OSU Webinar I
Bed Bugs: Know Your Enemy

Dr. Susan C. Jones
Professor of Entomology
jones.1800@osu.edu

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Bed Bugs: Know Your Enemy

What will you learn today?

- The growing bed bug problem
- How to recognize bed bugs and their tell-tale signs
- Biological characteristics of bed bugs
- Some health effects due to bed bugs
- How to protect oneself from bed bugs
- Some questions to ask clients who suspect that they have bed bugs
- Useful resources on bed bugs
Worldwide Resurgence of Bed Bugs Since Late 1990s

**SPAIN**

Aumenta la presencia de chinches en Barcelona

Las empresas de control de plagas descartan su desaparición, han incrementado las actuaciones contra estos insectos en Cataluña.

**CANADA**

Montreal: 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

By Valerie Elliott, Consumer Editor

LONDON'S smartest hotels are among a string of residential properties throughout the country which are facing an infestation of "super" bedbugs. The numbers of bloodsucking bugs have increased tenfold in a decade and pest control experts have commissioned a study to identify the cause of the invasion.

**AUSTRALIA**

The saying "don't let the bed bugs bite" has taken on new significance for Australia's burgeoning backpacker industry, which is facing an epidemic of the bloodsucking insects. The bugs, which can survive for months without feeding and are renowned as hitchhikers, travelling the world hidden in luggage, shoes and clothing, could cost the country's tourism industry tens of millions of pounds after they were found to have infected eight out of 10 backpacker hostels in Sydney's eastern suburbs alone. Many bedecks, particularly at Bondi Beach and Kings Cross, rely almost exclusively on British and Irish customers.
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

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

Cleveland Tops Terminix's Newest 'Top 20 Bed Bug Cities' List (1 Jan 2017-30 June 2017)

1. Cleveland, Ohio
2. Cincinnati, Ohio
4. Las Vegas, Nev.
5. Denver, Colo.
6. Houston, Texas
8. Indianapolis, Ind.
9. Oklahoma City, Okla.
OSU’s Ohio Statewide Bed Bug Surveys (2011 and 2016)

Survey regarding bed bug-related issues emailed or mailed to pest management companies and individuals licensed (category 10A) to treat for bed bugs in Ohio

– 2011 survey
  • Response Rate = 225/632 = 35.6%

– 2016 survey
  • Response Rate = 329/1041 = 31.6%
Estimated Total Number of Bed Bug Treatments by Licensed PMPs in Each County

Top counties for bed bugs:
1) Hamilton (ranked 3rd in pop. size)
2) Franklin (ranked 2nd in pop. size)
3) Butler (ranked 8th in pop. size), Lucas (ranked 6th in pop. size), Cuyahoga (ranked 1st in pop. size),
Estimated Total Number of Bed Bug Treatments by Licensed PMPs in Each County

Top counties for bed bugs:
1) Franklin (2nd in pop. size)
2) Hamilton (3rd in pop. size)
3) Montgomery (5th in pop. size)
4) Butler (8th in pop. size)
5) Cuyahoga (1st in pop. size)

4-5X higher than 2005 scale
Estimated Total Number of Bed Bug Treatments by Licensed PMPs in Each County

Top counties for bed bugs:
1) Franklin (ranked 2\textsuperscript{nd} in pop. size)
2) Cuyahoga (ranked 1\textsuperscript{st} in pop. size)
3) Lucas (ranked 6\textsuperscript{th} in pop. size)
4) Hamilton (ranked 3\textsuperscript{rd} in pop. size)
In the 9 most populated counties, the number of treatments per person showed an increasing trend from 2011 to 2016, with a faster increase in Franklin, Summit, Stark, and Lucas counties.
Residences made up the largest share of bed bug work, especially multi-unit residences.
The Bed Bug (*Cimex lectularius*) (Hemiptera: Cimicidae)

- Insects (true bug)
- Live indoors
- Typically feed at night
- Feed only on blood
  - Prefer to feed on humans
  - Alternate hosts: rodents, bats, birds, pets (cats, dogs, etc.)
- Cause significant economic, physical, & mental distress

Not caused by bad housekeeping!!
BED BUGS CAN HAPPEN TO ANYONE!
INTEGRATED PEST MANAGEMENT (IPM) PROCEDURES:

- Correctly identify the pest
- Conduct a thorough inspection
- Use sanitation measures
- Use non-chemical measures
- Apply insecticides to targeted sites
The Bed Bug Life Cycle

Unfed adults: ~1/4 to 3/8 inch long

KEY:
- moult
- feed

5 mm
0.2 inch

5th instar

4th instar

3rd instar

2nd instar

1st instar

eggs

bedbugfoundation.org
How to recognize if it’s a bed bug:

Shape and Size

- 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**

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

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

Female

Male
OSU Survey: Common Bed Bug “Imposters”

• Carpet beetles
• Cockroaches (esp. nymphs)
• Stink bugs
• Others, less common
  – Bat bugs
  – Other insects
  – Non-insects

About 15% of customers ask for bed bug treatment when they have a different pest
--A pictorial guide for recognizing bed bugs and other household pests

--Information on integrated pest management (IPM) strategies
Know your Pest: Carpet Beetles

Larval hairs can cause dermatitis in humans

- easily mistaken for bed bugs
- multiple symptoms including itching (pruritus) and rash—groups of spots; or red, inflamed skin with or without blisters
- complaints of being bitten by something causing an intense itching and rash
- in some people, irritation of respiratory tract and eyes
Carpet Beetles

- Larvae feed on animal materials
  - woolens, carpets, furs, hides, feathers, horns, bones, hair, silk, fish meal, insect pupae, dead insects
  - cause surface damage, misc. holes, uneven areas
- Larvae also feed on plant materials
  - rye meal, corn, red pepper, rice, flour, wheat
- Adults feed primarily on pollen & nectar (esp. *Spiraea* spp. & crape myrtle); pollen is required for egg production

![Bridal wreath spirea](image1)
![Japanese spirea](image2)
![Crape myrtle](image3)

*varied carpet beetle*
*Anthrenus verbasci*

James Kalisch, UNL Entomology
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
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)
Some of the challenges due to bed bugs:

- Nocturnal behavior
- Can feed on multiple warm-blooded animals
- Hide in many sites from floor to ceiling
- Very fast life cycle (many generations / year)
- Strong tendency to disperse
  - Hitchhiking
  - Walking
- Can survive starvation for months and months
- Bites cause variable reactions in humans
- Insecticide resistance
- Etc.
The Bed Bug Life Cycle

Total developmental time (egg to adult):

21 days @ 86°F
120 days @ 65°F
Life History Characteristics Show That Bed Bug Numbers Can Quickly Skyrocket … (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
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
Some bed bug hiding places

Behind A Hanging Picture

In Furniture

In Carpeting

In Electrical Outlets
Telltale Signs of Bed Bugs in Mattresses and Box Springs
Telltale Signs of Bed Bugs Behind Baseboards
In multi-family housing, bed bugs readily spread to units that are adjacent, below, and above the infested unit.
All stages of bed bugs moved extensively within and between apartments.

- Bugs moved from infested apartments to units on the same floor, above floor, and below floor.
- Bed bugs dispersed away from hosts and toward hosts.
- Female bugs appeared to be more active dispersers than males.
8 Verifis contained a total of 58 bed bugs (all stages) from living room, dining room, guest and master bedrooms.

4 ClimbUps contained a total of 38 bed bugs (all stages) from master bedroom only.

Key:
- ClimbUp: Blue
- Verifi: Red

Bed bug movement in vacant home—Assessment with Monitoring Devices

Monitors in place for 9 d

Home temperature: 65-70°F (18-21°C)
starved bed bugs can survive for a long time:

- Live adults for ~145 days
- Live immature bed bugs for ~110 days

Home vacated: late August 2012
Home temperature: 65-70°F (18-21°C)

Total volume
Cirkil applied: 15.13 gal CX + 1.26 gal RTU

1st Cirkil treatment
(3.5 gal Cirkil CX + 0.17 gal RTU)

2nd Cirkil treatment
(1.63 gal Cirkil CX + 0.13 gal RTU)

3rd Cirkil treatment
(5 gal Cirkil CX + 0.38 gal RTU)

4th Cirkil treatment
(5 gal Cirkil CX + 0.58 gal RTU)
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 Bug Hitchhikers—
in walker & wheelchair

Photos courtesy of General Pest Control Co.
Bed Bug Hitchhikers—
in shoe tread
--Bed Bug Hitchhikers—
in luggage
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.
Bed Bug Feeding Habits

- Often closely associated with hosts’ sleeping or resting sites (hide in many places)

- Locate their host using cues such as carbon dioxide, heat, odor

- Typically feed at night
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
Bullous Reactions to Bedbug Bites Reflect Cutaneous Vasculitis

Richard D. deShazo, MD, a Mark F. Feldlaufer, PhD, b Martin C. Mihm, Jr, MD, c Jerome Goddard, PhD d

aDivision of Clinical Immunology and Allergy, Departments of Medicine and Pediatrics, The University of Mississippi Medical Center, Jackson; bInvasive Insect Biocontrol and Behavior Laboratory, US Department of Agriculture, Beltsville, MD; cDepartment of Pathology, Harvard Medical School, Boston, Mass; dDepartment of Biochemistry, Molecular Biology, Entomology and Plant Pathology, Mississippi State University, Mississippi State.

Figure 1  Bullous reaction from an accidental bite of a C. lectularius nymph 24 hours after the bite. There is a visible path where the nymph appears to have probed before feeding at the main site (arrow). Line equals 10 mm.

Figure 3  Sequential photographs of a bedbug feeding site in our study subject between 24 hours and 4 weeks. There was progression from blister to bulla, lysis of bulla, and gradual healing at the bulla base with scarring and hyperpigmentation.
August 2010

CDC & EPA Joint Statement

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/
Health Effects from Bed Bugs

- Skin reactions (7 of 10 people on avg.)
  - Redness
  - Welts
  - Itching
- Secondary bacterial infections
- Anemia
- Asthma
- Anaphylactic shock
- Psychological effects
- Sleeplessness
- Agitation
- Anxiety
- Insecticide exposure
- …
Bed bugs and possible transmission of human pathogens: a systematic review

Olivia Lai1 · Derek Ho2 · Sharon Glick3 · Jared Jagdeo2,3,4

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Abstract The global population of bed bugs (Cimex lectularius and Cimex hemipterus, family Cimicidae) has undergone a significant resurgence since the late 1980s. This is likely due to an increase in global travel resulting in the worldwide spread of bed bugs. The worldwide spread of bed bugs is concerning, because they are a significant social and economic burden and a major concern to public health. According to the United States Environmental Protection Agency, bed bugs are "a pest of significant health importance". Additionally, 68% of U.S. pest professionals reported that bed bugs are the most challenging pest to treat. Up until now, disease pathogenhs have been reported in bed bug studies report that bed bugs may be competent vectors of pathogens, such as Bartonella quintana and Trypanosoma cruzi. However, public health reports have thus far failed to produce evidence that major infectious disease outbreaks have been associated with bed bugs. Since many disease pathogens have previously been reported in bed bugs, the worldwide bed bug population is now growing. It is increasing, it stands to reason to wonder if bed bugs can transmit human pathogens. This review included a literature search on recently published clinical and laboratory studies (1990-2016) to update the current knowledge of the health risk posed by bed bug infestations.

- So far, no studies have shown evidence that bed bugs are able to spread human diseases.
- Some studies have shown cimicids (bed bug relatives) can transmit disease to birds or bats.
- Certain human diseases can survive in bed bugs in the laboratory – a worrying sign.
- Even without spreading disease, bed bugs can cause health problems.
Bed Bug Prevention

• Recognize the telltale signs of bed bugs
• Take measures to reduce the risk of getting bed bugs
• Prevent bugs from spreading to new sites
Did you check for signs of bed bugs in your hotel/motel room when you last traveled?
BED BUG PREVENTION FOR TRAVELERS

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

• Pull back the bedding and look for black fecal spots on mattress & box springs (especially seams)
• Carefully examine the underside of the bed skirt
• Look for bb signs along bed frame (especially head board)
• Open nightstand drawers and look for bb signs along inner and outer edges
• Look for bb signs along 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 your items!
BED BUG PREVENTION
AT HOME

Don’t bring infested items home!

• Inspect clothing and luggage of travelers

• Inspect secondhand beds, bedding, furniture, & clothing
INTEGRATED PEST MANAGEMENT (IPM):  

Correctly identify the pest  

+  

Conduct a thorough inspection  

+  

Use sanitation measures  

+  

Use non-chemical measures  

+  

Apply insecticides to targeted sites
Some measures to help reduce the number of bed bugs:

Use a heavy-duty vacuum cleaner.

- Use a high efficiency particulate air (HEPA) filtered vacuum cleaner.
- It is useful to reduce the number of bed bugs. (A scraping action with the attachment is needed to remove eggs.)
- It is useful for cracks & crevices.
- Dispose of the vacuum bag afterwards.
- Remember that an on-site vacuum can serve as a harborage for bed bugs.
Vacuuming to contain bed bugs

Jones and Boggs. 2001. OSU Fact Sheet HYG-2158.
Some measures to help reduce the number of bed bugs:

Steaming

• Commercial steam unit preferable
• Dry steam preferable (less moisture)
• Surface temperature should be ~176°F (80°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
Disinfect Items by 

★★★★ Laundering & Drying★★★★  
(kills all bed bug life stages)

Launder clothing

• Wash in hot water (≥120°F)
• Use drier on hot setting (≥30 mins.)
• Dry clean items
Cold treatment has limitations for bed bugs

- Bed bugs are hardier against cold than heat
- They can be killed by freezing **continuously** at $<19^\circ F (-7^\circ C)$ for 3 weeks or $<5^\circ F (-15^\circ C)$ for 4 days
  - **Small** items can be placed in freezer at these temperatures to kill bed bugs (larger items are more insulated against cold)
  - Chest freezers work well; refrigerator-freezer units can work if “frost-free” setting is disabled. Use thermometer and timer to ensure proper treatment
- “Cold treatments” commercially available involve spraying items with dry ice—not yet much research into this kind of treatment
  - NOT a standalone measure (need to supplement with additional types of treatment)
  - Won’t penetrate certain materials, such as paper
Reasons why residents should not dispose of furniture, mattresses, etc.:

- Infested furniture often can be treated to eliminate the bed bugs.
- Bed bugs can quickly infest replacement furniture.
- Bed bugs will fall off the furniture as it is being moved, hence spreading the problem.
- Items placed in dumpsters often are picked up and reused, thereby spreading bed bugs to other households.
- If you choose disposal--Treat, deface, and wrap items before disposing of them.
DON’T use ultrasonic repellent devices against bed bugs or other insects.
Efficacy of Commercially Available Ultrasonic Pest Repellent Devices to Affect Behavior of Bed Bugs (Hemiptera: Cimicidae)

K. M. YTURRALDE AND R. W. HOFSTETTER

School of Forestry, Northern Arizona University, 200 East Pine Street, Flagstaff, AZ 86011

ABSTRACT Little is known about the behavior of bed bugs, *Cimex lectularius* L. (Hemiptera, Cimicidae), in the presence of ultrasonic devices. Bed bugs are known to have pheromones that are used as a deterrent and as a means of communication. Bed bugs, particularly *Cimex lectularius*, are often found in areas that are contaminated with cockroaches and other insects. Cockroach feces and shed skin can attract bed bugs. Our results confirm the ability of ultrasonic devices to repel bed bugs.

KEY WORDS bed bugs, ultrasonic devices, *Cimex lectularius*, cockroaches
DON’T use bug bombs for bed bugs!

www.nobuggy.com
Bug bombs can worsen a bed bug problem!

- "Bug Bombs" work very poorly against crawling insects
- Few bugs will be killed!
- “Bug Bombs” can cause bed bugs (and cockroaches) to scatter!!!
Over-the-Counter Foggers ("Bug Bombs")

Ineffectiveness of Over-the-Counter Total-Release Foggers Against the Bed Bug (Heteroptera: Cimicidae)

SUSAN C. JONES and JOSHUA L. BRYANT

Department of Entomology, The Ohio State University, 2501 Carmack Road, Columbus, OH 43210-1065

OSU Research

ABSTRACT Field-collected bed bugs (Cimex lectularius L.) showed little, if any, adverse effects after 2-h direct exposure to the aerosolated pyrethroid(s) from three over-the-counter total-release foggers (‘bug bombs’ or ‘foggers’): Hotshot Bedbug and Flea Fogger, Spectracide Bug Stop Indoor Fogger, and Eliminator Indoor Fogger. One field-collected population, EPM, was an exception in that there was significant mortality at 5–7 d when bugs out in the open had been exposed to the Spectracide Fogger; mortality was low when these bugs had access to an optional harborage, a situation observed for all field-collected populations when exposed to the three foggers. Even the Harlan strain, the long-term laboratory population that is susceptible to pyrethroids and that served as an internal control in these experiments, was unaffected if the bugs were covered by a thin cloth layer that excluded harborage. In residences and other settings, the majority of bed bugs hide in protected areas where they will not be directly contacted by the insecticide mist from foggers. This study provides strong evidence that over-the-counter total-release foggers should not be counted on for control of bed bugs, because 1) many field-collected bed bugs are resistant to pyrethroids and are not affected by brief exposure to low concentrations of pyrethrins and/or pyrethroids provided by foggers; and 2) there is minimal, if any, insecticide penetration into typical bed bug harborage sites. This study provides strong evidence that Hotshot Bedbug and Flea Fogger, Spectracide Bug Stop Indoor Fogger, and Eliminator Indoor Fogger were ineffective as bed bug control tools.
DON’T believe everything that you read on the internet about bed bugs.
Some questions to ask clients who suspect that they have bed bugs:

- Do you live in a single family home or apartment building?
- Have you captured / photographed any of the suspected bbs?
  - Yes: Have they been positively identified? Who did the ID? What stage(s) were present?
  - No: Have you seen any? Describe the bug.
- Why do you think that you have bed bugs (bbs)?
  - What are the symptoms?
  - When and where in residence?
  - Had you traveled or had visitors (esp. overnight) near the time when symptoms first appeared? (Any mention of bbs?) Have you recently acquired new or used furniture?
- Have you attempted to treat for bbs?
  - Yes: What measures have you taken? What results?
Some useful resources on bed bugs
http://u.osu.edu/bedbugs

Features:
• Household insect ID card w bed bug tips for printing
• Q&A
• Abstracts of research publications
http://centralohiobedbugs.org

Features:
• Advice for specific groups (hospitality, social work, schools, etc.)
• COBBTF conference presentations
• Links to resources specific to Central Ohio
http://www.cuyahogabedbugs.org/the-cuyahoga-county-bed-bug-task-force

Features:
• CCBBTF conference presentations
• Links to resources specific to Cleveland area
Features:

- Fact sheets and resources in numerous languages
- Video tutorials
http://www.stoppests.org

Features:

- Comprehensive IPM overview (covers various pests, not only bed bugs)
- Videos and written guides
Features:

- Numerous downloadable fact sheets, pamphlets, handouts, etc. with illustrations
- Spanish-language fact sheets and resources
Features:
• Many video tutorials

NOTE: OSU does not endorse specific products or services.
Coming Soon...

OSU’s Bed Bug Field Guide

• Free mobile app
• Bed bug identification, biology, and IPM strategies at your fingertips

Collaboration between:
• EduTechnologic
• OSU Urban Entomology team

Funding provided by:
• EPA Region 5
• Ohio Dept. Agriculture (ODA)
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• How to recognize bed bugs and their tell-tale signs
• Biological characteristics of bed bugs
• Some health effects due to bed bugs
• How to protect oneself from bed bugs
• Some questions to ask clients who suspect that they have bed bugs
• Useful resources on bed bugs
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Thank You!

Sleep tight,
and don’t let the …
… well, you know the rest
Questions?
Help us improve…tell us what you thought of the webinar.

https://www.surveymonkey.com/r/bbweb1