Why Has Red Scale Been Such a Problem and What Can You Do to Improve Control?

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Kearney Ag Center and Lindcove REC
• You can monitor and know when events are happening:
  • Pheromone traps
  • Crawler tapes
  • % infested fruits
The squares represent 20% of the card and so you can count scale in the squares and multiply x 5 to estimate the total number.

Cards can be used two ways:
1. To follow the generations
2. To estimate populations at the end of the season*
• First two generations of scales are synchronized and control works best on the first instars

Mixed stages
On leaves, twigs and fruit

Insecticides

Insecticides

550 DD
1100 DD
1650 DD

Male scale per card

Crawlers per tape

13-Mar 27-Apr 11-Jun 26-Jul 9-Sep 24-Oct

Male Scale Crawlers

0 5000 10000 15000 20000
0
50
100
150
200
250
300
Degree day units

Spring
High: 74
Low: 50
Average daily temperature = (74+50)/2 minus LDT 53
= 62-53
= 9 degree days/day
(61 days from male flight to crawlers)

Summer
High: 103
Low: 81
Average daily temperature = (103+81)/2 minus LDT 53
= 92-53
= 39 degree days/day
(15 days from male flight to crawlers)
Why so much scale in 2012-16? Perfect storm

1. Warm winters (2014-16) allow young stages to survive and the generations are no longer synchronized in the spring, so the insecticides don’t work as well
2. Higher degree day units for the past 5 years allows the 4th generation to grow up and the parasites can’t keep up with them
3. Drought – dusty, stressed trees have more scale, parasites don’t work as well when they have to get past the dust
What is happening in 2017?

[Link to website for more information]

California Red Scale Degree Days at Lindcove REC

- 1st Crawler Emergence @550 DD
- 2nd Crawler Emergence @1650 DD
- 3rd Crawler Emergence @2750 DD
The squares represent 20% of the card and so you can count scale in the squares and multiply x 5 to estimate the total number.

Cards can be used two ways:
1. To follow the generations
2. To estimate populations at the end of the season*
Based on the Organophosphate era
IGRs: lower male counts
Aphytis and Movento: higher male counts
At harvest check bins of fruit

Estimate the % of fruit with >10 scales

If you find more than 5% of fruit infested, the block likely needs a treatment next year
Spray coverage as measured by water sensitive paper
D2/40 Engine-powered Air-O-Fan Sprayer
15 foot 40 year old Atwood navels
Movento + 1% oil

<table>
<thead>
<tr>
<th></th>
<th>Inside</th>
<th>Outside</th>
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</thead>
<tbody>
<tr>
<td>High</td>
<td>56%</td>
<td>62%</td>
</tr>
<tr>
<td>Medium</td>
<td>72%</td>
<td>72%</td>
</tr>
<tr>
<td>Low</td>
<td>83%</td>
<td>87%</td>
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<thead>
<tr>
<th></th>
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</tr>
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<tbody>
<tr>
<td>High</td>
<td>33%</td>
<td>34%</td>
</tr>
<tr>
<td>Medium</td>
<td>61%</td>
<td>74%</td>
</tr>
<tr>
<td>Low</td>
<td>72%</td>
<td>67%</td>
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</table>
Treatments for California red scale control

Aphytis releases
100,000/acre distributed from Mar-Oct

Oils
415, 440, 455
*OPs and Carbamates
Lorsban, Supracide, Sevin

Insect Growth Regulators
Esteem\textsuperscript{1998}
Applaud/Centaur\textsuperscript{1997}
Lipid synthesis inhibitor
Movento\textsuperscript{2008}: foliar systemic

*Resistance
**Stage to Target:** March-October 3\textsuperscript{rd} instar scales  
**Efficacy:** Works well on 2\textsuperscript{nd} and 3\textsuperscript{rd} instar scales, but not 1\textsuperscript{sts}, molts or adults.  
**Resistance:** None  
**Specificity:** Only attacks California red scale  
**Natural enemies:** other natural enemies such as *Comperiella* and *Rhyzobius* join in  
**Issues:** Some years its more effective than other years.  
• Hot dry years seem to be more difficult.  
• Most citricola scale, Fuller rose beetle treatments (broad spectrum neonicotinoids) work against *Aphytis*. 
Cultural Control:
Reduce dust, prune trees, avoid broad spectrum pesticides, and have a high pressure washer available

Biological Control:
*Aphytis melinus*: Release 5,000/acre every two weeks from March 1 to October 31 = 100,000/acre
Cost: $.85/1,000 wasps = $85/acre

Parasitized scales flake off
Petroleum Oils

415, 435, 440, 455

Stage to Target: 1st or 2nd generation 1st instars
Efficacy: Works well on young stages, but allows enough to survive that it doesn’t eliminate populations
Resistance: None
Specificity: Broad spectrum against both pests and natural enemies, smothering
Toxicity to natural enemies: kills what it directly contacts, but residues don’t last too long. Exception is *Euseius* predatory mites are affected long-term.
Issues: During hot weather, the orchard must be well-irrigated and treatments applied at night/early morning
Effects of PureSpray oil (10E and 15E) on California red scale

- Higher distillation point and higher concentration = greater scale kill, but be careful of phytotoxicity
Organophosphates & Carbamates

*Lorsban, *Supracide, *Sevin

Stage to Target: 1st or 2nd generation white caps
Efficacy: varies, depends on resistance
Resistance: *common in the San Joaquin Valley
Specificity: broad spectrum, killing pests and natural enemies unless they have resistance
Toxicity to natural enemies:
• High toxicity for Supracide and Sevin. Depends on the rate for Lorsban.
• Aphytis, predatory mites, vedalia beetle have some resistance in the San Joaquin Valley
Issues: worker safety (restricted use), drift, and pesticide resistance
Insect Growth Regulators
Esteem and Applaud/Centaur

Stage to Target: 1\textsuperscript{st} or 2\textsuperscript{nd} generation 1\textsuperscript{st} instars as they start to molt.

Efficacy: Esteem was cheaper, shorter REI and perceived to be more efficacious than Applaud and so has been depended on for the past 15 years.

Resistance: Indications there is some Esteem resistance

Specificity: Works better on California red scale than citricola scale or cottony cushion scale

Toxicity to natural enemies: Only toxic to coccinellid predatory beetles such as Vedalia beetle.

Issues: coverage, timing and they only work on developing stages (eggs and molts) – so they can’t clean up a very heavy population
• Male scales molt more and so are more susceptible to IGRs = low pheromone trap counts
**Tetronic acid insecticide**

**Stage to Target:** younger instars

**Efficacy** depends on
- Adjuvants
- Timing (tree has to move the product)
- Water volume

**Resistance:** None

**Specificity:** Toxic to California red scale, citrus red mite, citrus leafminer, citrus thrips

**Toxicity to natural enemies:** Affects predatory mites but not predatory beetles or parasitic wasps

**Issues:** Uptake and movement into leaves and fruit.

*Does not control scales on twigs and trunk.* Can not clean up a heavy population of red scale. Requires an adjuvant.
## Pesticide screening

<table>
<thead>
<tr>
<th>Insecticide group</th>
<th>Chem grp</th>
<th>Parasites</th>
<th>Predatory mites</th>
<th>Predatory beetles</th>
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<tbody>
<tr>
<td>OP and Carbamate</td>
<td>1a,b</td>
<td>Rate dependent</td>
<td>Resistant</td>
<td>resistant</td>
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<tr>
<td>Neonicotinoids</td>
<td>4a</td>
<td>Toxic (9 wk)</td>
<td>Rate &amp; coverage dependent</td>
<td>Toxic</td>
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<tr>
<td>Insect growth regulators</td>
<td>7c, 16</td>
<td>Soft</td>
<td>Soft</td>
<td>Very toxic</td>
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<tr>
<td>Movento (spirotetramat)</td>
<td>23</td>
<td>Soft</td>
<td>Toxic</td>
<td>Soft</td>
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<tr>
<td>Oils</td>
<td></td>
<td>Synchronize</td>
<td>Reduce</td>
<td>Soft</td>
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Why are the systemic neonicotinoids (Admire Pro and generics, Assail, Platinum, Actara) not good products for California red scale?

• Reduce natural enemies
• Systemics control red scale on fruit but not wood
• Build up scale that can not be controlled by oils, IGRs or Movento
October 2004

Neonicotinoid impact on red scale
Assail and Admire

• High rates of neonicotinoids reduce scale on fruit
Neonicotinoids do not control scales on leaves or twigs

2004- Assail Trial

Treated on June 22, Assail 5.7 oz in 900 gpa
Neonicotinoids do not control scales on leaves or twigs.

2001 – Admire trial – Kern Co.

Admire applied May 21, Lorsban for citricola Oct 17
Why so much scale in 2012-16? Perfect storm

1. Warm winters (2014-16) allow young stages to survive and the generations are no longer synchronized in the spring, so the insecticides don’t work as well
2. Higher degree day units for the past 5 years adds another generation and the parasites can’t keep up with them
3. Drought – dusty, stressed trees have more scale, parasites don’t work as well when they have to get past the dust
4. Admire treatments and possibly Movento treatments are building scale on wood
5. The registered insecticides only last about 1 generation: great for light scale years and tough for heavy scale years.
Why don’t we have more red scale insecticides coming down the pike?

• The insecticide rate has to be high because water volume is high to achieve good coverage.
• This often makes the product too costly or raises registration concerns.
May 18th
Pheromone
dispensers
added

<table>
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<th>Date</th>
<th>Control</th>
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<tbody>
<tr>
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<tr>
<td>12-Jun</td>
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<td>12-Jul</td>
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<td>12-Aug</td>
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<tr>
<td>12-Sep</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>12-Oct</td>
<td>0</td>
<td>0</td>
</tr>
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</table>

CRS/Twig (Aug) | % Fruit with > 10 CRS
--- | ---
Control | 1.1/twig | 13%
Pheromone dispensers | 0.3/twig | 7%

180 dispensers/acre

Suterra Checkmate CRS slow release dispensers
What are we going to do about red scale?

Timing: hit the stage that is most sensitive and in tough situations apply multiple treatments

Good coverage: 750-1500 gpa for most chemicals, 250 gpa for Movento

Calibrate your rig correctly and Drive slowly! < 1.5 mph

Pheromone disruption: Suterra dispensers reduce scale about 50% in low to moderate populations

2017 should be better because we have had cold, wet winter weather (reduces dust, synchronizes scale, causes overwintering mortality of younger instars)