Integrated Pest Management

Understanding of:

- Crop/Pest Cycles
- Pest Management Tactics
- Economics
Cornerstones of IPM

- Pest Identification/Knowledge of Biology
- Sampling
- Evaluation of current and probable future damage
- Application of management tactics
Insect Pest Management

“Think like a bug”

Insects are Cold Blooded

Insects are Cyclical

Most insects have fairly specific needs
Insect Pest Management

Insects can be managed by:

- Killing them via physical, biological, or chemical means
- Interrupting their natural cycles
- By depriving them of a biological need
Codling Moth

- *Cydia pomonella* (Linaeus) Lepidoptera: Tortricidae
- Adult moths lay eggs on leaves and Fruit
- Larvae feed within fruit
Identification?

?? OR ??

?? OR ??
Identification?

Oriental Fruit Moth

OR

Codling Moth
Codling Moth Life Cycle

Simplified (Single Generation) Codling Moth Life Cycle
Codling Moth Life Cycle (Complete)

- 2 generations/yr
- Overwinters in soil or on tree
- Adults emerge in spring
- Larva feed inside apples
- Second generation returns to soil/tree
Sampling

- **Scouting**: Look for damaged fruit
- Pheromone Traps
- Which is more useful?
- Now what?
Phenology: Predictions....

- Insects are cold-blooded
- Predicts when a population will be present
- Allows us to target pests and life stages in time
Theories of Pest Management

**Preventative:** Resilience to pests
- Healthy soil, healthy plants
- Crop Rotations
- Biological Diversity

**Responsive:** Removal of pests
- Pesticides
- Physical destruction
1. PM by design (soil health, varietal choice, rotations)
2. PM using cultural and biological practices
3. PM using pesticides
Chemical/Pesticide Tactics

Most common tactics on conventional farms

“Organic” pesticides must have NOP/OMRI and certifier approval!
Chemical/Pesticide Tactics

- Behavioral Pesticides
  - Mating Disruption
- Non-living Pesticides
  - Entrust®, Oils
- Biological Pesticides
  - CM Virus
CM Management With MD

- Females produce a unique odor that attracts males
- Mating disruption adds lots of synthetic odor sources
- This confuses males, prevents mating, and infested fruit
CM Management With MD

- **Mating Disruption**: targets **adults** in both generations
- Apply pheromones before spring flight
CM Management by Oils and Entrust®
Timing Oils and Entrust

- Oils should NEVER follow Sulfur
- Entrust® should be applied in the evening

Entrust® every 7-10 days
Oil every 2-7 days
CM Management by Oils and Entrust®

- **Oils (Eggs)**
- **Entrust (Larvae)**

**Spring Generation**

**Summer Generation**

- **Entrust (Larvae)**
- **Oils (Eggs)**
Timing Oils and Entrust

- Oils should NEVER follow Sulfur
- Entrust® should be applied in the evening

Entrust® every 7-10 days
Oil every 2-7 days
CM Granulosis Virus (i.e. CYD-X®)

Kills CM larva prior to entering apple

Very specific: less harmful to overall system health
CM Management by Virus

Virus (Larvae)

Spring Generation

Virus (Larvae)

Summer Generation
Timing Virus

- Oils should NEVER follow Sulfur
- Entrust® should be applied in the evening

Virus every 4-7 days
CM Management by Virus

- On farm CM virus trials w/ Mating Disruption
- Virus applied 3 rates with 3 different timings
  - 4.4 oz every 7 days
  - 8.8 oz every 14 days
  - 13.2 oz every 21 days
- Increased frequency of application more important than rate!!
- Short residual

Mean followed by the same letter are not significantly different at p = 0.05.
Cultural/Physical Tactics

- Hand picking/pruning
- Tillage/Cultivation
- Pest Barriers
- Crop Rotation/Cover Crops
PM by Hand

- The "Original" Pest Management
- Picking insects, hoeing/pulling weeds, pruning diseased crops
- Effective but labor intensive
- Limited by scale of operation/available labor
CM Management by Hand?

Spring Generation

Remove Overwintering Habitat (Prunings, Bins Etc.)
Cultivation/Soil Disturbance

- The "standard" organic weed management practice
- Lots of implements available
- Rely on careful timing
- Can have a large impact on soil quality
CM Management by Hog Tillage
CM Management by Hog Tillage

Kill Larva Before Adult Emergence

Spring Generation

Summer Generation
3-Fold reduction in fruit with entries after 2 years of rotational grazing

$p = 0.019, t = 3.83, \text{d.f.} = 4$
Biological Control

- Augmentation
- Habitat Restoration
- Livestock Integration
Habitat Restoration BPM

The most systemic BPM tactic
Relies on crop/non-crop diversity
Flowering strips and borders, tree rows, etc
Secondary pollination and aesthetic benefits
Overall landscape structure may limit efficacy
CM Management by Diversity Management

Spring Generation

Summer Generation

Promote Predators that Eat Pest???
Proper identification lets us know if we have a problem

Sampling provides us timings for proper management

Good pest management will use multiple tactics

Tactics that attack multiple life stages will provide better control and are less prone to pest resistance
Total CM Management Program

- Oils for Eggs
- Virus and Entrust for Larvae
- Sanitation/Hogs? For Late Larvae
- Biological Control??
- Physical Barrier
- MD for Adults
- Summer Generation
- Spring Generation
Conclusions

- OPM requires a broad approach
- Lots of available tools; the challenge lies in how they are fit together
- Pest Management should not be the focus but rather part of the system
- The best PM tactics may be those that provide additional benefits
Acknowledgements

- David Epstein and Larry Gut: Virus Data
- Krista Buehrer: Hog data
- Pete McGhee: Phenology Charts