Managing Grape Diseases in Missouri

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Outline

• Introduction
• IPM considerations with grape disease management
• The “big 4” grape diseases
• Additional grape diseases of concern
• Putting it together
Introduction

• Missouri’s grape industry
  – Based on genetically diverse grape cultivars
    • Vinifera cultivars
    • French hybrid cultivars
    • American hybrid cultivars
    • American cultivars
  – Many small and a few large vineyards
  – Varying levels of attention relative to disease management
  – Native grapes – ready source of inoculum
  – Climate conducive to disease development
IPM - Cultural Practices

• Canopy management
  – Control canopy density
    • Overcrowded canopies have poor air movement, more disease problems
    • More difficult to spray crowded canopies
  – Spur positioning
  – Shoot removal – useful to reduce canopy density
  – Leaf removal – shady side
  – Shoot positioning
  – Hedging and skirting
IPM - Cultural Practices

• Irrigation – high humidity favors disease; more problems with furrow or sprinkler irrigation

• Weed management – weeds under the canopy can impede air movement; weeds can act as alternate hosts

• Pruning and sanitation is important – remove diseased plant parts, overwintering sites
IPM – Host Susceptibility

• Relative degree – some cultivars are resistant

• Before or after a specific period the host may not be susceptible

• Critical period – host is particularly susceptible; tied to host growth stage, environmental conditions, or commonly both
Common Grape Diseases

• The big 4
  – Black rot
  – Downy mildew
  – Powdery mildew
  – Phomopsis

Other Diseases

- Anthracnose
- Bunch rots
- Eutypa dieback
- Pierce’s disease
- Crown gall
- Virus diseases
Managing Grape Diseases

- Identification and understanding
- Develop management strategy
  - Resistance
  - Sanitation
  - Cultural practices
  - Pesticides
Black Rot

• Causal agent – *Guignardia bidwelli*
• Fungal disease
• Signs and symptoms
  – Foliar symptoms
    • Reddish brown circular lesions with dark margin; black pycnidia in center
  – Fruit symptoms
    • Light brown lesions that engulf fruit
    • Fruit dries and becomes mummy
Black Rot

- Signs and symptoms
Black Rot

- Disease progression
  - Overwinters in mummified fruit on trellis or on the ground
  - Favorable conditions
    - Warm
    - Humid
    - Free water on plant
  - Critical period – immediately prior to bloom through 3-4 weeks post bloom

Source: [http://www.oardc.ohio-state.edu/fruitpathology/organic/grape/All-Grapes.html](http://www.oardc.ohio-state.edu/fruitpathology/organic/grape/All-Grapes.html)
Black Rot

• Management strategy
  – Resistant cultivars - Norton/Cynthiana
  – Varying degrees of resistance - Cascade, Cayuga White, Chancellor, Chardonel, Baco noir, Catawba, Chambourcin, Elvira, Ives, Vidal blanc, Vignoles
  – Susceptible cultivars - Vinifera and most American and French Hybrid cultivars
Black Rot

• Management strategy
  – Sanitation
    • Removal of mummies, especially those on the trellis, is critical
  – Cultural practices
    • Proper training and pruning to manage canopy density and improve spray coverage
Black Rot

• Management strategy
  – Pesticides
    • Management based on use of protective fungicides, supplemented with curative fungicides
    • Regular spray schedule is essential - protect from shoot development until veraison
Black Rot

• Management strategy
  – Pesticides
    • Non-systemic preventative – mancozeb, ferbam, ziram
    • Systemic preventative – Abound, Pristine, Flint, Quadris, Sovran
    • Curative – Rally, Bayleton, Elite, Procure
Downy Mildew

- Causal agent – *Plasmopara viticola*
- Fungus-like disease (oomycete)
- Signs and symptoms
  - Foliar symptoms
    - Upper leaf surface – yellowish lesions
    - Lower leaf surface – whitish, downy growth
    - Defoliation
  - Fruit symptoms – light brown to purple color, whitish growth on berries, shatter
Downy Mildew

- Signs and symptoms


Source: [http://www.oardc.ohio-state.edu/fruitpathology/organic/Grape/downymildew.html](http://www.oardc.ohio-state.edu/fruitpathology/organic/Grape/downymildew.html)
Downy Mildew

- Disease progression
  - Overwinters as oospores in leaf litter on vineyard floor
  - Favorable conditions
    - Warm
    - Humid
    - Free water on plant
  - Infections can take place as long as stomata are functional
  - Late season defoliation can lead to winter injury and reduced crop next season

Source: [http://www.oardc.ohio-state.edu/fruitpathology/organic/grape/All-Grapes.html](http://www.oardc.ohio-state.edu/fruitpathology/organic/grape/All-Grapes.html)
Downy Mildew

• Management strategy
  – Resistant cultivars
    • Vinifera cultivars are generally most susceptible
    • American and French hybrid cultivars are generally intermediate - Baco Noir, Concord, Horizon, St. Pepin, Stueben, LaCrosse, Leon Millot, Marechal Foch
    • Susceptible cultivars - Catawba, Chancellor, Chardonnay, Delaware, Fredonia, Ives, Niagara, White Riesling, and Rougeon.
Downy Mildew

• Management strategy
  – Sanitation
    • Destroy fallen leaves
  – Cultural practices
    • Proper training and pruning
    • Good weed control
    • High trellising
Downy Mildew

• Management strategy
  – Pesticides
    • Management based on use of protective fungicides, supplemented with curative fungicides
    • Regular spray schedule is essential - protect from shoot development until post harvest
Downy Mildew

- Management strategy
  - Pesticides
    - Non-systemic protectant – captan, mancozeb, copper, ziram
    - Systemic protectant – Abound (?), Sovran (?), Pristine (?), Quadris
    - Curative – Ridomil, phosphorus acid
    - (?) = reported resistance
Powdery Mildew

- Causal agent – *Uncinula necator*
- Fungal disease
- Signs and symptoms
  - Foliar symptoms – powdery or dusty appearance on upper surface
  - Fruit symptoms – misshapen, rusty, split
Powdery Mildew

• Signs and symptoms
Powdery Mildew

- Disease progression
  - Overwinter as cleistothecia in bark crevices
  - Favorable conditions
    - Mild temperatures (68-77°F)
    - Humid
    - Inhibited by free water

Source: [http://www.oardc.ohio-state.edu/fruitpathology/organic/Grape/powderymildew.html](http://www.oardc.ohio-state.edu/fruitpathology/organic/Grape/powderymildew.html)
Powdery Mildew

- Management strategy
  - Resistant cultivars
    - Norton/Cynthiana, other American cultivars
  - Susceptible cultivars
    - Certain French hybrid and vinifera cultivars – Vidal, Seyval, Chancellor
Powdery Mildew

• Management strategy
  – Cultural practices
    • Proper training and pruning
Powdery Mildew

• Management strategy
  – Pesticides
    • Management based on use of dormant and protective fungicides
    • Susceptible stages are pre-bloom to fruit set; postharvest
Powdery Mildew

- Management strategy
  - Pesticides
    - Dormant – lime sulfur
    - Preventative – sulfur (on non-sensitive cultivars), copper (on non-sensitive cultivars), Abound (?), Pristine, Rubigan (?), Procure (?), Rally (?), Elite (?), JMS Stylet oil, Topsin-M, Endura, Quintec, Sovran (?), Flint (?), Quadris, Tebuzol (?)
    - Curative – Rally (?), Bayleton (?)
    - (?) = reported resistance
Phomopsis

- Causal agent – *Phomopsis viticola*
- Fungal disease
- Signs and symptoms
  - Foliar and shoot symptoms
    - Black spots and lesions
  - Fruit and rachis symptoms
    - Shriveling and death of rachis
    - Black lesions on fruit, berries shrivel
Phomopsis

• Signs and symptoms
Phomopsis

- **Disease progression**
  - Overwinters in lesions on 1-3 year wood
  - Favorable conditions
    - Cane and leaf spot – cool and rainy conditions from beginning of growing season through fruit set
    - Fruit rot and rachis blight – cool rainy conditions at the end of July or early August

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Phomopsis

- Management strategy
  - Susceptible cultivars
    - Vignoles, Seyval blanc, Vidal blanc, Chardonel, Concord and Delaware
Phomopsis

• Management strategy
  – Sanitation
    • Remove and destroy dead and diseased wood
  – Cultural practices
    • Use pathogen free planting stock
    • Proper training and pruning
Phomopsis

• Management strategy
  – Pesticides
    • Management based on use of protective fungicides from ½ inch shoots to berry set to control cane and leaf phase, and through remainder of season to control berry and rachis forms
    • No fungicide will control fruit rot once symptoms occur
Phomopsis

• Management strategy
  – Pesticides
    • Non-systemic preventative – captan, mancozeb, ziram
    • Systemic preventative – Abound, Pristine, Topsin-M
Anthracnose

- Causal agent – *Elsinoe ampelina*
- Fungal disease
- Signs and symptoms
  - All succulent vine parts are susceptible
  - Shoots – spots that enlarge and become sunken
  - Fruit – reddish circular spots that become whitish in the center
Anthracnose

• Management
  – Overwinter as sclerotia on infected shoots
  – Sanitation is very important
  – Eliminate wild grapes near the vineyard
  – Cultivars differ in their susceptibility
  – Canopy management can aid in disease control
  – Fungicide use – lime sulfur (dormant), foliar fungicides
Bunch (Sour) Rots

- Causal agent – *Botrytis cinerea* and others
- Fungal disease
- Signs and symptoms
  - Fruit symptoms – color change, shriveling and rot of berries near harvest
Bunch Rots

- Favorable conditions
  - 55-79°F
  - High humidity or free water
  - Dense canopies
  - Tight clusters

- Management
  - Timely harvest
  - Canopy management
  - Avoid tight clustered cultivars
  - Fungicide protection – Rovral, Vangard, Elevate
Eutypa Dieback

- Causal agent – *Eutypa lata*
- Fungal disease
- Signs and symptoms
  - Trunk cankers; brown areas in section
  - Weak, stunted spring shoot growth
  - Small leaves, cupped, distorted, yellow
  - Death of cordons or trunks
Eutypa Dieback

• Management
  – Fungus present in older wood
  – Infections often take place via pruning wounds
  – Identify and remove infected wood in late spring; destroy infected wood
  – Retrain vines as needed; consider double trunks
Crown Gall

- Casual agent - *Agrobacterium tumefaciens*
- Bacterial disease
- Symptoms
  - overgrowths or galls, often near the soil line
  - Initially light colored, later dark brown, knotty, and rough
  - Poor growth, dieback, sometimes vine death

Crown Gall

• Management
  – Bacteria are found in debris in soil and also systemically in vines
  – A wound is necessary to initiate the gall – grafting, pruning, machinery operations, **freezing injury**
  – Use practices that reduce the risk of winter injury
    • Select hardy cultivars
    • Mount or bury cold tender cultivars
    • Proper pruning and crop load management
    • Proper disease control
  – Prune out aerial galls
  – Trunk renewal
  – Consider double trunks
  – Clean nursery stock
Pierce’s Disease

- Causal agent - *Xylella fastidiosa*; vectored by sharpshooters
- Xylem limited bacteria
- Symptoms
  - leaves become slightly yellow or red along margins
  - fruit clusters shrivel or raisin
  - dried leaves fall leaving the petiole (leaf stem) attached to the cane
  - wood on new canes matures irregularly
  - Vines weaken and may die
Pierce’s Disease

- Management
  - Vector control
  - Remove vines infected for more than one year
  - Vine renewal may work
Virus Diseases

- Virus-like diseases reported in Missouri:
  - fanleaf virus (GFLV)
  - fleck virus (GFkV),
  - grapevine virus A (GVA)
  - leafroll associated viruses 1 and 3

- Symptoms
  - Foliar abnormalities
  - Vigor decline, delayed fruit maturity
  - Fruit quality issues
  - Vine decline and death

Source: [http://www.agf.gov.bc.ca/cropprot/grapeipm/virus.htm](http://www.agf.gov.bc.ca/cropprot/grapeipm/virus.htm)
Virus Diseases

• Management
  – Use virus tested planting stock
  – Vector management
  – Removal of infected vines

Grapevine fleck virus
Source: http://iv.ucdavis.edu/Viticultural_Information/?uid=156&ds=351

Kober stem pitting disease (Grapevine virus A)
Source: http://wine.wsu.edu/research-extension/files/2010/07/symptoms-fig12.jpg
Putting it Together

• Dormant
  – Powdery Mildew
  – Anthracnose
Putting it Together

• 1 inch shoot growth
  – **Phomopsis**
  – Black Rot
  – Downy Mildew
  – Powdery Mildew
Putting it Together

• 3-5 inch shoot growth
  – Phomopsis (shoot, rachis)
  – Powdery Mildew (susceptible cultivars)
  – Black Rot
  – Downy Mildew
Putting it Together

• 10 inch shoot growth
  – *Phomopsis* (shoot, rachis)
  – *Powdery Mildew* (susceptible cultivars)
  – *Black Rot* (problem vineyards)
  – *Downy Mildew* (susceptible cultivars)
Putting it Together

• Immediate prebloom to early bloom – **critical spray**
  – Phomopsis (fruit infections)
  – Powdery Mildew
  – Black Rot
  – Downy Mildew
Putting it Together

• First postbloom spray (10-14 days after prebloom spray) – **critical spray**
  – Phomopsis (fruit infections)
  – Powdery Mildew
  – Black Rot
  – Downy Mildew
Putting it Together

- Second postbloom spray (10-14 days after first postbloom spray)
  - Black Rot
  - Downy Mildew
  - Phomopsis (fruit infections)
  - Powdery Mildew
Putting it Together

• Additional summer cover sprays
  – Downy Mildew
  – Powdery Mildew (susceptible cultivars)
  – Black Rot (foliar)
  – Bunch Rots
Putting it Together

- Postharvest sprays
  - Downy mildew
  - Powdery mildew
Putting it Together

• Selecting fungicides
  – Vineyard factors
    • Cultivars – resistant vs susceptible, phytotoxicity problems
    • History and disease pressure
  – Weather
    • Temperature
    • Rainfall, dew, humidity
Putting it Together

• Selecting fungicides
  – Fungicide factors
    • Type of activity – protectant, curative
    • Diseases controlled
    • Preharvest interval
    • Resistance management
    • Other factors – compatibility, spray equipment
    • Cost
Managing Pesticide Resistance

• Use unrelated fungicides in rotation – alternate SI fungicides with strobilurins or other fungicides (see FRAC codes)
• Minimize the selection of resistant strains by limiting the number of sprays
• Maintain a good preventative spray program
• Use higher rates when intervals between applications are expected to be longer
Grapevine Galls

- Lots of interesting galls found on grapes

Grape phylloxera
Grape tomato gall (tumid gall)
Grape eryneum mite
Unknown gall
Any Questions?