Management of Key Vineyard Pests

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Sources: E154, Fruit Mgmt Guide 2016

MICHIGAN STATE UNIVERSITY | Extension

FOR COMMERCIAL FRUIT GROWERS

Michigan Fruit Management Guide

2016

Extension Bulletin E154 • Information Current as of November 1, 2015 • Revised Annually • **DESTROY PREVIOUS EDITIONS**

Management of Key Vineyard Pests

- Insect pest life cycles, damage, recommended management

- Disease life cycles, damage, recommended management

Verbage

- Residual
- Contact material
- Ingestion material
- Systemic material
- Scouting
- Cultural control
- Primary Inoculum
- Secondary Inoculum

Insect Pests

- Spring bud feeders:
  - Flea beetles
  - Climbing cutworm

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  - Climbing cutworm
- Leaf feeders:
  - Leafhoppers
  - Japanese Beetle

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- Leaf feeders:
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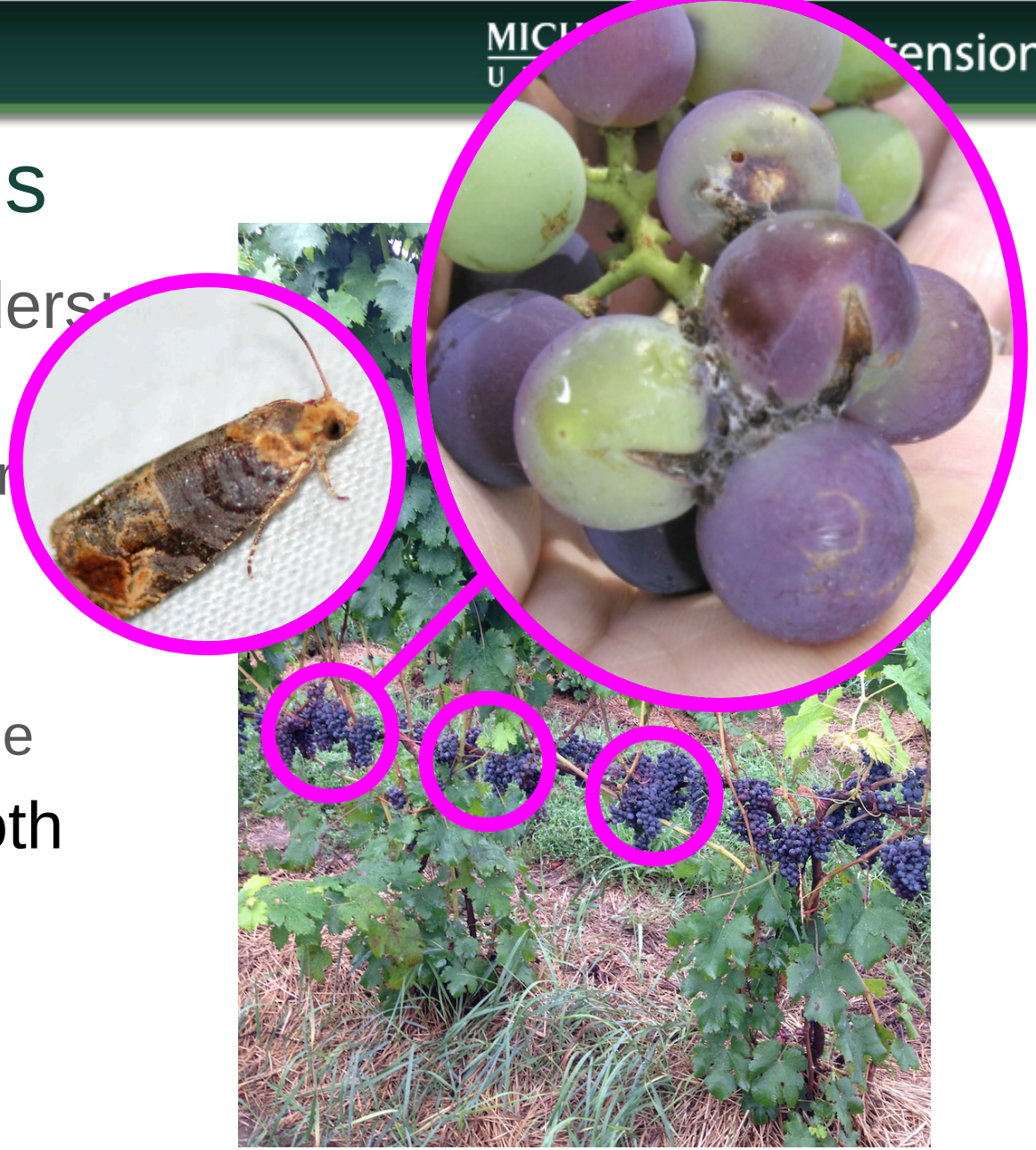
  - Japanese Beetle
- Grape Berry Moth



Insect Pests

- Spring bud feeders:
  - Flea beetles
  - Climbing cutworm
- Leaf feeders:
  - Leafhopper
  - Japanese Beetle
- Grape Berry Moth
- Mealybug
- Phylloxera

Classes of Insecticides

- “Reduced-risk”
  - longer residual
  - ingestion poisons
  - specific
- “Broad-Spectrum”
  - =“Conventional”
  - shorter residual
  - contact poisons
  - kill everything

Classes of Insecticides

- "Reduced-risk"
  - Delegate, SpinTor, Entrust
  - Intrepid
  - Altacor, Belt
  - Dipel (B.T.)
  - Agri-Mek
  - Oberon, Movento
- Broad-spectrum
  - Lorsban, Imidan
  - Danitol, Mustang Max, etc.
  - Lannate, Sevin
- In Between
  - Neonicotinoids

What is "reduced risk?"

- "Risk" refers to…
  - Applicator, consumer, and neighbor health risks
  - Non-target critters
    - Bees
    - Predatory insects
    - Predatory mites
    - Parasitoids

- Official "Reduced Risk" EPA designation for some materials.

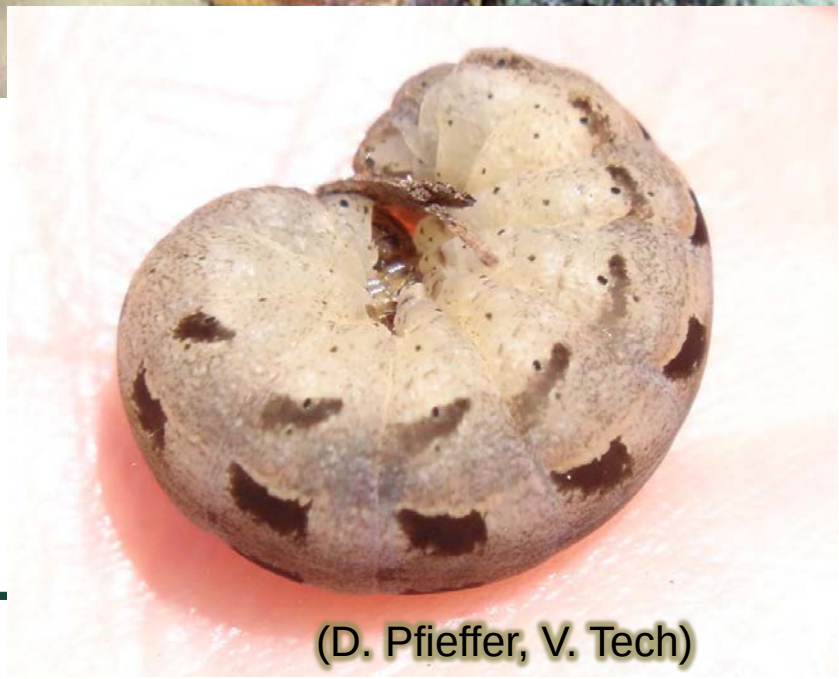
- Often, these are *ingestion poisons* rather than *contact poisons*.
  - *More thorough coverage needed,*
  - *More precise timing needed*

Bud Feeders

- Feeds from bud swell to 2-5 inch shoots
- Scouting: brown/black, hollowed out buds.
- Can result in serious damage!

Bud Feeders

- Flea beetle on clay soils
- Cutworm on sandy soils
- Cultural control:
  - Leave extra buds
    - (+ frost protection)
  - Clean understory
  - >4% buds: poison



Cultural control: Sanitation

No place for flea beetle to emerge from!

Insecticides for Bud Feeders

- **Flea Beetle**
  - Pyrethroids
    - Gladiator
    - Brigade
    - Brigadier
    - Danitol
    - Hero
    - Baythroid
    - Mustang Max
  - Sevin

Climbing Cutworm

Excellent control

Pyrethroids: Gladiator, Brigade, Danitol, Hero, Baythroid, Mustang Max

Lorsban

Good control

Oberon*

Delegate*

Altacor*

The Leafhoppers

- do not overwinter in Michigan
- Adults come in on storm fronts from the Gulf in May or June
- Summer leaf feeding

Adult potato leafhopper

Leafhopper damage

- During an infestation:
  - clouds of them jump up from the grass when disturbed.
- Leaf damage: stippling on leaf surface, to yellow or rust colored.

Insecticides for *Leafhoppers*

- Excellent Control
  - Belay, Scorpion*, Venom, Leverage, Agriflex
  - Baythroid
- Good Control
  - Lannate, Sevin
  - Brigade, Danitol, Mustang Max
  - Gladiator

- Soil-applied, 6-12” shoot:
  - Admire Pro*
  - Platinum
  - Venom

- Note: generally a nuisance pest when present, sprays seldom needed.

Japanese Beetle

- Grubs underground in sod, pasture, turf environments
- Adults emerge Jun/Jul, migrate into vineyards
- Traps: NOT RECOMMENDED

Insecticides for Japanese Beetle

- Good Control:
  - Altacor*
  - Avaunt*
  - Neonicotinoids: Provado*, Actara*, Assail*, Belay
  - Pyrethroids: Brigade, Danitol, Baythroid, Mustang Max, Hero
  - Imidan
  - Sevin

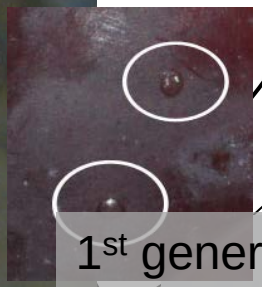
- *Excellent* Control:
  - Scorpion* (Neonic)

- JB tend to clump in small areas, usually spot-spraying is what's needed.

A note on leaf-feeders…

- Looks ugly?
  - May be harming yield, quality, growth, or hardiness
  - But not always!
  - Leafhoppers: Mild damage -> no impact on fruit quality…
  - JB 15% leaf loss or more

Grape Berry Moth



1st generation

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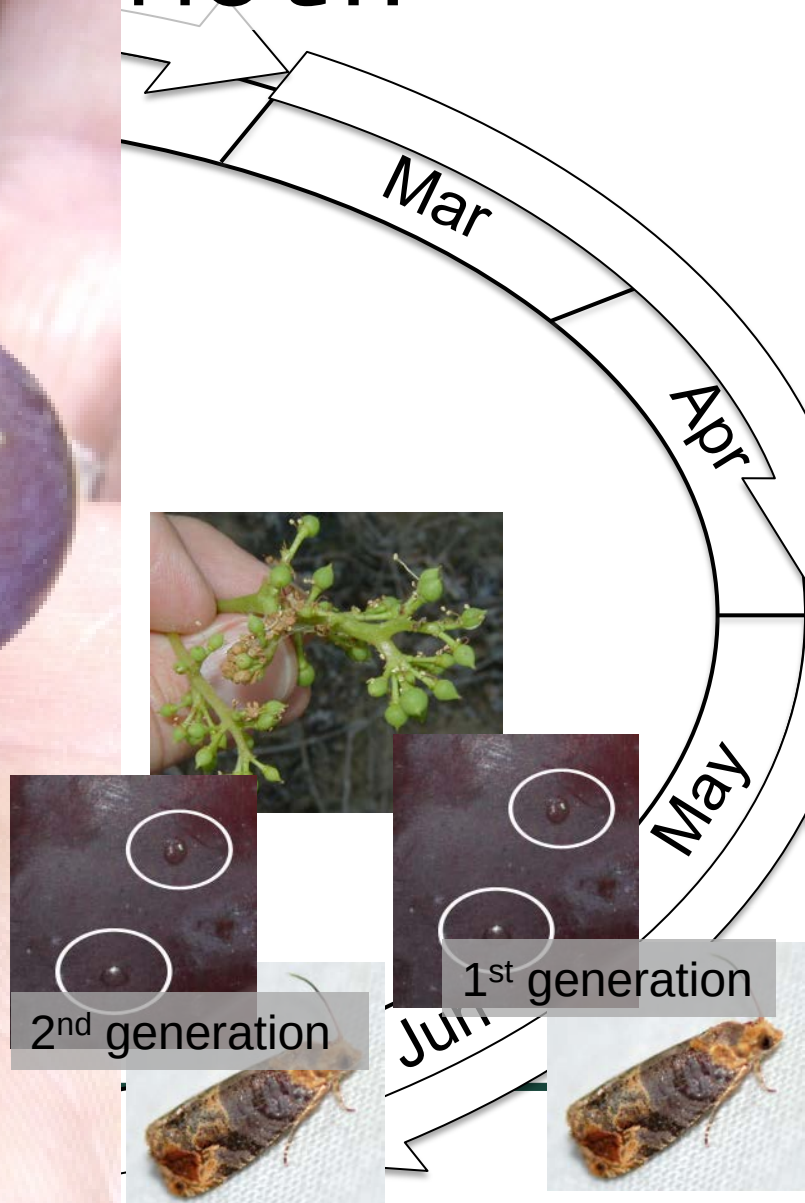
Moth



2nd generation

1st generation

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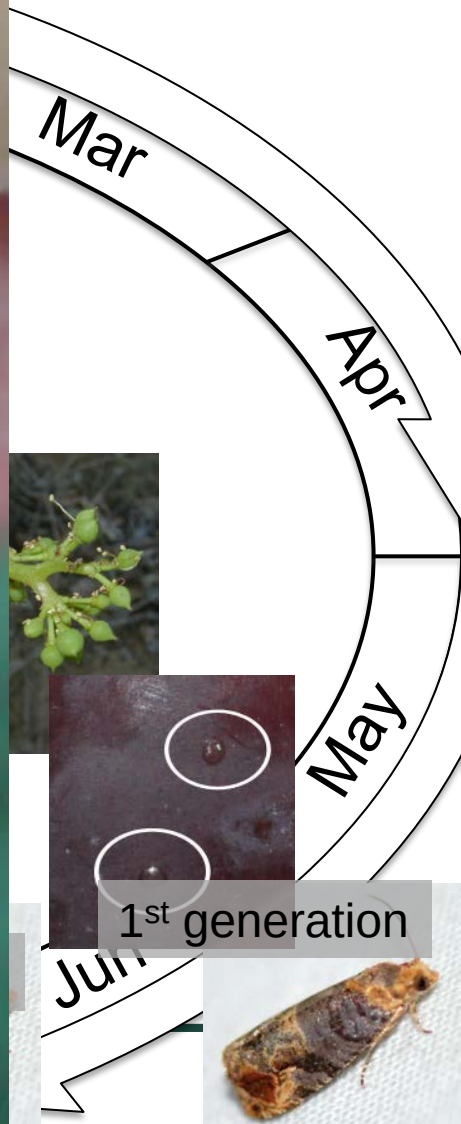
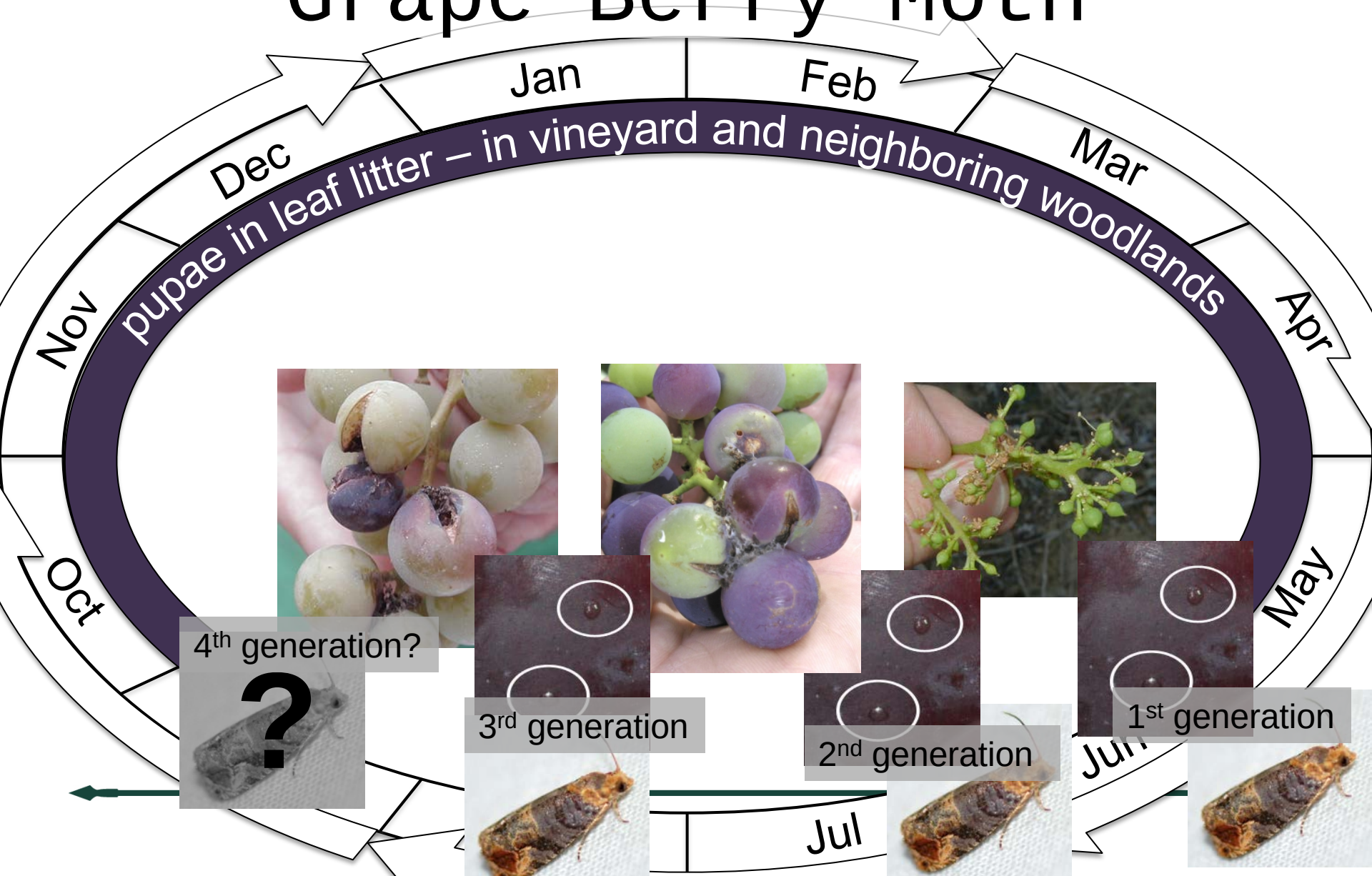


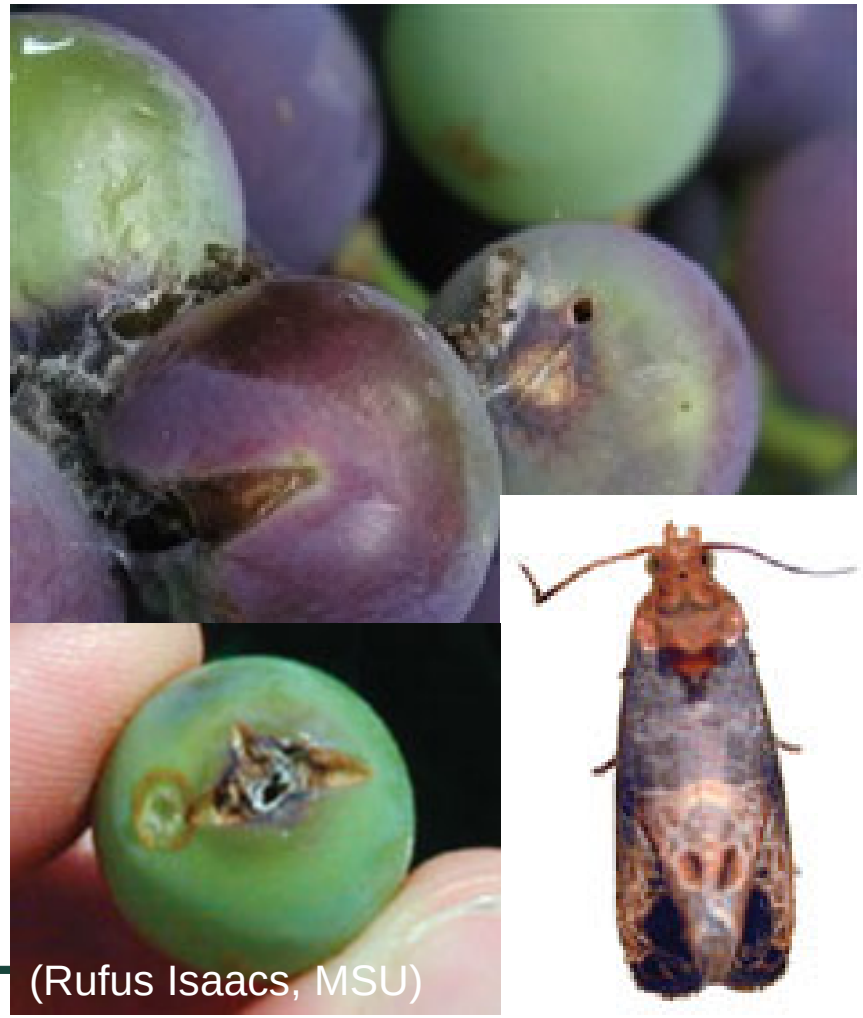
1st generation

Grape Berry Moth



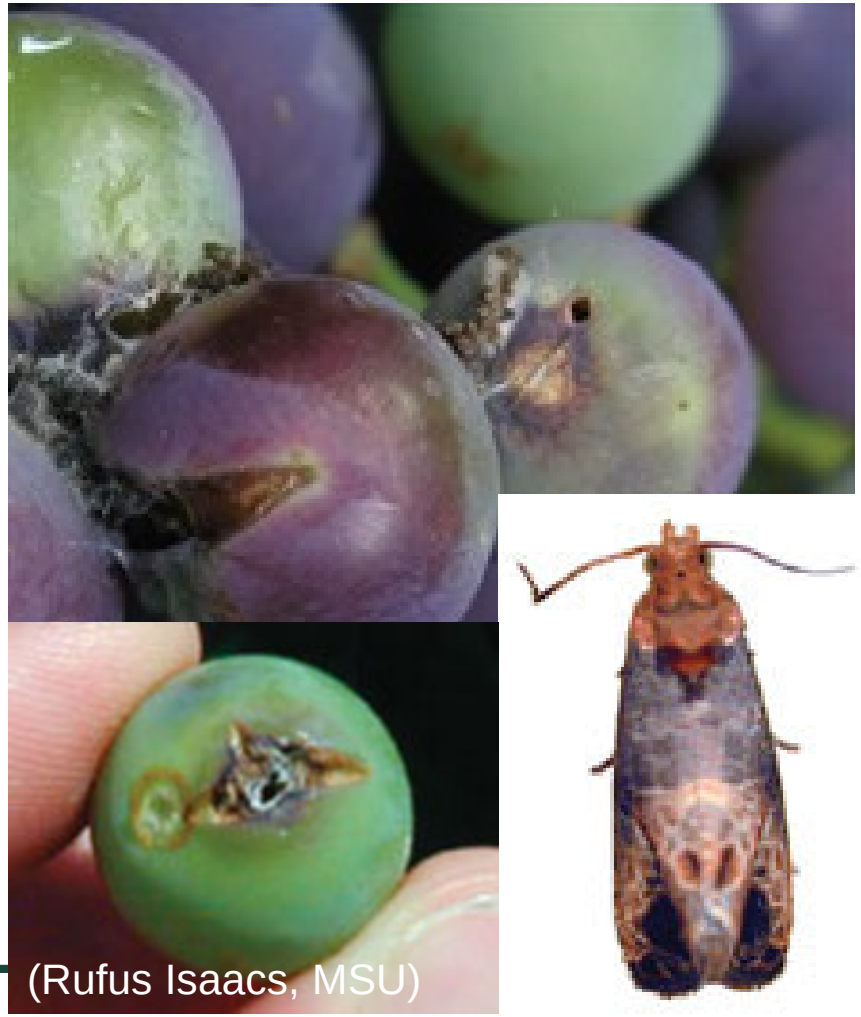
Grape Berry Moth

- Scouting
  - flat, white eggs on clusters
  - characteristic wounds and webbing in clusters
  - infested red grapes will get color early in the season
- Infestation worse on borders



Grape Berry Moth

- Sprays: timing and location of sprays are everything.



Grape Berry Moth: Many poisons that work well...

Excellent Control:

- Intrepid*
- Altacor* and Belt*
- Imidan
- Sevin
- Danitol, Hero, Gladiator

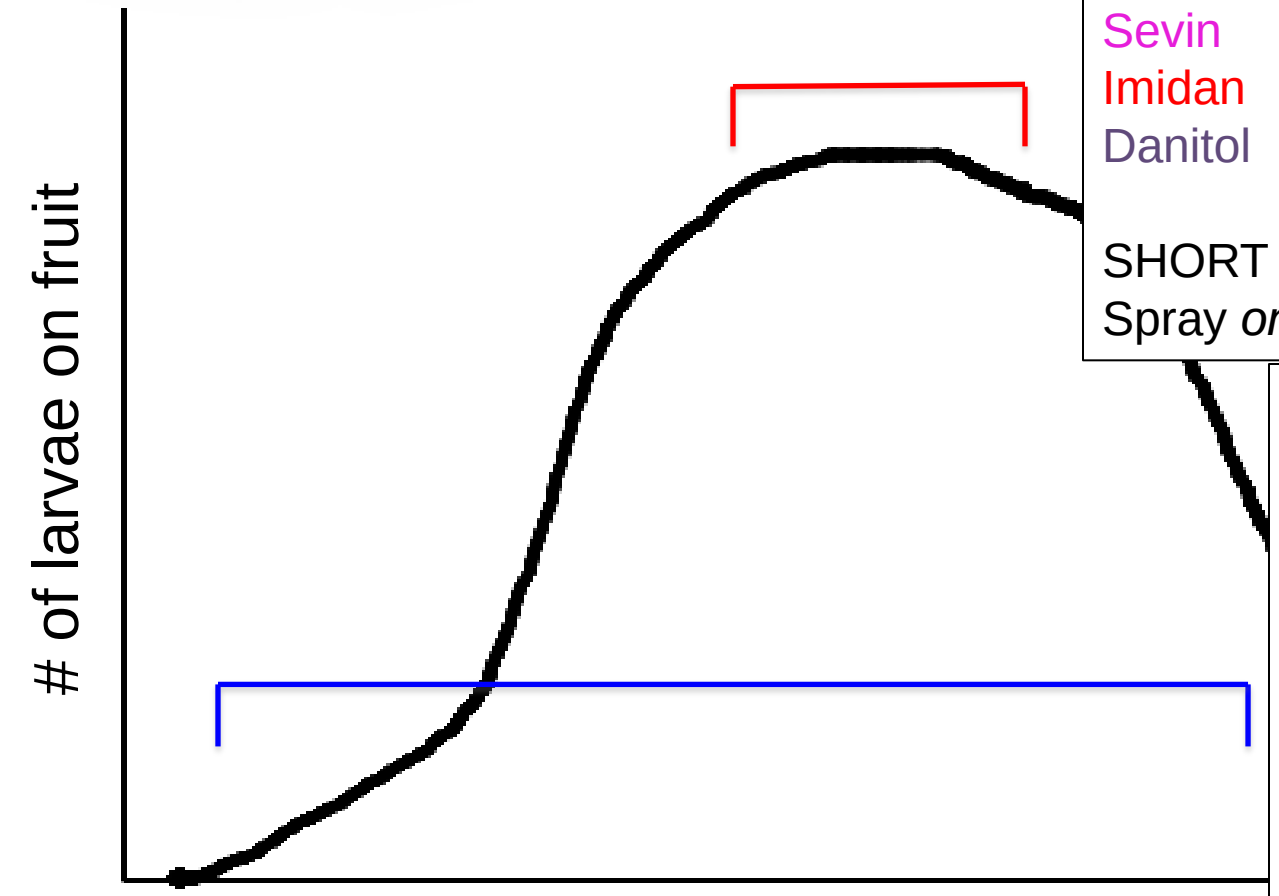
Good Control:

- BT toxin*
- Entrust*
- Avaunt*
- Neonics: Belay, Scorpion*, Venom
- Oberon*
- Spinosyns: Delegate,* SpinTor*
- Lannate
- Pyrethroids: Mustang Max, Leverage, Baythroid, Brigade

Grape Berry Moth: Spray Timing

- Why is timing so important?

Grape Berry Moth: Spray Timing



Broad spectrum contact poisons:
Sevin
Imidan
Danitol

SHORT residual,
Spray *on* larvae directly

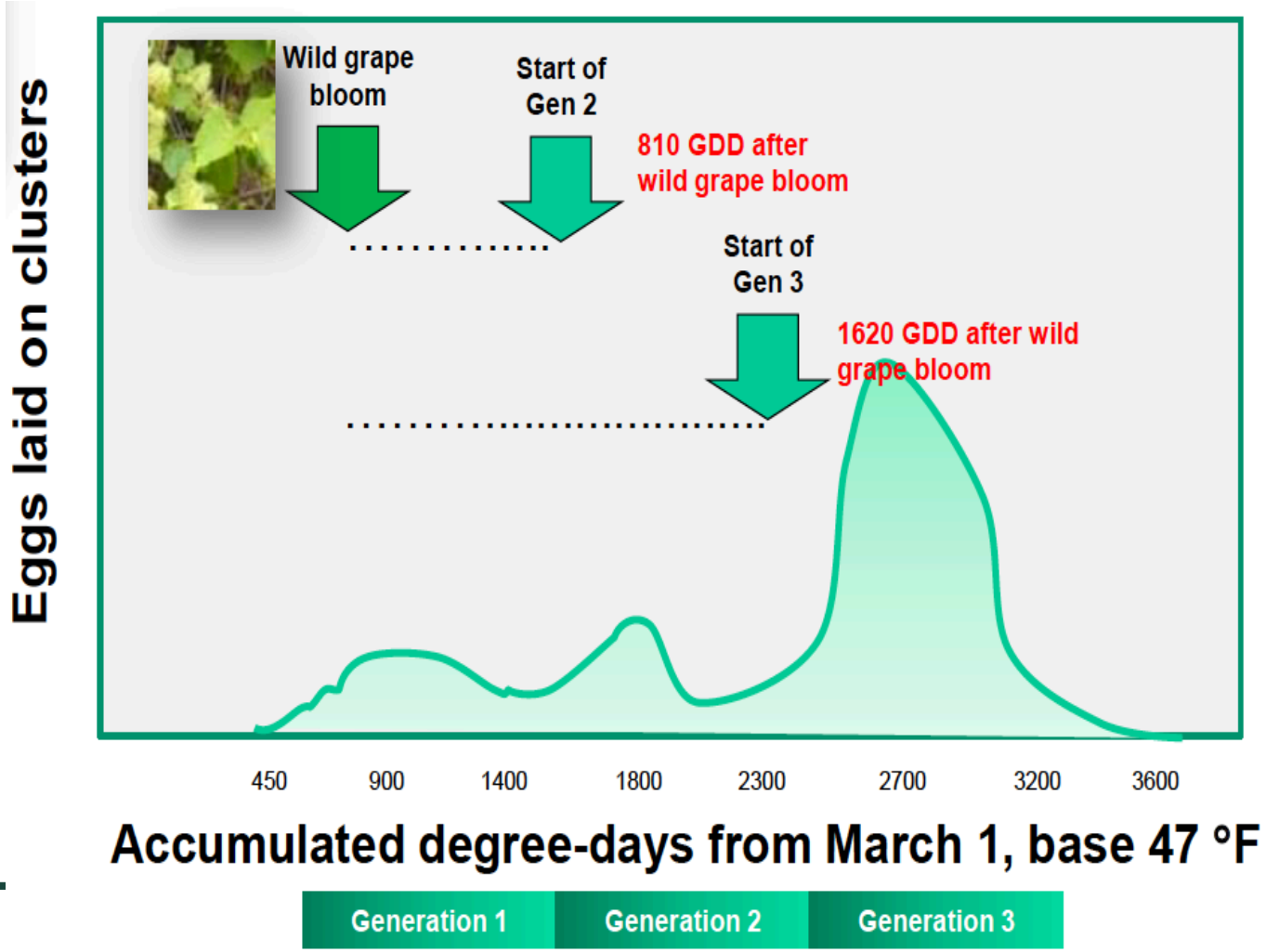
Reduced risk ingestion poisons:
Altacor
Belt
Intrepid
Dipel
Entrust

LONG residual,
spray on leaf surface BEFORE larvae hatch

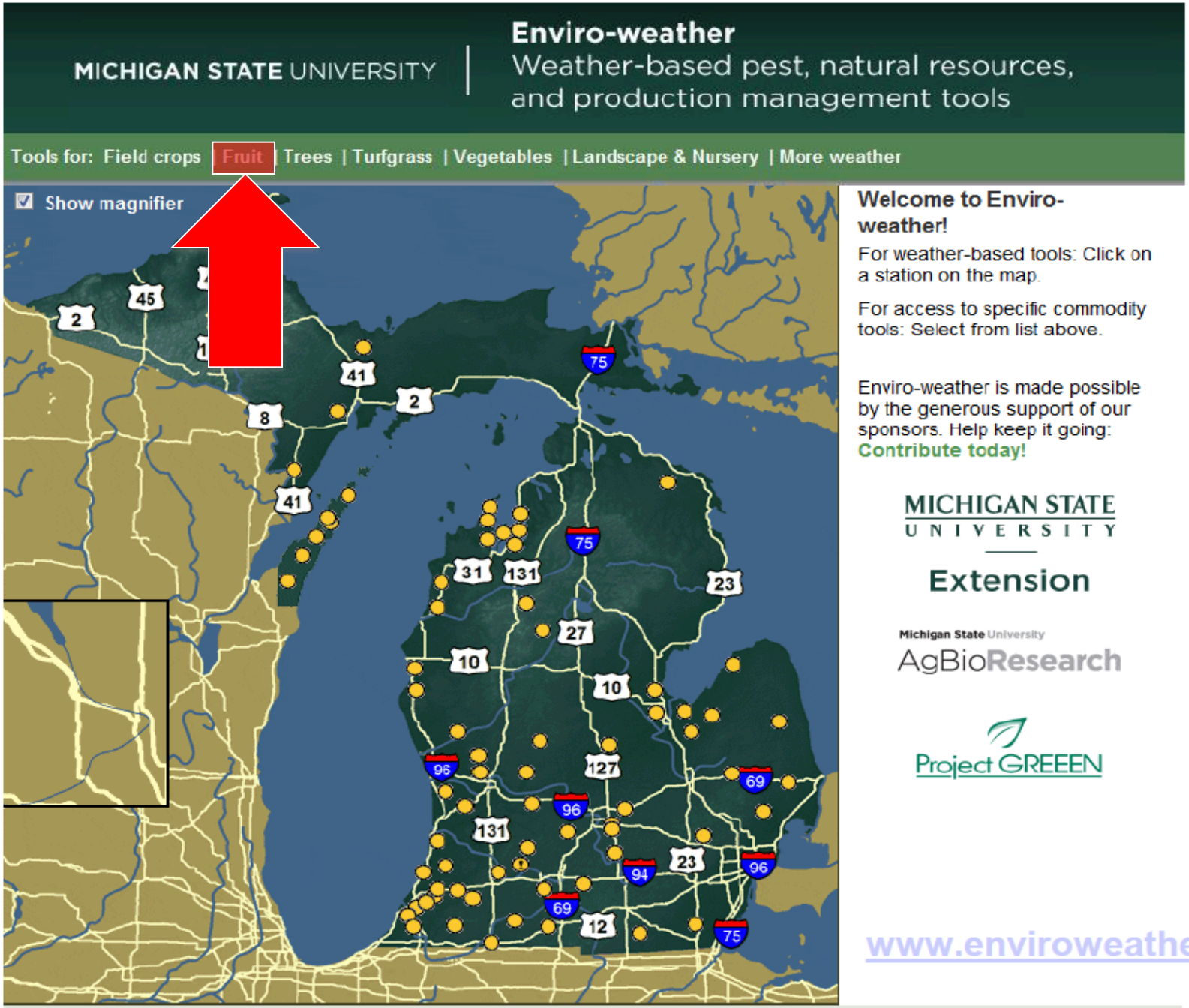
What is a “Growing Degree Day?”

Grape Berry Moth: Spray Timing

- That's why we suggest Growing Degree Day model.



How can I track berry moth degree days?



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Weather-based pest, natural resources, and production management tools

Tools for: Field crops | Fruit | Trees | Turfgrass | Vegetables | Landscape & Nursery | More weather

Expand All | Contract All

Resources for:

Tree fruit

- Apple
- Cherry
- Pear
- Other tree fruit
- Multi-Crop Disease Summaries

Small fruit

- Blueberry
- Grape
- Other Small
- Multi-Crop Disease Summaries

Tools for fruit are made possible by the generous support of:

Michigan State Horticultural Society

GREAT LAKES EXPO FRUIT, VEGETABLE & FARM MARKET

East Lansing (MSUHort), Michigan

Latest observations at East Lansing (MSUHort)

12/04/2014 03:00 PM (Station online). Measurements by 5-minute average or total unless otherwise indicated.

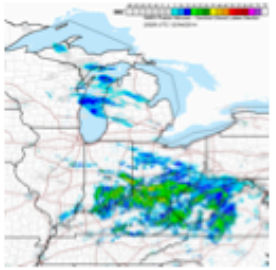
30.6 F	Air temperature
0.0 in.	Rainfall(12/04/2014)
43.5%	Relative Humidity
11.0 F	Dewpoint
E	Wind Direction (hourly average)
3.6 mi./hr.	Windspeed
0%	Percent of last full hour wet - leaf wetness (tripod-mount)

eather observations and summaries

- vernight temperatures/ hours below freezing
- Rainfall comparisons for Region
- Temperature, rainfall and degree-day summary
- Rainfall comparisons last 5 years at this station
- Soil conditions
- More weather for this station

Degree-day tools

- Current degree day maps
- Degree Day accumulations for Region
- Degree Day accumulations for Region (alfalfa and corn development)
- Average degree day summary
- Degree day comparisons: Compare 2 sensors



National Weather Service radar and local forecast for East Lansing

Weather Station at East Lansing (MSUHort)

Thanks to our station sponsors:

This station is hosted at MSU Horticulture

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Crop Development

- Concord Berry Weight Model

Pest Management

- Grape Berry Moth
- Black Rot of grapes
- Daily Weather and Disease Summary for Station
- Station Disease Report: Seasonal History of Wetting Events
- Regional Disease Report

Resources

- IPM Resources
- Grapes.msu.edu
- MSUE News for Fruit

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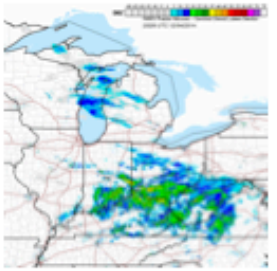

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We estimated 810 GDD around **July 2nd**.
910 GDD **July 6th or 7th**

- Spray Belt, Altacor, Delegate, or Intrepid as close to July 2nd (810 GDD) as possible!
- Spray Sevin, Imidan, Danitol (or other Pyrethroids) at July 6 or 7 (910 GDD).

Grape Berry Moth: Points to Remember

1. Scout vineyards to determine the level and distribution of GBM.
   - Focus in regions with higher pressure (near woodlots)
2. If cluster protection needed, time sprays to **prevent larval entry.**
3. Sprayers must get excellent ***cluster*** coverage.
   - pruning to keep canopy open
   - increase water volume through season
   - spray every row

Critical for any insecticide, essential for many new insecticides

4. Select insecticides based on:
   - activity spectrum
   - residual control
   - resistance management
5. Beware of late-season pest pressure starting at veraison.

A note on spray equipment…

- Good coverage matters for:
  - reduced-risk insecticide applications
  - consistent disease control – reduce # of sprays needed
- Early season: not much foliage, kick it up a notch and skip rows.
- As canopy fills in:
  - Slow down
  - Spray every row

Grape Mealybug and Leafroll virus

- In vinifera winegrapes
- Numerous infestations detected 2014 in Michigan
- Vector the grape leafroll virus
- Virus causing vine decline in some vineyards

- Grape leafroll virus
  - White varieties: leaf curl
  - Red varieties: leaf curl plus early senescence

Grape Mealybug and Leafroll virus

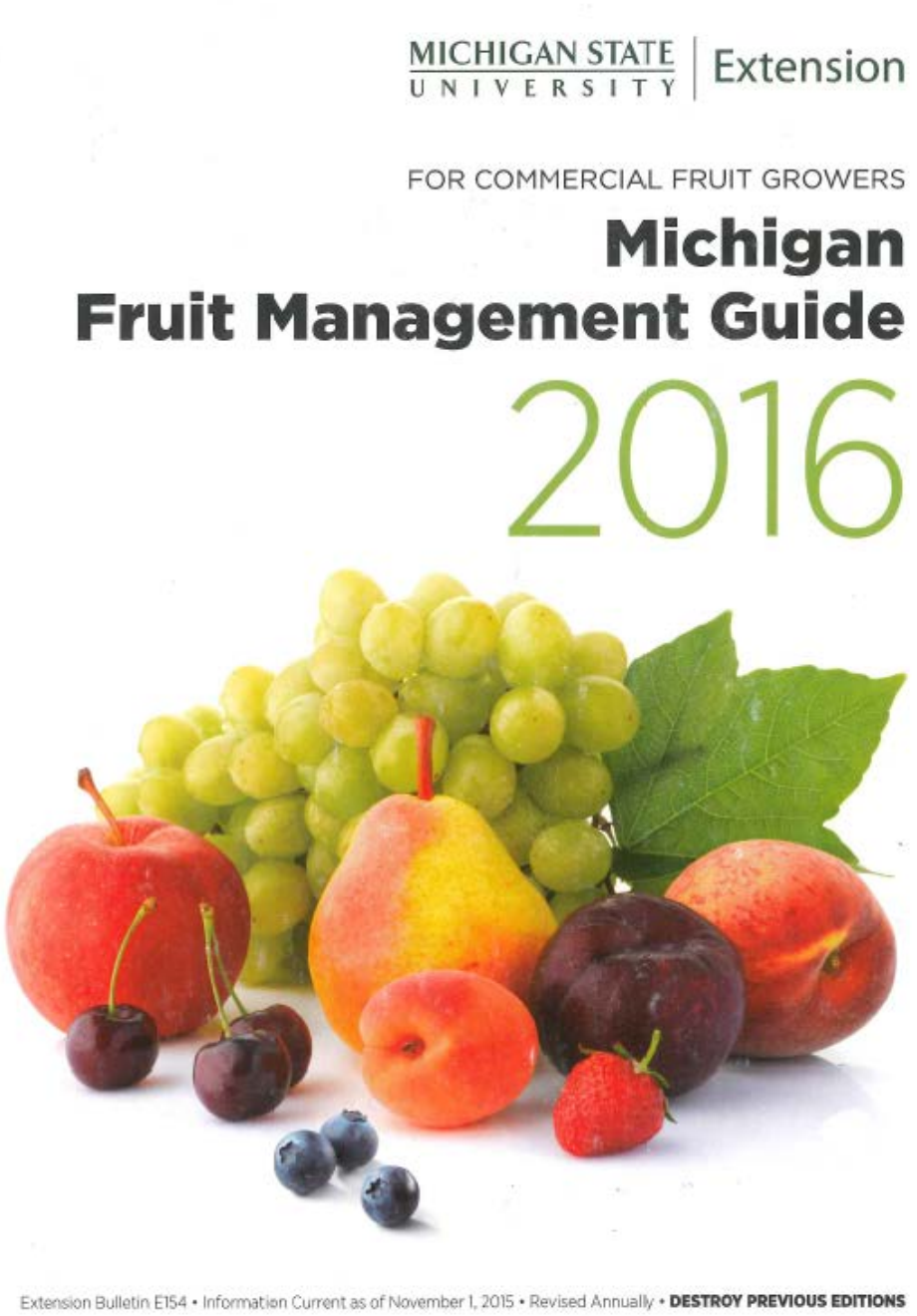
- Prevent spread of virus:
  - Chemical option for mealybug
  - Movento
  - Source new vines from virus-tested suppliers

Grape Mealybug and Leafroll Virus

- Prevent spread of *mealybug:*
  - moves on machinery, harvested grapes, people
  - SW Michigan wineries, growers doing custom harvest, etc: *practice sanitation*

- **Confused yet?**

- Available at your local MSU Extension office
- Also online:
  - shop.msu.edu
  - Extension Bookstore tab off on the right



Disease Management

- Powdery Mildew
- Downy Mildew
- Black Rot
- Phomopsis
- Anthracnose
- Botrytis

Types of Fungicides

- **Protectants**
  - On surface of plant - kill fungal spores as they germinate, therefore:
    - *Preventative only*
  - Kill by poisoning several sites in fungus, therefore:
    - *Less likely for resistance to develop*
- **Systemics**
  - Absorbed into plant and kill fungus as it penetrates the plant.
  - Generally a single-mode poison:
    - *resistance more likely*

Modes of Action

FRAC code:
Fungicide Resistance Action Committee

- Rotate FRAC codes throughout the season!
- Especially with systemic fungicides

Cultural Control!

- Air
- Sunlight

- On leaves
- On clusters

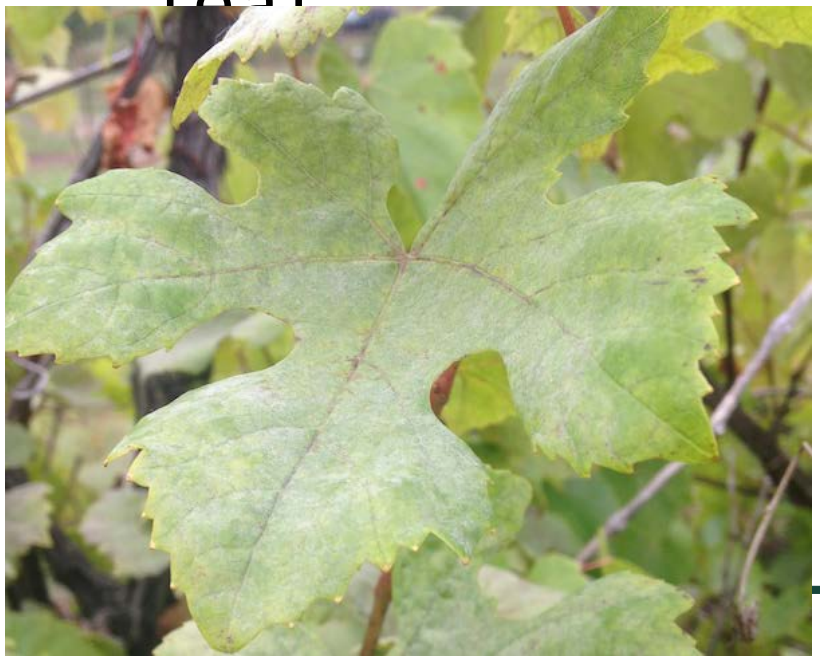
- With pruning!

- Resistant varieties! (when marketing permits)

- See Fruit Management Guide for big list

Powdery Mildew

- On Leaves
  - Looks like a white powder on the top of the leaf



Powdery Mildew

- On fruit:
  - Powdery only at first
  - Eventual

Powdery Mildew

- Overwinters on bark
- **Primary** spores from **bud break** to **bloom**, 0.1” rain and >50 F
- After initial infection

Powdery Mildew

- Lives on surface of plant parts, injects haustoria into plant.

Powdery Mildew

- **Most** susceptible varieties:
  - Most vinifera fall into this category.
  - **Hybrids: Chardonel, Vidal Blanc, Vignoles**
- **Least** susceptible varieties:
  - **Cayuga White, Chambourcin, Corot Noir, Noiret, Traminette, Marquette**

Everything else:
Moderately susceptible.

Powdery Mildew

- Most important time to cover *fruit*:
  - Pre-bloom, until
  - 2-4 wks later
    - *depending on var.*
- Cover leaves afterwards:
  - For sugar, esp.

Powdery Mildew

Most effective materials:

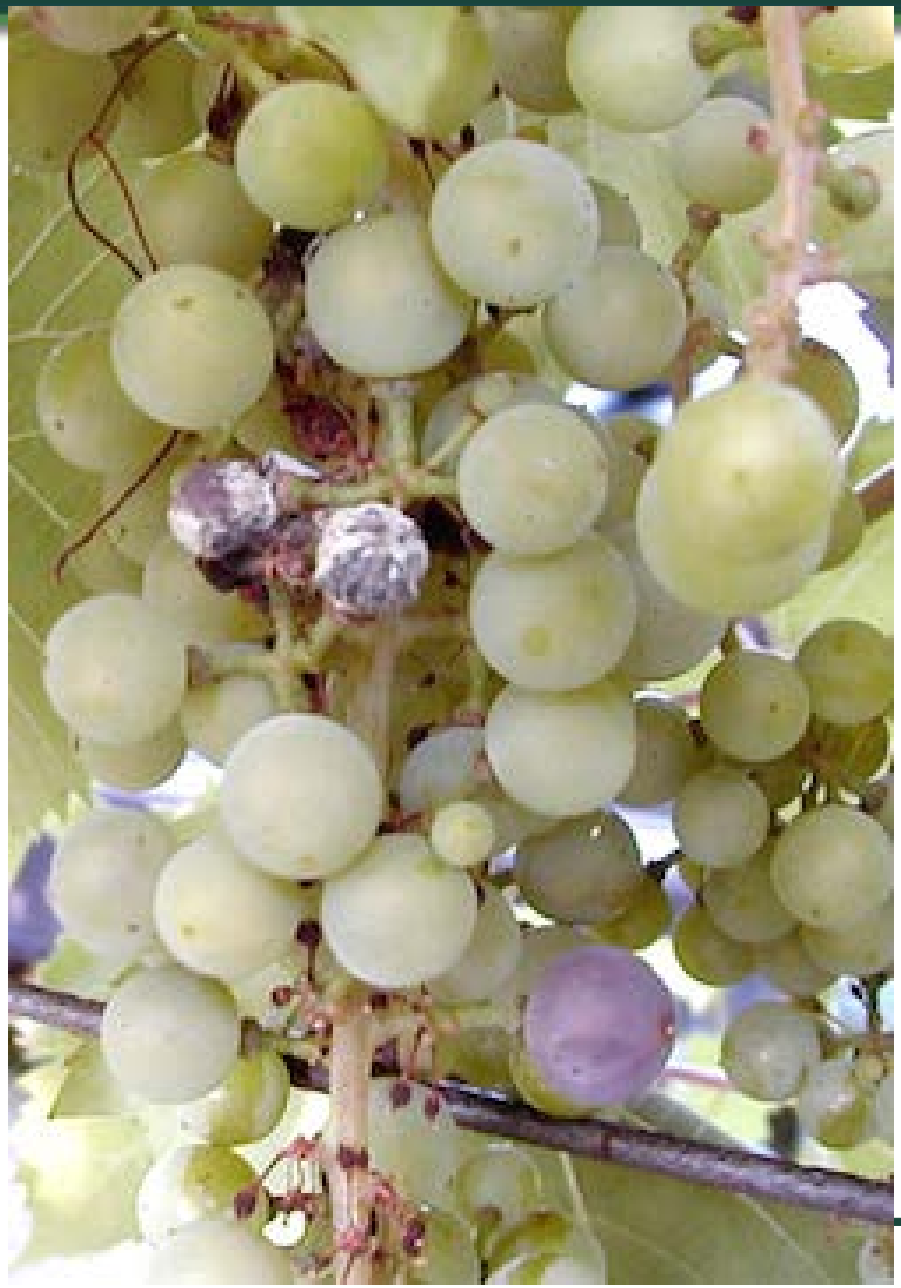
- Endura (7)
- JMS Stylet Oil
- Bayleton
- Elite
- Mettle
- Procure/Viticure
- Rally

Flint
Sovran
Pristine (11 & 7)
Inspire Super (3 & 9)
Luna Experience (3 & 7)
Quadris Top (3 & 11)

*Quintec (13)
*Topsin M (1)
*Torino
*Vivando
Revus

Downy Mildew

- On leaves:
  - Orange/brown oil spots on top side
  - White, “downy” areas on underside of leaf

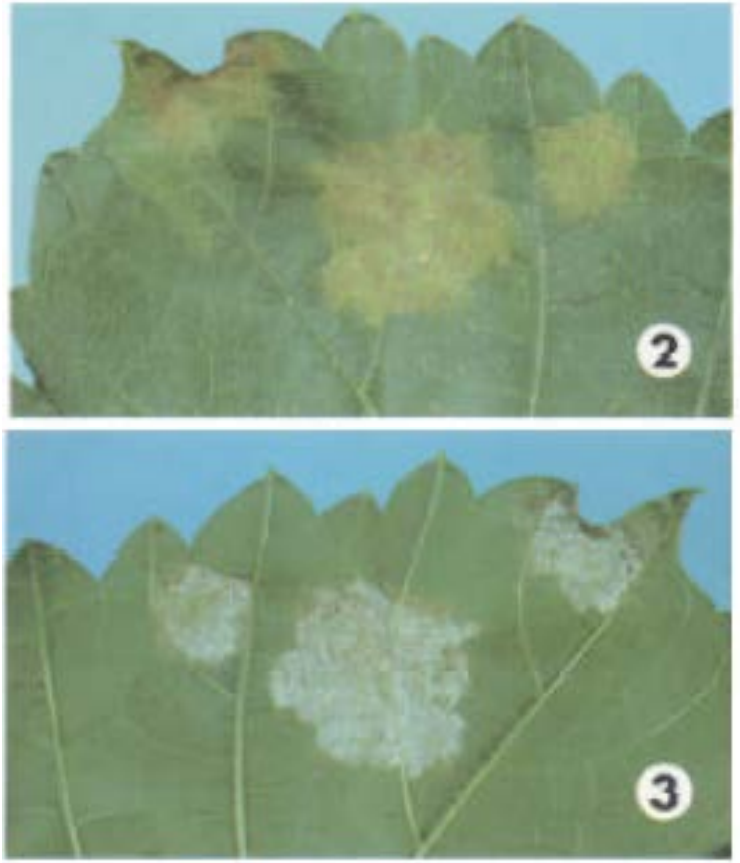


Downy Mildew

- On fruit:
  - White downy sporulation on berry
- Primary inoculum:
  - Infected leaves on vineyard floor

Downy Mildew

- Overwinters on leaves / soil surface
- Primary infections:
  - 2-3 weeks before bloom
  - *Rain splash required for infection:* saturated soil surface
- Secondary infections: warm wet nights



How to get downed by downy mildew:

- Scout from truck or tractor or don't scout at all
- Let the disease get established
- Use ineffective materials or at too low a rate
- Grow a humongous canopy
- Poor fungicide coverage

Downy Mildew

- **Most effective** materials:

  Protectants
  - Captan (protectant only, M4)
  - Manzate, Koverall, etc.
  - Copper products (M1)

  Systemics
  - Abound
  - Sovran
  - Tanos (11 & 27)
  - Pristine (11 & 7)
  - Quadris Top (11 & 3)

- Phosphonates
  - Agri-Fos
  - Aliette
  - Phostrol
  - Prophyt
- Ridomil products
- Special systemics for downy:
  - Zampro (40 & 45)
  - Revus (40)
  - Revus Top (40 & 3)
  - *Presidio*

Black Rot

- On leaves:
  - Light brown, roughly circular spots
  - Ring of fruiting bodies as they mature: ***secondary***

Black Rot

- On fruit:
  - Starts as small whitish spot
  - Brown spot expands outwards.
  - Berries shrivel to mummies: ***primary inoculum***
- Also forms shoot lesions

Black Rot

- Overwinters in mummy berries on vineyard floor
- Primary spores emerge from 6” shoot until just after bloom
- Berries susceptible from beginning of bloom until 3-5 weeks later

Black Rot

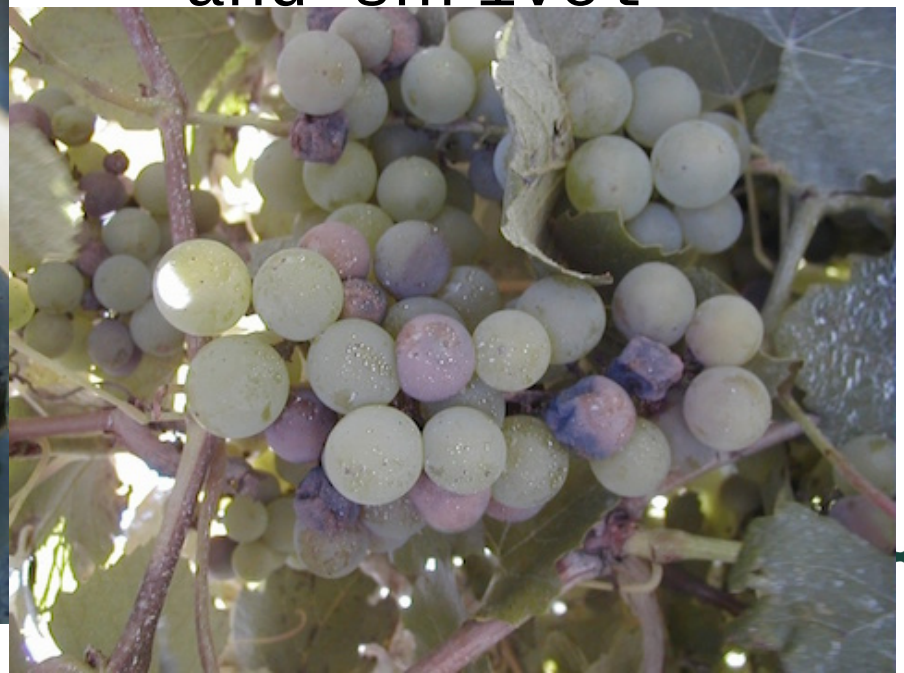
- **Protectants:**
  - Manzate, Koverall, etc.
- **Systemics:**
  - Abound
  - Flint
  - Pristine
  - Sovran
  - Inspire Super (3 & 9)
  - Luna Experience (3 & 7)
  - Quadris Top (3 & 11)
  - Revus Top (3 & 40)
- Mild activity:
  - Copper
  - Phosphonates
  - Revus
  - Ridomil
- NOT Sulfur

Phomopsis

- On leaves:
  - Puckered, brown spots usually with yellow surrounding
- On shoots:
  - Lesions:

Phomopsis

- On fruit:
  - Usually rachis is infected
  - Berries go brown and shrivel



Phomopsis

- **Protectants:**
  - Captan
  - Manzate, Koverall, etc.

- **Systemics:**
  - Abound
  - Flint
  - Sovran

  Phosphonates:
  - Agri-Fos
  - Phostrol
  - Prophyt
  - Gavel

  Luna Experience

  Pristine

Sour Rot

- Smells and tastes of vinegar
- Usually fruit flies present
- Caused by group of yeasts and fungi vectored by the flies – no single causative agent
- No visible

Sour Rot

- Risk factors:
  - tight-clustered varieties
  - wet clusters after veraison
  - rainfall
  - thick canopy
  - wounds: birds, insects, powdery mildew

Sour Rot

- Chemical options:
  - Not a fungus! Fungicides won't help
  - Biologicals as protectants: for example, Serenade
  - Broad spectrum insecticides when fruit flies appear

Botrytis Fruit Rot

- On fruit only
- Primary inoculum is *ubiquitous*
- Infection occurs late
- Ants instead of fruit flies.
- Does not smell of vinegar
- Fuzzy

Botrytis Fruit Rot

- Risk factors:
  - tight-clustered varieties
  - wet clusters after veraison
  - thick canopy
  - wounds: birds, insects, powdery mildew
  - excessive Nitrogen

Botrytis Fruit Rot

- **Most susceptible** varieties:
  - vinifera:
    Chard
    C
    n
  - F
    Seyv tes
    super hardy; La

Gewurtz

Seyval

Botrytis Fruit Rot

- **Most resistant** varieties:
  - juice grapes: Concord and Niagara both resistant.
  - French hybrids: Foch, Vidal Blanc
  - Cornell hybrids: Cayuga white, Arandell, Aromella, Corot Noir, Noiret
  - Minnesota hybrids: Marquette
  - vinifera: Cabernet Franc, Cabernet Sauvignon, Blaufrankische

Unsprayed Cab Franc

Marquette 2014

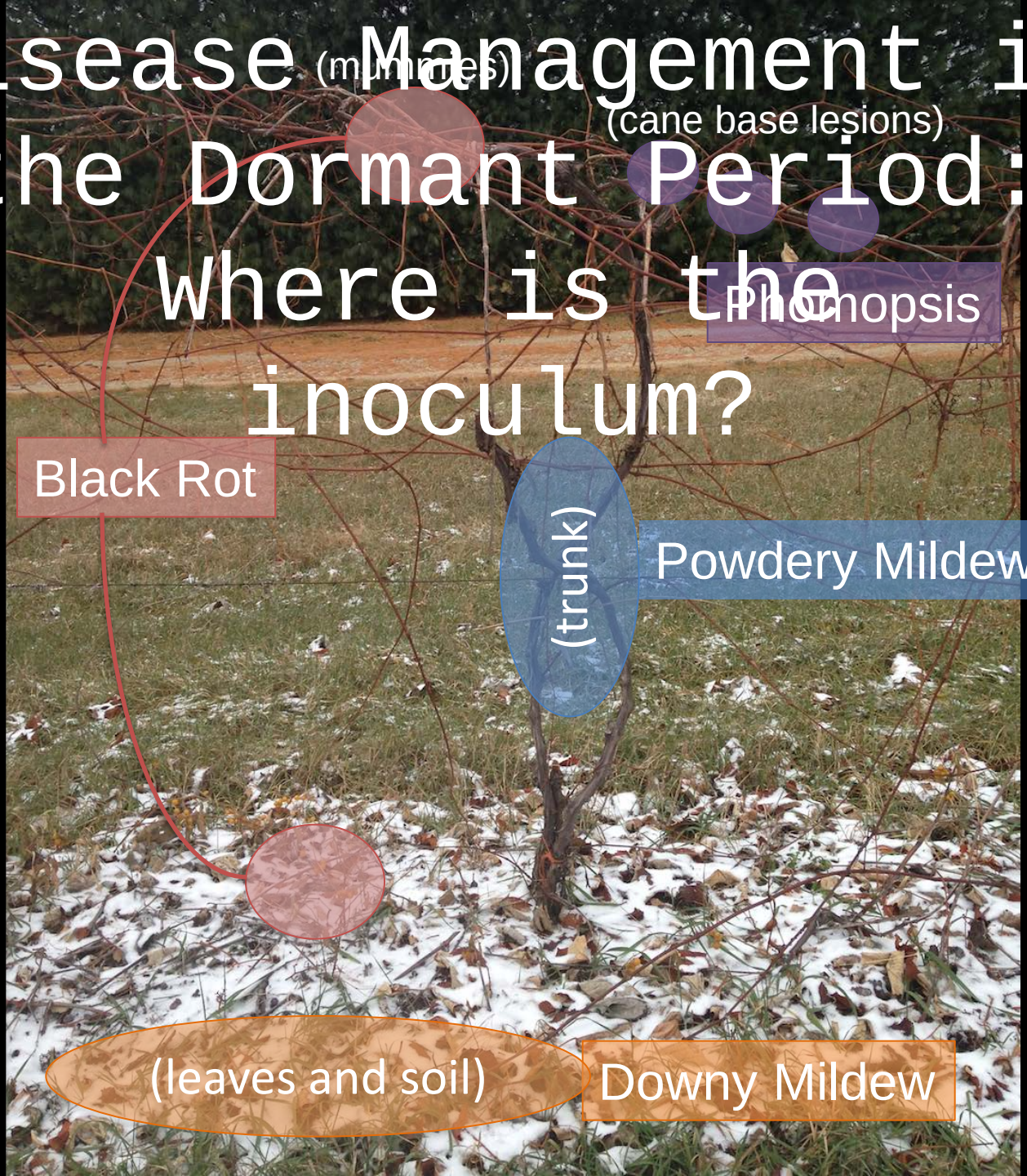
Botrytis Fruit Rot

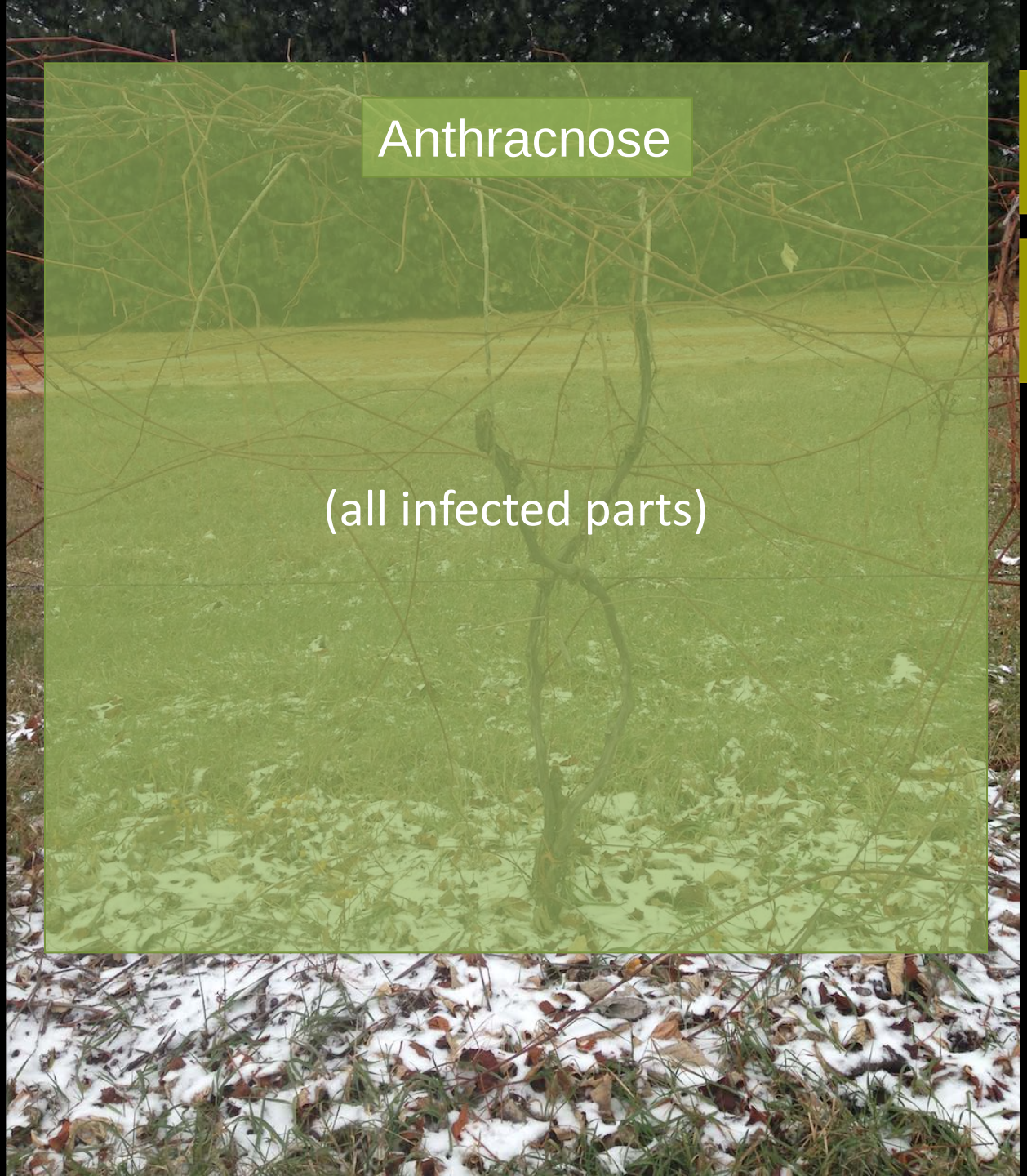
- Most effective materials:
  - Group 7
    - Endura
    - Luna Experience
  - Group 9
    - Inspire Super
    - Scala
    - Switch
    - Vanguard
  - Elevate
- Infections possible from bloom onwards
- Most important to cover after a rain post-veraison

Botrytis AND Sour Rot

- Cultural management:
  - air flow and sunlight penetration
    - prune harder
    - on VSP, timely shoot-tucking and hedging
    - **leaf removal in fruiting zone**
  - site selection / variety

Disease Management in the Dormant Period: Where is the inoculum?





Sour rots: everywhere

Botrytis: everywhere

Disease Management in Dormant Period

- Dormant sprays
  - Lime sulfur (M2)
  - Sulfur (M2)
  - Copper (M1)
- After leaf fall
- and/or before bud break

- See p.50 of Fruit Management Guide 2016
- “Fruit fungicides that have a shared mode of action”

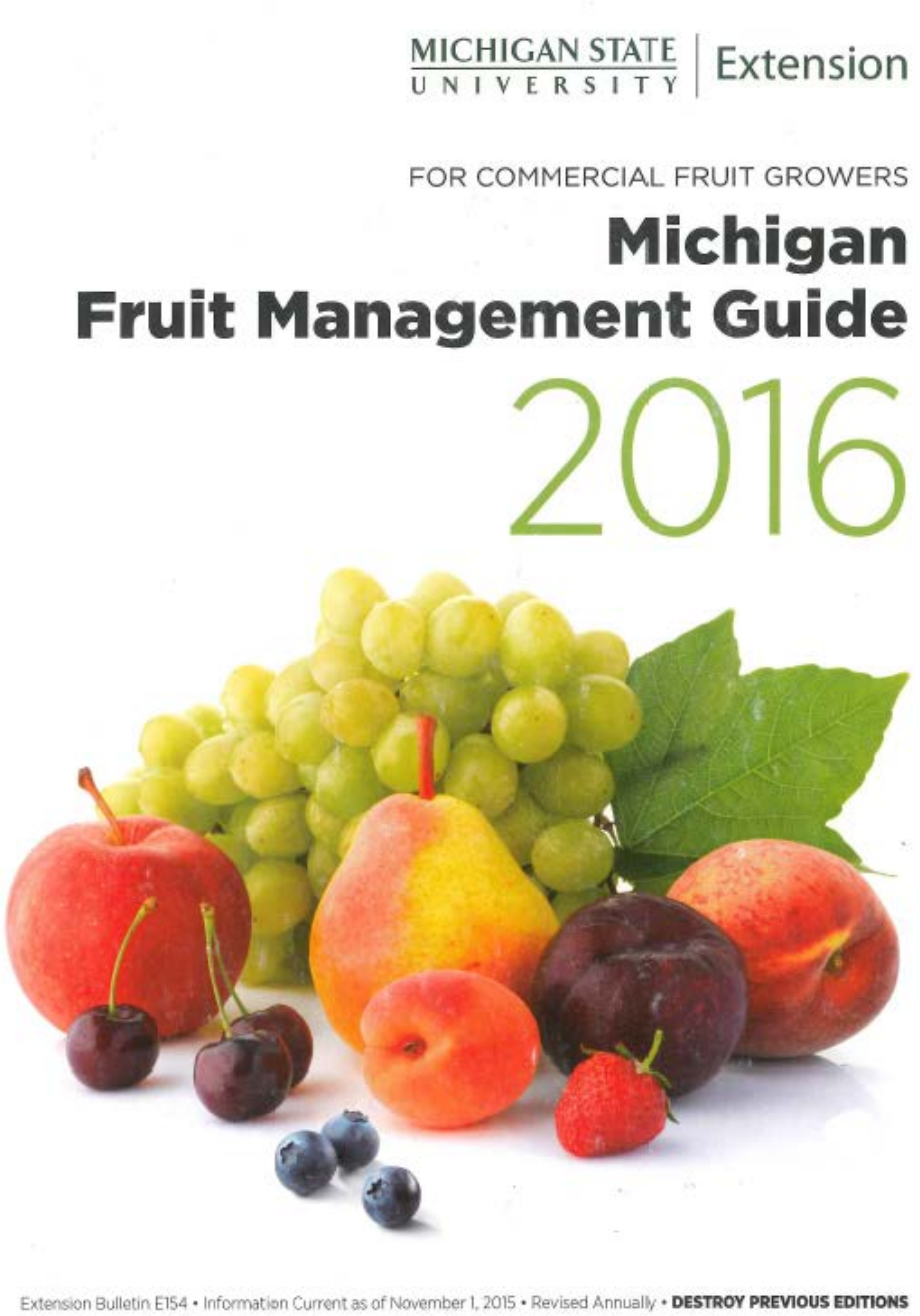
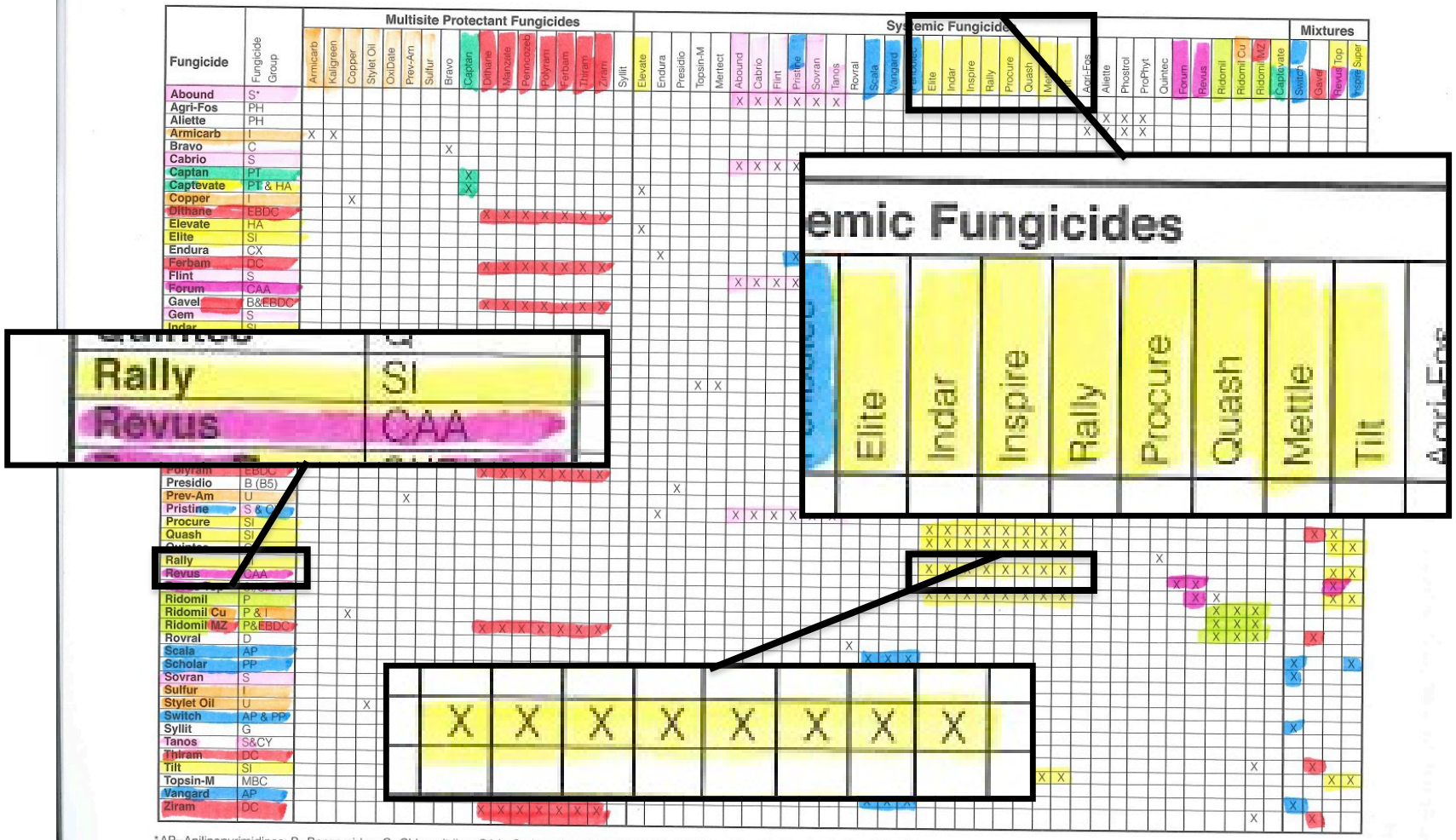
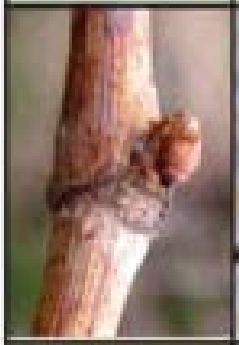
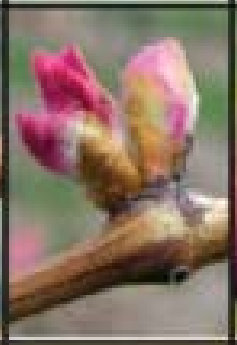
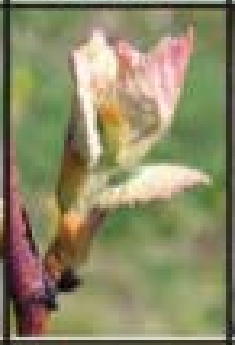
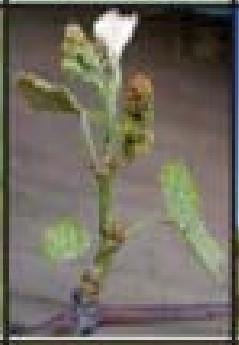


Table 3. Fruit fungicides that have a shared mode of action (biocontrol agents and antibiotics not included).

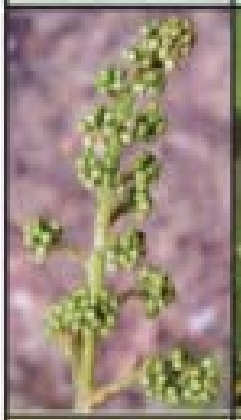
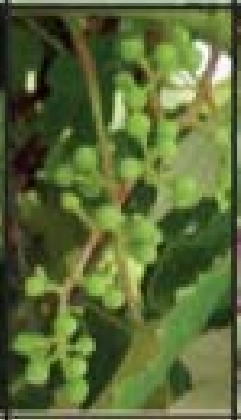


*AP=Anilinopyrimidines; B=Benzamides; C=Chloronitriles; CAA=Carboxylic acid amides; CX=Carboxamides; D=Dicarboximides; DC=Dithiocarbamates; EBDC=Ethylene bisdithiocarbamates; G=Guanidines; HA=Hydroxyanilides; I=Inorganics; MBC=Methyl benzimidazole carbamates; P=Phenylamides; PH=Phosphonates; PP=Phenylpyrroles; PT=Phthalimides; Q=Quinolines; S=Strobilurins; SI=Sterol inhibitors; U=unclassified.

Grapevine growth stages

Vegetative growth						
Dormant	Early bud swell	Late bud swell	Bud burst	1- to 3-inch shoots	4- to 8-inch shoots	10- to16-inch shoots
						
Bud closed. No visible indication of growth.	The bud is visibly swollen, brown and fuzzy. No green or pink tissue is visible yet.	The bud has elongated and green or pink leaf tissue is visible though bud is still closed.	The leaves have separated at the tip, usually exposing the growing point.	The shoot is 1-3 inches (2.5-7.5 cm) long with 1-3 small leaves at right angles to the stem.	Shoots are 4-8 inches (10-20 cm) long with 3-6 leaves. Flower clusters are exposed.	Shoots are 10-16 inches (25-40 cm long). Flower clusters are clearly visible.

Grapevine growth stages

Reproductive growth						
Immediate prebloom	First bloom	Full bloom	Buckshot berries	Berry touch/ bunch closure	Veraison	Ripe for harvest
						
Caps are still attached. No flowers are visible.	First flowers open, caps are falling off.	Most of the flowers are open.	Berries are the size of buckshot pellets.	Berries touch and cluster is starting to close.	Berries soften and change color as they begin to ripen.	Berries are soft and ripe with high sugar content.

Bud Break

Phenology	Pests	Material
Bud Break If scouting reveals significant damage	**Climbing Cutworm** 	Pyrethroids: Danitol, etc Lorsban
	Grape Flea Beetle 	Sevin Pyrethroids: Danitol, Baythroid, etc. Delegate*, Oberon*, Altacor*

(Longstroth)

Shoot Growth

- Main Early Problem is Disease
- Scout for black rot, powdery mildew, and phomopsis symptoms
  - symptoms = secondary inoculum
- Spray to protect shoot growth
  - Group 11 or Group 3 work well against all 3
  - (e.g. Flint, Sovran, Bayleton, Rally)
  - More commonly used: Group M3 (Manzate, Koverall)
- More rain = sprays more critical

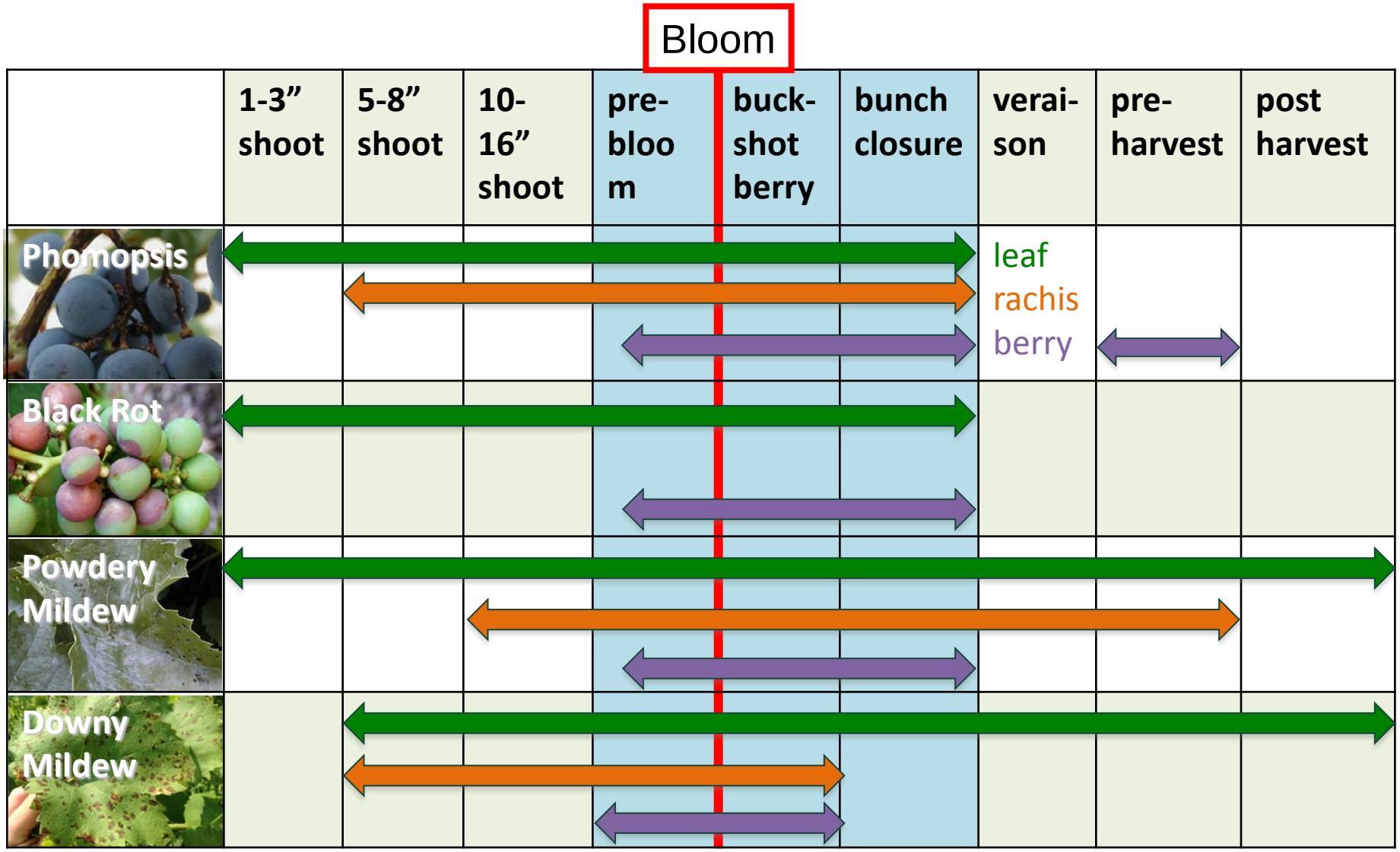
(Longstroth)

Bloom Time!

- Most important time for disease control.
- All diseases are active and controls are needed.
- Insecticides also used if insects are feeding on bloom and young berries.
- Bloom and post bloom sprays!!

(Longstroth)

Infection Risk (Michigan)



Grape diseases through the season

DORMANT SPRAYS

Phomopsis

Anthracnose

Black rot

Powdery mildew

Downy mildew

Botrytis

Bud swell | Shoot growth | Bloom | Fruit set | Berry-touch | Veraison | Harvest

Post Bloom

1st Cover - *(Post-bloom)* 2 weeks after prebloom spray	**Grape Berry Moth: GDD 810 & 1620**	Intrepid, Altacor, Belt, Imidan, Sevin, Danitol
	Grape Leafhopper (if needed)	Neonics, Pyrethroids

(Longstroth)

Late season

- Ripening fruit become resistant to

  Black Rot and **Powdery Mildew**
- **Downy mildew** comes. Especially in wet, dewy condition
- Scout and protect!

(Longstroth)

After veraison, before harvest

After veraison	**MALB, wasps, fruit flies** (if needed)	Pyrethroid, Sevin
	Sour Rot (some varieties)	Serenade
	Botrytis (some varieties)	Switch, Vanguard, Scala (9), Endura (7)

(Longstroth)

MSU In-season Resources for grape pest management, 20

- Weekly to bi-weekly scouting reports by MSU research and extension:
  - **grapes.msu.edu**
  - grape email digest

MSU In-season Resources for grape pest management, 20

- In-season grape grower meetings.
- In-season scouting meetings in Coloma.