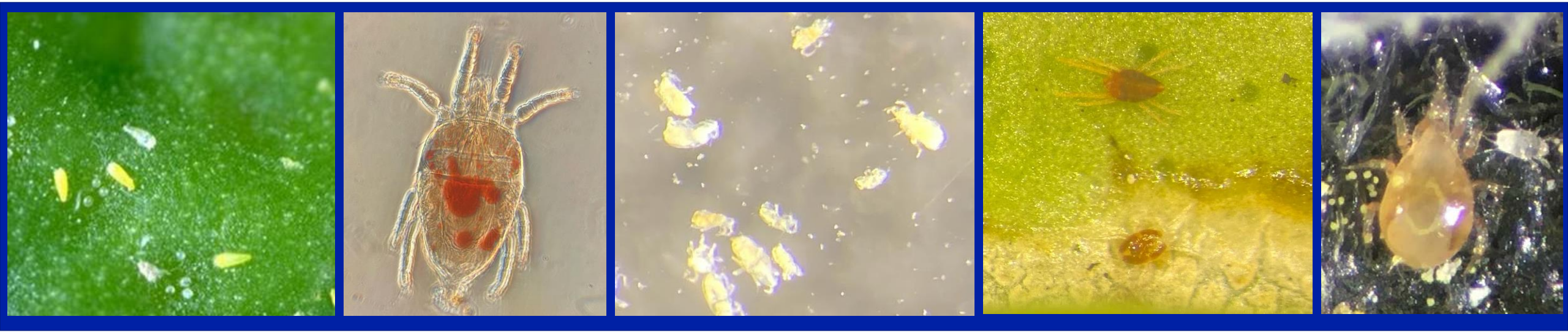

# Mites in citrus

Citrus Insect Management Workshop 2025

Emilie Demard

February 5th, 2025

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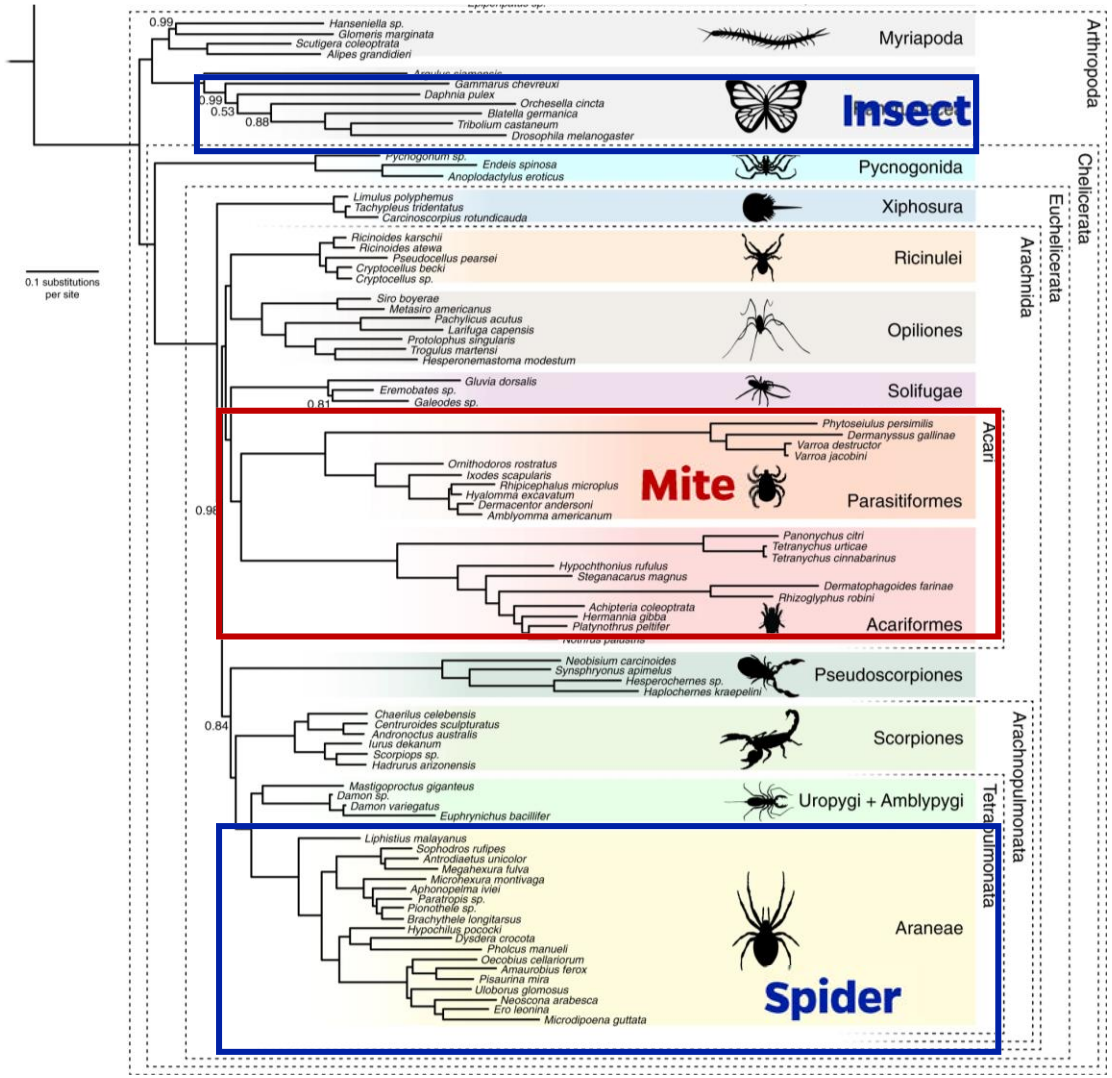
# What is a mite?

- Mites are NOT insects nor spiders
- Gathered in the group “Acari”
- Different food sources
  - Plant (pest mites)
  - Other arthropods (predatory mites)
  - Pollen
  - Fungi




Lozano-Fernandez et al. 2019

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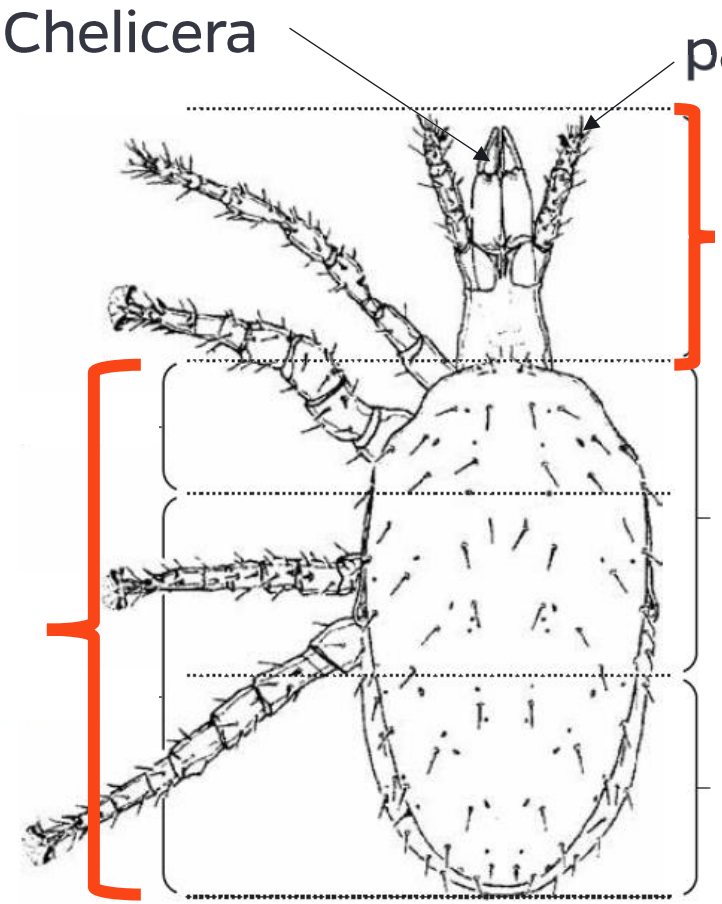
# What is a mite?

- Mites are NOT insects nor spiders
- Gathered in the group “Acari”
- Morphology
  - 4 pairs of legs
  - 2 body parts
  - No antennae
  - No wings
  - Really tiny (mm)

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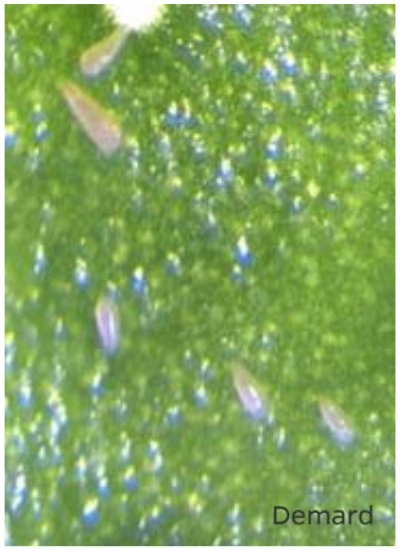
# Four families of economic importance in citrus

Eriophyidae (rust mites)




Citrus rust mite

Tetranychidae (spider mites)


Citrus red mite

Tenuipalpidae (flat mites)


*Brevipalpus* spp.

Tarsonemidae

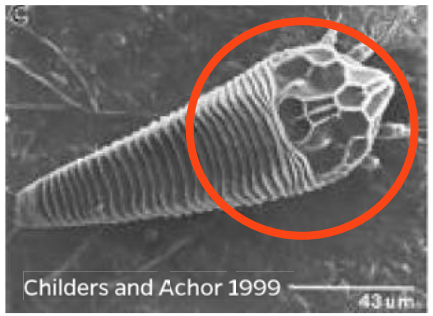

Broad mite

# Rust mite: Identification

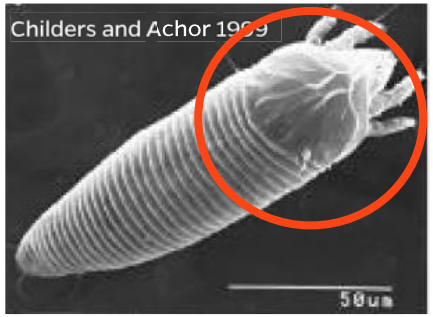
- Family: Eriophyidae
- Only 2 pair of legs
- Extremely tiny ≈ 150 µm → hand lens
- Slow movers
- White, yellow, pink to light brown
- Two species of economic importance in Florida


Citrus rust mite (CRM)
*Phyllocoptruta oleivora*

75% CRM




Pink citrus rust mite (PCRM)
*Aculops pelekassi*




4-22% PCRM

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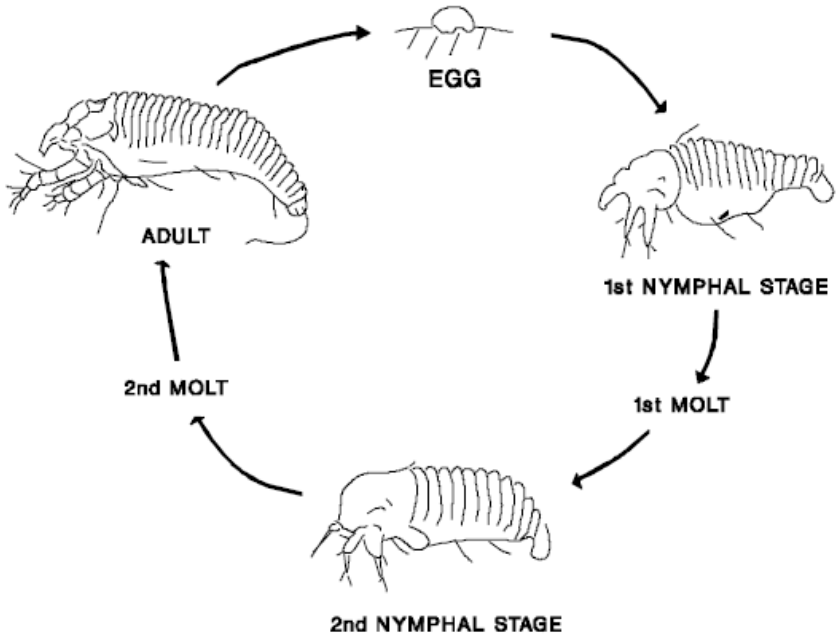
# Rust mite: Damages

- On leaves
  - Upper surface: bronze-like damages, yellowish discoloration
  - PCRM: Leaf distortion and curling of leaf margins


- On fruit
  - Immature fruit: destruction of epidermis cells resulting in russeting (sharkskin)
  - Mature fruit: polish appearance (bronzing)

# Rust mite: Biology

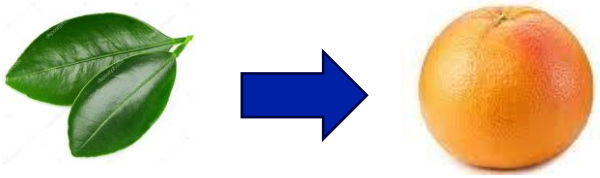
- During summer, 10 days to go from egg to adult
- Up to 30 generations/year for CRM
- PCRM: Starts April-May and peaks in June-July
- CRM: Starts in May-July and peaks in August




Knapp 1994

# Rust mite: Monitoring

- When?
  - Scout leaves in spring (April-May) and fruit early summer
  - Monitor throughout summer until fall (October)



- How often?
  - Every 10-14 days from April-September
- How?
  - With a hand lens (X10)
  - Count the number of mites in one lens field (1 lens field=1.53 $cm^2$)

Threshold for miticides intervention

- 6 rust mites/$cm^2$ for processed fruit
- 2 rust mites/$cm^2$ for fresh fruit

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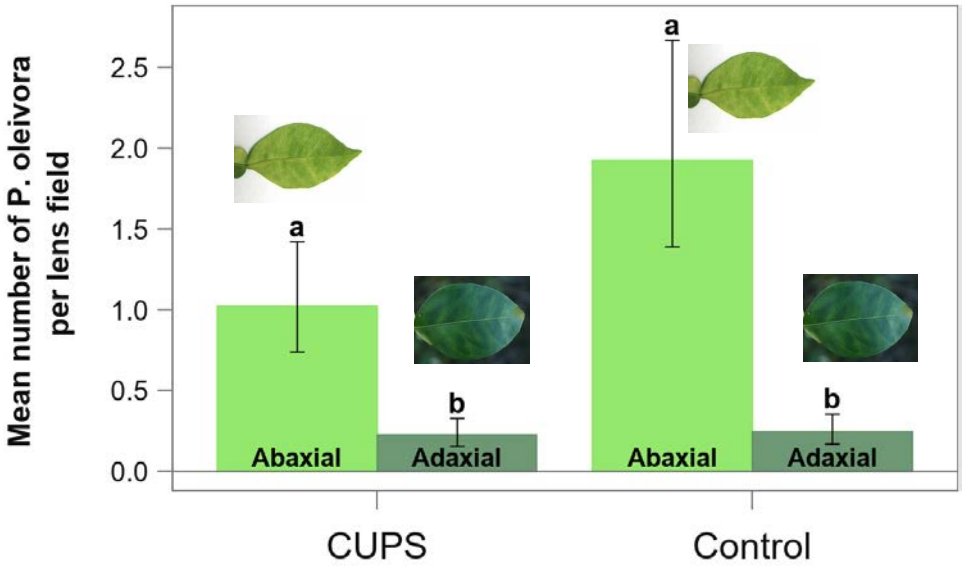
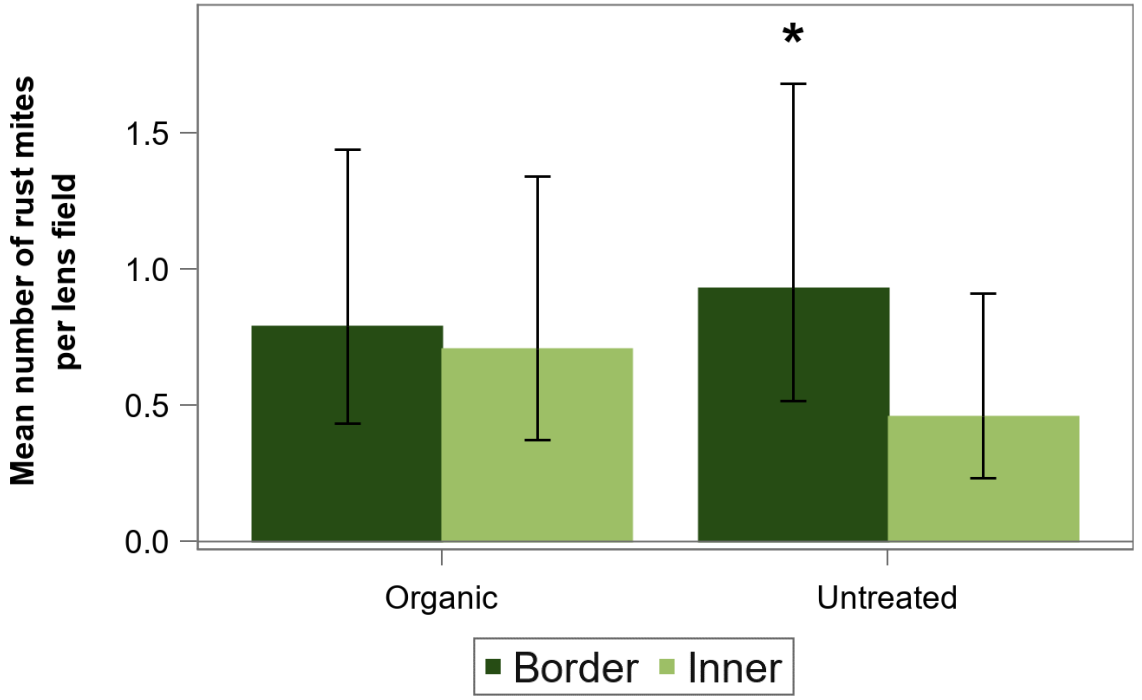
# Rust mite: Monitoring

- Where?
  - Leaves: prefer abaxial surface (lower side)
  - North bottom quadrant of tree is preferred
  - Border effect: higher density on trees located at the edge of the grove

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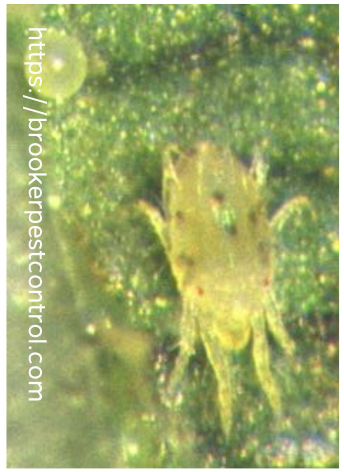
# Spider mite: Identification

Citrus red mite,
*Panonychus citri*


Six-spotted mite,
*Eotetranychus sexmaculatus*




Texas citrus mite,
*Eutetranychus banksi*


Two-spotted spider mite (TSSP),
*Tetranychus urticae*


Problem in nursery

**4 species of economic importance**

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# Spider mite: Identification

Spider mite identification is tricky!


Colors variations in two spotted spider mite females


Red hybrid F1 females of TSSP


Citrus red mite

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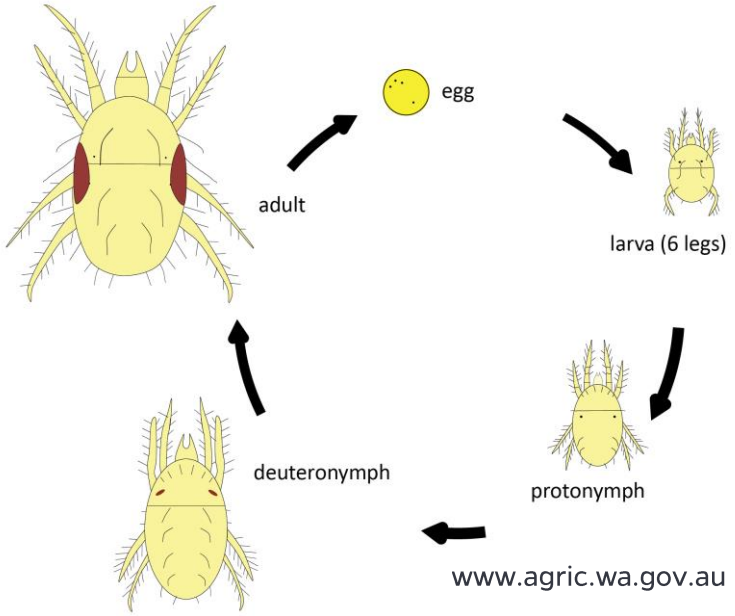
# Spider mite: Damages & biology

- On leaves
  - Small yellow spots = Stippling
  - Premature leaf drop & defoliation
  - Webbing


Stippling


- Biology
  - Depending on conditions:
    - 7-10 days in summer
    - 12-21 days in winter
  - 10-20 generations/year

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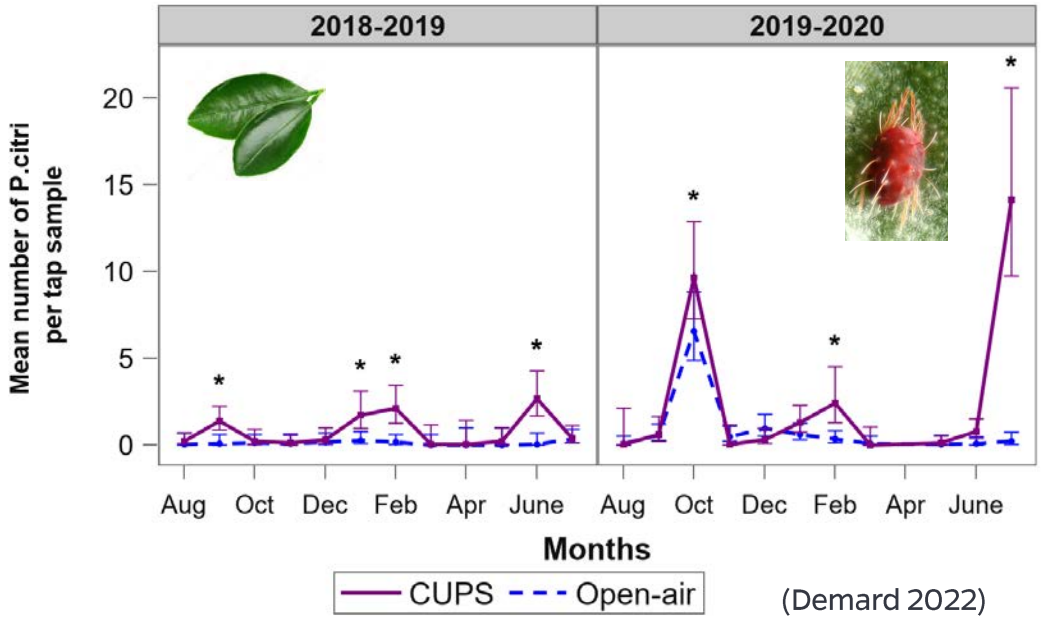
# Spider mite: Monitoring

- When?
  - Scout leaves in spring (March) → every 2 weeks
  - Monitor throughout summer until fall (October)→ every week
- How?
  - With a hand lens (X10)
  - 1 leave/quadrant
- Where?
  - Under side of the leaves: TSSP
  - Upper side of the leaves: Other spider mites

Example: Citrus red mite




(Demard 2022)

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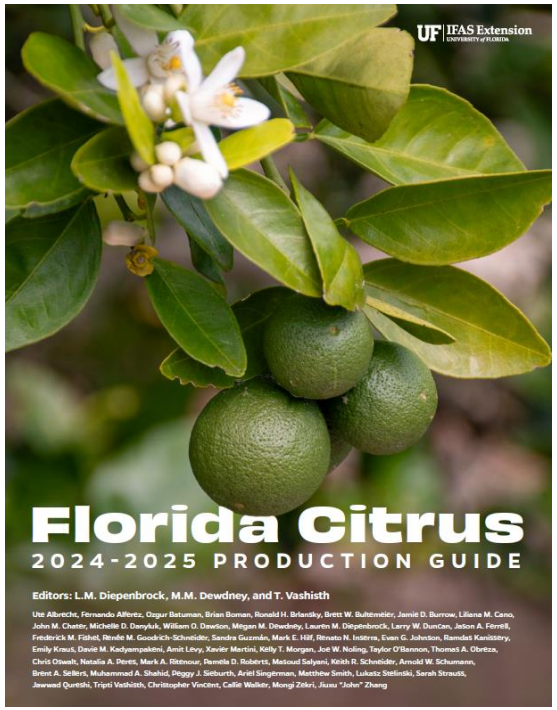
# Spider mite: Monitoring

- Citrus production guide

Table 1. Control thresholds and appropriate sample sizes for 10 acres.

| **If the control threshold is:** | **Sample Size** (Sample trees should be uniformly scattered across a 10-acre block. Do not sample adjacent trees.) |
|---|---|
| 5 mites/leaf | Examine 4 leaves/tree from 6 trees/area from 4 areas/10 acres = 96 leaves on 24 trees/10 acres |
| 8 mites/leaf | Examine 4 leaves/tree from 6 trees/area from 3 areas/10 acres = 72 leaves on 18 trees/10 acres |
| 10 mites/leaf | Examine 4 leaves/tree from 5 trees/area from 2 areas/10 acres = 40 leaves on 10 trees/10 acres |
| 15 mites/leaf | Examine 4 leaves/tree from 4 trees/area from 2 areas/10 acres = 32 leaves on 8 trees/10 acres |




Threshold for miticides intervention

- 5 to 10 motile spider mites/leaf

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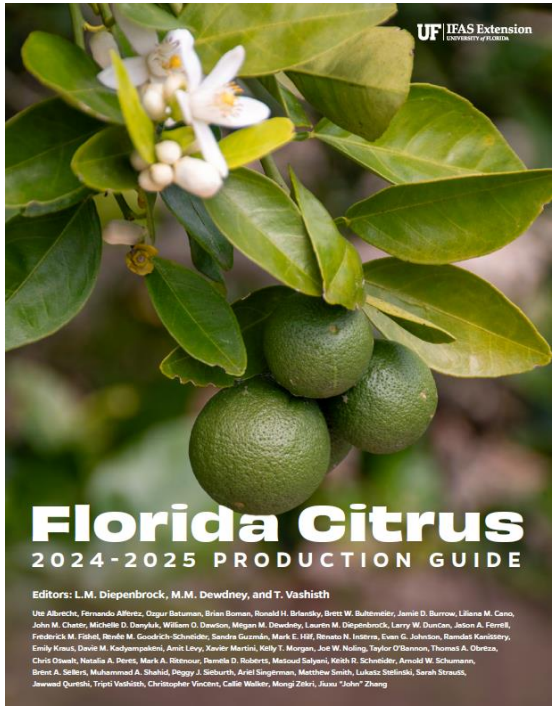
# Spider mite: Monitoring

- Citrus production guide

Table 1. Top 10 resistant arthropods, based on the number of unique active ingredients for which resistance has been reported and the number of cases reported (Whalon et al., 2008).

| Species | Taxonomy | Pest type | No. active ingredients | Cases |
|---|---|---|---|---|
| *Tetranychus urticae* | Acari: Tetranychidae | Crop | 92 | 367 |
| *Plutella xylostella* | Lepidoptera: Plutellidae | Crop | 81 | 437 |
| *Myzus persicae* | Homoptera: Aphididae | Crop | 73 | 320 |
| *Leptinotarsa decemlineata* | Coleoptera: Chrysomelidae | Crop | 51 | 188 |
| *Musca domestica* | Diptera: Muscidae | Urban | 47 | 195 |
| *Blattella germanica* | Blattodea: Blattellidae | Urban | 43 | 213 |
| *Boophilus microplus* | Acari: Ixodidae | Lifestock | 43 | 151 |
| *Helicoverpa armigera* | Lepidoptera: Noctuidae | Crop | 42 | 608 |
| *Bemisia tabaci* | Homoptera: Aleyrodidae | Crop | 42 | 281 |
| *Panonychus ulmi* | Acari: Tetranychidae | Crop | 42 | 181 |

(Van Leeuwen et al. 2010)

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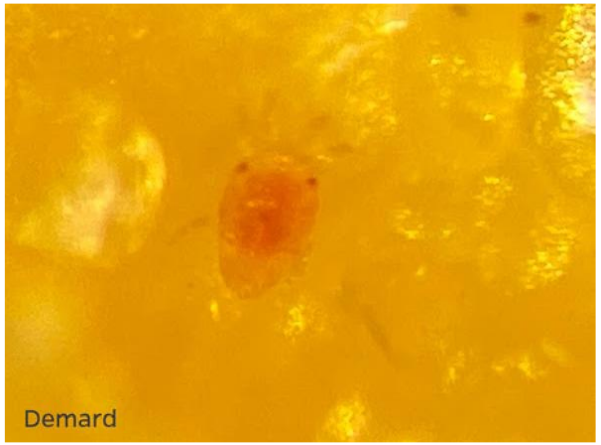
# Flat mite: Identification

- Mainly in tropical and subtropical areas
- Some species vector plant viruses
- Genus *Brevipalpus* species associated with Citrus leprosis virus (CiVL)
  - ***B. californicus***
  - ***B. yothersi***

  **Presumed primary vectors of citrus leprosis**
  - *B. obovatus*
  - *B. phoenicis*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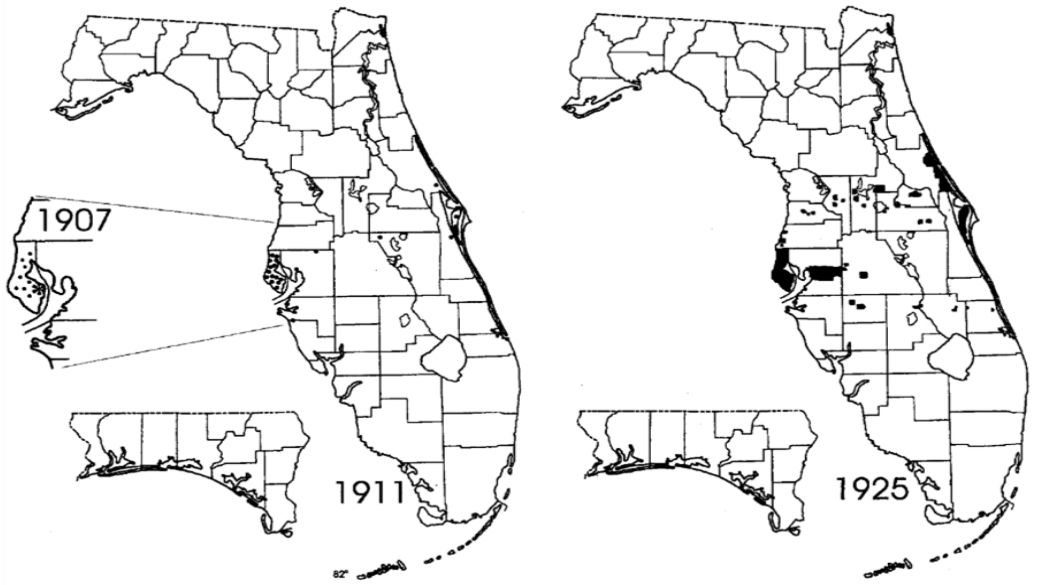
# Flat mite: Citrus leprosis virus

- Serious disease of citrus prior to 1920's
- No finds of the virus were reported since 1968
- Reasons for disappearance of the virus were unknown
- CiLV exists under two types:
  - Cytoplasmic type
  - Nuclear type




(Childers et al. 2003)

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# Flat mite: Damages & biology

Damages

- Scabbing on fruit
- Fruit drop
- Excessive leaf drop
- Dieback of shoots



Biology

- Long life cycle (60 days)
- Eggs and adults found in crevices, stems, lesions



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# Broad mite: Identification & biology

## Identification

- 1 species : *Polyphagotarsonemus latus*
- White-yellowish
- 160 microns in length


## Biology

- Eggs in lower surfaces of young apical leaves
- Nymph females are picked up by the males and moved to newly developing flush and young citrus fruit


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# Broad mite: Damages

- On young leaves
  - Toxic saliva: distorted leaf
  - Terminal dieback on seedling
  - Witches'-broom on bud

- On fruit
  - Silver blemishes
  - Reduced fruit growth



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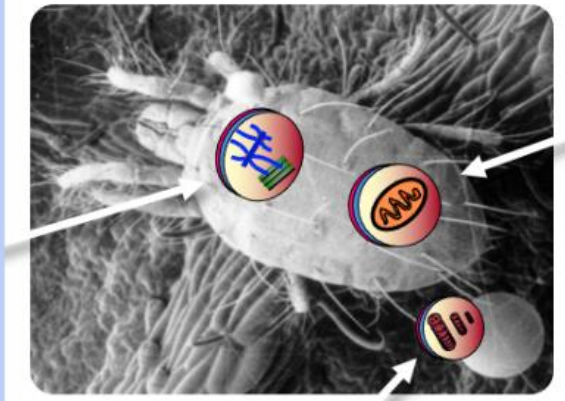
# Chemical control

**Mites - Mode of Action Classification by Target Site**



### Nerve & Muscle Targets

1. Acetylcholinesterase (AChE) inhibitors
   *1A: Carbamates*
   *1B: Organophosphates*
2. GABA-gated chloride channel blockers
   *2A: Cyclodiene Organochlorines*
3. Sodium channel modulators
   *3A: Pyrethrins, Pyrethroids*
5. Nicotinic acetylcholine receptor (nAChR) allosteric modulators – site I
   *Spinosyns*
6. Glutamate-gated chloride channel (GluCl) allosteric modulators
   *Avermectins, Milbemycins*
19. Octopamine receptor agonists
    *Amitraz*
32. Nicotinic acetylcholine receptor (nAChR) allosteric modulators Site II
    *GS-omega/kappa HXTX-HV1a Peptide*
30. GABA-gated chloride channel allosteric modulators
    *Isoxazolines*
33. Calcium-activated potassium channel (KCa2) modulators
    *Acynonapyr*

Agri-Mek, Agri-Flex, Reaper

### Respiration Targets

12. Inhibitors of mitochondrial ATP synthesis
    *12A: Difenthiuron*
    *12B: Organotin miticides*
    *12C: Propargite*
13. Uncouplers of oxidative phosphorylation via disruption of the proton gradient
    *Chlorfenapyr*
20. Mitochondrial complex III electron transport inhibitors – Qo site
    *20B: Acequinocyl*
    *20C: Fluacrypyrim*
    *20D: Bifenazate*
21. Mitochondrial complex I electron transport inhibitors
    *21A: METI acaricides*
25. Mitochondrial complex II electron transport inhibitors
    *25A: Cyenopyrafen, Cyflumetofen*
    *25B: Pyflubumide*
34. Mitochondrial complex III electron transport inhibitors – Qi site
    *Flometoquin*

Vendex

Comite

Nexter

Apta

### Growth & Development Targets

10. Mite growth inhibitors affecting CHS1
    *10A: Clofentezine, Diflovidazin Hexythiazox*
    *10B: Etoxazole*
15. Inhibitors of chitin biosynthesis affecting CHS1
    *Benzoylureas*
23. Inhibitors of acetyl-CoA carboxylase
    *Tetronic & Tetramic acid derivatives*

Micromite

Envidor

### Unknown or uncertain MoA

*Benzoximate, Chinomethionat, Dicofol*

Sulfur, Petroleum Oil

https://irac-online.org

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# Chemical control

- Florida Citrus Guide recommendation (2024-25) on miticide use

Table 2. Citrus miticide selection.*

| Supplemental (Early Spring) | Postbloom | Summer | Fall | Supplemental Fall |
|---|---|---|---|---|
| -- | -- | Agri-mek + oil | -- | -- |
| Apta | Apta | -- | Apta | Apta |
| -- | -- | -- | Comite | Comite |
| Envidor | Envidor | Envidor | Envidor | Envidor |
| -- | Petroleum oil | Petroleum oil | Petroleum oil | -- |
| -- | -- | -- | Sulfur | Sulfur |
| -- | -- | Micromite | Micromite | -- |
| -- | -- | -- | Nexter | Nexter |
| Movento | Movento | Movento | -- | -- |
| Vendex | Vendex | -- | Vendex | Vendex |

*Except for petroleum oil, do not use the same miticide chemistry more than once a year.

Resistance

2011 database on global acaricide resistance level:
**1177 reports** on resistance in **79 species** from Acari (Marcic 2012).

**To avoid resistance no miticide except petroleum oil should be used more than once a year**

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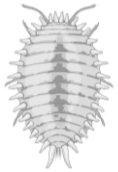
# Biological control: Predatory mites

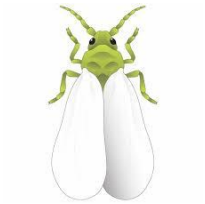
Sold by

- Phytoseiidae: most common family
- Larger & faster than pest mites
- Feed on:

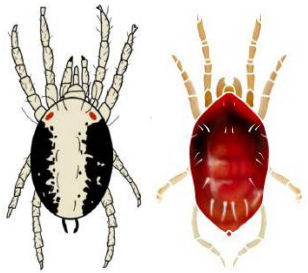
Thrips



Mealybugs



Whiteflies



Spider mites

Commercially available species

*Amblyseius cucumeris*

*Amblyseius swirskii*

*Neoseiulus californicus*

*Phytoseiulus persimilis*

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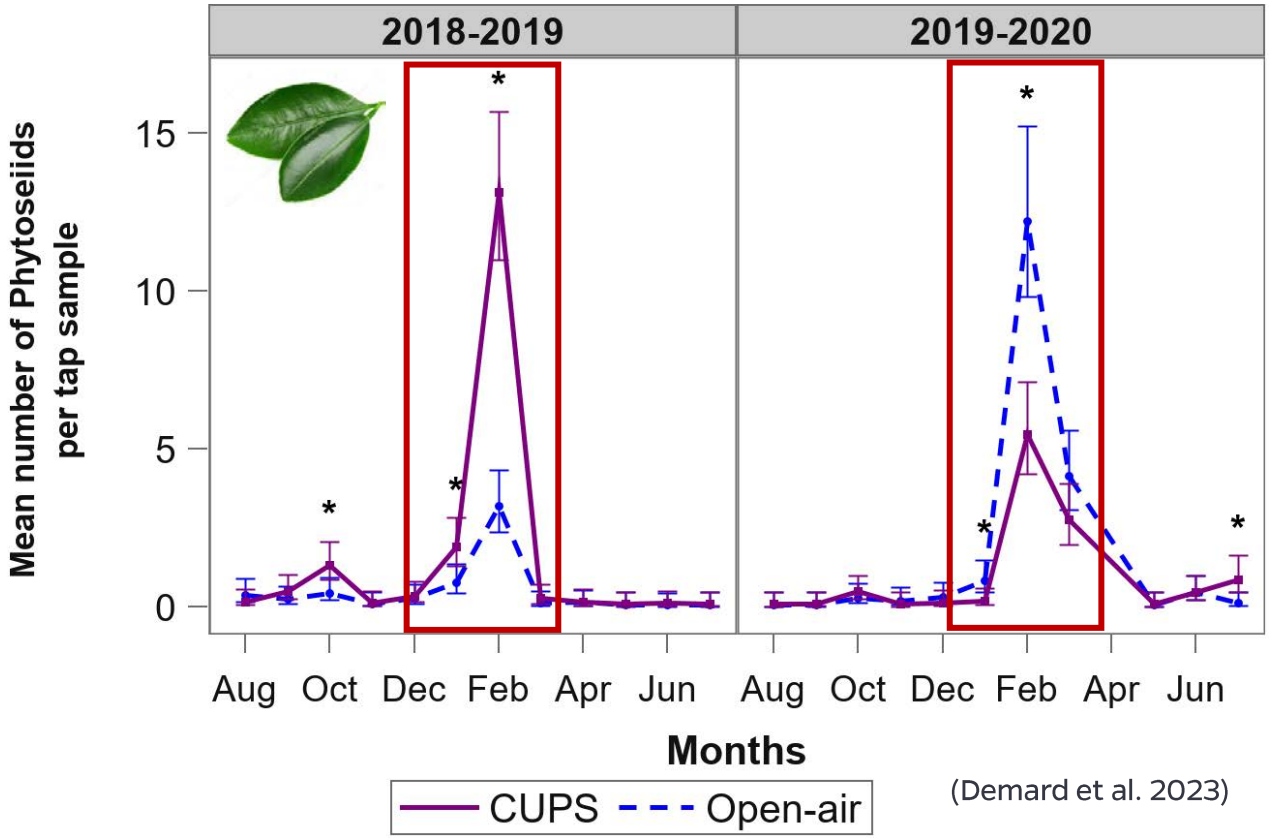
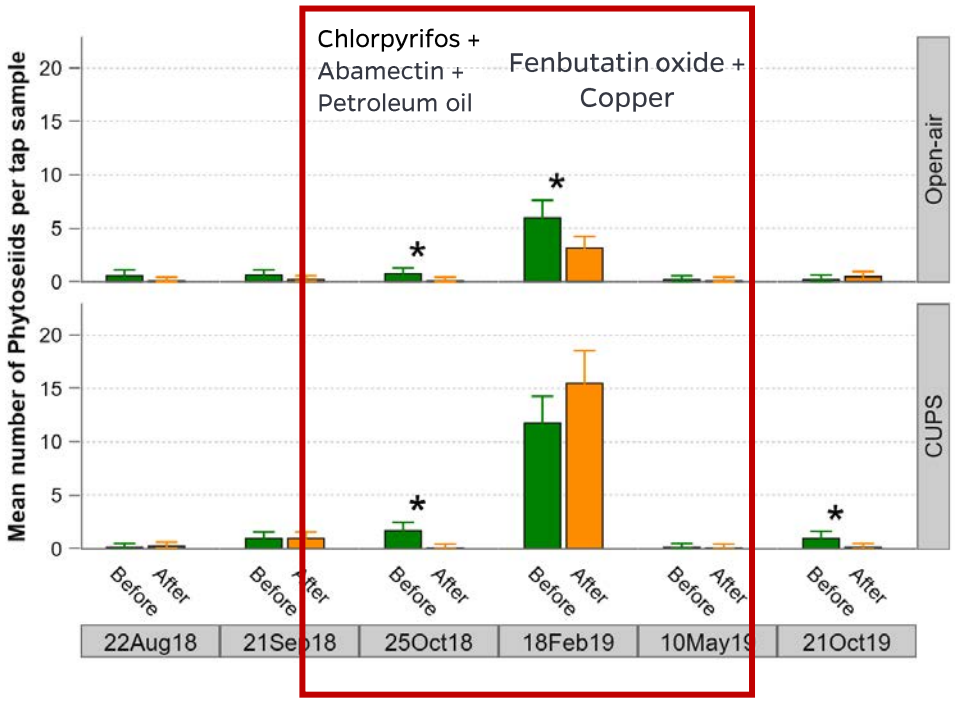
# Conservation of predatory mites

- Avoid spraying acaricides during bloom (Feb-April)




(Demard et al. 2023)

Some sprays reduced the abundance of phytoseiids

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# Thank you for your attention

Questions?

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