Biodiversity: The Clarksville Organic Apple Project

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Many Organic Input Suppliers
Biodiversity? Feed and Protect--it will come!
Organic Apple Orchard Ecosystem

- Marketing
- Landscape Ecology
- Production Ecology
- Pest & Disease Complex
- Natural Enemies
- Ground Cover Dynamics
  - Organic Matter
  - Micro/Macro Flora and Fauna
  - Carbon Nitrogen Flux
  - Micro-nutrients
  - Water
  - pH

Systems Integration

Land

Soil
**Orchard Establishment Approach**

- **Diagnostics Tests: Remediation after Corn/Soybean rotation to plant Apples**
  - Organic Matter & Mineralization
  - Soil Food-web Structure & Composition
  - Carbon/Nitrogen budget analysis
  - Nematode Community Structure

- **Ground Cover & Surrounding Habitat Management**
  - Mulching
  - Legume green manure
  - Grass drive rows
  - Weed seed-bank management
  - Rootstock & Variety Selections

- **Pest Management: Strategies, Tactics and Tools ("Techniques")**
  - Monitoring: direct (1x/wk) & Indirect (traps, pit falls, spore rods)
  - Population suppression, exclusion, resistant rootstock and sine varieties, Pheromone Disruption, Virus, Biological Control agents, augmentation from Ecological Diversity strips.
  - Pesticides treatment thresholds, best management practices

- **Trees Planted 2nd year**
- **Trees Harvested 5th year**

Start from the soil up: green manure planted in spring 1st year
Organic Plot
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Goldrush
Pest Complex

Apple maggot
Plum Curculio
Fruitworms
Tarnished plant bug

Leafrollers
European red mite
Spotted Tentiform leafminor
Rosy apple aphids
Organic Functional Diversity Strategies

- **Cultural Control**
  - Living barrier
  - Ground cover
  - Sanitation
  - Mulching
  - Timed Mowing
  - Habitat Manipulations

- **Natural and Biological Control**
  - Generalist predators OK
  - Augmentative releases not necessary
  - Nectar reward helped parasitoids

- **Organic Ecology**
  - Soft pesticides
  - Attract and Kill
  - Trap out
  - Virus

- **Pheromone disruption**

- **Host Plant Resistance**

- **IPM Principles**
  - Monitoring
  - Timing
  - Thresholds
Alternative Orchard Designs

- Manipulate micro-environment...high tunnel
- Barriers to human, odor, noise & chemical trespass...
- Wildlife control & reduced impacts...
- Barriers to insect and disease movement...SITE OF BIOPESTICIDE APPLICATION & SEMIOCHEMICAL RELEASE

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Extra Floral Nectaries + Waxy Cuticle

• Feed the Good Guys
• Catch & Redistribute pheromone/kairomones
Clarksville Organic Apple Project

- Soil, ground cover & tree
- Pathogen Control
- Organic IPM
  - Attract & Kill PC
  - Surround
  - Virus for CM
  - Predators for OBLR
  - Predators for Soft insects
- Diversity Strips = mesoarea
- Research
  - Beneficial Insect Monitoring Transects
  - Root stocks
  - Ground covers/mulches
  - Pest management
  - Soil management
- Open Access to Visitors
- Regional Educational Impact
Bio-Diversity Strips for IPM

Project Goal- Use border plantings to provide food (pollen & nectar) and refuge for beneficial insects.

Establish Strips
- Native Plants that provide food throughout the season
- Irrigated & plastic mulch

Neutral Strips (Control)
- Neutral (?) = orchard grass
- Weed suppression & compaction

Alternative Crops: multi-cropping
- Herbs, flowers, potted plants

Plants:
- Anise Hyssop
- Borage
- Carrot
- Chives
- Comfrey
- Coriander
- Dill
- Fennel
- Lavender
- Liatrus
- Majoram
- Oregano
- Parsley
- Physostegia
- St. John's Wort
- Tansy
- Thyme
- Valerian
- Yarrow
- Willow
Diversity Strip

- Reservoir for beneficial insects
  - Predators and parasitoids
- Establish Durable Plants
- Provide Nectar, Pollen, and Refuge
- Established durable planting that requires low maintenance.
Fall 2005 Diversity Strip

Some Plots are 6ft High and Dense Flower and Nectar Reward Season Long

Picture = Late September
Damage or Trap Catch by location

- **PC Damage**: Damage Assessment 2002, Worst PC yr
- **Ground Beetles**: % occurrence in pitfall traps
- **Syphids**: % occurrence on yellow sticky traps
- **All Predators**: % occurrence on yellow sticky traps

The top end of each figure is the south end of the plot.

Data represent percent occurrence in traps.
Biological Control: Rosie Apple Aphids, Tarnished Plant Bugs, Leafrollers, Budworms, Fruitworms, CM/OFM, Mites, ...

• Monitoring?
• Ratios for Thresholds?
  – Predators : Pest
• Establish Predators & Parasites w/ in Orchard
  – Especially: Mites, Rosie Aphid, Mites & Leafrollers
• Works for many pest species—Except for PC
• Sulfur can induce Mite outbreaks
Granulosis Virus: Codling Moth

• Key Issues
  - Cost
  - Timing
    • Spray Frequency & Rate
  - Integration with other Tactics and Tools
    • Understanding establishment & reinfestation
    • In Combination with Pheromones
Mites Present a Growing Challenge for Organic Growers-

- Sulfur Reduces Predators
- Oils Reduce Predators, but Timing may resolve impact
- Surround Irritates Predators & May reduce numbers
- PyGanic Reduces Predators but is very short-lived
ER-Mite, 2-Spotted, Bryobia, Specialist & Generalist Predators

Sulfur Induced! Surround Induced?

Year Per Leaf


9 8 7 6 5 4 3 2 1 0

Variable
ERM TSSM Bryobia Spec. Pr Gen. Pr

ER-Mite, 2-Spotted, Bryobia, Specialist & Generalist Predators

Sulfur Induced! Surround Induced?

Year

Per Leaf

2001 2002 2003 2004
Fruit Fly Bait and Kill with Spinosad

- Better Bait Formulation.
- Get low-volume application technology distributed.
- Adjust dosage to Adult fly densities to reduce costs.
Ground Cover, Nutrients & Weed Control

- Swiss Sandwich System
- Flaming for Weed Control
- Composting
- Legume Grass Drive Row = nutrients

Remove Herbicides From Tree Fruit Agriculture
Biodiversity: Building Credits

- Hawk Perch
- Bat Houses
- Bumblebee Hotels
- Earwig Hotels, Soap, Tankage
Education: Growers & Technical folks Together

Bringing growers & other interested folks together in the field...