Control of Direct Pests in Organic Apple: Successes and Challenges

Jay Brunner
Washington State University
Tree Fruit Research and Extension Center
## Direct Pests of Tree Fruit
(Apple pests in red)

<table>
<thead>
<tr>
<th>Lepidoptera</th>
<th>Diptera</th>
<th>Homoptera</th>
<th>Thysanoptera</th>
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<td>Codling moth</td>
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<td>Peach twig borer</td>
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<td>Campylomma</td>
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</tr>
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<td>Lesser appleworm</td>
<td></td>
<td>Box elder bug</td>
<td></td>
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<td>Leafrollers</td>
<td></td>
<td></td>
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<td>Lacanobia sp.</td>
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<td></td>
<td></td>
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<td>Rosy apple aphid</td>
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<td>San Jose scale</td>
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# Control Tactics for Direct Pests of Tree Fruit Crops

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<tr>
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Direct Pests of Tree Fruit
(Apple pests in red)

**Lepidoptera**
- Codling moth
- Oriental fruit moth
- Peach twig borer
- Lesser appleworm
- Leafrollers
- Lacanobia sp.
- Eye spotted bud moth

**Diptera**
- Apple maggot
- Western cherry fruit fly
- Spotted winged drosophila

**Hemiptera**
- Lygus bug
- Stink bugs
- Campylomma
- Box elder bug

**Thysanoptera**
- Western flower thrips

**Homoptera**
- Pear psylla (russet)
- Rosy apple aphid
- San Jose scale
Codling Moth Control
Key to apple organic production

• Use of **pheromones** (mating disruption) is necessary to sustain control of CM

• Only **hand applied dispensers are registered** for use in organic orchards – loss of this technology in organic apple production would be a disaster.

• **Sprayable pheromone** formulations and **puffer technology** are **NOT registered** for use in organic apples.

• Supplementing pheromone treatment with insecticides is necessary to achieve acceptable crop protection.

• Overuse of some supplemental insecticides could disruption biological control for other pests.
Codling Moth Control
Key to apple organic production

• **Supplementing pheromone** treatment with insecticides is necessary to achieve acceptable crop protection.

• What are the options and what works?

  Entrust (spinosad)
  CpGV (virus) - Cyd-X, ViroSoft
  Horticultural Mineral oil / Fish Oil
  Particle film (Surround)
  Bt products
  Neem
  Biological control
  Nematodes
Supplementing pheromone treatment with insecticides is usually necessary to achieve acceptable crop protection.

What are the options and what works?

- Entrust (spinosad)
- CpGV (virus) - Cyd-X, ViroSoft
- Horticultural Mineral oil / Fish Oil
- Particle film (Surround)
- Bt products
- Neem
- Biological control
- Nematodes

Experience indicates that these options have limited value.

Biological control can always add value to any program but not a primary control for CM.
Entrust the organic formulation of spinosad

Spinosyn-based products (Entrust and Success) provide good control in a season long program, however, there are significant numbers of “stings” present at harvest.

Can achieve an 85–90% reduction in successful entries in high pressure situations which is not good enough to keep a resident population from increasing.

Entrust (spinosad) is also an excellent control for leafroller larvae and other Lepidoptera larvae in tree fruit crops.
Codling Moth Control
Key to apple organic production

Oil is an ovicide against codling moth
Applied 50 DD prior to egg hatch, repeated at 150 DD (high pressure) or 200 DD (low pressure) intervals
Key to good efficacy is coverage!

Replicated single tree plots
Handgun applications
1% oil v/v
Three applications per gen.

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<tr>
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<tr>
<td>HMO-summer</td>
<td>79%</td>
<td>59%</td>
</tr>
<tr>
<td>Assail</td>
<td>92%</td>
<td>88%</td>
</tr>
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Concerns with long-term effects of multiple applications on plant vigor/fruit size
Particle film technology - Surround

Summer use **suppresses** several pests
**Mode of action** - mortality of young larvae/nymphs; repellency of larvae or adults

**Disrupts biological control** of spider mites and leafminer (parasite) - possibly other general predators

**Used more for sunburn protection** than as a pesticide

Surround has an impact on:
- Codling moth
- Leaf rollers
- Lacanobia
- Apple maggot (MI)
## CM Granulosis Virus Bioassay results - 2003

### Dose-response bioassay

<table>
<thead>
<tr>
<th></th>
<th>Cyd-X</th>
<th>Carpovirusine</th>
<th>Virosoft</th>
</tr>
</thead>
<tbody>
<tr>
<td>( \text{LC}_{50} (10^{13}\text{OB/1000L}) )</td>
<td>0.039</td>
<td>0.003</td>
<td>0.089</td>
</tr>
</tbody>
</table>

No statistical difference between products

### Field-age residue bioassay

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Average corrected % mortality (7d)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1 DAT</td>
</tr>
<tr>
<td>Cyd-X</td>
<td>59b</td>
</tr>
<tr>
<td>Carpovirusine</td>
<td>71b</td>
</tr>
<tr>
<td>Virosoft</td>
<td>59b</td>
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<th>Rate AI/A (OBx10^{13})</th>
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<tr>
<td>Cyd-X</td>
<td>0.27</td>
<td>14 d (6)</td>
<td>40.0</td>
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<td>7 d (12)</td>
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<td>38.8</td>
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<tr>
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<td>40 gram</td>
<td>14 d (6)</td>
<td>22.8</td>
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<tr>
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<td>% injury</td>
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Is it possible to redeem an organic orchard from brink of disaster with current tools?

**Case study** - Frenchman Ridge Organic Apple Orchard

260 acres (Delicious, Fuji, Gala, Braeburn, Pink Lady)

In organic production for several years

Not isolated site - Frenchman Hill area of WA

Gradual loss of codling moth control over time
Is it possible to redeem an organic orchard from brink of disaster with current tools?

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260 acres (Delicious, Fuji, Gala, Braeburn, Pink Lady)

In organic production for several years

Not isolated site – Frenchman Hill area of WA

Gradual loss of codling moth control over time

**2002**

CM density: 75 CM/trap

Pesticides: 15 acre applications

Products used:

Pheromone (600 dpa), oil, Bt

0.6 bins injured fruit/A hand removed

5% fruit injury at harvest (estimated)

64% packout (16 of 25 boxes)

Insecticide + applications = $762/acre

Concerns about oil effect on fruit size/quality
Organic control at orchard - 2002

Ridge

Bloom

Mating Disruption (600 dispensers per acre)

DD from biofix

- Moth flight
- Egg hatch

May June July Aug. Sept.
Is it possible to redeem an organic orchard from brink of disaster with current tools?

**Case study - Frenchman Ridge Organic Apple Orchard**

**2003**

CM density: 50 CM/trap

Pesticides: 11.25 acre applications

Products used:

- Pheromone (600 dpa), CpGV, oil, Bt, Entrust

>1% fruit injury at harvest (estimated)

No hand removal of injured fruit

85% packout (21 of 25 boxes)

Insecticide + applications = $796/acre

Concerns about oil effects reduced but concerns about Entrust effect on biological control of aphids
Organic control at Ridge orchard - 2003

- Bloom
- Mating Disruption (600 dispensers per acre)
- DD from biofix

- Moth flight
- Egg hatch

25% of acres
Is it possible to redeem an organic orchard from brink of disaster with current tools?

**Case study - Frenchman Ridge Organic Apple Orchard**

**2004**

CM density: 1.5 CM/trap

Pesticides: 9.25 acre applications (targeted use & partial sprays)

Products used:

- Pheromone (600 dpa), CpGV, oil, Bt, Entrust (targeted use)

>1% fruit injury at harvest (estimated)

No hand removal of injured fruit

85% packout (21 of 25 boxes)

Insecticide + applications = $563/acre

Reduced concerns about oil effects and about Entrust effect on biological control of aphids
Is it possible to redeem an organic orchard from brink of disaster with current tools?

Case study - Frenchman Ridge Organic Apple Orchard

Moths per trap

<table>
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<tr>
<th>Year</th>
<th>1st generation</th>
<th>2nd generation</th>
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<tbody>
<tr>
<td>2002</td>
<td>10</td>
<td>40</td>
</tr>
<tr>
<td>2003</td>
<td>40</td>
<td>20</td>
</tr>
<tr>
<td>2004</td>
<td>0.7</td>
<td>0.9</td>
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Reduced codling moth population as demonstrated by dramatic reductions in pheromone trap captures
Is it possible to redeem an organic orchard from brink of disaster with current tools?

**Case study – Frenchman Ridge Organic Apple Orchard**

**Moths per trap**

- 2002: 1st generation = 10, 2nd generation = 40
- 2003: 1st generation = 30, 2nd generation = 45
- 2004: 1st generation = 0.7, 2nd generation = 0.9

Reduced codling moth population as demonstrated by dramatic reductions in pheromone trap captures.

**Control costs/A**

- 2002: $350 Insecticides, $400 Applications
- 2003: $515 Insecticides, $505 Applications
- 2004: $333 Insecticides, $330 Applications

Codling moth control costs increased in 2003 but declined in 2004 as pest population was reduced to manageable levels.
Is it possible to redeem an organic orchard from brink of disaster with current tools?

Case study - Frenchman Ridge Organic Apple Orchard

Packed bins per acre

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<tr>
<th>Year</th>
<th>2002</th>
<th>2003</th>
<th>2004</th>
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<tbody>
<tr>
<td>%</td>
<td>64%</td>
<td>85%</td>
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Fruit quality (yield) increased due to successful control of codling moth. Fruit quality maintained even though control costs reduced in 2004.
Is it possible to redeem an organic orchard from brink of disaster with current tools?

Case study - Frenchman Ridge Organic Apple Orchard

Packed bins per acre

Fruit quality (yield) increased due to successful control of codling moth. Fruit quality maintained even though control costs reduced in 2004.

Net return per acre

Bottom line - net return per acre increased even with increase cost of codling mot control due to reduced crop loss.
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(Apple pests in red)

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- Lesser appleworm
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**Diptera**
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- Spotted winged drosophila

**Hemiptera**
- Lygus bug
- Stink bugs
- Campylomma
- Box elder bug

**Thysanoptera**
- Western flower thrips

**Homoptera**
- Pear psylla (russet)
- Rosy apple aphid
- San Jose scale
True bug control in organic production

**Mullein plant bug**

- Different susceptibilities between apple varieties
- Some chemical controls - soaps, neem, pyrethrins (?)
- Not identified as major pest by organic producers

**Lygus bug**

- Risk of damage associated with cropping mix and possibly ground cover
  
  **Management of ground cover can reduce risk of injury**
  
  **Fruit injury by Lygus does not show up as a major factor in cullage assessments of apple, conventional or organic**
True bug control in organic production

**Stink Bugs**

Immigration from native habitats late in season
Locally important pest and movements unpredictable
NO known effective organic chemical controls
Multiple species involved - complex varies depending on habitats

Possible control options:
Lure and kill stations
Trap crops
Stink Bugs - Attract and kill approaches

**Attract-and-kill:**
Lures placed on mullein plants at 20’ intervals along orchard borders
Alternate baited/sprayed (*Carzol with handgun*) blocks with unbaited/unsprayed blocks (400’ sections)
Four orchards were treated then sampled at harvest for injury

= Baited plant

BORDER VEGETATION

ORCHARD
True bug control in organic production

Stink Bugs - Attract and kill approaches

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Harvest Damage: 50% reduction in fruit injury

![% fruit damage](chart)

- Baited: a
- Check: b
True bug control in organic production

**Stink Bugs** - Attract and kill approaches

**Attract-and-kill:**

It might be possible to use pyramid traps as an attract-and-kill technology.

Possible to achieve high mortality of bugs by treating surface of pyramid traps with effective insecticides.

Traps could be placed far enough outside orchards to avoid contamination issues.

Concerns over use of multiple pheromones in traps and cost of technology.
Threats to Organic Tree Fruit Production in the Western US

- Pheromone technology delisted as an approved organic control – Lose control of KEY Lep pests
- Lose spinosad (Entrust) efficacy due to resistance or delisted as approved control – Lose control of several key pests
- True bugs – no effective controls for most species
- New exotic pests;
  
  e.g. spotted winded drosophila, brown marmorated stink bug