PURDUE EXTENSION | LOCAL FACES COUNTLESS CONNECTIONS

Prevention and Management of Key Insect Pests in Vegetables

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Agenda

- General IPM (Integrated Pest Management)
- Preventing insect problems in vegetables
- Insecticide tools for fixing problems
- Three case studies
  - Caterpillars on cabbage
  - Striped cucumber beetles on muskmelons
  - Corn earworm on sweet corn

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Valuable Resources

- Midwest Vegetable Production Guide
- Vegetable Insect Management

Midwest Vegetable Production Guide for Commercial Growers

2014

Illinois
University of Illinois Extension
C1373-14

Indiana
Purdue Extension
ID-56

Iowa

Vegetable Insect Management

Meister Media Worldwide

www.meisterpro.com

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Integrated Pest Management

- … a system in which a combination of methods is used to maintain pest populations at low levels while allowing for profitable production with minimal adverse effects on the environment

(Foster and Flood, 2005)

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Integrated Pest Management

- Combination of methods
- Profitable production
- Minimal adverse effects
  - Farm workers
  - Non-target organisms
  - Consumers

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Frequency of Insect Damage to Vegetables

Never/Rarely	Sometimes	Usually/Always
Carrot	Asparagus	Broccoli
Green onion	Beans	Cabbage
Lettuce	Pepper	Cantaloupe
Pea	Spinach	Cauliflower
Radish	Tomato	Cucumber
	Bulb onion	Eggplant
		Potato
		Squash
		Sweet corn

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Management Tactics

- Preventive Practices
  - Lower the population of the pest
  - Increase the ability of the crop to tolerate the pest
  - May be minor changes or changes to the entire system
- Responsive Practices
  - Action taken in response to some indication that damage might occur
  - Usually need to act quickly, i.e., insecticides

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Mechanical and Physical Control

- Hand destruction

Colorado Potato Beetle

Hornworms

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Mechanical and Physical Control

- Hand destruction
- Barriers and screens

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Mechanical and Physical Control

- Hand destruction
- Barriers and screens
- Trapping and collecting machines

Hopper Dozer

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Cultural Control

- Crop rotation

Western Corn Rootworm

Colorado Potato Beetle

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Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation

Squash Vine Borer

Squash Bug

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Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation
- Tillage

Black Cutworm

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Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation
- Tillage
- Timing of planting or harvesting

Seedcorn Maggot

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Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation
- Tillage
- Timing of planting or harvesting

Corn Earworm

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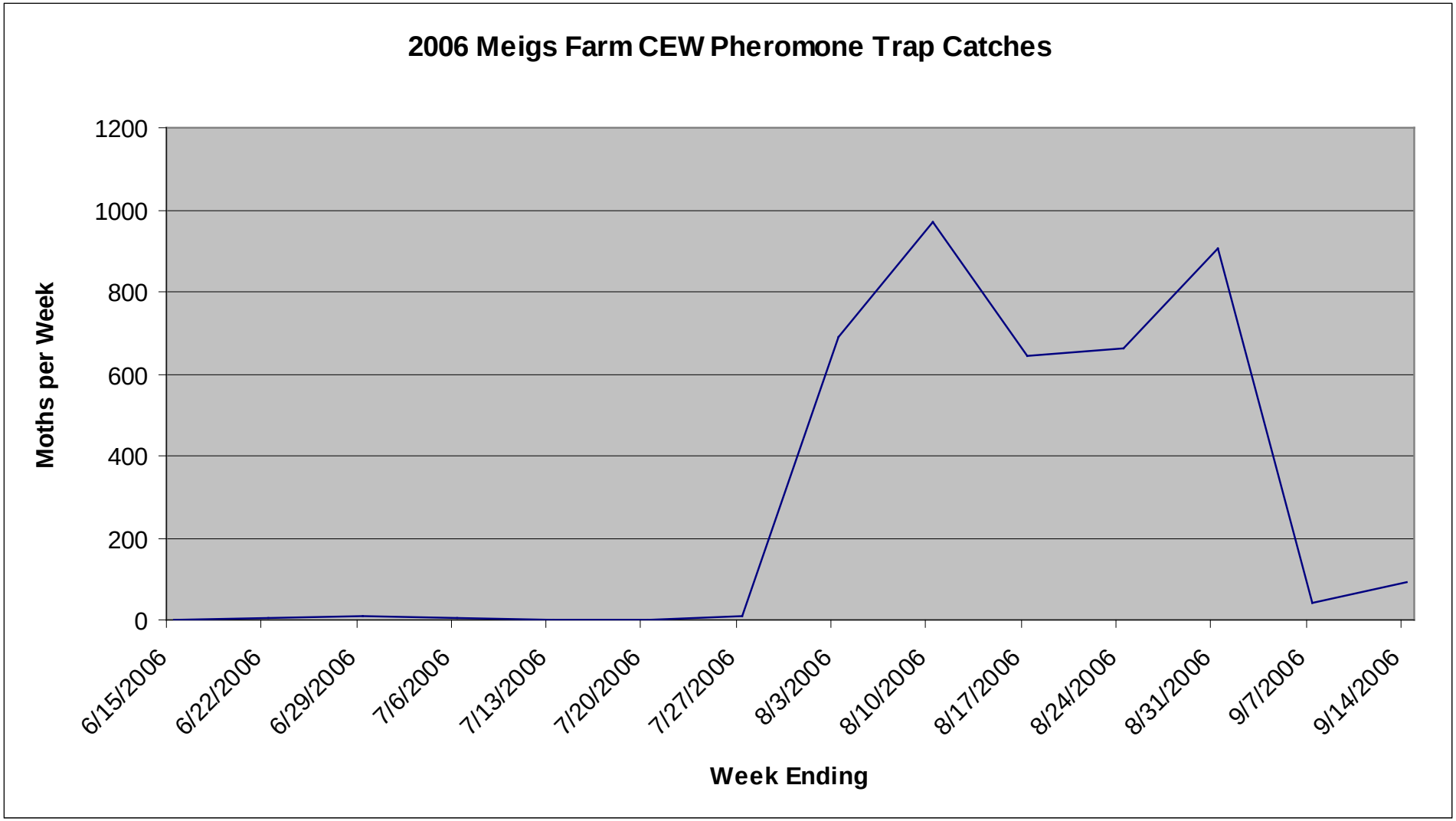

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Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation
- Tillage
- Timing of planting or harvesting
- Pruning and thinning
- Fertilization

Diamondback Moth

Aphids

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Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation
- Tillage
- Timing of planting or harvesting
- Pruning and thinning
- Fertilization
- Water Management
- Trap Crop

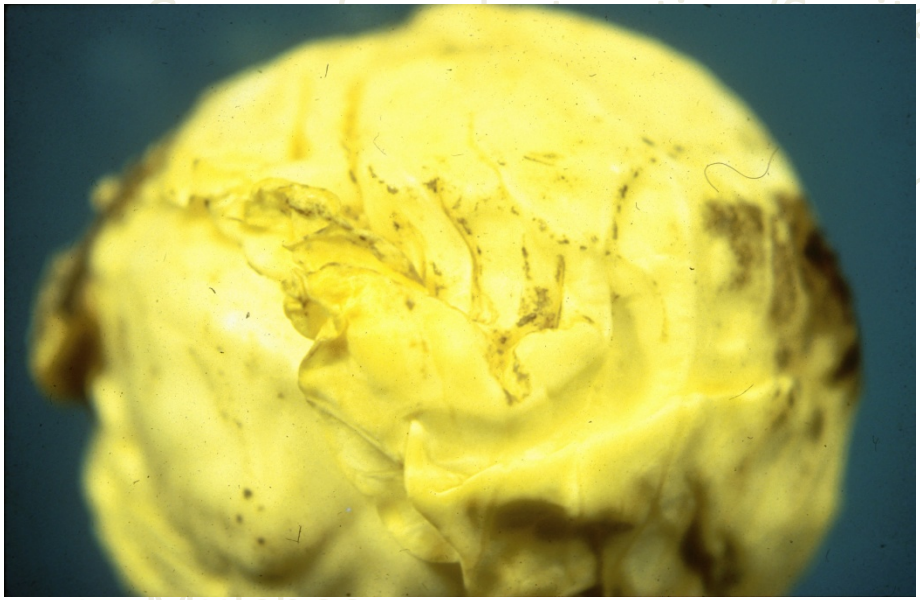
Colorado Potato Beetle

Cultural Control

- Crop rotation
- Crop refuse destruction/Sanitation
- Tillage
- Timing of planting or harvesting
- Pruning and thinning
- Fertilization
- Water Management
- Trap Crop
- Mulches

Cultural Control

- Crop rotation



- Mulches
- Farm Wide Management

Onion Thrips

Host Plant Resistance

- More important for diseases
- Limited value for insects
- Exception: thrips on cabbage
  - Green Cup
  - Blue Pak
  - Rio Verde
  - Ruby Perfection
  - Super Red 80
  - Huron

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Biological Control

- Conservation
- Augmentation
- Introduction

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Conservation Biological Control

- Use practices that conserve the natural enemies that occur naturally
- Usually involves selection of pesticides

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Example of Conservation of Natural Enemies

- Diamondback moth on cabbage

Augmentation Biological Control

- Rear and release natural enemies without expectation that they will necessarily establish and reproduce
- Biological pesticide
- Works better in confined spaces such as greenhouses or high tunnels

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Introduction of Natural Enemies

- Usually when the pest has been introduced from another area
- Go to original source of pest to find natural enemies
- Not for farmers; more for government agencies

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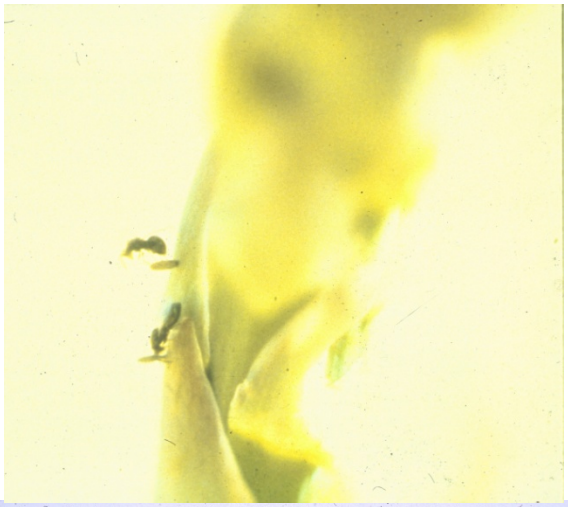
Predators

Parasites



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Pathogens

Understanding Pest and Crop Dynamics

- The insect life cycle is controlled by weather related factors and the biology of the insect
- The crop life cycle is controlled by the climate and when and where you decide to plant
- Each crop has a stage when it is vulnerable to its pests
- Each pest has a particular life stage that will damage the crop
- When the vulnerable stage of the crop and the damaging stage of the pest overlap, you have opened the “window of vulnerability”

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Monitoring

- Goal is to know when pests are present and in way numbers
- Can be accomplished by direct observations, traps, devices

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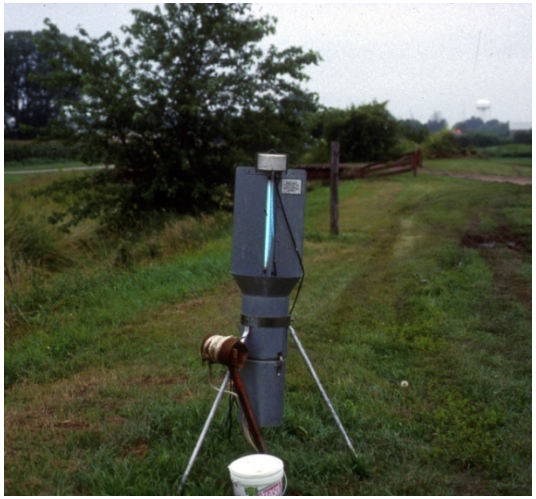

Economic Thresholds

- Tells us how many are too many
- Density of insects that will cause losses greater than the cost of preventing the damage
- Examples
  - 20% of cabbage plants infested with imported cabbageworm or cabbage looper from cupping until early head
  - 1 striped cucumber beetle per cantaloupe plant
  - 10 corn earworm moths/night/trap for sweet corn

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Control Options

- Generally, an insecticide
  - Relatively inexpensive
  - Fast acting
  - Readily available
  - Easy to apply

Benefits of Insecticides

- Effective
- Fast acting
- Easy to apply
- Relatively inexpensive
- Lots of options that allow for targeting specific pests

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Insecticides

- Remain the primary responsive control method

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Disadvantages of Insecticides

- Resistance
- Resurgence
- Replacement
- Biomagnification
- Effects on humans: farmers, workers, consumers
- Effects on wildlife, pollinators, natural enemies

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Case Studies of Insect Management on Vegetables

- Indirect pest/Pest complex: Caterpillars on cabbage
- Insect that vectors disease: Striped cucumber beetles on cantaloupes
- Direct pest: Corn earworm on sweet corn

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Indirect Pests/Insect Complex: Caterpillars on Cabbage

- Imported cabbageworm
- Diamondback moth
- Cabbage looper

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Imported Cabbageworm

Imported cabbageworm damage on cabbage
[Picture by R. Foster]

Imported Cabbageworm

- Active early in spring
- Can be devastating if not controlled
- Frass can be contaminant
- Easy to control with many insecticides
- Bt insecticides are very effective

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Diamondback Moth

Diamondback moth larva
[Picture by W. Cranshaw]

Diamondback Moth

- Reach 5/8 inch long
- Occurs throughout the season
- Worldwide pest
- Resistant to many pesticides
- Can reach exceedingly high numbers
- Parasites are important factor
- In Indiana, most insecticides are still effective
- Bt insecticides and Entrust are organic options

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Cabbage Looper

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Cabbage Looper

- Don’t overwinter in Indiana
- Migrate in from South, arriving May-June
- Reach 2 inches long
- Most difficult of caterpillars to control
- Bt products have limited effectiveness

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Warrior II* at 0.96-1.6 fl. oz. per acre. *Cole crops only.* Do not exceed 15.36 fl. oz. per acre per season. 1-day PHI. *RUP.*

per season. 7-day PHI. *RUP.*

Mustang MAX* at 2.24-4.0 fl. oz. per acre. Do not exceed 0.15 lb. a.i. per acre per season. Allow 7 days between applications. 1-day PHI. *RUP.*

Caterpillar Thresholds

Crop	Stage	% Infested	
		Diamondback Moth Larvae	Imported Cabbageworm & Cabbage Looper
Cabbage — Fresh	seed bed	not applicable	not applicable
	transplant to cupping	50% with ≥ 5 larvae/plant	30%
	cupping to early head	50% with ≥ 5 larvae/plant	20%
	early head to harvest	10% with ≥ 1 larva/plant	10%
Broccoli, Cauliflower	seedbed	10%	10%
	transplant to first curl	40%	20%
	first curd to harvest	10%	10%

Pounce 25WP* at 3.2-12.8 oz. per acre. Rate varies with crop — see label. Do not exceed 0.8 lb. a.i. per acre per season for broccoli. Do not exceed 0.4 lb. a.i. per acre per season for cabbage, cauliflower, Brussels sprouts, and collards. 1-day PHI. *RUP.*

Root Maggots

Cabbage maggot injury is usually more severe when fields have decaying organic matter present, such as plowed down cover crop, or when cool, wet conditions prevail.

Insect Control

Aphids, Leafminers

Conserve natural enemies.

Limit the use of insecticides to conserve predators and parasites.

Recommended Products

RR **Actara*** at 1.5-3 oz. per acre. *Aphids only*. Do not exceed 11 oz. per acre pre season. 0-day PHI for broccoli, Brussels sprouts, cabbage and cauliflower. 7-day PHI for leafy greens.

Admire PRO* at 4.4-10.5 fl. oz. per acre. Do not exceed 0.38 lb. a.i. per acre per season. 21-day PHI.

RR **Assail 30SG*** at 2-4 oz. per acre. *Aphids only*. Do not exceed 0.375 lb. a.i. per acre per season. 7-day PHI.

Belay 2.13SC* at 3-4 fl. oz. per acre. *Aphids only*. 21-day PHI.

Closer 2SC* at 1.5-2 fl. oz. per acre. 3-day PHI.

Dimethoate 400* or **Dimethoate 4E*** at 0.5-1 pt. per acre, or **Dimethoate 2.67EC*** at 0.75-1.5 pts. per acre. 7-day PHI for broccoli and cauliflower. 10-day PHI for Brussels sprouts, 14-day PHI for kale and mustard.

Entrust* at 1.25-3 oz. per acre. *Leafminers only*. Do not exceed 9 oz. per acre per season. 1-day PHI.

RR **Fulfill*** at 2.75 oz. per acre. Do not exceed 5.5 oz. per

Caterpillars (Imported Cabbageworms, Cabbage Loopers, Diamondback Moth Larvae, Cross-Striped Cabbageworms)

Recommended Products

Ambush 25W* at 3.2-12.8 oz. per acre. Rate varies with crop — see label. Do not exceed 0.8 lb. a.i. per acre per season to broccoli, cauliflower, collards, and Brussels sprouts. Do not exceed 1 lb. a.i. per acre per season for cabbage. 1-day PHI. *RUP*.

Asana XL* at 2.9-9.6 fl. oz. per acre. *Cole crops and collards only*. *Cole crops*: Do not exceed 0.4 lb. a.i. per acre per season. 3-day PHI. *Collards*: Do not exceed 0.2 lb. a.i. per acre per season. 7-day PHI. *RUP*.

RR **Avaunt 30WDG*** at 2.5-3.5 oz. per acre. Do not exceed 14 oz. per acre per season. 3-day PHI.

BP Several ***Bacillus thuringiensis*** products (Agree*, Biobit*, Dipel*, Javelin*, Lepinox*, Xentari*) are available. Follow label directions. Begin applications when worms are small. Using *Bt* products will help conserve beneficial insects. 0-day PHI.

Baythroid* at 1.6-3.2 fl. oz. per acre. Do not exceed 12.8 fl. oz. per acre per season. 0-day PHI. RUP.

Brigade 2EC* at 2.1-6.4 fl. oz., or **Brigade WBS*** at 5.3-16 oz. per acre. Do not exceed 0.5 lb a.i. per acre per season. 7-day PHI. *RUP*.

RR **Confirm 2F*** at 6.0-8.0 fl. oz. per acre. Do not exceed

Management Strategy

- Scout and treat when necessary
- Remember that damage to portions of the plant you don’t intend to eat can often be tolerated
- Don’t spray pyrethroids early to conserve parasites
- Pyrethroids may be necessary to control cabbage loopers

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Insect Vector of Plant Disease: Striped Cucumber Beetle

- Overwinters as adults
- One generation per year
- Feeds on leaves, stems, fruit
- Transmits bacterial wilt of cucurbits

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Striped Cucumber Beetle Damage

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Important Points to Remember

- The only way to avoid bacterial wilt is to prevent beetle feeding

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- Cucumber beetles are not always present

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Important Points to Remember

- The only way to avoid bacterial wilt is to prevent beetle feeding
- Cucumber beetles are not always present
- Cucumber beetles are not efficient vectors of bacteria

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Decision Making

- Sampling:Direct Counts
- Threshold: 1 beetle/plant

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Management Options

- Row covers can protect plants from early season feeding (must be removed at flowering)
- Soil insecticides (Admire or Platinum) will provide 2-3 weeks control
- Foliar insecticides (Sevin, pyrethroids)
- Organic options:
  - Trap crop
  - Surround?, Pyrethrum?

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Corn Earworm

- Pest of sweet corn and tomato
- Two generations per year where it overwinters– 2nd is usually most important
- Does not overwinter in large numbers in northern 2/3 of Indiana

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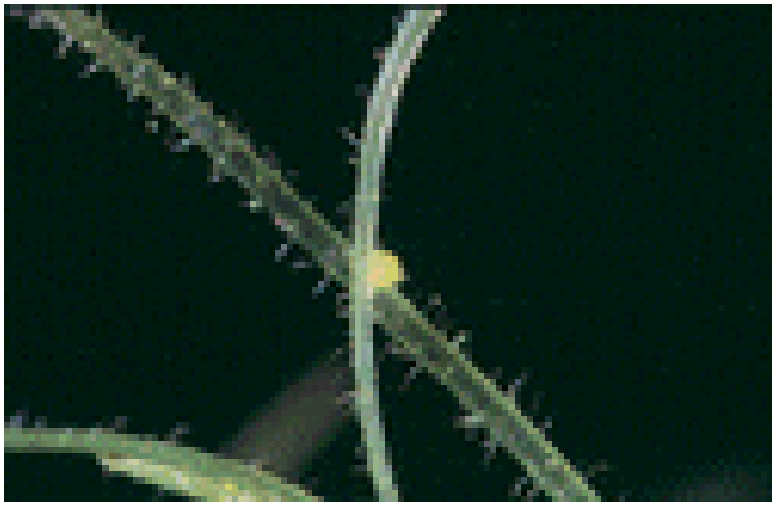
Corn Earworm Biology

- Females prefer to lay eggs on green silks



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Corn Earworm Biology

- Females prefer to lay eggs on green silks
- When larvae hatch, they move directly into the ear tip
- Once inside the ear, the larvae are protected from insecticides

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Corn Earworm Control

- Must have insecticide present on silk when larvae hatches from egg
- Pyrethroids have been primary control options, especially Brigade, Mustang Max, Hero, and Warrior
- Some concerns about resistance
- Coragen and Radiant appear to be good alternatives

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Corn Earworm Management

- Treat when fresh, green silks are present (start at 70%)
- Treat if catching more than 10 moths per night

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Corn Earworm Management

- Make treatments every 2-5 days from 70% silks until silks are brown; generally 3-4 treatments
- Shorten interval if temperatures are high
- Shorten interval if moth catches are high

Corn Earworm Management

- First generation populations may or may not reach economic levels
- During much of the season, few earworms present
- Once the second generation hits, populations will likely be high for the rest of the season
- Date of arrival of second generation is variable
- A pheromone trap is a critical management tool

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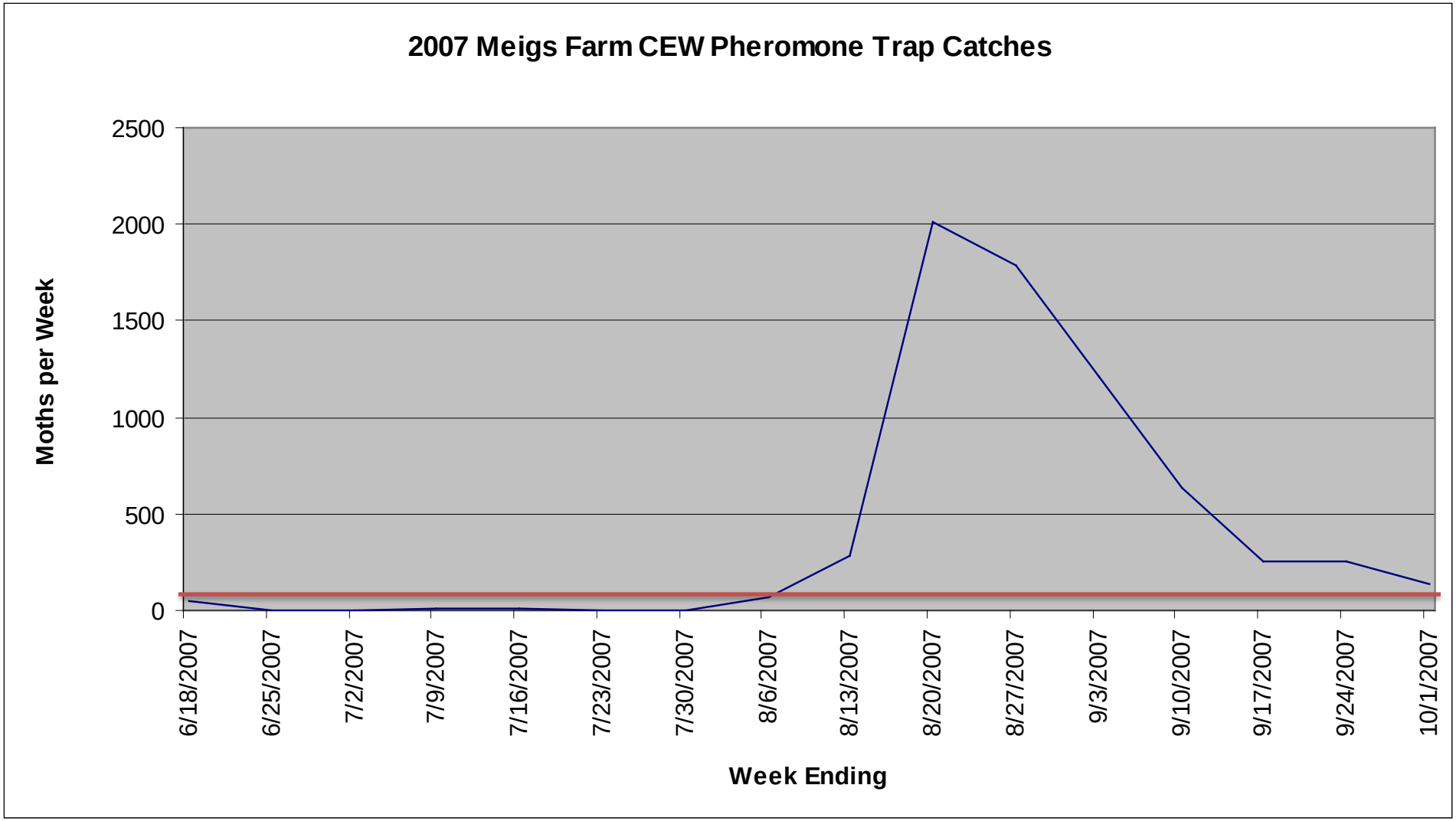

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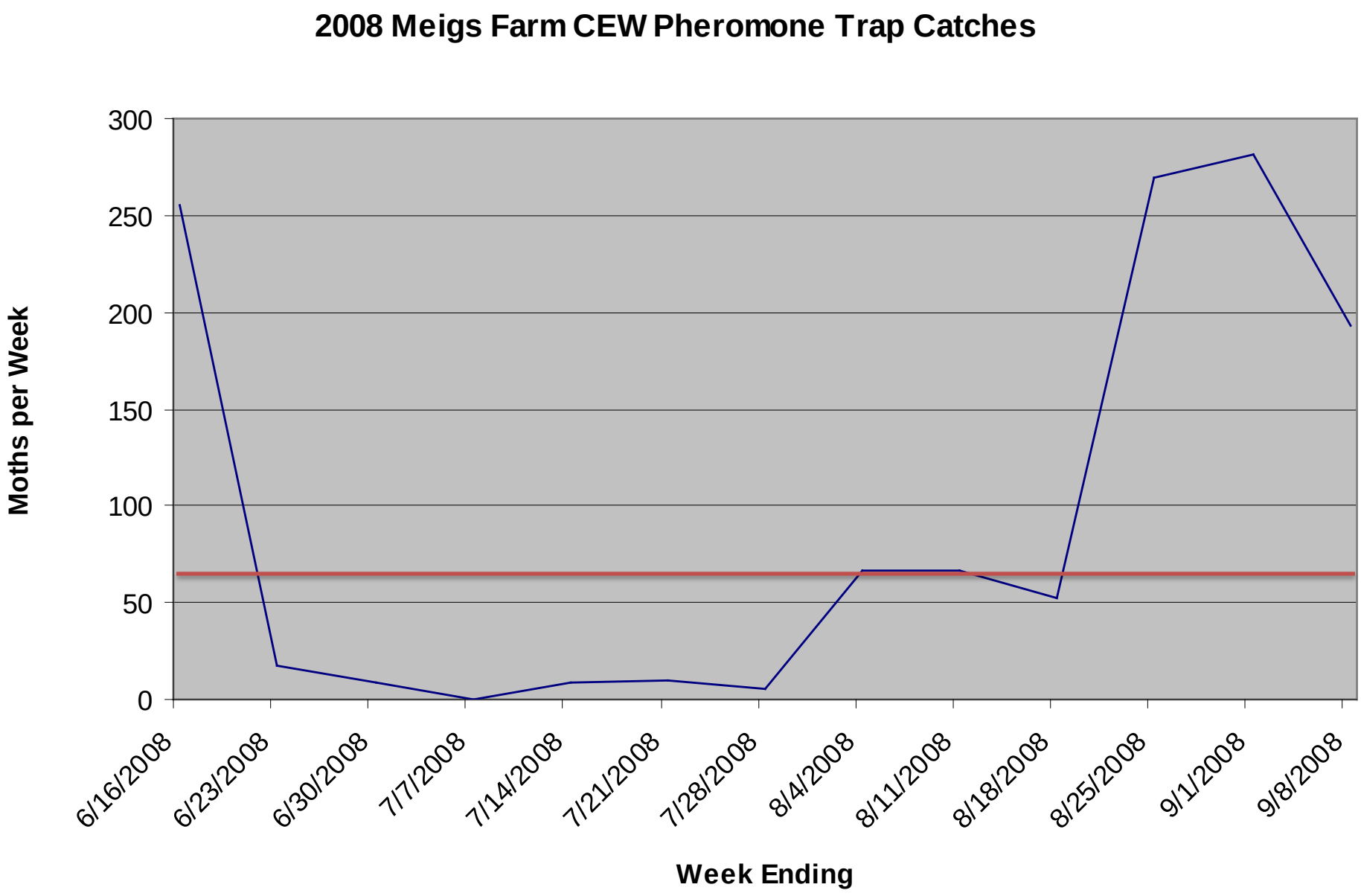

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Quiz Question

Which of the following factors is most important in determining the level of corn earworm control you will receive?

A. Choice of insecticide
B. Nozzle tip type
C. Gallonage
D. Timing
E. Pressure

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D. Timing
E. Pressure

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CEW Management Tips

- The first application (70% silks) is the most critical, with each succeeding spray being less important
- Getting good coverage of the silks is imperative – consider drop nozzles. Test with water sensitive paper.
- High gallonage is preferred – 20 gallons per acre or more

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Questions?