

# SYSTEMS USED TO COMBAT OTHER VECTOR TRANSMITTED BACTERIA, PIERCE'S DISEASE IN GRAPES

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# Vascular Diseases Caused by Fastidious Prokaryotes

- Fastidious Phloem-Limited Bacteria – Citrus greening (huanglongbing)
- Spiroplasmas and Phytoplasmas – Citrus stubborn
- *Xylella fastidiosa* – Citrus variegated chlorosis, Pierce's disease of grape

# PIERCE'S DISEASE

- **Primary factor limiting production of bunch grapes in the southern U.S.**
- **Most muscadines cultivars are resistant, but a few develop symptoms (Carlos, Pride)**
- **Resistance has been the only effective control**



# Comparisons of Citrus Greening and Grape Pierce's Disease

- Both are graft and vector transmissible.
- Antibiotics provide some symptom remission in both.
- Electron microscopy used for first identification of both in late 60s and early 70s.
- Both are caused by a small, Gram-negative bacterium.

*Diaphorina citri*, Asian citrus psyllid



Photograph by: Douglas L. Caldwell, University of Florida



*Oncometopia nigricans*

# Comparisons of Citrus Greening and Grape Pierce's Disease

- *Xylella fastidiosa* can be grown in culture; *Candidatus Liberibacter* has not been grown in culture.
- *Xylella* colonizes the xylem; *Candidatus* the phloem.
- Citrus greening has yellows type symptoms; Pierce's disease has wilt type symptoms.

Greening

Healthy



University of Florida

Pierce's disease



Chung & Brlansky, UF EDIS Publication, 9/20/05



# Management Strategies for Pierce's Disease

- Exclusion of bacterium or vector (CG) – very difficult to sustain in today's world.

*X. fastidiosa* and sharpshooter vectors have a very wide host range.

Bacteria and vectors could be moved in or on many species and types of plants.



Homalodisca vitripennis Glassy-Winged Sharpshooter (GWSS)



Oncometopia nigricans

# Management Strategies for Pierce's Disease

- Exclusion of bacterium or vector (CG)
- Systemic insecticides for the control of GWSS where grape to grape spread is important (CG).

# Insecticides for the Control of Pierce's disease

- Prior to approximately 2000, Insecticide applications had not been effective for controlling spread of PD.
- PD spread was primarily to grapes from outside the vineyard.
- In CA, vectors and alternate hosts were in riparian habitats.
- In Florida, there was an abundance of alternate hosts and different vectors.
- Introduction of GWSS into California changed situation and within vineyard spread became most important.

*Homalodisca vitripennis* Glassy-  
Winged Sharpshooter (GWSS)



Vine-to-vine spread became important in California with introduction of GWSS. This contributed to severity of PD and effectiveness of systemic insecticides.

# Systemic Insecticides for the Control of Pierce's disease in Southern California

- Introduction of GWSS and build up in citrus groves threatened grape industry in Temecula area.
- 40% vineyard loss to Pierce's disease
- Area-wide GWSS management program was initiated in 2000.

# Systemic Insecticides for the Control of Pierce's disease in Southern California

- Area-wide management program in Riverside county involves treatment of both citrus and grapevine
- Systemic insecticides such as Admire are effective.
- GWSS numbers have declined in the area

# Systemic Insecticides for the Control of Pierce's disease in Southern California

- Five years field experience shows that Admire in May protects against GWSS and vine-to-vine spread of Pierce's disease.
- Untreated vineyards (mostly organic growers) still suffer rapid and severe losses.
- No evidence of pathogen spread from organic vineyards to treated vineyards.



# Management Strategies for Pierce's Disease

- Exclusion of bacterium or vector (CG)
- Systemic insecticides for the control of GWSS where grape to grape spread is important (CG).
- Eliminate sources of bacterial inoculum (CG- Orange Jasmine) – May not be possible for PD in Florida but could help with CG (Need sensitive, early detection methods).

# Selected hosts of Pierce's Disease Strain of *Xylella fastidiosa*

- Alfalfa
- Almond
- Elderberry
- Beautyberry
- Blackberry
- Cherry
- Dallis grass
- Wild Grapevine
- Lupine
- Maple
- Peppervine
- Poison Hemlock
- Periwinkle
- Umbrella sedge
- Virginia Creeper
- Western Redbud
- Wild strawberry
- Numerous symptomless hosts

# Southern California Recommendations

- Apply Admire in May.
- Monitor for PD and rogue any infected vines.
- Continue area-wide GWSS management.

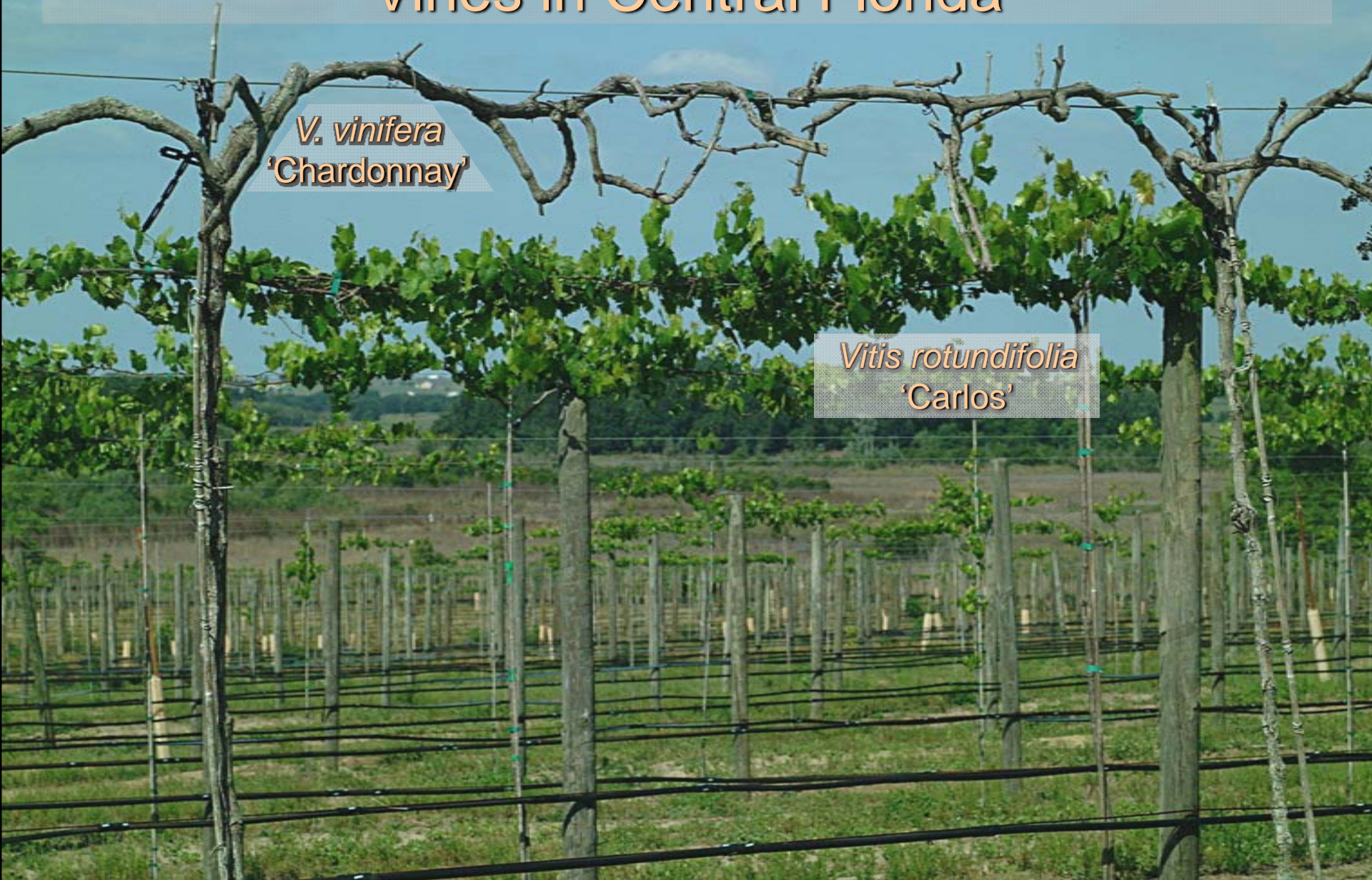
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- Eliminate sources of bacterial inoculum (CG).
- Plant resistance, when available – Limits availability of desirable wine grapes; may be difficult for CG.

# Pierce's Disease Susceptible and Tolerant Vines in Central Florida

*V. vinifera*  
'Chardonnay'

*Vitis rotundifolia*  
'Carlos'



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- Plant resistance, when available
- Minimize other stresses on the host plant (CG) – water stress, poor fertility, other diseases, root damage, overproduction, etc.

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- Eliminate sources of bacterial inoculum (CG).
- Plant resistance, when available
- Minimize other stresses on the host plant (CG)
- Antibiotics, bactericides, other chemicals, etc. (CG)
  - Can give temporary symptom remission, but not practical or effective in long term. Needs research with citrus greening.

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- Antibiotics, bactericides, other chemicals, etc. (CG)
- Genetically engineered plant resistance (CG)



# Selecting PD Resistant Transgenic Grapevines in Greenhouse at MREC



Susceptible  
Control Vines

'Thompson Seedless'

Transgenic Vines  
w Lytic Peptide

Resistant Control  
'Tampa'

These vines were  
inoculated in July 2004

Since even resistant  
controls developed  
symptoms, the PD test is  
considered to be  
stringent

Lack of symptoms in  
transgenic plants that  
contain proprietary lytic  
peptide genes suggest  
high level of resistance

Approximately 100 highly  
resistant lines have since  
been selected, 10 of  
which are being  
propagated for field trials

# Florida Transgenic Grape Field Site



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- Genetically engineered plant resistance (CG)
- Interference with bacterial genes involved pathogenicity - biofilm formation, quorum sensing, enzymes to dissolve vessel pit membranes, toxins, etc.

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- Interference with bacterial genes involved pathogenicity
- Biological control with benign strains of *Xylella fastidiosa*.

# Cross Protection for PD Control in a New Vineyard Planting

- Planted Cabernet Sauvignon/Freedom in Leesburg vineyard in February 1997
- Inoculated new shoots with protectant isolates of *Xylella fastidiosa* when growth was 18-30 inches long. No further inoculations were done.





## 10-year old Cabernet Sauvignon in Apopka

- Untreated Cabernet Sauvignon vines all died in less than 4 years at Leesburg
- One benign strain of *Xylella fastidiosa* (EB92-1) was able to colonize and protect Cabernet Sauvignon grapevines against PD for at least 3-4 years in vineyard at Leesburg, when experiment was concluded.

# Current and Future Testing of Biological Control of Pierce's Disease



Evaluate effectiveness in commercial vineyards in different areas – California, Florida, Georgia, South Carolina, North Carolina



Evaluate effectiveness in various genotypes - Chardonnay, Merlot, Mourvedre, Chenin Blanc, Ruby Cabernet, Cabernet Franc, Cynthiana, Seyval Blanc, Golden Muscat, Chambourcin

Commercial treatment available for grape growers to use – 2-4years

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Special thanks to numerous  
cooperators and co-workers over  
the years

Thank you for listening!