Upcoming Webinars

• April 1, 2020: Supporting Pollinators in Your Landscape - Yolanda Schmidt, NDSU Extension agriculture and natural resources agent, Pierce County

• April 8, 2020 Food Safety in Times of Coronavirus: Resources to Help with Food Safety, Meal Planning and Food Storage - Julie Garden-Robinson, NDSU Extension food and nutrition specialist
Zoom Controls
Please Complete the Survey

• Please complete the short online survey that will be emailed to you after today’s webinar. It will take just a couple minutes!

• Be sure to sign up for an opportunity to win a prize in the drawing. After submitting the survey, a form to fill out with your name/address will appear.

• Acknowledgement: This project was supported by the U.S. Department of Agriculture’s (USDA) Agricultural Marketing Service through grant 14-SCBGP-ND-0038.
Outline

• Big Three
  – Black Rot
    • Impact
    • Symptoms/identification
    • IMP – cultural/chemical
  – Powdery Mildew
  – Downy Mildew
• Other diseases, pests, disorders(briefly)
• Cultivation resources
• Questions/Comments
Black Rot

- Caused by fungus *Guignardia bidwellii*
- Favored by warm weather, still a threat in ND
- Often develops in combination with rainfall
Impact

• Up to 100% yield loss
• Can affect all above ground parts of the vine
• Easily considered most important disease of ND grapes
Identification

» Starts on leaves
• **Fruit:**
  – Easily noticed on green berries
  – Eventually, entire berry rots and has a deflated appearance.
  – Shriveled berry becomes a mummy
Look-alike’s

- Botrytis rot:

Photo by Greg Krieger
mummified fruit containing fruiting bodies (perithecia and pycnidia) overwinter on ground and vines

mummified fruit with perithecia

perithecia containing ascospores

pycnidiospores infect other young tissues

infected berries

ascospores are ejected into air during spring rain

ascospores

black fruiting bodies (pycnidia) form within lesions

lesions develop on young shoots and leaves
Management

• Cultural:
  – Clean up mummies - vital
  – Remove infected portions of the plant
  – Prune to promote good airflow
Black Rot: Chemical

- Critical time: protect young fruit from pre-bloom until about 4 weeks post-bloom
- Organic products such as copper and sulfur are **not** very effective!
## BR Fungicide Recommendations

<table>
<thead>
<tr>
<th>Product</th>
<th>Class</th>
<th>Rate*** (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mancozeb*</td>
<td>Protectant</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Captan – not effective</td>
<td>Protectant</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Ziram</td>
<td>Systemic</td>
<td>2-6 oz.</td>
</tr>
</tbody>
</table>

**One of the above plus the following at 3rd or 4th application:**

<table>
<thead>
<tr>
<th>Product</th>
<th>Class</th>
<th>Rate*** (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bayleton</td>
<td>Systemic</td>
<td>2-6 oz.</td>
</tr>
<tr>
<td>Mettle</td>
<td>Systemic</td>
<td>3-5 fl. oz.</td>
</tr>
<tr>
<td>Pristine</td>
<td>Systemic/mix</td>
<td></td>
</tr>
<tr>
<td>Rally</td>
<td>Systemic</td>
<td>3-5 oz.</td>
</tr>
<tr>
<td>Tebuzol</td>
<td>Systemic</td>
<td>4 oz.</td>
</tr>
</tbody>
</table>

*Recommended protectant

**Or any product labeled for grapes with tebuconazole

***Always follow the label’s rate and schedule guidelines as they are subject to change at any time since this material was compiled.
Chemical cont.

- Apply protectants (mancozeb/captan) every 7-10 days or as label directs, adjusting for weather as needed.
- Combining cultural with chemical and incorporating a systemic in with a protectant fungicide will result in superior control.
- Rotate modes of action:
Powdery Mildew

- Caused by *Erysiphe necator*
- Relative humidity needs to be >40%
- Rainfall can actually be detrimental to the fungus’ growth
Powdery Mildew Impact

• Up to yield 100% loss
• Can affect any green tissue and the fruit
• Common disease in ND, most common world-wide
• Colonizes lower surface
  – Start as chlorotic spots on upper leaf surface
  – Manifest into mature, white colonies
• Optimal temp range from 70-86°F
Powdery Mildew
Affected Leaf
Powdery Mildew – Fruit Infection

Can result in berry desiccation
Powdery Mildew

- Fungus is almost entirely external
- White coloring is due to sporulation
Late season symptoms
fungus overwinters in dormant buds

cleistothecium containing ascospores

infected buds give rise to young shoots completely covered by fungus

developing buds become infected

cleistothecia are produced on leaves, shoots and berries in late summer

infected grape cluster

ascospores are released in spring

fungus sporulates on surface of green shoots and leaves

fungus on leaves, shoots and berries produces conidia that are spread by wind

conidia and ascospores infect green tissue
Powdery Mildew Management

• All cultivars susceptible

• Properly prune and train vine

• Remove leaves around berry clusters immediately after fruit set

• Begin fungicide applications when temperatures reach >50°F
  – Recall opt temp of 70-86°F
  – Fruit highly susceptible for 1 month after bloom
### Powdery Mildew Management

- Thallus of fungus is outside of host tissue

<table>
<thead>
<tr>
<th>Product</th>
<th>Class</th>
<th>Rate* (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sulfur*</td>
<td>Topical</td>
<td>Per label</td>
</tr>
<tr>
<td>Endura</td>
<td>Systemic</td>
<td>4.5 oz.</td>
</tr>
<tr>
<td>Inspire Super/Quadris Top</td>
<td>Systemic/mix</td>
<td>16–20 fl. oz.</td>
</tr>
<tr>
<td>JMS Stylet Oil</td>
<td>Topical mineral oil</td>
<td>1-2 gallons</td>
</tr>
<tr>
<td>Pristine</td>
<td>Systemic/mix</td>
<td>8-12.5 oz.</td>
</tr>
<tr>
<td>Quintec</td>
<td>Systemic</td>
<td>3-4 oz.</td>
</tr>
<tr>
<td>Revus Top</td>
<td>Systemic/mix</td>
<td>7 fl. oz.</td>
</tr>
<tr>
<td>Tavano</td>
<td>Topical</td>
<td>3.75-13 fl. oz.</td>
</tr>
<tr>
<td>Potassium salts</td>
<td>Topical</td>
<td>Mix to label</td>
</tr>
</tbody>
</table>

*Always follow the label’s rate and schedule guidelines*
Fungicides specifically for PM

• Sulfur: with some warnings
  – Pay attention to formulation, available in: DF, F, WP, D. Different rates for each formulation!

• Potassium salts will kick back existing colonies – will not prevent establishment, and unknown to help manage any other fungal pathogens
Downy Mildew

- Caused by oomycete *Plasmopara viticola*
- Favored by warm and humid weather
DM - Impact

- Can affect all green parts of vine
- Potential exists for complete defoliation on susceptible cultivars
DM - Identification
DM – symptoms on berries
DM Fruiting Bodies
DM Biology

• Requires wet weather
  – Can ‘explode’ very quickly

• Survives winter in fallen infected leaves

• Infection begins when shoots about 8 inches long

• Temp at least 50, with rainfall

• Repeating cycles fast: 5-7 days
fungus overwinters as oospores inside fallen leaves

moisture induces production of sporangium in spring

sporangium liberates zoospores in water

zoospores are rain-splashed to susceptible tissue, encyst and germinate by forming a germ tube which enters stoma of tissue

infected shoot with distorted growth

infected tendrils

infected cluster

yellow-brown spots appear on upper leaf surface, with white patches of sporulation on underside of leaf

(cross section of leaf)

(cross section of berry)

stoma

sporangiophore and sporangia protruding through stoma
DM Cultural Management

• Proper site selection and vine training/canopy management
• Mulch around plant
• Eliminate suckers or other green foliage at ground
• Destroy nearby secondary hosts
• Clean up debris
• All of these are practical in aiding reduce infection but fungicides still recommended
# DM – Fungicide Recommendations

<table>
<thead>
<tr>
<th>Product</th>
<th>Class</th>
<th>Rate* (per acre)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Captan</td>
<td>Protectant</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Fixed copper and lime</td>
<td>Protectant</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Forum</td>
<td>Protectant</td>
<td>6 oz.</td>
</tr>
<tr>
<td>Mancozeb</td>
<td>Protectant</td>
<td>3 lbs.</td>
</tr>
<tr>
<td>Phosphorus acid</td>
<td>Topical</td>
<td></td>
</tr>
<tr>
<td>Presidio</td>
<td>Systemic Oomycide</td>
<td>3-4 fl. oz.</td>
</tr>
<tr>
<td>Inspire Super (Quadris Top)</td>
<td>Systemic</td>
<td>16 – 20 fl. oz.</td>
</tr>
<tr>
<td>Ranman</td>
<td>Systemic Oomycide</td>
<td></td>
</tr>
<tr>
<td>Revus</td>
<td>Systemic/Mix</td>
<td></td>
</tr>
<tr>
<td>Tanos</td>
<td>Oomycide</td>
<td></td>
</tr>
<tr>
<td>Zampro</td>
<td>Oomycide</td>
<td></td>
</tr>
</tbody>
</table>

Critical period is prebloom until about a month after.
Botrytis – Honorable Mention
Botrytis Biology

- Overwinters in infected debris on the ground and in the vine
- Infects dying tissue (wounds, hail, birds, infection scars from powdery mildew)
- Optimum temp 60-80 with moisture (fog, dew)
Botrytis Management

• Remove leaves around clusters

• Fungicides (if have history of disease)
  – At bloom, again veraison to harvest
  – Topsin M, Rovral, Vanguard, Elevate, Scala
Spray Guide

• Use correct PPE – PPE will differ based on product formulation – wettable powder vs flowable vs dust, etc.
• Don’t randomly mix fungicides
  – Precipitation
  – Phytotoxicity
• More is NOT better
  – Neither is less
• Pick the right day
  – Temp
  – Wind speed
  – Weather forecast
  – Stage of plant growth/disease
Fruit Pest Management Guide Link

Viruses

• There are several viruses in grapevine
  – Fanleaf
  – Tomato ringspot
  – Tobacco ringspot
  – Leafroll
  – Peach rosette mosaic
  – others
Common Virus Symptoms

- Variable, can be latent (symptomless)
- Stunting, reduced vigor
- Discoloration and distortion in foliage
- Poor fruit quality
Grapevine fanleaf virus: mosaic, vein-banding
Virus Prevention

• Use virus-indexed planting stock from a trusted nursery

• Don’t propagate yourself, or use stock from another grower

• Testing available, but can be expensive

• No realistic cure or treatment for an infected vine
Non-diseases
Arthropod pests

- Gall midges
- Spotted wing *Drosophila*
- Japanese beetles
- Potato leaf hoppers
- Japanese beetle
- Phylloxera
The map in Figure 1 below shows the number of traps positive compared to the total number of traps placed in each county.

Counts indicate the number of positive traps/the number of traps placed in each county.

North Dakota state agencies and the ND GIS Hub
Potato Leaf Hoppers

• Will cause a nasty-looking burn on leaf margins
Phylloxera

- European root stock will die from these aphid-like insects
- Resistant cultivars available and removing galled tissues
- Impossible to eradicate as some number of insects will remain on roots
Phylloxera continued

Great source for information on Phylloxera:
https://catalog.extension.oregonstate.edu/sites/catalog/files/project/pdf/ec1463
<table>
<thead>
<tr>
<th>Type of grape</th>
<th>Cultivars recommended</th>
<th>Ease of growth</th>
</tr>
</thead>
<tbody>
<tr>
<td>Juice</td>
<td>3 red varieties: ‘Valiant’, ‘King of the North’, ‘Bluebell’</td>
<td>Easiest</td>
</tr>
<tr>
<td>Table</td>
<td>A seedless, red variety: ‘Somerset’</td>
<td>Moderate</td>
</tr>
</tbody>
</table>
Production guide:

• Plant dormant rootstock end of May
  – Site selection/microclimate important (next slide)
• Should see green material in June
• Spacing:
  – 8’ rows; 6’ inside rows
  – Orient rows N – S
  – Control weeds 1.5’ on each side
• Construct trellis for new site in July or later
• Don’t prune until 2\textsuperscript{nd} year
• Won’t get a harvest until 3\textsuperscript{rd} year
(Ideal) Site Selection:

- A slope of up to 3% helps cold air leave the vineyard

![Diagram of cold air drainage and vineyard topography](image-url)
Additional Resources

• State Grape Specialist
• **Plant Diagnostic Lab**
• [https://www.ag.ndsu.edu/pdl/staff](https://www.ag.ndsu.edu/pdl/staff)
  – Jesse Ostrander (me) and Presley Mosher – **Plant Pathogens**
  – Alexander Knudson – **Plant Pests**
• **Fruit Pest Management Guide**
• **Grape Compendia**
  – Costly but thorough
Questions?
www.ag.ndsu.edu/fieldtofork