Black Scale Control Programs and Carbaryl Alternatives

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Black Scale Biology and Background

Hemiptera: Coccidae: *Saissetia oleae*

Geography

- Origin = South Africa
- Globally distributed today

History

- Introduced to CA in late 1800s
- Major pest – olive, citrus, ornamentals
- Minor pest – many other crop and non-crop species

Black Scale Biology and Background

Life-Stages and Identification

Crop Damage

- Pierce-suck feeding
- Honeydew = substrate for sooty mold
- Impacts on vigor, productivity and bloom

Black Scale Biology and Background

Life-Stages and Identification

Identification

- Distinctive “H” shape on later stages

Black Scale Biology and Background

Life-Stages and Identification

Adults/Eggs

Crawlers / 1st stage

2nd/3rd stage

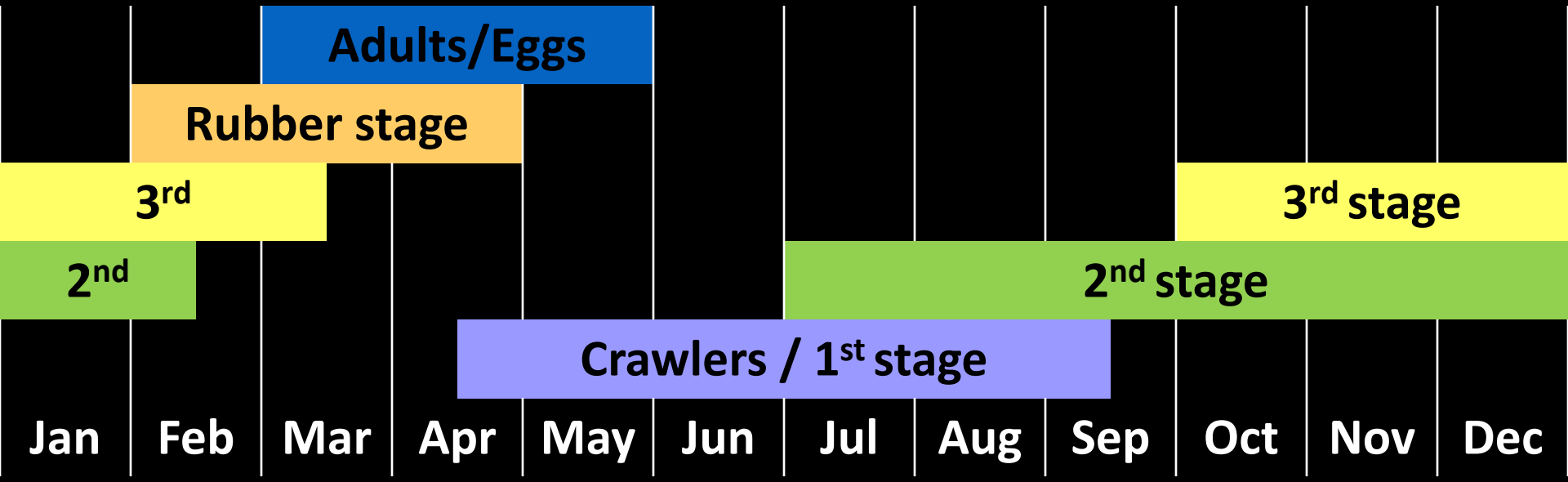
Rubber stage

Black Scale Biology and Background

Seasonal Ecology

Typically 1-2 generations/year

(2 @ Coastal, 1 @ Interior)



Black Scale Management

Natural Enemies and Biological Control

Importation of Natural Enemies

- Extensive attempts in olives/citrus
- 1890s = recent success with cottony cushion-scale
- Could this be repeated for olive scale?

Biological control has a long and rich history in California, beginning with the importation of the vedalia beetle for cottony cushion scale in 1889. *Above,* some of the UC pioneers of biological control and integrated pest management on an insect collection trip in Palm Canyon in 1948. From left to right: (top row) Huffaker, Fisher, Basinger; (middle row) Bartlett, Hagen, Smith, Sellers, Huges, Compere, Steinhaus; (bottom row) Flanders, Finney, Fleschner, Timberlake, Dietrick, DeBach. *Right,* cottony cushion scale was featured in a pest identification manual for California published in 1888.

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Natural Enemies and Biological Control

Limited Success

- Many importations
  - 40+ parasitoids
  - 10+ predators

- Poor performance due to…
  - Misidentification of scale and natural enemies
  - Improper/inadequate evaluation before release
  - Release into wrong conditions

- Efforts oscillate between chemical and biological

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Natural Enemies and Biological Control

Metaphycus helvolus

Attacks early instars

Metaphycus lounsburyi

Attacks late instars

Scutellista caerulea

Attacks adults

Larva consume eggs

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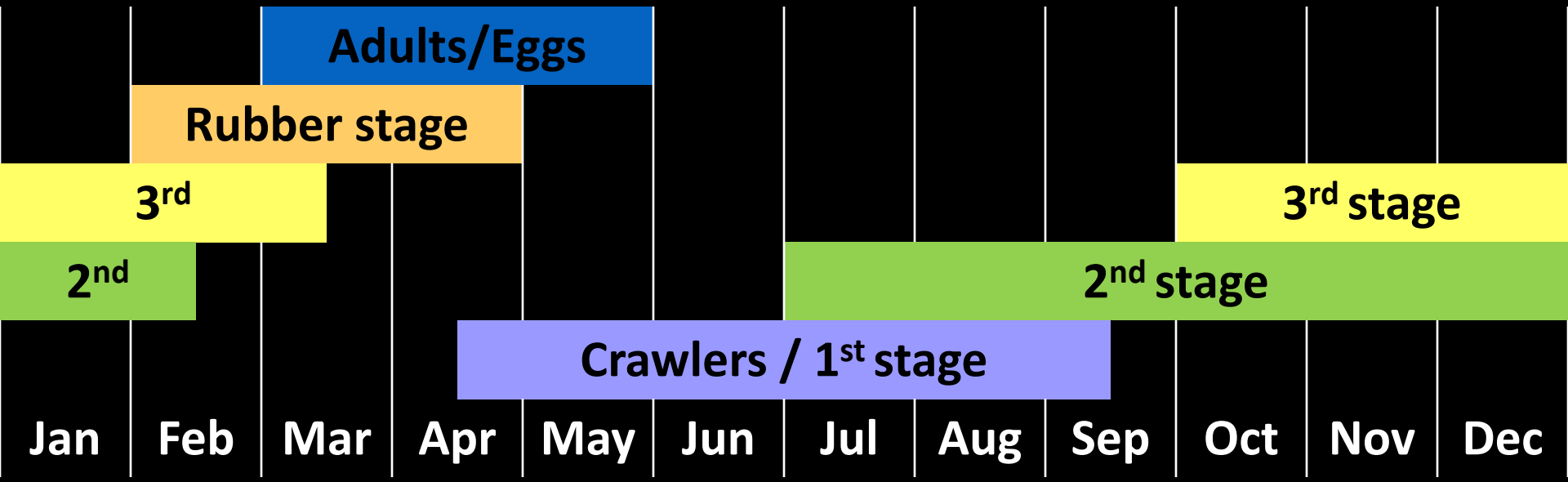
Natural Enemies and Biological Control

Limits to Stage Specific Natural Enemies



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Natural Enemies and Biological Control

Ant Interference

Photo: Kent Daane

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Cultural Controls

Effect of Canopy Microclimate Temperature

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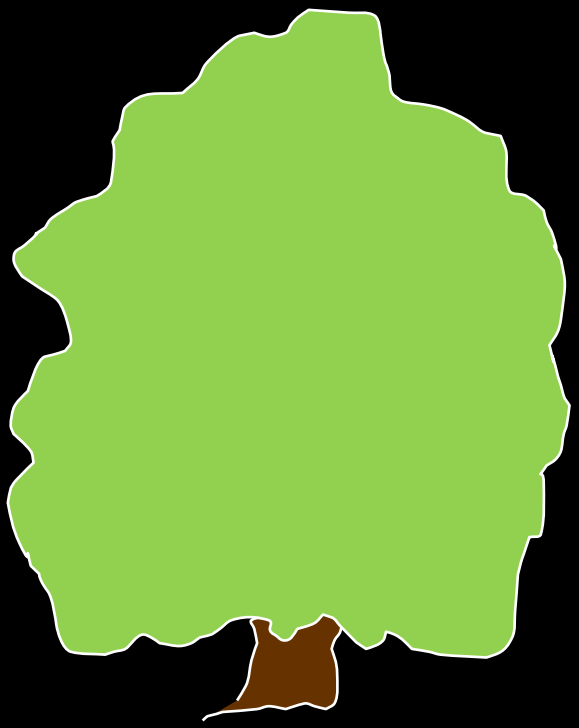
Cultural Controls

Closed vs. Open Canopies



CLOSED CANOPY

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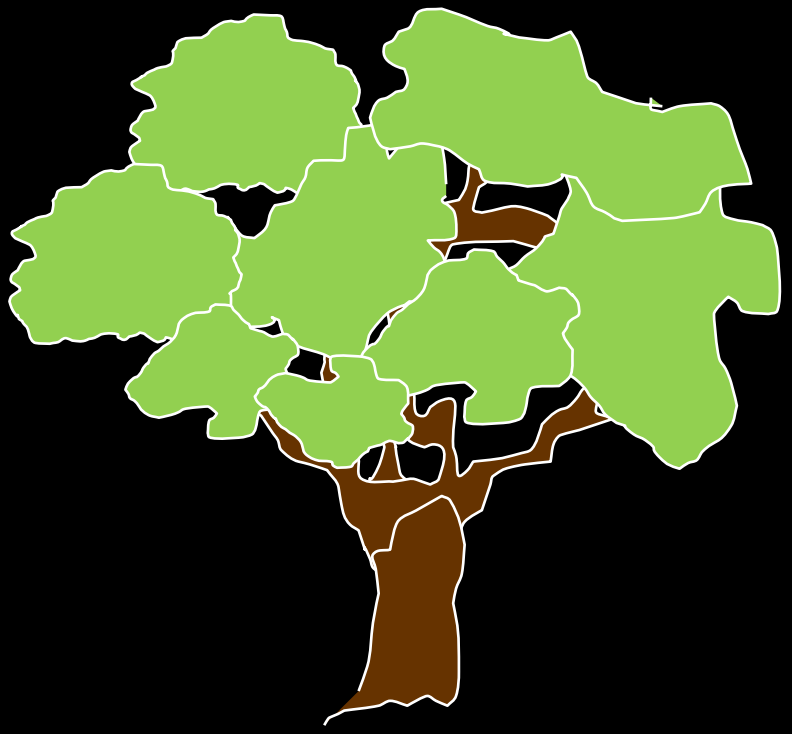
Cultural Controls

Closed vs. Open Canopies



OPEN CANOPY

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Super High Density Systems

Closed Canopies = More Black Scale?

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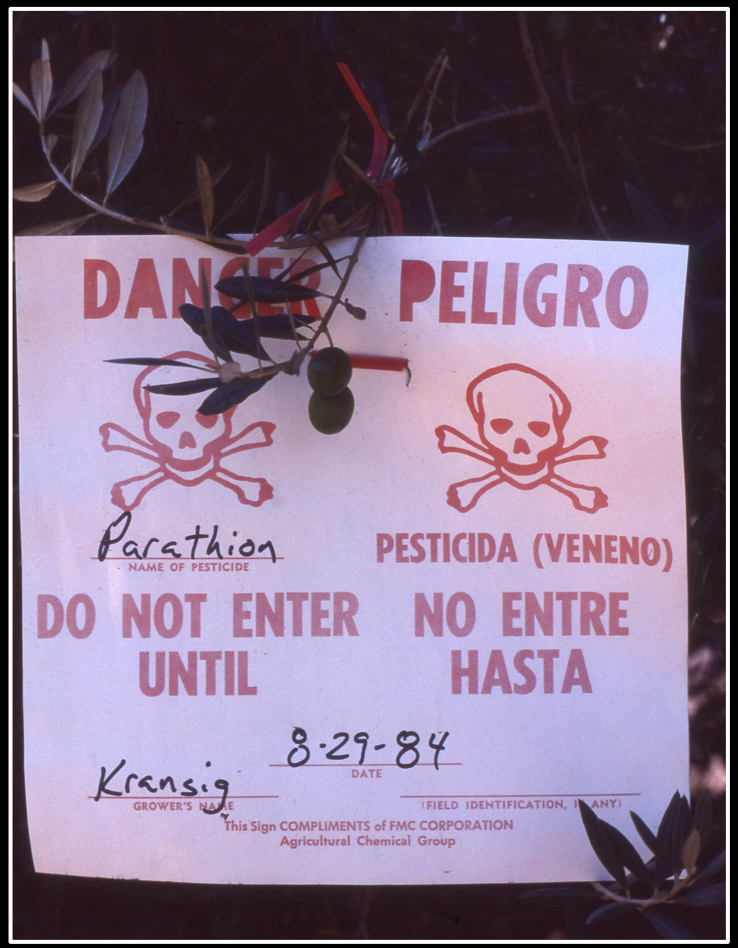
Chemical Controls

History of Chemical Use

- All of the "bad stuff" 1910s-1980s
  - Hydrocyanic acid gas
  - DDT
  - Calcium cyanide
  - Parathion, Malathion



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Chemical Controls

Modern Chemical Controls

- UC IPM Recommends
  - Postbloom/Summer (May-Aug.)
    - Oil
    - Pyriproxyfen (IGR)
    - Oil + carbaryl
  - Postharvest (Oct./Nov.)
    - Oil
    - Oil + methidathion

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Chemical Controls

Modern Chemical Controls

- What Actually Goes On
  - August = Oil + carbaryl (sometimes IGR)
  - November = Oil (sometimes methidathion, but not after 2011)
  - ~30% acreage annually

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Chemical Controls

Current Status of Carbaryl

- 2003 – EPA Registration Review
  - Aggregate risk data, restrict some uses
- 2014 – Cal-DPR "Risk Characterization"
  - Olive is a "top 5" user (tomato + citrus ~40%)
- 2016 – Cal-DPR "Critical Uses"
  - Olive = not a critical use

Though not meeting this document's definition of "critical", the following carbaryl uses are valued by industry or CDFA quarantine officials and should be carefully considered when selecting among mitigation options:

- **Citrus production**: no critical uses per se, though carbaryl is a valuable tool for late-season control of red scale, for helping prevent resistance, and for control of multiple insect species with a single application, and is one of several pesticides effective against Asian citrus psyllid (liquid formulations); and
- **Olive production**: no critical uses per se, though carbaryl is a useful rotation insecticide for scale control to help prevent resistance (liquid formulations).

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Market Summary

Production

- 56,000 acres (99% of US production)
  - ~40k oil
  - ~16k table

Exports

- 40% of crop exported ($40 million)
  - Canada – 37%
  - Mexico – 14%
  - EU – 10%
  - Japan – 7%
  - Taiwan – 5%
  - All others – 27%

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Market Summary

MRLs of Key AIs

Country	Carbaryl	Buprofezin	Pyriproxyfen
United States	10 / -	3.5 / 4.8	1 /2
Canada (37%)	10 / -	5 / -	1.5 / 2
Mexico (14%)	10 / -	3.5 / 4.8	1 / 2
EU (10%)	0.01 / 0.02	5 / 5	0.05 / 0.05
Japan (7%)	30 / 25	5 / -	1 / -
Taiwan (5%)	0.5 / -	1 / -	0.01 / -

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Alternative AIs?

Carbaryl

- Domestic scrutiny
- MRL restrictions in some export markets (EU, Taiwan)

Alternatives

- Insect growth regulators
  - Pyriproxyfen
  - Buprofezin
- Systemics
  - Neonicotinoids
    - Imidacloprid
    - Acetamiprid
  - Spriotetramat
- Other

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Alternative AIs?

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- Other

- Some of these promoted in other markets
- Limited use and efficacy data for olive scale in CA
- Moreover specifically for high-density plantings

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Summary and Conclusions

Black Scale Management

- Long history in California
- Biological control
  - Complicated by ecological considerations
- Cultural control
  - Open canopy is key
- Chemical control
  - Oils, carbaryl, IGRs

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Summary and Conclusions

CA Olive Industry Today

- High-density plantings
  - Changes to canopy structure
- Chemical regulations / MRLs
  - Possible restrictions
- Potential Research Opportunity
  - Black scale development in hedge-style plantings
  - Spray coverage, timing, AIs etc.
  - Natural enemy impacts



THANK YOU!

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