

# Dealing With Bed Bugs— The New Reality

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**THE OHIO STATE UNIVERSITY**

COLLEGE OF FOOD, AGRICULTURAL,  
AND ENVIRONMENTAL SCIENCES

# ***What will you learn today?***

-  *Some myths about bed bugs*
-  *How to recognize bed bugs*
-  *How to protect yourself from bed bugs*
-  *What to do if you have bed bugs*
-  *Treatment options for bed bugs*

# The Bed Bug

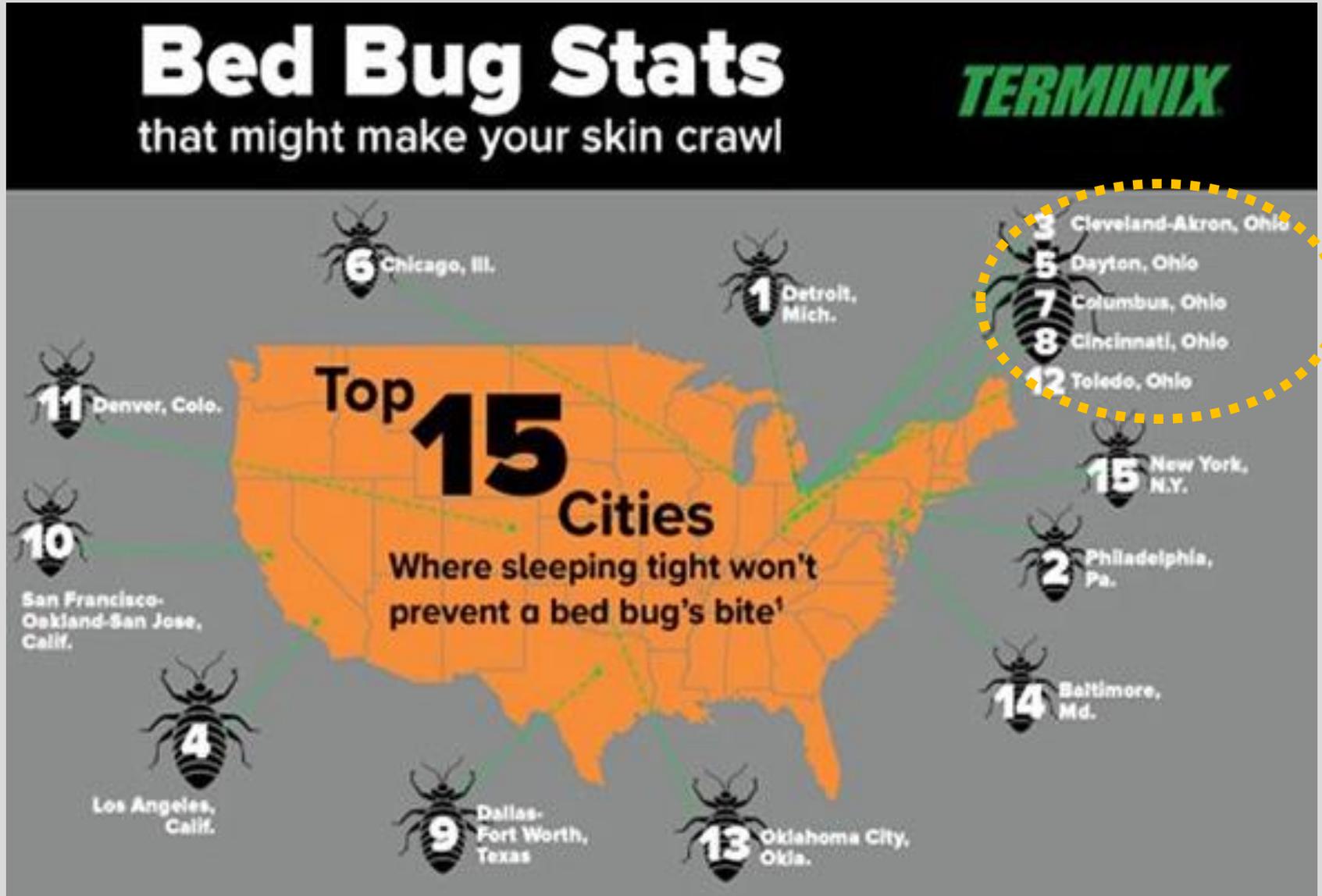
## (*Cimex lectularius*)

- 🪳 Insects (true bugs)
- 🪳 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



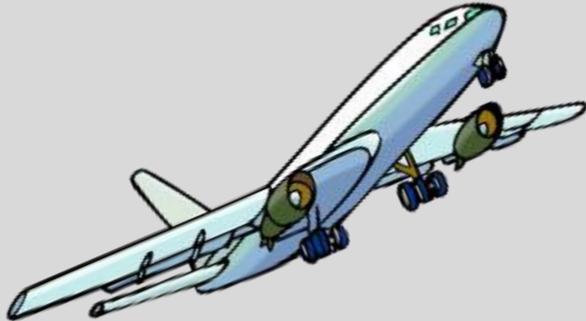
**Not caused by bad housekeeping!!**  
**BED BUGS CAN HAPPEN TO ANYONE!**

# The Most Bed Bug-Infested Cities in the U.S.--2016

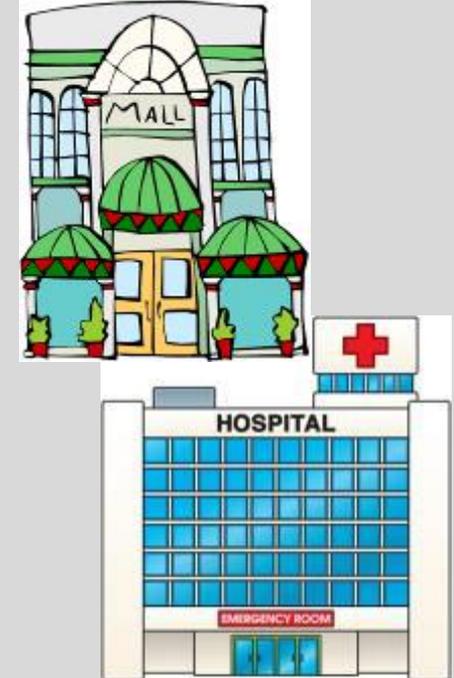




# Bed bugs can be found in:



- Apartment buildings
- Single-family homes
- Hotels and motels
- Assisted living facilities
- Office buildings
- Retail stores
- Movie theaters
- Libraries
- Schools
- Public transportation
- Hospitals



# Bed Bugs In Public Facilities



- Brought in by visitors, staff, etc.
- Brought in on clothing, coats, shoes, bags, purses, briefcases, wheelchairs, walkers, etc.
- Bugs then crawl into the facilities' chairs, carpeting, equipment, etc.
- A single bed bug does not warrant panic or business closure!

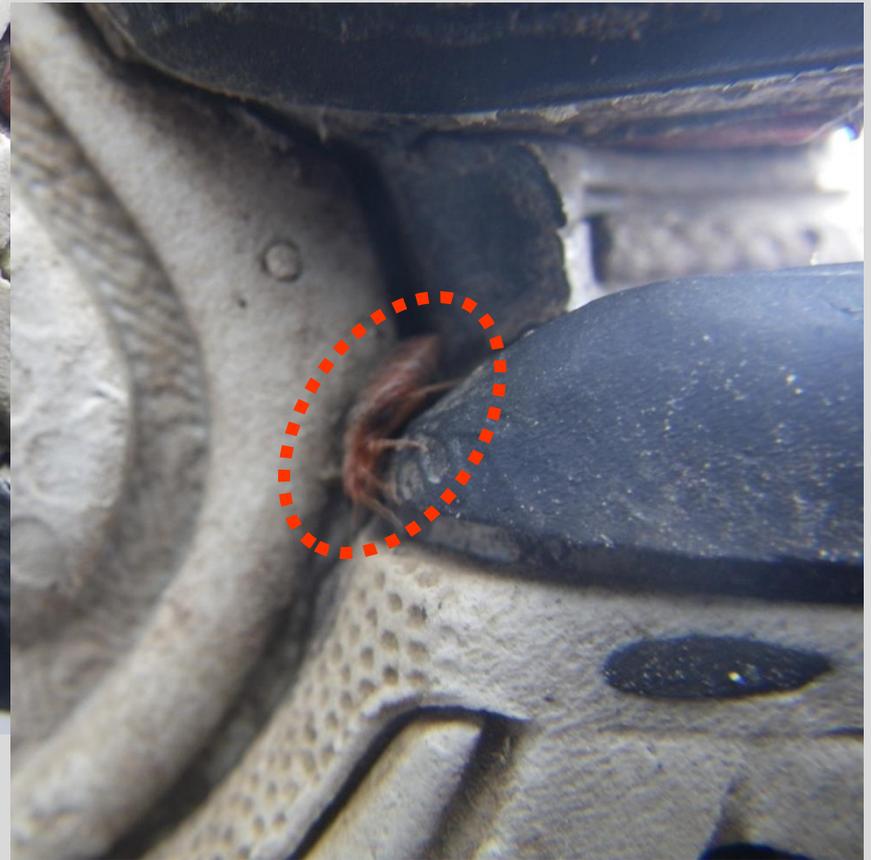
# --Bed Bug Hitchhikers— in walker & wheelchair



Photos courtesy of General Pest Control Co.

# --Bed Bug Hitchhikers— in shoe tread

Total of 13 bed bugs



# Bed Bugs In Public Facilities



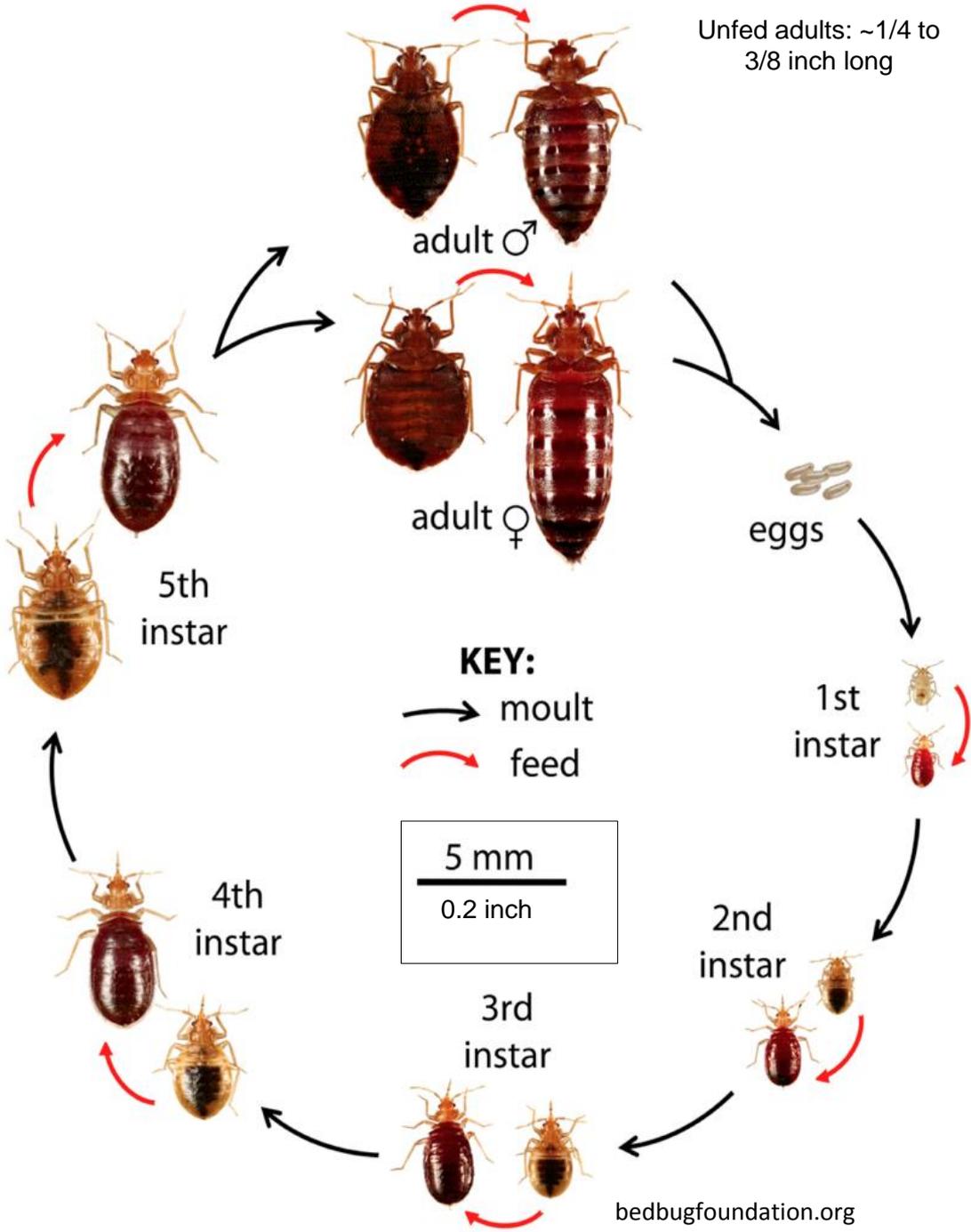
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# Control of Bed Bugs In Public Facilities



- *Early identification is very important*
  - Staff should be trained re. what to look for
  - Maintenance and cleaning crews should be on the lookout for telltale signs of bed bugs
- *Capture a bug for positive identification*

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



adult ♂

adult ♀

eggs

5th instar

**KEY:**

→ moults  
→ feeds

1st instar

4th instar

5 mm  
0.2 inch

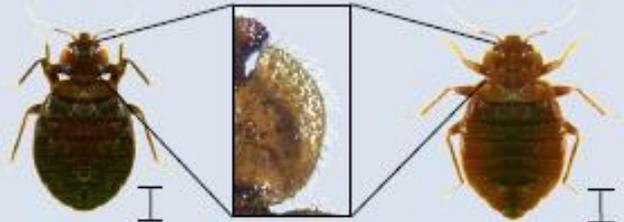
2nd instar

3rd instar

OHIO STATE UNIVERSITY EXTENSION

# Household Insect Identification Card

## Bed Bug (*Cimex lectularius*)



female

note short hairs on pronotum

male



immatures

fecal spotting

shed skins

## Bat Bug (*Cimex adjunctus*)

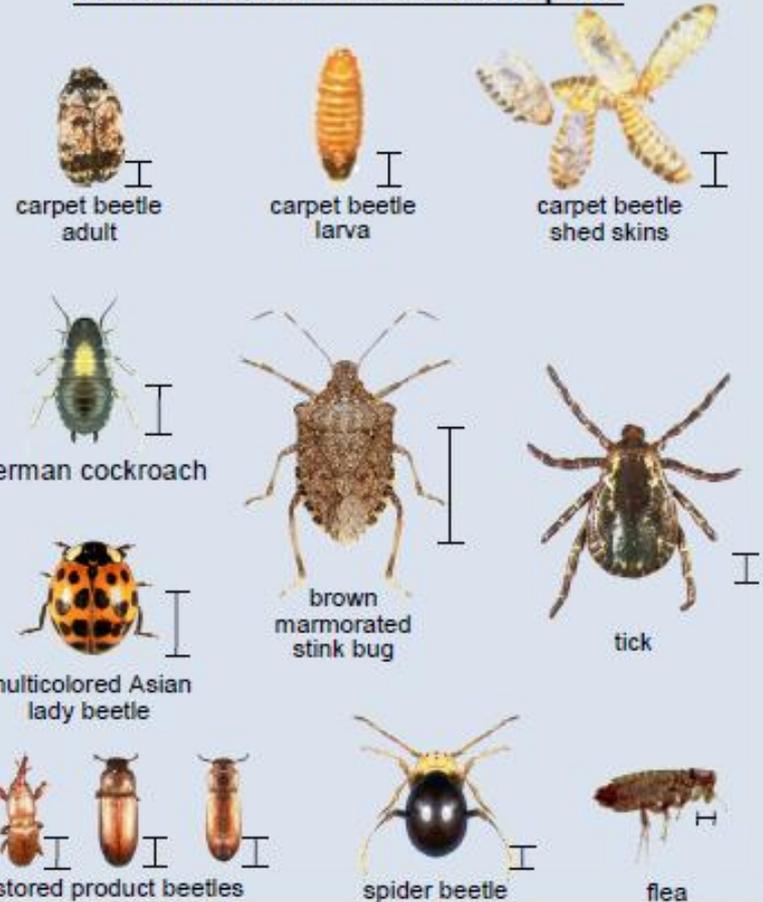


female

note long hairs on pronotum

male

## Miscellaneous Insects/Arthropods



carpet beetle adult

carpet beetle larva

carpet beetle shed skins

German cockroach

brown marmorated stink bug

tick

multicolored Asian lady beetle

stored product beetles

spider beetle

flea

Scale bar to lower right of each insect indicates actual size.

CFAES-1001-16

S.C. Jones, D.J. DeGirolamo, J.L. Bryant

Supported in part by National Institute of Food and Agriculture, Hatch project 211891, and state and federal funds appropriated to the Ohio Agricultural Research and Development Center, The Ohio State University

--A pictorial guide for recognizing bed bugs and other household pests  
--Information on integrated pest management strategies



## Resources

Additional information about bed bugs and other invasive species can be found using the following links.

### Multilingual Information

#### **Cornell University Cooperative Extension bed bug website**

<http://nyc.cce.cornell.edu/UrbanEnvironment/FAQsHotTopics/Pages/BedBugs.aspx>

Information in Italian, Creole, Spanish, Russian, Chinese, Mgoon, and English

#### **State of Virginia website with bed bug resources**

<http://www.vdacs.virginia.gov/pesticides/bedbugs-facts.shtml>

Information in Spanish and English

#### **University of California at Berkley bed bug evolution website**

[http://evolution.berkeley.edu/evolibrary/news/100901\\_bedbugs](http://evolution.berkeley.edu/evolibrary/news/100901_bedbugs)

Information in Spanish and English

#### **University of Kentucky bed bug website**

<http://www2.ca.uky.edu/entomology/entfacts/ef636.asp>

Information in Spanish and English

<http://u.osu.edu/bedbugs>

# 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**

# *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.



# 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

# BED BUG HABITS



Typically hide during the day in dark, protected sites (esp. cracks & crevices)



Can cling tightly to surfaces



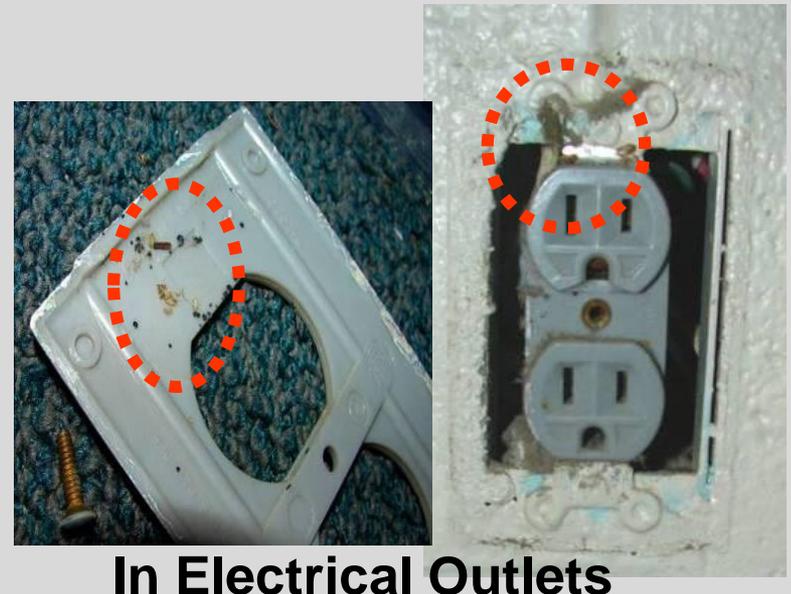
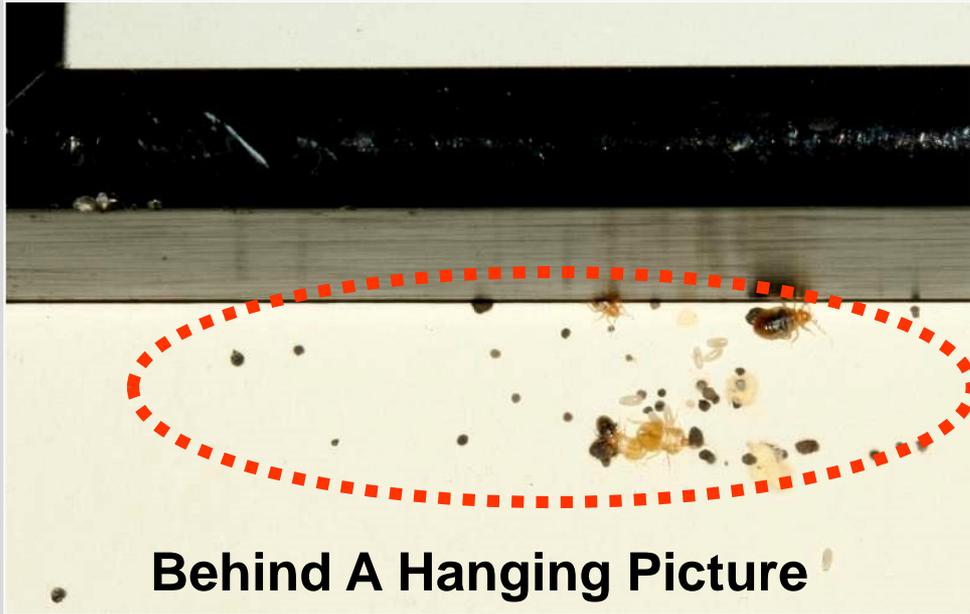
Cannot fly or jump



Can walk very fast



# Some bed bug hiding places



# 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



# 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)



# Telltale Signs of Bed Bugs Behind Baseboards



# Telltale Signs of Bed Bugs in Mattresses and Box Springs



# 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

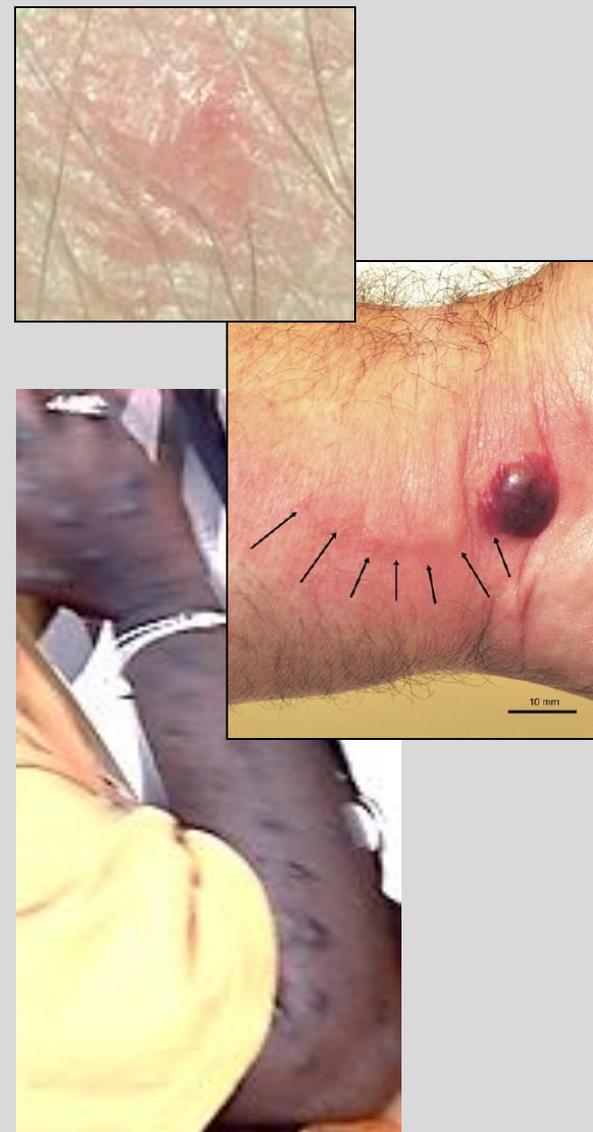
# Treatment of Bites

- Topical or systemic antihistamine or anti-inflammatory medications
- Do NOT use topical insecticides such as for scabies and head lice



# 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
- ...



August 2010



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## Joint Statement on Bed Bug Control in the United States from the U.S. Centers for Disease Control and Prevention (CDC) and the U.S. Environmental Protection Agency (EPA)

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### Introduction and Purpose

The Centers for Disease Control and Prevention (CDC) and the U.S. Environmental Protection Agency (EPA) developed this document to highlight emerging public health issues associated with bed bugs (*Cimex lectularius*) in communities throughout the United States.

Bed bugs (Photo 1) have been common in U.S. history. Although bed bug populations dropped dramatically during the mid-20th century (1), the United States is one of many countries now experiencing an alarming resurgence in the population of bed bugs. Though the exact cause is not known, experts suspect the resurgence is associated with increased resistance of bed bugs to available pesticides, greater international and domestic travel, lack of knowledge regarding control of bed bugs due to their



Photo 1. Bed Bug. Photo courtesy of Dr. Harold Harlan, Armed Forces Pest Management Board Image Library

prolonged absence, and the continuing decline or elimination of effective vector/pest control programs at state and local public health agencies.

In recent years, public health agencies across the country have been overwhelmed by complaints about bed bugs. An integrated approach to bed bug control involving federal, state, tribal and local public health professionals, together with pest management professionals, housing authorities and private citizens, will promote development and understanding of the best methods for managing and controlling bed bugs and preventing future infestations. Research, training and public education are critical to an effective strategy for reducing public health issues associated with the resurgence of bed bug populations.

### Impact of Bed Bugs on Public Health

Although bed bugs are not known to transmit disease, they are a pest of significant public health importance. Bed bugs fit into a category of blood-sucking ectoparasites (external parasites) similar to head lice (*Pediculus humanus capitis*). Bed bugs, like head lice, feed on the blood of humans but are not believed to transmit disease. Other ectoparasites, such as body lice (*Pediculus humanus corporis*), are known to transmit several serious diseases. Differences in the biology of similar species of pests, such as body lice and head lice (or bed bugs) can greatly impact the ability of pests to transmit disease.

# 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.cdc.gov/nceh/ehs/Publications/Bed_Bugs_CDC-EPA_Statement.htm)

<http://www.epa.gov/pesticides/bedbugs/>

# Tips for Employees That Make Home Visits



Tyvek boot covers



Tyvek coveralls

- Minimize items to be carried inside
- Don't sit on beds, upholstered furniture, or the floor
- Do a self-inspection immediately after departing (thoroughly inspect shoes)
- Change into fresh clothing ASAP (consider keeping a change of clothes at work)
- Bag used items (seal the bag)
- Dissolvable laundry bags are an option
- Disinfect clothing by laundering & drying



# Disinfect Items by ★★★ Laundering & Drying ★★★ (kills all bed bug life stages)

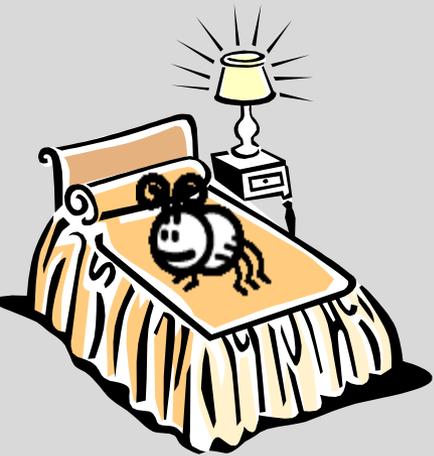
## Launder clothing

- Wash in hot water ( $\geq 120^{\circ}\text{F}$ )
- Use drier on hot setting ( $\geq 30$  mins.)
- Dry clean items

## Bag disinfected items



**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**

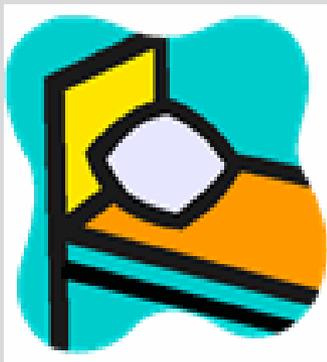
## **Reduce the chances of getting bed bugs from hotel/motel rooms!**

- 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!

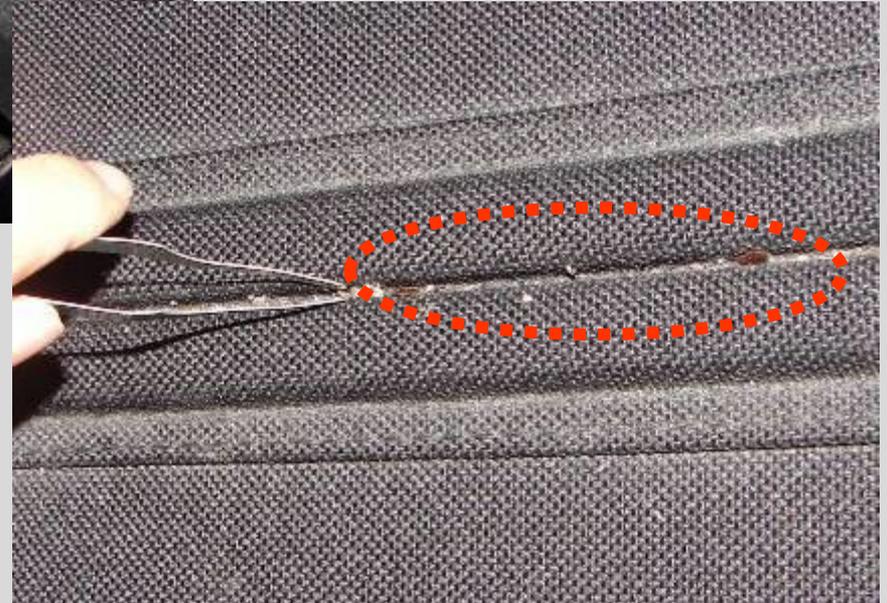
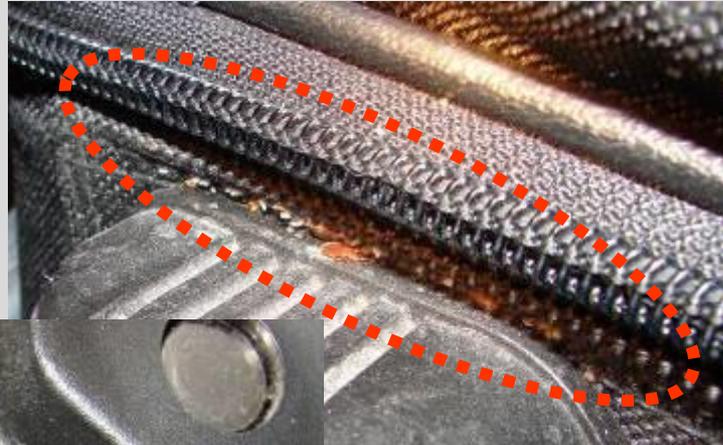
# BED BUG PREVENTION AT HOME

**Don't bring infested items home!**

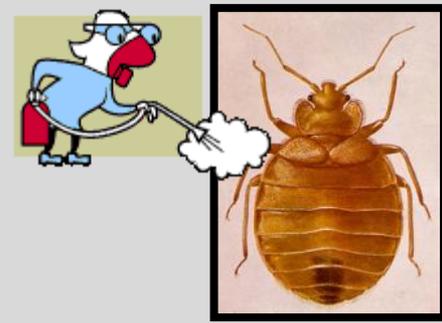
- **Inspect clothing and luggage of travelers**
- **Inspect secondhand beds, bedding, furniture, & clothing**



# --Bed Bug Hitchhikers— in luggage



# Treatment Options



- Insecticides
  - Residual products (dust, liquid, aerosols)
  - Fumigation (sulfuryl fluoride)



- Heat treatment (whole structure, container)



# ***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.**

--Active Monitoring Tool--

## Bed Bug-Sniffing Dogs



- Dog and handler should be specially trained and certified
- Enable rapid inspections
- Useful for large-scale inspections
- Expensive
- Much variability among canine detection firms (10–100% accuracy; mean accuracy 44%; 15% false positives [Cooper et al. 2014 JEE 107:2171-2181])

# --Passive Monitoring Devices--

## Sticky Traps

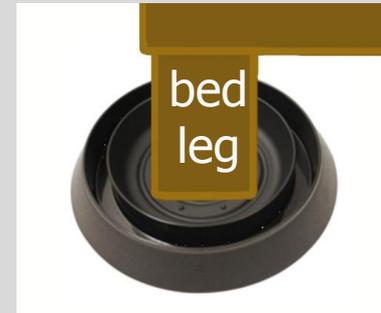
Sticky traps have low levels of effectiveness in capturing bed bugs.



## Bed Bug Pitfall Traps



ClimbUp  
Interceptor



LightsOut  
Interceptor

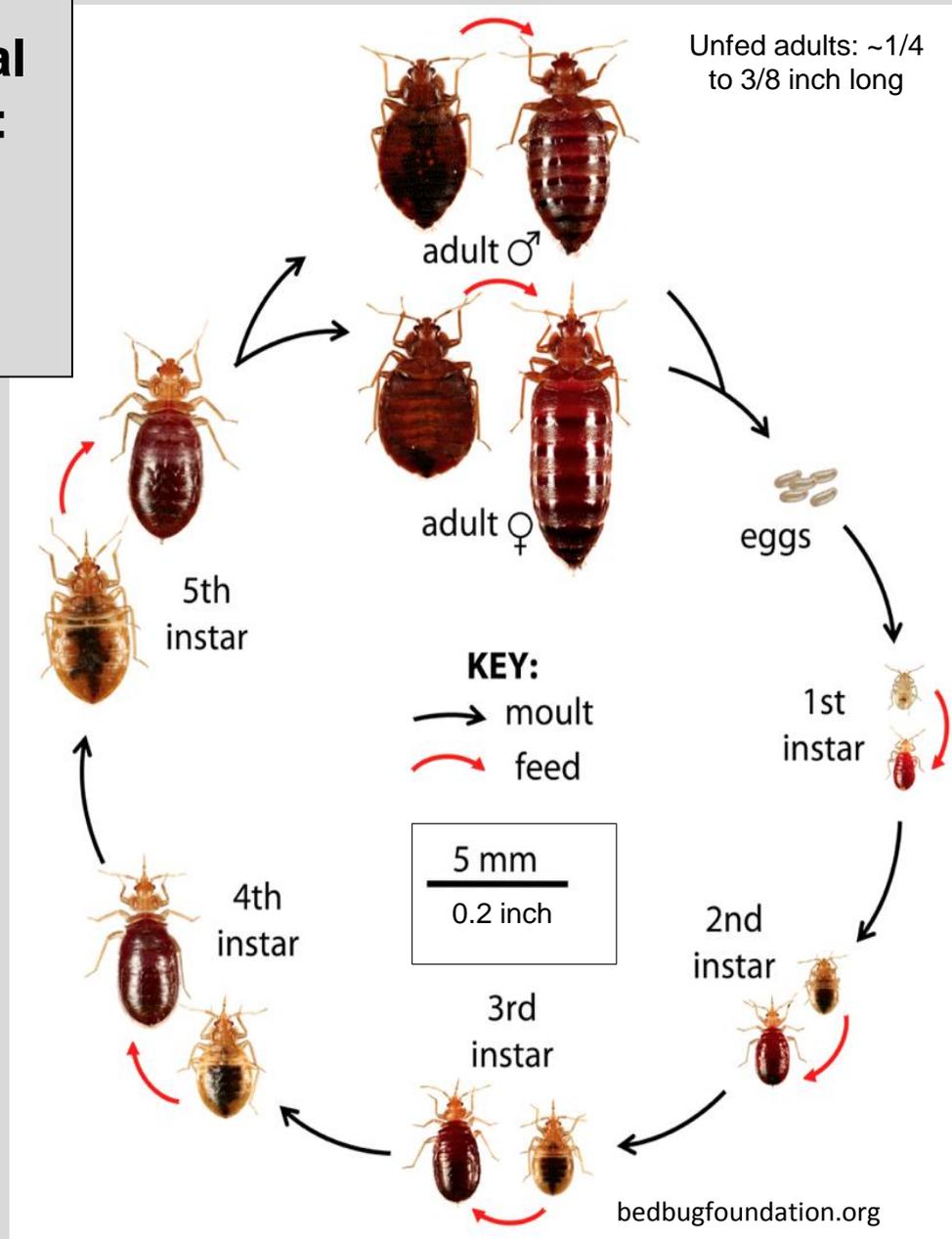


BB Stop  
Pitfall Trap

# 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

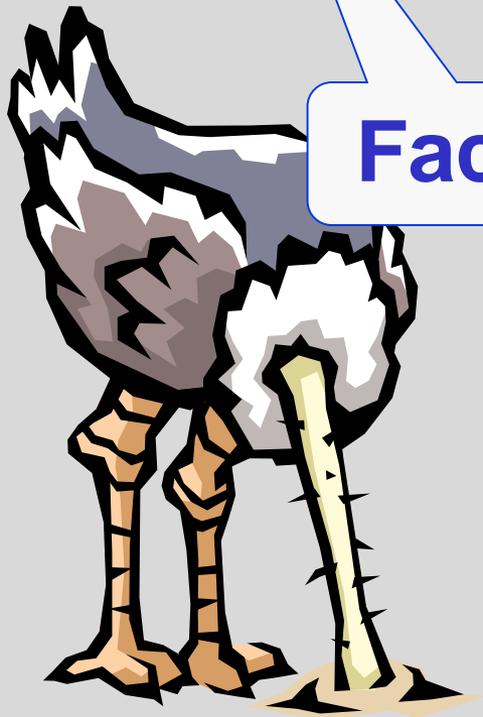
# Fact? or Fiction?

**Fiction!!!**



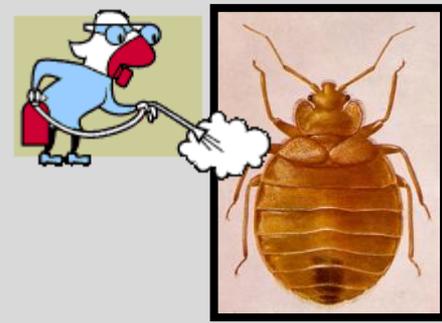
"If I ignore the bed bug problem, it will eventually go away."

**Fact!!!**



If untreated, the bed bug problem will become **MUCH** worse.

# Treatment Options



- Insecticides
  - Residual products (dust, liquid, aerosols)
  - Fumigation (sulfuryl fluoride)

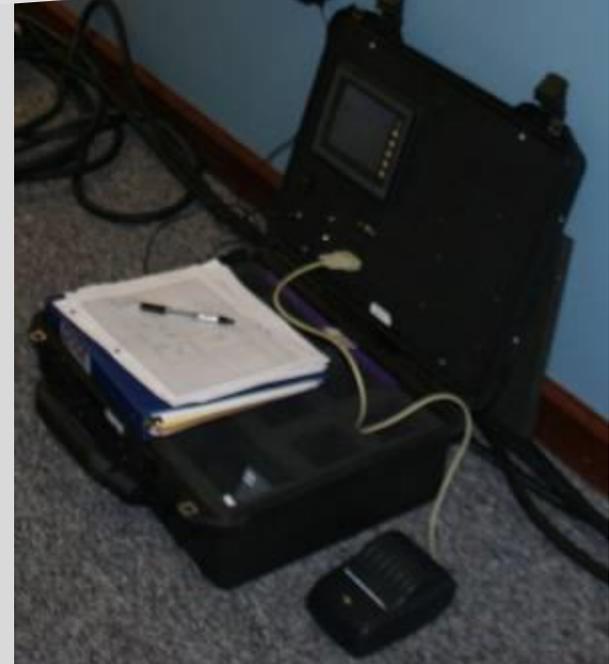
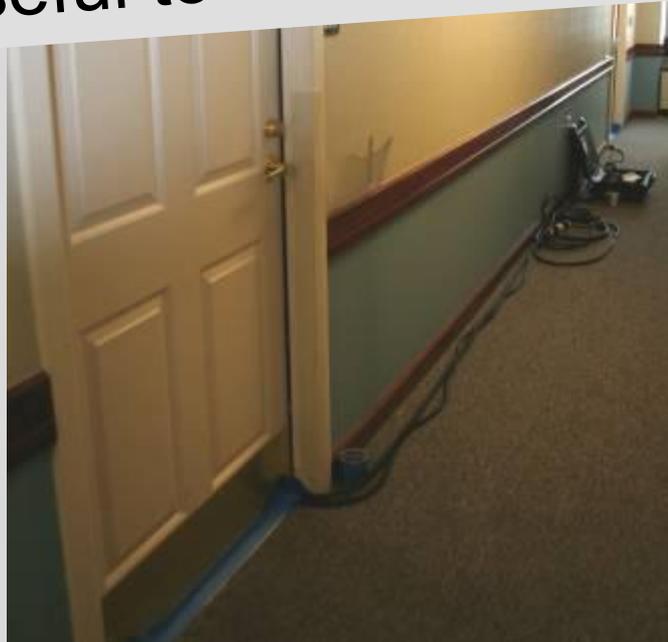


- Heat treatment (whole structure, container)



# Whole Room Heat Treatment

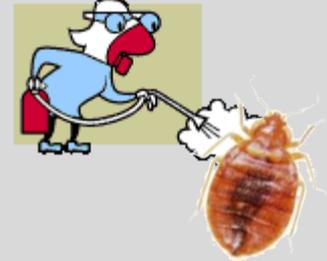
- Typically a 6-8 hour process
- Temperature: 135°F [57.2°C]
- Double or more the cost of an insecticide treatment
- Offers no residual protection so useful to include an insecticide



# ***Some Basics of Bed Bug Management Using Insecticides***

- Bed bug control is time-intensive and labor-intensive.
- A thorough inspection to locate all bed bug harborages is critical.
- Spot treat all harborage sites.

# ***Some Basics of Bed Bug Management Using Insecticides***



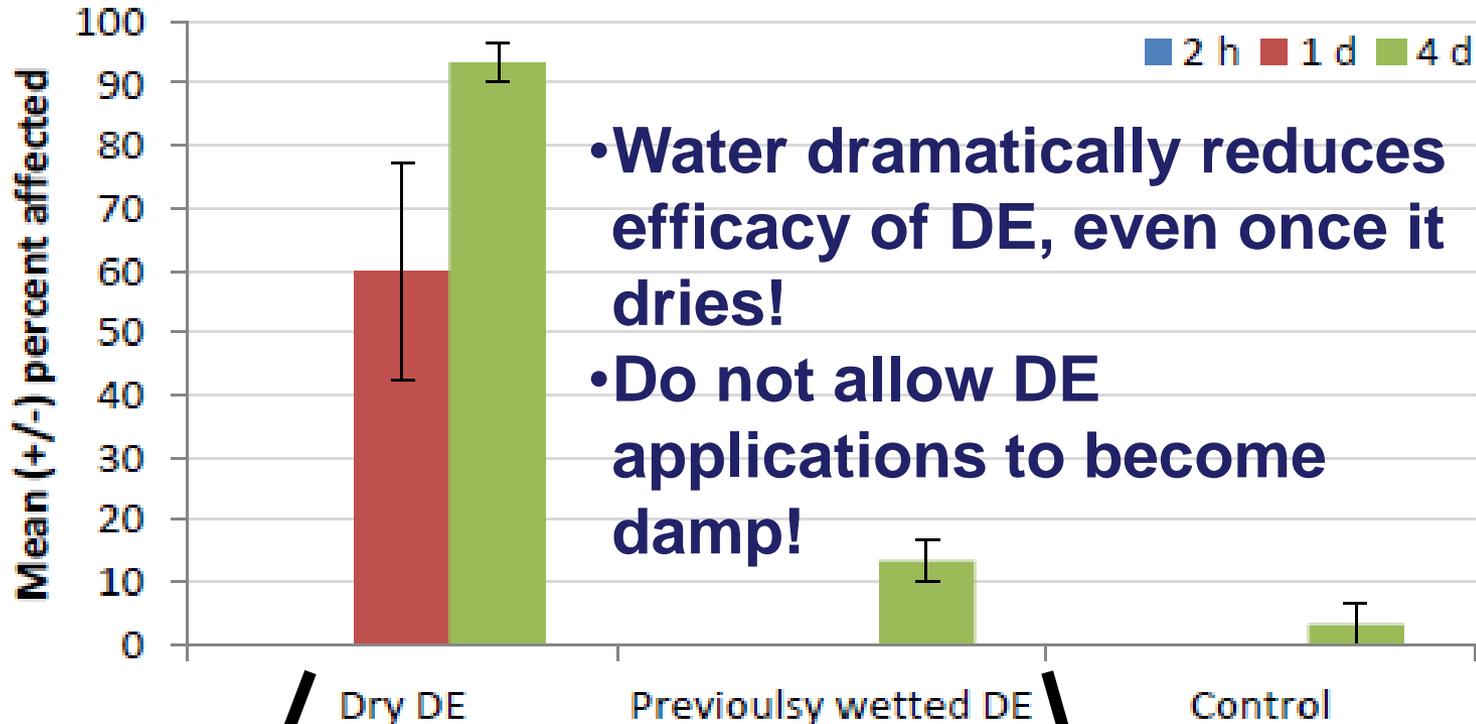
- Residual insecticides are very important
- Low impact products are an option (diatomaceous earth, silica gel, insect growth regulators [IGRs] {but recent research indicates that IGRs are not very effective against bed bugs})

## Some newer insecticides for use against bed bugs:

<b>Active Ingredient</b> (insecticide class)	<b>Product Name(s)</b>
<b>Imidacloprid + <math>\beta</math>-cyfluthrin</b> (neonicotinoid + pyrethroid)	<b>Temprid<sup>®</sup> SC</b>
<b>Chlorfenapyr</b> (halogenated pyrrole)	<b>Phantom<sup>®</sup> SC</b> <b>Phantom<sup>®</sup> PI</b>
<b>Acetamiprid + bifenthrin</b> (neonicotinoid + pyrethroid)	<b>Transport<sup>®</sup> Mikron</b> <b>Transport<sup>®</sup> GHP</b>
<b>Thiamethoxam + <math>\lambda</math>-cyhalothrin</b> (neonicotinoid + pyrethroid)	<b>Tandem<sup>®</sup></b>
<b>Dinotefuran + diatomaceous earth</b> (neonicotinoid + silica dioxide)	<b>Prescription Treatment</b> <b>Alpine<sup>®</sup> Dust</b> <b>Alpine<sup>®</sup> PI</b>
<b>Amorphous silica gel</b>	<b>CimeXa<sup>™</sup></b>

— OSU Research Study —

# Efficacy of Diatomaceous Earth Against Bed Bugs



- Water dramatically reduces efficacy of DE, even once it dries!
- Do not allow DE applications to become damp!



# **Some Basics of Bed Bug Management** **Using Insecticides**

- There is no single “magic bullet”
- Bed bug control typically takes several treatments (average of 3 trts)
- It is important to use several different formulations (dusts, sprays, etc.), and often, several different insecticides
- Don’t keep using the same insecticide (rotate insecticide use)



# ***Consider hiring a professional pest control company for bed bug work***

- Make sure properly licensed
- Check for satisfied customer references that relate to bed bug control
- Determine if they will be doing many of the things that you learn today

OH Dept. of Agriculture  
Pesticide Regulation Section  
614-728-6987; 800-282-1955  
<http://www.agri.ohio.gov>

# 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

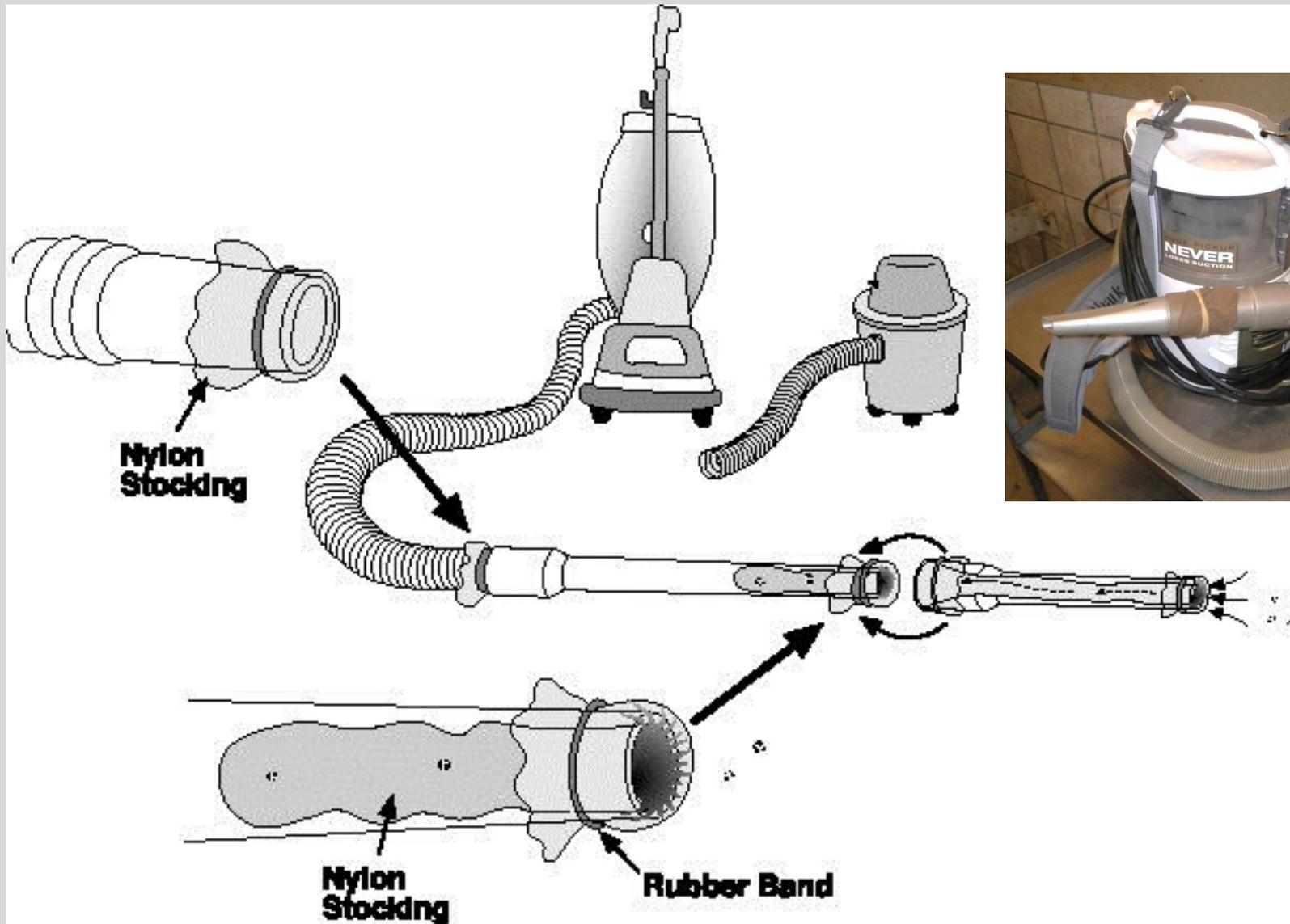
# *Some measures to help reduce the number of bed bugs:*

## **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.

# Vacuating to contain bed bugs



# ***What can I do to help solve a bed bug infestation?***

## **Laundry bedding, clothing, etc.!**

- **Wash in hot water ( $\geq 120^{\circ}\text{F}$ )**
- **Drier on hot setting ( $\geq 30$  mins.)**

It is important to keep disinfected items bagged while bed bug eradication efforts are on-going at your residence.



# *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



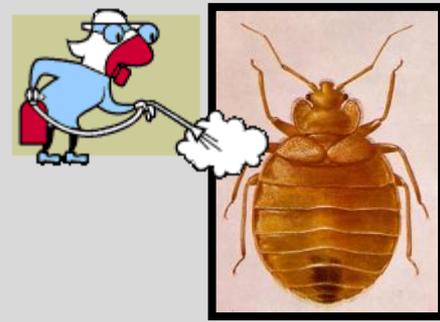
Photo courtesy of General Pest Control Co.

# Cold Treatment

*Not a standalone measure  
against bed bugs.*



**CRYONITE**



# Insecticides

- **DO NOT** apply insecticide sprays to
  - Human skin
  - Clothing
  - Bed linens
  - Bedding

Products containing DEET  
repel bed bugs only for  
short periods of time



# ***BUYER BEWARE:***

***Boric acid products don't work!***

- Boric acid does not kill bed bugs.
- Boric acid is a stomach poison that must be eaten by an insect.

**Remember that bed bugs feed only  
on blood.**

# ***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)**



**DON'T use bug bombs  
for bed bugs!**



*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”)

“Kills on contact”  
“Effective long-term control”



“Kills on contact”  
“Kills flying, crawling,  
and biting insects”



“Kills on contact”  
“Kills bugs you see, kills  
bugs you don't see!”



HOUSEHOLD AND STRUCTURAL INSECTS

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

SUSAN C. JONES<sup>1</sup> AND JOSHUA L. BRYANT

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

J. Econ. Entomol. 105(3): 957-963 (2012); DOI: <http://dx.doi.org/10.1603/EC12037>

**ABSTRACT** Field-collected bed bugs (*Cimex lectularius* L.) showed little, if any, adverse effects after 2-h direct exposure to the aerosolized 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 sites where they will not be directly contacted by the insecticide mist from foggers. This study provides scientific data supporting the position that total-release foggers should not be recommended for control of bed bugs, because 1) many field-collected bed bugs are resistant to pyrethroids; they are not affected by brief exposure to low concentrations of pyrethrins and/or pyrethroids 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.



# Efficacy of Commercially Available Ultrasonic Pest Repellent Devices to Affect Behavior of Bed Bugs (*Hemiptera: Cimicidae*)

K. M. YTURRALDE<sup>1</sup> AND R. W. HOFSTETTER

School of Forestry, Northern Arizona University, 200 East  
AZ 86011

J. Econ. Entomol. 100: 166-171 (2007)  
**ABSTRACT** Little is known about the behavior of bed bugs, *Cimex lectularius* L. (Hemiptera: Cimicidae), although many studies have shown that they are attracted to sound. The purpose of this study was to determine if ultrasonic repellent devices could be used to repel bed bugs. Female bed bugs were tested with or without sound during choice trials. However, the results showed that bed bugs did not respond to sound and control devices. Our results confirm that ultrasonic repellent devices are not a promising tool for repelling bed bugs.

**KEY WORDS** bed bug



cockroach feces

bed bugs nearby

cockroach shed skin

166  
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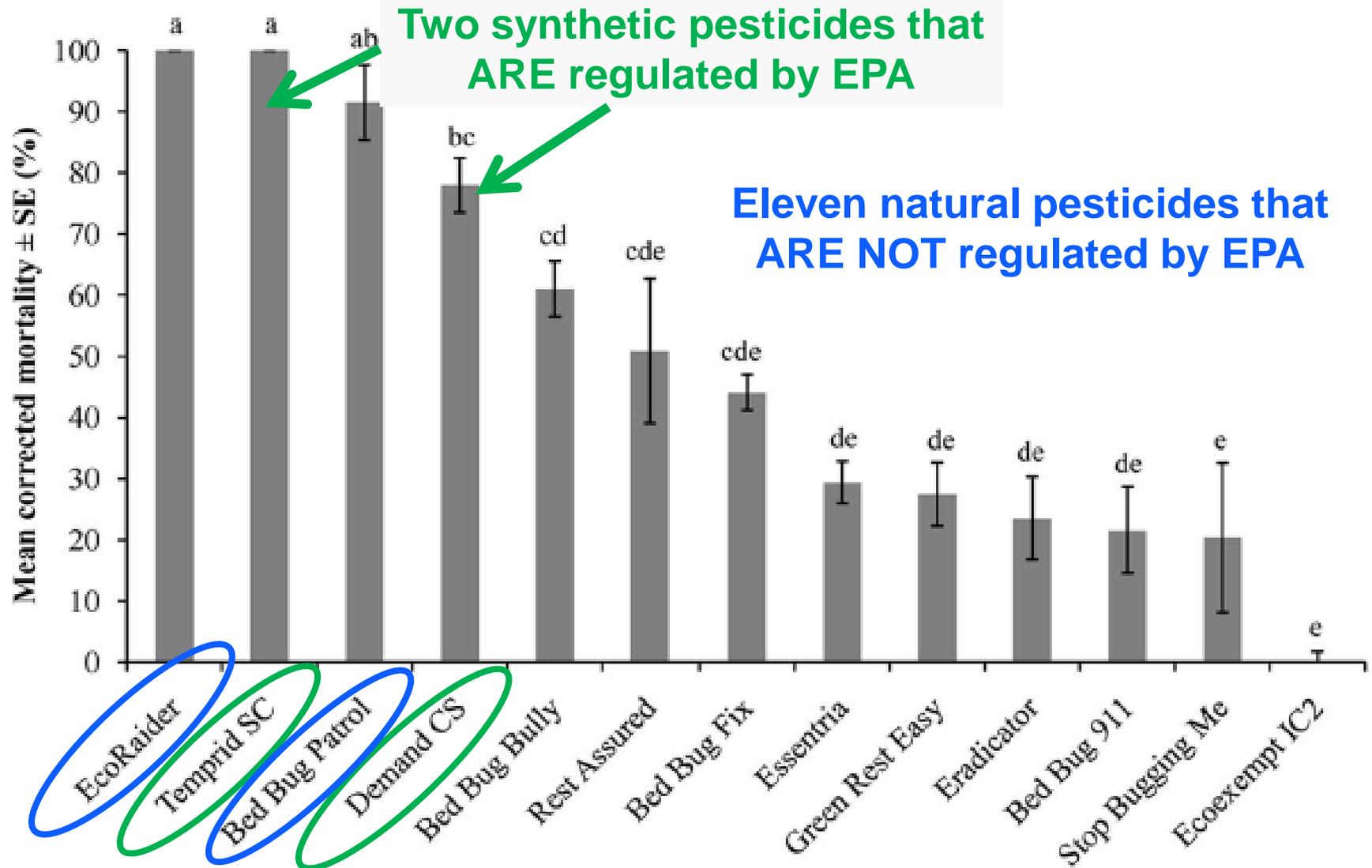
*Cimex lectularius*

# **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

# Rutgers Univ. 2014 Study

## Percentage of dead bed bug nymphs at 10 days after being directly sprayed



# --Summary--

## Bed Bug Workshop



- *Dispelled some myths about bed bugs*
- *How to recognize bed bugs*
- *Measures to protect yourself from bed bugs*
- *What to do if you have bed bugs*
- *Treatment options for bed bugs*

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# Thank You!



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

