EUROPEAN RED MITE

*Panonychus ulmi*

Adult female

Overwintering eggs
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, Carzol, Envidor, Kanemite, Nexter, Onager, Portal, Savey, Vendex, Zeal
Effectiveness of Prebloom Oil Through Time

- Winter eggs of ERM become more susceptible to killing with oil as hatch period approaches.
- For effective control, want 95% kill of eggs; can be achieved with adequate spray coverage.
- 100 (acceptable) to 300 (preferred in large trees) gal/A needed.

% Oil needed for effective control at different periods (Chapman & Lienk)

<table>
<thead>
<tr>
<th>Period</th>
<th>Dormant</th>
<th>Silver Tip</th>
<th>Green Tip</th>
<th>1/2” Green</th>
<th>Tight Cluster</th>
<th>Pink</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>6%</td>
<td>4%</td>
<td>3%</td>
<td>2%</td>
<td>1%</td>
<td>1%</td>
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EUROPEAN RED MITE LIFE HISTORY

overwintered eggs; bases of buds, spurs

eggs hatch; nymphs, larvae

1st summer eggs

mixed stages; 7-8 generations

1st winter eggs

Dormant TC (Macs)

Pink Petal Fall Fruit Set mid-June Early August
EUROPEAN RED MITE

ERM summer eggs

ERM summer motiles

Shoot damage
SEQUENTIAL SAMPLING CHART FOR MITES

THRESHOLD = 2.5/LEAF

Leaves with mites

Sample in 7 days

Continue sampling

Sample in 14 days

Leaves examined
Managing Mite Resistance

• Because mites have many generations per year, potential to develop resistance is high.

• Resistant mites are theoretically “less fit” or weaker than susceptible individuals
• Have shorter lives:
  ➢ physically smaller or weaker
  ➢ produce fewer offspring
  ➢ take longer to develop
  ➢ mating success is lower

• In the absence of competition from susceptible individuals, resistant pests rapidly multiply.

KEY TO MANAGEMENT OF RESISTANCE TO INSECTICIDES AND MITICIDES:
• Reduce Selection Pressure that Favors the Survival of Resistant Individuals

Potential Tactics for Reducing Selection Pressure for Miticide Resistance
• Treat different generations with materials of different chemical classes.
• Use nonchemical control tactics where possible (e.g., biological control; predators).
• Good miticide stewardship:
  - Apply only when necessary
  - Use correct dosages
  - Obtain adequate coverage
  - Optimize timing
Choosing a Miticide

1992 Options
- oil
- Morestan (prebloom)
- Carzol
- Omite
- Vydate
- Kelthane

• Many more options today, but important to keep in mind how they may/may not differ
  [1A] Carzol: carbamate; acetylcholinesterase inhibitor
  [12B] Vendex: disrupts ATP formation
  [6] Agri-Mek: GABA site; affects Cl-ion channel; inhibits nerve transmissions
  [25] Acramite: GABA site (probably); contact activity
  [10A] Apollo/Savey/Onager: growth inhibitors
  [10B] Zeal: growth inhibitor
  [20B] Kanemite: METI (mitochondrial electron transport inhibitor), Site II
  [21] Nexter/Portal: METI (mitochondrial electron transport inhibitor), Site I
  [23] Envidor: inhibitor of lipid synthesis

IRAC - Insecticide Resistance Action Committee
• International organization committed to prolonging the effectiveness of pesticides at risk for resistance development.
• The number codes represent Mode of Action Classification Groups.
• An arthropod population is more likely to exhibit cross-resistance to materials within the same group.
BIOLOGICAL CONTROL OF EUROPEAN RED MITE

Major species
Phytoseiidae:
Typhlodromus pyri
Amblyseius fallacis
Stigmaeidae:
Zetzelia mali

Feeding on ERM
Adult
Eggs
San Jose Scale

Two generations per year in NY

- Crawlers emerge about mid-June and in early August in WNY
- Can be timed by using DD accumulations:
  - 1st gen: 500 DD (base 50° F) from March 1, or 310 DD after 1st adult catch
  - 2nd gen: 1450 DD from March 1, or 400 DD after 1st adult catch
- Can monitor for crawlers using tape traps on scaffold branches
San Jose Scale
Treatment Considerations

• Problem populations more common in larger, poorly pruned standard size trees with inadequate spray coverage

• Early season sprays help prevent SJS establishment
  – Oil at dormant to 1/2-inch green
  – ½-inch Green to Tight Cluster:
    ✷ Oil
    ✷ Lorsban 4EC or Supracide
    ✷ Esteem (IGR) plus oil
    ✷ Centaur (IGR)

• Early season pruning to remove infested branches, open up canopy for better coverage

• Well-timed summer sprays at 1st and peak (7-10 days later) crawler activity: Esteem, Centaur, OPs, Provado, Movento* (PF-1st cover)
Movento 240SC

**Active Ingredient:** Spirotetramat

- Tetramic acid insecticide
- 2-way systemic activity, moves to all areas of the plant, including new shoot, leaf and root tissues
- Primary mode of action: ingestion
- Lipid biosynthesis inhibitor active against immatures; also, reduced egg-laying and offspring survival when adults treated
- Primary targets: sucking insect pests
  - Scales, Aphids, Pear Psylla, Mealybugs, Thrips
- Short PHI (7 days) and REI (24 hr)
- Favorable environmental profile
  - minimal risk to beneficial insects
1. Ultor 150SC 14.0 oz/A + 1.0% Oil @ Petal Fall
   Belt 480 SC @ 2C-6C

2. Ultor 150SC 14.0 oz/A + 1.0% Oil @ Petal Fall + 1C
   Belt 480 SC @ 2C-6C

3. Calypso 4F 3.0 oz/A @ Pink
   Ultor 150SC 14.0 oz/A + 1.0% Oil @ Petal Fall
   Belt 480 SC @ 2C-6C

4. Esteem 35WP 5.0 oz/A @ Pink
   Belt 480 SC @ 2C-6C

5. Guthion 50WSP 1.5 lb/A @ Petal Fall-6C

6. Untreated Check
Damage from SJS at Harvest

% of Fruit w/ SJS Damage

- Ultor/Oil@ PF: 4.0 ab
- Ultor/Oil@ PF+1C: 2.3 a
- Calypso @ Pink, Ultor/Oil@ PF: 4.3 ab
- Esteem @ Pink: 14.0 ab
- Guthion PF-6C: 0.3 a
- Untreated: 38.7 b
TARNISHED PLANT BUG

Adult

Damage to fruit

Older nymph
Tarnished Plant Bug

• **Monitoring Methods**
  – Can use white sticky-board traps, but generally very sensitive
  – Most injury caused by Pink

• **Threshold**
  Prebloom-Petal Fall: 3 bleeding sites/tree, 5 adults by tight cluster or 7 by late pink stage

• **Control Tactics**
  – Insecticides (advisability questionable): pyrethroids*, Beleaf
  – Good orchard floor management to **reduce alternate weed hosts essential**
Beleaf 50SG
(Flonicamid) - FMC

- New Chemistry, new mode of action
  - Pyradinecarboxamide - “selective feeding blocker”
  - Efficacy against aphids and plant bugs
  - Not yet tested in NY, but NJ reports good results against green peach aphid and TPB in peaches
  - Label also lists rosy apple aphid, green aphids, and woolly apple aphid

- Low toxicity to beneficial arthropods

- Labeled in pome fruits and stone fruits

- REI = 12 hrs; PHI = 21 days
Plum Curculio

Monitoring Methods
After 1-2 warm (60°F) evenings following petal fall, egg laying will start

Threshold
Appropriate weather/phenology conditions

Control Tactics
Guthion, Imidan, Actara, Calypso, Avaunt, Pyrethroid
Surround an option for organic growers.
Can stop sprays at 308 DD (base 50°F) after petal fall of apples
[Warm spring: 2 sprays; cold spring: 3 sprays]
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.
EXAMPLE OF PLUM CURCULIO MODEL PREDICTIONS IN GENEVA FOR THE 2005 SEASON

0 DD

PF spray
May 23

165 DD

1C
June 6

308 DD, 40% oviposition; end of immigration

June 11

463 DD

June 20
End of Protection

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

0 DD 120 DD 291 DD
PF spray May 15 1C May 30 2C June 12 June 14
308 DD, 40% oviposition; end of immigration
June 26 End of Protection

3 Total sprays needed
WHY DOES THE MODEL WORK?

- Indigenous and early immigrating PC in treated orchards are killed by the petal fall and any subsequent sprays.
- After 40% oviposition, PC immigration into orchards and movement between trees is nearly over.
- Protection until the end of the oviposition cycle therefore not necessary.
“Advanced IPM” Tactics for Plum Curculio
Odor-Baited Trap Tree Approach

- Trap Trees set up around perimeter prior to Petal Fall
- Baited with olfactory attractant (benzaldehyde) and aggregation pheromone
- Full block spray at PF; later sprays applied to trap trees only (according to degree day oviposition model)
- Fruit damage assessments in Trap Tree and nearest neighbor trees at harvest
Results

Plum Curculio Harvest Damage 2010

- **Advanced IPM**
- **Grower Standard**

<table>
<thead>
<tr>
<th>Farm</th>
<th>% PC damage</th>
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<tbody>
<tr>
<td>1</td>
<td>6.0</td>
</tr>
<tr>
<td>2</td>
<td>1.0</td>
</tr>
<tr>
<td>3</td>
<td>3.0</td>
</tr>
<tr>
<td>4</td>
<td>13.0</td>
</tr>
<tr>
<td>5</td>
<td>0.5</td>
</tr>
<tr>
<td>Average</td>
<td>3.5</td>
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- Farm 4 had the highest % PC damage.
- The average % PC damage was 3.5.
- The % PC damage was significantly higher in the Advanced IPM compared to the Grower Standard.
Obliquebanded Leafroller, *Choristoneura rosaceana*

- **Adult**
- **Mature larva**
- **Fruit damage by over-wintered brood**
- **Fruit damage by summer brood**
- **Foliar damage by summer brood**
Why OBLR Doesn’t Fit the Mold

- ‘Terrible Tortricid’ - Same family as codling moth, oriental fruit moth, lesser appleworm, grape berry moth

  BUT

- Prefers foliage to fruit
- Overwinters as a larva, not as a pupa
- Causes feeding damage much earlier than other worms
- Life cycle is out of sync with most other pests
- Has a great capacity to develop insecticide resistance
OBLR Overwintered Brood

- Overwinters as 1st or 2nd instar on tree or in protected location nearby (spins hibernaculum)
- Larva becomes active in spring when buds open
- Ties leaves together to conceal itself
- Often found in blossom cluster, even inside flower
- Feeds on newly set fruit buds; most abort, those that don’t are misshapen with large, deep cavities
- Traditionally causes 2-3% damage, often not noticeable; becoming more of a problem.
Control of Overwintering OBLR Larvae - Is it Economically Justified?

- Most fruit damaged before petal fall drops before harvest
- OW-OBLR damage at harvest is usually <1%
- Potential benefits from controlling early generation
  - Reduction of early season fruit damage
  - Possible reduction of subsequent damage from the summer generation
- Decisions for Controlling Overwintering OBLR
  - Sample for larvae at bloom
  - Base decision on past history of OBLR infestations
Insecticide Efficacy against Overwintering OBLR

- Recommended products:
  - Proclaim
  - Rimon
  - Intrepid
  - B.t.s
  - Altacor/Belt/Delegate possible, but probably better to save for internal Leps in summer
  - Lorsban 75WG still labeled for PF; suitable for susceptible populations

- Usually one spray (PF) as good as two (Pink & PF)
- Fruit damage usually reduced by 40-60%
- Newer IPM-compatible insecticides may have sub-lethal effects on surviving adults.
Implications for Future Management of OBLR with Soft Insecticides

• Preliminary research suggests “soft insecticides” are not necessarily less toxic to beneficials helping to control OBLR than are conventional materials.

• OBLR adults appear to be very mobile & capable of re-infesting nearby clean orchards during the summer.

• Therefore, stable insecticide control cannot be maintained in relatively small areas, even after multiple seasons of treatment with soft materials.
Delegate 25WG
(Spinetoram) - Dow AgroSciences

- Spinosyn (same class as SpinTor)
  - Chemically modified spinosad to be more active and effective against a broader range of insects
  - Efficacy against internal feeding Lepidoptera such as oriental fruit moth & codling moth; plus leafrollers
  - Additionally, thrips and psylla (rec. use of adjuvant)
  - [“Suppression” against plum curculio and apple maggot]
- Acts by disrupting insect nerve function
- Nontoxic to birds, fish, aquatic invertebrates, and most beneficial arthropods
- Labeled in pome fruits and stone fruits
- REI = 4 hrs; PHI = 7 days
Avermectin (2nd generation); related to Agri-Mek

Labeled in pome fruits (restricted use)
- Primary target pests are leafrollers, leafminers and fruitworms
- “Suppression of oriental fruit moth, codling moth, pear psylla, and spider mites”
- Translaminar, quickly absorbed into leaf tissue
- Recommend adjuvant (HMO, or non-ionic surfactant)

REI = 48 hrs; PHI = 14 days
Altacor 35WG

Active Ingredient: Rynaxypyr

- Novel anthranilic diamide insecticide
- Translaminar activity
- Primary mode of action: ingestion
- Affects insect ryanodine receptors (calcium regulation), causes paralysis
- Primary targets: Lepidoptera - OBLR, Codling Moth, Oriental Fruit Moth, European Apple Sawfly, Leafminers
- Short PHI (5 days) and REI (4 hr)
- Favorable environmental profile
  - low impact on beneficial insects
  - does not flare mites or secondary pests
  - low toxicity to bees, birds, fish and mammals
Active Ingredient: Flubendiamide

- Novel phthalic acid diamide insecticide
- Translaminar activity, strong rainfast characteristics
- Primary mode of action: ingestion
- Affects insect ryanodine receptors (calcium regulation), causes cessation of feeding, paralysis
- Primary targets: Lepidoptera - OBLR, Codling Moth, Oriental Fruit Moth, Leafminers
- Short PHI (14 days) and REI (12 hr)
- Favorable environmental profile
  - minimal risk to beneficial insects, honey bees
Possible Seasonal Programs Using Reduced-Risk or OP-Replacement Products

- **Rosy Apple Aphid**: Actara, Assail, Calypso, Beleaf
- **Leafminers**: Actara, Altacor, Assail, Calypso
- **Plum Curculio**: Actara, Avaunt, Calypso
- **Internal Leps**: Assail, Avaunt, Calypso, Delegate, Intrepid, Rimon, Altacor, Belt
- **OBLR**: B.t., Delegate, Intrepid, Proclaim, Rimon, Altacor, Belt
- **European Apple Sawfly**: Actara, Assail, Avaunt, Calypso, Altacor

(to be continued...)

**Pink Petal Fall Summer**