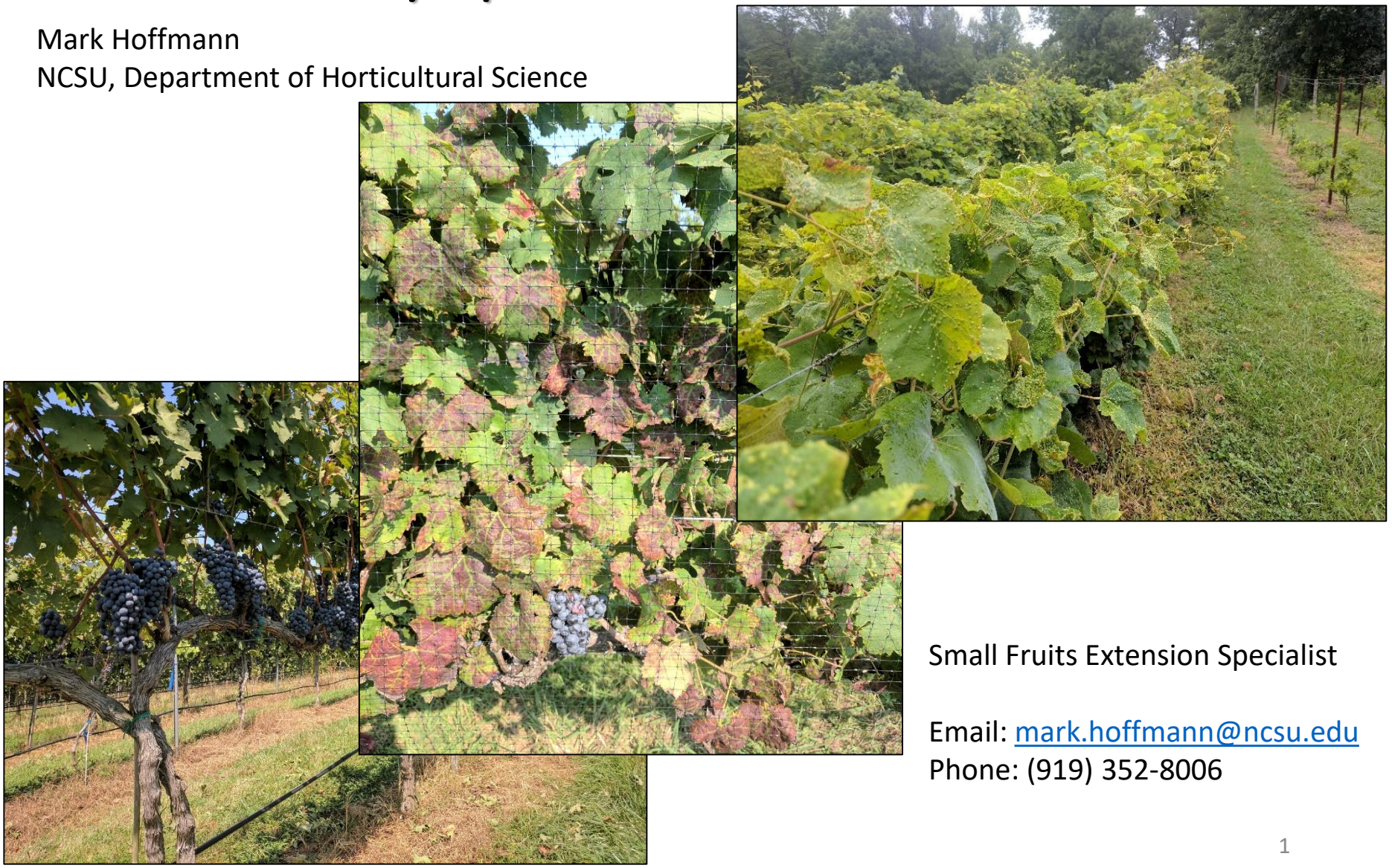
What we know and don't know: Diseases and Symptoms

Mark Hoffmann
NCSU, Department of Horticultural Science



Small Fruits Extension Specialist

Email: mark.hoffmann@ncsu.edu
Phone: (919) 352-8006

What we know and don't know: Diseases and Symptoms

NC STATE UNIVERSITY

- **Downey, Blackrot, Phomopsis:**

Don't forget prevention during dormant season and early spring

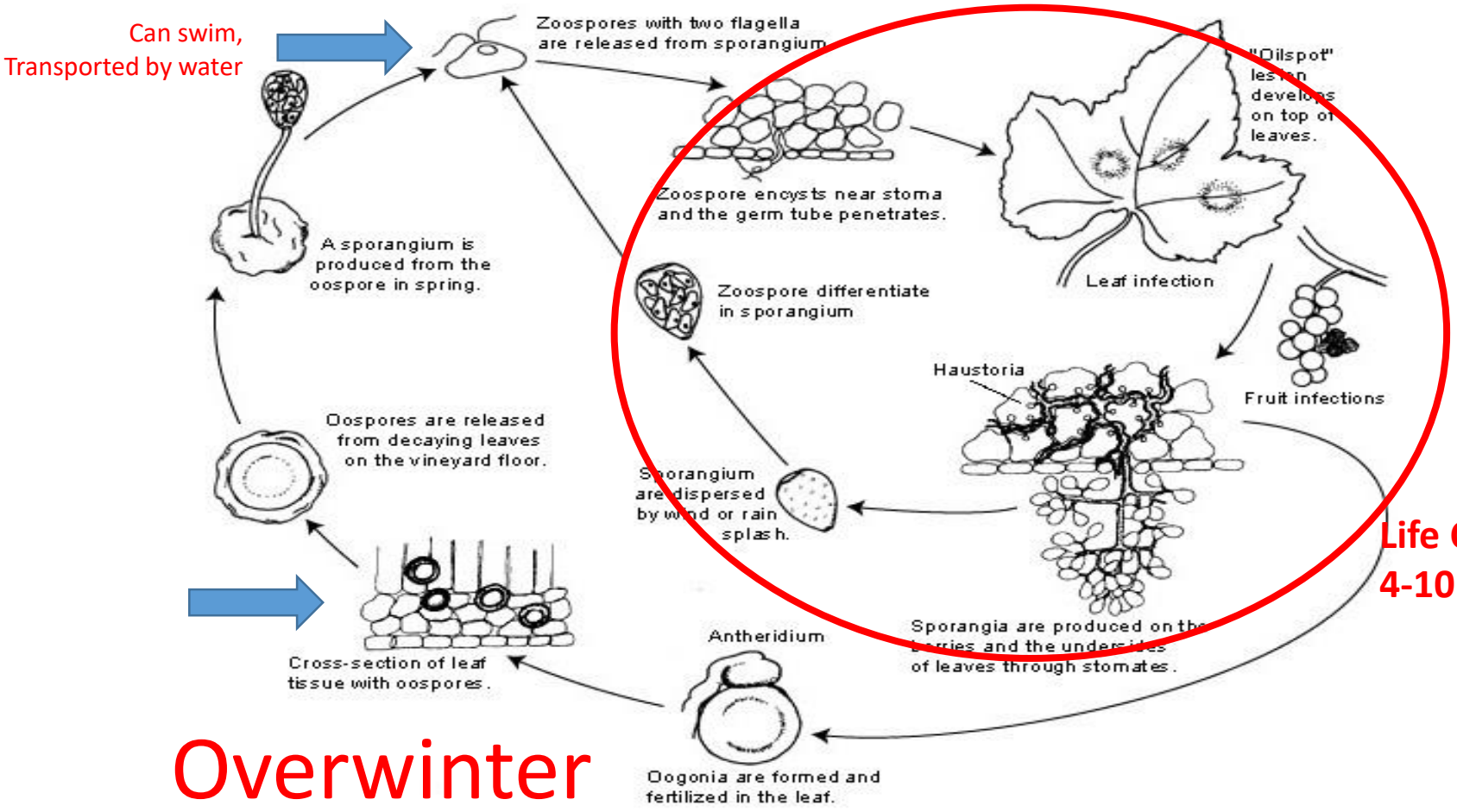
- **Virus? Genetic? Nutritional? Spray Injury?**

Symptoms: Where does the damage come from

Assessment: Assessing vine health?

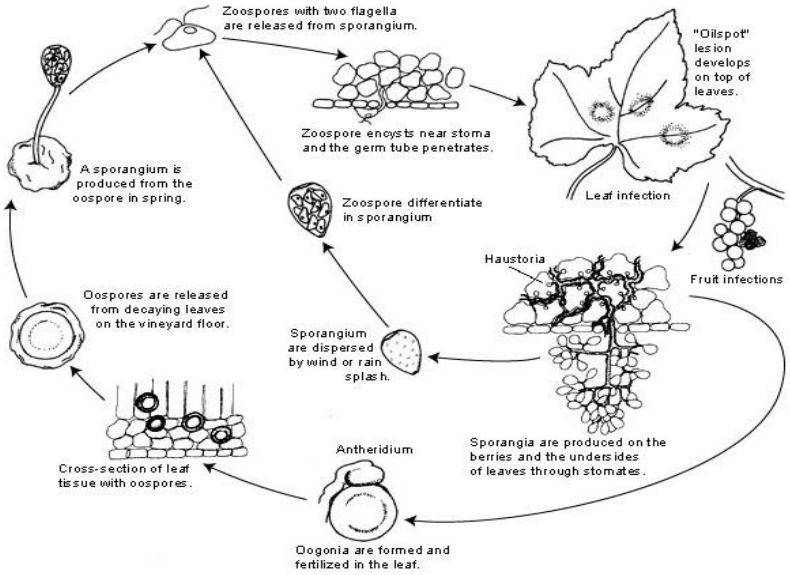
What we know: Prevention

Downey Mildew: *Plasmospara viticola*



Ash, G. 2000. Downy mildew of grape. 2000. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-1112-01
Updated 2017

What we know: Prevention
Downey Mildew: *Plasmospara viticola*



- Humid conditions
- Cool conditions (50-85F)
- Rain transports zoospores

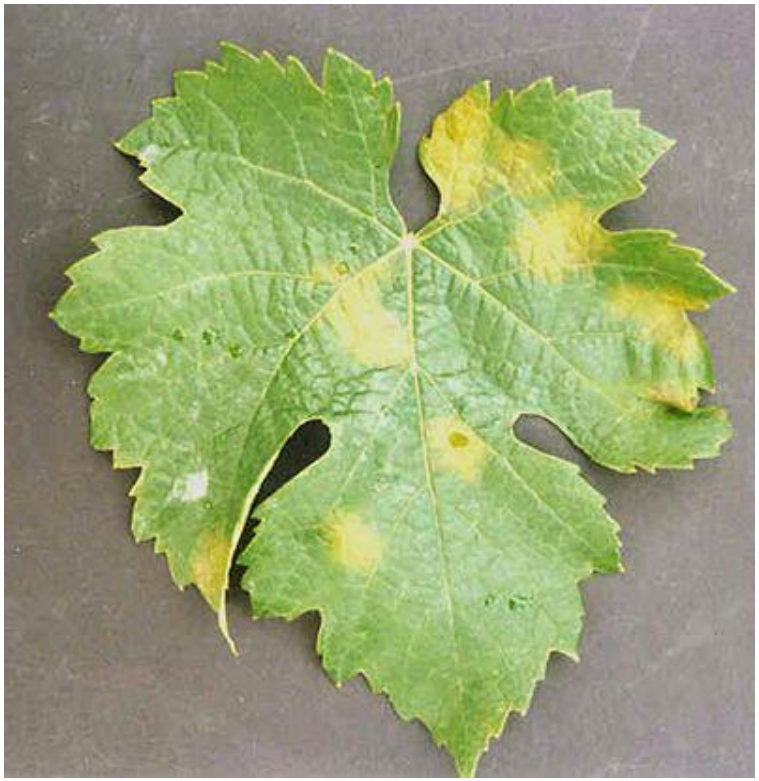
Ash, G. 2000. Downy mildew of grape. 2000. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-1112-01
Updated 2017

What we know: Prevention

Downey Mildew: *Plasmospara viticola*

NC STATE UNIVERSITY

Upper Side



Under Side

Ash, G. 2000. Downy mildew of grape. 2000. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-1112-01
Updated 2017

What we know: Prevention

Downey Mildew: *Plasmospara viticola*

What we know: Management
Downey Mildew: *Plasmospara viticola*

Right now:

- **Canopy Management!**
- **Spray, Spray, Spray (list of sprays follows)**
- **Spray BEFORE rain if you have a few hours or a day of incubation.**
- **Follow up with another spray if there is a dry spill.**

Dormant Season: Remove of leaf debris from trellis!!!
Put on preventative sprays (Mancozeb, Pristine)

Ash, G. 2000. Downy mildew of grape. 2000. *The Plant Health Instructor*. DOI: 10.1094/PHI-I-2000-1112-01
Updated 2017

IPM

NC STATE UNIVERSITY

Efficacy of selected fungicides against diseases of bunch grapes							
Chemical name (Fungicide product name)	**Anthracnose**	**Black rot**	**Bitter rot**	**Botrytis rot**	**Downy mildew**	**Phomopsis cane and leaf spot**	**Powdery mildew**
Azoxystrobin **(Abound)**		+++++[a]	+++++	+++[b]	+++++[b]	+++	+++++[b]
Benzovindiflupyr **(Aprovia)**, Isofedamid **(Kenja)**	+++[c]	++++		+++++[b]			++++[c]
Boscalid **(Endura)**				+++++[b]			++++[c]
Boscalid + Pyraclostrobin **(Pristine)**	++++	+++++	+++++	+++++[b]	+++++[b]	+++++	+++++
Captan **(Captan, Captec, etc.)**	+++	+++	+++++	++	++++	++++	NA
Fixed coppers and Bordeaux mixture (various)		+++	++	+++	+++	++	++
Cyazofamid **(Ranman)**				++++			
Cyflufenamid **(Torino)**		NA	NA	NA	NA	NA	++++
Cyprodinil **(Vangard)**		NA	NA	+++++[b]	NA	NA	++
Cyprodinil + Fludioxonil **(Switch)**				++++[b]			
Cyprodinil + Difenoconazole **(Inspire Super)**		++++		++++[b]			++++
Famoxadone + cymoxanil **(Tanos)**					+++[b]		
Fenhexamid **(Elevate)**		NA	NA	+++++[b]	NA	NA	NA
Ferbam **(Ferbam)**		++++	+++	NA	++	++	NA
Fenarimol **(Rubigan)**		++	NA	NA	NA	NA	+++++[b]
Fluopyrum + tebuconazole **(Luna Experience)**	NA	+++++	NA	+++++[b]	NA	NA	+++++
Iprodione **(Rovral, Meteor)**	NA	NA	NA	+++[b]	NA	NA	NA
Kresoxim-methyl **(Sovran)**		+++++	+++++	++[b]	+++[b]	+++	+++++[b]
Lime Sulfur (dormant application)	+++			NA	NA	+++	++
Mancozeb (various: Penncozeb, Dithane, etc)		+++++	+++++	NA	+++++	+++++	NA
Mandipropamid **(Revus),** Dimethomorph **(Forum),** Dimethomorph + Ametoctradin **(Zampro)**	NA	NA	NA	NA	+++++	NA	NA
Mandipropamid + Difenoconazole **(Revus Top)**		++++	++++[c]	NA	+++++	+++[c]	++++
Mefanoxam + Copper **(Ridomil Gold Copper)**		++	++	++	+++++	++	++
Mefanoxam + Mancozeb **(Ridomil Gold MZ)**		+++	+++	NA	+++++	+++	NA
Metrafenone **(Vivando)**		NA	NA	NA	NA	NA	++++
Myclobutanil **(Rally)**		+++++	++	NA	NA	NA	+++++[b]
Phosphonate **(ProPhyt, Phostrol, etc.)**					++++		
Sulfur[d] (various)		NA	NA	NA	NA	++	+++++
Tebuconazole **(Elite)**		+++++	NA	NA	NA	NA	+++++[b]
Tetraconazole **(Mettle)**							++++[b]
Thiophanate-methyl **(Topsin M)**		++	+++	NA	NA	+++	+++++[b]
Trifloxystrobin **(Flint)**		+++++	+++++	++++	+++	++	+++++[b]
Triflumazole **(Procure and Viticure)**		+++[b]	NA	NA	NA	NA	+++++
Ziram **(Ziram)**		++++	NA	++	++++	+++	NA

[a] The efficacy rating: NA = no significant activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity

[b] Resistance (or occasional failure of control) has been observed in some southeastern states, thus, if control failure occurs, it could indicate resistance has developed. The efficacy rating could be impacted by resistance development. If resistance has occurred, use of fungicides in the same class would likewise show resistance, and a substitute fungicide should be considered for pathogen management.

[c] Insufficient data for the pathogen-chemical combination. The rating was given based on the general knowledge on the material.

[d] Sulfur will cause burn on sensitive varieties, especially on hot days when temperature reaches above 85F when foliage are wet.

IPM

Tools IPM

Prevention

Sanitation

Removing residues, fruit, canes etc. that might harbor pests or pathogens

Cultural

Reduce potential environments suitable for pests or pathogens

- Pruning
- Shoot positioning
- Canopy management

Chemical

Create chemical condition to suppress the establishment of a pest/pathogen

- Dormant Sprays

Monitoring

Eye, Microscope

Insects, Mites, some diseases:

- Hand lens
- Microscope

Traps

Insects:

- **Grape Root Borer!**
- Grape Berry Moth

Laboratory Assessment

Isolations from tissue
Protein detection methods
Molecular detection methods

- Plant Disease and Insect Clinic
- Clemson

Control

Physical

Physical destruction of infested material or material with disease symptoms

Biological

Pest control with non-chemical measures

- Rootstocks
- Predators
- Pheromones

Chemical

Pest control with pesticides

- Fungicides
- Nematicides
- Insecticides
- Herbicides

IPM

Prevention: Sanitation in dormant season

Pruning out dead spurs, remove old fruit and debris from trellis and soil, remove and destroy dead wood, leafs and diseased canes

- Birds-Eye (*Elsinoe ampleina*)
- Bitter Rot (*Greeneria uvicola*)
- Black Rot (*Guignardia bidwellii*)
- Botrytis (*Botrytis cinerea*)
- Macrophoma (*Botryosphaeria dothidea*)
- Phomopsis (*Phomopsis viticola*)
- ESCA/Eutypia etc. (many)
- Ripe Rot (*Colletotrichum* species)
- Downey Mildew (*Plasmopara viticola*)

IPM

Prevention: Sanitation

- **Mostly in dormant season**
- **Helps to prevent from fungal and insect diseases**

IPM

Vineyard Santiation

- Prune out wood with infections and remove from vineyard
- Weed Control!!!
- Remove and destroy mummies
- Remove dead leaf material

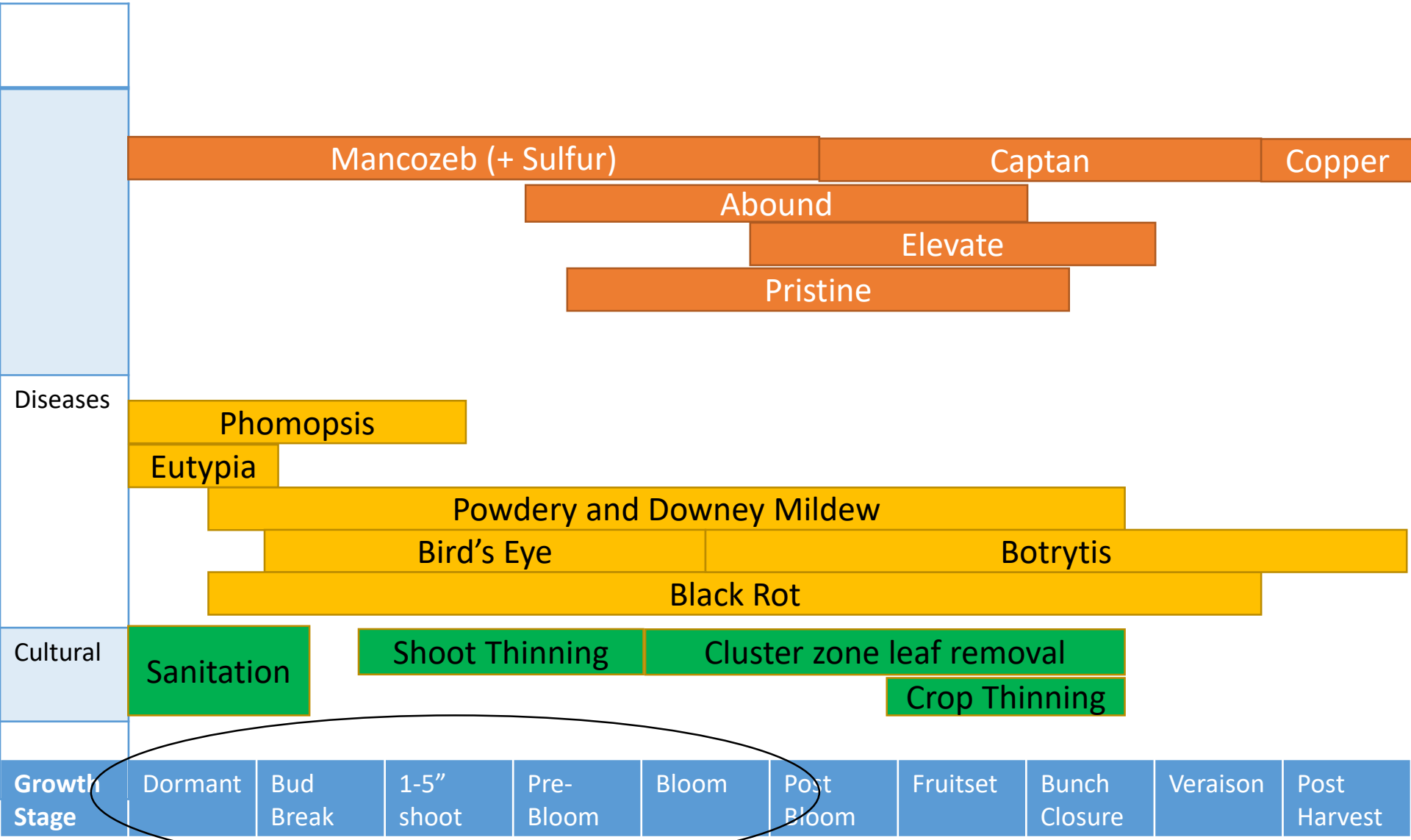
IPM

Prevention: Sanitation in dormant season

Sanitation one of the most important measures in Vineyard IPM

IPM

Prevention: Chemical Sprays



IPM

NC STATE UNIVERSITY

Efficacy of selected fungicides against diseases of bunch grapes							
Chemical name (Fungicide product name)	**Anthracnose**	**Black rot**	**Bitter rot**	**Botrytis rot**	**Downy mildew**	**Phomopsis cane and leaf spot**	**Powdery mildew**
Azoxystrobin **(Abound)**		+++++[a]	+++++	+++[b]	+++++[b]	+++	+++++[b]
Benzovindiflupyr **(Aprovia)**, Isofedamid **(Kenja)**	+++[c]	++++		+++++[b]			++++[c]
Boscalid **(Endura)**				+++++[b]			++++[c]
Boscalid + Pyraclostrobin **(Pristine)**	++++	+++++	+++++	+++++[b]	+++++[b]	+++++	+++++
Captan **(Captan, Captec, etc.)**	+++	+++	+++++	++	++++	++++	**NA**
Fixed coppers and Bordeaux mixture (various)		+++	++	+++	+++	++	++
Cyazofamid **(Ranman)**				++++			
Cyflufenamid **(Torino)**		**NA**	**NA**	**NA**	**NA**	**NA**	++++
Cyprodinil **(Vangard)**		**NA**	**NA**	+++++[b]	**NA**	**NA**	++
Cyprodinil + Fludioxonil **(Switch)**				++++[b]			
Cyprodinil + Difenoconazole **(Inspire Super)**		++++		++++[b]			++++
Famoxadone + cymoxanil **(Tanos)**					+++[b]		
Fenhexamid **(Elevate)**		**NA**	**NA**	+++++[b]	**NA**	**NA**	**NA**
Ferbam **(Ferbam)**		++++	+++	**NA**	++	++	**NA**
Fenarimol **(Rubigan)**		++	**NA**	**NA**	**NA**	**NA**	+++++[b]
Fluopyrum + tebuconazole **(Luna Experience)**	**NA**	+++++	**NA**	+++++[b]	**NA**	**NA**	+++++
Iprodione **(Rovral, Meteor)**	**NA**	**NA**	**NA**	+++[b]	**NA**	**NA**	**NA**
Kresoxim-methyl **(Sovran)**		+++++	+++++	++[b]	+++[b]	+++	+++++[b]
Lime Sulfur (dormant application)	+++			**NA**	**NA**	+++	++
Mancozeb (various: Penncozeb, Dithane, etc)		+++++	+++++	**NA**	+++++	+++++	**NA**
Mandipropamid **(Revus),** Dimethomorph **(Forum),** Dimethomorph + Ametoctradin **(Zampro)**	**NA**	**NA**	**NA**	**NA**	+++++	**NA**	**NA**
Mandipropamid + Difenoconazole **(Revus Top)**		++++	++++[c]	**NA**	+++++	+++[c]	++++
Mefanoxam + Copper **(Ridomil Gold Copper)**		++	++	++	+++++	++	++
Mefanoxam + Mancozeb **(Ridomil Gold MZ)**		+++	+++	**NA**	+++++	+++	**NA**
Metrafenone **(Vivando)**		**NA**	**NA**	**NA**	**NA**	**NA**	++++
Myclobutanil **(Rally)**		+++++	++	**NA**	**NA**	**NA**	+++++[b]
Phosphonate **(ProPhyt, Phostrol, etc.)**					++++		
Sulfur[d] (various)		**NA**	**NA**	**NA**	**NA**	++	+++++
Tebuconazole **(Elite)**		+++++	**NA**	**NA**	**NA**	**NA**	+++++[b]
Tetraconazole **(Mettle)**							++++[b]
Thiophanate-methyl **(Topsin M)**		++	+++	**NA**	**NA**	+++	+++++[b]
Trifloxystrobin **(Flint)**		+++++	+++++	++++	+++	++	+++++[b]
Triflumazole **(Procure and Viticure)**		+++[b]	**NA**	**NA**	**NA**	**NA**	+++++
Ziram **(Ziram)**		++++	**NA**	++	++++	+++	**NA**

[a] The efficacy rating: NA = no significant activity; + = very limited activity, ++ = limited activity, +++ = moderate activity, ++++ = good activity, +++++ = excellent activity

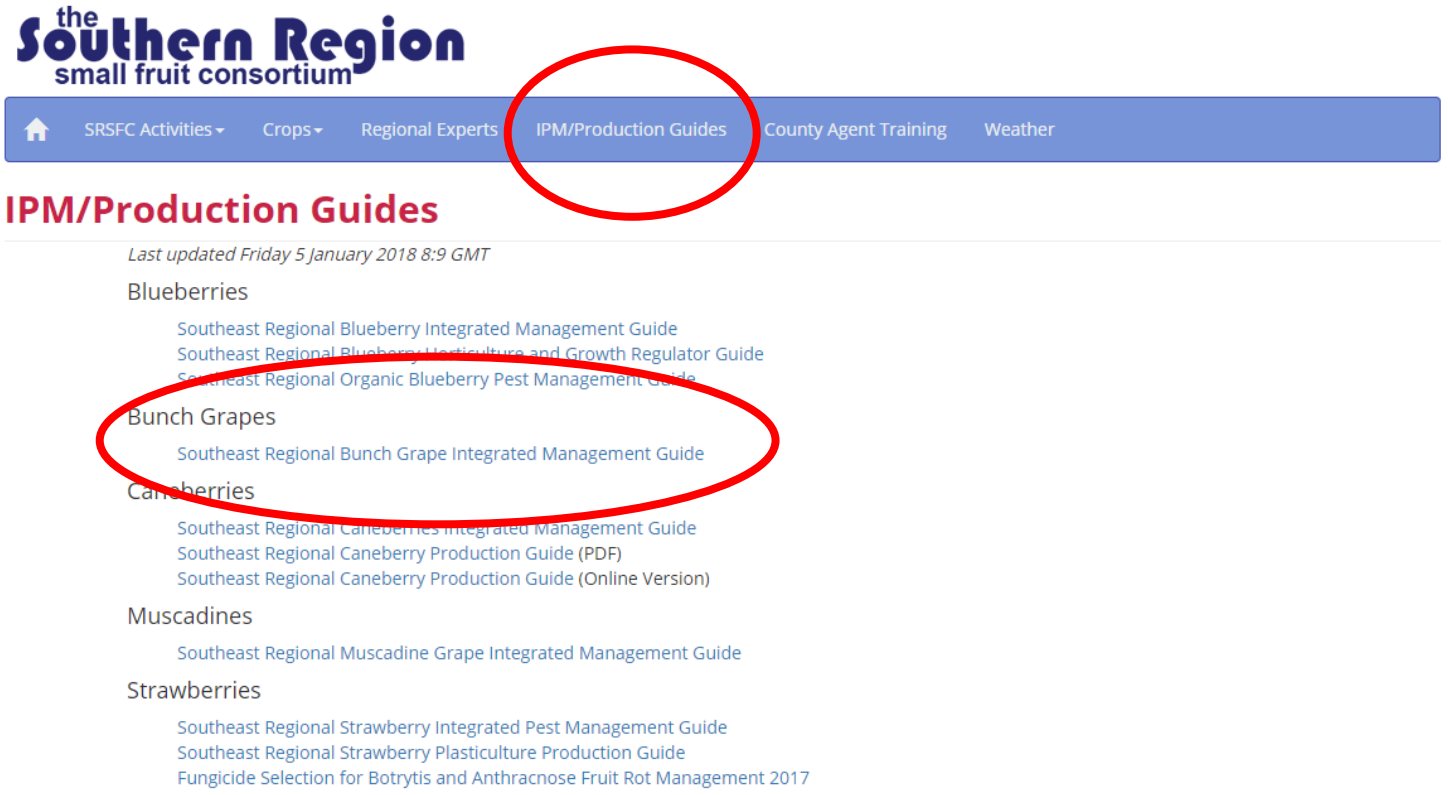
[b] Resistance (or occasional failure of control) has been observed in some southeastern states, thus, if control failure occurs, it could indicate resistance has developed. The efficacy rating could be impacted by resistance development. If resistance has occurred, use of fungicides in the same class would likewise show resistance, and a substitute fungicide should be considered for pathogen management.

[c] Insufficient data for the pathogen-chemical combination. The rating was given based on the general knowledge on the material.

[d] Sulfur will cause burn on sensitive varieties, especially on hot days when temperature reaches above 85F when foliage are wet.

IPM

Control: Main Pests and Diseases



www.smallfruits.org

Grape IPM Guide, including SWD, Mealybug and Root Borer

IPM

Monitoring: Main Fungal/Bacterial Diseases

Growth Stage	Main Diseases
Dormancy	**Preventative Measures**, Chemical LLS applications; Crown Gall and cold injury
Bud Swell	*Prevenative: Phomopsis; Powdery*;
Bud Break, 1-5” shoots	Phomopsis; ***Preventative Sprays:*** *Downey; Powdery; Black Rot;*
Pre Bloom	**Preventative:** Powdery; Downey; Black Rot; Birds Eye**;**
Bloom/Postbloom	Botrytis; Powdery; Downey; Black Rot; Birds Eye; ***Preventative:*** *Bitter Rot; Ripe Rot;*
Fruit Set and Fruit Growth	Phomopsis; Powdery; Downey; Black Rot; Birds Eye; Bitter Rot; Ripe Rot; Pierces Symptoms
Berry touch	Botrytis; Ripe Rot; Bitter Rot; Downey; Powdery; Virus Symptoms; Pierces; Dead Arm; Sudden death;
Bunch closure	
Veraison	Botrytis; Ripe and Bitter Rot; Virus Symptoms;
Pre-Harvest	Downey; Powdery; Botrytis; Phomopsis; Ripe Rot; Virus Symptoms;
Post-Harvest	Downey; Powdery; Virus Symptoms; Dead Arm;

What we don't know: Symptoms and Assessment

What we don't know: Symptoms and Assessment

Abiotic?

Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Spray Injury?

No burns

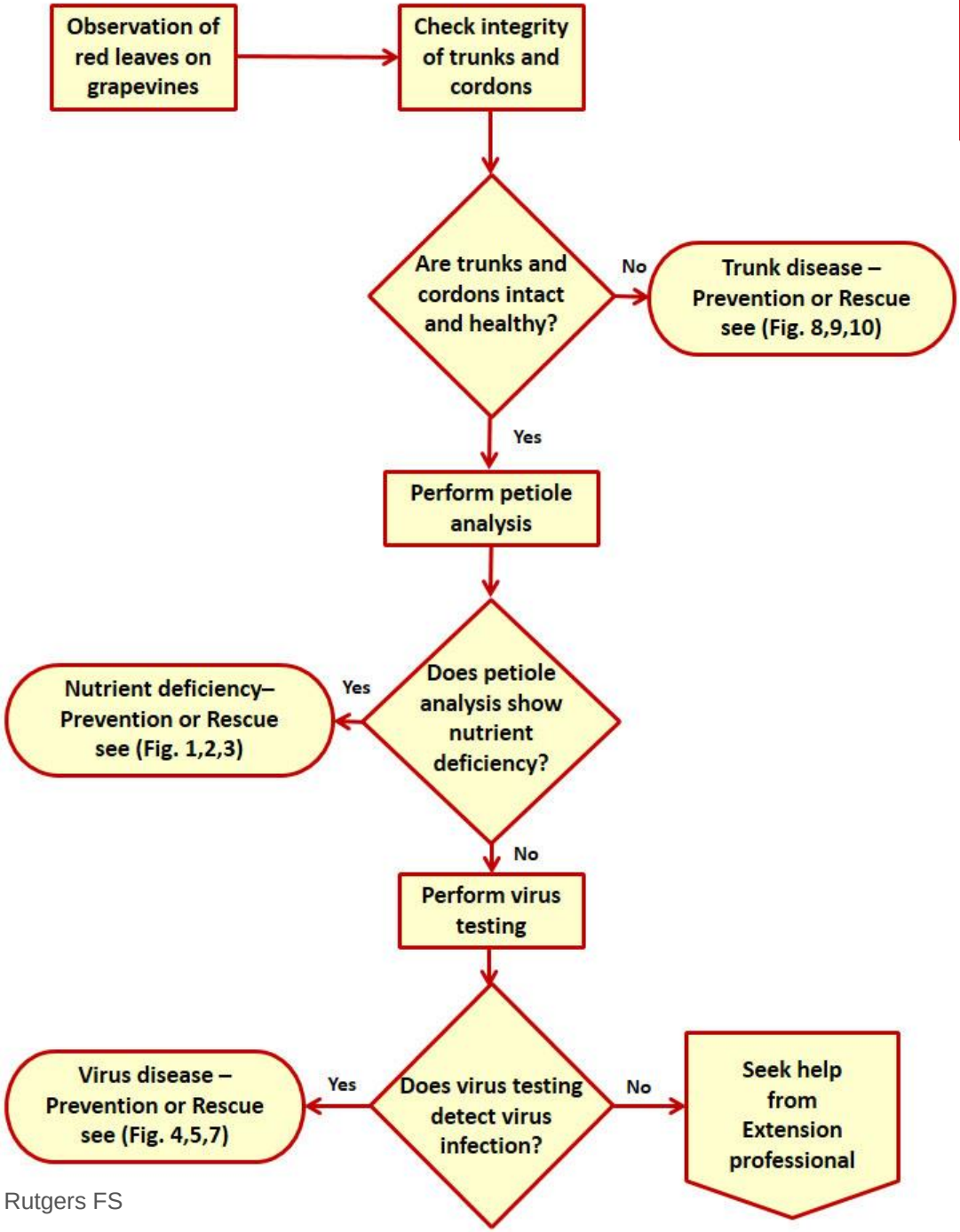
Biotic?

Jordan, 2013, eXtension

Step 1:
Most commons?

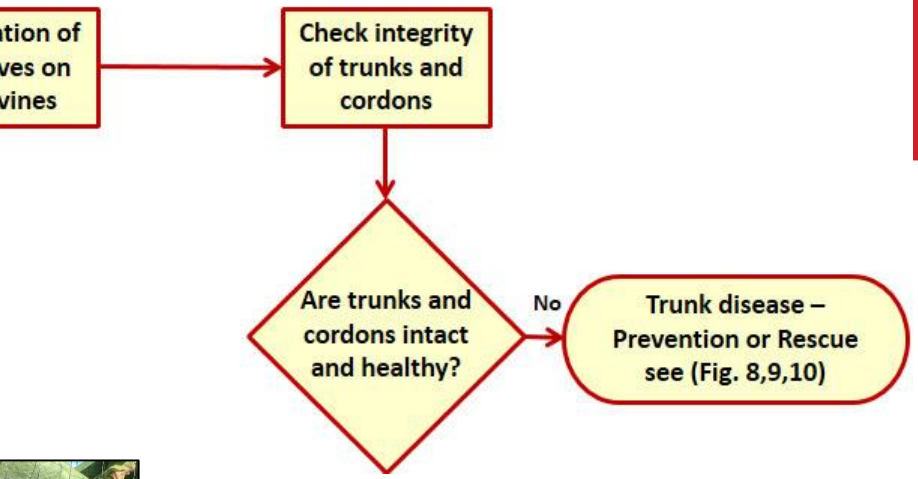
Step 2:
Abiotic?

Step 3:
Biotic?



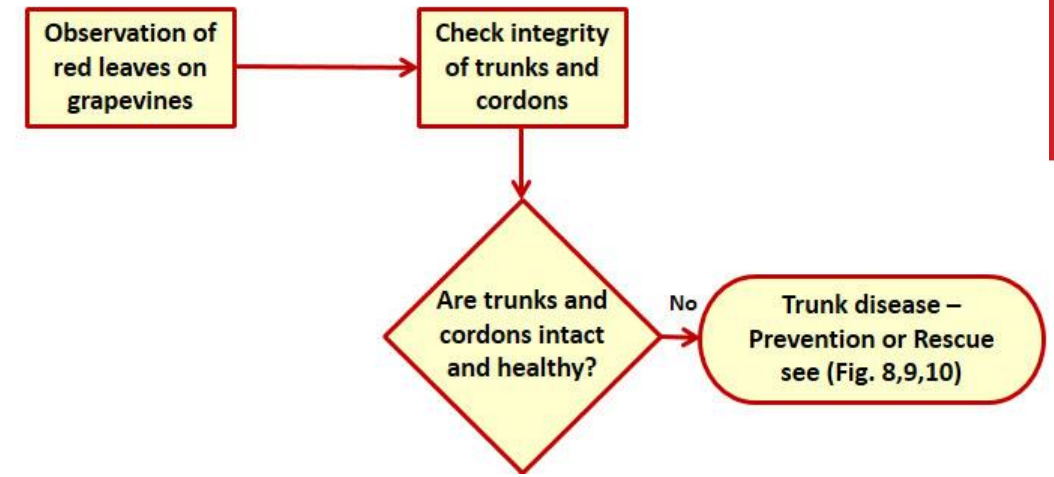
Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Step 1



Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Step 1



Most Commons:

- trunk injury (Crown Gall, Wood-borne Diseases)

Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Crown Gall

Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Crown Gall

Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

IPM

Trunk Diseases

NC STATE UNIVERSITY

good

Not so good

IPM

Trunk Diseases

Complex causal agents: in vinifera and muscadines

- Eutypia dieback (*Eutypia lata*)
- Botryosphaeria dieback (members of *Botryosphaeriacea*)
- Phomospis dieback (*Phomopsis viticola*)
- ESCA (Black Measels) (*Phaeoacremonium* and *Phaeomoniella* species)

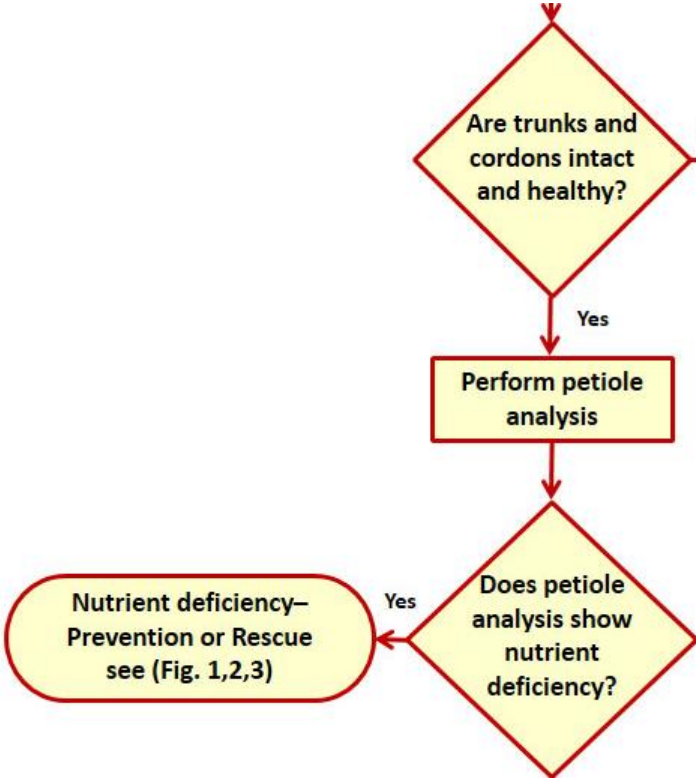
IPM

Trunk Diseases

IPM

Trunk Diseases

Step 2:
Abiotic?



- Records! (Spray, Soil and Nutrient)
- Take extra Petiole Samples
- **Take extra Soil Sample**

Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Grapevine Nutrition: Sampling

NC STATE UNIVERSITY

Grapevine Nutrition: Sampling

NC STATE UNIVERSITY

Bloom
collect petioles from leaves located opposite the first or second flower cluster from the bottom of the shoot.

70 to 100 Days after Bloom
collect petioles from the youngest fully expanded leaves (usually located 5 to 7 leaves back from the shoot tip).

Grapevine Nutrition: Sampling

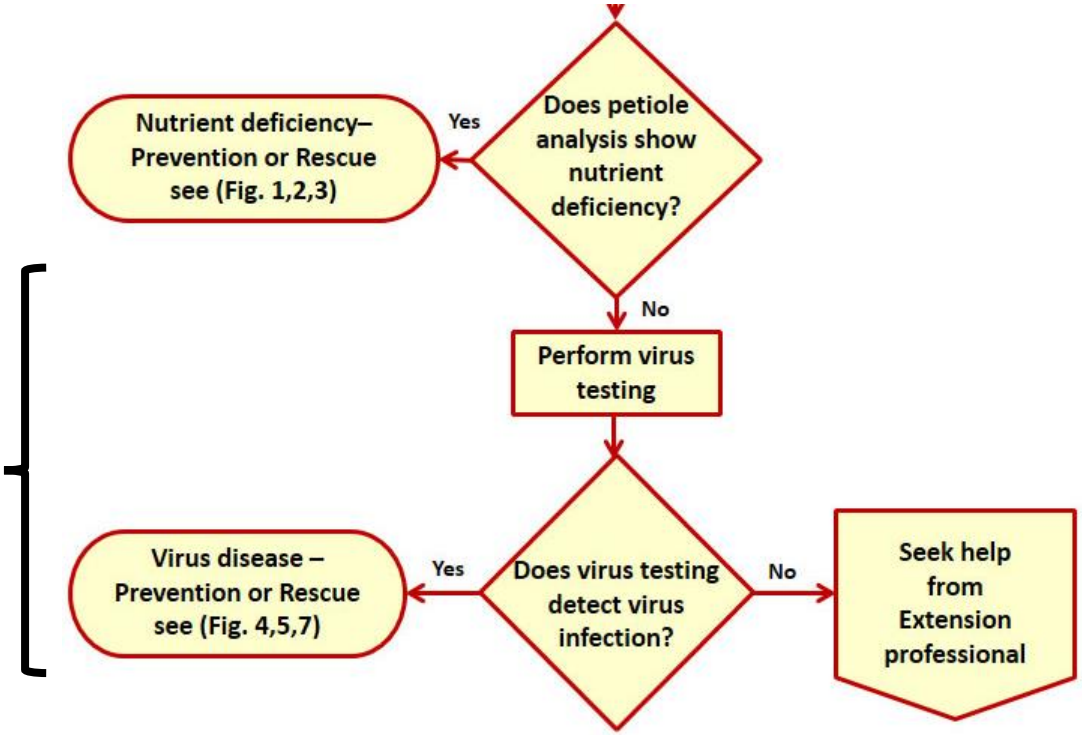
NC STATE UNIVERSITY

Nutrient	Soil		Bloom petiole		Late-summer petiole	
Nitrogen	--[z]	--	1.2 - 2.2	%	0.8 - 1.2	%
Phosphorus	20 - 50	ppm	0.17 - 0.30	%	0.14 - 0.30	%
Potassium	75-100	ppm	1.5 - 2.5	%	1.2 - 2.0	%
Calcium	500 - 2000	ppm	1.0 - 3.0	%	1.0 - 2.0	%
Magnesium	100 - 250	ppm	0.3 - 0.5	%	0.35 - 0.75	%
Boron	0.3 - 2.0	ppm	25 - 50	ppm	25 - 50	ppm
Iron	20	ppm	30 - 100	ppm	30 - 100	ppm
Manganese	20	ppm	25 - 1000	ppm	100 - 1500	ppm
Copper	0.5	ppm	5-15	ppm	5 - 15	ppm
Zinc	2	ppm	30-60	ppm	30 - 60	ppm
Aluminum	*< 100	ppm				
Organic matter	3 - 5	%				

[z] Soil nitrogen is not normally evaluated for vineyards.

Mark L. Chien (Penn State): **"Grapevine Nutrition"**

Step 3:
Biotic?



- **Assume biotic factors!**
- **Test for biotic factors if possible**

Gohil, Nita, Pavlis and Ward 2016: Rutgers FS 1260

Viruses

Virus	Name
GLRaV 1-10	Grapevine leafroll associated virus 1-10
GRBV	Grapevine red blotch virus
GVA-F	Grapevine virus A-F
GFkV	Grapevine fleck virus
GFLV	
GRSPaV	Grapevine ringspot associated virus
Many many more	

IPM

Viruses

Grape Leafroll associated Virus (GLRaV 1-10)

IPM

Viruses

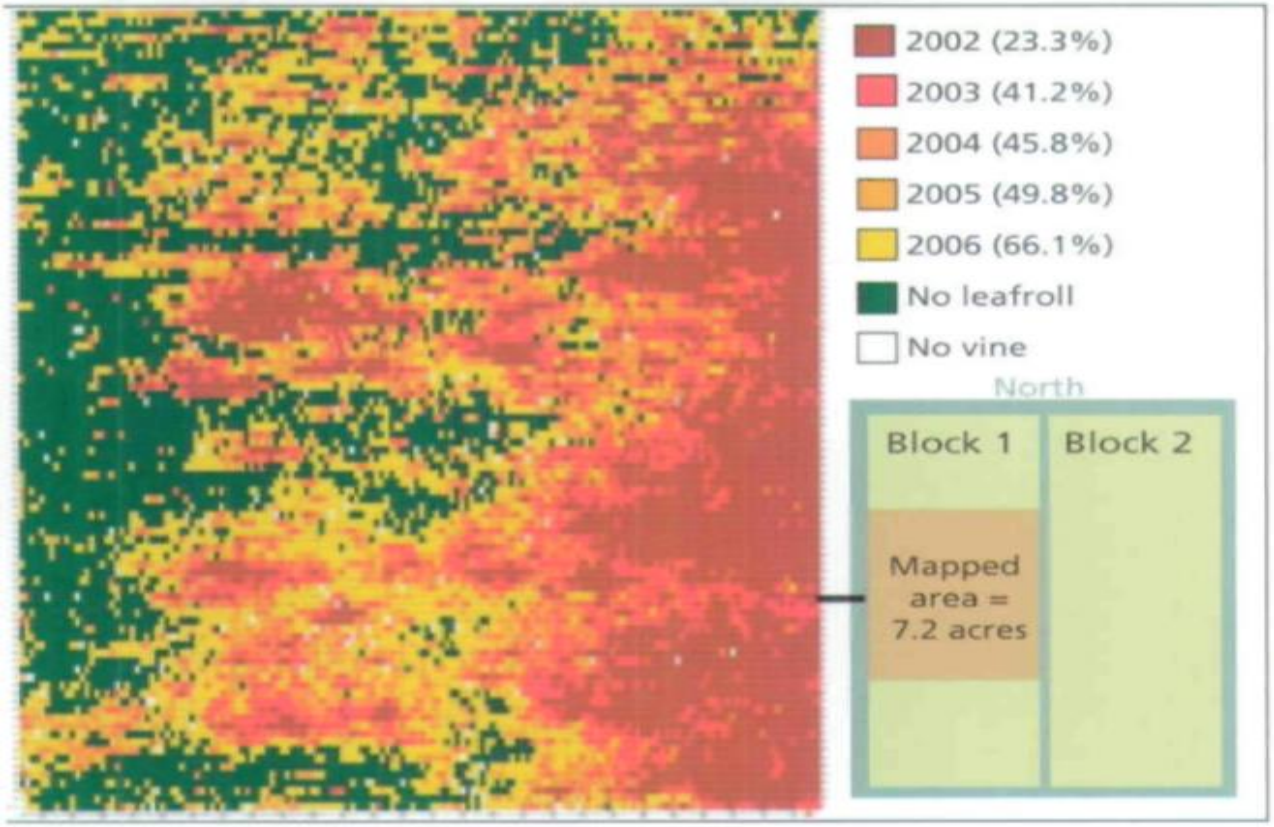
Grape Leafroll associated Virus (GLRaV 1-10)

- Transmitted via Mealybugs
- Please contact Hannah Burrack

IPM

Viruses

Grape Leafroll associated Virus (GLRaV-3, Cab sauv)



Gorino et al. 2008, California Agriculture 62(4): 156-160

IPM

Viruses

Grape Red Blotch associated Virus (GRBaV)

IPM

Viruses

Grape Red Blotch associated Virus (GRBaV)

IPM

Viruses

Grape Red Blotch associated Virus (GRBaV)

- Negative impact on productivity and quality
- **One vineyard tested positive in North Carolina**
- Spread by propagation material
- Vectored by **three cornered alfalfa treehopper** (*Spissistilus festinus*)
- Parasite on: peanut, vegetables, soybean, alfalfa, legume pasture, forages

IPM

Viruses

Grape Red Blotch associated Virus (GRBaV)

- Are vectors present?
- One positive? How many vineyards are affected?

Summary

NC STATE UNIVERSITY

More Information

- https://grapes.ces.ncsu.edu (Grower information)
- https://entomology.ces.ncsu.edu/ (Insect Pest Info)
- https://smallfruits.cals.ncsu.edu (Blog and Info Material)
- https://smallfruits.org (Pest Management Guides)
- https://site.extension.uga.edu/viticulture/ (Cains' Blog)

Thank you!

NC STATE UNIVERSITY

Thank you for you attention

NCSU
Department of Horticultural Science
2721 Founders Drive (Kilgore Hall), Room 258
Raleigh, 27695 NC

office (919) 513-0772
cell (919) 352 8006
Email: mark.hoffmann@ncsu.edu
https://smallfruits.cals.ncsu.edu