

## Understanding and Suppressing Litter Beetles

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## Introduction

- Litter Beetles
- Lesser mealworm, *Alphitobius diaperinus* (Panzer)
- cosmopolitan general stored product pest
- inhabits poultry droppings and litter
- vector and reservoir of several poultry parasites



## Introduction

- damage to poultry housing
- suspected to be a health risk to humans
- move en masse toward artificial lights



## Introduction

- *Alphitobius diaperinus* is a member of the tenebrionid family
- eleven known *Alphitobius* spp.
- two species
- The other species in U.S., *A. laevigatus* (Fabricius) or black fungus beetle
- less commonly encountered
- vector pathogens and parasites and occasionally cause damage to poultry housing
- Economic Impact: 1 to 6 million in GA 1996

## Distribution

- Presently known worldwide
- originated in sub-Saharan Africa
- introduced from Europe
- considered a tropical exotic species in North America
- Distributed from Maine to Texas

## Description

- Lesser mealworm adults are broadly-oval, moderately convex
- black or brownish-black and usually shiny in appearance
- Color can be variable depending on age or 'strain'
- Length is approximately 5.8 to 6.3 mm
- Antennae are densely clothed with short yellowish hairs

## Description

- Eggs are approximately 1.5 mm in length
- creamy white to tan colored
- slender with slightly rounded ends
- Larvae have a segmented body
- abdominal tip tapering posteriorly
- three pairs of legs
- Freshly-emerged larvae are a milky color

## Life Cycle & Biology

- *Alphitobius diaperinus* is usually found infesting flour, meal, and other grain products
- poorly maintained grain processing plants
- Of course, found throughout poultry
- After mating, a female beetle has the potential to lay over 2,000 eggs (with an average closer to 200 to 400)

## Life Cycle & Biology

- Adults lay the eggs in crevices
- Adults can live for months
- Females continue to lay eggs most of their life at one to five eggs per day
- Larvae hatch in 2-3 days
- complete development stage in 40 to 100 days
- Larvae consume spilled feed, manure, and in some cases dead or sick birds and cracked eggs

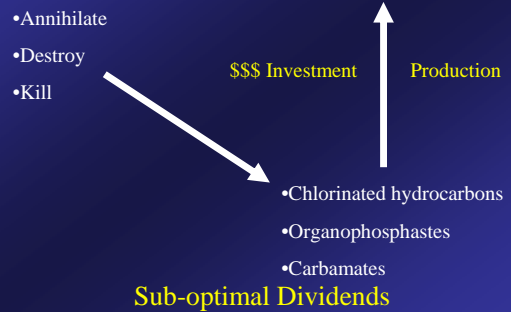


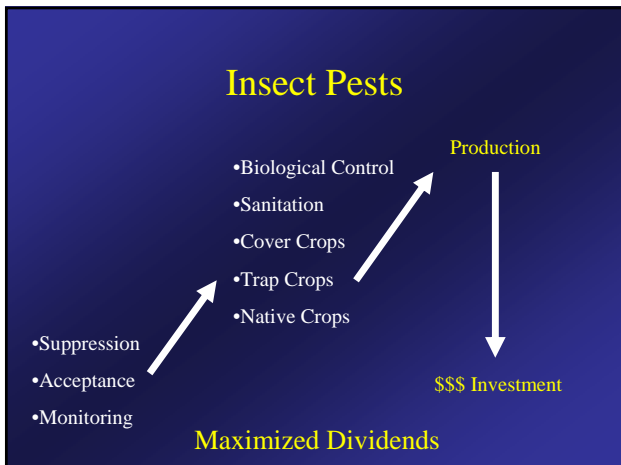
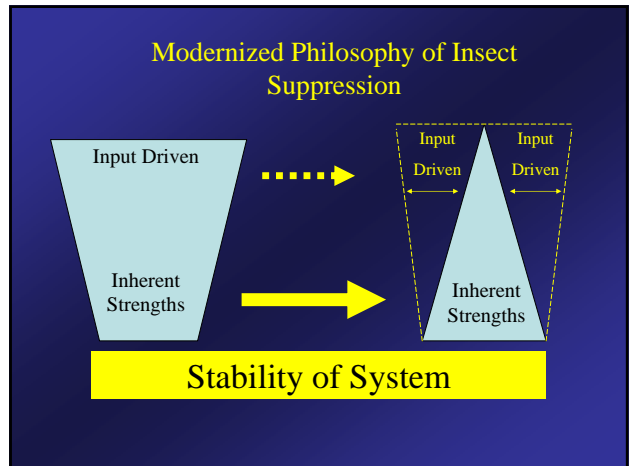
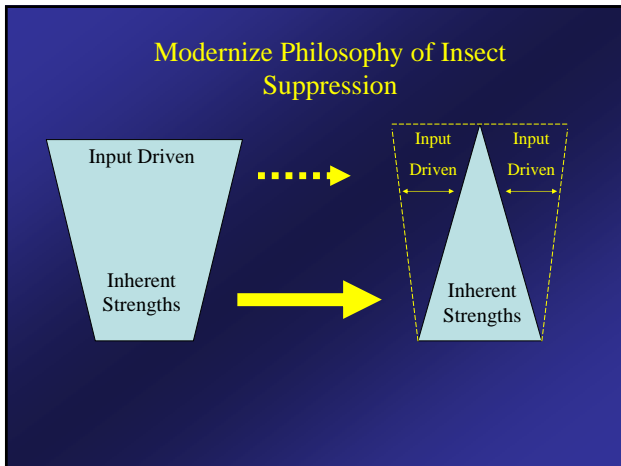
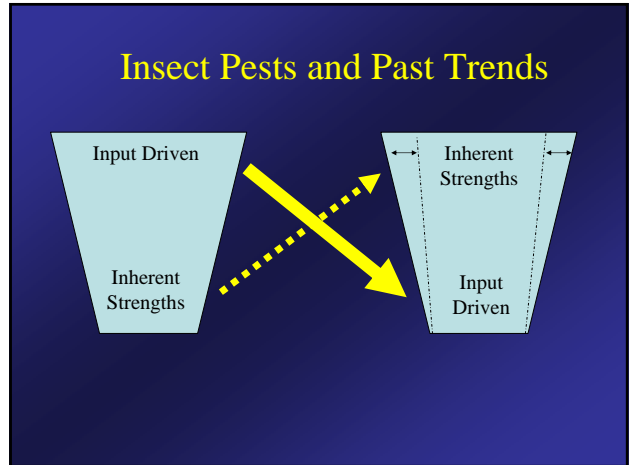
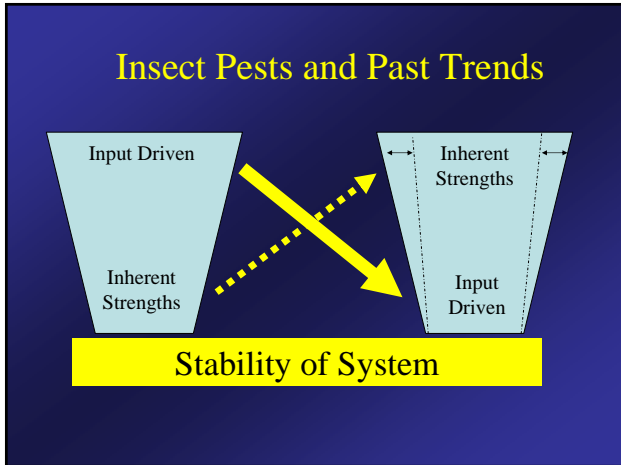
## Damage



## Control

## Insect Pests in the Past





- ### Integrated Pest Management
- Biological
  - Cultural
  - Chemical

## Biological Control

- Several species identified
- None available commercially
- fungal pathogen *Beauveria bassiana* holds the greatest promise
- Granular formations of *B. bassiana* strains provided 60 to 90% suppression
- Natural protozoan infections
- Steinernematid nematodes do not appear to provide long-term control

## Biological Control

- web contents of two spider species were found to have high numbers of adults
- natural predation by spiders

## Cultural Control

- Cold weather is a simple cultural control method for producers in northern locations
- removing manure at these times
- Frequent manure cleanout or removal of litter
- Some types of insulation are more resistant to burrowing
- mechanical barriers

## Cultural Control

- Water is a key need for mealworm beetles so check pipes and waterers for leaks.
- All measures to keep the litter dry will help to keep beetle numbers down.
- Feed storage areas or spilled feed outside the houses can be a starting point for infestations by beetles
- Move feeders and waterers when practical to pack down loose litter and make it less suitable for the insects.

## Sampling is Important

- preference of mealworm larvae and beetles to get under objects has been used to develop a trap to monitor them in poultry litter
- no treatment guidelines in terms of numbers of beetles caught
- you can detect them early and look at changes in trap counts over time
- trap catches also let you evaluate control measures that have been applied

## Sampling is Important

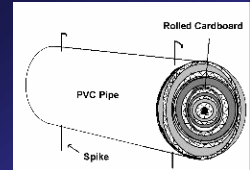
- trap is a 9-inch length of 1-1/2 inch PVC pipe
- contains a piece of 8-inch x 11-inch corrugated cardboard
- rolled up so that the 8-inch length is inside the pipe
- Lesser mealworm beetles and larvae will crawl between the cardboard layers to hide
- Holes should be drilled at each end of the pipe so that stakes can be used to hold the trap in place in the litter

## Sampling is Important

- traps should be put in open centers of the house for easy retrieval
- Avoid placing them near walls, feeders, or waterers
- Three traps, approximately evenly spaced along the center line of each house
- checked easily by removing and unrolling the cardboard to count beetles and larvae

## Sampling is Important

- date and numbers found should be recorded so that trends can be detected
- traps need to be checked at regular intervals



## Chemical Control

- Several formulations of carbaryl
- boric acid is available as a soil and premise treatment in some states
- Lime hydrate (calcium hydroxide) provided increased mortality among adult and larval *A. diaperinus* in the laboratory

## Chemical Control

- Different classes of insecticide
- Organophosphates: synthetic (Rabon)
- Pyrethroids: natural and synthetic (Grenade & Tempo)
- Naturals: spinosad (Extinosad)

## Chemical Control

### Floor Management- Litter

Rabon  
50WP 4 lbs in 50 gal water - Apply 1 to 2 gal of diluted spray per 100 sq ft (styrofoam) evenly for penetration. Also treat walls, roosts, cracks, and crevices.

## Chemical Control

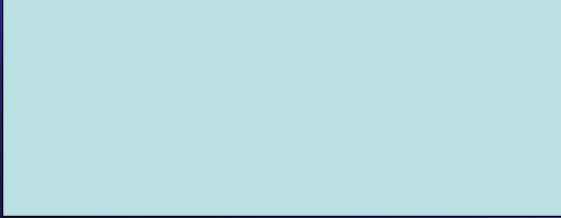
### Floor Management- Litter

Rabon  
Beetle (dust) 4 to 8 oz per 100 square feet  
Shield

## Chemical Control

### Residual Wall Treatments

Countdown (cyfluthrin) See label for rates - Apply to walls and ceilings, do not treat entire floor area. Do not apply when birds are present.



## New Chemicals



## What is Extinosad?

- Spinosad the Molecule
- Completely new class of chemistry
- No known cross-resistance with other chemistries
- Excellent tool for resistance management

## Spinosad History

- Soil sample taken in 1983 by Lilly employee (abandoned Rum Still on a Caribbean Island)
- First activity in mosquito larval screen in 1985 at Greenfield with confirmation in blowfly and stable fly screens
- First AgChem field trial in 1988
- Joint development of strains/ fermentation processing between DowElanco (Dow AgroSciences) and Lilly
- Elanco started working with it for animal use in 1993
- First launch by Dow Elanco in 1997 in US (EPA)
  - Currently registered in over 60 countries
- First launch by Elanco Animal Health in 2000 (Australia for use on sheep)
- Other approvals since 2000 in U.S. and Brazil.

## The organism

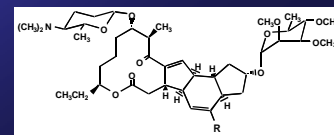


The organism is an Actinomycete bacterium *Saccharopolyspora spinosa*



The active ingredient is spinosad which is composed of 2 metabolites - spinosyns A and D

## Spinosad



- Spinosyns are a naturally derived group of insect control molecules from a new species of Actinomycetes, *Saccharopolyspora spinosa*.
- There are 23 naturally occurring known spinosyns.
- Spinosad is a mixture containing multiple natural spinosyn factors with factors A and D being the most abundant.
- No antimicrobial activity.

## Extinosad

- 44.2% active ingredient
- general surface spray or a crack and crevice application
- 2 oz/10 gal
- 1 gal/500 square feet
- do not allow run-off to occur

## Rabon Products Auburn University

- Tetrachlorvinphos
- Organophosphate
- 50 WP
- Ravap EC
- Rabon Beetle Shield

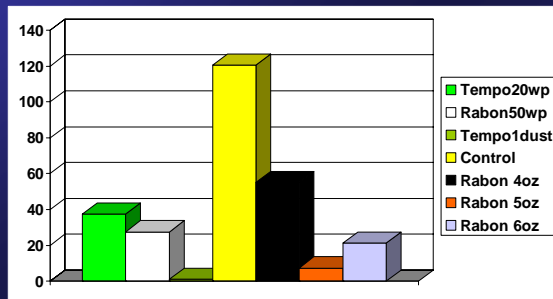
## Rabon 50 WP

- ½ pd per six gallons water
- Six gallons will cover 300 to 600 square feet

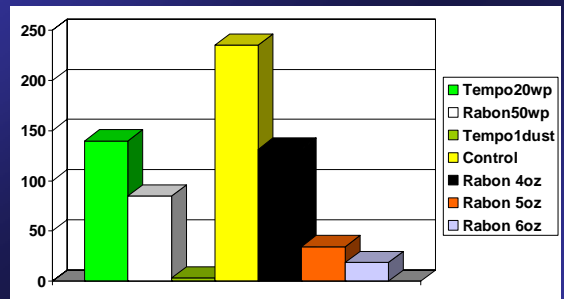
## Rabon Beetle Shield 3%

- 4-8 oz per 100 square feet

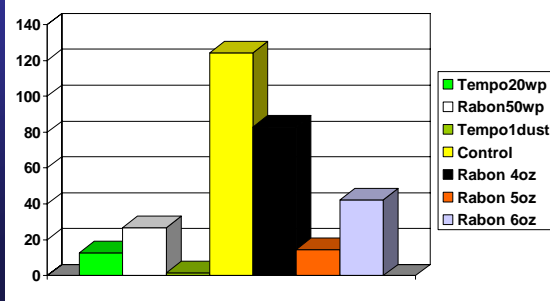
Overall Average Adult Litter Beetles/Tube



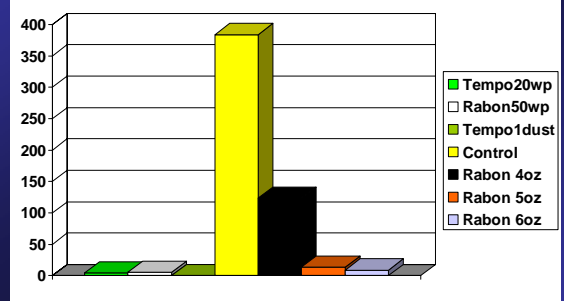
Overall Average Larval Litter Beetles/Tube



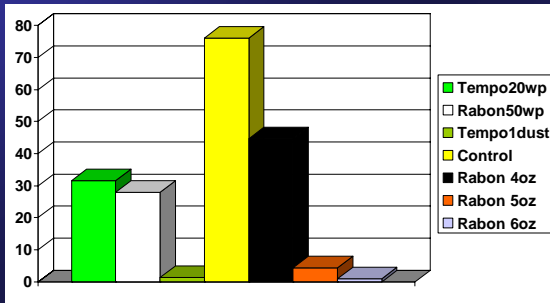
### Brooding - Adult Litter Beetles/Tube



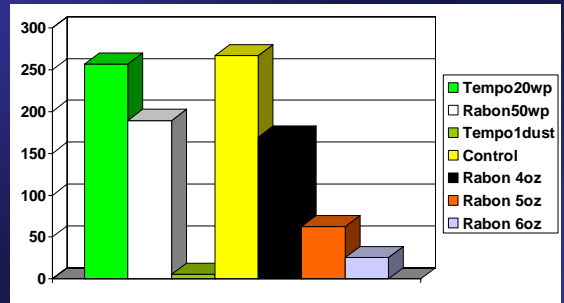
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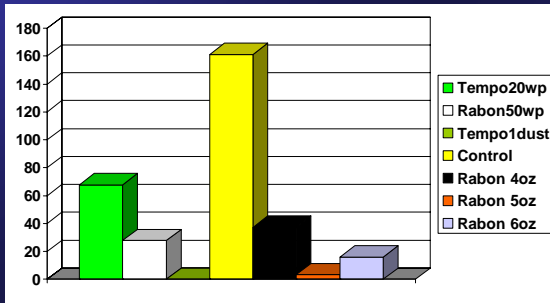
### Mid Growout Adult Litter Beetles/Tube



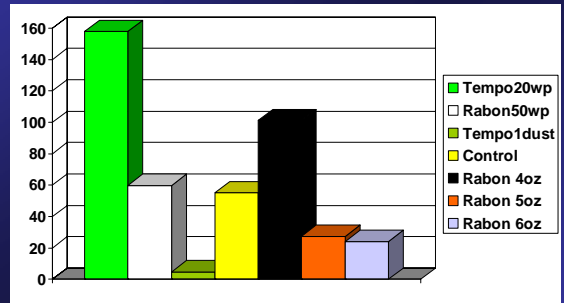
### Mid Growout Larval Litter Beetles/Tube



### Late Growout Adult Litter Beetles/Tube



### Late Growout Larval Litter Beetles/Tube



## Durashield



## Durashield

- Controls ants, bees, beetles, cluster flies, cockroaches, crickets, darkling beetles, earwigs, fire ants, fleas, flies, gnats, house flies, moths, northern fowl mites, silverfish, sowbugs, spiders, stable flies, wasps and yellowjackets
- Chlorpyrifos
- Organophosphate

## Durashield

- 2-4 oz/1,000 square feet
- 20-50 gals/20,000 square feet
- Treat top of litter
- Don't skip flock
- Spray walls (whole wall every other flock)
- Once populations is reduced can focus on feeder areas

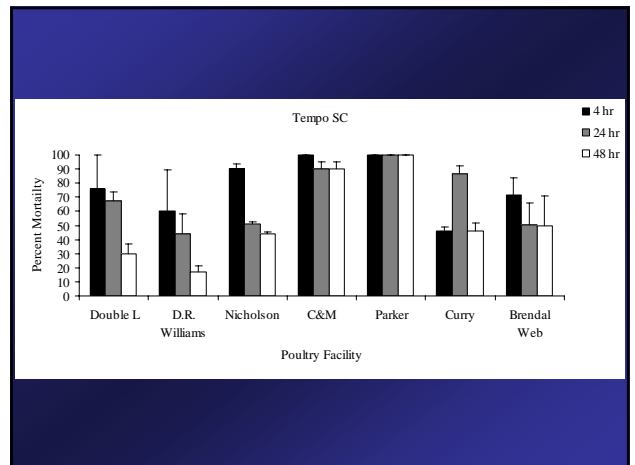
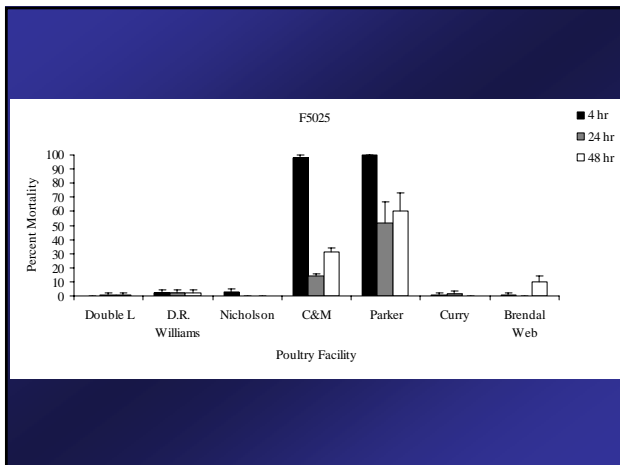
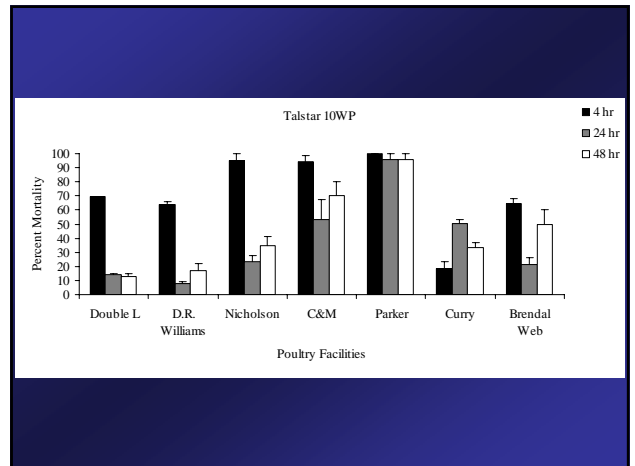
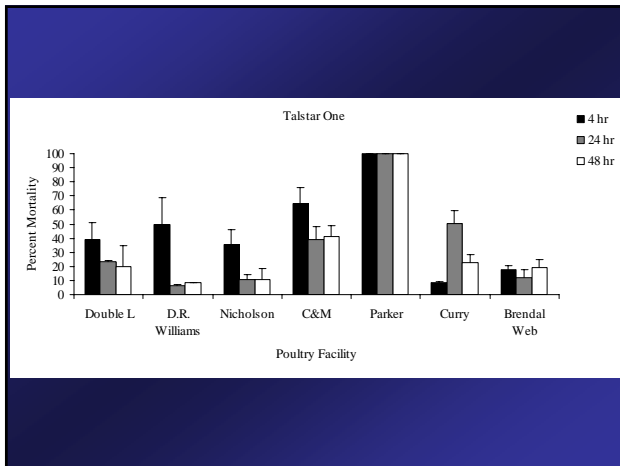
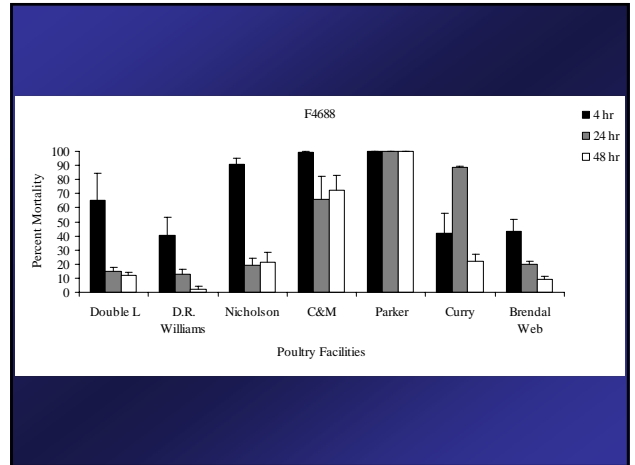
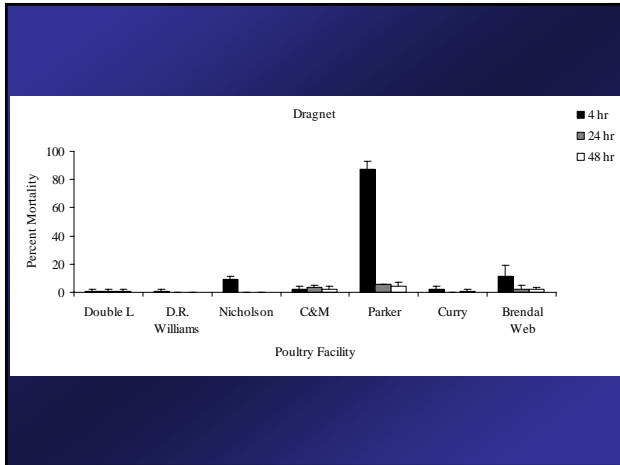
## In summary

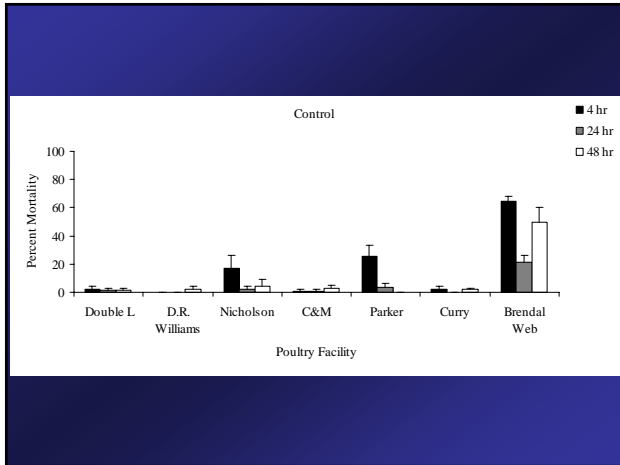
- Darkling beetle is not going away
- There are a number of methods
- Use an IPM approach
- Manage for resistance (**Rabon**, **Tempo**, & **Extinosad**)
- If using chemicals, use caution

## Texas Study 2005

- Seven facilities
- Six compounds
- Adult & Immatures







- ## Summary
- Results vary between facilities
  - Knock down is different from Kill
  - Rotation is an important part of IPM
  - Bi-annual testing for resistance
    - Maintain efficiency
    - Reduce costs
    - Reduce beetle populations

Thank You!

## Switching Gears!

### Waste Management

## Livestock Production in Texas

Animal	Ranking
• 13.5 million beef	1
• 94 thousand sheep, etc	1
• 1 million horses, etc	1
• 1.2 million poultry/egg	6
• 79 million broilers	6
• 309 thousand dairy	9
• 128 thousand hogs	16

## Livestock Production in Texas

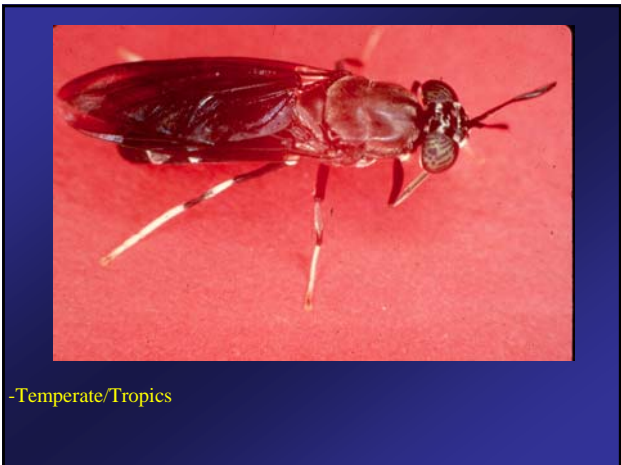
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The Black Soldier Fly, *Hermetia illucens*:

A Sustainable Manure Management System for Confined Animal Facilities

Jeffery K. Tomberlin  
Texas Cooperative Extension & Texas Agricultural Experiment Station





-Temperate/Tropics

-Colonizes variety of wastes



-Temperate/Tropics

-April through October

-Colonizes variety of wastes



Most work with poultry



Most work with poultry



Most work with poultry

-b/c of high density of larvae



Most work with poultry

-b/c of high density of larvae

Initially thought of as pest





Furman et al. 1959  
Sheppard 1983

House fly management

Manure management?

## The house fly as a means to reduce manure

- Calvert et al. 1969
- Calvert et al. 1970
- Miller et al. 1974
- Eby and Dendy 1978
- Chiou & Chen 1982

## The house fly as a means to reduce manure

Pro

Con

-Biological favorable

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## The house fly as a means to reduce manure

Pro

Con

-Biological favorable

-High protein

-Separate facility is expensive

-Mechanical extraction

## The black soldier fly as a means to reduce waste

Pro

Con

## The black soldier fly as a means to reduce waste

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Con

-Non-pest species

## The black soldier fly as a means to reduce waste

Pro

Con

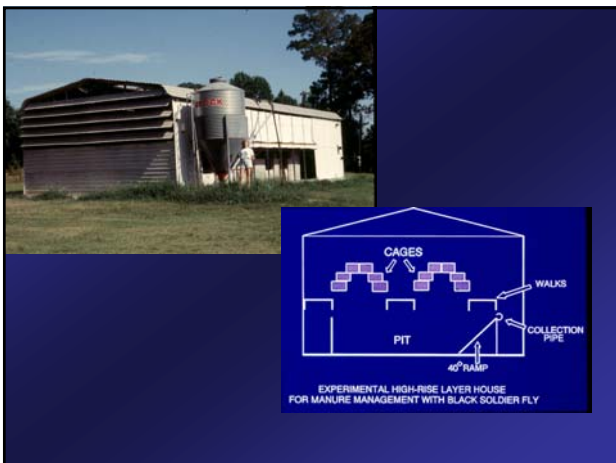
-Non-pest species  
-High density population

## The black soldier fly as a means to reduce waste

Pro

Con

?



## Sheppard et al. 1994

-50% reduction in manure accumulation

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## Sheppard et al. 1994

-50% reduction in manure  
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equally

-Complete suppression of house flies

-Self-harvest prepupae (30% fat &  
42% protein)

Thank You!