



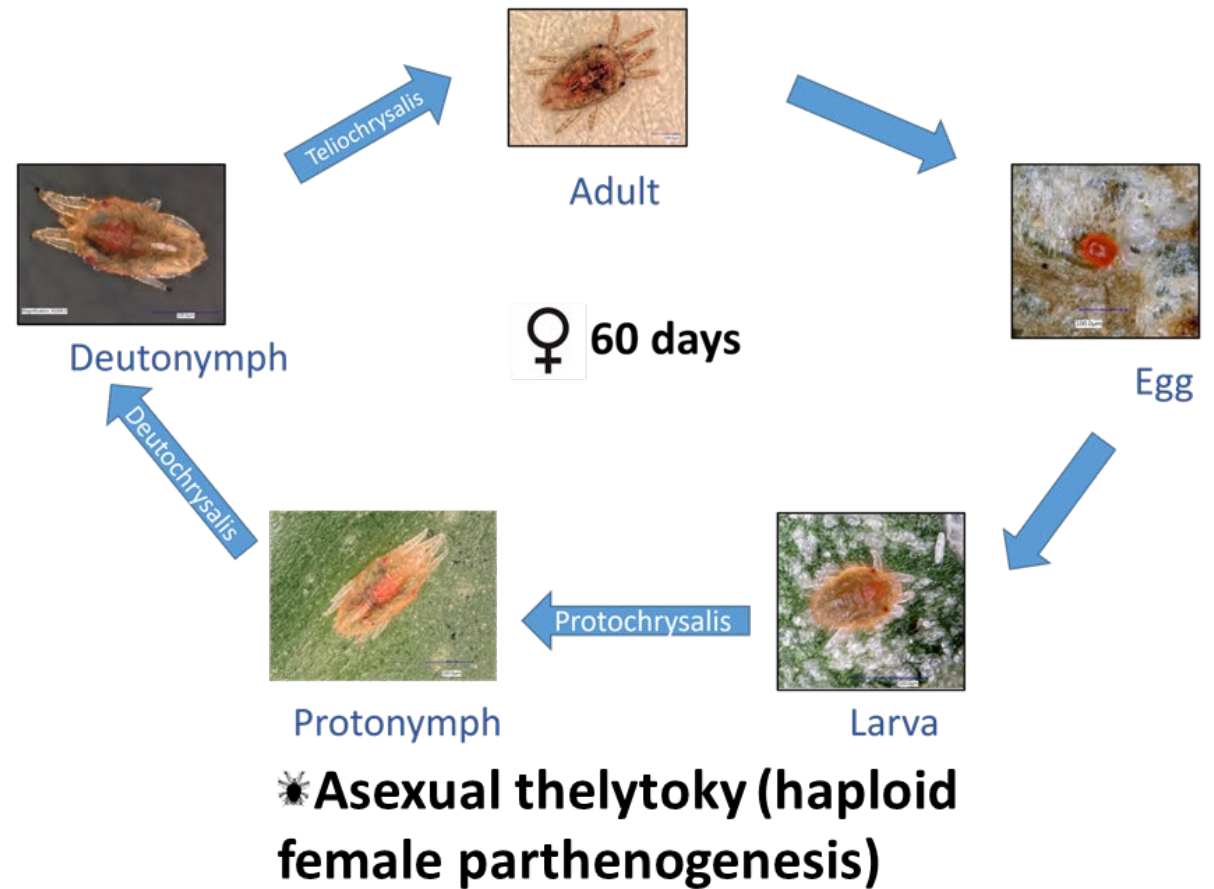
# VIRAL DISEASES TRANSMITTED BY BREVIPALPUS MITES

Daniel Carrillo & Aline D. Tassi, UF/IFAS TREC

- Flat mites = Family Tenuipalpide (891 spp.)
- Genus *Brevipalpus* = 289 spp.
- Mainly in tropical and subtropical areas
- Some species transmit viruses
  - *B. californicus*
  - *B. yothersi* Presumed primary vectors of citrus leprosis
  - *B. tucuman*
  - *B. obovatus*
  - *B. phoenicis*
  - *B. papayensis*



- Long life cycle
- Eggs in crevices or fruit, stems, and lesions
- Larvae- 3 pairs of legs
- Nymphs – 4 pairs of legs
- Adult – flat and relatively long lived



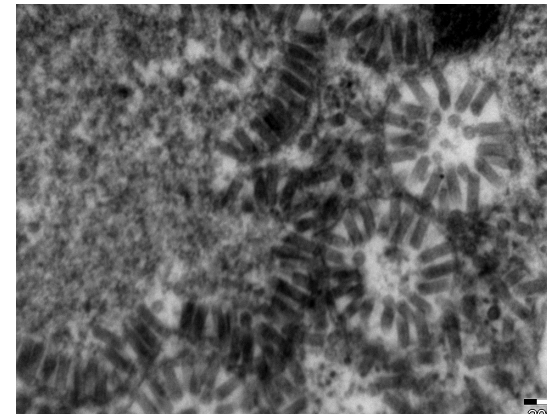
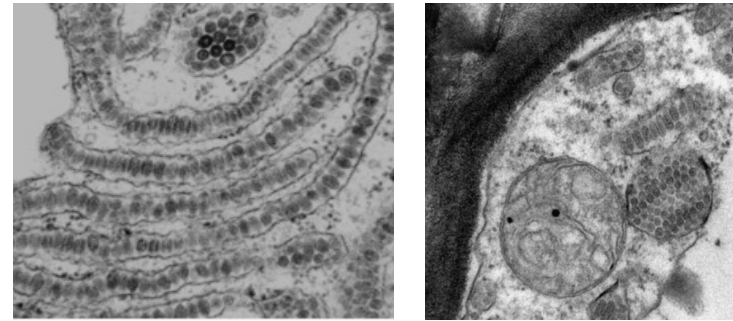
# *Brevipalpus* mites and their transmitted viruses

Family Kitaviridae

Cytoplasmic type: Cilevirus  
Higrevirus

Family: Rhabdoviridae

Nuclear type: Dichorhavirus



non-systemic

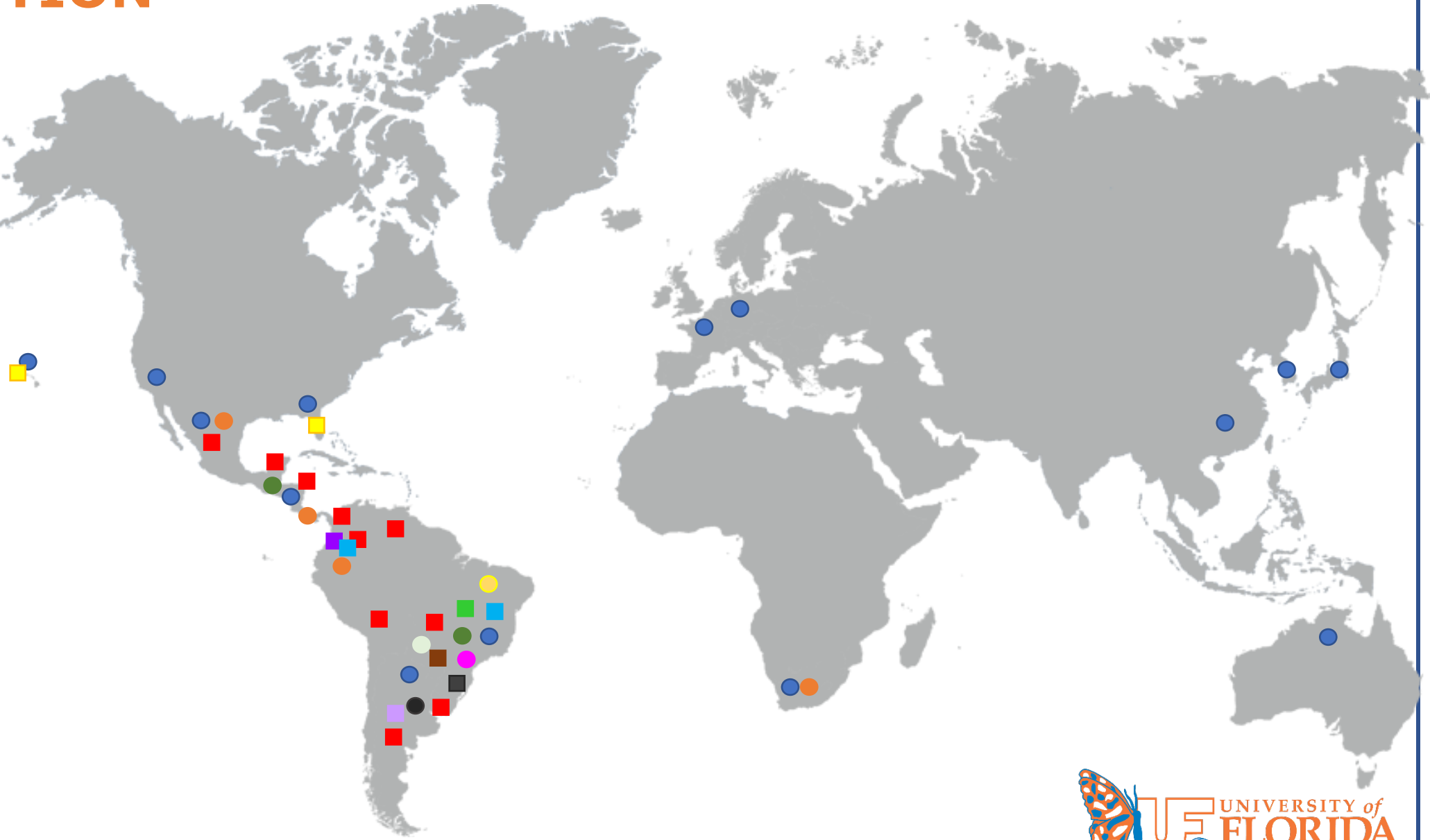
# DISTRIBUTION

## Dichorhavirus

- OFV
- OFV\_citrus
- CoRSV
- CiLV-N
- CiCSV
- CiBSV
- CiCSV

## Kitavirus

- CiLV-C\_CRD
- CiLV-C\_SJP
- CiLV-C2
- PfGSV
- SvRSV
- LigCSV
- LigLV
- CiLV-C2 Hib

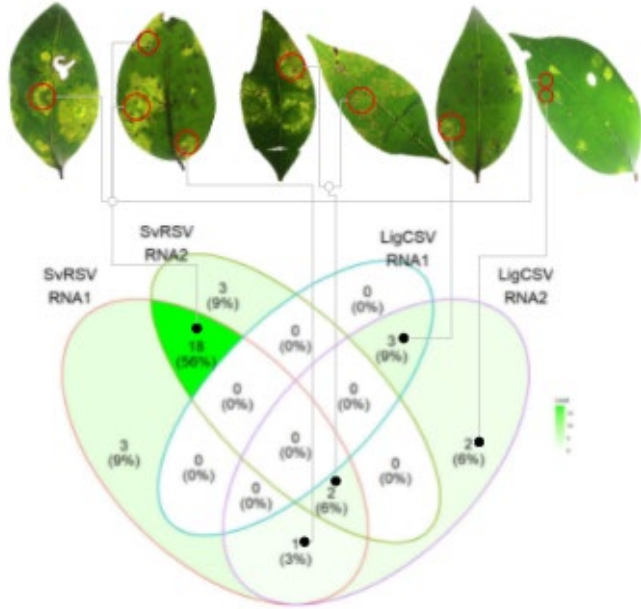


# SYMPTOMS



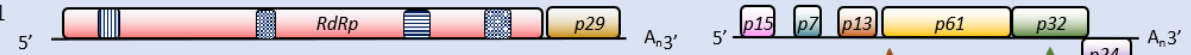
# Cilevirus

# Passion fruit green spot virus and new Kitaviridae



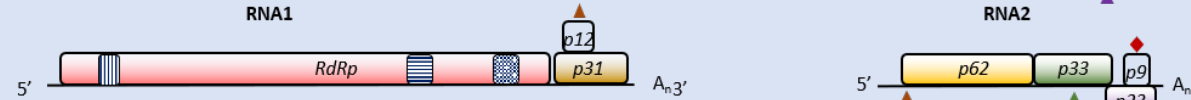
## *Cilevirus passiflorae*

passion fruit green spot virus Snp1  
MK804171 & MK804172



## *Cilevirus solani*

Solanum violifolium ringspot virus  
OK626439 & OK626440



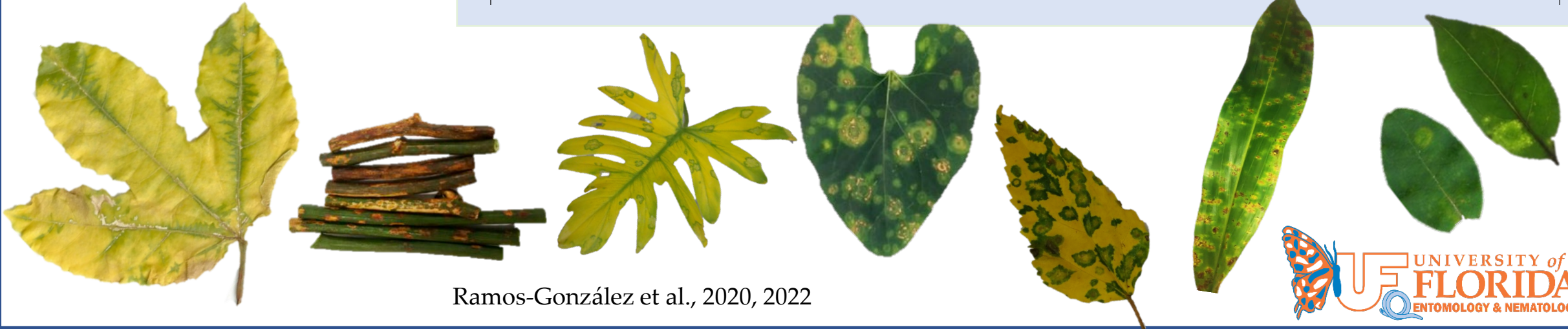
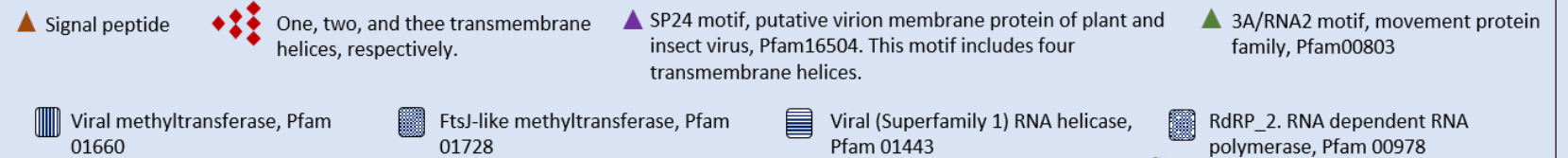
## *Cilevirus australis*

Ligustrum chlorotic spot virus  
OK626447 & OK626448



## *Cilevirus ligustri*

Ligustrum leprosis virus  
OK626451 and OK626452



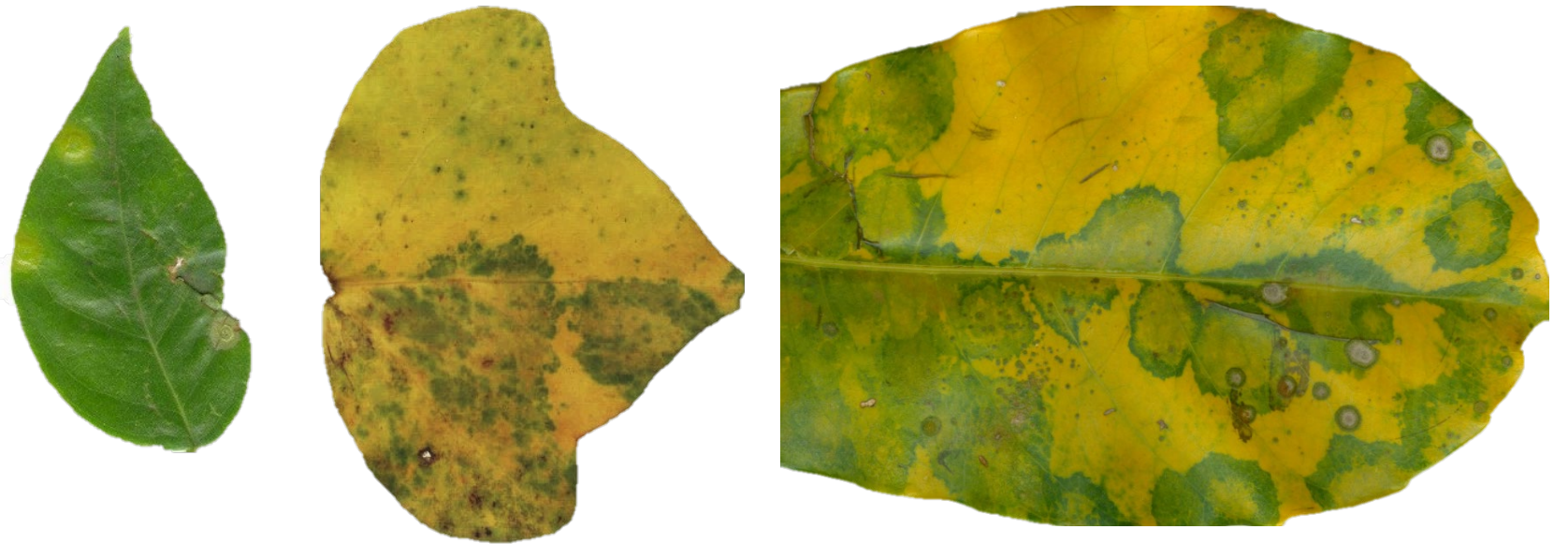
Ramos-González et al., 2020, 2022

# Cilevirus

*Cilevirus passiflorae*



- Cestrum nocturnum* - Solanaceae
- Lonicera japonicum* -  
Caprifoliaceae
- Barleria cristata* - Acanthaceae
- Thumbergia erecta* - Acanthaceae
- Hibiscus rosa-sinensis* - Malvaceae
- Brunfelsia uniflora* - Solanaceae
- Eugenia uniflora* - Myrtaceae
- Hedera canariensis* - Araliaceae
- Schefflera actinophylla* - Araliaceae



# Higrevirus

## *Higrevirus waimanalo*

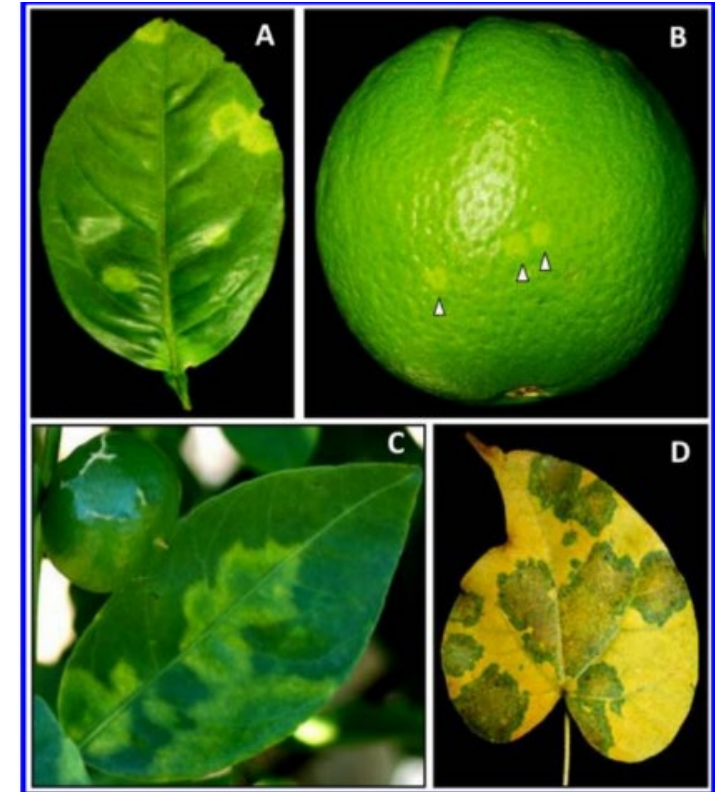
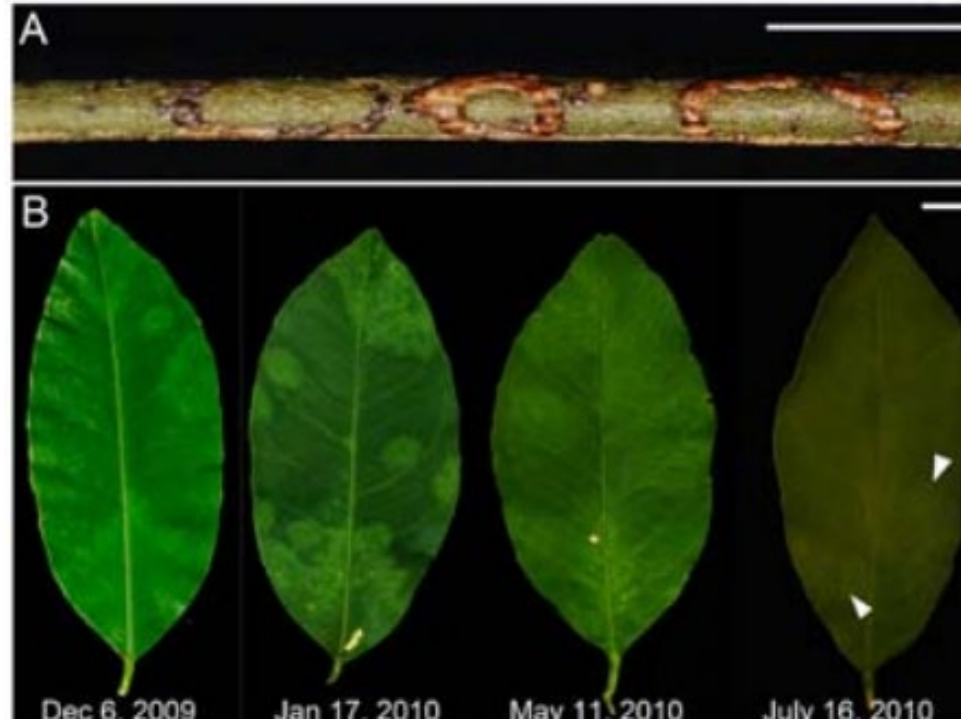


Fig. 3. Natural hosts of *Hibiscus green spot virus 2* (HGSV-2) include navel sweet orange (*Citrus sinensis*) A, leaf, and B, fruit. Arrowheads indicate three lesions on immature fruit. C, Mandarin (*C. reticulata*) leaf and D, hau (*Hibiscus tiliaceus*) leaf infected by HGSV-2.

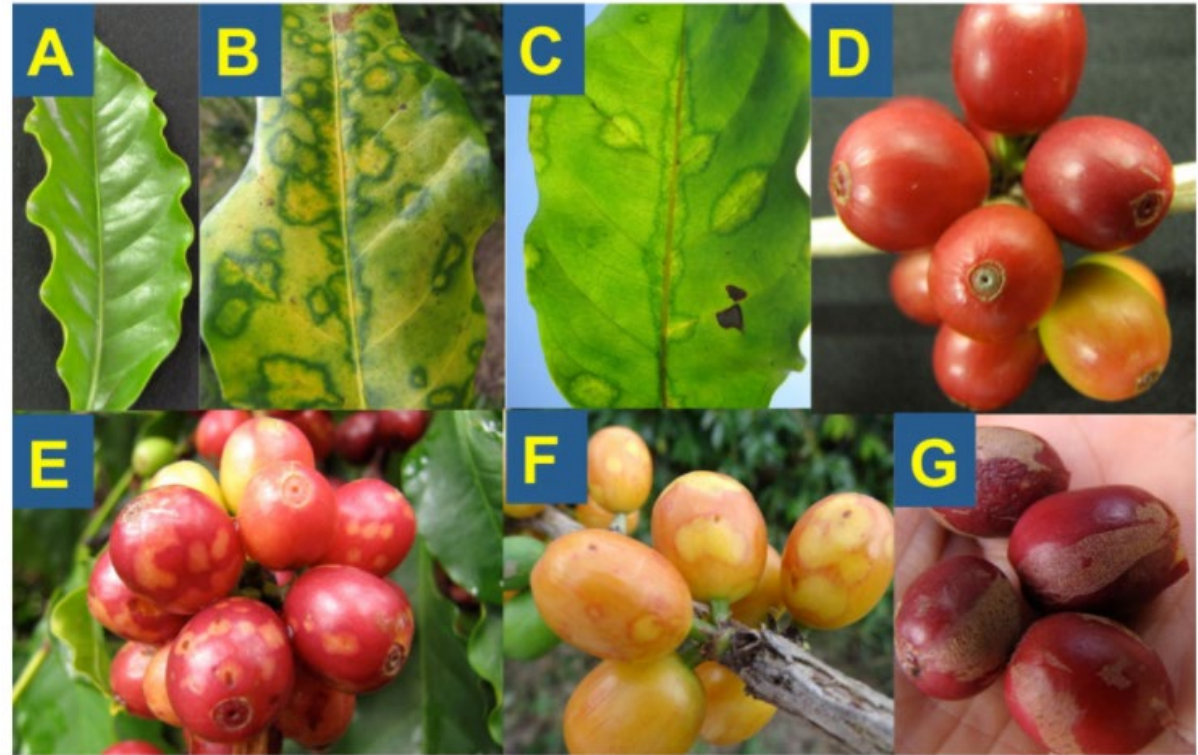
Melzer et al 2022; Roy et al 2015

# Dichorhavirus



*Coffee ringspot virus*

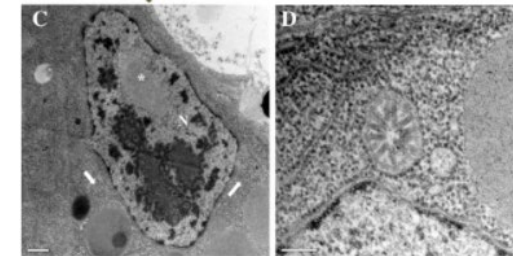
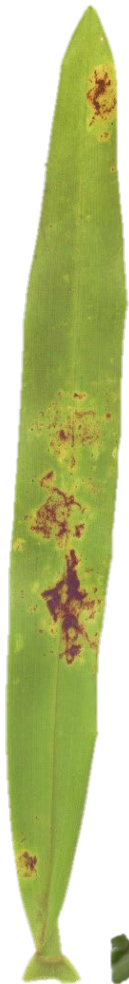
# Dichorhavirus coffeae



Ramalho et al 2014,2015; Nunes et 2022

# Dichorhavirus

# Dichorhavirus clerodendri

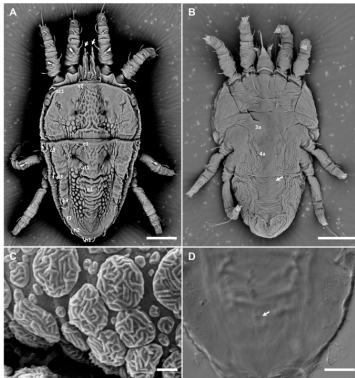
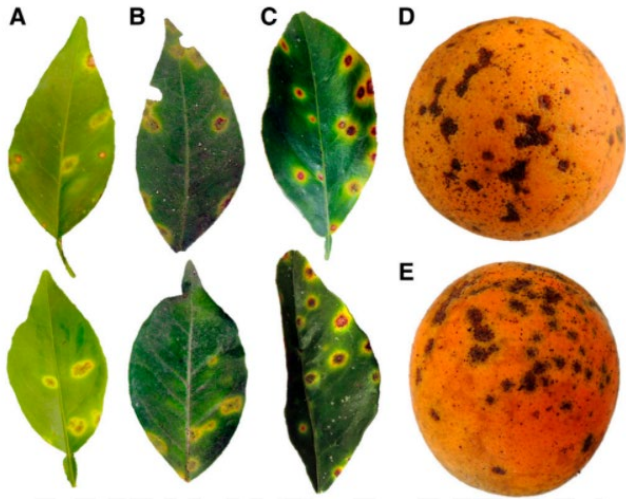


*Clerodendrum chlorotic spot virus*



# Dichorhavirus

# Dichorhavirus leprosis

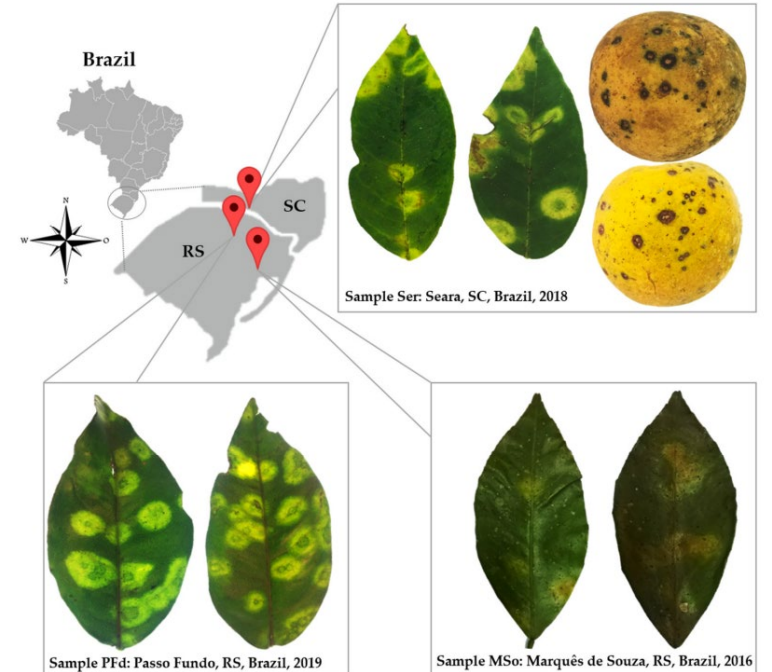


## Citrus leprosis virus N

Ramos-González et al., 2017

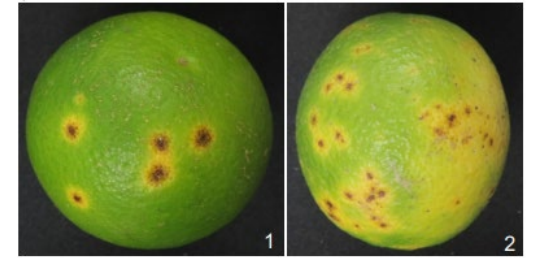
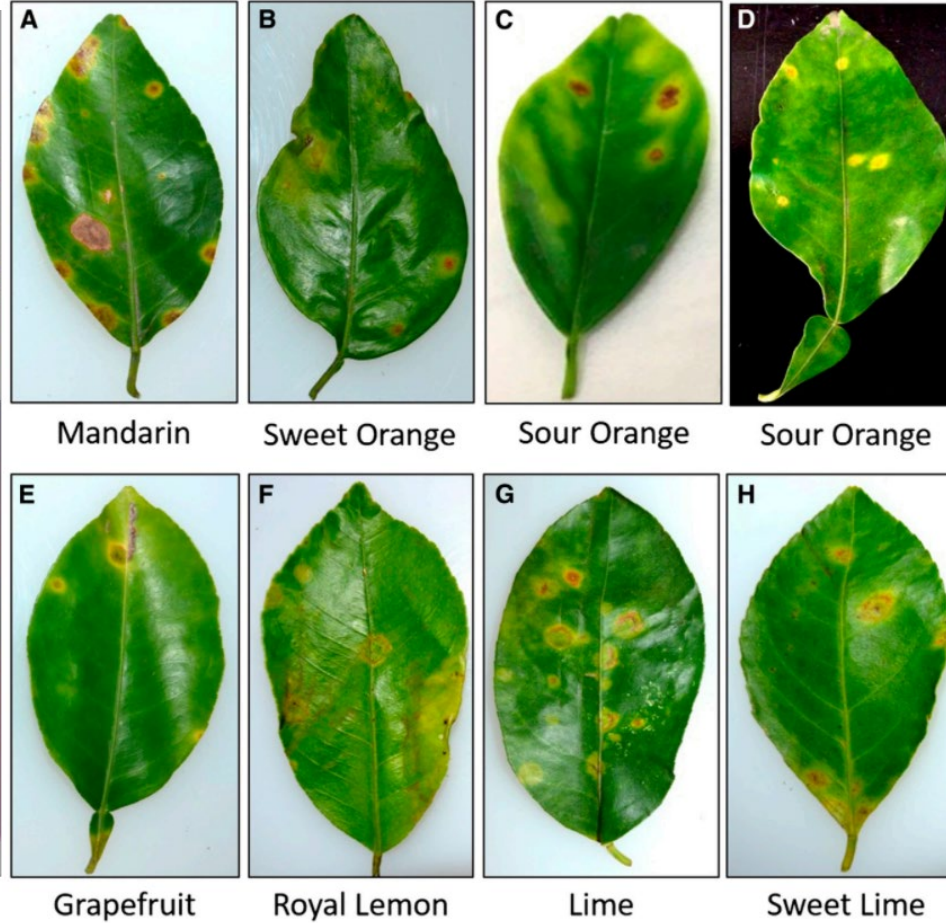
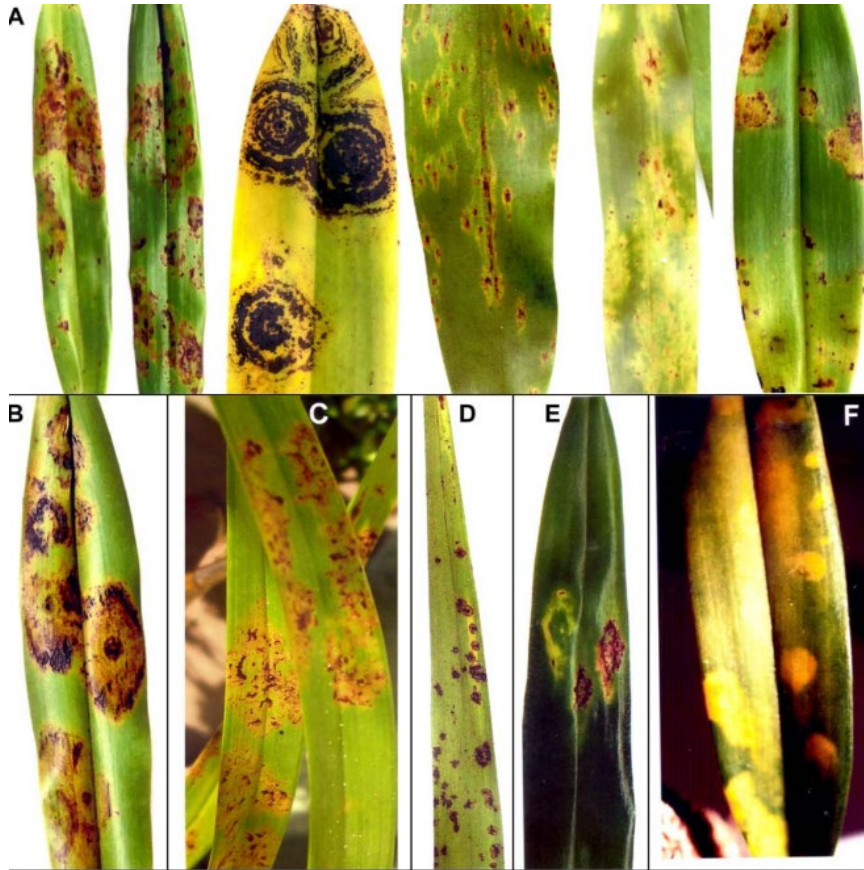
# Dichorhavirus

## *Dichorhavirus citri* *Dichorhavirus australis*



# Dichorhavirus

# Dichorhavirus orchidaceae



# Orchid fleck virus

Roy et al., 2015, 2020; Cook et al., 2019; Dietzgen et al., 2021; Olmedo Velarde et al., 2021

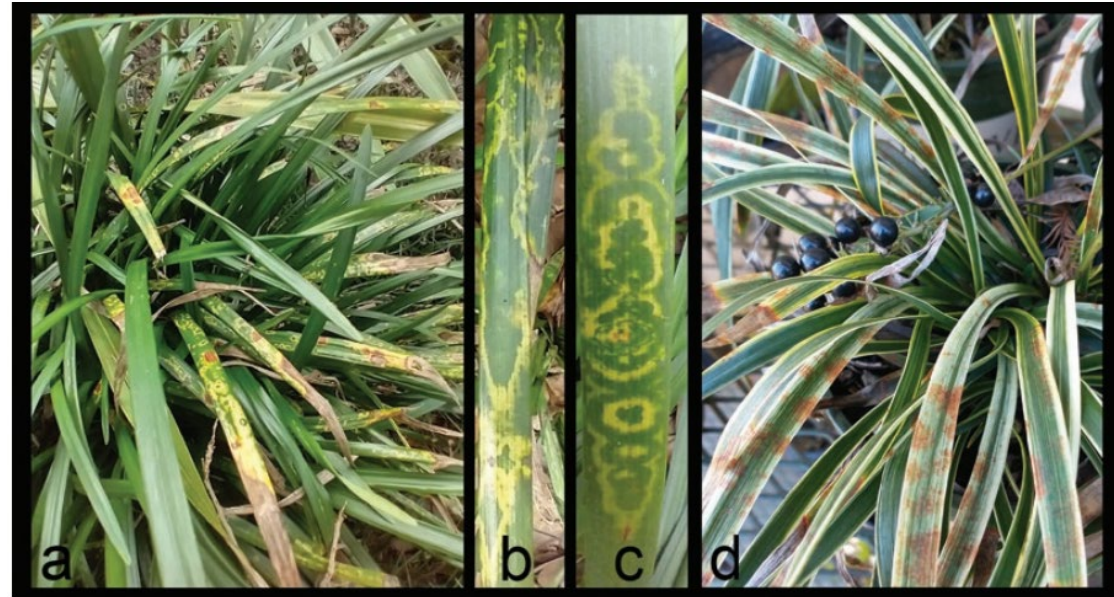
*Dichorhavirus orchidaceae*



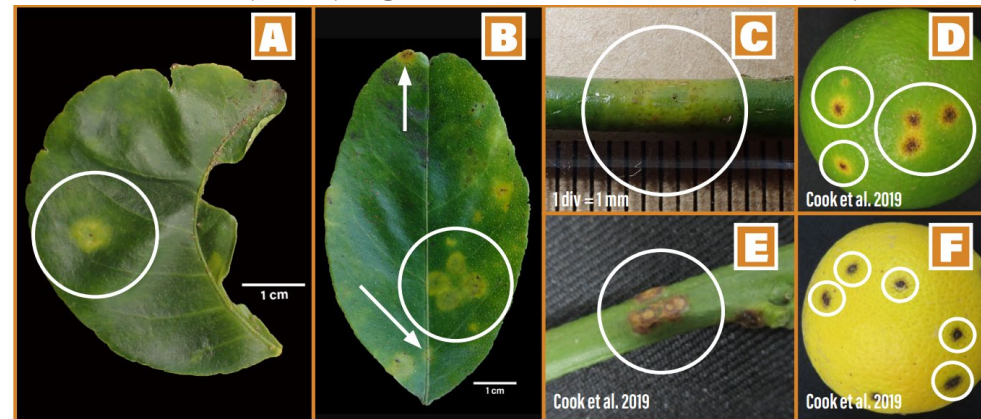
# Dichorhavirus

## Dichorhavirus orchidaceae

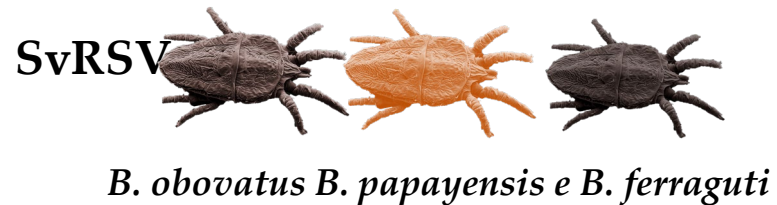
## Florida



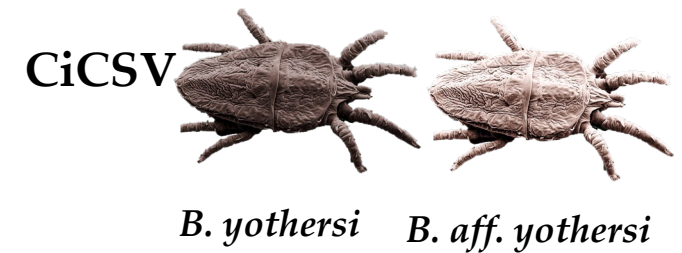
*Liriope muscari*, *Ophiopogon intermedius* and *Aspidistra elatior*



# Cilevirus



# Dichorhavirus



# Leprosis syndrome

- Citrus leprosis virus C
- Citrus leprosis virus C2
- **Orchid fleck virus**
- Citrus chlorotic spot virus
- Citrus bright spot virus
- Citrus leprosis virus N
- Hibiscus green spot virus 2

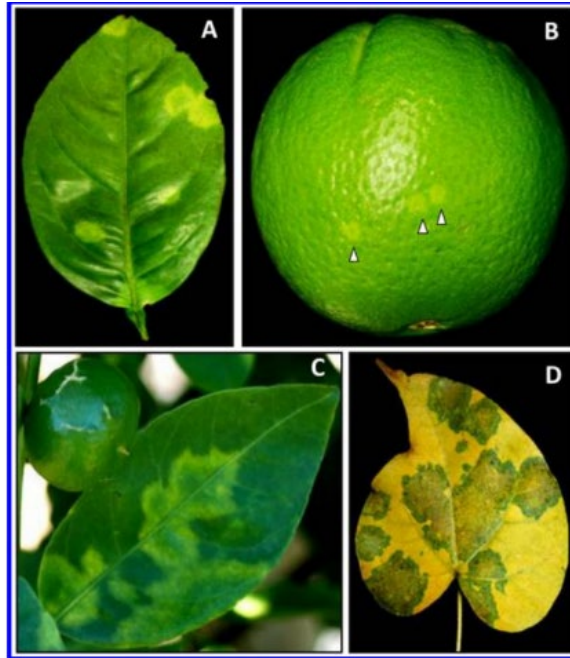
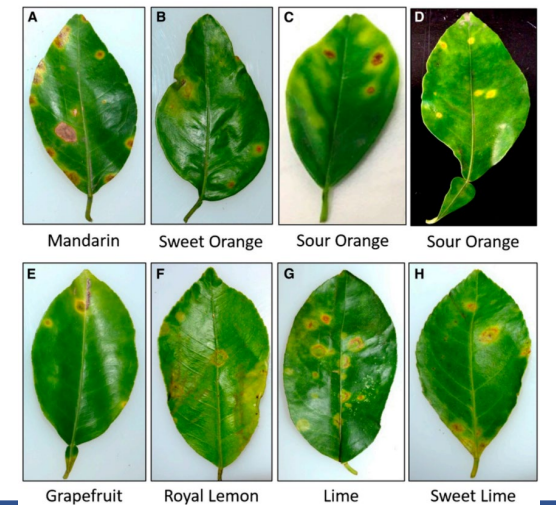
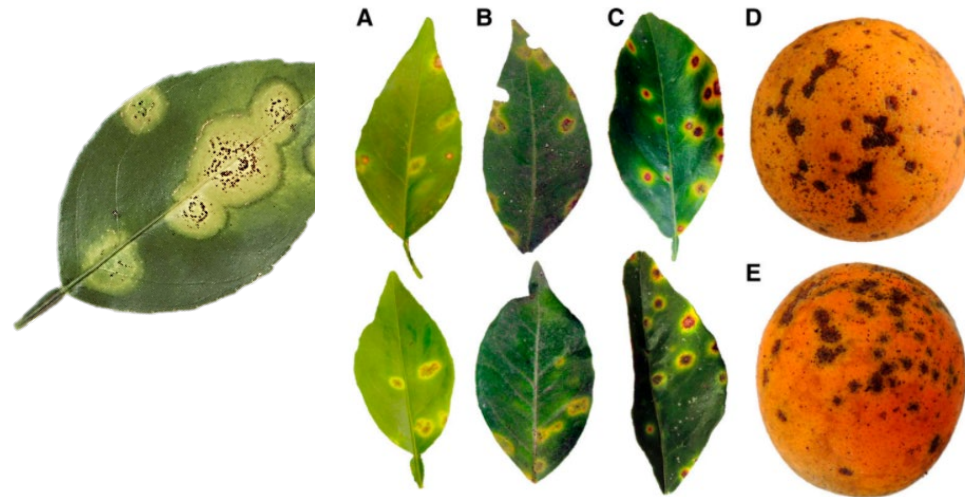
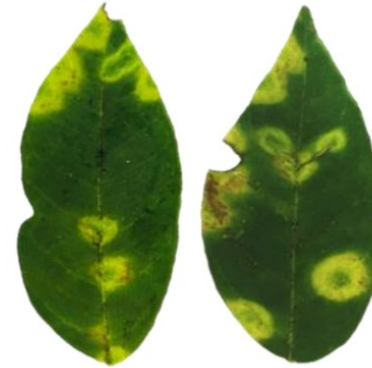
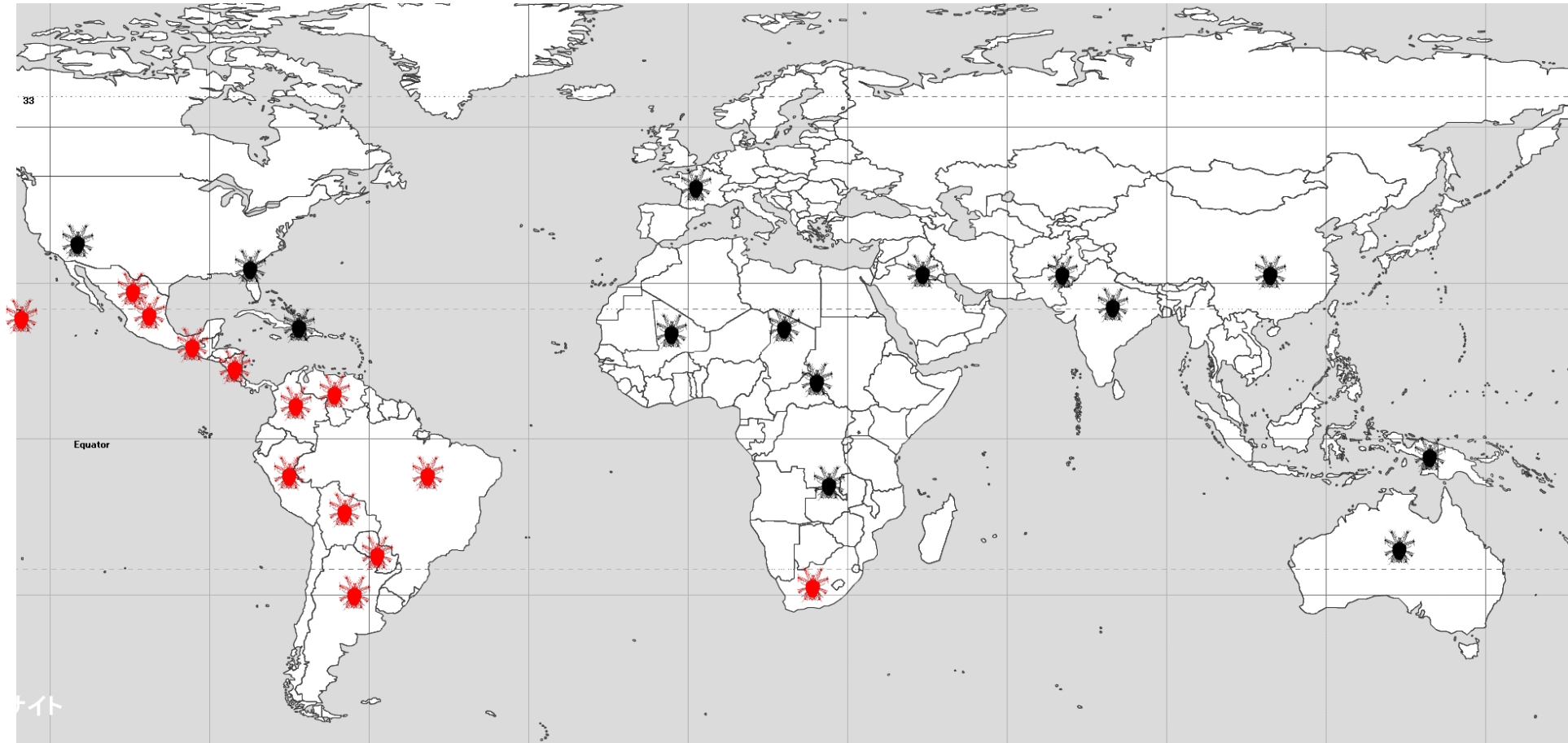


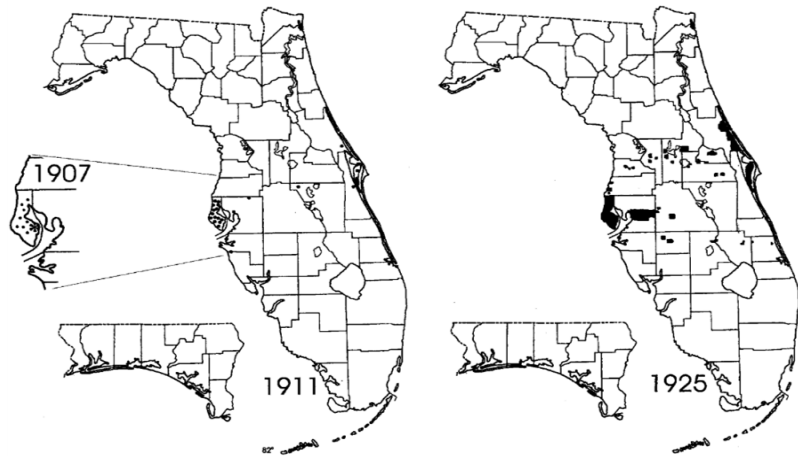
Fig. 3. Natural hosts of *Hibiscus green spot virus 2* (HGSV-2) include navel sweet orange (*Citrus sinensis*) **A**, leaf, and **B**, fruit. Arrowheads indicate three lesions on immature fruit. **C**, Mandarin (*C. reticulata*) leaf and **D**, hau (*Hibiscus tiliaceus*) leaf infected by HGSV-2.



# Citrus leprosis is restricted to the Americas, Hawaii & South Africa

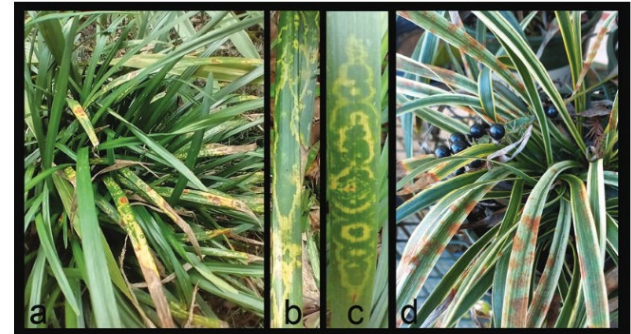


**Citrus leprosis existed and caused major damage in Florida in the late 1800's and early 1900's, causing at the time 50-75% losses by fruit drop**



# Recently, two of three main viruses known to cause leprosis were found in ornamentals in Florida and California

- Three OFV strains infecting *Liriope* spp., *Smilax* spp., *Pandanus* sp. and *Aspidistra* spp. in Florida
- Two OFV strains in orchids (Cymbidium, Dendrobium and Dendrochilum) in California
- Hibiscus infecting cilevirus (CiL C2H) in Florida



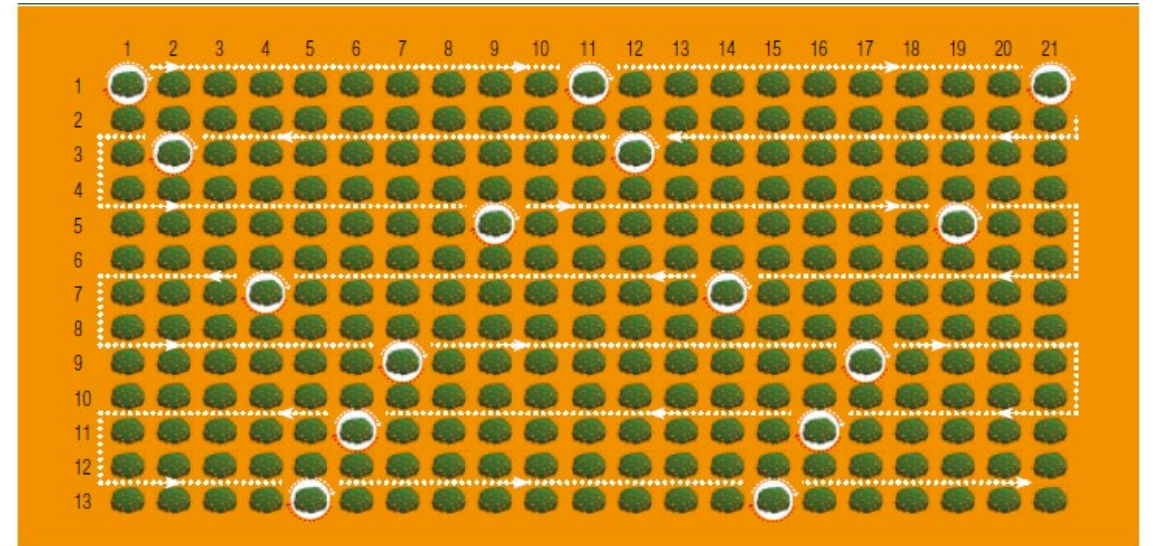
## Damage:

- fruit blemishing,
- fruit drop
- excessive leaf drop
- dieback of shoots



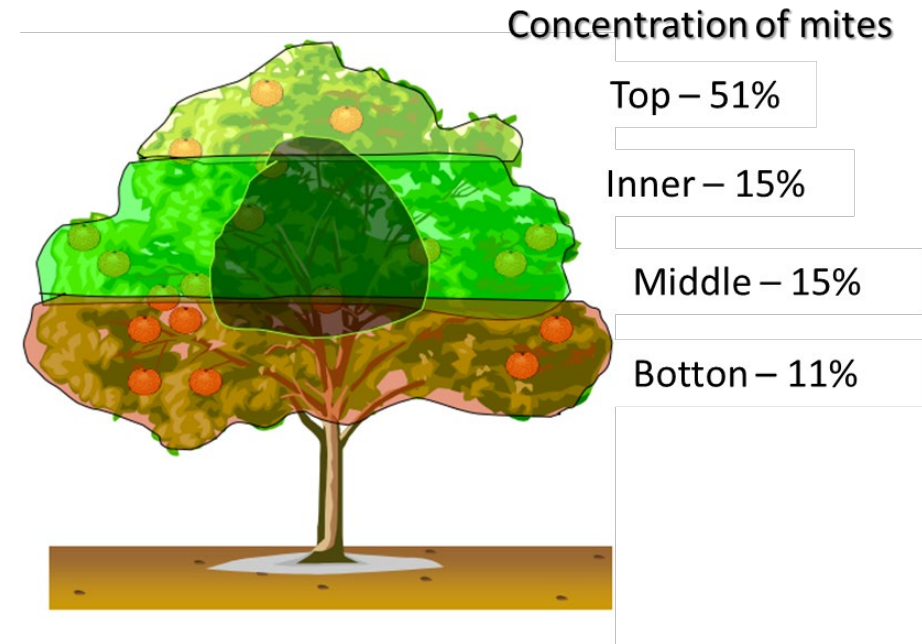
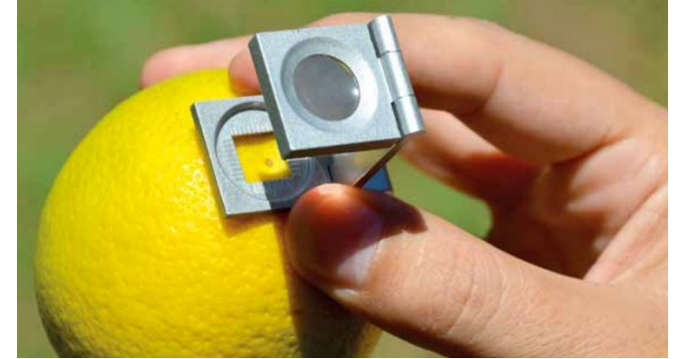
# Monitoring (Brazil)

- 5% of the plants
- One out of every ten trees in alternate rows
- 3 to 5 fruits or branches per plant every 7 to 14 days



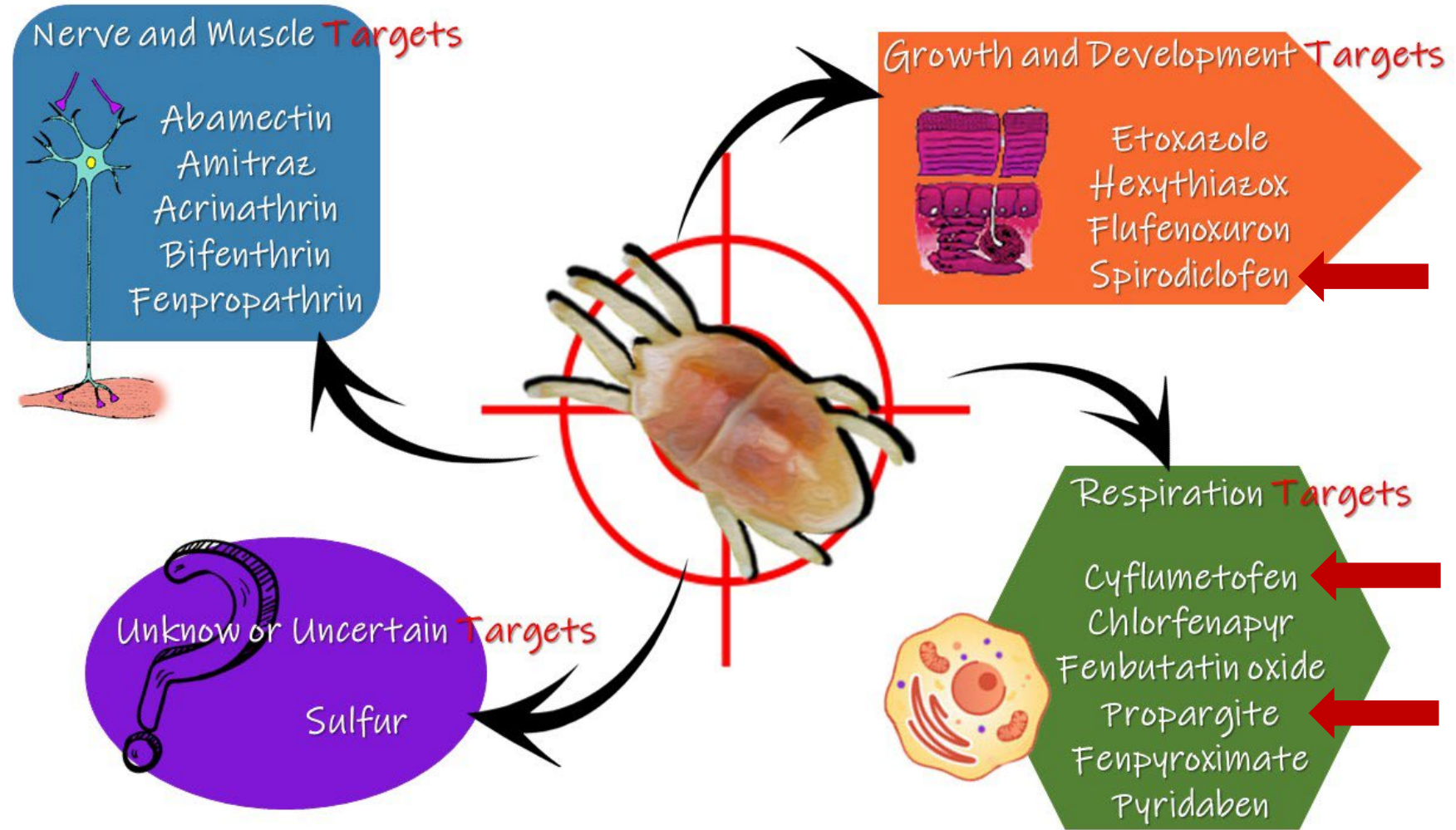
# Monitoring (Brazil)

- Ripe fruit more than 3 cm in diameter (with scab)
- In the absence of fruit, inspect the branches in the first 30 cm from the tip
- Action threshold: 1 to 5% of the fruits and/or branches have mites



Source: Fundecitrus

# Chemical Control (Brazil)



# Cultural practices

- Reduce dust
- Promote non-host cover crops
- Control citrus scab and scales
- Disinfest harvesting material
- Sanitation (dropped fruit)
- Pruning



# Moving forward

- Identify viruses and vectors
- Design targeted control strategies
- Biological Control



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Potential of predatory mites for biological control of *Brevipalpus yothersi* (Acari: Tenuipalpidae)

Pollane S. Argolo<sup>a</sup>, Alexandra M. Revynthi<sup>a</sup>, Maria A. Canon<sup>a</sup>, Marielle M. Berto<sup>a</sup>, Daniel Junior Andrade<sup>b</sup>, Ismail Döker<sup>c</sup>, Amy Roda<sup>d</sup>, Daniel Carrillo<sup>a,\*</sup>





# Thank you!

Questions?

