New Publications

Midwest Grape Production Guide

Arkansas
University of Arkansas
Cooperative Extension Service

Illinois
University of Illinois Extension
KCK206

Indiana
 Purdue Extension
SB-169

Iowa
Iowa State University Extension
PM 1375

Kansas
Kansas State University
Agricultural Experiment Station
and Cooperative Extension Service

Kentucky
University of Kentucky
Cooperative Extension Service

Missouri
University of Missouri
Missouri State University

Nebraska
University of Nebraska
Lincoln Extension

Ohio
Ohio State University Extension

Oklahoma
Oklahoma State University
Oklahoma Cooperative Extension Service

West Virginia
West Virginia University

This publication contains general information and is not intended for selection of specific practices.
Check out our Websites at
www.hort.purdue.edu/fruitveg/
www.indianawines.org
Midwest Small Fruit and Grape Spray Guide

Available in hard copy at registration desk or from Purdue Media Distribution (1-888-EXT-INFO)

Also Available on-line at www.hort.purdue.edu/fruitveg/

Arkansas
University of Arkansas Cooperative Extension Service

Illinois
University of Illinois Extension RN03-06

Indiana
Purdue Extension ID-109

Iowa
Iowa State University Extension P11 1575

Kansas
Kansas State University Agricultural Experiment Station and Cooperative Extension Service S 115

Kentucky
University of Kentucky Cooperative Extension Service ID-64

Missouri
University of Missouri Missour State University M 1377

Nebraska
University of Nebraska – Lincoln Extension

Ohio
Ohio State University Extension 50132

Oklahoma
Oklahoma State University Oklahoma Cooperative Extension Service ED47

West Virginia
West Virginia University Extension Service Publication 865
Grapes are susceptible to several fungal diseases.

- Black rot
- Powdery mildew
- Downy mildew
- Phomopsis cane and leaf spot
- Botrytis fruit rot
- Miscellaneous fruit rots

Grapes are susceptible to a few insect pests

- Japanese beetles
- Flea beetles
- Grape berry moth
- Grape root borers
- Multicolored Asian Lady Beetles***
Effective Grape Disease Control

- Combination of cultural and chemical methods
- Proper identification of disease
  - Some chemicals are specific for certain disease causing organisms
- Proper selection of control measures
  - Cultural management to reduce incidence
  - Chemical application to prevent infection
- Proper application of chemicals
  - Timing
  - Rate
  - Coverage
Cultural Methods of Disease Management

- **Cultivar resistance**
  - Cultivars vary significantly in their susceptibility to particular diseases (esp. mildews)
  - See Table 4 in ID-169

- **All aspects of canopy management**
  - Encourage air flow within canopy
  - Proper vine spacing
  - Appropriate training system
  - Proper plant nutrition program
  - Shoot positioning
  - Leaf removal
  - Etc.
Proper coverage using an air carrier sprayer
Common Grape Diseases

Black rot (*Guignardia bidwellii*)
Common Grape Diseases

Powdery mildew (*Uncinula necator*)
Common Grape Diseases

Downy Mildew (*Plasmopara viticola*)
Common Grape Diseases

Botrytis Bunch Rot (*Botrytis cinerea*)
Common Grape Diseases

Phomopsis Cane and Leaf Spot

(*Phomopsis viticola*)
Common Grape Diseases

Anthracnose (*Elsinoe ampelina*)
Common Grape Diseases

Bitter rot (*Greeneria uvicola*)
Fungicides Types

- Based on mode of action
  - Protectant
    - Must be on the plant prior to an infection event - preventative program. Most are broad spectrum. Some phytotoxicity.
      - Captan, mancozeb, ziram, copper, sulfur
  - Systemic
    - Most are locally systemic (not throughout the plant). Most have eradicative action and can stop disease development after infection occurs if applied soon enough.
      - Sterol inhibitors and ridomil
  - Semi-systemic
    - Most are trans-laminar systemic so they are very resistant to wash off. Usually don’t have much eradicative action.
      - Strobilurins
Fungicide Classes

• **Dithiocarbamates, phthalimides**
  - Captan, mancozeb, ziram, ferbam, etc.
  - Broad spectrum, protectants

• **Other broad-spectrum fungicides**
  - Copper, sulfur (inorganics)

• **Sterol inhibitors (DMI)**
  - Nova, Rubigan, Bayleton, Elite, Procure, etc.
  - Specific for certain diseases, esp. powdery mildew and black rot

• **Boscalid (new product for powdery mildew, Endura)**
  - Component of Pristine

• **Stobilurins (Reduced risk)**
  - Abound, Sovran, Flint, Pristine*
  - Broad spectrum

• **Botryocides (specific for Botrytis cinerea)**
  - Rovral, Elevate, Vangard

• **Alternatives (organic and/or reduced risk)**
  - Oils, phosphorous acid, potassium bi-carbonate, potassium monophosphate, Oxidate, compost tea, Seranade, etc.
Managing Fungicide Resistance

Many of the newer fungicides affect a single “site” in the fungal cell metabolism, and consequently, are susceptible to development of resistance in the pathogen population. The Fungicide Resistance Action Committee has developed a set of codes to use in managing resistance.

Strategies for managing fungicide resistance

- Follow label exactly
  - Number of applications, rates, etc.
- Do not apply a fungicide susceptible to resistance development when an epidemic has already started.
  - Use a material that will kill the existing population
  - Many alternatives (oils, phos, KBC, etc. fit this category)
- Rotate to another mode of action class (FRAC Code)
  - Keeps resistant populations from building up
- Tank mix with broad spectrum fungicides
  - Kills both resistant and susceptible populations
- Understand the FRAC codes and use fungicides accordingly
<table>
<thead>
<tr>
<th>FRAC Code</th>
<th>Group Name</th>
<th>Common Name</th>
<th>Examples</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Methyl Benzimidazole Carbamates</td>
<td>Benzimidazoles thiophanates</td>
<td>Benlate, Topsin M</td>
<td>High risk, Cross rs common</td>
</tr>
<tr>
<td>2</td>
<td>Dicarboximides</td>
<td>dicarboximides</td>
<td>Rovral</td>
<td>Medium to high risk, Cross rs common</td>
</tr>
<tr>
<td>3</td>
<td>DMI (SBI class I)</td>
<td>Triazoles, pyridines, Pyrimidines</td>
<td>Nova, Bayleton, Rubigan, Elite, Procure, Scala</td>
<td>Medium risk, Cross rs likely</td>
</tr>
<tr>
<td>4</td>
<td>Phenyl Amides</td>
<td>metalaxyl</td>
<td>Ridomil</td>
<td>High risk, Cross rs common</td>
</tr>
<tr>
<td>7</td>
<td>carboximides</td>
<td>Boscald</td>
<td>Endura</td>
<td>Medium risk</td>
</tr>
<tr>
<td>9</td>
<td>Anilino-Pyrimidines</td>
<td>cyprodinil</td>
<td>Vanguard</td>
<td>Medium risk</td>
</tr>
<tr>
<td>11</td>
<td>Quinone outside Inhibitors</td>
<td>azoxystrobin, pyraclostrobin, kresoxim-methyl trifloxyostrobin</td>
<td>Abound, Pristine, Sovran, Flint</td>
<td>High risk, Cross rs shown between all members of Qol group.</td>
</tr>
<tr>
<td>13</td>
<td>Quinolines</td>
<td>Quinoxyfen</td>
<td>Quintec</td>
<td>Medium risk</td>
</tr>
<tr>
<td>17</td>
<td>hydroxyanilides</td>
<td>fenhexamide</td>
<td>Elevate</td>
<td>Medium risk</td>
</tr>
<tr>
<td>33</td>
<td>Phosphonates</td>
<td>Fosetyl-Al, Phosphorous acid</td>
<td>Aliette, Phosphorous acid</td>
<td>Risk unknown, assumed to be low</td>
</tr>
<tr>
<td>M</td>
<td>Multi-site contact activity</td>
<td>Inorganics, Dithiocarbamates, Phthalimides</td>
<td>Copper, sulfur, Ferbam, mancozeb, ziram captan</td>
<td>Low risk, no Cross resistance</td>
</tr>
</tbody>
</table>
Resistance Development Potential

- **Bunch Rot** (*Botrytis cinerea*)
  - Fungicide resistance is very common
  - Strategies of tank mixes with FRAC M and rotation to other FRAC groups
- **Powdery Mildew** (*Uncinula necator*)
  - Fungicide resistance is very common (esp NE US)
  - Strategies of tank mixes, rotation, use of sulfur, potassium salts, oils, etc. as eradicants if a epidemic is started.
- **Downy mildew** (*Plasmopora viticola*)
  - Fungicide resistance is possible (ridomil) so only combination products are sold. Not sure about strobies.
  - Several good eradicants in group M & 33.
- **Black rot** (*Guignardia bidwellii*)
  - Fungicide resistance has never been shown. Apparently low risk.
- **Phomopsis Cane & Leaf Spot** (*Phomopsis viticola*)
  - Fungicide resistance unknown.
Recommended Spray Program for Indiana Vineyards

• **Early** (1-12 inch shoots)
  - Broad spectrum protectant (mancozeb)
  - Repeat at 7-10 day intervals depending on rainfall and shoot growth rate (3-4 sprays)

• **Mid** (pre bloom, bloom, and post bloom)
  - *Three most important sprays of the year!*
  - Use “best” products: strobies and sterol inhibitors in rotation.
    (Sprays about 10 days apart)
  - Be sure to get thorough coverage, especially clusters

• **Late** (2 weeks post bloom through veraison)
  - Use products on 14-21 day schedule. Choose products depending on weather, cultivar susceptibility, etc.
  - Scout for mildew outbreaks and spray accordingly

• **Post harvest**
  - Maintain good leaf health until first frost
### Disease Calendar

<table>
<thead>
<tr>
<th></th>
<th>Budbreak</th>
<th>Pre-bloom</th>
<th>Bloom</th>
<th>1st Post-bloom</th>
<th>Cluster closing</th>
<th>Veraison</th>
<th>Harvest</th>
<th>Leaf drop</th>
</tr>
</thead>
<tbody>
<tr>
<td>Black rot</td>
<td>++</td>
<td>+++</td>
<td>++</td>
<td>+++++</td>
<td>+++</td>
<td>+</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>Powdery Mildew</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++++</td>
<td>++++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Downy Mildew</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
<td>+++</td>
<td>++++</td>
<td>++++</td>
<td>++</td>
<td>+++</td>
</tr>
<tr>
<td>Phomopsis</td>
<td>++++</td>
<td>+++</td>
<td>+++</td>
<td>+++++</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+++</td>
</tr>
<tr>
<td>Botrytis</td>
<td>+</td>
<td>+++</td>
<td>++</td>
<td>+</td>
<td>++++</td>
<td>++++</td>
<td>++</td>
<td>0</td>
</tr>
<tr>
<td>Bitter rot</td>
<td>++</td>
<td>++</td>
<td>+++</td>
<td>+++++</td>
<td>+</td>
<td>+</td>
<td>+++</td>
<td>0</td>
</tr>
<tr>
<td>Anthracnose</td>
<td>++++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>++</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
</tbody>
</table>

+, ++, +++ etc. denotes fungus activity
+++++++ denotes appropriate time to spray
Disease Control Summary

- Know cultivar susceptibility
- Understand pathogen biology
- Develop a disease management strategy
  - Cultural methods
  - Chemical methods
- Practice proper chemical application techniques
  - Rates
  - Timing
  - Coverage
Grape Insect Pest Control

- Proper identification of pest
- Proper selection of insecticide or other control measure
- Determination of economic threshold
- Proper timing
  - Monitor population with pheromone traps
- Thorough coverage of susceptible plant parts
Common Grape Insect Pests

Japanese beetle
Japanese Beetle Damage
Japanese Beetle Damage
Edge Effect
Japanese Beetle Damage
3 day weekend!
Common Grape Insect Pests

Grape berry moth
Common Grape Insect Pests

Grape flea beetle
Leaf Phylloxera
Leaf Phylloxera
Not-so-Common Grape Insect Pest

- Multicolored Asian Lady Beetle
  - Not a pest, but a winemakers nightmare!
Multicolored Asian Lady Beetles on Fruit
Multicolored Asian Lady Beetles on Fruit
Multicolored Asian Lady Beetles in Juice
MALB from 30 lbs Fruit
Insect Management

• **Grape Berry Moth**
  – Monitor population with pheromone traps
  – Disrupt mating with pheromones
  – Add insecticide into cover sprays when needed

• **Japanese beetle**
  – Monitor damage and spray if necessary
  – Don’t overreact to minor damage
  – Don’t wait until all your leaves are gone

• **Other insect pests**
  – Monitor and treat only if necessary
  – Scout for Grape Flea Beetle damage
  – Scout for grape phylloxera (leaf form)
Grape Insecticides

- For Grape Berry Moth
  - Sevin
  - Imidan
  - Danitol (RUP)
  - Guthion (RUP)
  - Intrepid

- For Japanese Beetle
  - Sevin
  - Danitol (RUP)
  - Imidan

- For Grape Leafhopper (not a big problem)
  - Assail
  - Applaud
  - Danitol (RUP)
  - Provado
  - Sevin
Grape Insecticides

Miscellaneous pests

- For Grape phylloxera (leaf form)
  - Danitol (RUP)
  - Thiodan (endosulfan) --- *phytotoxic*

- For Multicolored Asian Lady Beetle
  - Provado (0 day PHI)
  - Malathion (3 day PHI)
  - Neemix or Aza-Direct (0 day PHI)
  - Pyrethrins (0 day PHI)
Managing Insecticide Resistance

• Similar to fungicide resistance management
  – IRAC codes for mode of action
  – Rotate chemistry where possible
  – Utilize mating disruption where possible

• Grape pest known to have developed insecticide resistance:
  – Grape berry moth
  – Two spotted and European red spider mites
Organic Production?

• In the Midwest, very few grape cultivars can be grown without controlling diseases and the dominant insect pests.
  – Norton is the most disease resistant
  – Cayuga White, Steuben, etc are also candidates
• Organic production does NOT mean NO SPRAY, it often means that more spraying will be necessary.
  – Organic growers will have to grow varieties that are tolerant of major diseases, and use OMRI certified fungicides such as copper, sulfur (on non-sensitive cultivars), phosphorous acid, bi-carbonates, oils, etc. on a regular basis throughout the season to maintain acceptable disease control.
  – Organic control of Japanese beetles? (Neem extracts? Surround?)
• Environmental impact of “organic production” can be worse than with modern reduced risk chemicals.
Weed Control & Vineyard Floor Management

- **Cover crop between rows**
  - planted perennial cover crop - usually grass
  - native species - mixture
- Provides solid surface for equipment
- Reduces soil compaction
- Increases water infiltration, reduces runoff and erosion

- **Weed-free strip beneath vine row**
  - eliminate competition for water, nutrients
  - improve air movement - reduce disease incidence
  - eliminate crop contamination
Weeds

Any plant in the vine row other than grapevines

• Grasses
• Broadleafs
• Brushy perennial weeds: brambles, poison ivy, etc.
Weed Control in the Vine Row

Pre-emergent + post-emergent herbicides
- Band-applied - one or both sides of each row
- Single of double sided boom
  - Even fan nozzles
  - Offset nozzle body
  - Low volume (20-40 gpa)
  - Low pressure (15-30 psi)
- Low-volume CDA Sprayers (for post-emergent)

Mechanical weeding
Mulching
Herbicides

Pre-emergent and post-emergent herbicides

- Pre-emergent - prevent weeds from becoming established
- Post-emergent - kill or suppress existing weeds
- Tank mix post-emergent plus one or more pre-emergent (selected for problem weeds)
# Post-emergent herbicides

## Broad Spectrum
- Roundup, Touchdown - glyphosate
- Rely - glufosinate
- Gramoxone Super, Extra - paraquat (RUP)
- Aim - carfentrazone

## Grass Specific
- Poast - sethoxydim
- Fusilade 2000 - fluazifop (non-bearing)
- Select - clethodim (non-bearing)
- Reglone - diquat (non-bearing)
Pre-emergent herbicides

- Surflan (oryzalin)
- Treflan (trifluralin)
- Princep (simazine)
- Solicam (norflurazon)
- Karmex (diuron)
- Casoron (dichlobenil)
- Devrinol (napropamide)
- Treflan (trifluralin)
- Goal (oxyfluorfen)
- Prowl (pendimethalin) (non-bearing)
- Gallery (isoxaben) (non-bearing)
- Kerb (pronamide) (RUP)
- Chateau (flumioxazin)

Differ in specificity, soil behavior, vine age restrictions, etc. See Weed Control chapter in ID-169

READ THE LABEL
Herbicide Sprayer
Boom and Nozzles
Spray nozzles

Standard

Even

A
Type 4183A
Single Swivel Nozzle
Low volume CDA Sprayers
Post-emergent Only
Post Emergent Strip
Damage from 2,4-D
Damage from Dicamba
Mechanical weeding

• **Grape hoe**
  – Green hoe
  – Radius

• **Rotary cultivator**
  – Weed Badger
  – other
Rotary Cultivators
Mulching

- **Mow & Throw**
  - Grow cover crop between row, mow, and throw mulch under row
- **Apply organic mulch under vine row** (wood chips, leaves, etc.)
- **Plastic or fabric mulch**
- **Herbicide desiccated cover crop**
  - Grow rye fall-spring, kill with herbicide and leave in place as a mulch**
- **Living mulch?**
  - Non-competitive ground cover
Pesticide Application Licenses
www.btny.purdue.edu/ppp/
www.oisc.purdue.edu

• Private Applicator
  – Required to purchase and apply any Restricted Use Pesticide on land they own, rent or otherwise control
  – Recommended for all growers (especially those that plan to sell their produce)

• Commercial Applicator
  – Required for any person that applies a pesticide for hire.
• Pesticide application records are REQUIRED for Restricted Use Pesticides
• Pesticide application records are highly recommended for General Use Pesticides
• See Record Keeping charts in ID-169
  – Record date, time, field, stage of growth.
  – Record chemical applied and EPA registration number.
  – Record rate, volume applied, etc
  – Record weather conditions, etc.
• Keep records for a minimum of 3 years
Pest Management Summary

- Grapes (and other fruit crops) require intensive management of pests, especially diseases.
  - Proper pest and disease identification
  - Understand pest biology
  - Choose appropriate control measures
  - Apply materials timely and effectively
  - Stay current on pesticide registrations and application rules.
  - Be a good neighbor and land steward