Pierce's Disease and Cotton Root Rot

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Presentation Outline

Part I. Pierce's Disease

- Disease Biology
- Diagnosis
- Impact
- Control

Part II. Cotton Root Rot

- · Disease Biology
- Diagnosis
- Impact
- Control

Xylella fastidiosa

Biology – the cause

Xylem

Bacterium

- Xylem limited,
- "fastidious" = difficult to grow on artificial media in the lab,
- Produces a filamentous matric for attachment and adhesion.

Bacteria in xylem -

Santarosa et al., Am. J. Enol. Vitic. 67:1 (2016)



Photo: Electron Microscopy Laboratory, U.C. Berkeley

Xylella fastidiosa Biology - ecology

- Native to SE United States,
- Intolerant to cold temperatures,
 - restricted to parts of U.S. with mild winters,
- Considered more serious on sites located in hot climates with shallow soils.



Xylella fastidiosa

Biology - spread

- Xylem feeding insects.
 - Sharpshooter leafhoppers and spittlebugs,
 - Green and red- headed sharpshooters, -
 - Xyphon (formerly Carneocephala) fulgida,
 prefers grasses and certain annual weeds ,
 - Blue-green sharpshooter, 👡
 - Hordnia atropunctata,
 - abundant on cultivated grape,
 - also many other perennials,
 common in riparian areas ,
 - Glassy winged sharpshooter
 - Homalodisca vitripennis ,
 - breeds in different habitats,
 - moves more widely and more often,
 - feeds & breeds well on grape high populations develop on citrus. Other major habitats?
 - larger,
 - feeds better on woody stems.
- Efficiency varies with vector, host plant species, and pathogen population in plant.





Biology - Strain/Pathovar Relationships

Five Distinct Genotypes (Taxon)

- X. fastidiosa subsp. fastidiosa
 - grape, almond,
- X. fastidiosa subsp. multiplex,
 - peach, elm , plum, peach, grape (V. aestivalis), sycamore, almond, ragweed, oak,
- X. fastidiosa subsp. pauca,
 - citrus, coffee,
- X. fastidiosa subsp. Sandyi,
 oleander,
 - X. fastidiosa subsp. tashke,
 - chitalpa.

Xylella fastidiosa

Biology - Diseases of "Economic" Hosts

- Pierce's disease
- Almond leaf scorch
- Phony peach disease
- Alfalfa dwarf disease
- Citrus variegated chlorosis
- Ragweed stunt disease
- Periwinkle wilt disease
- Leaf scorch of elm, oak, mulberry, sycamore, maple, plum, coffee, oleander and avocado



http://ucce.ucdavis.edu/files/repository/calag/img5904p227.jpg Phony Peach Disease



http://edis.ifas.ufl.edu/in174 BLS on elm



Xylella fastidiosa

Biology – Weedy Hosts

- Texas (Dr. Mark Black, Uvalde),
 - ragweed, Mexican hat, slim aster, common sunflower,
 - redbud, red oak, sycamore, western soapberry, cedar elm,
- California,
 - Periwinkle, blackberry, wild grapevines, mugwort, mulefat, elerberry, stinging nettle.

Pierce's Disease/Xylella fastidiosa Recognition/Diagnosis

- Symptomology,
- Isolation on specialized culture media,
- ELISA (enzyme linked immunosorbent assay),
- PCR (polymerase chain reaction) and Real Time PCR.





Pierce's Disease/Xylella fastidiosa

Detection - Foliar Symptoms

- Initiate in midsummer and continue to fall,
- Early = dying and scorching of leaves usually with chlorotic margins,
- Leaves die in days or weeks,
- Red fruited varieties may have red discoloration,
- Progress up and down cane from point of inoculation,
- Blade separates from petiole, which is retained.

Pierce's Disease/Xylella fastidiosa

Detection – Foliar Symptoms

- New, young leaves,
 - late to bud out, stunting,
 - interveinal chlorosis (resembles zinc deficiency),
- Mid-to-late summer,
 - leaf scorch on outer margin, moving inward,
- Other Sources of variability,
 - cultivars,
 - climate.







Foliar Symptoms Varietal Comparisons in Grape



Pierce's Disease/Xylella fastidiosa

Detection Vine Symptoms

- Canes dieback from tips,
- Vines may decline during winter with slow, stunted growth in spring,
- Suckers form at base of vine,
- Green "islands", reflecting incomplete cane maturation,
- Note varietal differences.





Pierce's Disease/Xylella fastidiosa

Detection - Fruit symptoms, raisining



Fruit clusters on infected canes wilt and dry – at or after veraison.



Pierce's Disease/ Xylella fastidiosa

Detection - Clinical Diagnosis, Isolation of bacterium

- No false positives,
- · Inexpensive,
- Lengthy,
 - elaborate media prep,
 - may take weeks for growth,
- Negative result has degree of uncertainty.



Pierces' Disease/Xylella fastidiosa Detection – Clinical Diagnosis (ELISA)

- Relatively inexpensive,
- easy to perform,
- fairly insensitive,
 - requires minimum of 1000 bacteria/gm tissue,
- reliability problems,
 - subjective judgment on positive reaction,
 - variability in reagent quality.





Pierce's Disease/ Xylella fastidiosa

Clinical Diagnosis - nucleic acid assays/PCR

- Extremely sensitive,
- High specificity,
- Adaptable, quick, ease of use,
- Provides for quantitative assay,
- Presence of inhibitors false negatives,
- Laborious extraction protocols,
- Uneven distribution and low levels of bacterium in host tissues.



Pierce's Disease - Xylella fastidiosa

Diagnostic tips

- Field symptoms can vary,
 - varieties some may harbor bacterium with no symptoms, some may recover,
 - environment,
 - strains?
- Clinical procedures rely on proper sampling in the field,
 - first, oldest, symptomatic leaves on canes are most reliable,
- All diagnostic tests require proper interpretation,
- No method is 100% reliable.



Pierce's Disease - Xylella fastidiosa

Viognier



Pierce's Disease/ Xylella fastidiosa

- Site selection,
 - proximity to water,
 - history of incidence and severity in vicinity,
 - nearby vegetation (300 ft. weed-free barriers around vineyards),
- Varietal selection,
 - note variability in response among varieties,
 - use of resistant varieties in Gulf Coastal States,
- Vector management,
 - monitoring,
 - insecticides,
- Vineyard floor management,
- consistent, relentless control of weeds,
- Roguing, eradicative pruning,
- Use certified, disease free propagation materials.

Pierce's Disease/ Xylella fastidiosa

Control – Varietal Selection

Susceptible

- Chardonnay
- Mission
- Barbera
- Fiesta
- Pinot Noir
- French Colombard

Intermediate (?)

- Thompson Seedless
- Cabernet Sauvignon
- Gray Riesling
- Merlot
- Napa Gamay
- Petite Sirah
- Sauvignon Blanc

Tolerant (?)

- Chenin Blanc
- Sylvaner
- Ruby Cabernet
- White Reisling
- Carlos
- Cynthiana (Norton)

Resistant

- Blanc duBois
- Orlando Seedless
- Black Spanish
- Champanel
- Roucaneuf

Pierce's Disease/ Xylella fastidiosa

Control – Imidacloprid Vector Control (Admire®)

- Split Applications, 30 Days Apart,
- Begin in Mid April-Early May,
- 1st Leaf Vines Get Half Rate,
- 30 Day PHI, 12 Hr REI.



Photo Courtesy Jim Kamas

There Are Other Neonicotenoid Insecticides Labeled for Soil & Foliar Applications But Imidacloprid <u>Deters</u> Feeding, Others Do Not

Texas PD Management Guide

Available for Download on Aggie Horticulture Fruit & Nut Resources



http://aggie-horticulture.tamu.edu/fruit-nut/files/2010/10/Texas-Grape-Growers-PD-Management-Guide.pdf

Pierce's Disease/ Xylella fastidiosa

Some Final Observations

- Pierce's disease has gone through a period of abatement in recent years,
 - Cyclical ebbs and flows in epidemics are common,
 - Climatic conditions usually involved,
 - 2010 and 2011 experienced periods of cold that might have been curative,
 - Periods of drought during 2009 2011 decreased sharpshooter populations,
 - Improved grower education and acceptance of management priniciples increased over the past decade
- Pierce's disease has increased during the 2016 growing season,
 - wet winter and spring elevated sharpshooters.
- Potential Losing Imidacloprid Because of Beehive Colony Collapse.

Phymatotrichopsis omnivora

Biology – the cause

Fungus

- Root rot,
- "omnivorus" = has many economically important hosts,
 - 2000 species of plants,
 - grasses (monocots) are resistant,
- Survives in the soil for decades without a host,
 - produces tiny seed-like structures called sclerotia,
- [0eijb



Strands of P.o. on infected roots



P.o. as seen through a microscope

Over 2000 Known Cultivated Hosts



Phymatotrichopsis omnivora

Biology – ecology

- The disease is restricted to the Southwestern U.S. and Mexico
- Ubiquitous to:
 - Calcareous clay loam soils with pH of 7.0 – 8.5
 - Upland Blackland Sites
 - Hill Country Alluvial Soils
 - West Texas At Risk
 - East Texas?
 - High summertime temperatures
- Occurs in patches in cultivated crops.

Multi-state distribution of P.o.



Distribution of Texas Vineyards infested with P.o.



Cotton Root Rot – P. omnivora

Biology – spread

- Grows from vine to vine by growing through soil as strands called rhizomorphs,
 - contact roots, grow along surface toward the lower stem,
 - root is destroyed, fills with survival structures,
- Invades new areas by movement of sclerotia
 - equipment, tilling, etc.
- No insects involved in spread,
- No long distance spread by spores.
 - mats on soil produce nonfunctional spores.





Cotton Root Rot/ P. omnivora

Recognition/Diagnosis

- Most likely to occur when soils reach > 82°F,
- Starts with yellowing and bronzing of leaves with marginal chlorosis/necrosis,
- Wilting of older leaves within 72 hrs.,
- Permanent wilting shortly after 3 days,
- Disease severity increases following rains,







Cotton Root Rot/ P. omnivora

Recognition/Diagnosis

- Vines are pulled from soil with little effort,
 - root bark is decayed and necrotic.



Cotton Root Rot/ P. omnivora

Impact - disease progress in a vineyard



Cotton Root Rot – P. omnivora

Control Strategies

• Avoidance,

- · Knowing where the pathogen is,
- Knowing soil conditions favoring pathogen,
- · Pre-plant with alfalfa,

• Fumigation,

- Works initially, but limited effectiveness,
- Soil amendments (?),
 - Sulfur not effective in changing soil pH,
 - High nitrogen fertilizers ineffective,
- Organic Matter (?),
 - Should help in creating biodiversity of soil flora
- Beneficial Micro-organisms (?),
 - Actinovate^{®.}



Cotton Root Rot – P. omnivora

Control Strategies - Rootstocks

- Certain rootstocks consistently appear to be tolerant to the pathogen,
 - does not reflect resistance (roots of survivors appear to be infected),
 - Champanel, Black Spanish, Dog Ridge, Mustang, La Pryor,
- Survival of roots may be dependent on ability to sprout after infection ,
- Periderm formation appears to be another important factor.





Cotton Root Rot - P. omnivora

Control Strategies – Fungicides, Topguard® Terra

- Early testing proved *P.* omnivora was sensitive to triazole fungicides,
- Recent research has shown that one of those triazoles, flutriafol, effectively protects vines from infection,
 - both existing mature vines, as well as newly planted vines,
- Soil-applied through irrigation systems (chemigation),
- Being applied under a Special Local Needs Label (24c).





Cotton Root Rot – P. omnivora

Control Strategies – Fungicides, Topguard[®] Terra

FIFRA Section 24 (c) Special Local Need FOR DISTRIBUTION AND USE ONLY WITHIN THE STATE OF TEXAS



Follow all applicable directions, restrictions, and precautions on this Supplemental label and the main EPA-registered label.

Cotton Root Rot – P. omnivora

Control Strategies – Fungicides, Topguard[®] Terra

CROP	PESTS	RATE OF APPLICATION	
Grapes (soll applied)	Texas Root Rot Cotton Root Rot (Phymatotrichopsis omnivora)	Product Rate FI. Oz per Acre*	Pounds active Ingredient per Acre
		7.6 - 15.3	0.25 - 0.5
DIRECTIONS FOR USE THROUGH DRIP IRRIGATION APPLICATION INSTRUCTIONS Apply at recommended use rates through above ground drip irrigation system as outlined in USE DIRECTIONS section of this label. APPLICATION RATE Apply TOPGUARD Terra in a single application at 15.3 oz per acre or in a split of two applications of 7.6 oz			
APPLICATION TIMING Make Initial application between 30 to 60 days after bud break. If a split application is desired, make second application no closer than 45 days after first application but not within 14 days of harvest. When using a split application, the second timing may be applied as a postharvest to manage late season disease.			

DIRECTIONS FOR USE

Cotton Root Rot – P. omnivora Some Final Observations

- Need to follow lable recommendations for fungicide applications,
 - Modifying application methods may have led to phytoxicity (methods and timing),
- Increasing in grapevine acreage is leading to greater numbers of affected growers,
- More research is needed

Need Help?



