Bed Bug Research

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Connecticut Bed Bug Forum III
Southern Connecticut State University
New Haven, CT
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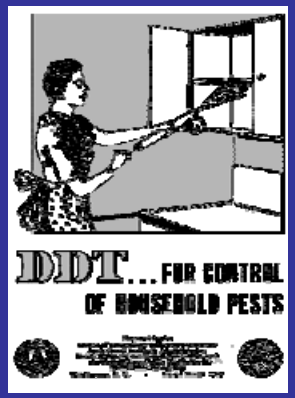
The More Things Change, the More They Stay the Same

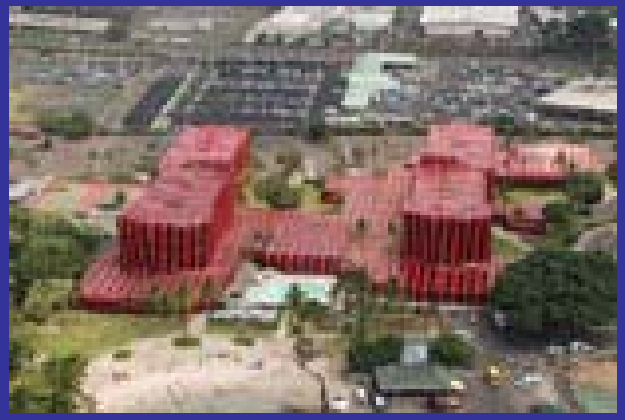
1906: B. H. Walden, a station entomologist, used hydrocyanic acid to fumigate a house. After achieving total eradication, 5 more houses were treated.



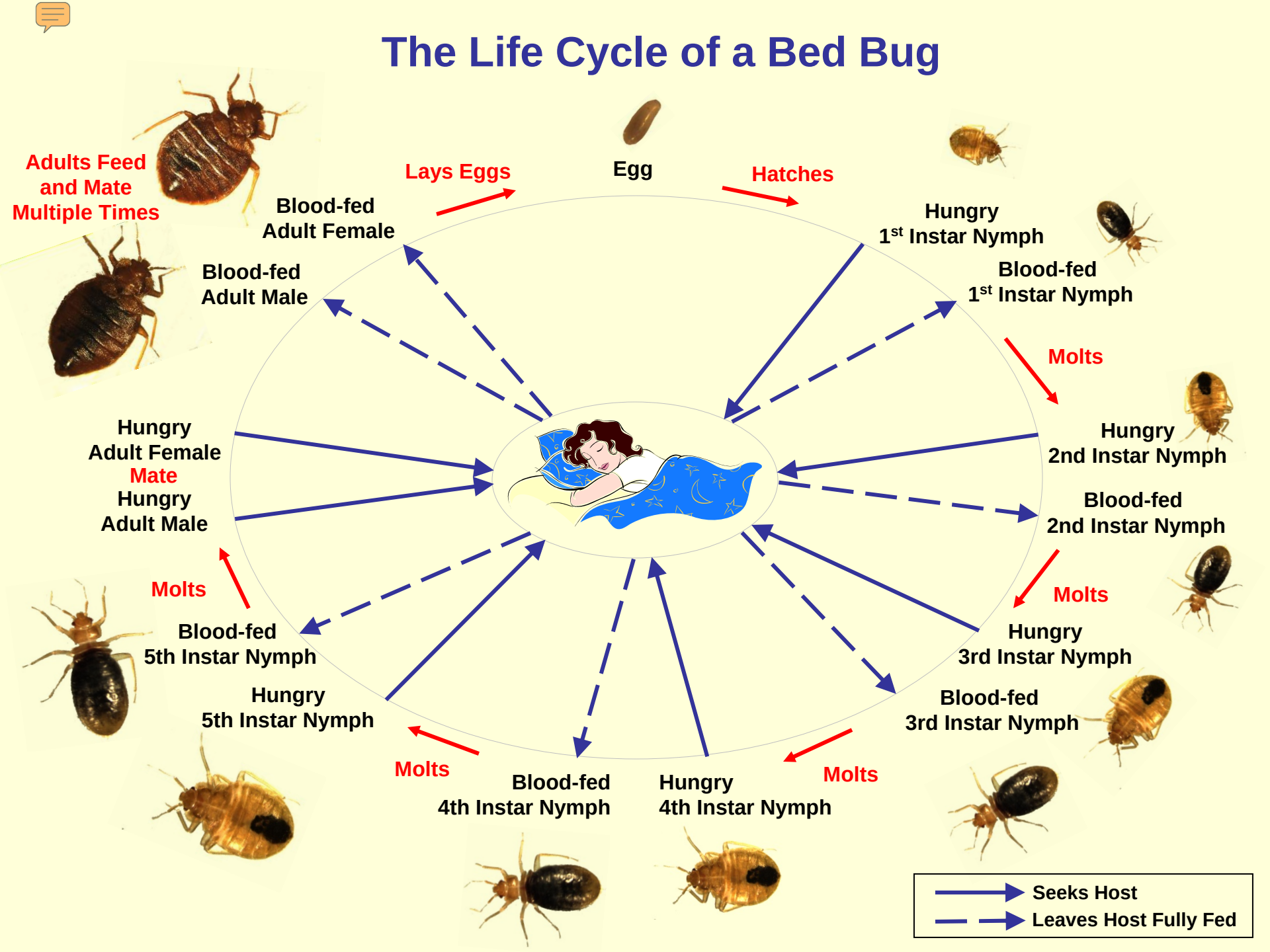
USDA pamphlet, 1947

1945: Practical trials were conducted at the Experiment Station using DDT against bed bugs.

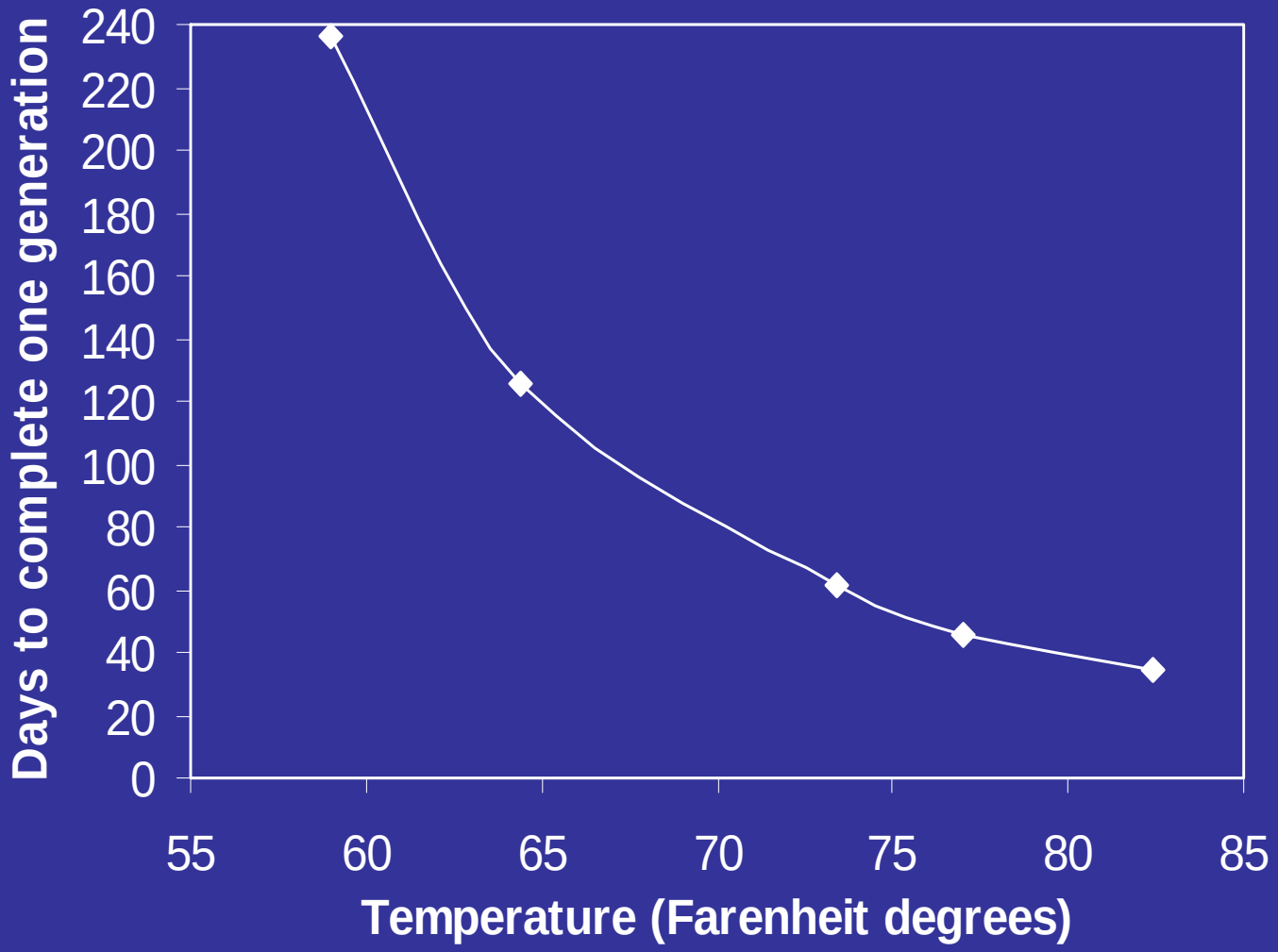
2008: Fumigating a hotel complex for bed bugs in Hawaii



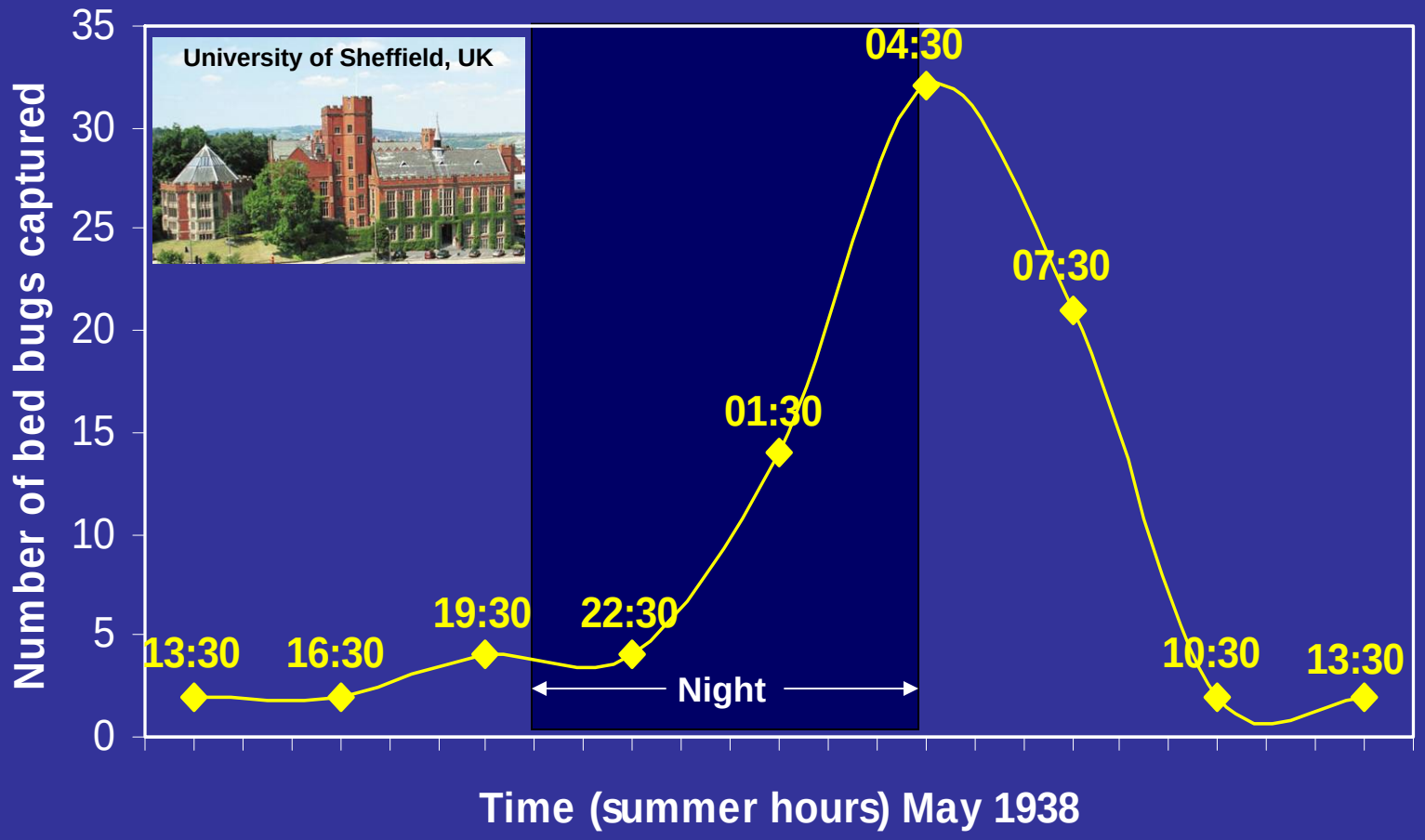
The Life Cycle of a Bed Bug



Average number of days needed by a bed bug to complete one generation at specific temperatures (Johnson 1942)



Activity of bed bugs captured in traps during 3 hr intervals (Mellanby 1939)



Don’t Let the Bed Bugs Bite!

Bites on Arm Showing Rounded Swellings with Diffuse Redness

Forearm Showing Linear Blisters

Forearm Showing Multiple Blisters from Bed Bugs in a Sleeping Bag

New Haven Apartment, 2007

White sheet on bed

Bed bugs in refrigerator

A carbon dioxide, heat and chemical lure trap for the bedbug, *Cimex lectularius*

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Abstract. A trap for the collection of bedbugs, *Cimex lectularius* Linnaeus (Hemiptera: Cimicidae), is described. The trap was baited with CO_2 (50–400 mL/min), heat (37.2–42.2 °C) and a chemical lure comprised of 33.0 μg proprionic acid, 0.33 μg butyric acid, 0.33 μg valeric acid, 100 μg octenol and 100 μg L-lactic acid, impregnated into a gel. Laboratory studies, conducted in a square arena measuring 183 cm on each side, showed that traps with and without baits captured adult bedbugs, but traps with CO_2 emissions of 50–400 mL/min caught significantly ($P < 0.05$) more bedbugs than traps without CO_2. In an infested unoccupied apartment, traps with heat and with or without the chemical lure were tested without CO_2 on 29 trap-days and with CO_2 on 9 trap-days. The numbers of bedbugs captured were 656 and 5898 in traps without and with CO_2, respectively. The numbers of bedbugs of all development stages captured were significantly greater in traps with CO_2 ($\chi^2 = 15\,942$, d.f. = 1, $P < 10^{-9}$). A non-parametric two-way

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Infested Apartments

Furniture removed from apartment

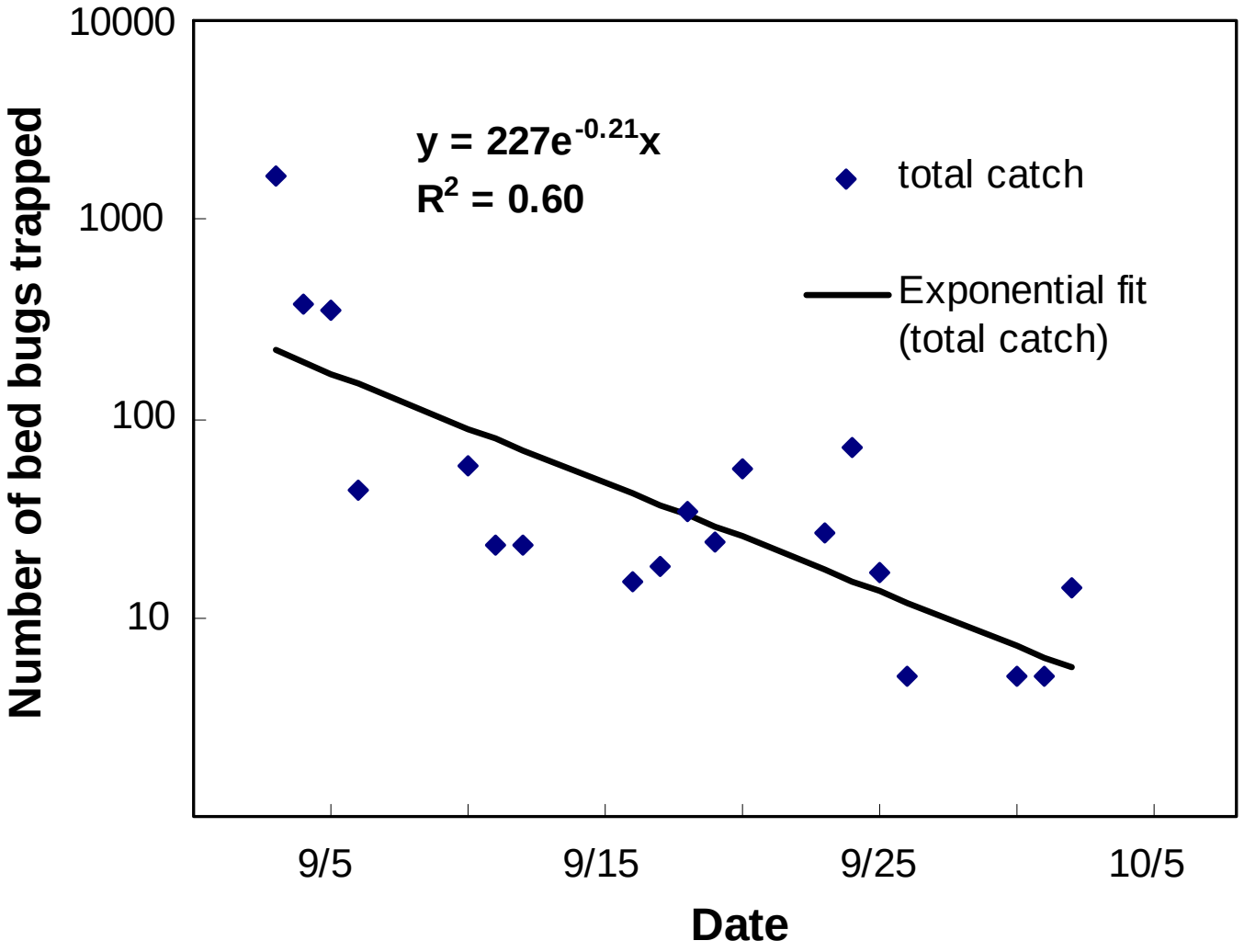
Apartment with furniture

Nonparametric two-way analysis of variance of data from 6 different types of bed bug traps tested in an unoccupied apartment without furniture

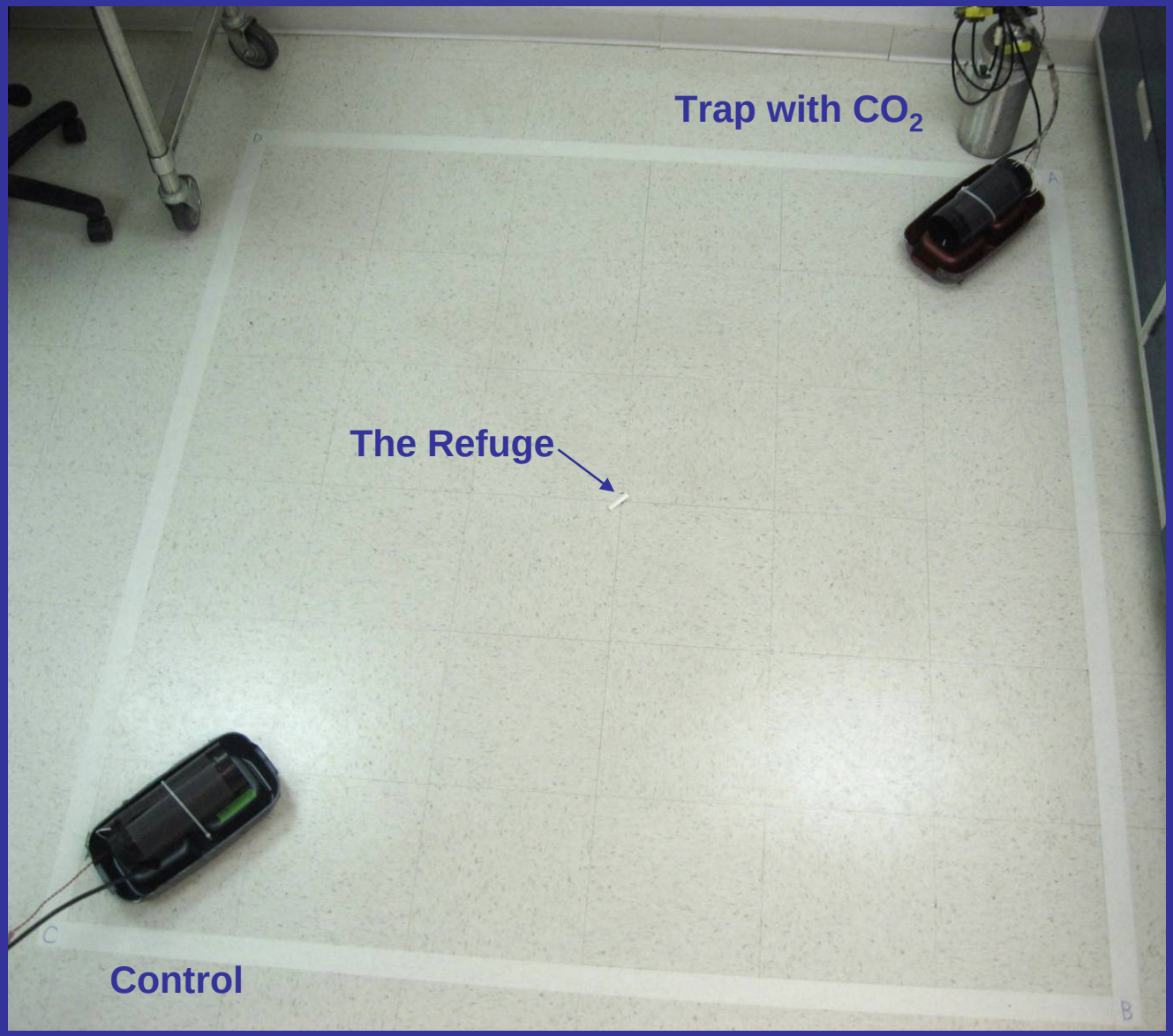
Trap Type				No. Bed Bugs Collected	Mean Rank[1]	
Trap No.	CO_2	Heat	Lure		Total	
1	x[2]	x	x	1,476	5.14	a
3	x	x	0	668	4.10	ab
4	x	0	0	336	3.62	b
5	0	0	x	179	3.57	bc
2	0	x	0	80	2.48	cd
6	0	0	0	94	2.10	d
				2,833	$p<10^{-7}$	

[1] Ranks followed by the same letter are not significantly different ($p<0.05$).
[2] x = bait present; 0 = bait absent.

Decline of Numbers of Captured Bed Bugs in a Naturally Infested Apartment, September 4 - October 5, 2007



The Bed Bug Arena

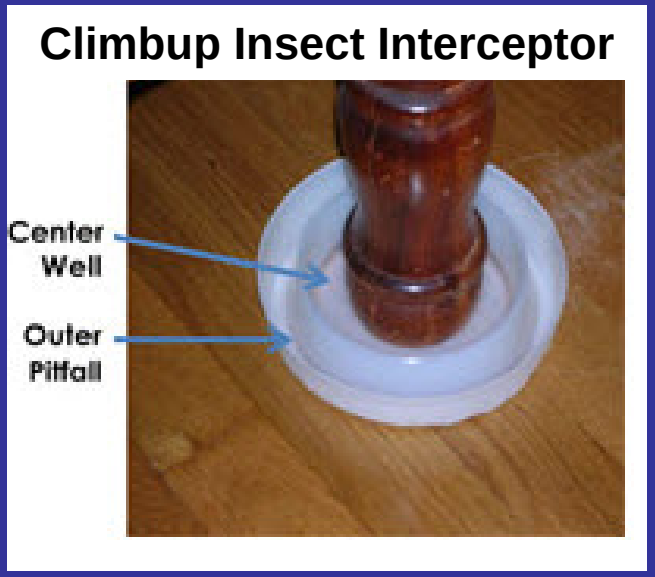


Number of bed bugs captured in traps placed in the laboratory arena

Experiment No.	Treatment[a]		Replicates	Total bed bugs			
	Trap 1	Trap 2		Released	Trap 1	Trap 2	Not captured
1	50 CO_2	0	4	40	**31**[b]	2	7
2	0	50 CO_2	4	40	4	**28**	8
3	100 CO_2	0	8	80	**60**	8	12
4	300 CO_2	0	4	40	**26**	6	8
5	400 CO_2	0	8	80	**60**	7	13
6	400 CO_2	400 air	4	40	**26**	6	8
7	400 CO_2, H, L	400 air	4	40	**30**	5	5
8	H	0	8	80	**37**	12	31
9	L	0	4	40	10	12	18

[a]Numbers indicate flow rate (mL / min) of released gas in trap (CO_2 or air), H signifies heated trap, L signifies the use of the chemical lure, and 0 indicates that an attractant was absent.
[b]Counts in yellow are significantly ($p<0.05$) larger than the catch in the other trap.

Types of Traps Tested in the Laboratory Arena



Number of Bed Bugs Captured in Traps in the Laboratory Arena

Expt. No.	Treatment		No. of Reps	No. Released	Total Bed Bugs		
	Trap 1	Trap 2			In Trap 1	In Trap 2	Not Captured
1	Dome w/ heat	Dome w/ no heat	4	40	5	5	30
2	Dome w/ heat	Standard (CO_2)	4	40	0	37	3
3	Dome w/ heat	NightWatch (CO_2)	4	40	2	32	5
4	Climbup	NightWatch (CO_2)	4	40	3	29	8
5	Climbup	Climbup w/ CO_2	4	40	0	31	9
6	Climbup (CO_2)	Standard (CO_2)	4	40	1	33	6

Residual Insecticides Registered for Control of Bed Bugs on Surfaces other than on Mattresses

Shelves of insecticides designed for bed bug control at Karp's Hardware, Hope St., Stamford, March 10, 2008

lambda-cyhalothrin

permethrin

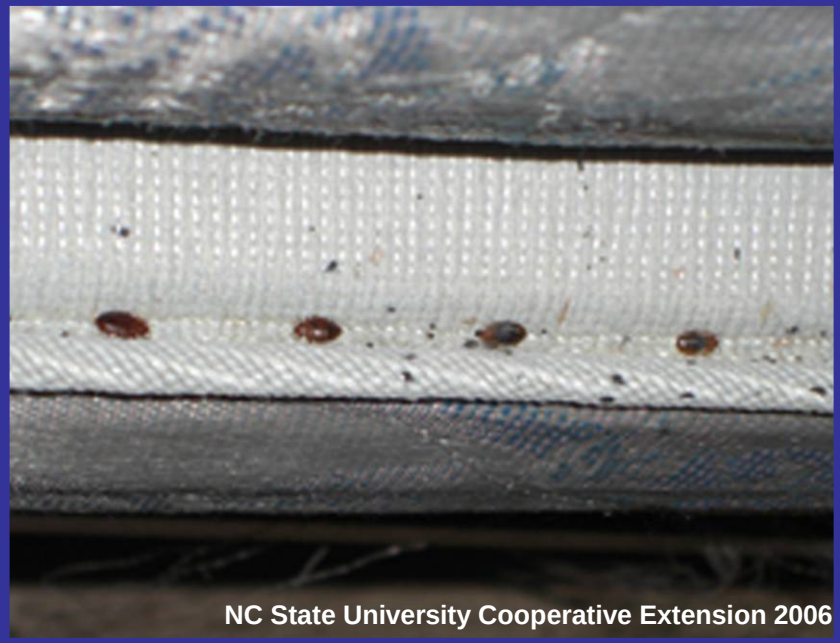
(s)-hydroprene

bifenthrin

fenvalerate

propoxur

Insecticides Registered for Control of Bed Bugs on Mattresses



Residual Chemicals

deltamethrin

cyfluthrin

silica

ground limestone

permethrin

pyrethrins

Contact Chemicals

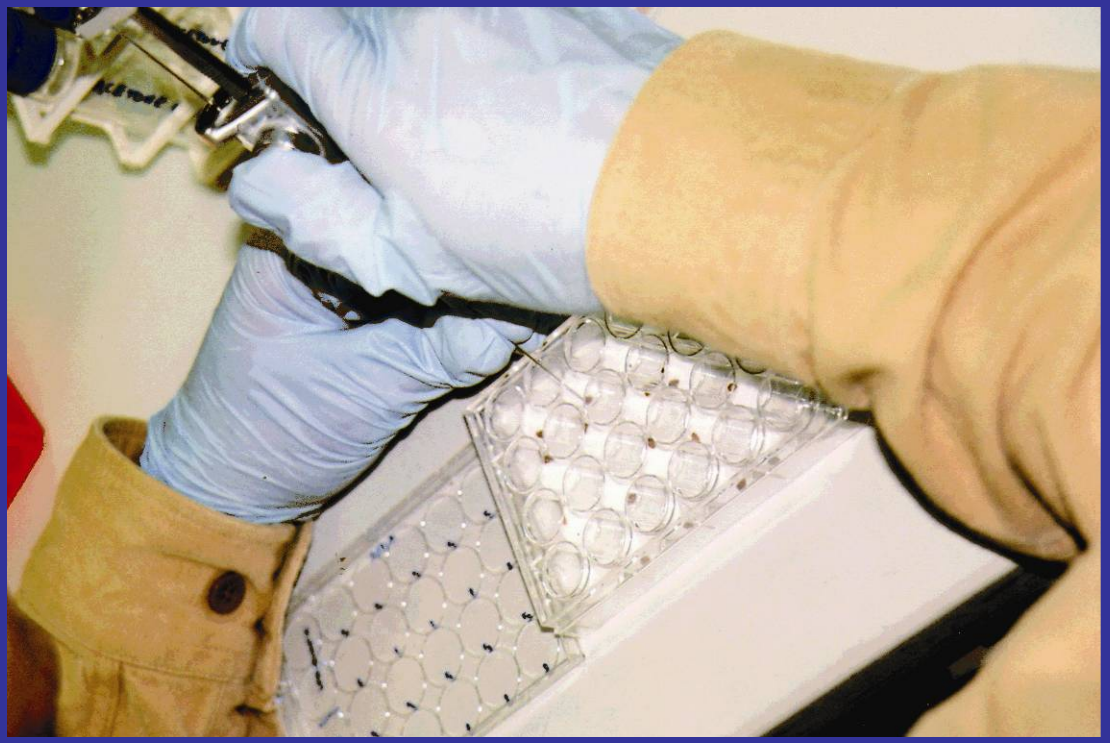
pyrethrins

d-phenothrin

alcohols

Application of Pyrethroids to Bed Bugs

Dr. Cowles assembling Hamilton Repeating Dispenser



Placing a small drop of a pyrethroid insecticide on a bed bug

Percent Mortality of Bed Bugs 72 Hours after Exposure to 1000ppm of Specific Insecticide

Class*	Common Name	% Mortality
I	D-Phenothrin	5
I	Pyrethrins	5
I	d-Trans Allethrin	5
I	Tetramethrin	5
I	Permethrin	0
I	Resmethrin	5
II	Lambda Cyhalothrin	95
II	Trans cypermethrin	35
II	Cis cypermethrin	80
II	Fenvalerate	5
II	Fenpropathrin	10
II	Cyfluthrin	80
II	Deltamethrin	90
Negative Control	Acetone	0

*Type of alcohol in the insecticide determines the Class designation

Liquid and Dust Formulations of Insecticides Tested against Bed Bugs

Formulation	Trade Name	Common Name
Liquid	Bedlam	D-Phenothrin
	D-Force HPX	Deltamethrin
	Cyonara 9.7	Lambda Cyhalothrin
Dust	Delta Dust	Deltamethrin
	Drione	Pyrethrins
	Tempo Dust	Cyfluthrin
	Syloid Silica Gel	None

Percent Mortality of Bed Bugs on Filter Paper, Hardboard, and Mattress Cover Previously Treated with D-Force HPX at the Recommended Rate

Surface	Age of D-Force HPX when bed bugs first exposed (days)					
	1	15	35	56	112	168
Filter Paper	100	73	77	50	50	23
Hardboard	93	27	37	17	43	13
Mattress Cover	90	27	10	7	40	3

Percent Mortality of Bed Bugs on Filter Paper, Hardboard, and Mattress Cover Previously Treated with Drione at the Recommended Rate

Surface	Age of Drione residue when bed bugs first exposed (days)					
	1	15	35	56	112	168
Filter Paper	100	100	100	100	100	100
Hardboard	100	100	100	100	100	100
Mattress Cover	100	100	100	100	100	100

Percent Mortality of Bed Bugs on Filter Paper, Hardboard, and Mattress Cover Previously Treated with Syloid Silica Gel

Surface	Age of Syloid Silica Gel dust when bed bugs first exposed (days)				
	1	15	35	56	112
Filter Paper	100	100	100	100	100
Hardboard	100	100	100	100	100
Mattress Cover	100	100	100	100	100

Non-chemical Control of Bed Bugs

Vacuuming

Reducing clutter

Laundering & Drying

Steam Treatment

Filling Cracks & Crevices

Thermal Treatment

Mattress encasement

Cold Treatment (including Cryonite)

The Bat Bug: *Cimex adjunctus* Barber

Little brown bat infested with bat bugs, 2008

The Virus Lab at the Connecticut Agricultural Experiment Station

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