



Grape and Wine Institute

University of Missouri

Grape Diseases and Management

Advanced Beginner Grape School
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IPM and Grape Diseases

Multiple Techniques to Manage Disease

- Site selection
- Cultivar susceptibility
- Nutrient management
- Canopy management
- Sanitation
- Fungicides



IPM and Grape Diseases

Site Selection

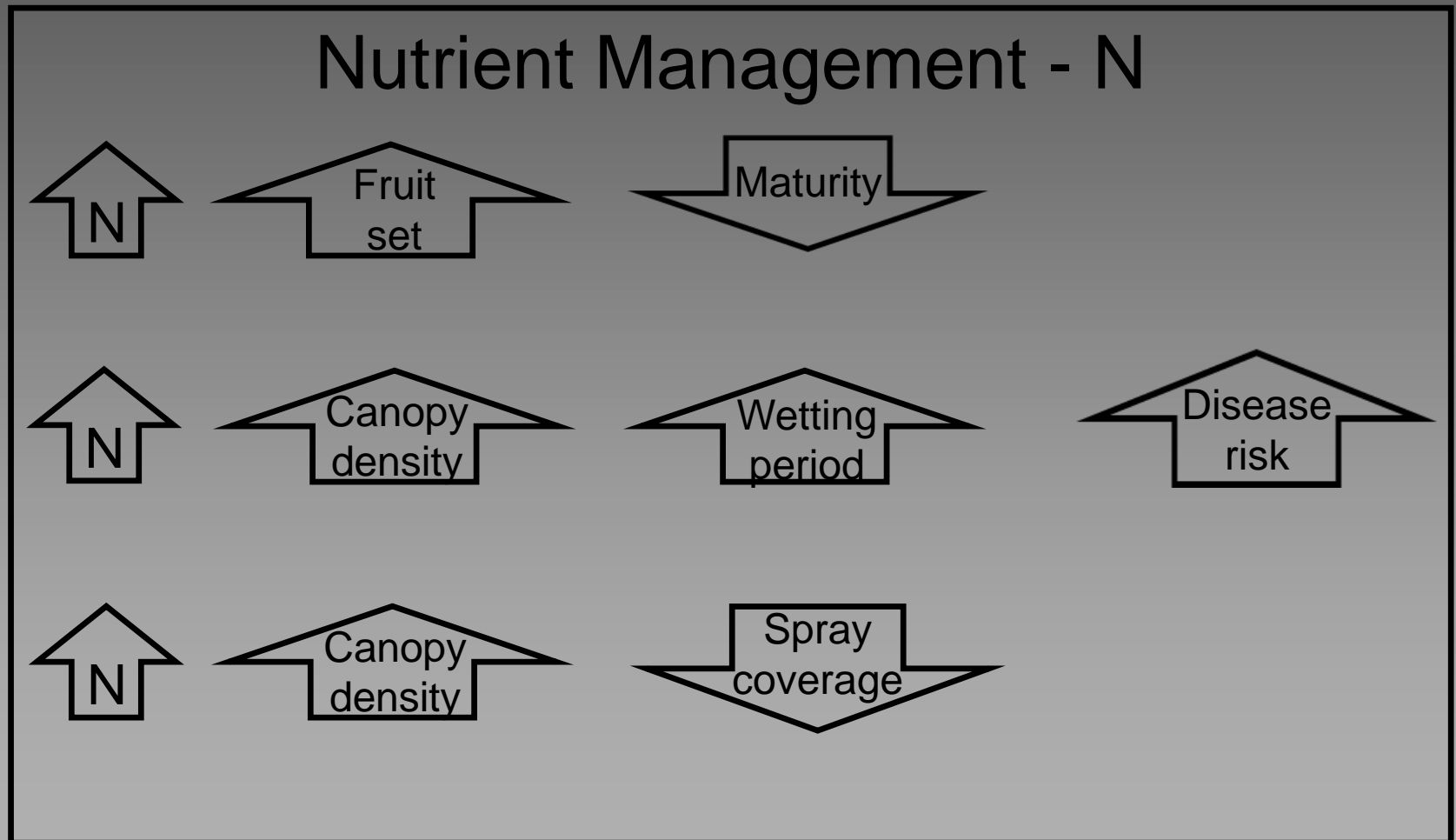
- Row orientation
- Surrounding vegetation
- Aspect
- Soil



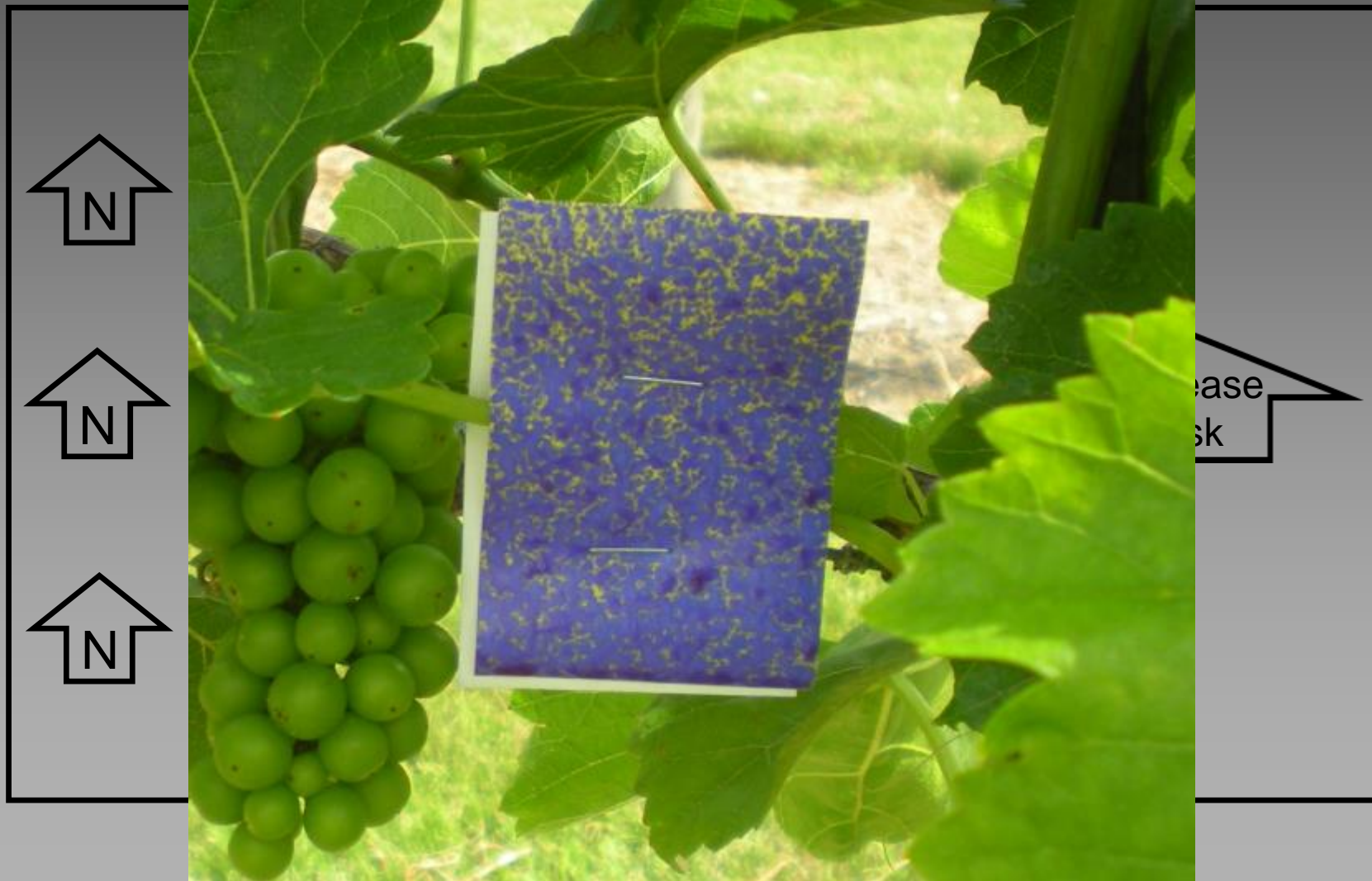
Host Plant Resistance



IPM and Grape Diseases

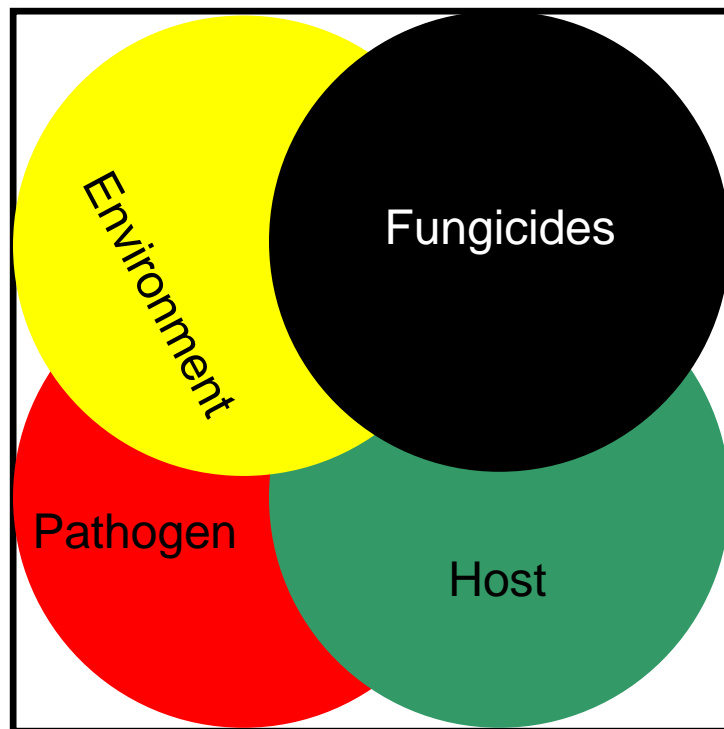


IPM and Grape Diseases



Factors resulting in disease

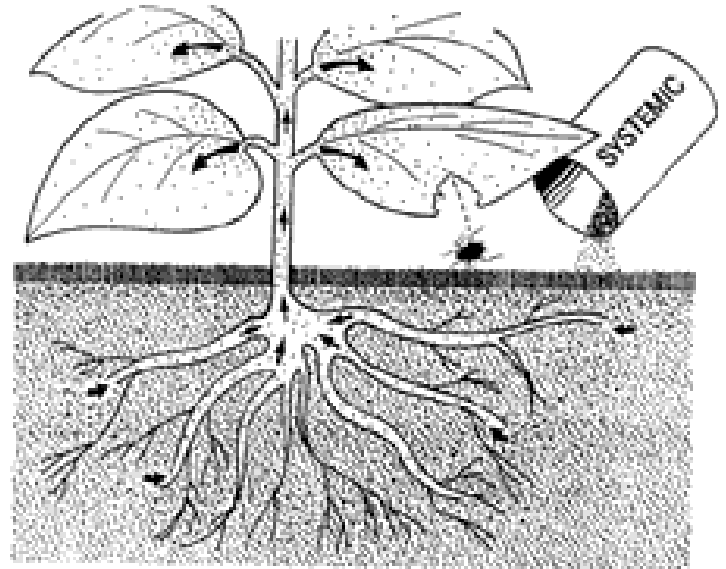
- Fungicides are part of proactive disease management
- Interaction of fungicides
 - environment
 - plant
 - pathogen



Fungicides Types

- Systemic –absorbed
 - Xylem mobile
 - Amphimobile
 - Locally systemic
 - (Strobilurins: Abound, Sovran, Pristine, & Flint)
 - (Sterol-inhibitors: Rally, Rubigan, Elite, & Procure)
 - Translaminar

- Contact – adsorbed
 - (mancozeb)



Fungicides and Environment

- Systemic
 - Rainfast in 2 hrs.
 - Best choice during wet rainy periods
- Contact
 - Not as rainfast as systemic fungicides
 - Prone to wash-off
 - Can be redistributed by rain, dew, irrigation



Fungicides and the grape plant

- Systemic
 - Dilution over time from plant growth
 - Plant will metabolize some fungicide to non-active components
- Contact
 - New plant growth not protected
 - UV light, microbes, & heat can degrade fungicide



Marquette shoot on August 9, 2010

Over 12 inches of new shoot growth and three fully expanded leaves in 7 days!



The Marquette shoot in the photograph above on August 16, 2010

Factors Resulting In Disease

- Water/Moisture
- Temperature
- Susceptible Host
- Pathogen

- Black rot example
 - Temperature
 - Moisture

Period of continuous leaf wetness needed for infection by black rot at different air temperatures

Temperature		Hours of leaf wetness required for infection
° C	° F	
7.0	45	No infection
10.0	50	24
13.0	55	12
15.5	60	9
18.5	65	8
21.0	70	7
24.0	75	7
26.5	80	6
29.0	85	9
32.0	90	12

Disease and Environmental Conditions

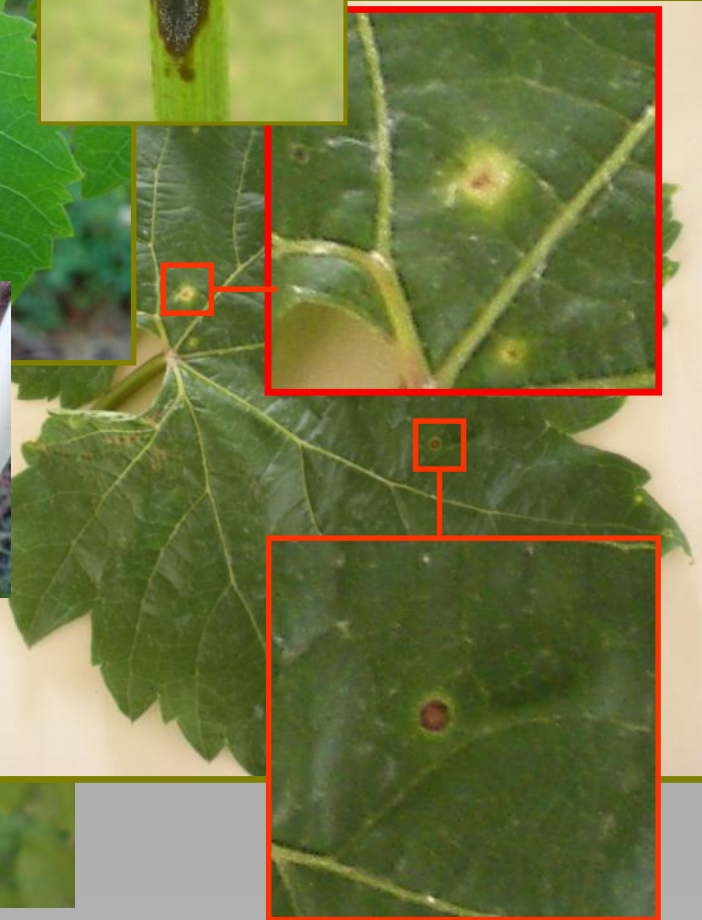
- Immediate environmental conditions
- Future environmental conditions

Some questions to ask yourself

- How long has cover spray been on?
- Are you nearing the end of the cover spray interval?
- Have your vines grown a lot during this cover spray interval?
- What do the environmental conditions look like going forward?
- What are the most likely disease threats going forward?

Grape Diseases

- Powdery mildew
- Downy mildew
- Black rot
- Anthracnose
- Phomopsis
- Eutypa
- Ripe rot
- Sour rot
- Crown gall



Powdery Mildew

- Fungal Disease
- Can infect all green tissue
- Cluster petioles and stems
 - Susceptible all season
- Berries susceptibility
 - Based on sugar content
 - <10% high, >10% none
- Overwinters in buds & canes
- Dependent on environment
 - Temps. 68-80F
 - Cloudy and High Humidity









Powdery Mildew Management

Early Control is Critical

- Heavy rains will disrupt development
- Dry, warm, am/pm dews favor development
- Fungicide applications; 8-10" shoot-pre-bloom
 - 2-3 Applications ,repeat Sept-Oct.; Weather dependent
- Overwinter as cleistothecia on trunks and cordons
- Commercial
 - Rally 40WSP
 - Tebuzol 45DF
 - Strobilurins; Sovran, Flint
 - Broader spectrum; Control other diseases
 - Protective qualities



Downy Mildew



- Similar to a fungal disease, actually water mold or oomycete
- Overwinters in infected leaves
- Early leaf infection moves to blossoms
- Favored by rapid growth + wet conditions
- Ideal temperature for infection 65° F













Diffuse Downy Mildew

“Typical” Downy Mildew



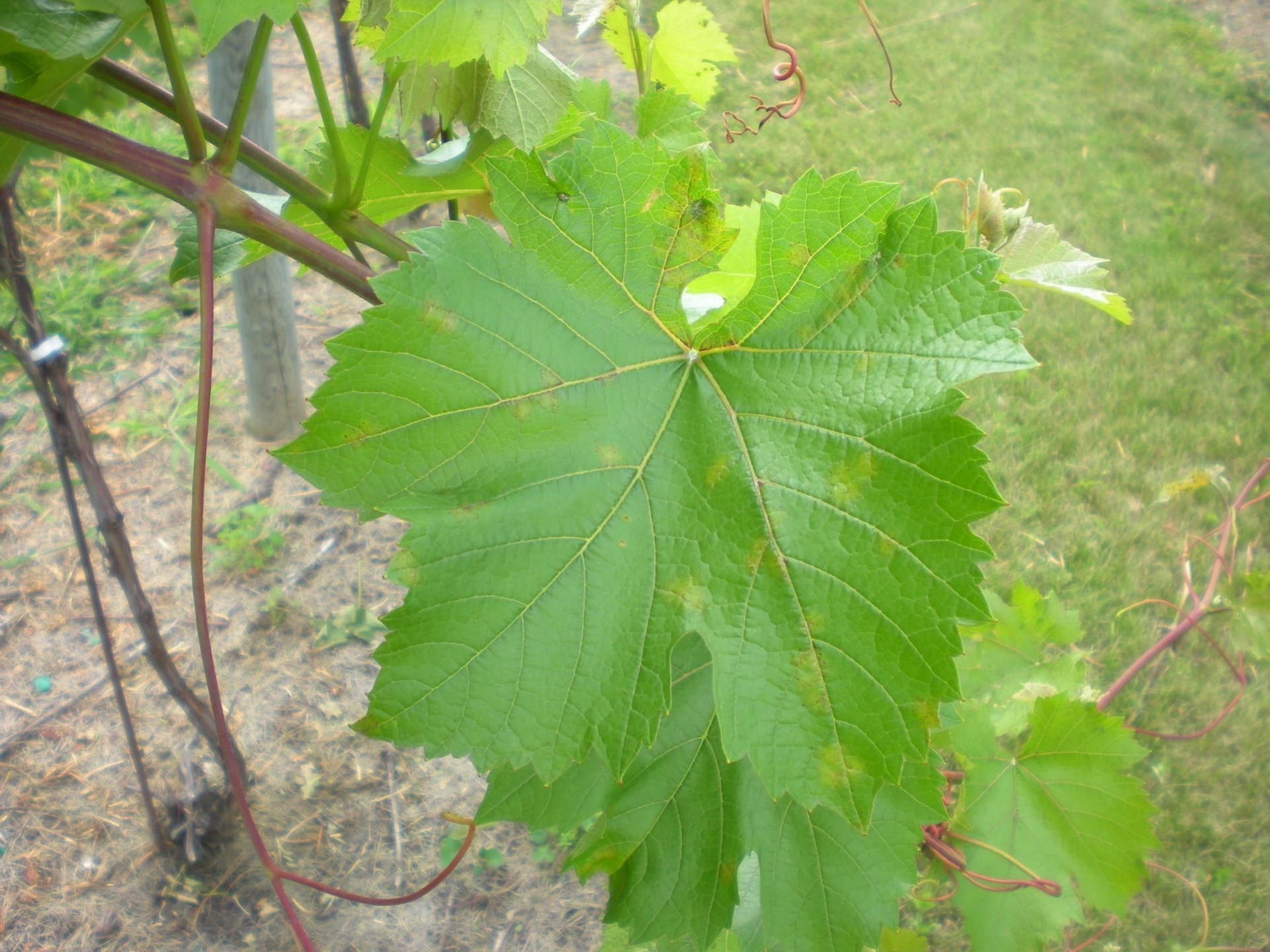
















Downy Mildew Management

- **Susceptibility Dependent on Variety**
 - Vinifera hybrids most- American least
- **Control Starts Early**
 - Initial shoot growth to pre-bloom
 - Critical before bloom to prevent fruit infection
 - Fungicide applications very effective
 - Continue 10-14 interval dependent on weather
- **Commercial**
 - Sovran 50WG
 - Mancozeb 75DF
 - Captan 50WP

Downy Mildew Identification



Greatest Misconception - misunderstanding

- Powdery mildew

- Infection can occur on upper and lower leaf surface
- Free water especially rainfall detrimental to conidia

- Downy mildew

- Infection occurs on bottom of leaf
- Free water present zoospore released
- Germ tube enters through stomates
- Downy growth on underside of leaf produce secondary inoculum

Grape IPM Challenges

Greatest Misconception - misunderstanding

- Powdery mildew



- Downy mildew



underside of leaf
produce secondary
inoculum

Powdery Mildew

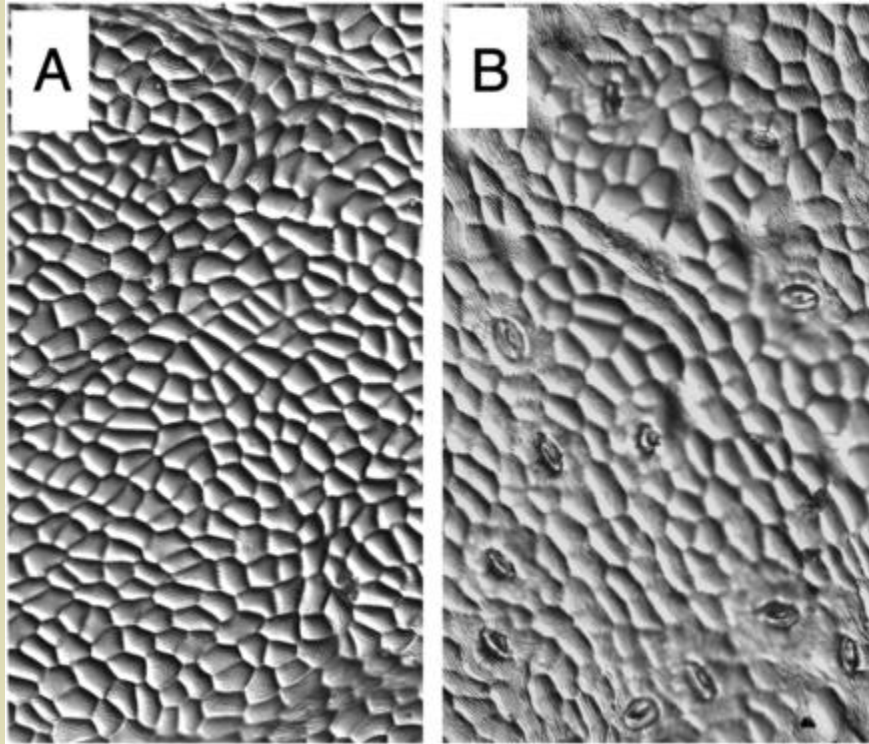


Downy Mildew



Foliar Phylloxera and Downy mildew

(A) Adaxial (upper) leaf surface of grape leaf



(B) Adaxial (upper) leaf surface of phylloxera infected grape leaf

Foliar Phylloxera and Downy mildew



Foliar Phylloxera and Downy mildew



Leaf age and Downy mildew



Black Rot



- Fungal disease infecting leaves - fruit
 - Overwinters in mummified fruit
- Infects early leaves
 - Requires a wetting period
 - Temperature + rainfall (.1”+) + Hrs. leaf wetness
 - Sporulates on leaves and infects fruit
 - Susceptibility lessens as leaves and fruit mature
 - Vinifera+++, riparia resistant
 - Control with Mancozeb 75DF
 - Begin at Pre-bloom – Veraison
 - Intervals of 14 days, 21 days dry weather













Photo Credit: Steve Jordon UW-Madison

Phomopsis

- Fungus overwinters in canes and buds
- Spores released in spring
 - Needs free water
 - Optimum Temps. of 65 – 70 ° F
 - Susceptibility
 - Very young tissue of shoots and fruit
 - Bud break – early fruit set
 - Varies among cultivars











Phomopsis on the cane and leaf (inset).

Photo credit
<https://go.dmacc.edu/programs/viticulture/blog/Lists/Posts/Post.aspx?ID=35>

Phomopsis Management

- **Sanitation**
 - Remove all dead and infected canes
 - Use only clean healthy propagation wood
- **Fungicide Program**
 - Start early shoot development
 - Continue through fruit set-pea sized fruit
 - Early protection
 - Captan 50WP or Mancozeb 75DF



Anthracnose



- Fungus overwinters in canes and berries
- Develops during seasons with frequent rain events
 - Needs 12 hr. continuous leaf wetness
 - Optimum Temps. Of 75-79 ° F
 - Susceptibility
 - Very young succulent tissue of stems and shoots
 - Berries also susceptible “birds eye rot”
 - Leaves crinkled, curled, shot-hole





Frontenac 8.12.14



Louise Swenson 8.12.14



St. Pepin 8.12.14







Anthracnose Management



- **Sanitation**
 - Remove all dead and infected canes
- **Fungicide Program**
 - Lime sulfur at end of dormant season
 - The environment of the growing season (wet and warm) and previous seasons anthracnose incidence will dictate your management program

Botrytis Bunch Rot

- Fungal pathogen overwinters in mummified fruit, canes, and leaves
- Can infect at flowering and become latent
- Also can infect ripening fruit, especially damaged fruit



Botrytis bunch rot on fruit with formation of grey mold.

Ripe Rot



Ripe rot infected cluster of Frontenac Gris from a vineyard in Vernon County . Spores produced on rotting fruit can infect neighboring clusters.



A grape berry exhibiting the characteristic orange colored "goo" of Ripe rot after incubation in a warm, moist environment.

23 August 2010

Other Grape IPM Challenges

- Eutypa dieback
 - Scout vineyards in early June
 - Remove suspect vines and destroy
 - Sanitation important
 - No fungicides for control



Other Grape IPM Challenges

- Crown gall (*Agrobacterium tumefaciens*)
 - Wounds serve as infection sites
 - Avoid root, crown and trunk wounding
- Management
 - Sanitation
 - Double trunking
 - Prune out galls on trunks and canes





**Abiotic Disorder
2, 4-D**





**Abiotic Disorder
Hail Damage**



**Abiotic Disorder
Frost Damage**

Downy Mildew



Abiotic Disorder
Parazone Damage

Grape Pests and Phenology

Growth stage Visual	Bud swell	Shoot 1-5"	Shoot 8-12"	Pre- bloom	Bloom	Pea- sized	Berry touch	Bunch closin g	Verais on	Pre- harvest	Harves t	Post- Harves t
Growth stage Modified Eichhorn-Lorenz	2-3	7-13	14-18	19-22	23	31	32	33-34	35	36-37	38	39-47
Insects												
Cutworm	+	+										
Grape Flea beetle	+											
Rose Chafer				+	+	+						
Grape Berry Moth				+	+	+	+	+	+	+	+	+
Grape Leafhopper				+	+		+	+	+	+	+	
Potato Leafhopper			+	+	+		+	+	+			
Japanese beetle								+	+	+		
Diseases												
Phomopsis		+	+	+	+	+	+	+	+	+	+	
Black rot		+	+	+	+	+	+	+	+			
Downy mildew			+	+	+	+	+	+	+	+	+	+
Powdery mildew		+	+	+	+	+	+	+	+	+	+	+
Botrytis bunch rot					+			+	+	+	+	