

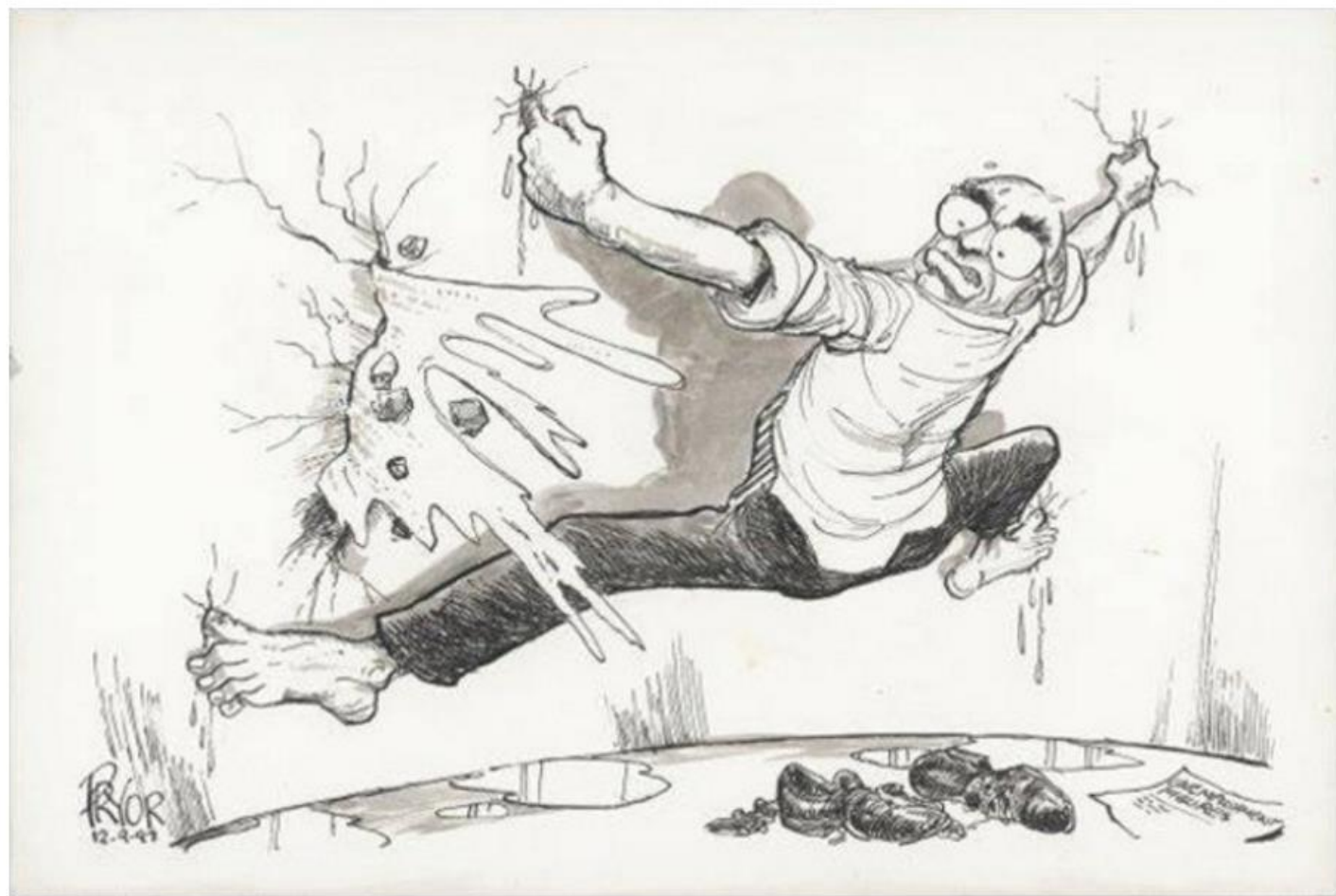
Fundamentals of Integrated Disease Management in Vineyards



Department of Plant Pathology

College of Agricultural & Environmental Sciences

UNIVERSITY OF GEORGIA





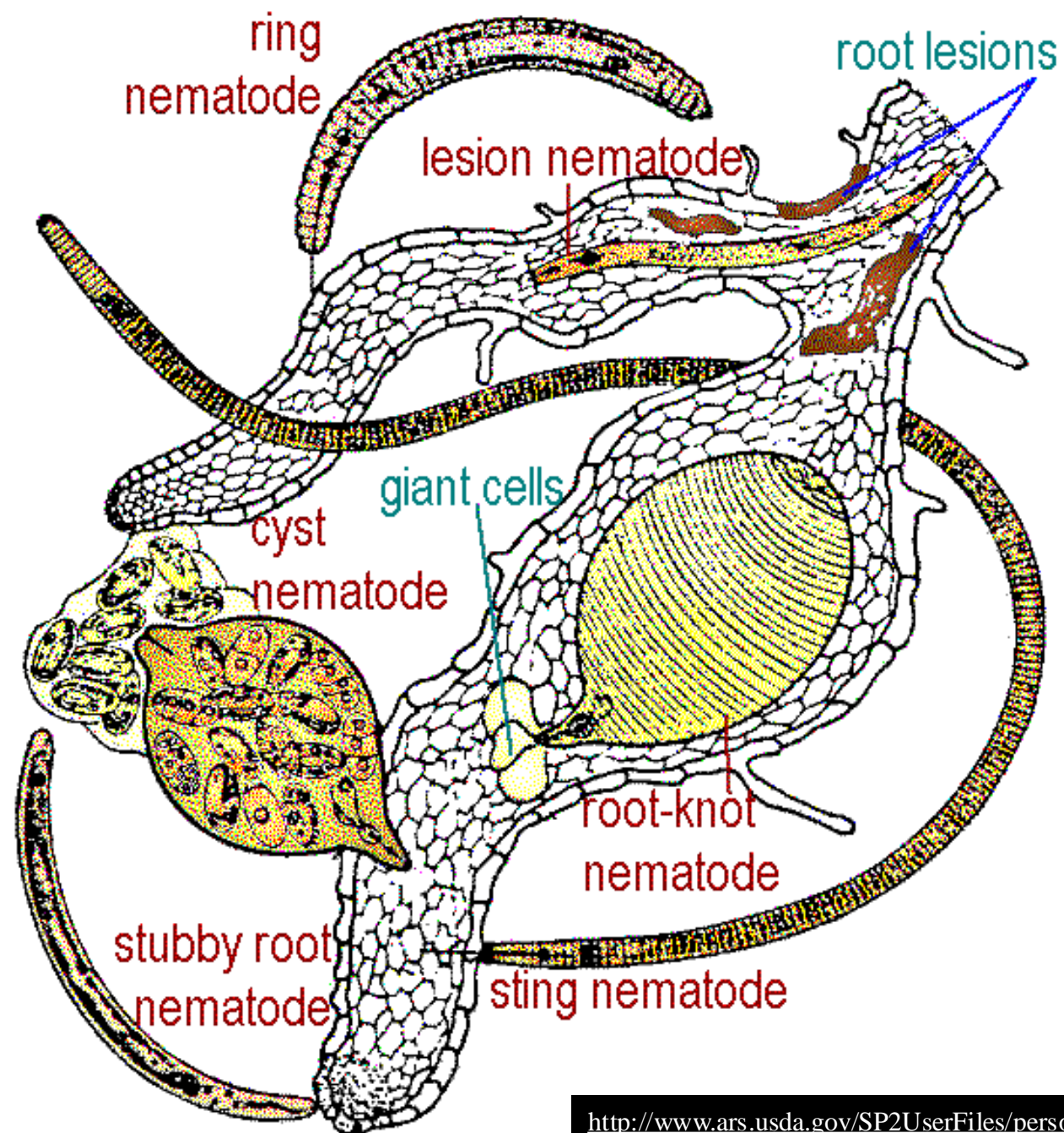
Cabernet Sauvignon
Cabernet Franc
Merlot
Riesling
Chardonnay
Seyval Blanc
Chambourcin
Cab Franc
Viognier
Malbec

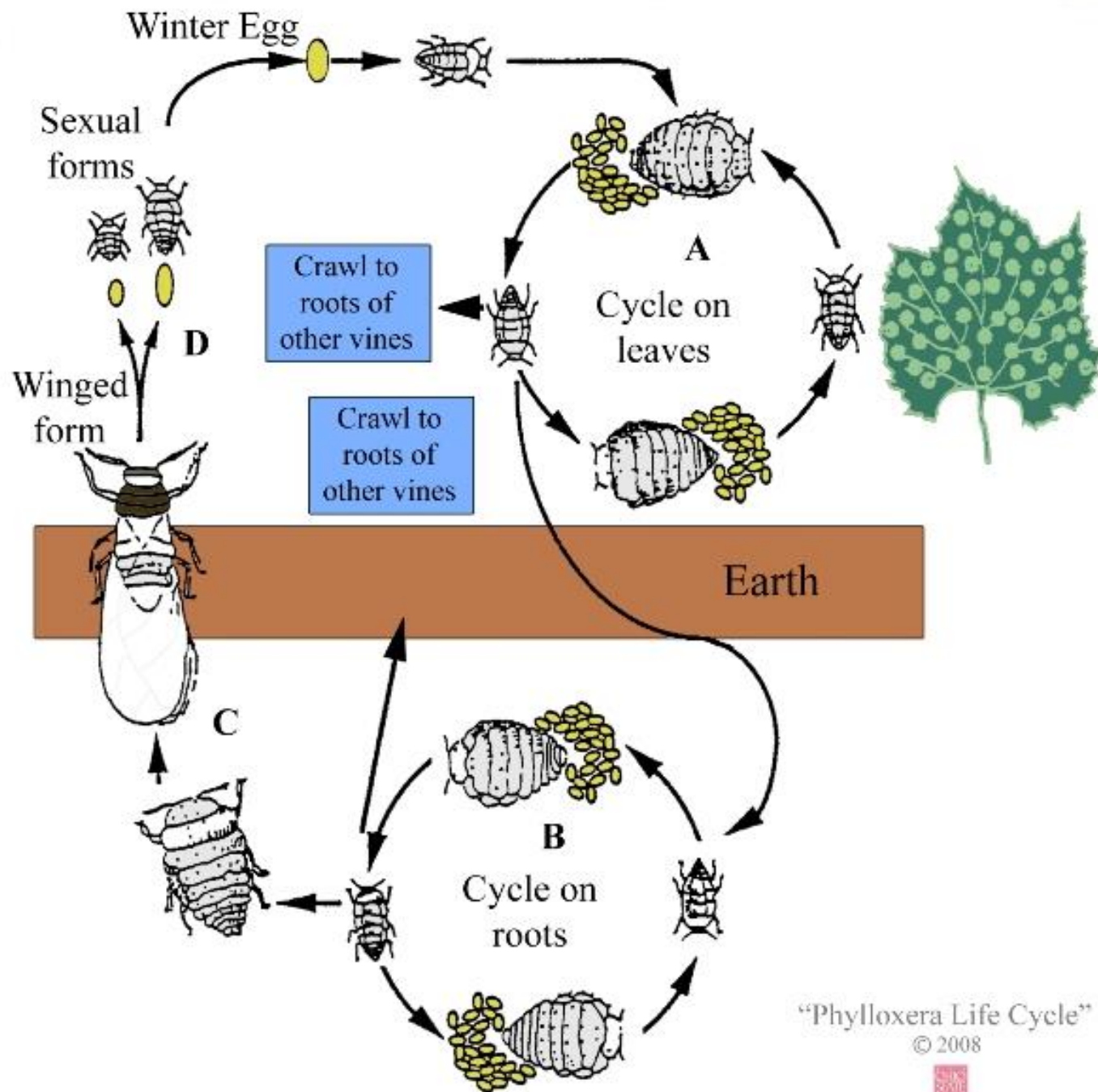
Chardonnay
Sangiovese
Tannat
Pinot Blanc
Vidal
Pinot Noir
Gewurztraminer
Trebbiano
Pinot Gris
Primitivo

* Suwannee
* Black Spanish / Lenoir
* Blanc Du Bois
* Norton / Cynthiana
* Muscadines

Soil samples and nematode samples should be conducted prior to vineyard establishment, and soil samples and tissue samples should be conducted yearly if possible.

Select rootstocks which are resistant to Phylloxera and nematodes. Make sure all plant parts are certified to be free of viruses, crown gall, etc.







Crown Gall of Grape

- ❖ *Vitis vinifera* cultivars are most susceptible to crown gall, but American and French-American hybrids, as well as many root stocks, are also susceptible to infection.
- ❖ Crown gall develops on trunks and canes wounded by subfreezing temperatures or other injuries. Plant cells which are active in healing a wound are susceptible to infection.













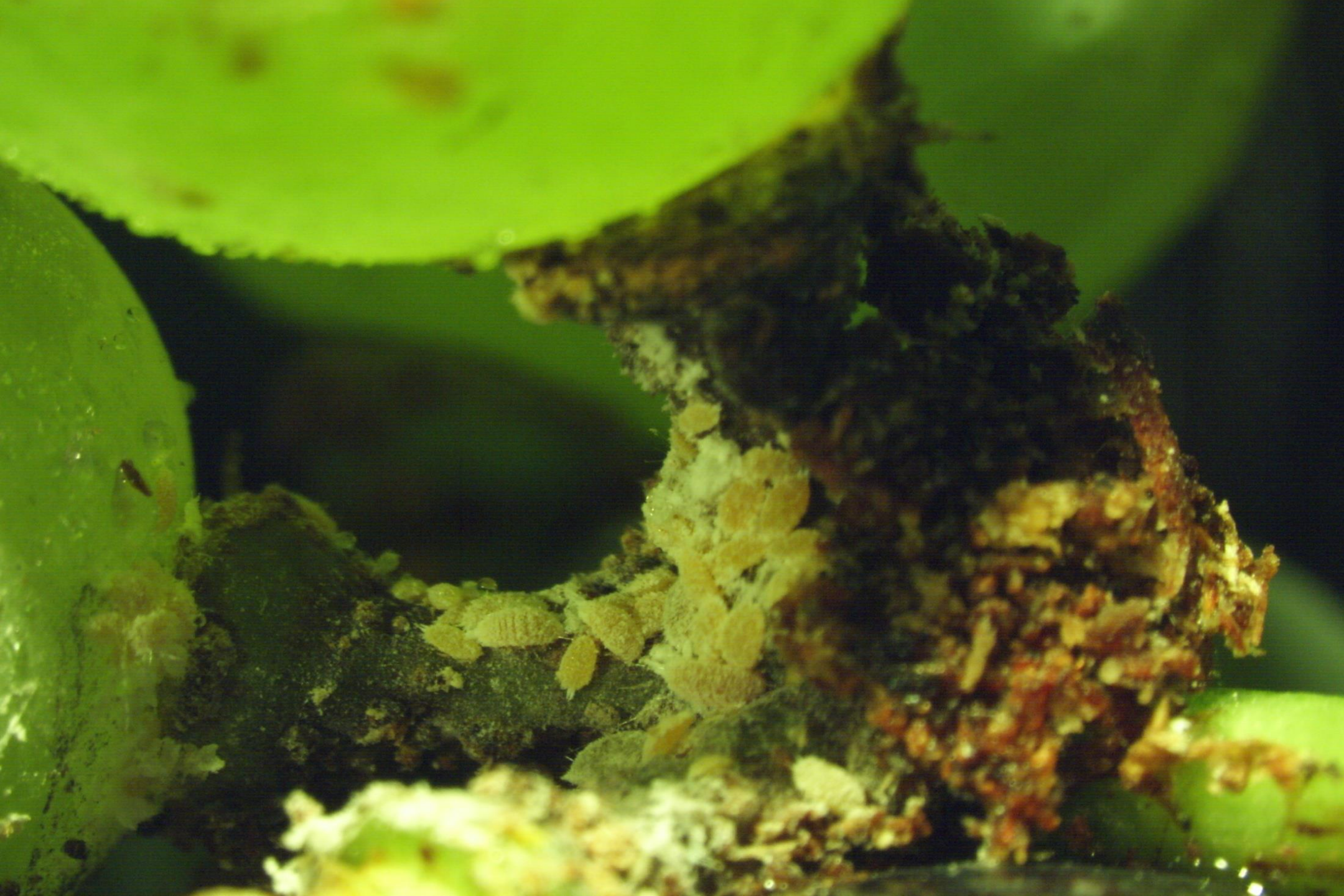
Georgia Grape Virus Survey

	GLRaV									Grapevine virus									
Vineyard	1	2	3	4	5	6	7	9	10	A	B	D	E	GRSPaV	GFLV	GSyV-1	GFkV	ToRSV	GRLaV
A	-	-	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	-
B	-	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+
C	+	+	-	+	+	-	-	-	-	-	+	-	-	+	-	-	-	-	+
D	+	+	+	-	-	-	-	-	-	-	-	-	-	+	-	-	-	-	+
E	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
F	-	+	+	-	-	+	-	-	-	-	-	-	-	-	-	-	-	-	-
Statewide	+	+	+	+	+	+	-	-	-	-	+	-	-	+	-	-	-	-	+

*Grapevine rupestris stem pitting-associated virus (GRSPaV), Grapevine virus A , B, D, E (GVA, GVB, GVD, GVE), Grapevine fanleaf virus (GFLV),Grapevine fleck virus (GFkV), Grapevine Syrah Virus 1 (GSyV-1), Tomato ringspot virus (ToRSV), Grapevine redleaf-associated virus (GRLaV).



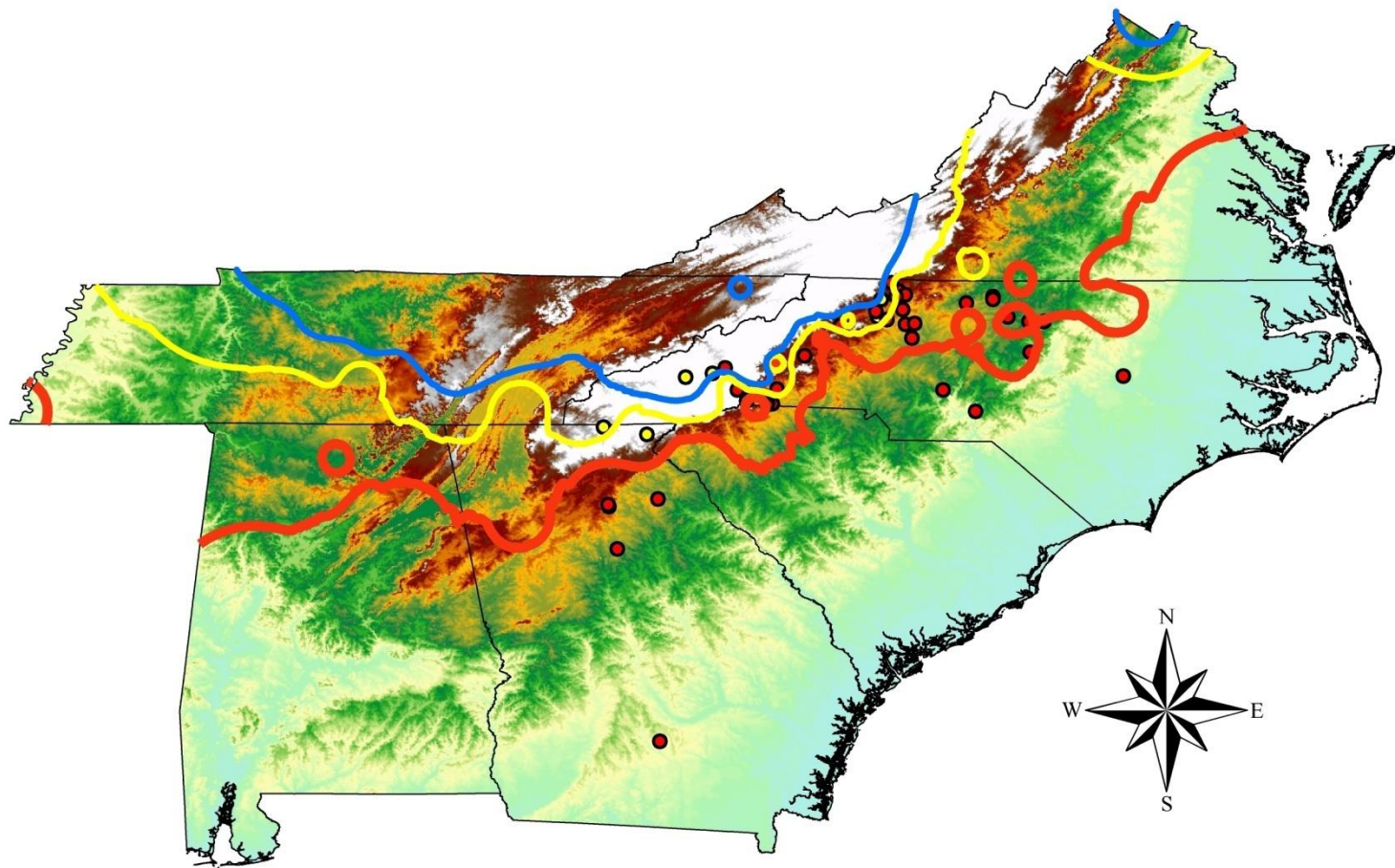




“Pierce’s disease is a principal factor limiting production of both *V. labrusca* and *V. vinifera* grapes in the Gulf Coastal Plains of the United States.”

Goheen and Hopkins, Compendium of Grape Diseases (1998).





Temperature $\leq -12.2^{\circ}\text{C}$ contour lines

1972-1997 (25-year average)

- 1 day (very high risk areas to the South and East)
- 2 days (high risk areas to the South and East)
- 3 or more days (moderate risk areas to the South and East and low risk areas to the North and West)
- Pierce's disease positive sites
- Pierce's disease negative sites



27% *X. fastidiosa*
positive



Oncometopia orbona

33% *X. fastidiosa*
positive



Bespeckled leafhopper;
Paraphlepsius irroratus

28% *X. fastidiosa*
positive



Graphocephala versuta



Agallia constricta

Primary Southeastern Bunch Grape Diseases

- ❖ Black Rot (*Guignardia bidwellii*)
- ❖ Downy Mildew (*Plasmopara viticola*)
- ❖ Powdery Mildew (*Erysiphe necator*)
- ❖ Botrytis Bunch Rot (*Botrytis cinerea*)
- ❖ Phomopsis Cane and Leaf Spot (*Phomopsis viticola*)
- ❖ Anthracnose or Bird's-eye Rot (*Elsinoë ampelina*)
- ❖ Bitter Rot (*Melanconium fuligineum*)
- ❖ Ripe Rot (*Colletotrichum gloeosporioedes*)
- ❖ Sour Rot

Principal Southeastern Foliar/Fruit Diseases

	Relative importance	
	Fruit	Foliage
Downy mildew	++	+++++
Powdery mildew	++	+++++
Black rot	+++++	++
Phomopsis	+++	++
Botrytis	+++++	-
Bitter rot	+++++	++
Ripe rot	+++++	-
Anthracnose or Bird's Eye Rot	+++++	+++
Sour rot	+++++	-

Harrison and Sutton; NC State

Anthracnose (budbreak to bloom)

Downy Mildew (immediate pre-bloom to senescence)

Phomopsis (budbreak to fruit set)

Black Rot (immediate pre-bloom to veraison)







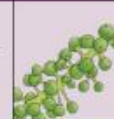



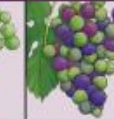

















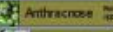

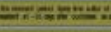
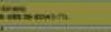






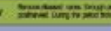
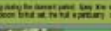
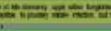
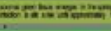

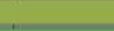




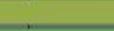
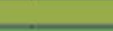


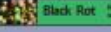
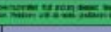
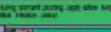
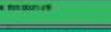

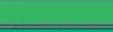



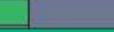




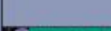

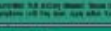









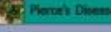



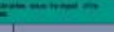






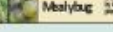
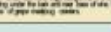


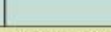

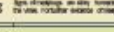
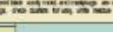
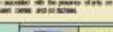
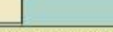

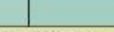

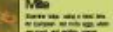

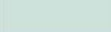
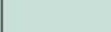

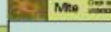
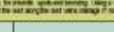
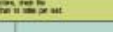


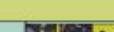


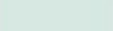
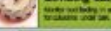


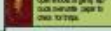






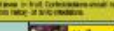

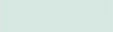
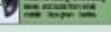
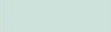
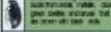









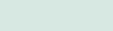
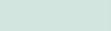
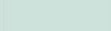
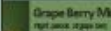

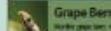
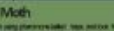


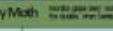

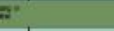

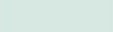
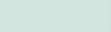
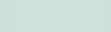
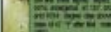



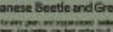
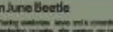















Botrytis (late season if weather conducive)

Powdery mildew (season long; bloom is critical timeframe)

Non-specific bunch rots

[illegible]

Column headings for the different cost management systems are based on the topics covered in the *Strategic Cost Management* course taught using several Management Tools.

1	2	3	4	5	6	7	8	9	10	11	12	13
DORMANT	BUD SWELL	BUD BREAK	PREBLOOM	BLOOM	FRUIT SET	BB-SIZED FRUIT	PEA-SIZED FRUIT	BERRY TOUCH	BUNCH CLOSURE	VERAISON	PREHARVEST	HARVEST
												
CANE AND SPUR PRUNING <small>Pruning is essential for healthy vines. It removes dead wood, improves air circulation, and directs energy to fruiting canes. Timing is critical: dormant pruning in late winter/early spring, and summer pruning after harvest.</small>	SHOOT THINNING <small>Removes excess shoots to reduce canopy density, improve light penetration, and prevent shading. Done when shoots are 12-18 inches long.</small>	SHOOT THINNING <small>Removes excess shoots to reduce canopy density, improve light penetration, and prevent shading. Done when shoots are 12-18 inches long.</small>	SAMPLING <small>Monitoring fruit quality and yield. Includes visual inspection for size, color, and sugar content. Use a refractometer for Brix levels.</small>	LEAF REMOVAL <small>Removes leaves that are shaded or damaged to improve fruit quality and reduce disease risk. Done when fruit is pea-sized.</small>	LEAF REMOVAL <small>Removes leaves that are shaded or damaged to improve fruit quality and reduce disease risk. Done when fruit is pea-sized.</small>	LEAF REMOVAL <small>Removes leaves that are shaded or damaged to improve fruit quality and reduce disease risk. Done when fruit is pea-sized.</small>	LEAF REMOVAL <small>Removes leaves that are shaded or damaged to improve fruit quality and reduce disease risk. Done when fruit is pea-sized.</small>	LEAF REMOVAL <small>Removes leaves that are shaded or damaged to improve fruit quality and reduce disease risk. Done when fruit is pea-sized.</small>	SAMPLING <small>Monitoring fruit quality and yield. Includes visual inspection for size, color, and sugar content. Use a refractometer for Brix levels.</small>	SCOUTING <small>Monitoring for pests and diseases. Includes visual inspection of leaves, fruit, and canopy for signs of infestation.</small>	HARVEST <small>Timing is critical for optimal flavor and sugar content. Harvest when fruit is fully colored and has reached target Brix levels.</small>	
												
FROST DAMAGE <small>Can be caused by late frosts or early frosts. Symptoms include leaf curling, necrosis, and fruit damage. Prevention includes frost protection measures like frost blankets or irrigation.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>	SHOOT POSITIONING <small>Ensures shoots are positioned correctly for optimal growth and fruiting. Avoids shading and promotes even canopy development.</small>
DORMANT	BUDSWELL	BUD BREAK/AND NEW SHOOTSPRAYS*	PREBLOOM	BLOOM	POSTBLOOM*	FRUITSET*	EARLY COVER SPRAYS*	BERRY TOUCH/AND BUNCH CLOSURE*	LATE COVER SPRAYS*	VERAISON	PREHARVEST	POSTHARVEST*
												
Botrytis/Phaeria canker <small>Common fungal disease causing necrotic lesions on buds, leaves, and fruit. Spread by wind and rain. Control with fungicides.</small>	Crown gall <small>Bacterial disease causing tumor-like growths at the base of the vine. Spread by soil and pruning tools. Control with sanitation and grafting.</small>											
												
Anthraxnose <small>Fungal disease causing necrotic lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Phomopsis <small>Fungal disease causing necrotic lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Powdery Mildew <small>Fungal disease causing white powdery growths on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Downy Mildew <small>Fungal disease causing yellowish-green lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Black Rot <small>Fungal disease causing necrotic lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Botrytis <small>Fungal disease causing necrotic lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Ripe Rot <small>Fungal disease causing necrotic lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Bitter Rot <small>Fungal disease causing necrotic lesions on leaves and fruit. Spread by wind and rain. Control with fungicides.</small>	Pierce's Disease <small>Bacterial disease causing wilting and necrosis of leaves and fruit. Spread by insects. Control with insecticides.</small>				
												
Malyg <small>Grasshopper/leafhopper pest causing damage to leaves and fruit. Control with insecticides.</small>	Malyg <small>Grasshopper/leafhopper pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>	Sharpshooter/Leafhopper <small>Pest causing damage to leaves and fruit. Control with insecticides.</small>
												
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Climbing Cutworm <small>Larval pest causing damage to leaves and fruit. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>	Grape Root Borer <small>Larval pest causing damage to roots and trunk. Control with insecticides.</small>
												
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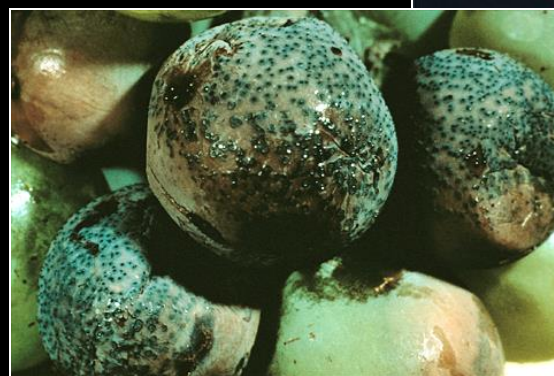
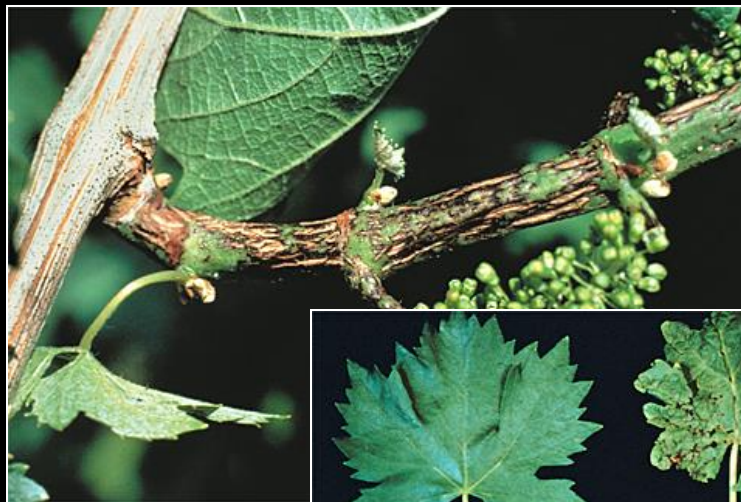
Cultural Control Methods

- ❖ Select planting sites with direct, all-day sunlight (avoid shade). Good soil drainage and air circulation are also very important. Orient rows to take full advantage of sunlight and wind movement. Cultural practices that increase air circulation and light penetration in the vineyard will reduce wetting periods and should be beneficial for control.
- ❖ Carefully prune out badly infected canes to reduce the carryover of spores. Select only strong, healthy canes that are uniform in color to produce the next season's crop.

Phomopsis Cane and Leaf Spot

(Phomopsis viticola)

- ❖ Southeastern climates are particularly conducive for disease development.
- ❖ Early sprays are particularly important.
- ❖ Continue applications till at least green pea stage.



Downy Mildew

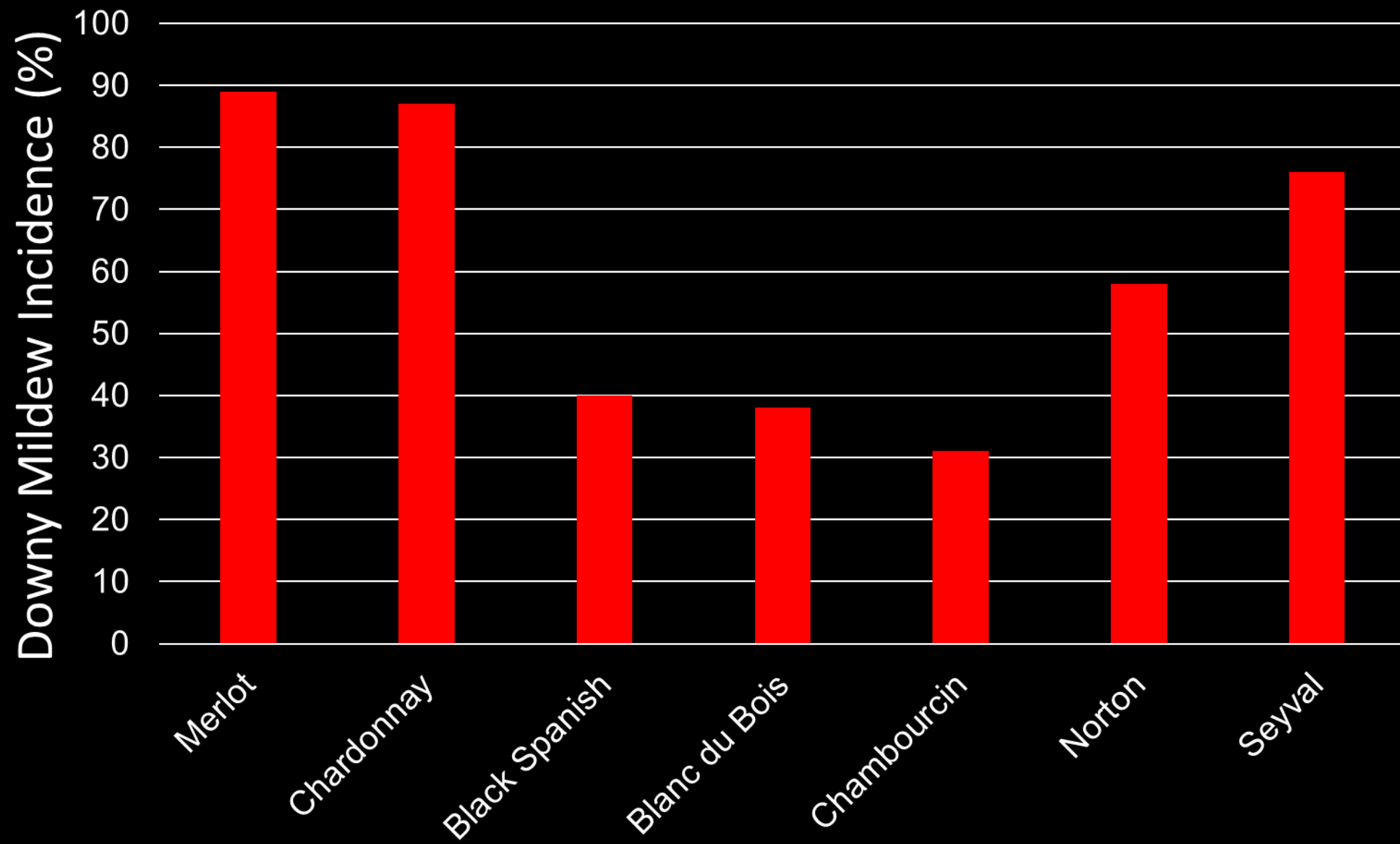
(Plasmopara viticola)

- ❖ Attacks all green parts of the vine, but leaves are particularly susceptible.
- ❖ *Vitis vinifera* are highly susceptible, *V. aestivalis* and *V. labrusca* are less susceptible, and *V. rotundifolia* is resistant.
- ❖ Infected leaves drop, resulting in reduced sugars in the fruit and decreased hardiness of overwintering buds.









Powdery Mildew

(*Erysiphe necator*)

- ❖ Can also infect all green vine parts.
- ❖ White powdery growth
- ❖ Infected fruit may cause off flavor in wines.









Botrytis Bunch Rot

(Botrytis cinerea)

- ❖ Botrytis infects primarily at bloom, killing flowers, but also readily infects dead or injured tissue.
- ❖ Bloom sprays are essential for control of this disease.
- ❖ Also sprayed prior to bunch closing, at the beginning of fruit ripening, and prior to harvest.





Bitter Rot

(Melanconium fuligineum)

- ❖ Overwinters on canes and mummified fruit.
- ❖ Can infect all green vine parts, to include the pedicels.
- ❖ Fruit is infected at maturity.
- ❖ Fungicides can be applied late-season and at preharvest to control fruit rots.



Ripe Rot

(Colletotrichum gloeosporioides)

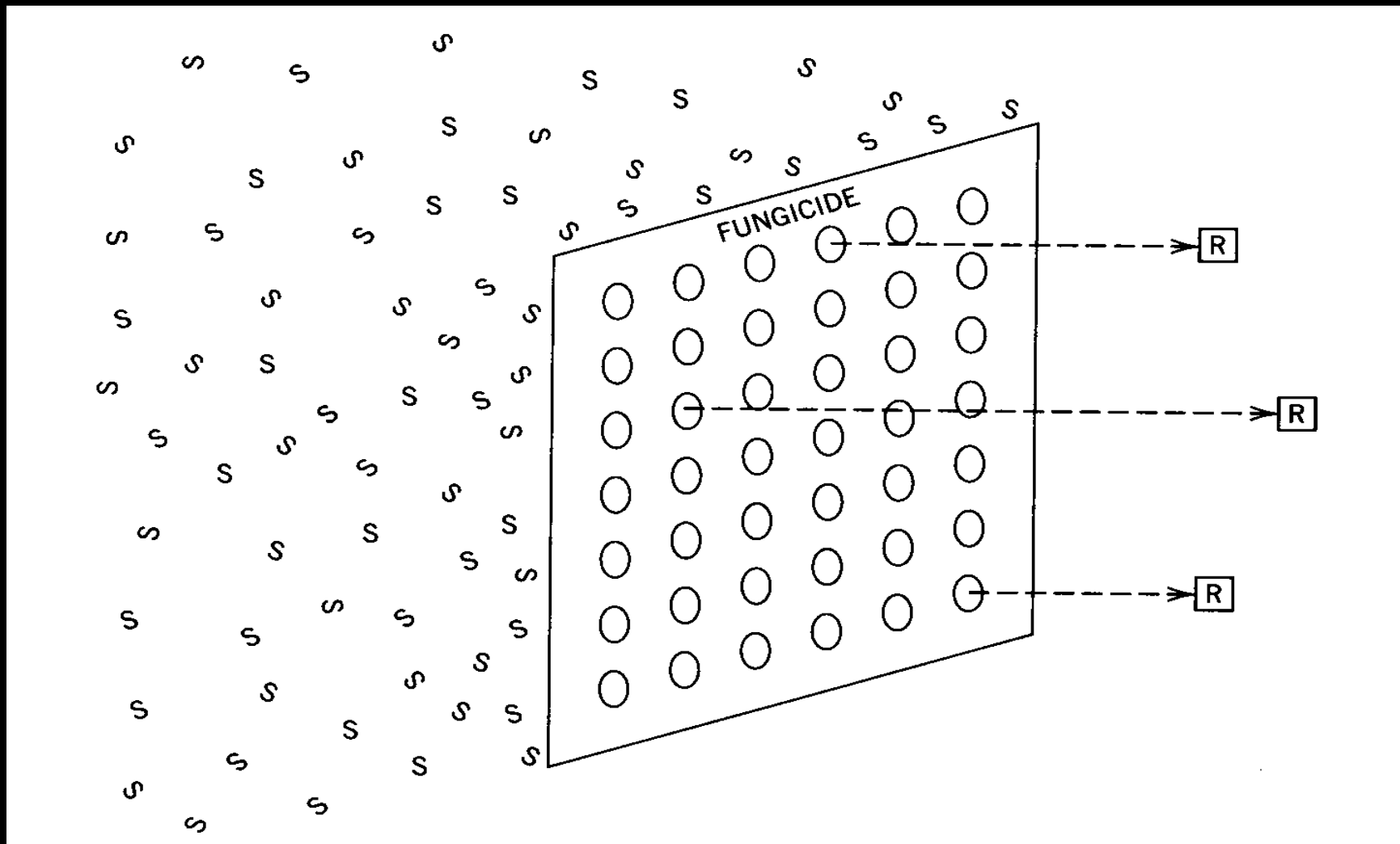
- ❖ Overwinters on canes, dormant vines and mummies.
- ❖ Fruit can become infected anytime during fruit development, but the infection is quiescent until fruit maturation.
- ❖ For control, fungicides should be applied from bloom until preharvest.



Sour Rot

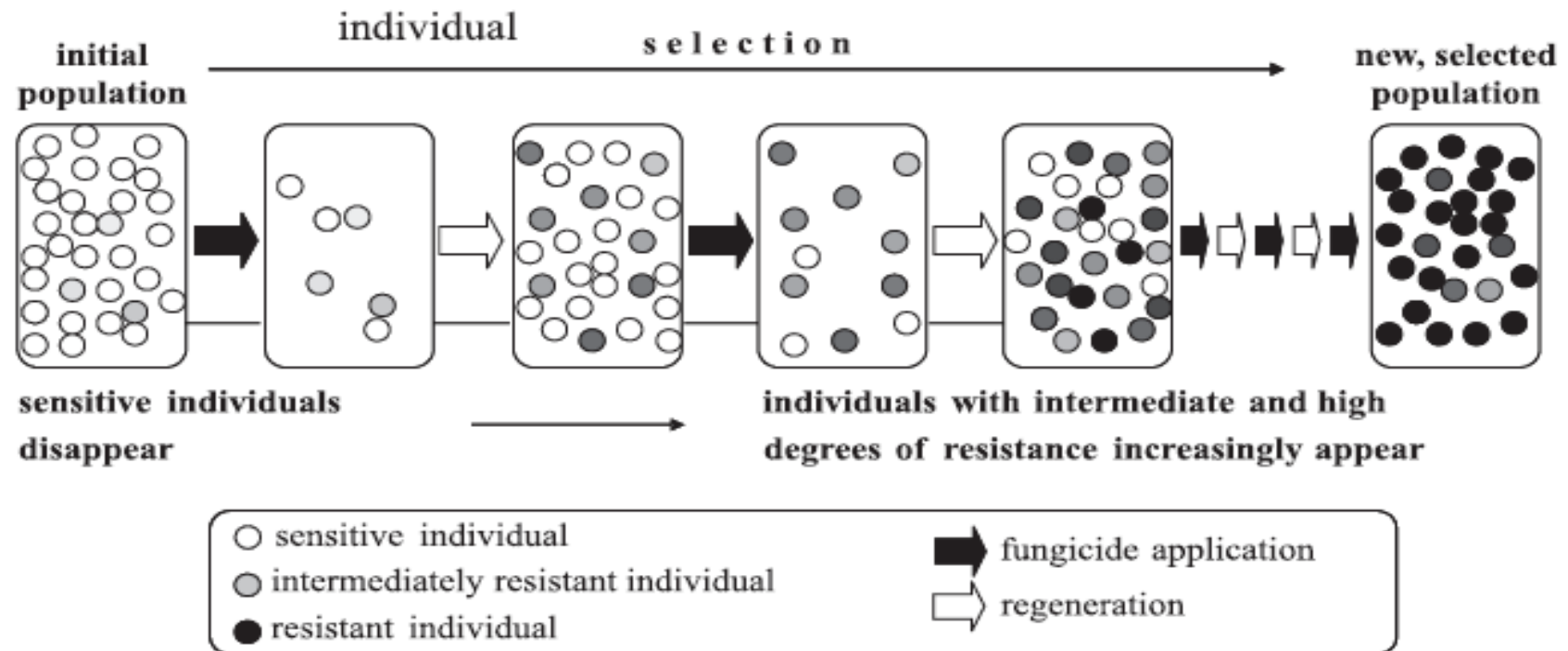
- ❖ Caused by a multitude of organisms.
- ❖ Infections result from wounds (insects, birds, mechanical damage, etc.) or other diseases.
- ❖ Control is best achieved through reduction of damage.



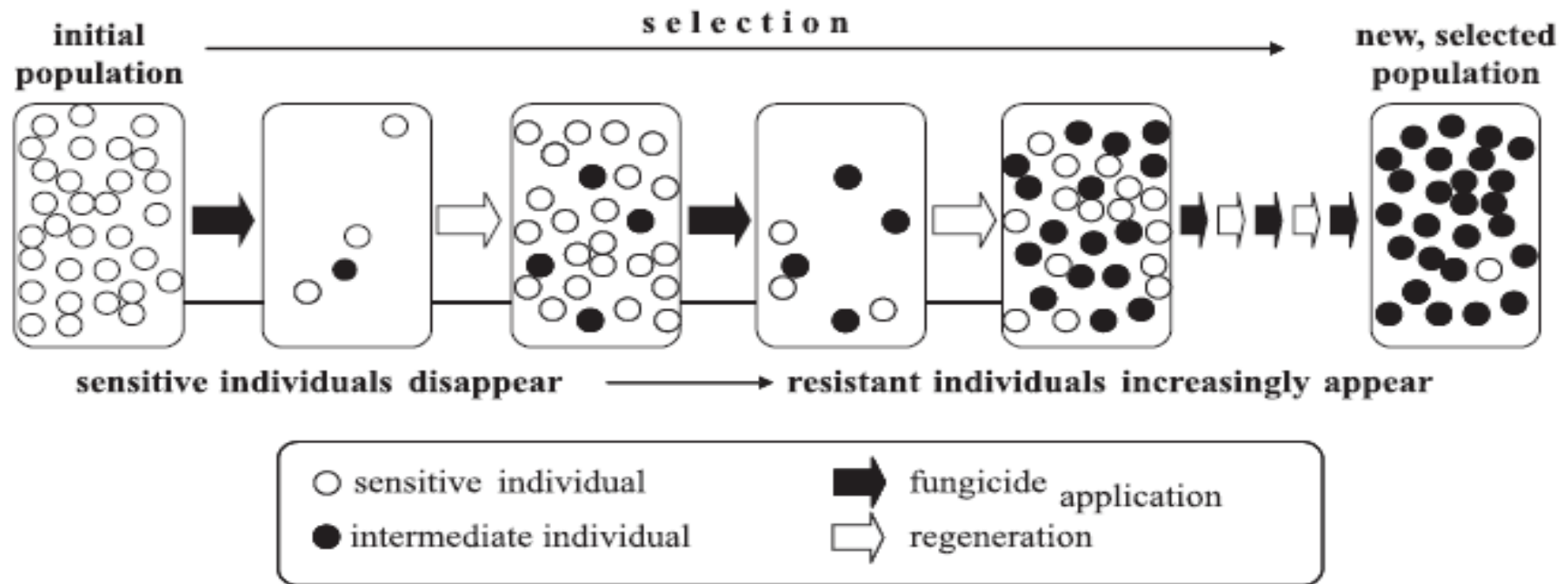


R = resistant S = sensitive

Evolution of fungicide resistance: quantitative resistance



Evolution of fungicide resistance: qualitative resistance



Southeast Regional Bunch Grape

INTEGRATED
MANAGEMENT
GUIDE

2023



*A Guide for Managing Diseases, Insects,
Weeds, and Wildlife in Grapes in the Southeast*





Questions???