Factors contributing to the complexity of host/pest interactions in tree fruit systems:

- Fruit trees are perennial crops; their long-lived nature encourages the development of host/pest interactions.
- Orchards are highly diverse habitats with numerous ecological niches incorporating a variety of secondary host plants, invertebrate and vertebrate species, and therefore a variety of potential pests and natural enemies.
- Tree fruits represent a relatively rich food resource, able to be exploited by many species.
- Abandoned, wild or volunteer pome fruit or stone fruit trees are usually located in proximity to crop trees, in which naturally occurring pest populations are not controlled.

**PLUM CURCULIO** – *Conotrachelus nenuphar*

- Adult feeding damage
- Oviposition damage
- Larval feeding
- Oviposition scars at harvest

**PLUM CURCULIO: MANAGEMENT**

**ASSUMPTIONS**

- Commercial apple orchards in NY do not harbor indigenous infestations of PC adults.
- Adults overwinter in ground debris outside of orchard.
- PC adults begin to immigrate into the edges of orchards from outside sources in spring before petal fall (55-60°F).
- Usually in the trees during bloom.
- Annual length of oviposition period depends upon seasonal temperatures after petal fall.
- Effective control requires preventive insecticide sprays from petal fall until the end of oviposition period.

**PLUM CURCULIO OVIPOSITION MODEL**

- Experimentally derived from modeling cumulative Plum Curculio oviposition and DD accumulation (base temp 50°F) after petal fall.
- Model assumes that fruit requires protection from petal fall until about 40% of the cumulative oviposition is completed (308 DD) - corresponds with the end of their immigration into orchard.
- Depending on spring temperatures, PC control could require either 2 or 3 sprays (Petal Fall plus 1 or 2 more).

**EXAMPLE OF PLUM CURCULIO MODEL PREDICTIONS IN GENEVA FOR THE 2005 SEASON**

- 0 DD
- 165 DD
- 308 DD, 40% oviposition; end of immigration
- 463 DD
- FF spray May 21
- 16 June
- June 11
- June 26

2 Total sprays needed
EXAMPLE OF PLUM CURCULIO MODEL PREDICTIONS IN GENEVA FOR THE 2006 SEASON

- Petal Fall
  - Note date of Petal Fall in McIntosh apple variety

Then:
- Use Petal Fall date + NEWA Apple Insect Model to determine the end of PC immigration into orchards (corresponding to the end of fruit protection period). Maintain pesticide coverage until this date has passed.
- Suggested Action Threshold: 308 DD (base 50°F) from petal fall in Macs.

Tortricids: Most Important Internal Fruit Feeding Lepidoptera

- Codling moth, *Cydia pomonella*
- Oriental fruit moth, *Grapholita molesta*
- Lesser appleworm, *Grapholita prunivora*

Fruit Injuries by Various Internal Lepidoptera Larvae

- Codling moth
- Lesser appleworm
- Oriental fruit moth

Oriental Fruit Moth, *Grapholita molesta*

- Egg
- Larval tunnelling and "flagged shoot" (can also occur on apple)
- Internal fruit damage

Codling Moth, *Cydia pomonella*

- Egg, "red ring stage"
- Larva
- Severe tunnelling
- External feeding damage
Differences in Life Histories and Spray Timings

Critical protection windows for Internal Lepidoptera

Bloom

Codling Moth

Petal Fall

Late Pink to Bloom

Recommended Approach

Activity: Monitor for 1st adult flight (pheromone traps); note biofix
Pheromone mating disruption: Isomate OFM TT / Isomate CM/OFM TT / Checkmate CM-OFM Duel

Petal Fall

Activity: Use biofix + NEWA Apple Insect Model to time sprays for 1st larval generation
Suggested Action Threshold: 350-375 DD (base 45°F) from biofix

Summer (July, August):

Activity: Use biofix + NEWA Apple Insect Model to time sprays for 2nd larval generation
Suggested Action Threshold: 10% hatch point estimated at 175-200 DD (base 45°F) from first sustained adult catches of the 2nd and 3rd broods; follow-up applications at 10–14-d interval

Oriental Fruit Moth

Recommended Approach

Late Pink to Bloom

Activity: Monitor for 1st adult flight (pheromone traps); note biofix
Pheromone mating disruption: Isomate OFM TT / Isomate CM/OFM TT / Checkmate CM-OFM Duel

Petal Fall

Activity: Use biofix + NEWA Apple Insect Model to time sprays for 1st larval generation
Suggested Action Threshold: 350-375 DD (base 45°F) from biofix

Summer (July, August):

Activity: Use biofix + NEWA Apple Insect Model to time sprays for 2nd larval generation
Suggested Action Threshold: 10% hatch point estimated at 175-200 DD (base 45°F) from first sustained adult catches of the 2nd and 3rd broods; follow-up applications at 10–14-d interval

Codling Moth

Recommended Approach

Bloom

Activity: Monitor for 1st adult flight (pheromone traps); note biofix
Pheromone mating disruption: Isomate CM/OFM TT / Checkmate CM-OFM Duel
(Additionally, in High-risk blocks: Cydex/Madex CM Virus)

June

Activity: Use biofix + NEWA Apple Insect Model to time sprays for 1st larval generation
Suggested Action Threshold: For larvicidal products, 250-360 DD (base 50°F) from biofix; 150 DD for ovicides

Summer (mid-late July):

Activity: Use biofix + NEWA Apple Insect Model to time sprays for 2nd larval generation
Suggested Action Threshold: For larvicidal products, 250-360 DD (base 50°F) from first sustained adult catch of the 2nd brood; 150 DD for ovicides

Obliquebanded Leafroller

Choristoneura rosaceana

Recommended Approach

Late Bloom

Activity: Use Obliquebanded Leafroller Sampling Form to examine bud clusters for 3% infestation threshold of OBLR larvae (Ref: TF Guidelines Insect & Mite Mgt Chapter)
Suggested Action Threshold: 3% of clusters infested

June

Activity: Monitor for 1st adult flight (pheromone traps); Use biofix + NEWA Apple Insect Model to time sprays for 1st larval generation
Suggested Action Threshold: High-risk blocks: 360 DD (base 43°F) from biofix
OR
Suggested Action Threshold: Low-risk blocks: 600 DD (base 43°F) from biofix – Use Obliquebanded Leafroller Sampling Form to examine expanding terminals for 3% infestation threshold of OBLR larvae

Sampling for a Treatment Decision

Number of Infested Clusters

Total number sampled

STOP SAMPLING AND TREAT!

Obliquebanded Leafroller

Recommended Approach

Late Bloom

Activity: Use Obliquebanded Leafroller Sampling Form to examine bud clusters for 3% infestation threshold of OBLR larvae (Ref: TF Guidelines Insect & Mite Mgt Chapter)
Suggested Action Threshold: 3% of clusters infested

June

Activity: Monitor for 1st adult flight (pheromone traps); Use biofix + NEWA Apple Insect Model to time sprays for 1st larval generation
Suggested Action Threshold: High-risk blocks: 360 DD (base 43°F) from biofix
OR
Suggested Action Threshold: Low-risk blocks: 600 DD (base 43°F) from biofix – Use Obliquebanded Leafroller Sampling Form to examine expanding terminals for 3% infestation threshold of OBLR larvae
**Principles of Apple Maggot Management**

- Commercial apple orchards in New York State have no internal infestations of AM.
- AM management programs are designed to control flies immigrating into orchards from outside sources.
- Preventive insecticide sprays are effective in controlling AM.
- Not all orchards need protective sprays; many that do, don’t need them for the entire AM flight period.
- Recommended treatment threshold is 5 flies/trap; below this number, captures can be ignored.
- Implementing this strategy can cut the avg number of sprays applied by 50%.

**Apple Maggot Recommended Approach**

July 1
Activity: Place 2-3 volatile-baited AM sphere traps along edge of apple orchard adjacent to hedgerows or source of immigrating adults. Check traps at least twice per week.
Suggested Action Threshold: Average capture of 5 AM adults per trap.
Select appropriate product to apply during adult oviposition period. Repeat if threshold is reached again after period of spray residual efficacy has lapsed (10-14 days)
Continue checking traps using same procedure to protect fruit through August; protection generally not needed beyond this point.

**European Red Mite Life History**

- Overwintered eggs; bases of buds, spurs
- 1st summer eggs; mixed stages; 7-8 generations
- 1st winter eggs; petals, fruit

<table>
<thead>
<tr>
<th>Stage</th>
<th>Dates</th>
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<tbody>
<tr>
<td>Dormant</td>
<td>Mid-October</td>
</tr>
<tr>
<td>TC (Macs)</td>
<td>Late October</td>
</tr>
<tr>
<td>Pink</td>
<td>Early November</td>
</tr>
<tr>
<td>Petal Fall</td>
<td>Late November</td>
</tr>
<tr>
<td>Fruit Set</td>
<td>Late December</td>
</tr>
<tr>
<td>mid-June</td>
<td>Early August</td>
</tr>
<tr>
<td>Early August</td>
<td>Late August-July</td>
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</tbody>
</table>
Some Guiding Principles of Mite Management

- Can be considered a 2-phase process:
  - Early season program, against overwintering generation
  - Summer program, against new populations

- Usually, a preventive approach (i.e., without need to sample) is advised for early season, depending on previous year’s pressure:
  - delayed dormant oil, an ovicide-larvacide (Apollo/Savey/Onager/Zeal) applied prebloom or (with addition of Agri-Mek) after petal fall.

- For summer populations, scouting/sampling advised to pick up rapid mite increases on new foliage, especially during early summer when trees are most susceptible.
  - Thresholds increase as the summer goes on:
    - June: 2.5 ERM/leaf; July: 5.0 ERM/leaf; Aug: 7.5 ERM/leaf
  - When numbers of motiles (everything but eggs) reach or approach threshold, a “rescue” material can be recommended:
    - Acramite, Apollo, Envidor, Kanemite, Nexter, Onager, Portal, Savey, Zeal

BIOLOGICAL CONTROL OF EUROPEAN RED MITE

Typhlodromus pyri

- Adult
  - Feeding on ERM

- Paper band to trap overwintering T. pyri

- Hibernating T. pyri

Transfer of infested clusters to target tree

European Red Mite

Recommended Approach

Delayed Dormant
Activity: Be familiar with past history of ERM. Examine spurs for overwintered eggs.
Suggested Action Threshold: 10% spurs with eggs.
Treatment Options:
  - Oil – Half inch green – 2%; Tight cluster – 1% OR
  - Apollo / Savey / Zeal – Tight cluster, Pink OR
  - Apollo / Savey / Zeal / Agri-Mek – Petal fall

Summer: From mid-June to mid-August, leaves sampled for motiles. Use date-appropriate sampling form to determine whether motiles are over threshold (2.5 / 5.0 / 7.5 per leaf).
[Monitor for presence of predatory mite populations. 1 predator/10 leaves > potential for effective biological control]

Treatment Options:
  - Kanemite / Nexter / Portal / Acramite / Envidor – Summer months