Spider Mite Management in Walnuts

David Haviland
Entomology Farm Advisor
UCCE Kern County
Tri-County Walnut Day, 2008
Mite damage

- Leaf stippling
- Browning of leaves
- Leaf desiccation/drop
- Early defoliation
  - Reduces yields
  - Reduces quality
- Late defoliation
  - Interferes with harvest
Pacific or twospotted spider mite
Overwintering female

Pacific or twospotted spider mite
Being eaten by a western predatory mite

Western predatory mite

European red mite
**Overwintering stage**
- Reddish orange mature females
- Protected areas in the tree
- Leaf litter, trash on the ground

**Spring**
- Become active in warm weather
- Begin feeding on walnut leaves or ground cover
- Lay eggs on the undersides of leaves
Summer
- Populations increase in June/July
- Colonies develop on undersides of leaves
- Heavy populations go to tops of leaves

cont’d
- Reproduce quickly
- Multiple generations
- Generation in as little as 7 days
- Proliferate in dusty conditions
- Proliferate in the absence of biocontrol
Mite-promoting conditions

- Dust
- Orchard operations (i.e., mowing cover crops)
- Water-stressed trees
  - Insufficient irrigation
  - Excessively hot weather
- Use of broad-spectrum insecticides
  - Lack of beneficial organisms
Monitoring

• Start in mid- to late-May
• Monitor weekly
• Use field bindweed as an indicator
• Check hotspots and field edges (dusty)
• Look for brown leaf clusters
  – Lower branches in inner canopy
• Check random infested leaflets for predators
Western Predatory Mite

*Galendromus (Metaseiulus) occidentalis*

- Teardrop shaped, clear to red
- Most dependable predator
- Can complete life cycle in 7 days
- Can provide compete control of spider mites
- Often arrive late, since no alternate food source in the spring
Sixspotted thrips
  *Scolothrips sexmaculatus*

- Larvae yellowish, cylindrical
- Adults with 6 spots
- Both are predacious on mites
- Can provide compete control of spider mites
- Often arrive late, since no alternate food source in the spring
Thresholds to treat

- Treat if brown clusters of leaves are present on 10% of the trees, and no predators are present.
- If predators (mites, thrips, spider mite destroyers) are present on at least half of the leaflets, they will probably control mites (increase monitoring to make sure).
Threshold Modifications

• If very hot weather is anticipated, pull the trigger a little early
• If population is increasing in early June or July, and leaf drop will be severe enough to expose the nuts to sunburn or interfere with sweeping at harvest, then pull the trigger
• Mite build-ups by mid-August can be ignored
Treatments

**Agri-Mek**
- 2.5-5 fl oz/100 gal
- or
- 10-20 fl oz/ac
- Label recommends addition of hort oil
- Effective against propargite-resist mites

**Omite**
- 1.5 lb/100gal
- or
- 4-6 lb/ac (5-12.5lb/ac)
- Do not use within 14 days of oil
- Some resistance documented in the SJV, not consistent
Life Cycle

egg
larva
protonymph
deutonymph
adult
### Registration Status of Selected Miticides for Use Against Spider Mites in California (Current as of March, 2007)

David Haviland, Entomology Farm Advisor, UCCE- Kern County

**Key:**
- **YES** = fully registered for use
- **NB** = registered for use on non-bearing crops only
- **No** = not registered for use

<table>
<thead>
<tr>
<th>IRAC Number</th>
<th>Almond</th>
<th>Nut Crops</th>
<th>Pistachio</th>
<th>Walnut</th>
<th>Apricot</th>
<th>Cherry</th>
<th>Peach</th>
<th>Plum</th>
<th>Nectarine</th>
<th>Citrus</th>
<th>Pome Fruits</th>
<th>Pear</th>
<th>Grape</th>
<th>Cotton</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acramite</td>
<td>25</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Agri-Mek</td>
<td>6</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Apollo</td>
<td>10A</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Carzol</td>
<td>1A</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Comite</td>
<td>12C</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Danitol</td>
<td>3</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Desperado</td>
<td>21</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Dicofol</td>
<td>UNC</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Ecotrol</td>
<td>-</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Envidor</td>
<td>23</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Fujimite</td>
<td>21</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NB</td>
<td>NB</td>
<td>NB</td>
<td>NB</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Kanemite</td>
<td>20B</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Kelthane</td>
<td>UNC</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Nexter</td>
<td>21</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Oberon</td>
<td>23</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Omite</td>
<td>12C</td>
<td>YES</td>
<td>NB</td>
<td>YES</td>
<td>NB</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Onager</td>
<td>10A</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Vendex</td>
<td>12B</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
<tr>
<td>Zeal</td>
<td>10B</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>NB</td>
<td>NB</td>
<td>NB</td>
<td>NB</td>
<td>NB</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>Zephyr</td>
<td>6</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
<td>YES</td>
<td>YES</td>
<td>NO</td>
<td>NO</td>
<td>NO</td>
</tr>
</tbody>
</table>

---


2. Insecticide Resistance Action Committee (IRAC) numbers used to denote different modes of action. Same number indicates same mode of action

3. Miticide is registered for the crop, but one or more spider mites are not listed on the label as target pests

4. For use on non-bearing, or post-harvest on bearing

5. For use on any non-bearing, or post-harvest on bearing navelss or grapefruit

6. OMRI certified for use on organic crops

**Disclaimer**: Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.
# Table of Some of the Most Common Miticides for Use Against Spider Mites in California (Version 2, Mar 2007)

David Haviland; Entomology Farm Advisor, UCCE- Kern County

<table>
<thead>
<tr>
<th>Miticide</th>
<th>Active Ingredient</th>
<th>Producer</th>
<th>Targeted life stages and mode of action</th>
<th>IRAC Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acramite</td>
<td>bifenthrin</td>
<td>Chemtura</td>
<td>contact toxin on all stages by unknown mechanism in nervous system</td>
<td>25</td>
</tr>
<tr>
<td>Agri-Mek</td>
<td>abamectin</td>
<td>Syngenta</td>
<td>contact or ingestion toxin that paralyzes juveniles and adults; death by starvation</td>
<td>6</td>
</tr>
<tr>
<td>Apollo</td>
<td>cefetemizine</td>
<td>MANA</td>
<td>growth regulator of mite eggs and some nymphs</td>
<td>10A</td>
</tr>
<tr>
<td>Carzol</td>
<td>formetanate</td>
<td>Gowan</td>
<td>contact toxin that inhibits acetylcholinesterase and monoamine oxidase</td>
<td>1A</td>
</tr>
<tr>
<td>Comite</td>
<td>propargite</td>
<td>Chemtura</td>
<td>contact on juveniles and adults by inhibition of ATP synthesis</td>
<td>12C</td>
</tr>
<tr>
<td>Danitol</td>
<td>fenpropathrin</td>
<td>Valent</td>
<td>nerve toxin to juveniles and adults by modification of sodium channels (pyrethroid)</td>
<td>3</td>
</tr>
<tr>
<td>Desperado</td>
<td>pyridaben/sulfur</td>
<td>Wilbur-Ellis</td>
<td>contact on juveniles and adults by inhibition of energy production, plus sulfur</td>
<td>21</td>
</tr>
<tr>
<td>Dicofol</td>
<td>dicofol</td>
<td>multiple</td>
<td>contact toxin of juveniles and adults with unknown mode of action</td>
<td>UNC</td>
</tr>
<tr>
<td>Ecotrol</td>
<td>botanical oils</td>
<td>EcoSMART</td>
<td>contact on all stages; inhibits nervous system by blocking octopamine receptors</td>
<td>-</td>
</tr>
<tr>
<td>Envidor</td>
<td>spirodiclofen</td>
<td>Bayer</td>
<td>contact on all mite stages by inhibiting lipid biosynthesis; most effective on juveniles</td>
<td>23</td>
</tr>
<tr>
<td>Fujime</td>
<td>fenpyroximate</td>
<td>Nicheno</td>
<td>contact toxin to eggs, juveniles and adults; inhibits electron transport in the mitochondria</td>
<td>21</td>
</tr>
<tr>
<td>Kanemite</td>
<td>acequinocyl</td>
<td>Arysta</td>
<td>contact toxin to eggs, juveniles and adults; inhibits electron transport in the mitochondria</td>
<td>20B</td>
</tr>
<tr>
<td>Kelthane</td>
<td>dicofol</td>
<td>Dow</td>
<td>contact toxin of juveniles and adults with unknown mode of action</td>
<td>UNC</td>
</tr>
<tr>
<td>Nexter</td>
<td>pyridaben</td>
<td>BASF</td>
<td>contact on juveniles and adults by inhibition of energy production</td>
<td>21</td>
</tr>
<tr>
<td>Oberon</td>
<td>spiromesfen</td>
<td>Bayer</td>
<td>contact on all mite stages by inhibiting lipid biosynthesis; most effective on juveniles</td>
<td>23</td>
</tr>
<tr>
<td>Omite</td>
<td>propargite</td>
<td>Chemtura</td>
<td>contact on juveniles and adults by inhibition of ATP synthesis</td>
<td>12C</td>
</tr>
<tr>
<td>Onager</td>
<td>hexythiazox</td>
<td>Gowen</td>
<td>mite growth regulator; adult females lay sterile eggs; contact toxin on eggs and juveniles</td>
<td>10A</td>
</tr>
<tr>
<td>Vendex</td>
<td>fenbutatin-oxide</td>
<td>Du Pont</td>
<td>contact toxin to juveniles and adults by inhibition of ATP synthesis</td>
<td>12B</td>
</tr>
<tr>
<td>Zeal</td>
<td>etoxazole</td>
<td>Valent</td>
<td>contact toxin on eggs; inhibits molting of juveniles; adult females produce sterile eggs</td>
<td>10B</td>
</tr>
</tbody>
</table>

1 Spider mite species include *Tetranychus* spp. (pacific, two-spotted, strawberry, McDaniel, Carine spider mites), *Panonychus* spp. (European, citrus red mites), *Eo tetranychus* spp. (Willamette, Yuma spider mites), *Eotetranychus banksi* (Texas citrus mite)

2 Pesticide-related information is always changing. To recommend changes to the table please contact David Haviland. dhaviland@ucdavis.edu, 661 868-6215

3 Insecticide Resistance Action Committee (IRAC) numbers used to denote different modes of action. Same number indicates same mode of action

**Disclaimer:** Discussion of research findings necessitates using trade names. This does not constitute product endorsement, nor does it suggest products not listed would not be suitable for use. Some research results included involve use of chemicals which are currently registered for use, or may involve use which would be considered out of label. These results are reported but are not a recommendation from the University of California for use. Consult the label and use it as the basis of all recommendations.
Newer miticides

Growth Regulators
- **Envidor**
  - Inhibits lipid biosynthesis on immatures
  - Have to molt, slow-acting; mites must come in physical contact
- **Onager**
  - Adult females lay sterile eggs, some contact on juveniles
- **Zeal**
  - Adult females lay sterile eggs, contact on eggs, some on juveniles
  - Some translaminar activity
- **Apollo**
  - Growth regulator of eggs and nymphs
  - Facelift by MANA

Contact
- **Fujimite**
  - Contact to all stages, same MOA as Nexter
- **Desperado**
  - Don’t really have information on it, same a.i. as Nexter
Data from other trials

• Growth Regulators (Envidor, Zeal, Onager)
  – Plum 2005 (June)
    • All better than Acramite, but not as good as Agri-Mek
  – Peach 2006 (May)
    • All three comparable (but numerically just below) Agri-Mek
    • Envidor slightly longer residual than Zeal or Onager
  – Almond 2006-7 (May, July, July)
    • All good, Zeal longest residual early in the season
    • All good, Envidor longest residual at hull split

• Fujimite
  – Plum 2005 (June) and Peach 2006 (May)
    • Flared mites (very toxic to predatory mites)
  – Almond (Mid-July 2006, 2007)
    • 5+ weeks control (controls defoliated in 4 weeks)
    • Best candidate as an Omite replacement
  – Growers reporting very good results (but be careful early)
Almonds- preventative trial (2007)

2.5 acre plots, 6 replications, applications made with mite densities undetectable

Average mites per leaf

- Agri-Mek
- Zeal
- Envidor
- Onager
- Apollo
- Untreated (unreplicated, within trial)
- Untreated (unreplicated, adjacent block)

Application Date

Unreplicated control plots

Apollo
Envidor
Onager

Agri-Mek
Zeal
Large scale non-bearing almonds

[Graph showing spider mites per leaf for different treatments and DAT (days after treatment).]
Effects of miticides on predators

general statements (verdict still out on some)

• Thrips
  Agri-Mek → Agri-Mek very toxic

• Mites
  Agri-Mek → Moderate+
  Onager → Moderate
  Zeal → Toxic (sterilized)
  Envidor → Moderate +
  Acramite → Soft to Moderate
  Fujimite → Toxic (contact)
  Kanemite → Moderate
  Desperado → Toxic (contact)
  Ecotrol → Unknown
Placement Recommendations in Almonds

- **April**: Agri-Mek
- **May**: Omite, Savey, Nexter, Vendex, Oil, Zeal, Envidor
- **June**: Leaf hardening, Acramite
- **July**: Hull split
- **August**: Kanemite, Desperado, Fujimite, Ecotrol

Growth regulators

Contacts
Thank you

David Haviland
Entomology Farm Advisor
UCCE Kern County
Tri-County Walnut Day, 2008