
- Shed skins & eggshells
- Live bed bugs (nymphs & adults)
- Blood stains from crushed bugs
- Welts on exposed skin
- Distinctive “buggy” odor (in severe infestations)
Bed Bugs Behind A Hanging Picture

It’s important to treat all harborage sites!
Tell-tale Signs of Bed Bugs in Furniture

It’s important to treat all harborage sites!
Tell-tale Signs of Bed Bugs
Behind Baseboards

It’s important to treat all harborage sites!
Tell-tale Signs of Bed Bugs in Electrical Outlets

It’s important to treat all harborage sites!
BED BUG PREVENTION FOR TRAVELERS

Make it STANDARD PRACTICE to check for bed bugs in hotel/motel rooms!

Look for black spotting and other bb signs as you examine:

• mattress & box springs, especially seams
• underside of the bed skirt
• headboard and bed frame
• nightstand drawers, particularly inner and outer edges
• baseboards

DON’T STAY IN A ROOM THAT HAS BB SIGNS
BED BUG PREVENTION FOR TRAVELERS

Reduce the chances of getting bed bugs from hotel/motel rooms!

• Keep clothes in your zipped suitcase
  • Don’t keep clothes in hotel chest-of-drawers
  • OK to hang clothes in closet
• Don’t store your suitcase on the bed, floor, or upholstered furniture
• Keep your suitcase on the luggage rack (after first inspecting it for bb signs)
• The bathroom (tub) is the best place to store items!
INTEGRATED PEST MANAGEMENT (IPM) FOR BED BUGS:

- Correctly identify the pest
- Conduct a thorough inspection
- Use sanitation measures
- Use non-chemical measures
- Apply insecticides to targeted sites
Sanitation Measures

(Typically are used to supplement additional treatment measures.)
Some measures to help reduce the number of bed bugs:

- Launder bedding, clothing, etc.!
  - Wash in hot water (≥120°F, [50°C])
  - Keep dry items in drier on medium to hot setting for ≥30 minutes.

It is important to keep disinfected items bagged while bed bug eradication efforts are on-going at your residence.
Vacuuming to contain bed bugs
**Some measures to help reduce the number of bed bugs:**

**Steaming**

- Commercial steam unit preferable
- Dry steam preferable (less moisture)
- Surface temperature should be \( \sim 176^\circ F (80^\circ C) \)
- Steam immediately kills bed bugs & eggs
- Requires working slowly and thoroughly
- Steam can penetrate many fabrics & padding
  - Some materials too thick for heat transfer
- Prolonged drying time (use fan, dehumidifier, natural ventilation)
- No residual protection
Some measures to help reduce the number of bed bugs:

Install encasements

- Be sure to encase both the mattress & box springs
- Specialized encasements trap bed bugs and eggs
  - May take 1 year to “starve bugs out”
  - Bug activity is restricted to the exterior of the encasement, where bugs can be more easily treated
- Be careful not to tear or damage encasements and make sure the zipper stays closed
- Some exs: Clean Rest, Mattress Safe, National Allergy Supply, Protect-A-Bed, ...
ActiveGuard™ Liner

The liners consist of finely woven polyester fabric impregnated with 1.64% permethrin. The liners are kept in place on mattresses and box springs beneath bedding.
Bed Bug Interceptors

- Positioned under furniture legs
- Furniture must be kept in use—bugs are attracted to host’s CO₂
- Pitfall trap—bed bugs climb in and cannot escape*
  - *Inner walls of ClimbUps must be kept lubricated with talcum powder or bugs can escape
- Eliminate alternative ways for bugs to access furniture (don’t let bugs bypass interceptors)
  - Keep furniture several inches away from walls
  - Don’t let bed linens, dust ruffle, & bedding contact the floor or walls
FMC Verifi™ Bed Bug Detector

---Active Monitoring Device---

Front view (with cut away revealing interior components)

Rear view

A- CO₂ booster pack
B- lures (pheromone + kairomone)
C- pitfall trap area
D- harborage area
E- self-adhesive sticker

http://www.fmcprosolutions.com/BedBugs/PropertyManager/Home.aspx
Contact a professional pest control company to treat for bed bugs

• ODA website lists licensed pest management companies and applicators

Ohio Department of Agriculture Pesticide & Fertilizer Regulation Section

Pesticide Regulation Section
Ohio Department of Agriculture Division of Plant Industry
Pesticide & Fertilizer Regulation Section

Programs and Information
Pesticide & Fertilizer Regulation Section
Ohio Department of Agriculture Division of Plant Industry
Pesticide & Fertilizer Regulation Section

Compliance and Enforcement
Ohio Department of Agriculture Division of Plant Industry
Pesticide & Fertilizer Regulation Section

http://www.agri.ohio.gov
Contact a professional pest control company to treat for bed bugs

Once you’ve made sure they are properly licensed to apply pesticides:

• It’s advisable to obtain at least 3 estimates.
• Check for satisfied customer references that relate to bed bug control.
• Recognize that bed bug control typically takes several insecticide treatments.
Treatment Options

• Heat treatment (whole structure, container)
• Cold (usefulness is limited)
• Insecticides
  • Residual products (dust, liquid, aerosols)
  • Fumigation (sulfuryl fluoride)
Whole Room Heat Treatment
Containerized Heat Treatment

$\geq 120^\circ$ F for several hours
Cold Treatment
Some Basics of Bed Bug Management Using Insecticides

• There is no single “magic bullet”.
• A residual insecticide is necessary.
• Control of a bed bug infestation typically takes several treatments.
• It is important to use several different formulations, and often, several different insecticides.
• Don’t keep using the same insecticide (rotate insecticide use)
# Non-pyrethroid Insecticides With Residual Activity Against Bed Bugs

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<td>Dinofuran + diatomaceous earth (neonicotinoid + silica dioxide)</td>
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Some Insecticides Registered For Use Against Bed Bugs

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<th>Active Ingredient</th>
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<th>Miscellaneous Label Notes</th>
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| Diatomaceous earth (=silicon dioxide) | Natural Guard Crawling Insect Control | - Crack & crevice applications  
- Slow-acting  
- Residual (long-lasting) activity  
- Dusts should be applied in thin layers  
- DO NOT allow product to get wet or it will lose its effectiveness  
- Caution: Avoid inhalation; wear a dust mask during application  
- Pool grade DE should NEVER be used for pest control. Pool grade DE contains crystalline silica and can be a respiratory hazard.  
- Mattresses mentioned on label |
|                   | Safer® Brand Ant & Crawling Insect Killer |                                                                                                                                           |
|                   | MotherEarth™ D              |                                                                                                                                           |
Pesticide Misuse By Apt. Residents

Columbus, OH  4/26/11

Columbus, OH  6/28/12
BUYER BEWARE:

Grocery store insect sprays won’t eliminate a bed bug infestation!

- Must be sprayed directly on the bed bugs (‘kills on contact’)
- Most bugs are hiding and WILL NOT be killed
- Little or no residual activity (the chemical breaks down quickly)
DO NOT use “bug bombs” against bed bugs!

- “Bug Bombs” don’t work
- Few bugs will be killed!
- “Bug Bombs” can cause bed bugs to scatter!!!

“Bug Bombs” may worsen the bed bug problem!!
Words of caution regarding over-the-counter ‘natural products’ for bed bug control:

- Exempt from Environmental Protection Agency (EPA) registration
- EPA requires no efficacy data
- Claims often based on “satisfied customers”—be sure to ask for their research data and evaluate it carefully
- Botanical (plant based) products often have a strong odor
- Botanical products often have limited, if any, residual activity
The FTC complaint charges that the Cedarcide defendants make:

- **false claims** that scientific studies prove **Best Yet!** is effective at stopping and preventing bed bug infestations, and that it is more effective than synthetic pesticides at doing so;
- a false claim that the **Environmental Protection Agency** has warned consumers to avoid all synthetic pesticides for treating bed bug infestations;
- ...
- **false claims** that **Best Yet!** was invented for the U.S. Army at the request of the U.S. Department of Agriculture, and that the USDA has acknowledged the product as the **number one choice of bio-based pesticides**

The FTC complaint charges that the RMB Group defendants make

**unsupported claims** that **Rest Easy** kills and repels bed bugs, and that a consumer can **create a barrier against them by spraying the product around a bed.**
Bed Bug Basics

- Myths
- Historical perspective
- Identification
- Bed bug habits
- Prevention
- Self-protection
- Control
For More Information

http://ohioline.osu.edu

OSU Extension
Fact Sheets:
• HYG-2105 (Bed bugs)
• HYG-2105A (Bat bugs)
http://centralohiobedbugs.org

Bed Bugs 101
- About Bed Bugs
- Getting Rid of Bed Bugs

Guidance for Professionals
- Police, Fire & EMS
- Schools
- Health Professionals
- Social Services
- Landlords & Realtors
- Hospitality
- Retail/busines

Presentations available for group trainings

Bed Bug 101 Slideshow
Pictures
Traveling Tips
Extermination...
AND MORE!

Bug Bombs
Don't Work

Call 2-1-1 for bed bug answers
Call (614) 221-2285 if 211 doesn't work from your phone.

Hello!
My name is: bed bug

in the workplace

UPDATE 6/21/2012: When suspecting items have bed bugs and eggs, it is now recommended items be washed in hot water and dried at the highest dryer setting for AN ADDITIONAL 90 minutes AFTER THE ITEM IS DRY to kill bed bugs.
Thank You!

Sleep tight, 
and don’t let the ... 
... well, you know the rest