THE OHIO STATE UNIVERSITY

COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

OSU Webinar 2

Treating for Bed Bugs: Integrated Pest Management (IPM) Strategies

Dr. Susan C. Jones, Professor of Entomology

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INTEGRATED PEST MANAGEMENT (IPM) :

Correctly identify the pest

Webinar 1

+

Conduct a thorough inspection

+

Use sanitation measures

+

Use non-chemical measures

Webinar 2

+

Apply insecticides to targeted sites

Webinar 2
Treating for Bed Bugs
What will you learn today?

- *Insecticide resistance in bed bugs*
- *Tips for hiring a pest management professional (PMP)*
- *Inspection and monitoring options*
- *Ohio pesticide regulations*
- *Bed bug treatment options and general guidelines for:*
  - *heat treatments*
  - *insecticide treatments*
- *Bed bug products*
  - *Registered insecticides*
  - *Natural products (exempt from EPA registration)*

Worldwide Resurgence of Bed Bugs Since Late 1990s

Aumenta la presencia de chinches en Barcelona

SPAIN

Las empresas de control de plagas descartan su desaparic
han incrementado las actuaciones contra estos insectos en

★★★★☆ 10 votos | 42 comentarios

mardi 26 octobre 2010 à 18H38

CANADA

Montréal: épidémie de punaises de lit confirmée

nal de santé publiq

inefficaces, la

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sont pas

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THE TIMES
THE SUNDAY TIMES

ENGLAND

Archive Article | Please enjoy this article from The

From The Times

April 14, 2004

Bedbugs invade London's

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 t identify the cause of the invasion.

guardian.co.uk

AUSTRALIA

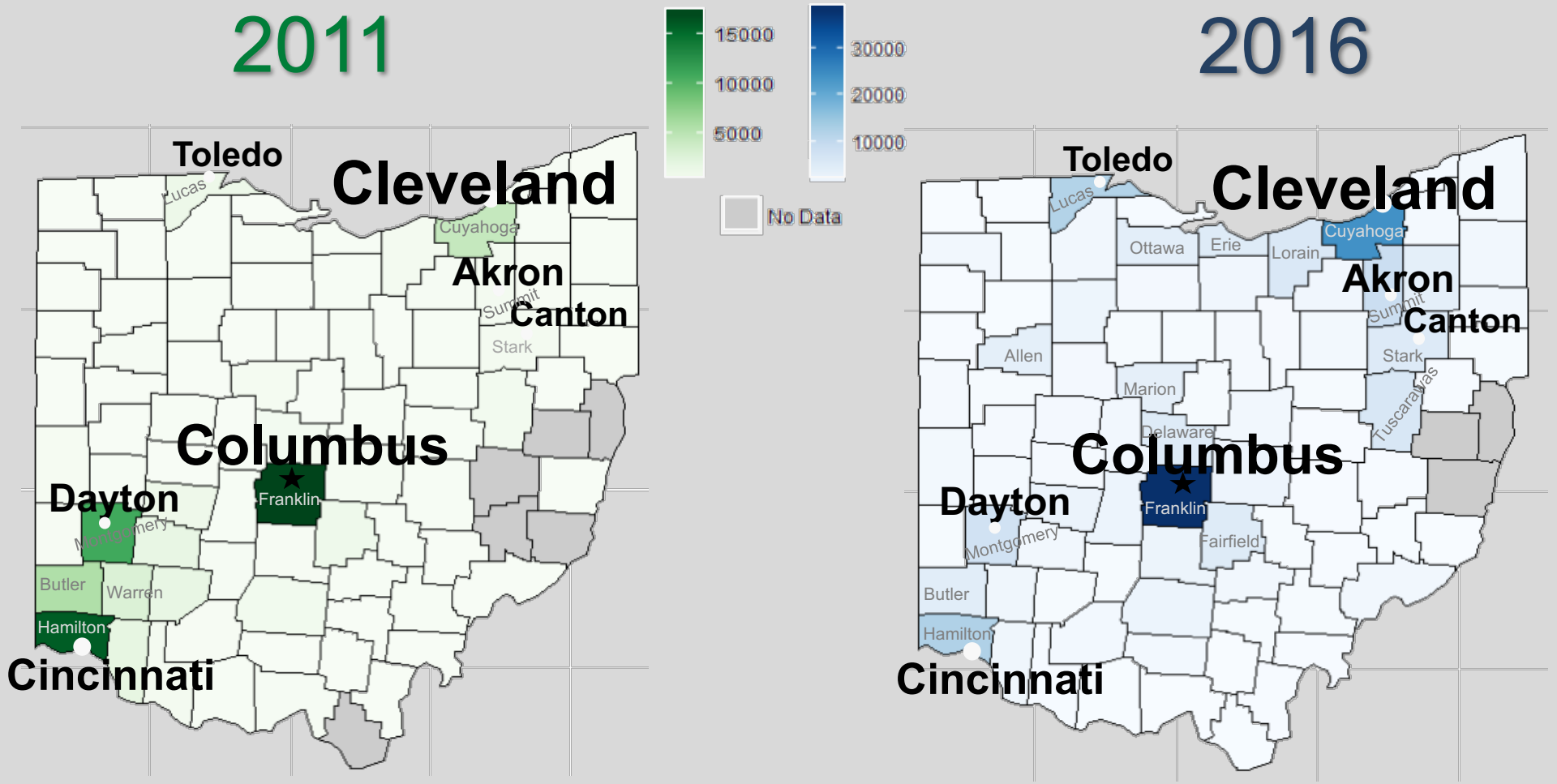
Bed bugs eat into tourism

Bernard O'Riordan in Sydney
The Guardian, Wednesday 6 April 2005 01.43 BST

A larger | smaller

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 infested eight out of 10 backpacker hostels in Sydney's eastern suburbs alone. Many bedsits, particularly at Bondi Beach and Kings Cross, rely almost exclusively on British and Irish customers.

Heat Map Showing Estimated Total Number of Bed Bug Treatments in Each County in Ohio during 2011 and 2016* (the darker the color, the more bed bug treatments)



*OSU surveys of pest management companies and individuals licensed (category 10A) to treat for bed bugs in Ohio

Some Reasons For the Resurgence of Bed Bugs

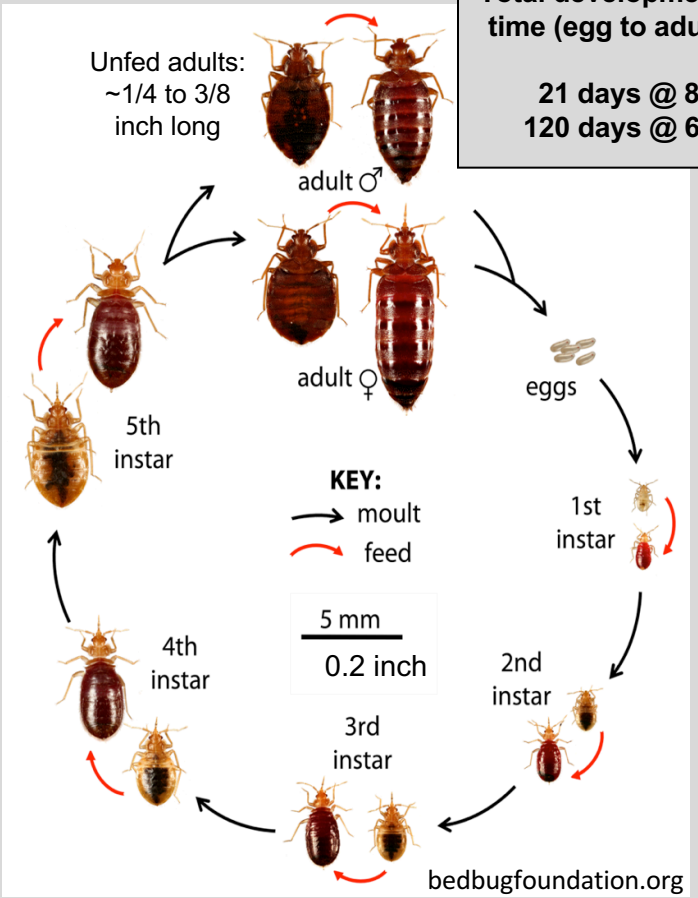
- International travel and commerce
- Housing with high tenant turnover
- Pesticide use has changed
  - Pesticide bans
  - Failure to re-register insecticides
  - Baits to control ants & cockroaches
- Insecticide resistance

Webinar 2

Some of the challenges due to bed bugs:

Webinar 1

- Nocturnal behavior
- Can feed on multiple types of warm-blooded animals
- Hide indoors in many sites from floor to ceiling
- Very fast life cycle (many generations per year)
- Strong tendency to disperse
  - Hitchhiking
  - Walking
- Can survive starvation for months and months
- Bites cause variable reactions in humans



Webinar 2

- Insecticide resistance
- Etc.

Definition of Resistance

"The inherited ability of a strain of some organism to survive doses of a toxicant that would kill the majority of individuals in a normal population of the same species."

World Health Organization (WHO)

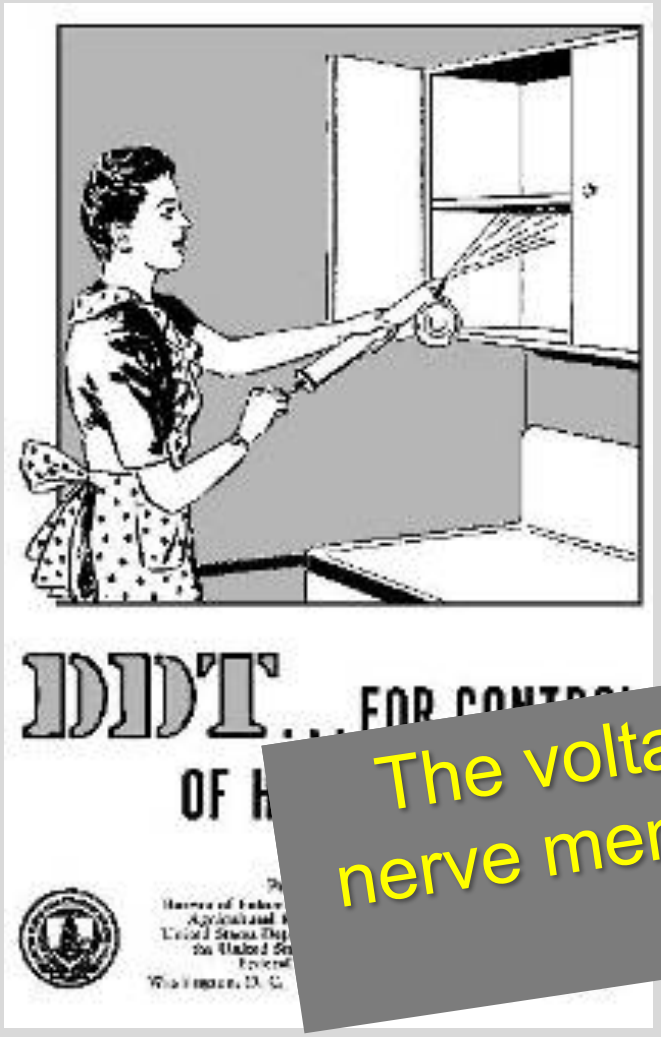
Pyrethroid Resistance

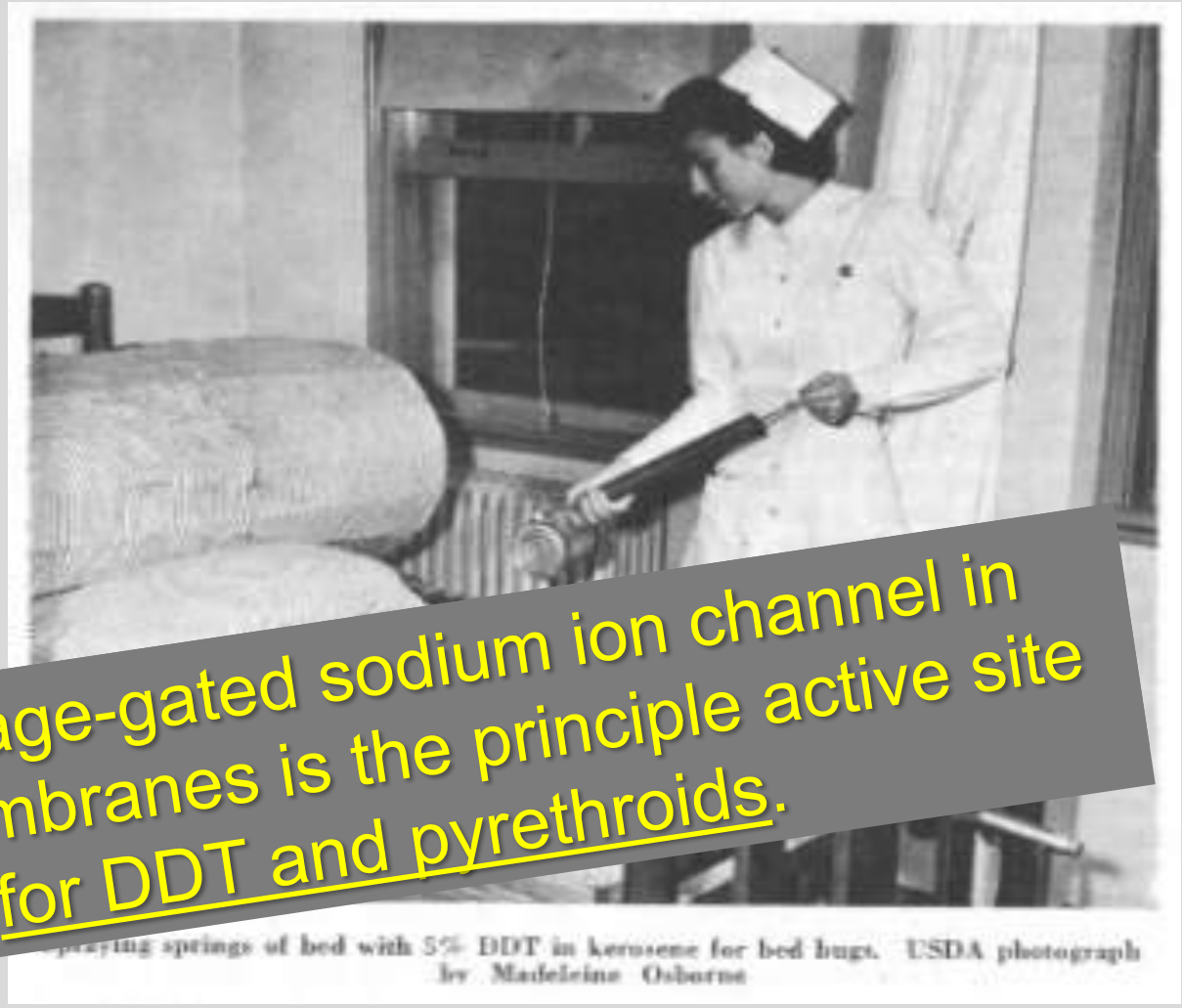
A class of synthetic insecticides mimicking the structure & properties of pyrethrum, which comes from chrysanthemum flowers

- **Extremely high levels of resistance to two pyrethroid insecticides (deltamethrin and λ-cyhalothrin) were detected in bed bug populations collected from human dwellings in Kentucky and Ohio.**
- **Resistance to pyrethroid insecticides was widespread in U.S. bed bug populations.**

Romero, Alvaro; Potter, Michael F.; Potter, Daniel A.; Haynes, Kenneth F. (2007) Insecticide Resistance in the Bed Bug: A Factor in the Pest's Sudden Resurgence? *Journal of Medical Entomology* 44(2): 175-178.

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





The voltage-gated sodium ion channel in nerve membranes is the principle active site for DDT and pyrethroids.

Some newer insecticides for use against bed bugs:

Active Ingredient (AI) (insecticide class)	Product Name(s)
Imidacloprid + ß-cyfluthrin (neonicotinoid + pyrethroid)	**Temprid® SC**
Acetamiprid + bifenthrin (neonicotinoid + pyrethroid)	**Transport® Mikron** **Transport® GHP**
Thiamethoxam + λ-cyhalothrin (neonicotinoid + pyrethroid)	**Tandem®**
Dinotefuran + diatomaceous earth (neonicotinoid + silica dioxide)	**Prescription Treatment** **Alpine® Dust** **Alpine® PI**
Chlorfenapyr (halogenated pyrrole)	**Phantom® SC** **Phantom® PI**
Amorphous silica gel	**CimeXa™**
Clothianidin + metofluthrin + PBO (neonicotinoid + pyrethroid + synergist)	**CrossFire®**

Bed bugs are developing resistance to newer insecticides…

Journal of Medical Entomology, 2016, 1–5
doi: 10.1093/jme/tjv253
Short Communication

Short Communication

High Levels of Resistance in the Common Bed Bug, *Cimex lectularius* (Hemiptera: Cimicidae), to Neonicotinoid Insecticides

Alvaro Romero[1,2] and Troy D. Anderson[3]

[1]Department of Entomology, Plant Pathology and Weed Science, New Mexico State Univ

Journal of Economic Entomology, 110(3), 2017, 1195–1202
doi: 10.1093/jee/tox070
Advance Access Publication Date: 10 April 2017
Research article

Household and Structural Insects

…sceptibility to Chlorfenapyr- and …oducts in Field Populations of the …nicidae)

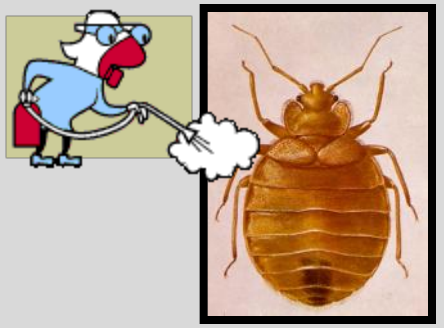
…f, Gary W. Bennett, and Ameya D. Gondhalekar[1]

…est Lafayette, IN 47907 (aashbroo@purdue.edu; mscharf@purdue.edu;

- Field collected bed bugs showed high levels of resistance to 4 neonicotinoids:
  - Acetamiprid (1 of 2 AIs in Transport)
  - Imidac…
  - Thiame…
  - Dinote…
- Pyrethroi… quickly b… neonicoti…

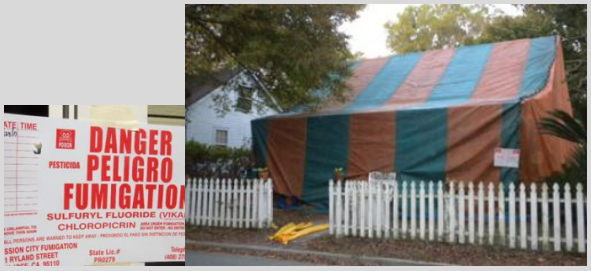
- Of 10 field strains, reduced susceptibility was detected in 3 strains exposed to chlorfenapyr (Phantom; a halogenated pyrrole) and 5 strains exposed to bifenthrin (Talstar; a pyrethroid).
- Susceptibility to chlorfenapyr and bifenthrin seems to be correlated despite the different insecticide classes.

Treatment Options

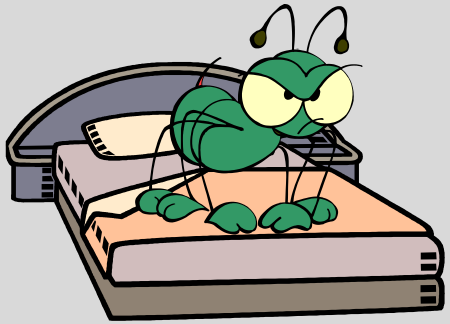


- Insecticide treatment (dusts, liquids, aerosols)
  - Residual insecticide products are essential

- Fumigation (sulfuryl fluoride)
  - Important to include residual insecticide product(s)



- Heat treatment (whole structure, container)
  - When possible, include residual insecticide product(s)



Questions?

Eliminating a bug bug infestation typically is NOT a do-it-yourself (DIY) task!

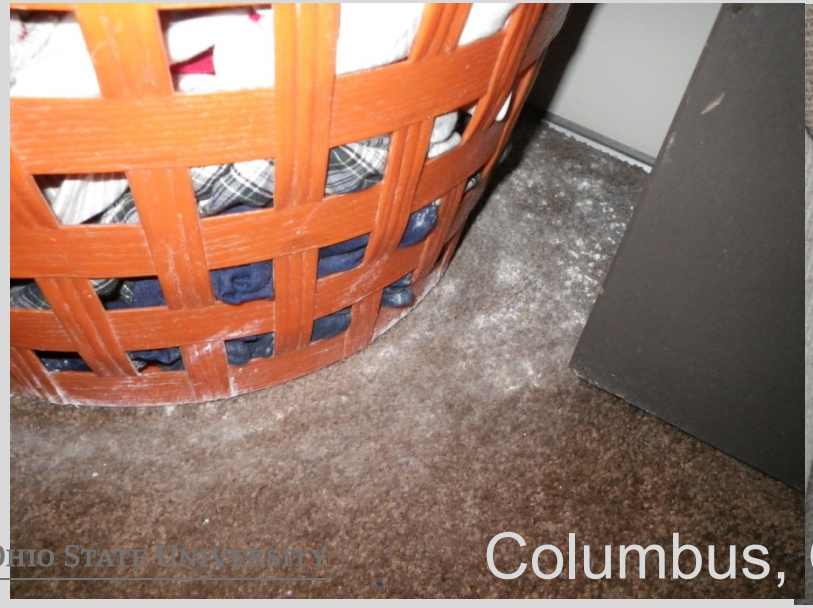
- Requires in-depth knowledge of:
  - Bed bug biology and behavior
  - Inspection and monitoring devices
  - Insecticides:
    - Safety (the labelling is the law)
    - Active ingredient (AI)
    - Formulations (dusts esp. important for bed bugs)
  - Building construction ….
- Requires the proper:
  - Procedures
  - Products
  - Equipment
  - Follow-up …

Ohio Revised Code (ORC) 921.24(A): No person shall apply, use, directly supervise such application or use, or recommend a pesticide for use inconsistent with the pesticide's labeling

http://codes.ohio.gov/orc/5321

For information on pesticides and pesticide safety, here's another really useful OSU website: https://pested.osu.edu/

Pesticide Misuse By Apt. Residents



BE AWARE:

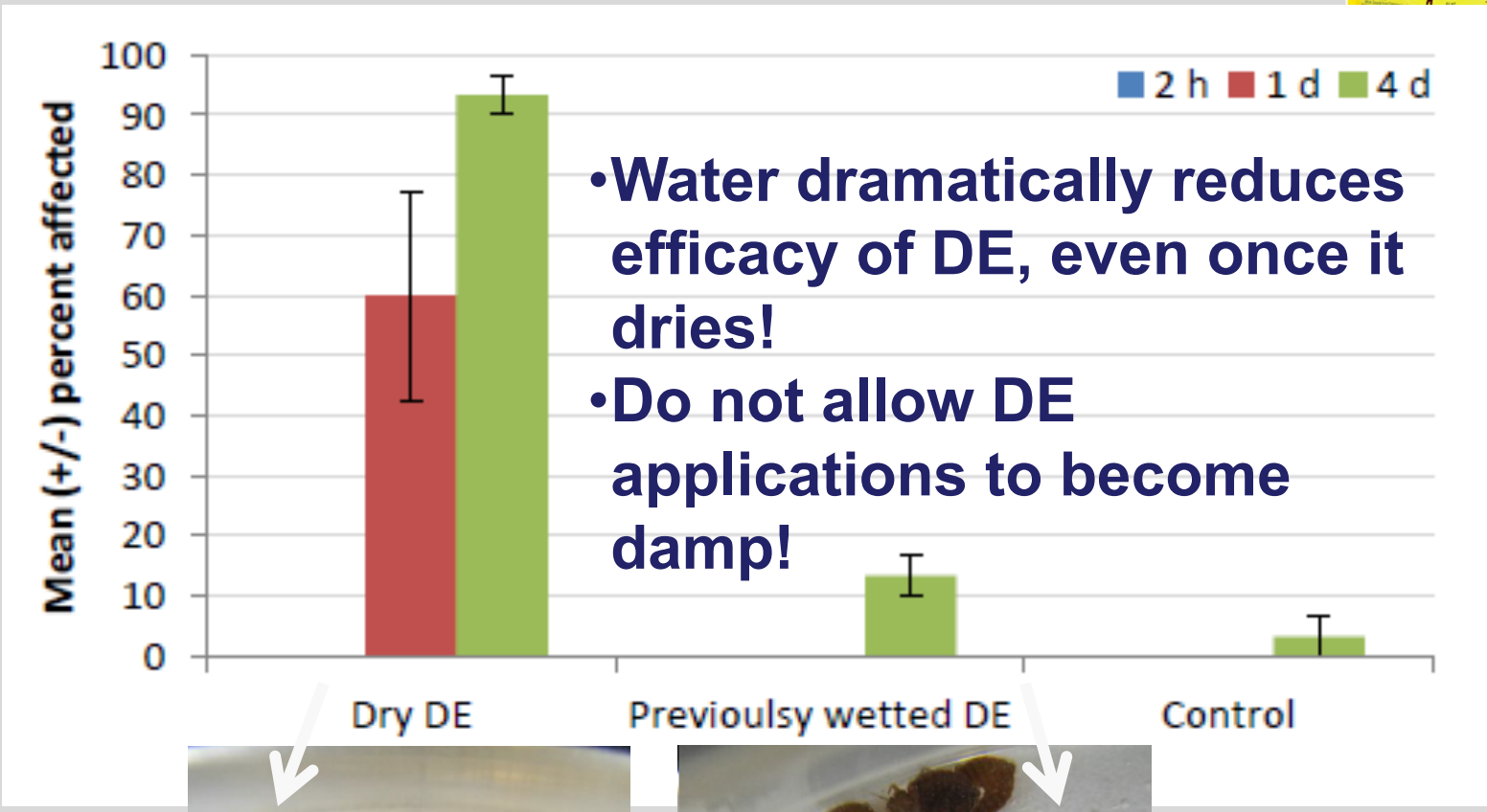
Boric acid products don't work against bed bugs!

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

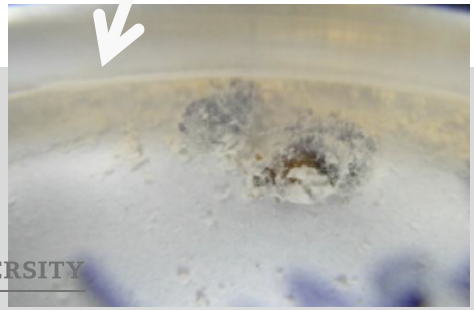
Remember that bed bugs feed only on blood.

— 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!**



BE AWARE:

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)

Contact a professional pest control company to treat for bed bugs

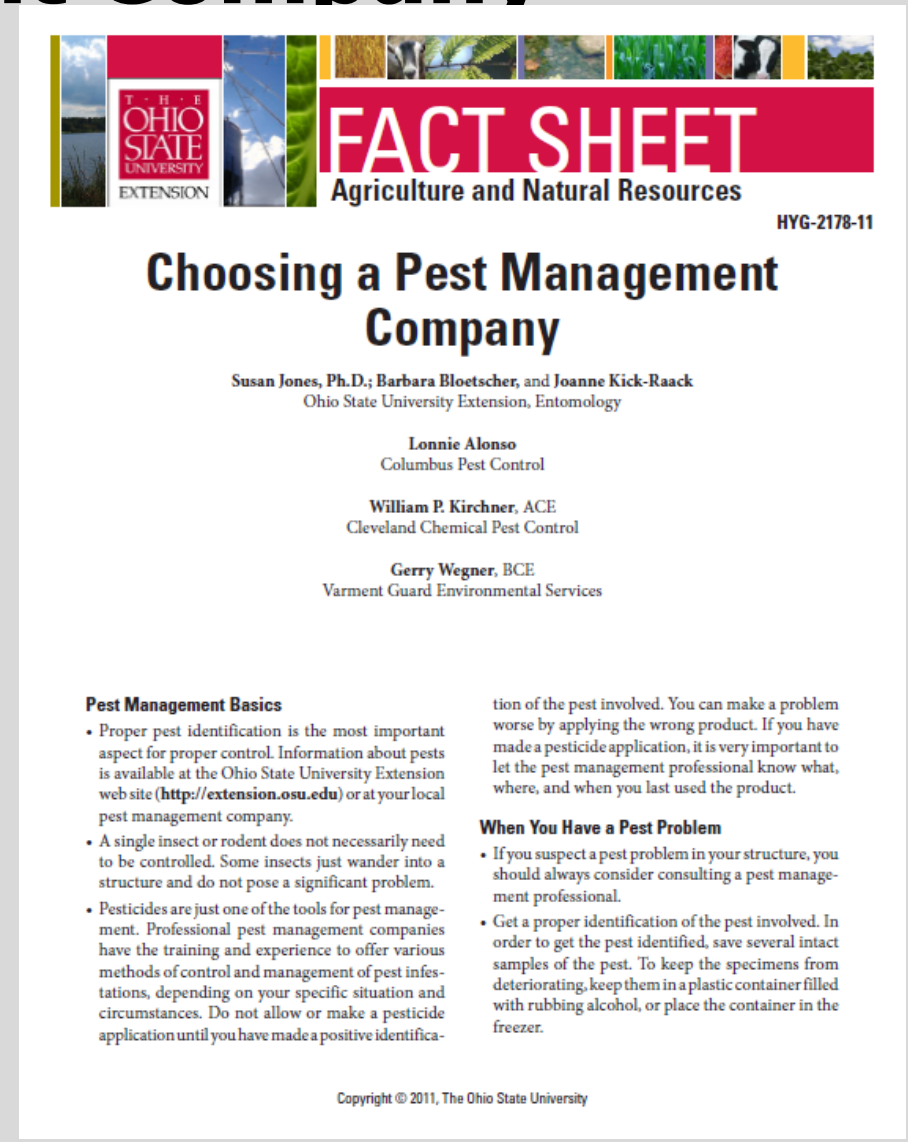
- ODA web site lists <u>licensed</u> pest mgt. companies and applicators

Questions to Ask a Pest Management Company When Considering Them for Bed Bug Work:

- Local, regional, or national Pest Management Association member?
- How long in business?
- Bed bug experience?
- What types of treatments? What chemicals? Cost estimate? How many treatments are expected for my bed bug problem?
- What sort of service agreement is offered?
- You can ask to see:
  - ODA Business and Custom Applicator's License
  - Certificate of insurance
  - Workers' compensation certificate
  - Material Safety Data Sheets (MSDS) and specimen labels

Tips for Choosing a Pest Management Company

- Obtain at least 3 competitive bids
- For each co. being considered, check for satisfied customer references that relate to bed bug control:
  - Chamber of Commerce
  - Better Business Bureau
  - Angie's List or similar
- https://ohioline.osu.edu/factsheet/HYG-2178-11 for more detailed info



THE OHIO STATE UNIVERSITY EXTENSION

FACT SHEET

Agriculture and Natural Resources

HYG-2178-11

Choosing a Pest Management Company

Susan Jones, Ph.D.; Barbara Bloetscher, and **Joanne Kick-Raack**
Ohio State University Extension, Entomology

Lonnie Alonso
Columbus Pest Control

William P. Kirchner, ACE
Cleveland Chemical Pest Control

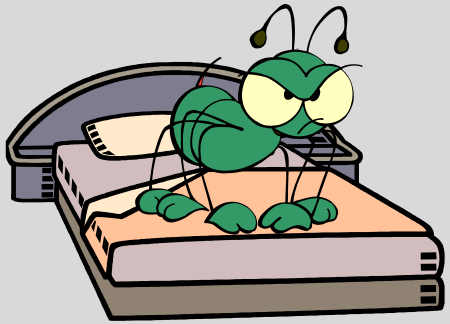
Gerry Wegner, BCE
Varment Guard Environmental Services

Pest Management Basics

- Proper pest identification is the most important aspect for proper control. Information about pests is available at the Ohio State University Extension web site (**http://extension.osu.edu**) or at your local pest management company.
- A single insect or rodent does not necessarily need to be controlled. Some insects just wander into a structure and do not pose a significant problem.
- Pesticides are just one of the tools for pest management. Professional pest management companies have the training and experience to offer various methods of control and management of pest infestations, depending on your specific situation and circumstances. Do not allow or make a pesticide application until you have made a positive identification of the pest involved. You can make a problem worse by applying the wrong product. If you have made a pesticide application, it is very important to let the pest management professional know what, where, and when you last used the product.

When You Have a Pest Problem

- If you suspect a pest problem in your structure, you should always consider consulting a pest management professional.
- Get a proper identification of the pest involved. In order to get the pest identified, save several intact samples of the pest. To keep the specimens from deteriorating, keep them in a plastic container filled with rubbing alcohol, or place the container in the freezer.



Questions?

In Ohio, when are Pesticide Applicators Required to be Licensed?

- Pesticide applications made for hire
- Public employees (federal, state, county, township, city, village or school district)
- When applying pesticides to publicly-accessible sites, such as:
  - Restaurants
  - Schools & daycares
  - Hospitals & medical centers
  - Parks
  - Golf courses
  - etc.
- Rental owners/employees w/ more than 4 apartments @ one location

In Ohio: Apartment/Rental Owners & Managers

Owners and employees of rental properties with **more than 4 apartment units at one location** are required to be licensed as Commercial Applicators in order to apply pesticides at those properties

In Ohio, request bed bug treatment information from your PMP:

On request from a resident or customer, the pest management provider must provide a *legibly written* statement detailing:

- Name of each product used
- Amount of each product applied
- Date of application

The individual can then look up product information online or via other sources.

§ 5321.04
Obligations of Landlord

(A) A Landlord who is a party to a rental agreement shall do all of the following:

1. Comply with the requirements of all applicable building, housing, health, and safety codes that materially affect health and safety;
2. Make all repairs and do whatever is reasonably necessary to put and keep the premises;
3. Keep all common areas of the premises in a safe and sanitary condition.

§ 5321.05
Obligations of Tenant

(A) A Tenant who is party to a rental agreement shall do all of the following…

1. Keep that part of the premises that he occupies and uses safe and sanitary;
5. Comply with the requirements imposed in tenants by all applicable state and local housing, health, and safety codes;…
9. (B) The Tenant shall not unreasonably withhold consent for the Landlord to enter…

Title 45 HOUSING CODE OF THE COLUMBUS CITY CODES

Article VII. General Regulation

Chapter 4551 RESPONSIBILITY OF OWNERS AND OCCUPANTS

4551.01 Responsibility of Owner

Responsibilities of owners and occupants include, but are not limited to, the following areas:

(f) Pest elimination. The owner is responsible for elimination of any insects, rats, or other pests in a dwelling containing two (2) or more dwelling units and on the premises thereof. He is also responsible whenever the infestation is caused by improper rat-proofing of the premises.

Title 45 HOUSING CODE OF THE COLUMBUS CITY CODES

Article VII. General Regulation

Chapter 4551 RESPONSIBILITY OF OWNERS AND OCCUPANTS

4551.02 Responsibility of Occupant

(f) Pest Elimination. The occupant is responsible for elimination of any insects, rats, or other pests within that part of the premises occupied and controlled by him in a single family dwelling or in a dwelling containing two (2) or more dwelling units if his unit is the only one infested unless infestation of the premises was caused by improper rat-proofing.

Bed Bugs In Public Facilities

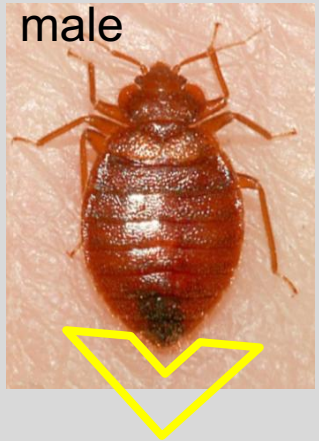
- Brought in by visitors, staff, etc.
- Brought in on clothing, coats, shoes, bags, purses, briefcases, wheelchairs, walkers, etc.
- Often it's one bug that then crawls into the facilities' chairs, carpeting, equipment, etc.
- A single bed bug does not warrant panic or business closure!

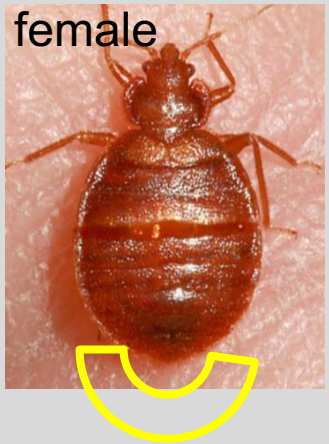
Bed Bugs In Public Facilities

- *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*

Bed Bugs In Public Facilities

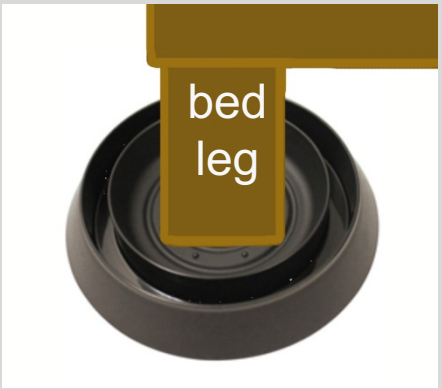
- *If it's a bed bug, then consider:*
  - If it's a bed bug nymph, it's too young to reproducing (it's not laying eggs)
  - If it's an adult male, he will never lay eggs
  - If it's a very flat adult female, she's not likely to be laying eggs
  - Mating typically occurs very soon after an adult female bed bug finishes feeding





Bed Bug Interceptors

ClimbUp® Interceptor



BlackOut® Interceptor

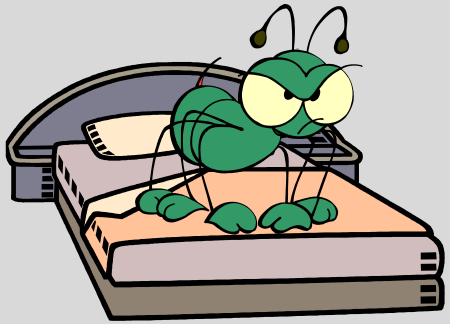
- Positioned under furniture legs
- Furniture must be kept in use—bugs are attracted to host's CO_2
- Pitfall trap—bed bugs climb in and cannot escape*
  - *Inner walls of ClimbUps must be kept lubricated with talcum powder or bugs can escape
- Eliminate alternative ways for bugs to access furniture (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

--Passive Monitoring Devices--

Sticky traps typically are not very useful for detecting bed bugs.

Sticky Traps

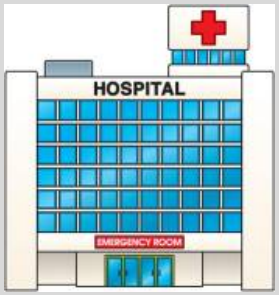
Bed Bug Detector Trap



Questions?

The treatment approach should be tailored to the setting (e.g., public facility, single family home, multi-family housing, etc.), its occupants (e.g., pregnant women, infants, health-compromised, elderly, etc.), and the severity of the bed bug problem.

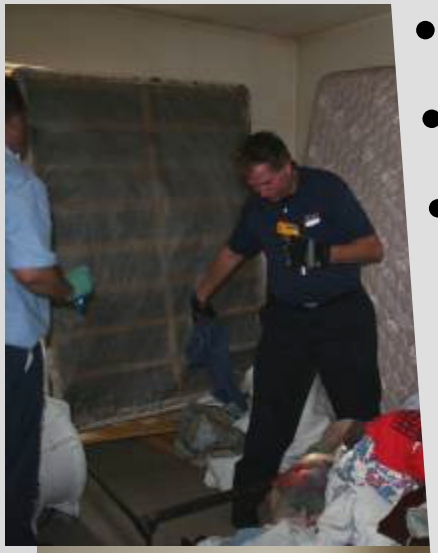
Non-chemical options are preferable in sensitive environments

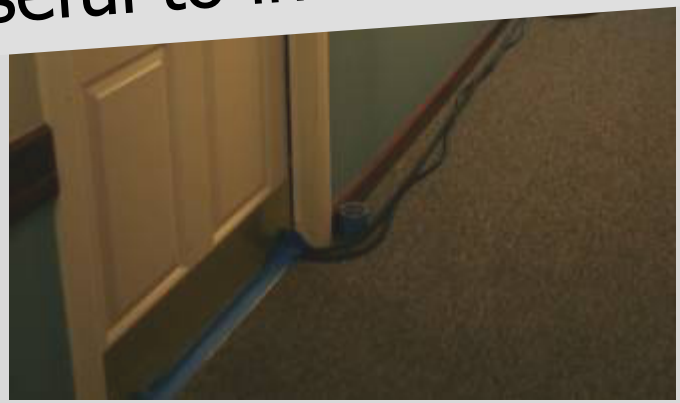


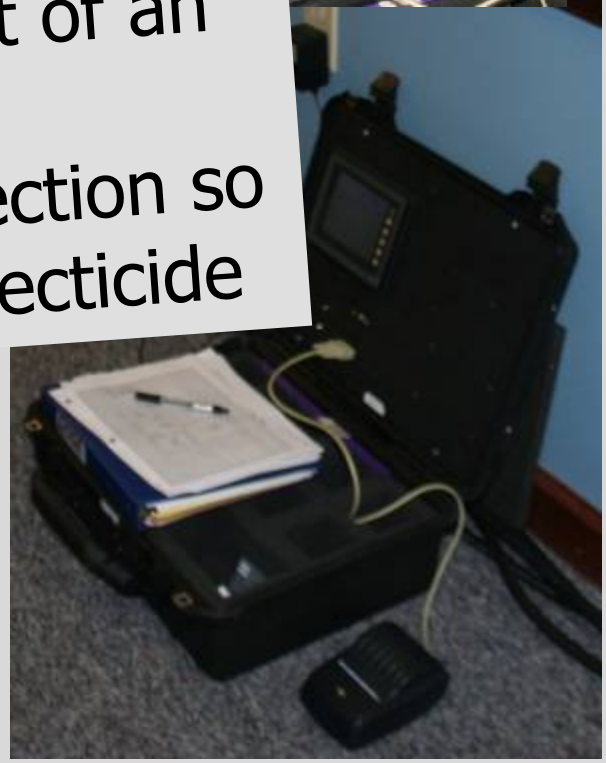
- Heat treatment (whole structure, container)
- Cold (usefulness is limited)
- Sanitation measures
- Steam

Whole Room Heat Treatment

- Typically a 6-8 hour process
- Temperature: 135ºF [57.2ºC]
- It's important to use temperature probes inside wall voids, furniture, etc.
- Double or more the cost of an insecticide treatment
- Offers no residual protection so useful to include an insecticide







Containerized Heat Treatment

≥120º F for several hours

HETTA SOLUTIONS

Portable Thermal Chamber

Cold Treatment

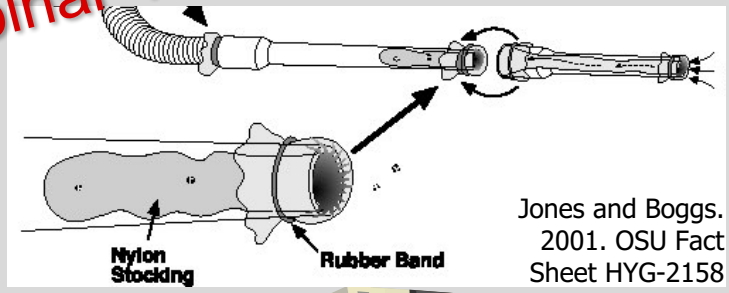
CRYONITE

Should NOT be a standalone measure for bed bugs

And … DIY sanitation measures can help reduce the number of bed bugs:

- Vacuuming (heavy-duty vacuum)
- Steaming (hand-held steamer)
- Clothes dryer (dry items kept for 30 min. @ >120ºF [49°C])
- Continuous freezing (small items) in chest freezer or refrigerator-freezer unit with *disabled "frost-free" setting*
  - <19°F [-7°C] for 3 weeks
  - <5°F [-15°C] for 4 days)

Webinar 1



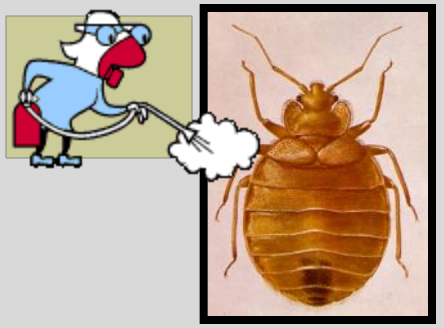
Jones and Boggs. 2001. OSU Fact Sheet HYG-2158

Here's a VERY important DIY measure:

Remove clutter!

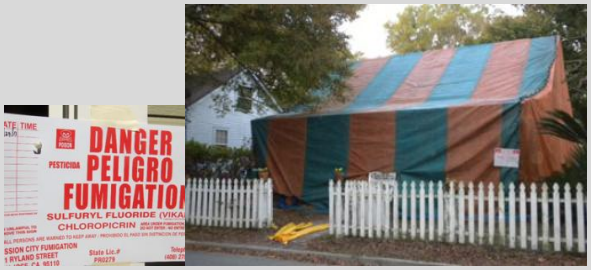
- Clutter offers many hiding places for bed bugs
- Clutter makes bed bugs difficult to detect
- Clutter makes bed bugs difficult to treat

Treatment Options



- Insecticide treatment (dusts, liquids, aerosols)
  - Residual insecticide products are essential

- Fumigation (sulfuryl fluoride)
  - Important to include residual insecticide product(s)

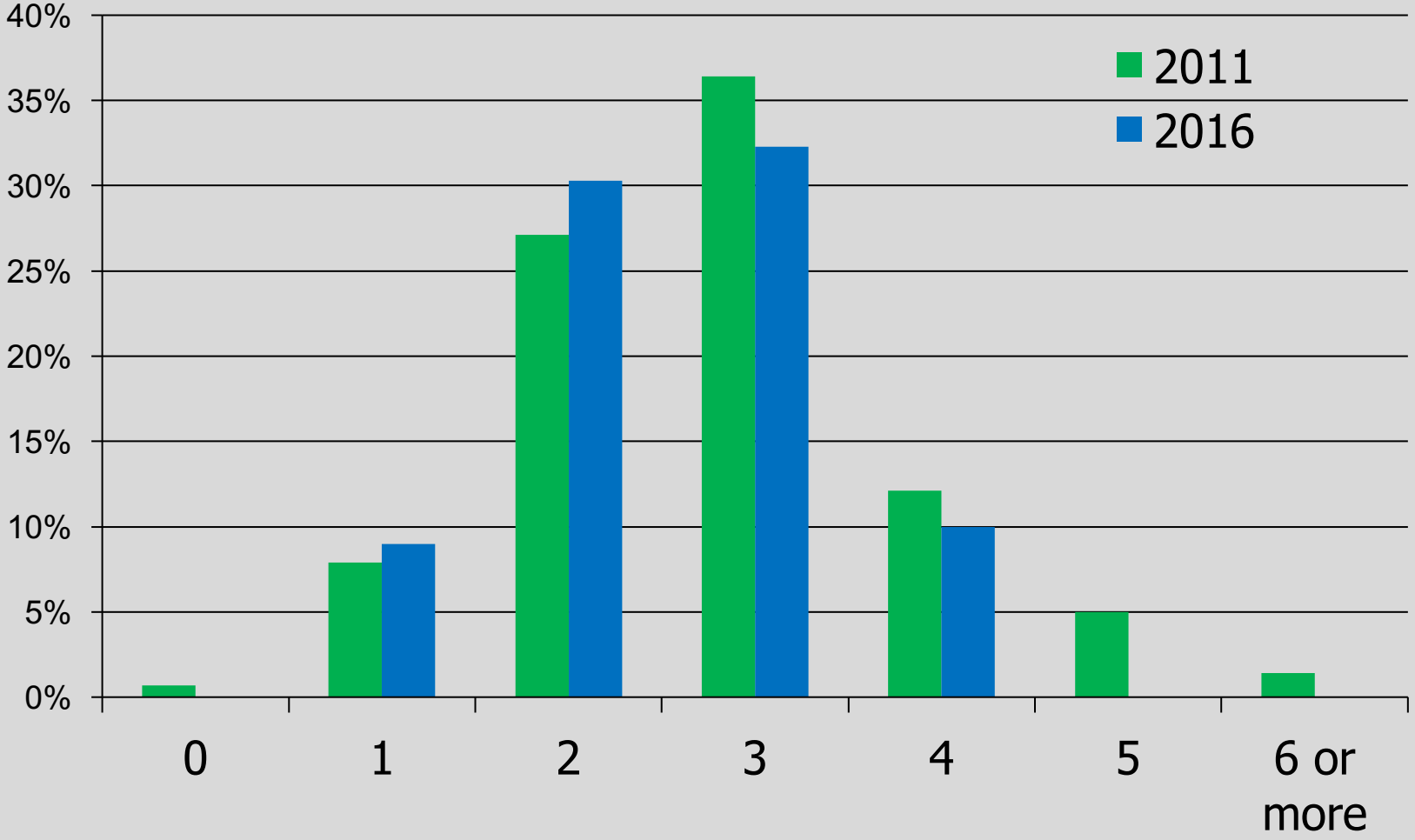


- Heat treatment (whole structure, container)
  - When possible, include residual insecticide product(s)

Some Basics of Bed Bug Management Using Insecticides

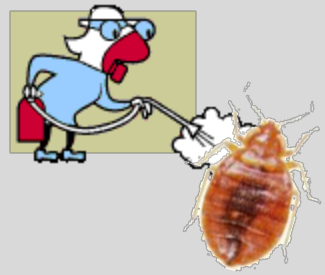
- Bed bug control typically takes several treatments (average of 2 to 3 trts)
- It is important to use several different formulations (dusts, sprays, etc.), and often, several different insecticides

OSU Survey: Visits Needed per Infestation



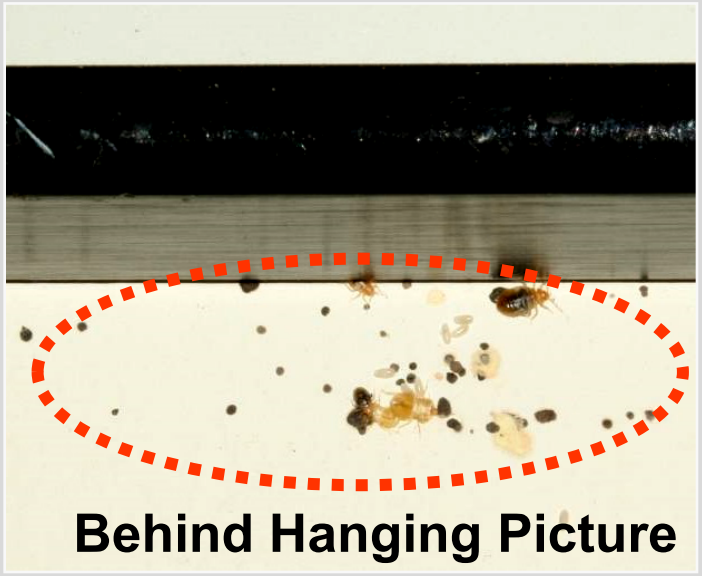
Clustered around average of 2-3 visits per infestation

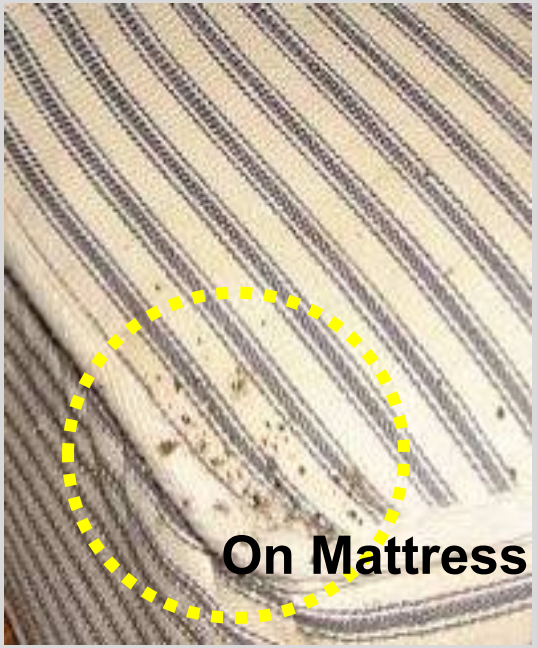
Some Basics of Bed Bug Management Using Insecticides

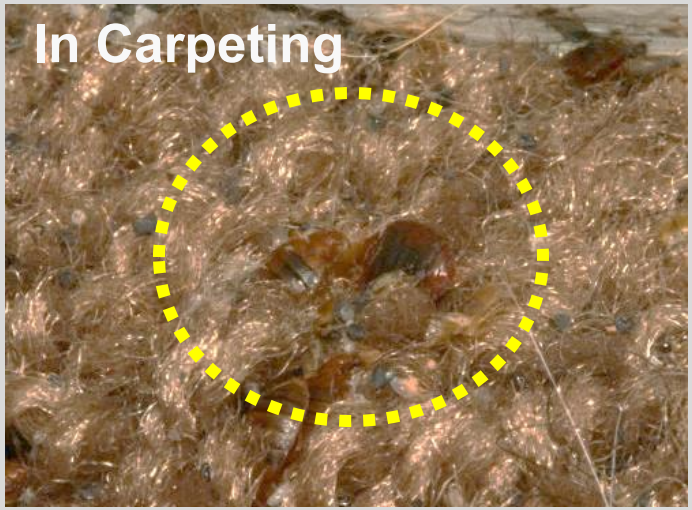


- Residual insecticides are essential!!!
- Bed bug control is time-intensive and labor-intensive
- Spot treat all harborage sites

It's very important to treat all bed bug hiding places:







Some newer insecticides for use against bed bugs:

Active Ingredient (insecticide class)	**Product Name(s)**
Imidacloprid + ß-cyfluthrin (neonicotinoid + pyrethroid)	**Temprid® SC**
Acetamiprid + bifenthrin (neonicotinoid + pyrethroid)	**Transport® Mikron** **Transport® GHP**
Thiamethoxam + λ-cyhalothrin (neonicotinoid + pyrethroid)	**Tandem®**
Dinotefuran + diatomaceous earth (neonicotinoid + silica dioxide)	**Prescription Treatment** **Alpine® Dust** **Alpine® PI**
Chlorfenapyr (halogenated pyrrole)	**Phantom® SC** **Phantom® PI**
Amorphous silica gel	**CimeXa™**
Clothianidin + metofluthrin + PBO (neonicotinoid + pyrethroid + synergist)	**CrossFire®**

Laboratory Assays of Various Insecticides Against Bed Bugs (Hemiptera: Cimicidae) and Their Eggs[1]

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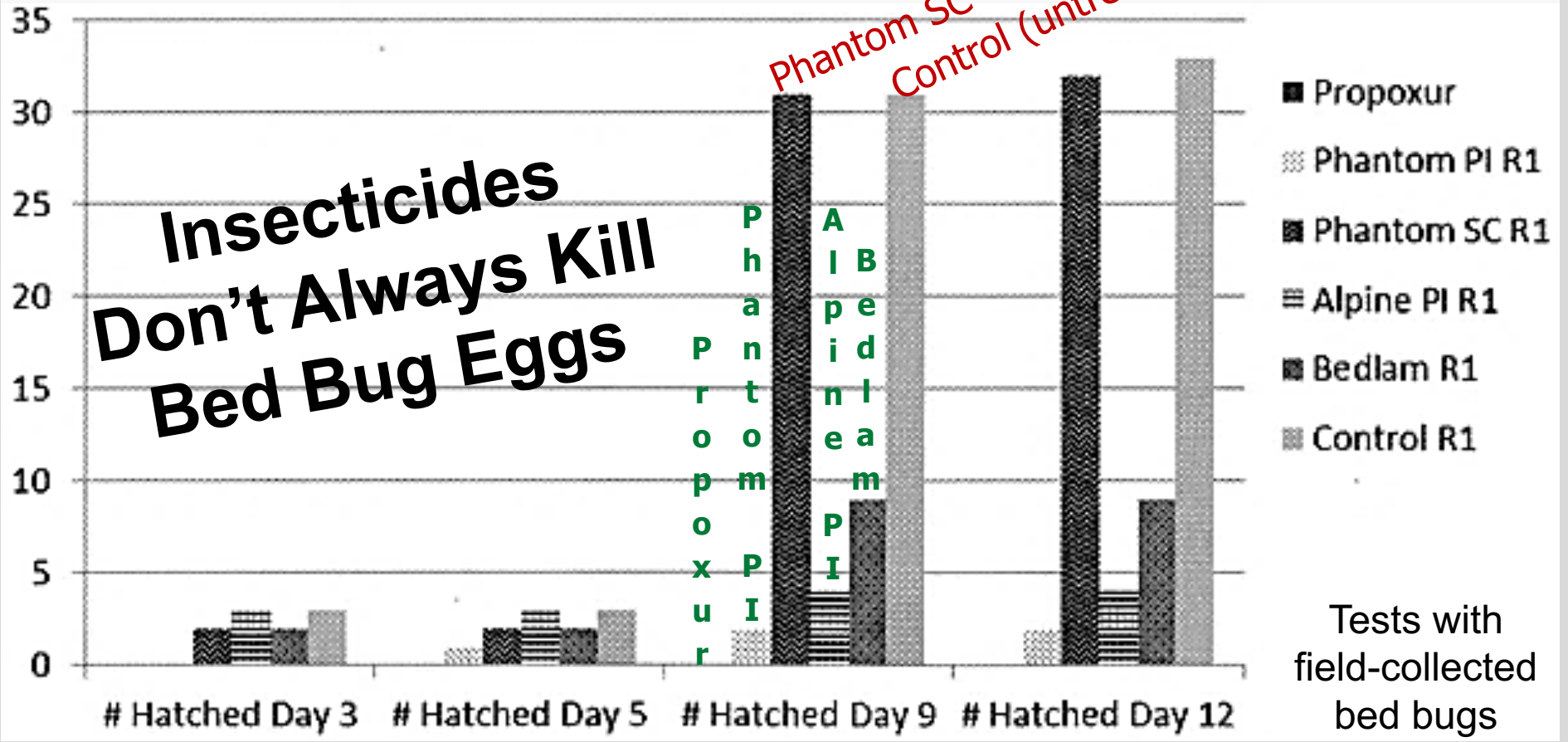
J. Entomol. Sci. 48(1): 65-69 (January 2013)

Number of Eggs Hatching After Being Directed Sprayed Until Wet (1-2 sec)



Tests with field-collected bed bugs

Insecticides Don't Always Kill Bed Bug Eggs

2016, 2495–2499

Egg Hatch Rate and Nymphal Survival of the Bed B (Hemiptera: Cimicidae) After Exposure to Insecticide Sprays

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Abstract

Few studies have address
bug, *Cimex lectularius* L. (
mation on which products
cide sprays applied directl
nymphs exposed to residu
was the most effective ins
(Jersey City) bed bugs co
hatch rate]), Demand CS
rate]). Demand CS and T
susceptible (Harold Harla
control (97% and 96%, re
survival for Bedlam and Ph
vival for Bedlam, 0% survi
Demand CS was less effe
only product to kill all ny
strain egg hatch (Phantom
of 141 alive. These findi
nymphs varies by strain, li

Eggs were directly sprayed (cont
were exposed to the resulting insecticide

Results w/ a pyrethroid-resistant bed bug strain (Jersey City).

- Bedlam = MGK-264 (AI: sumithrin {a pyrethroid})
  - Majority of eggs hatched (84%)
  - Almost all nymphs survived (99%)
- Demand CS (AI=λ-cyhalothrin {a pyrethroid})
  - Majority of eggs hatched (91%)
  - No nymphs survived
- Phantom SC (AI=chlorfenapyr)
  - Majority of eggs hatched (95%)
  - Very few nymphs survived (4%)
- Temprid SC (imidacloprid + ß-cyfluthrin)
  - Few eggs hatched (13%)
  - Some nymphs survived (38%)
- A combination of insecticides is needed to treat eggs so that any nymphs that hatch will be killed

Control (water):
- Almost all (99%) eggs hatched
- All nymphs survived

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. Study: Natural Pesticides

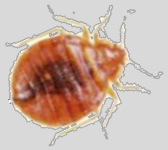
No.	Product Trade Name	Active Ingredients	Mortality (≥50%) at 10 days
1	EcoRaider	Geraniol (1%), Cedar Extract (1%) and Sodium Lauryl Sulfate (2%)	100%
2	Stop Bugging Me	2-Phenethyl Propionate (3%), Cinnamon Oil (0.1%), Eugenol (0.5%), Geraniol (0.2%) and Sodium Lauryl Sulfate (0.5%)	Low mortality (<50%)
3	Bed Bug Patrol	Clove Oil (0.003%), Peppermint Oil (1%) and Sodium Lauryl Sulfate (1.3%)	92%
4	Bed Bug Bully	Mint Oil (0.25%), Clove Oil (0.3%), Citronella Oil (0.4%) and Rosemary Oil (0.4%)	60%
5	Bed Bug Fix	2-Phenethyl Propionate (2%), Geraniol (1%), Cedar oil (0.3%), Eugenol (0	Low mortality (<50%)
6	Rest Assured	2- (1%)	Low mortality (<50%)
7	EcoEXEMPT IC2	Rc	Low mortality (<50%)
8	Green Rest Easy	Sc .3%), Cl	Low mortality (<50%)
9	Essentria	2- and Peppermint Oil (1.5 %)	Low mortality (<50%)
10	Bed Bug 911	Sodium Lauryl Sulfate (3%), Sodium Chloride (1%) and Citric Acid (0.2%)	Low mortality (<50%)
11	Eradicator	Sodium Lauryl Sulfate (1.5%), Sodium Chloride (0.5%) and Potassium Sorbate (0.06%)	Low mortality (<50%)
12	Temprid SC	Imida	100% @ 3d
13	Demand CS	Lamb	Low mortality (<50%)

Natural pesticides that ARE NOT regulated by the EPA

Synthetic pesticides that ARE regulated by the EPA

- 60 bed bug nymphs per pesticide (presumably pyrethroid resistant)
- Directly sprayed at a rate of 1 gallon/1000 ft^2

Treating For Bed Bugs



You now should be familiar with:

- *Insecticide resistance in bed bugs*
- *Tips for hiring a pest management professional (PMP)*
- *Inspection and monitoring options*
- *Ohio pesticide regulations*
- *Bed bug treatment options and general guidelines for:*
  - *Heat treatments*
  - *Insecticide treatments*
- *Efficacy data on various bed bug products*
  - *Registered insecticides*
  - *Natural products (exempt from EPA registration)*

Acknowledgements

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- Alex Tyrpak
- Tae-Young Lee

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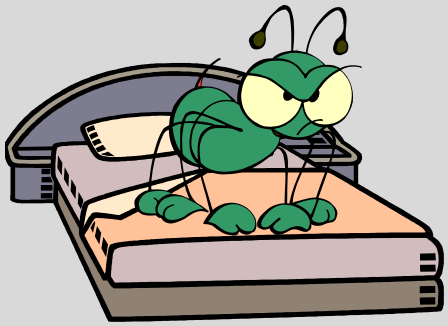
- Extension IPM Program

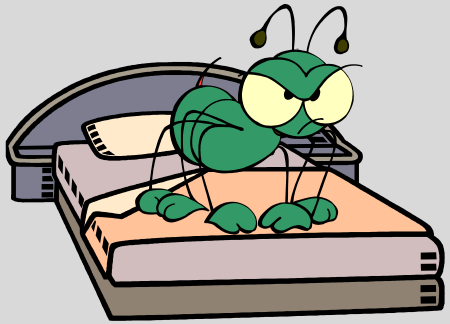
Thank You!

Sleep tight,

and don't let the …

… well, you know the rest





Questions?