Mites in Semi-moist Pet Foods:

Strategies to Prevent Infestation

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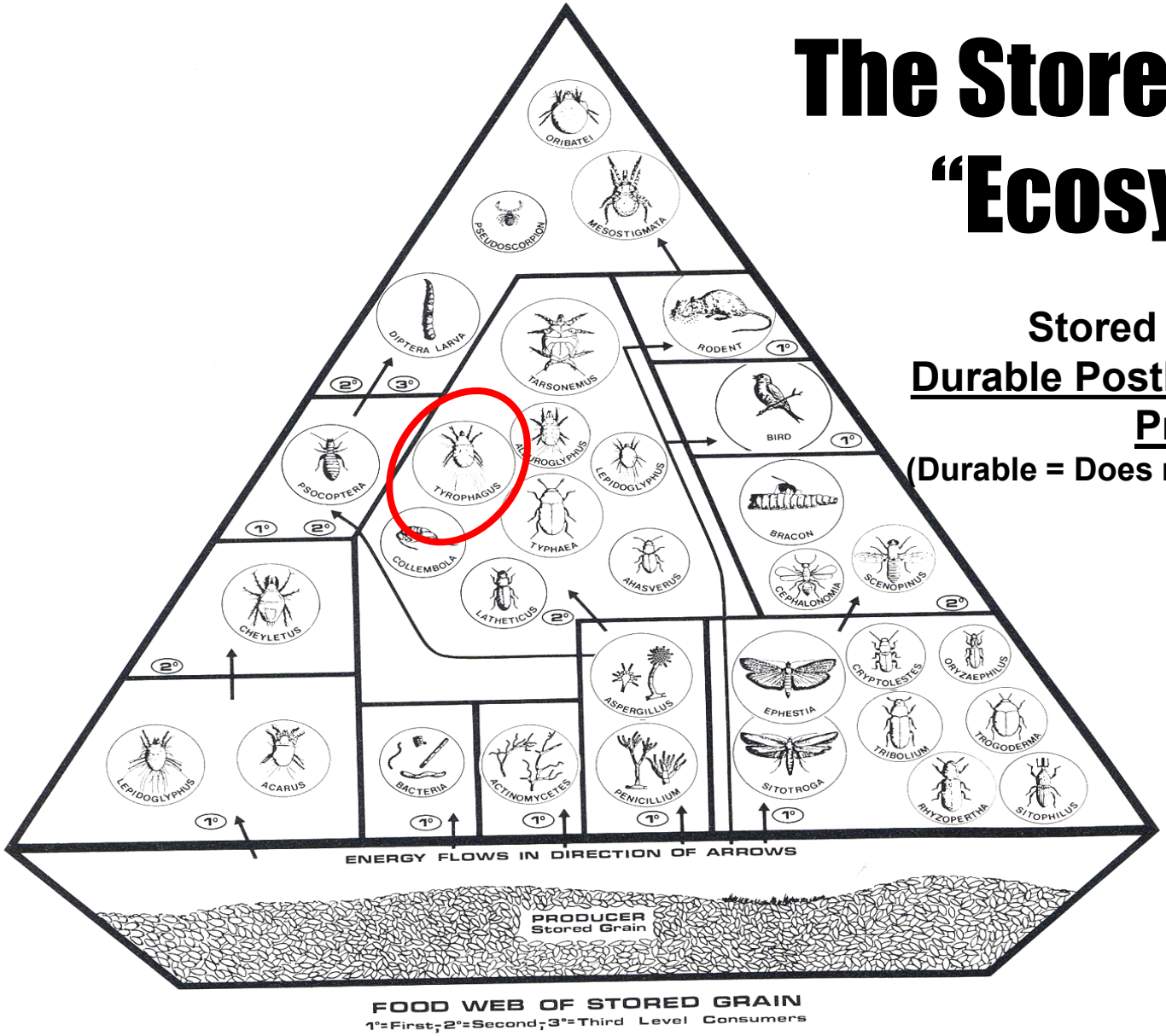
ADM
ADM MILLING


SPRINGFIELD
GROCERY
STORE

The Stored-Product "Ecosystem"

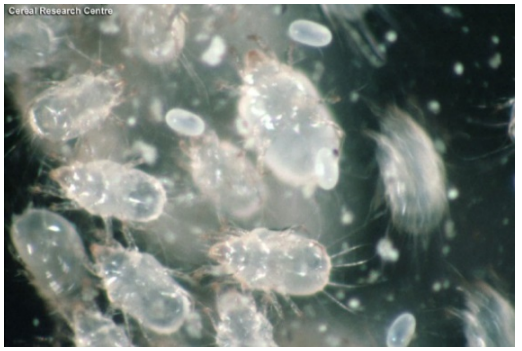
Stored Products are
<u>Durable Postharvest Agriculture Products</u>
(Durable = Does not require refrigeration)



FOOD WEB OF STORED GRAIN
1°=First; 2°=Second; 3°=Third Level Consumers

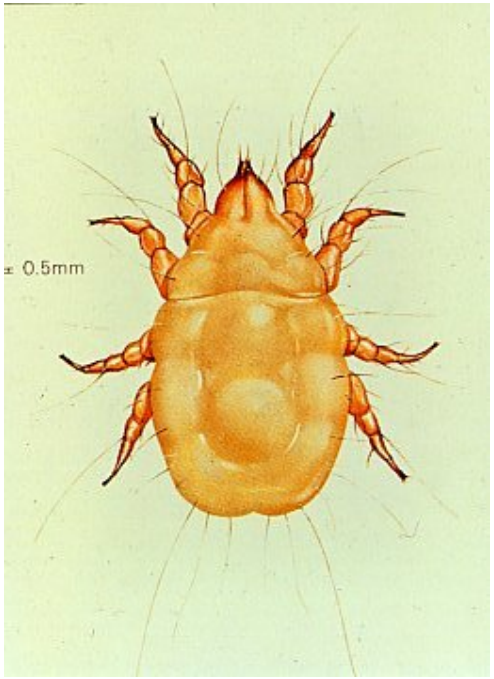
Tryophagus putrescentiae

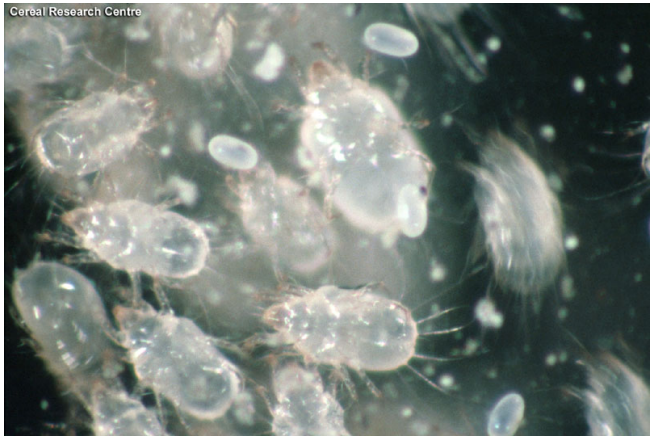
- Ham mite, cheese mite, mold mite, copra mite
- Prefers food 15-45% mc, high fat and protein; RH of 70%
- Females lay 3-8 eggs/day, develop in 11 days, live weeks to months
- Mites can be found in all human habitations; part of house-dust mite complex
- Food processing spaces can facilitate very successful mite populations!



Grain Mites: Not Insects!

Arachnids—Spiders and Mites





Body plan: 8 legs, 2 body sections, no wings

Semi-moist pet foods: 15-45% moisture content

Integrated Pest Management for Mites

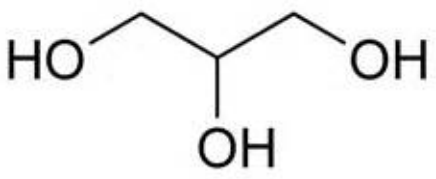
- **Prevention**
  - **Food-safe chemicals in recipe to deter mites**
  - **Thorough, effective and consistent cleaning**
  - **Pesticide sprays of processing and storage areas**
- **Monitoring**
  - **Traps to detect and monitor mites over space and time**
  - **Inspect work spaces and product**
  - **Monitor customer complaints**
- **Controls**
  - **Spot controls (clean and spray) small areas**
  - **Fumigate/treat entire structure if needed**

Semi-Moist Pet Foods and Mites: A Brief History

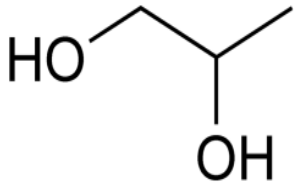
- Mites became pests of semi-moist pet foods from their inception in the 1960s; the problem was glycerol used as a humectant
- Some food preservatives and humectants other than glycerol could prevent mite infestations of pet foods
- All additives were established as "GRAS" compounds:
  Generally Recognized As Safe

Propylene Glycol: The solution for mites…at the time

- **Glycerol/glycerine and Propylene Glycol both have a simple 3-carbon chain for their molecules**
- **Glycerol has an alcohol group, -OH, on each of the three carbons.**
- **PG has alcohol groups just on the first 2 carbons**



Glycerol

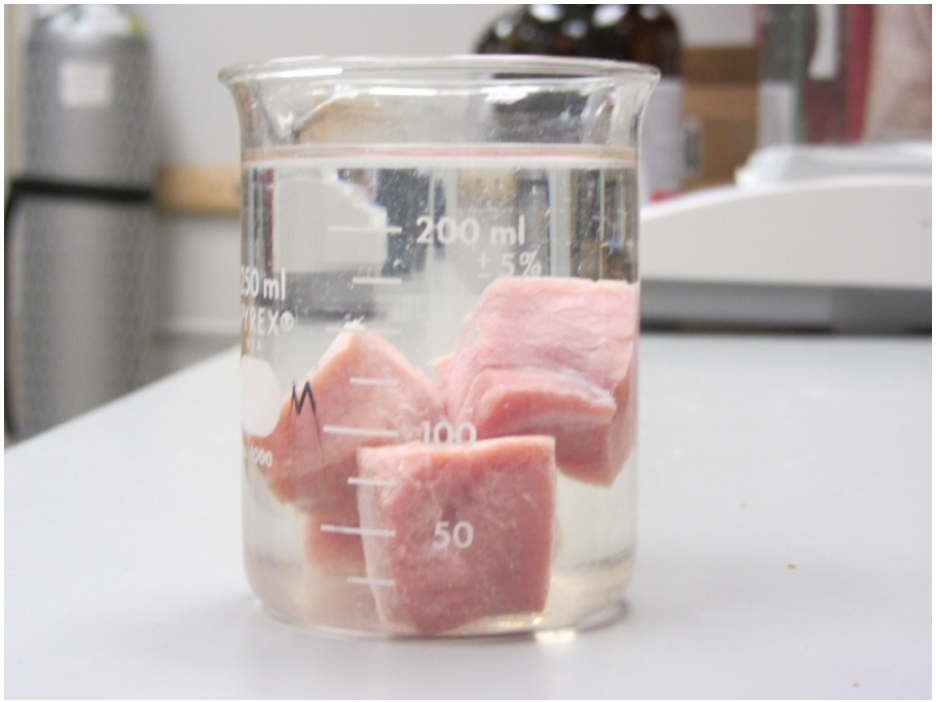


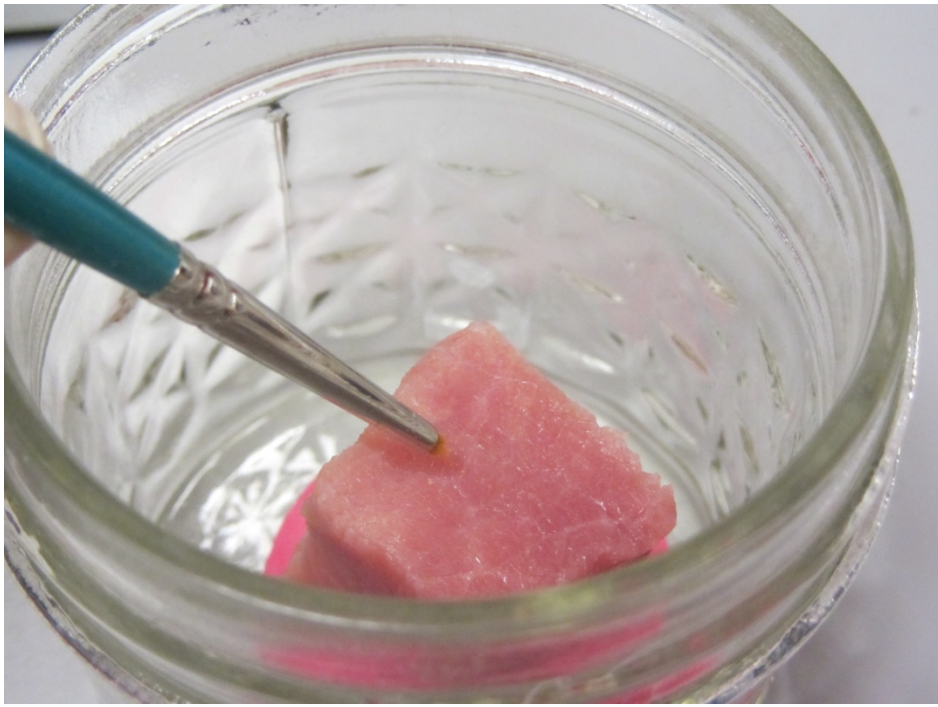
Propylene Glycol

Propylene Glycol Toxic to Cats!!!

- 1990s PG was found to cause formation of “Heinz Body” red blood cells leading to anemia in cats
- Extreme cases caused deaths
- Removed from most/all cat treats
- Concerns exist about contamination from dog foods; product recalls
- Research continues on alternatives to Propylene Glycol

Screening GRAS Food-Coatings to Prevent Mite Infestations on Hams

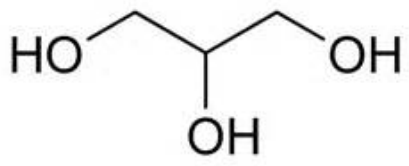




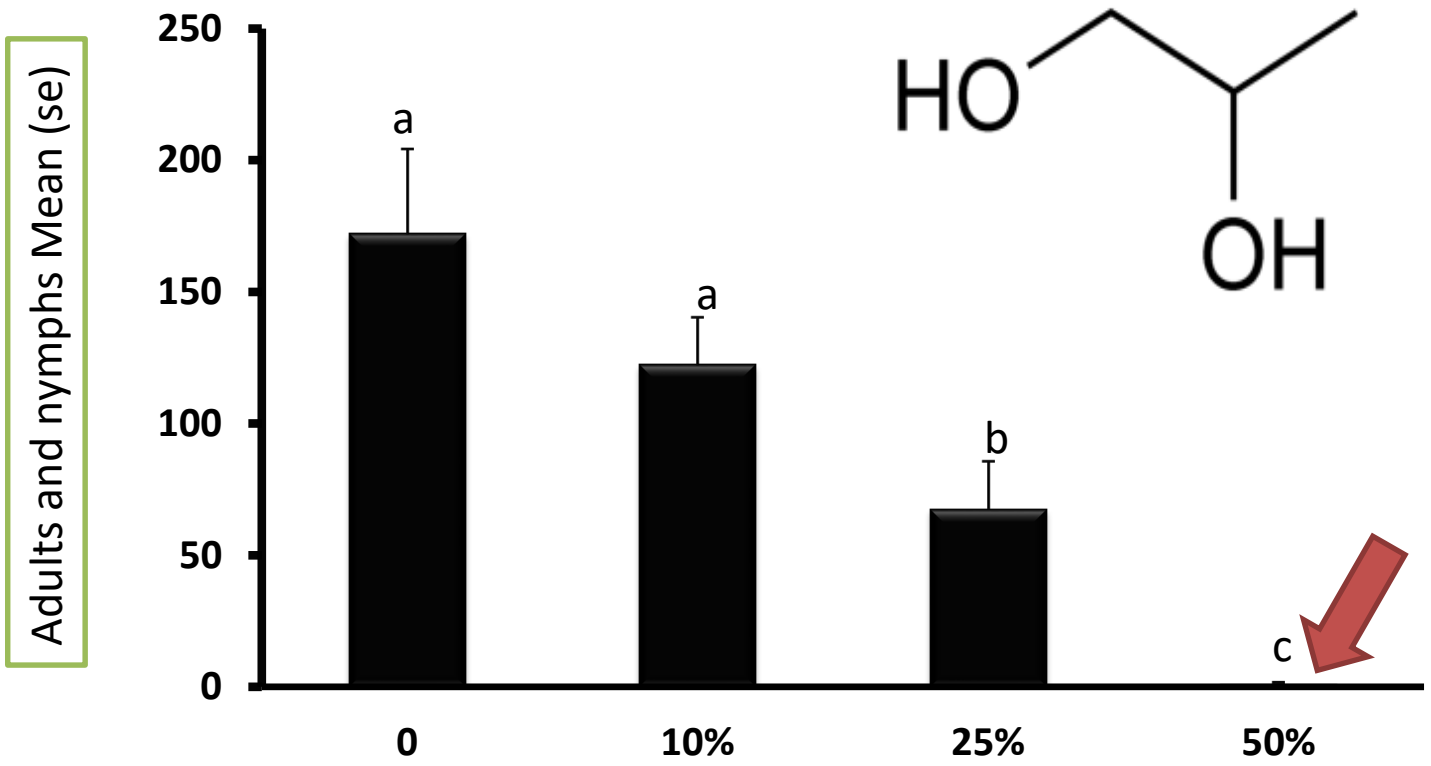
20 Adult Mites Applied to Coated Ham Cube, Incubated for 14 days, Resulting Population Counted

Effect of Glycerol Dips on Mite Infestation

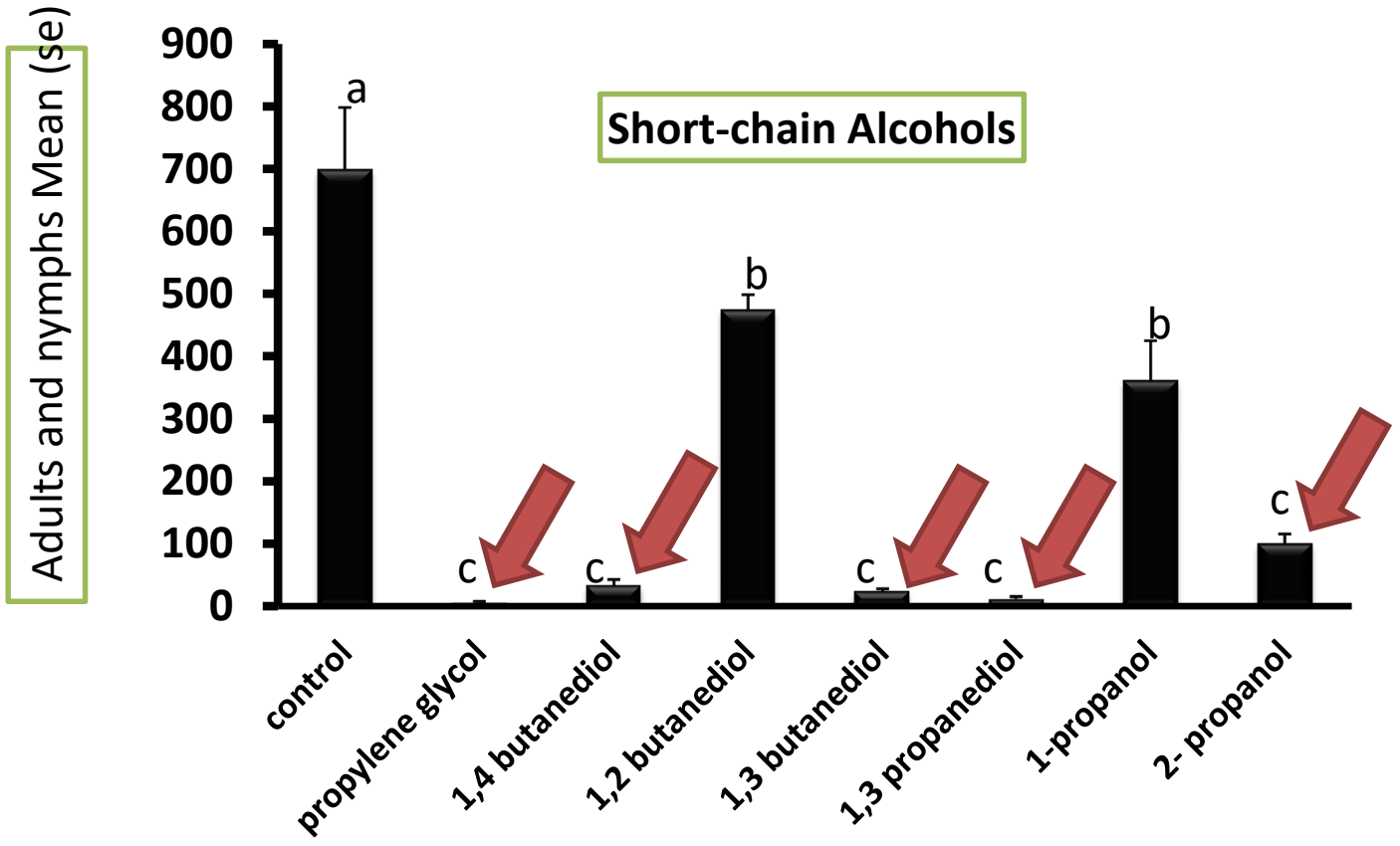
		Mean Mites	(SE)	Diff
water control	No Glycerol	367.4	(24.2)	a
glycerol in water	20 %	343.6	(25.6)	a
	50 %	323.2	(19.9)	ab
	100 %	279.2	(20.3)	b



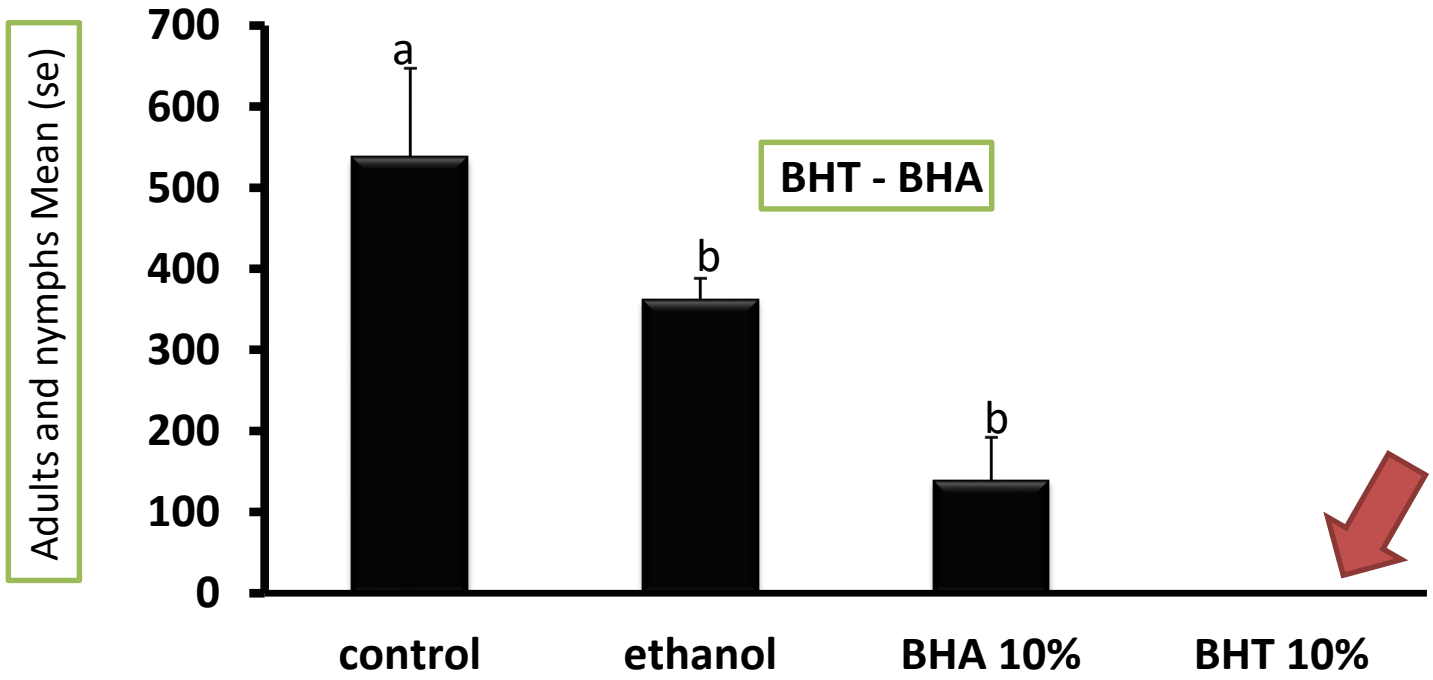
Population growth of mites on ham cubes treated with different concentrations of Propylene Glycol



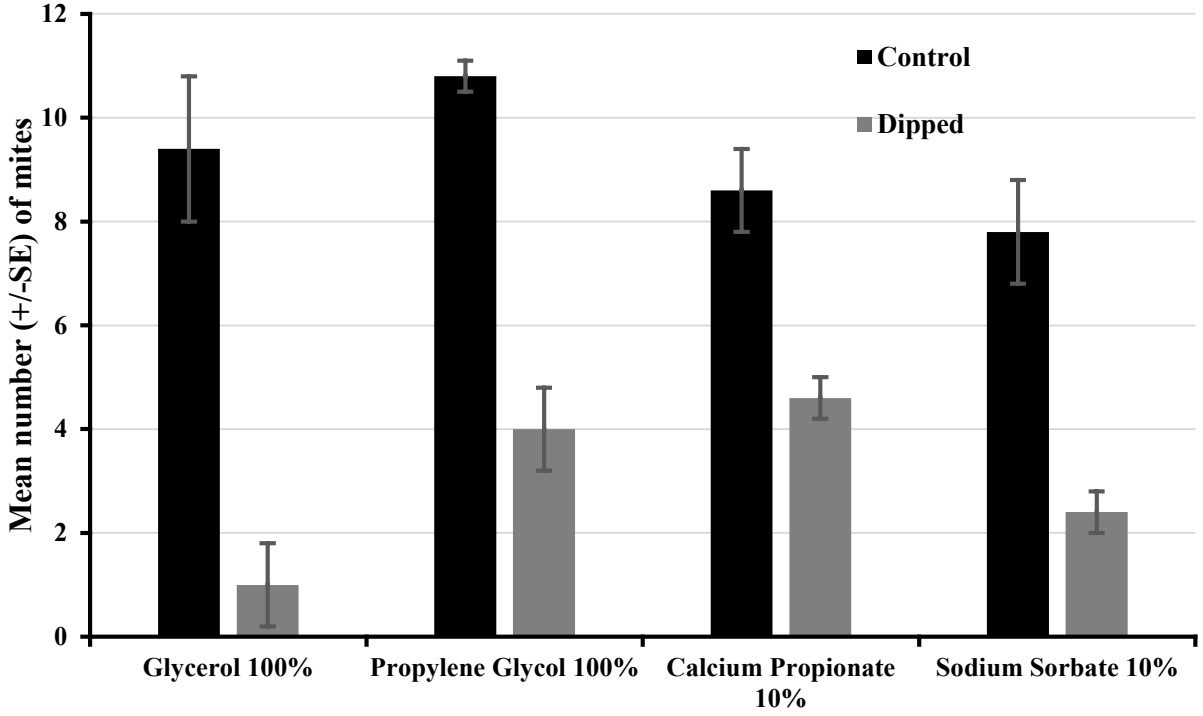
Population growth of *Tyrophagus putrescentiae* on ham treated with different short-chain alcohols

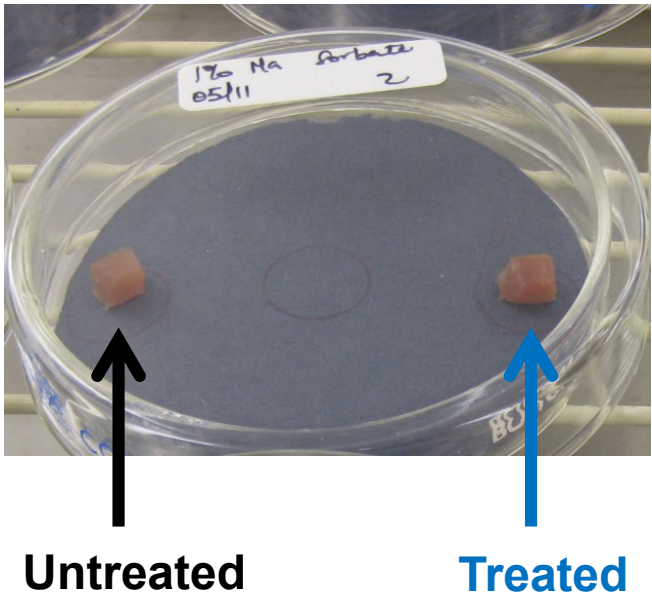


Population growth of *Tyrophagus putrescentiae* on ham treated with BHT and BHA

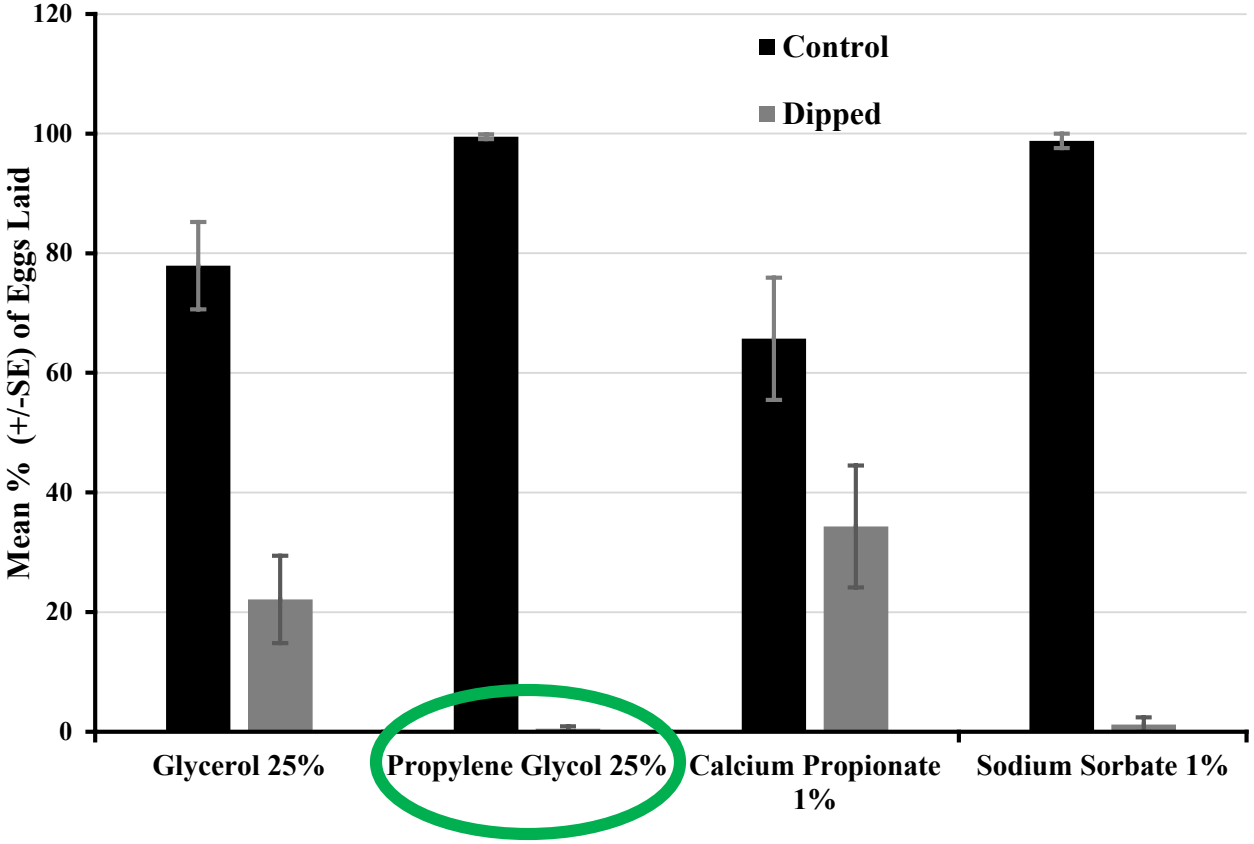


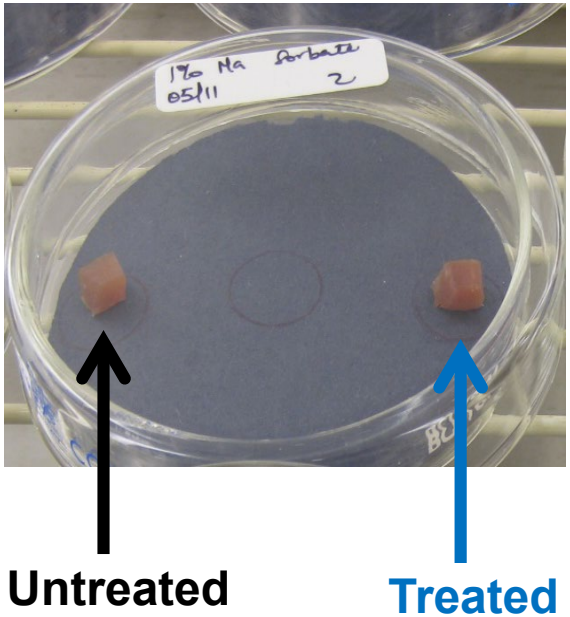
Orientation of mites to treated ham cubes





Egg placement by mites to treated vs untreated ham cubes after 24 hrs





Test of Food Gels w/PG to protect hams

Mean mite progeny produced on coated ham pieces from 20 mites after 14 days

• Water control	273
• PG-Alginate only	54
• Carrageenan only	28
• Agar only	111
• Xanthum gum only	29
• PG-Alginate w/50% PG	0
• Carrageenan w/50% PG	0
• Agar w/50% PG	0
• Xanthum gum w/50% PG	0

Coatings To Reduce the Rate of Propylene Glycol

Mean number of mites on ham cubes (20 mites inoculated/cube) coated with polysaccharides and different percentage of propylene glycol (PG) after 2 weeks incubation.

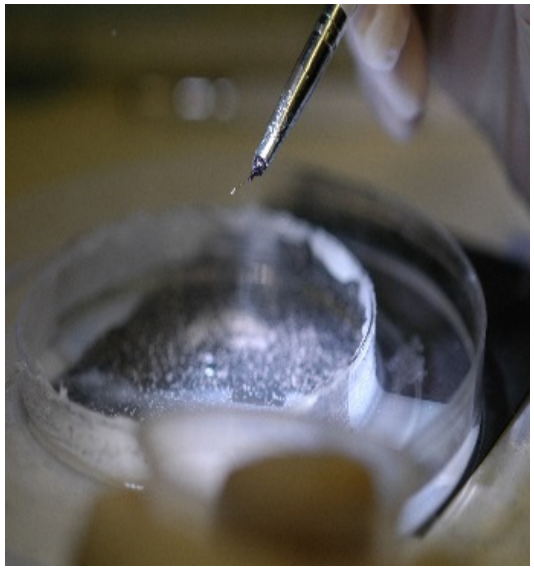
Polysaccharides	PG	Mite	
		Mean	SE
Control	0%	476[a]	48.7
PGA (1%) + CG (1%)	0%	186[b]	45.2
XG (1%)	0%	155[b]	54.1
XG (1%)	10%	70[bc]	48.2
PGA (1%) + CG (1%)	**10%**	2[c]	0.5
XG (1%)	**20%**	0[c]	0
PGA (1%) + CG (1%)	20%	0[c]	0
XG (1%)	30%	0[c]	0
PGA (1%) + CG (1%)	30%	0[c]	0
XG (1%)	50%	0[c]	0
PGA (1%) + CG (1%)	50%	0[c]	0

PGA: propylene glycol alginate
CG: carrageenan
XG: xanthan gum.

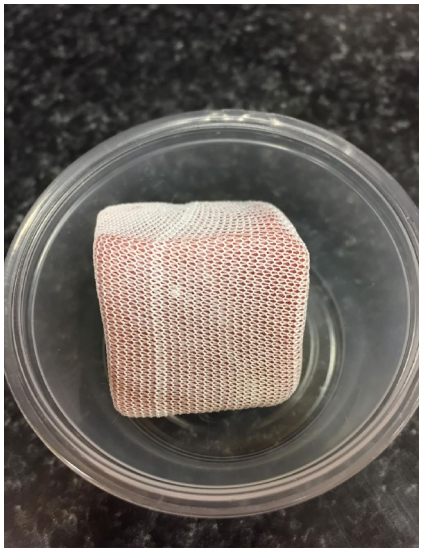
Nets could be made to keep mites off

Apply <u>Gels</u> with PG to Ham

Tested carrageenan, propylene glycol alginate and Xanthan



Challenge PG Gels w/Mites



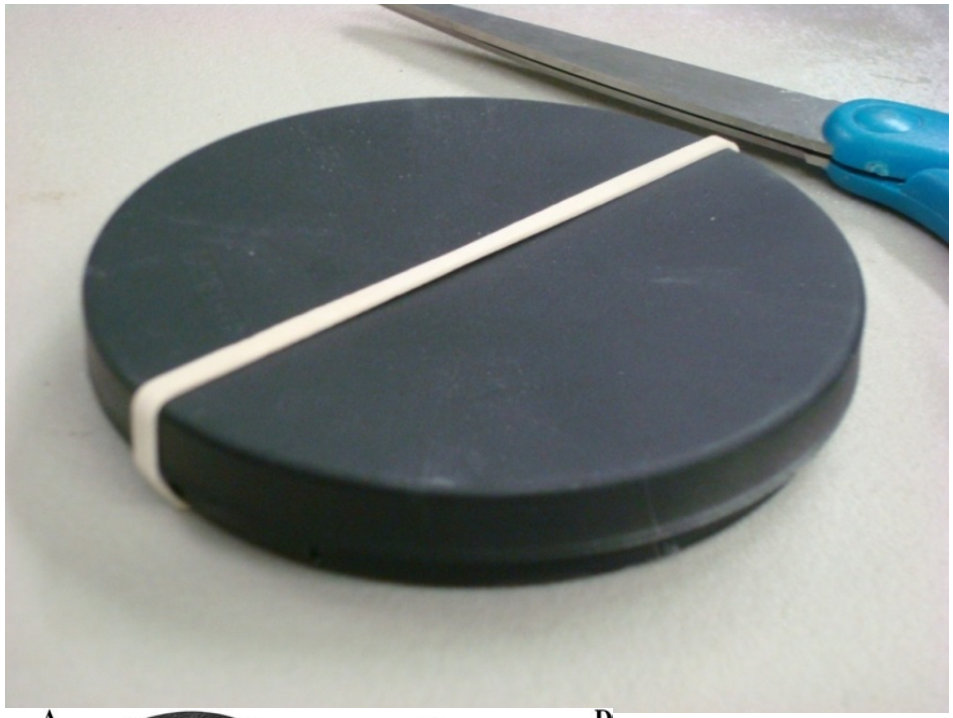
<u>Coat Nets</u> w/PG Gels

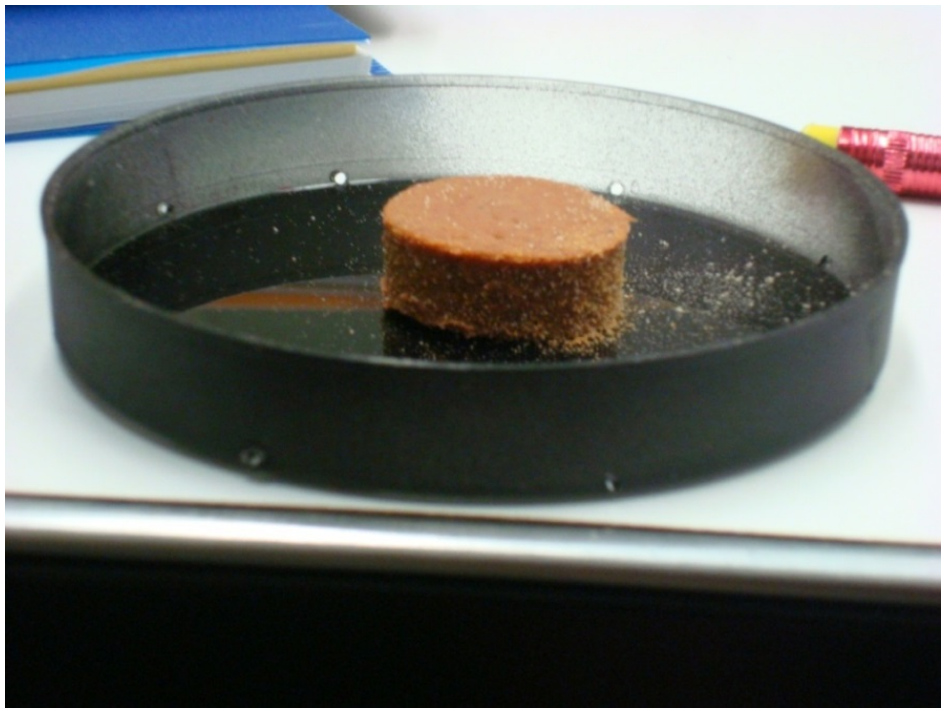
Textile Engineers

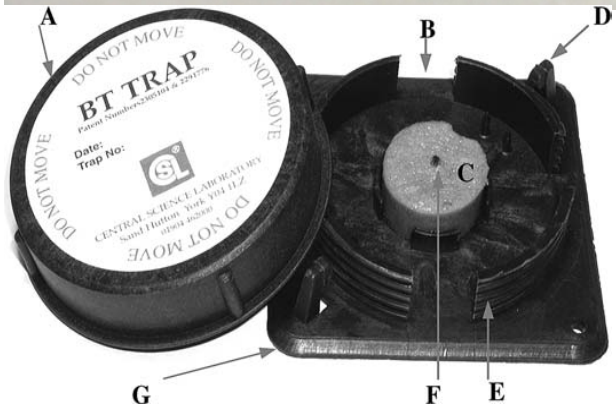
Can we monitor mites for IPM decisions?

The USDA meat inspector does not like this….

“KSU Trap” for Monitoring Mites



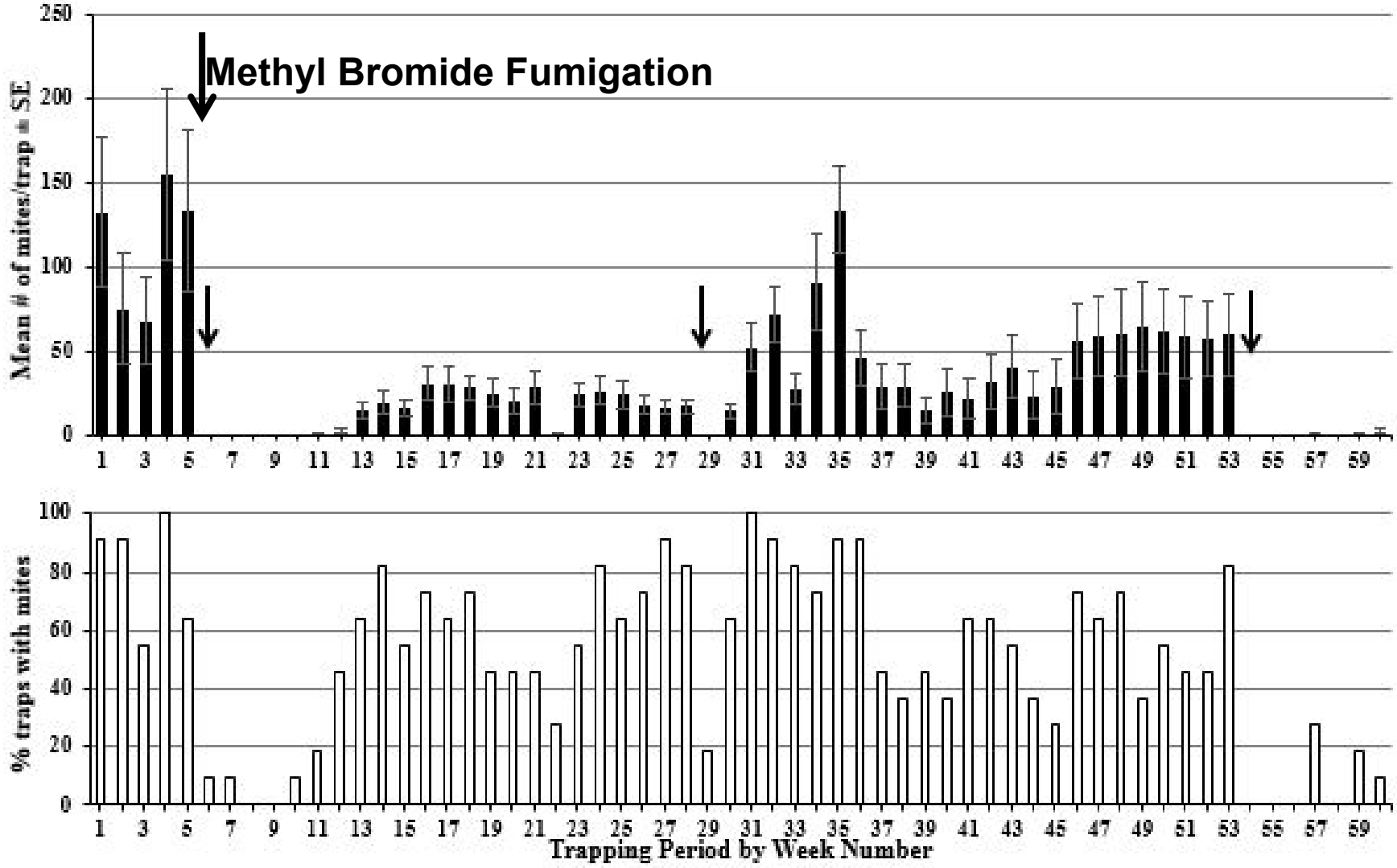




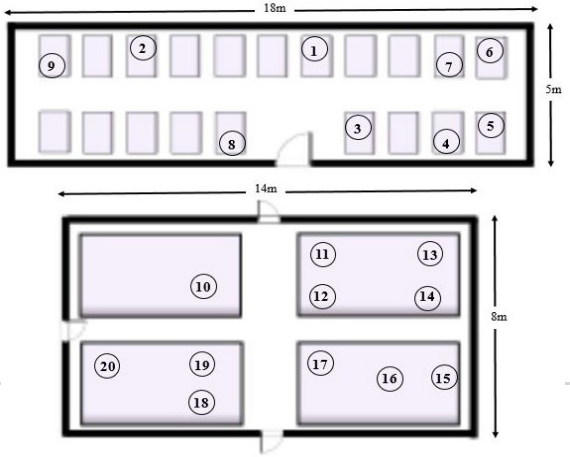
Trapping serves to:

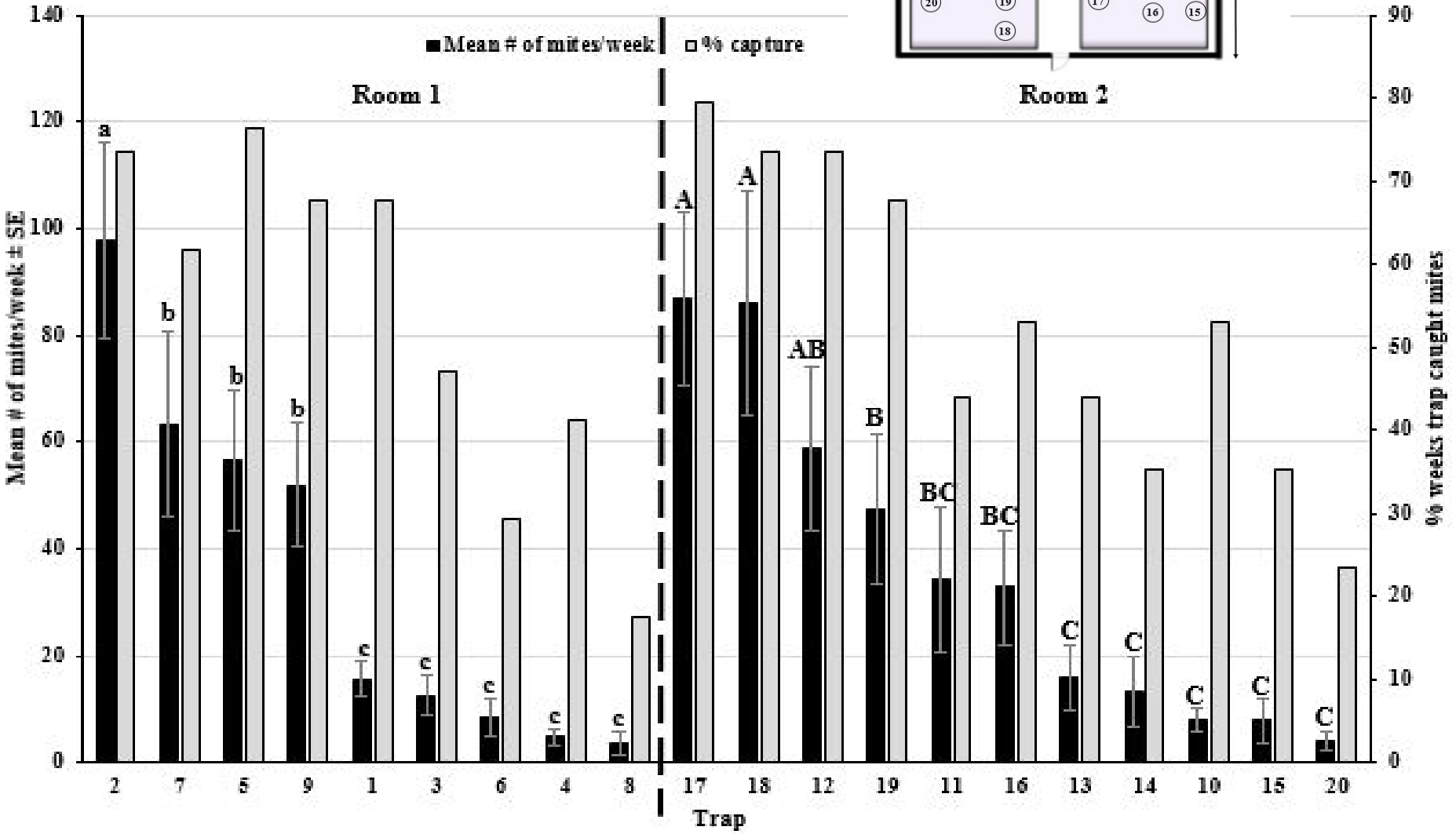
- **Detect presence of mites**
- **Monitor infestation over time and space**
- **A decision-making tool: it’s OK,..or <u>treat</u>!**

Trap catch by week
Monitor Fumigation Recovery

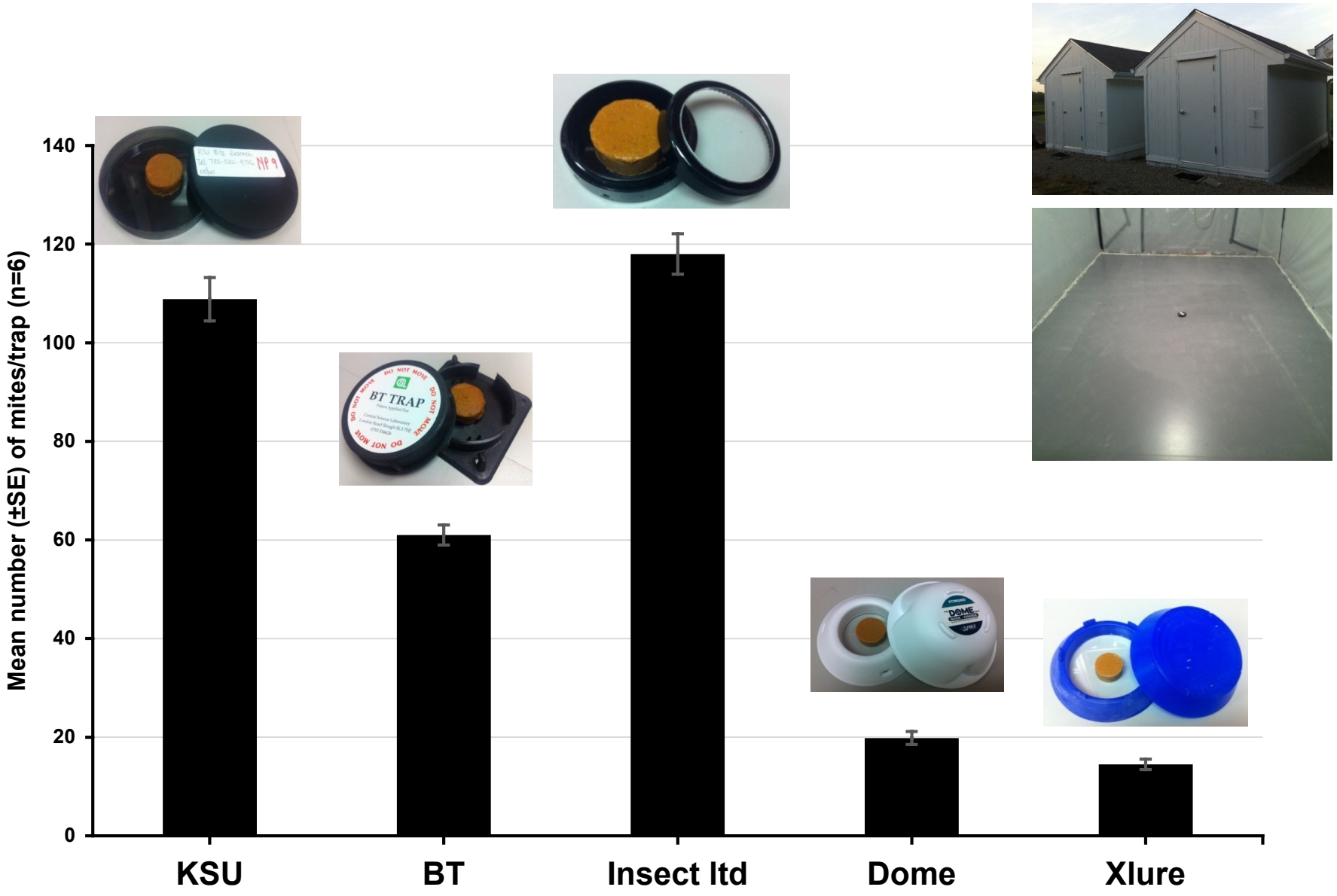


Trap catch by trap location

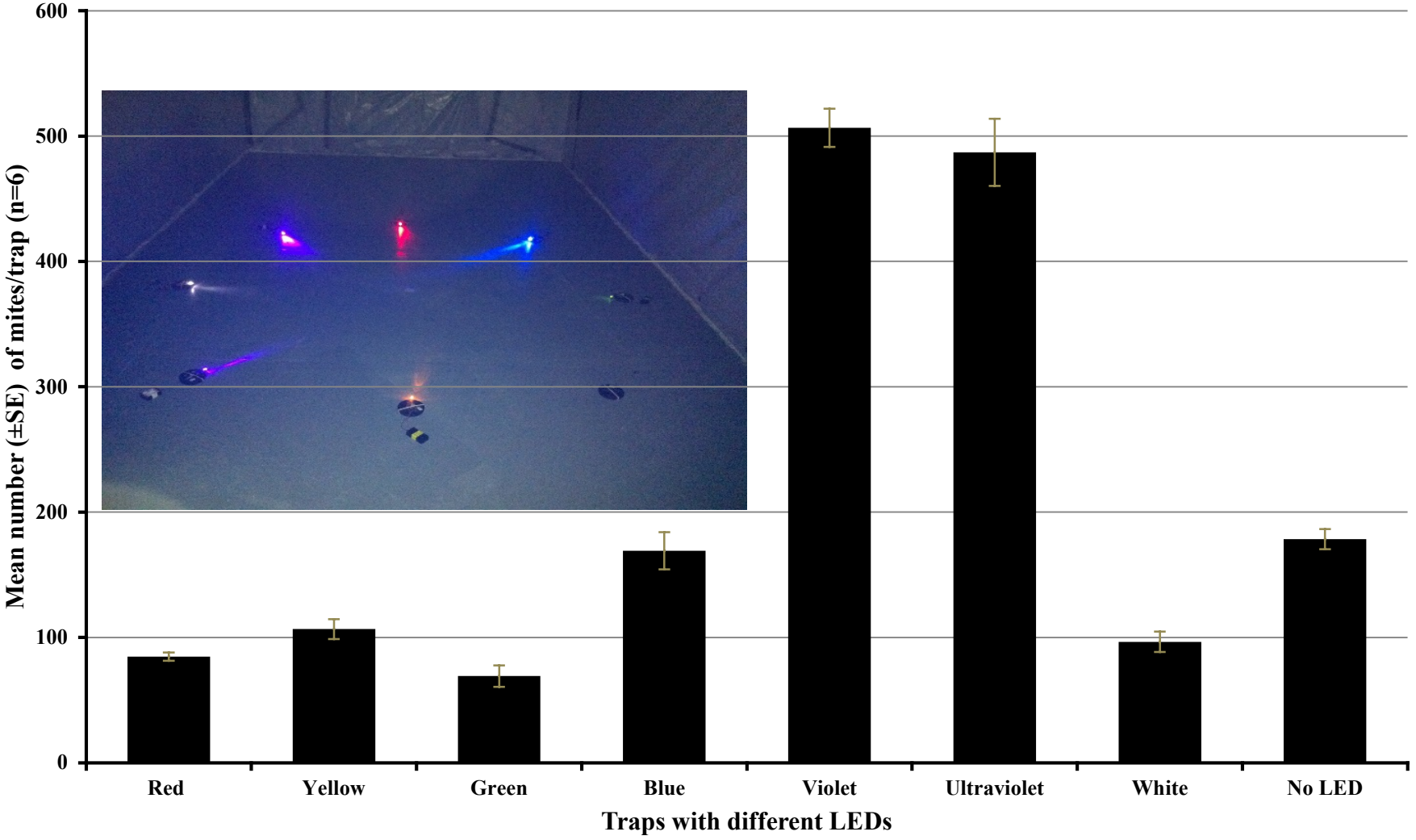




No-choice tests with different trap designs



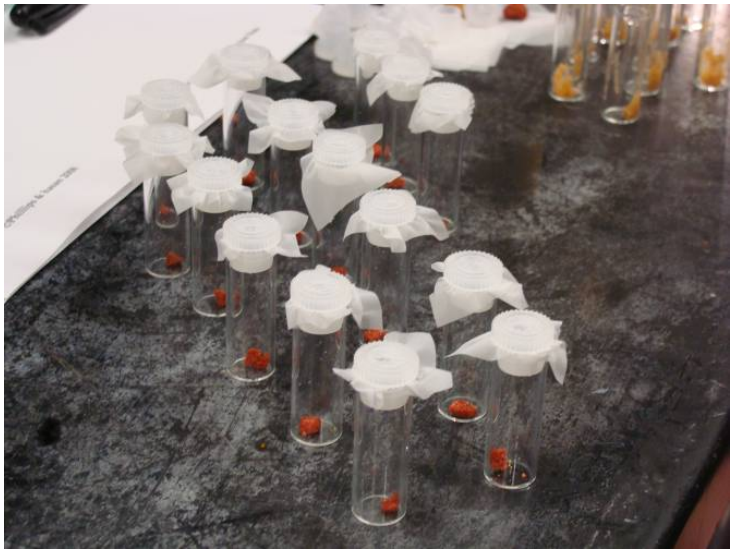
Enhancing (or Reducing) Orientation Responses with Light



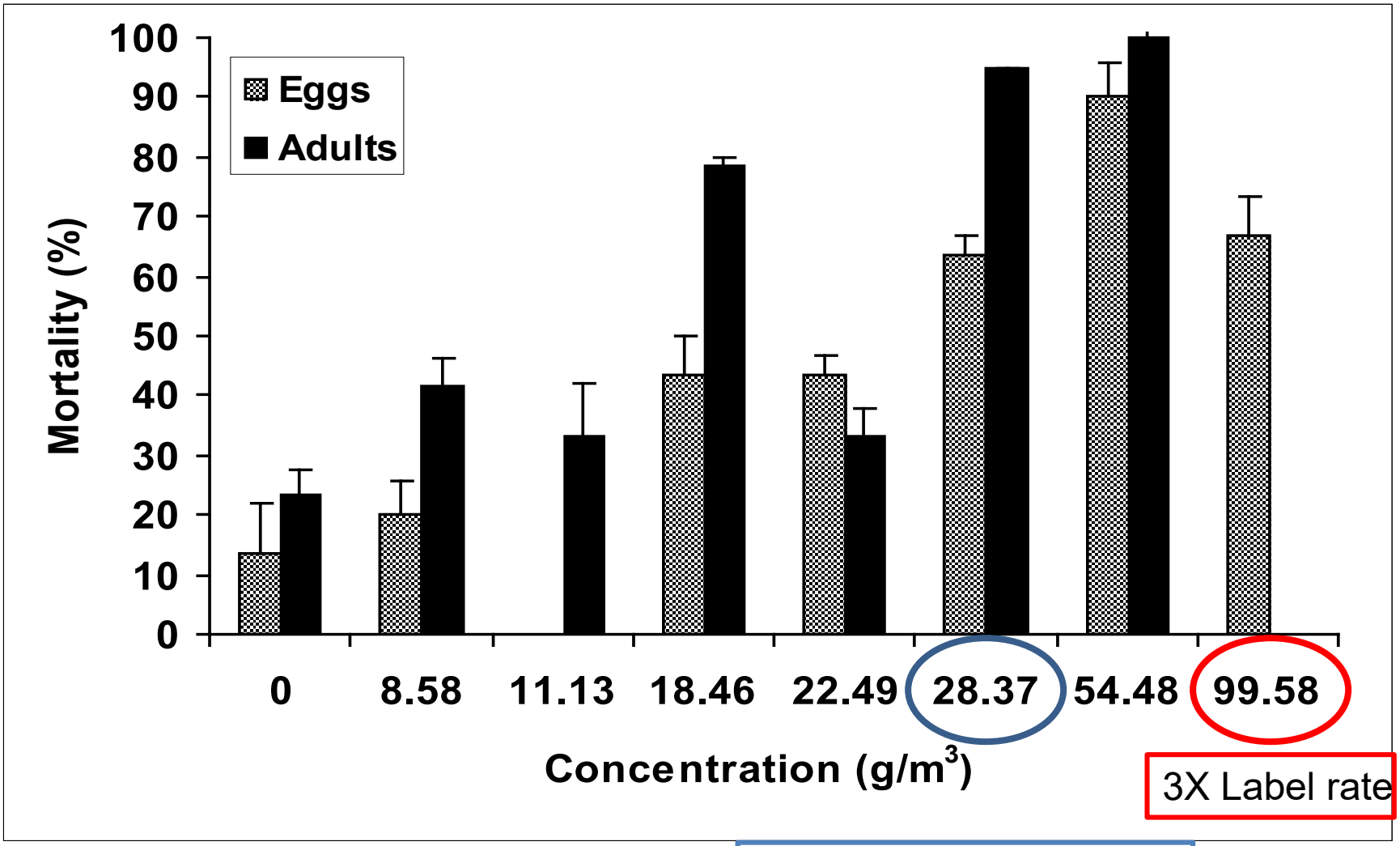
Controlling Mite Infestations Without Methyl Bromide

- Other fumigants
  - Phosphine
  - Sulfuryl Fluoride
- Controlled atmospheres: Low O_2, High CO_2, O_3
- Temperature extremes: Hot or Cold
- Combination methods?
- Pesticide sprays for floors/walls
- "New" Fumigants

Controlled Laboratory Fumigations

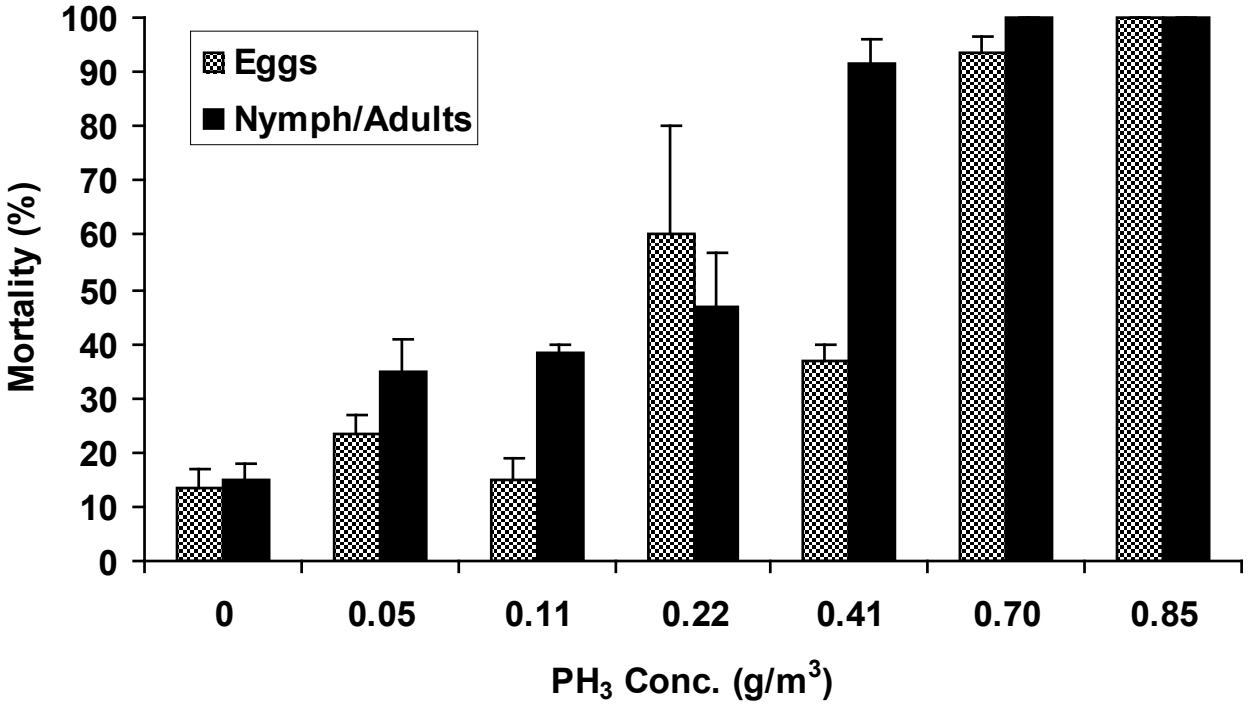


Mite Mortality w/ Sulfuryl Fluoride: 48h, 25°C

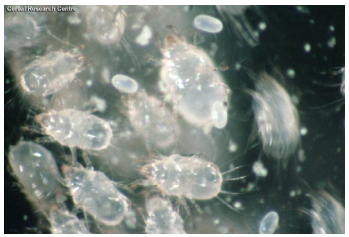


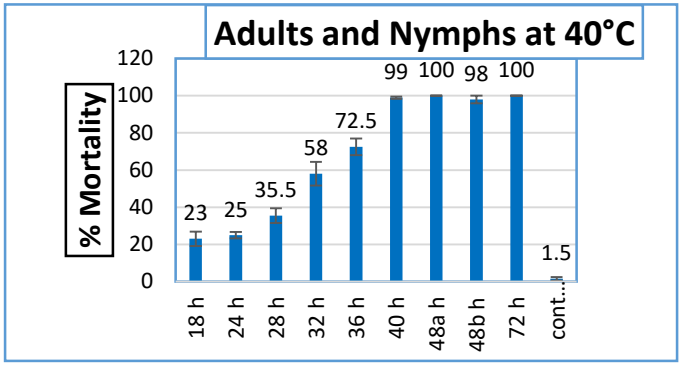
Phosphine Works for Ham Mites!

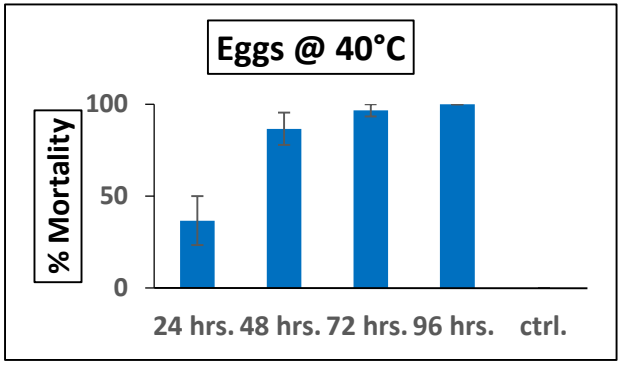
But not good for copper…



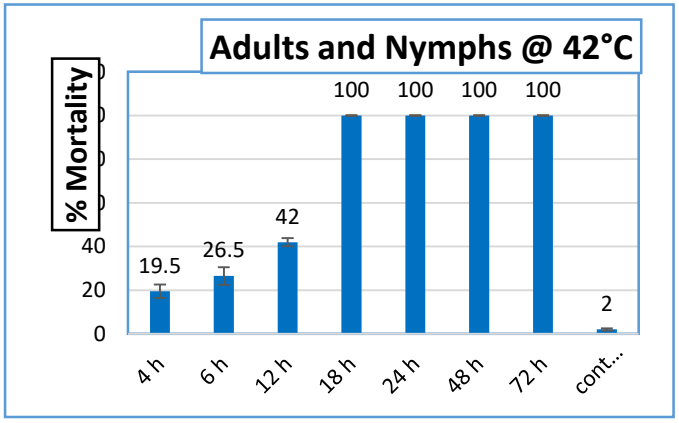
Mite Mortality from Heat: Oven studies

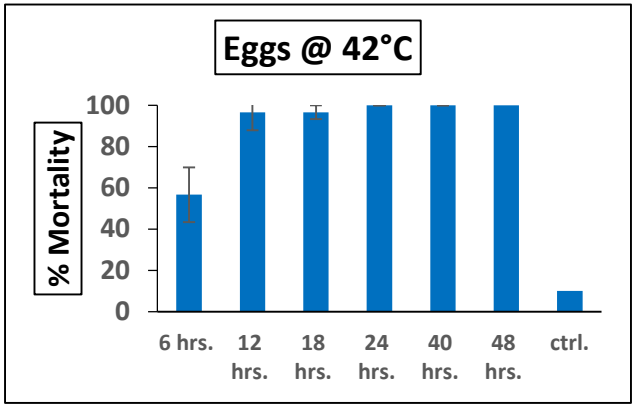






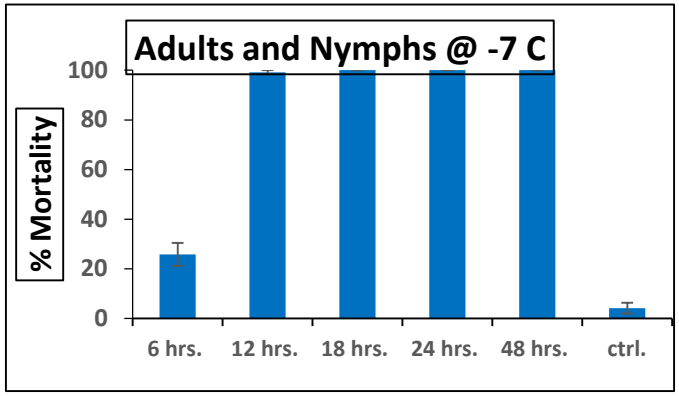
(=104°F)

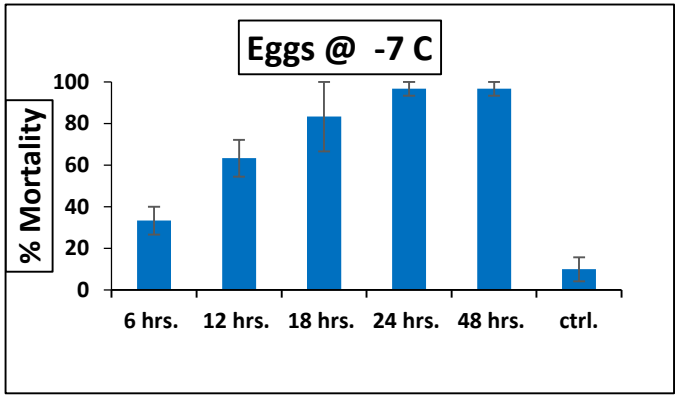




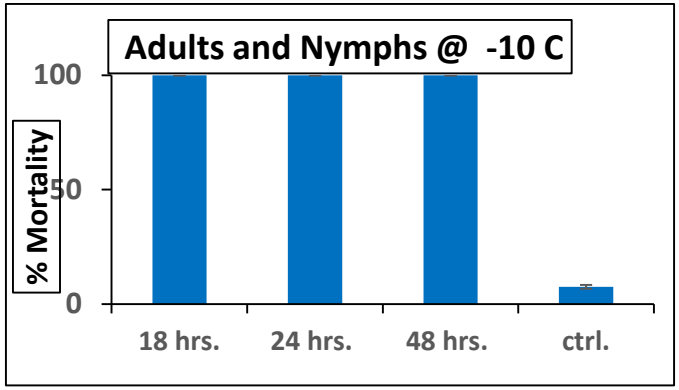
(=108°F)

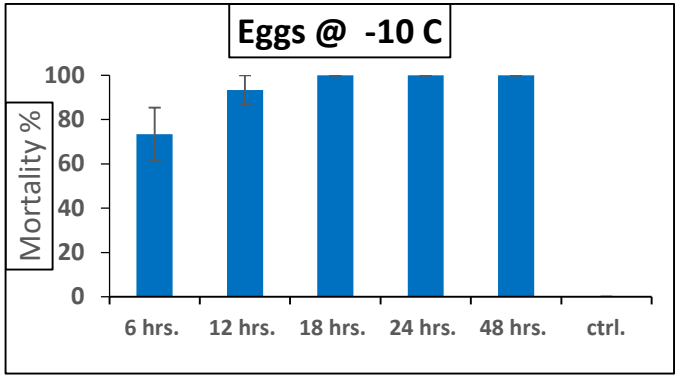
Cold Treatment for Mite Mortality: Freezer studies





(=19°F)



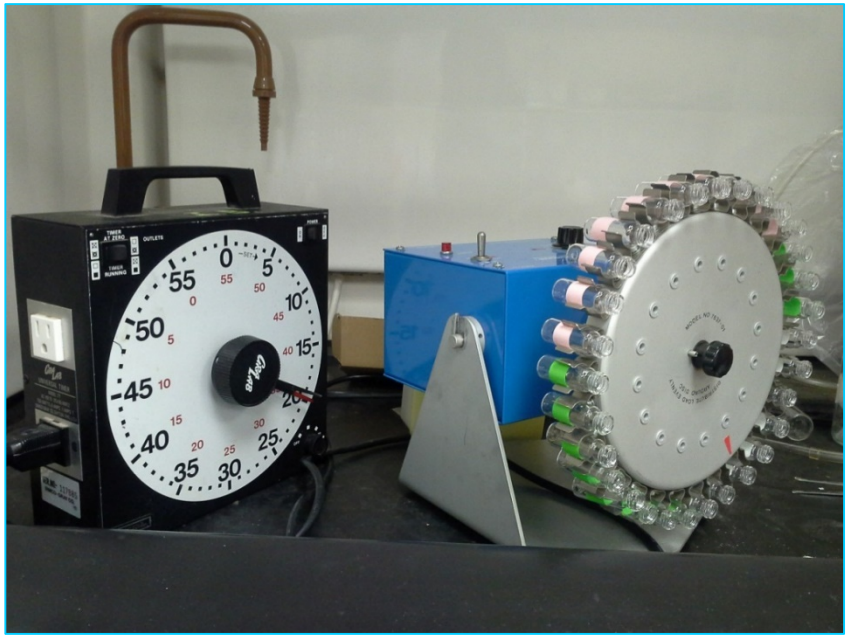


(=14°F)

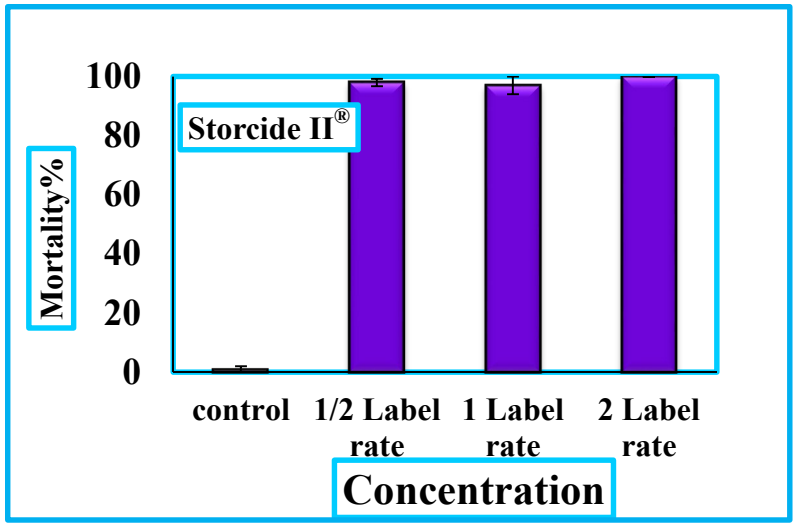
Screening Spray-on Pesticides

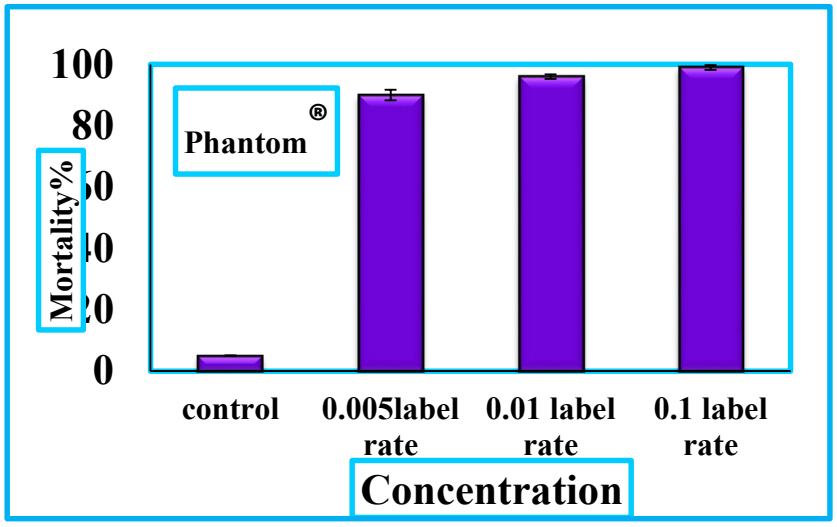
- Completely randomized design
- 20 unsexed adult mites

- Glass Vials treated with ½ x label rate, 1 x label rate and 2 x label rate

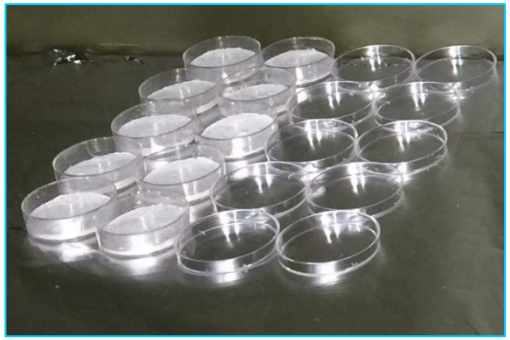


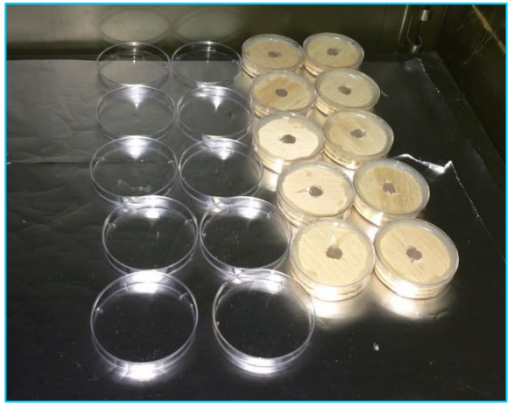
Residual sprays for surfaces





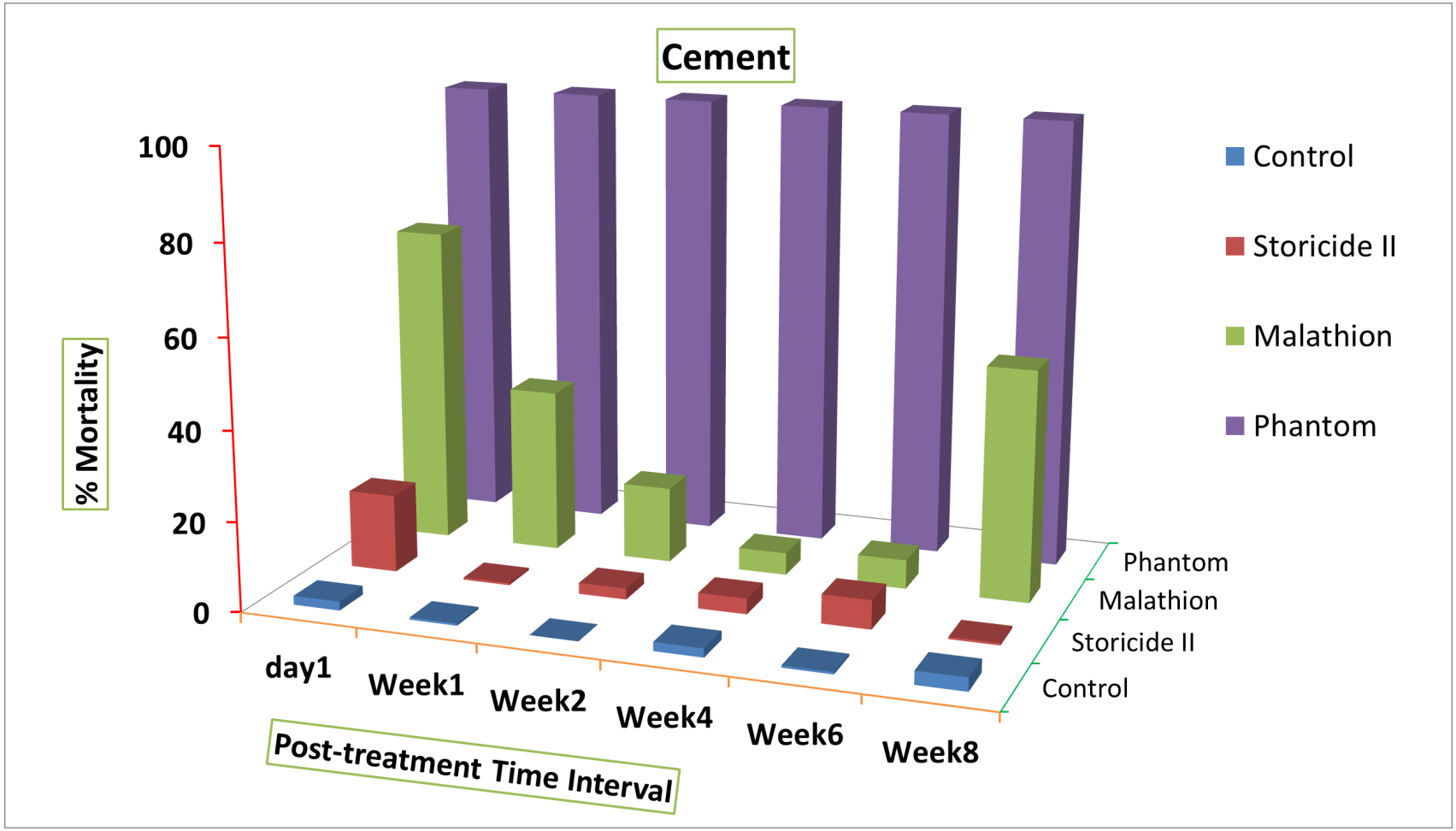
Residual activity on three surfaces



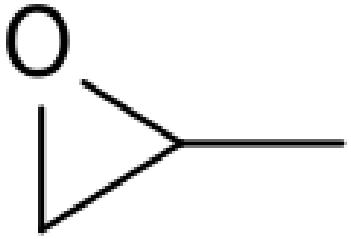


- Prepare dishes with three surfaces: concrete, metal and wood
- Artist's air brush to spray all dishes with label rates of Phantom, Storcide-II and Malathion
- Assay 20 mites per dish on dishes of different post-spray ages, up to 8 weeks
- Expose for 24 hrs and assess after 24 hrs recovery on clean dish

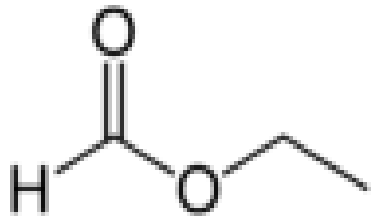
Ham mite mortality after 24-h exposure on sprayed surface up to 8 weeks post-spray



“Liquid” Fumigants

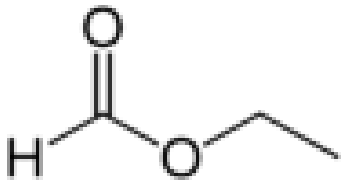


Propylene Oxide
mw=58, bp=34^{o} C

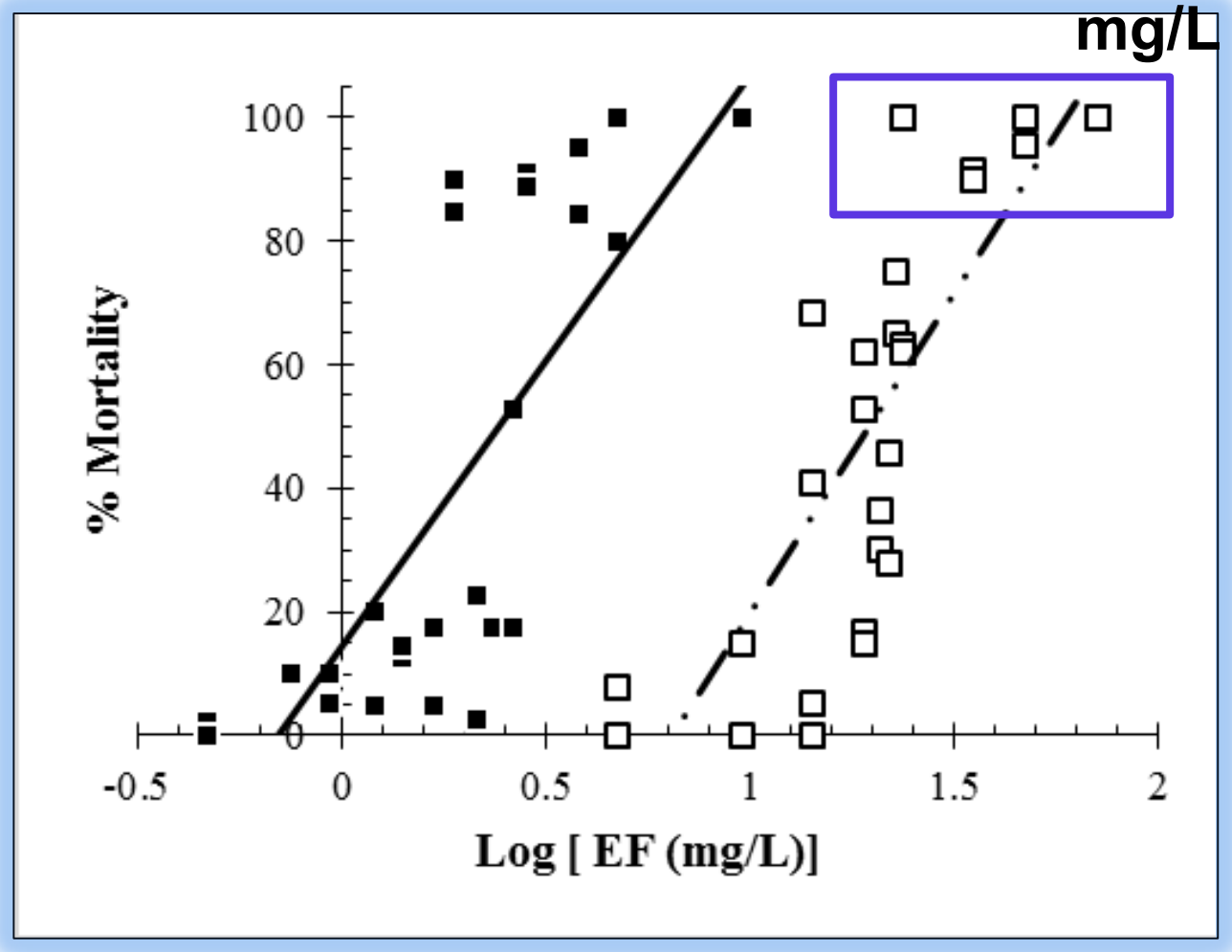


Ethyl Formate
mw=74, bp=54^{o} C

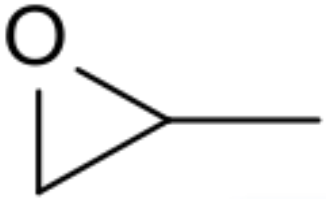
Ethyl Formate: Dose-Mortality Tests 24 Hrs @ 25° C



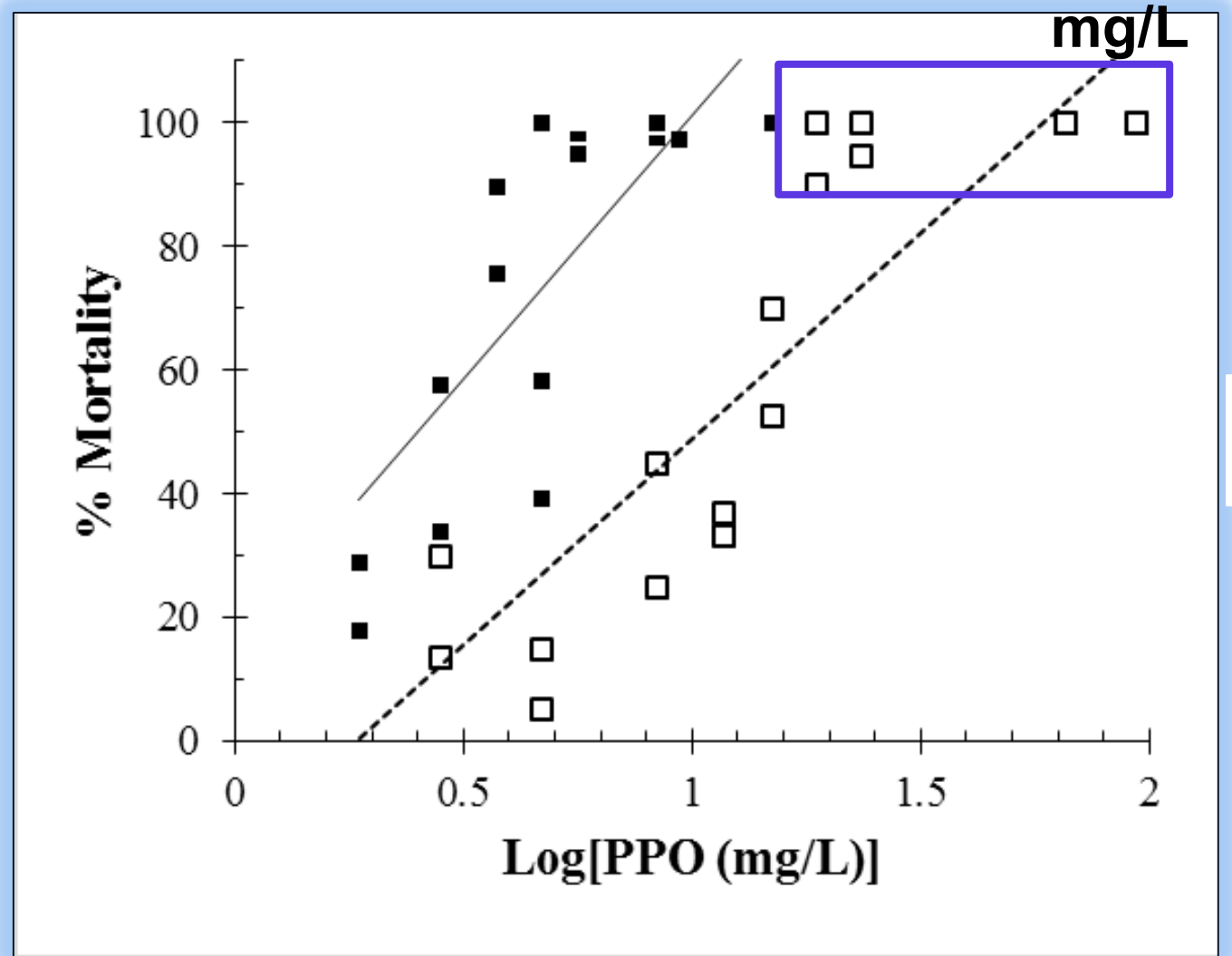
Approx. 100 mg/L



Propylene Oxide: Dose-Mortality Tests
24 Hrs @ 25° C



10-100 mg/L



IPM for Pet Foods

- **Sanitation: clean up and destroy all infested materials**
- **Practice prevention: clean, clean, clean again..**
- **Use traps to detect & monitor pest populations**
- **Fumigate only when necessary**
- **Heat treatments can disinfest buildings**
- **Cold treatments could disinfest packages**
- **Newly registered fumigants may help**

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