Developing an Effective Vineyard Fungal Pest Management Program

Texas A&M AgriLife Extension | Viticulture and Fruit Lab

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Axioms to Live By

- Great Wine is Only Made From Sound, Ripe Fruit
- Optimal Maturity Depends on Disease Free Clusters & Canopy
- Vine Health is Dependent on Effective Crop Control and a Healthy Canopy

Components of an Effective Management Program

- Relative Risk Assessment
- Timing
- Material Selection
- Effective Applications

Texas Grape Fungal Diseases Affecting Fruit & Foliage

- Powdery Mildew
- Black Rot
- Anthracnose
- Phomopsis Cane & Leaf Spot
- Downy Mildew
- Botrytis Bunch Rot
- Leaf Blight
- Summer Rot Complex

Managing the 4 Major Fungal &Fruit Diseases

Powdery Mildew

Downy Mildew

Black Rot

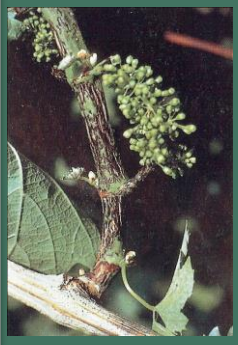
Phomopsis

Critical Elements in Fungal Disease Management

- Understand the pathogen biology
  - Environmental effects
  - When active
  - Cultural practices that favor/ disrupt
- Understand host susceptibility
  - Relative degree (cultivar effect)
  - When not susceptible
  - Critical, peak period
- Understand fungicide characteristics
  - Surface-active or penetrant?
  - Protectant? Post-infection? Eradicant?
  - Spectrum of activity
  - Resistance concerns and management

Phomopsis viticoli

- Cool, Wet Season Disease
- Overwintering Structures
- Latent Rachis Infections
- Infections Become Systemic



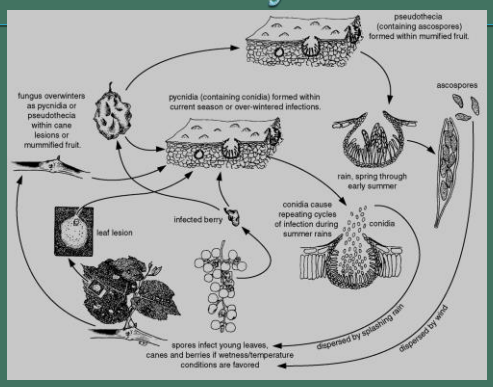
Management of Phomopsis

- Start Spray Program at 1-3" Shoot Growth
- Must Maintain Coverage As Shoots & Cluster Tissue Expands
- Berries Susceptible to Direct Infection Until Pea-Sized
- Rachis Tissue is Usually Most Critical In Minimizing Crop Loss
- EBDC (Mancozeb and others), Captan, Strobilurins Effective in Control

Black Rot

- Overwinters as Mummified Fruit or Cane Lesions
- Infection Periods are Temperature and Leaf Wetness Driven
- Key Periods of Susceptibility 2 Weeks Pre-bloom to 30 Days Post-bloom
- Achilles Heel of Organic Grape Production

Black Rot Life Cycle



Monitoring Black Rot Infection Periods

Leaf wetness duration and temperature necessary for infection by the black rot fungus.	
Temperature (degrees F)	**Hours of leaf wetness required for infection**
45	**No infection**
50	**24**
55	**12**
60	**9**
65	**8**
70	**7**
75	**7**
80	**6**
85	**9**
90	**12**

Black Rot Fungicide Options

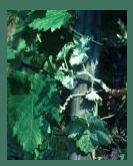
- Strobilurins- Abound, Flint, Pristine, Sovran
- DMI- Nova, Elite, etc.
- Mancozebs- Dithane, Penncozeb
- Carbamates- Ferbam

Powdery Mildew

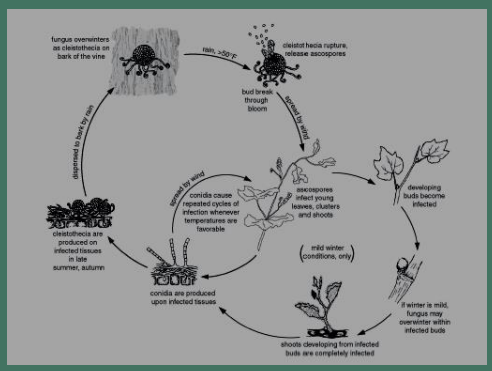
- Problematic in All Parts of the State
- 0.1” Rain & 50°F Needed for Primary Infection
- No Rainfall Needed for Secondary Infection
- Key Period of Susceptibility is 2 Weeks Pre-bloom to 30 Days Post-bloom

Powdery Mildew Lifecycle

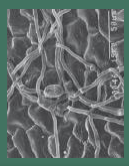










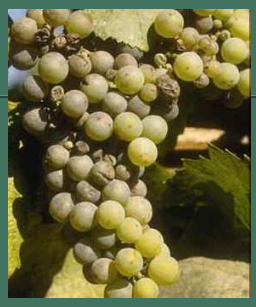



POWDERY MILDEW: EFFECT of TEMPERATURE on DISEASE SPREAD

Temp. (°F)	Generation time (days)
48	25
54	18
59	11
63	7
74	6
79	5
86	6
90	not active

Potential Losses from PM

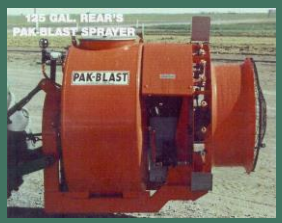
- **Direct Fruit Loss**
- **Loss of Fruit Quality**
- **Loss of Photosynthetic Area**



Powdery Mildew Fungicides Options

- Strobilurins- Flint, Abound, Pristine
- DMI- Nova, Elite
- Boscalids- Endura
- Other Unique Chemistries
- Sulfur
- Copper
- Other Contacts
  - Oils
  - Bicarbs
  - Peroxide Products

Resistance Management Is a Must!



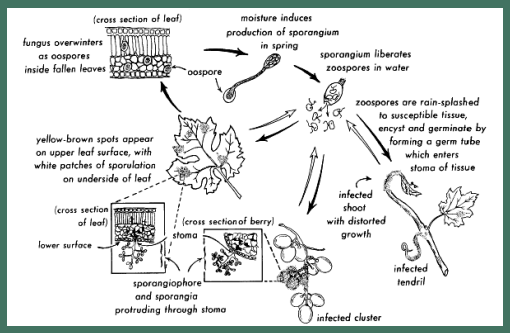
Powdery Mildew Rescue Treatments

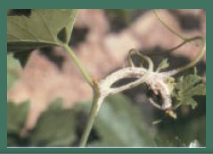
- Excellent Tank Mix Additions to Conventional Fungicides
- Important Products for Late Season (Post-harvest) Control of PM
- DO NOT WANT TO SOLELY RELY ON THEM WHEN SUSCEPTIBLE FRUIT ARE PRESENT

Downy Mildew

- Overwinters in Leaf Litter on Vineyard Floor
- Spores Disseminated by Splashing Rain
- Primary Infection Takes Place During Wet Nights
- Fruit/Rachis Infections Become Systemic

Downy Mildew Life Cycle





Potential Losses from Downy Mildew

- Direct Fruit Loss
- Loss of Photosynthetic Area (Foliage)
- Loss of Fruit Quality

Downy Mildew Management Considerations

- First primary infections occur about 2 - 3 weeks before bloom, to ~ 2 weeks post-bloom
  - ≥52°F, 0.1" rain
  - Critical time to prevent epidemic from starting
- Young Clusters Highly Susceptible

Chemicals Used to Manage Downy Mildew

- Mancozebs, Captan, Carbamates
- Strobilurins (some are much more effective than others)
- Copper Products
- Phos-Acids

Selecting Fungicides

- GENERAL PRINCIPLES
  - Understand fungicide characteristics
    - Surface-active or penetrant?
    - Protectant? Post-infection? Eradicant?
    - Spectrum of activity/ relative efficacy
    - Resistance concerns and management

Mancozeb Materials

- Trade Names- Dithane, Manzate & Penncozeb
- Excellent Protection Against Downy Mildew and Phomopsis
- Very Tenacious on Plant Material, Redistributes Well After Some Rain
- Need to Apply 3# to 4# Rate For Good Control
- Not Subject to Resistance
- 66 Day PHI, 24 Hour REI

Carbamate Fungicides

- Ferbam - (If You Can Find It) 7 Day PHI, 24 Hour REI, Rate is 4#/Acre, Only 3 Applications Per Season
- Ziram –(3-4#/acre, 21 Day PHI, 48 Hour REI
- Labeled For Black Rot, Downy Mildew, Phomopsis & "Ripe Rot"
- Up To 7 Ziram Applications Per Growing Cycle

Captan

- Old Class of Chemistry, Another Multi-site Toxin
- Very Active Preventative Against Downy Mildew & Phomopsis
- Black Rot is On the Label, but Don't Count On It!
- Very Helpful in Management of Sour Rot Complex
- "Cover Up" After Hail
- 3# to 4# Rates To Be Effective
- 1 Day PHI, 72 Hour REI

Locally Systemic Fungicides

- Some Have Great Protectant Activities While Others Are Stronger As Post-Infection Materials….(not post symptom)
- Advantage of Being Locally Systemic
  - Greater in Foliage Than Fruit
- Some Growers Get Lulled Into Complacency And Get Sloppy With Optimizing Coverage

Sterol Inhibitors

- Many Acronyms- SI's, DMI's, EBI's
  - 5 to 7 Day Protectant Activity
  - 7 to 10 Day Post-Infection Activity
- Initially Effective on 21 Day Intervals
  - Better Not Count on More Than 14 Days
- Resistance in Fungi is Multi-genic

SI Products

- Rally (40WSP)- Labeled at 2 to 5 ozs/Acre 14 Day PHI, 24 Hour REI. 48 oz/acre max.
  - 3-4 oz rate is Advisable, 5 oz Rate is Post-Infection Black Rot Rate
- Elite (45WP)- Labeled at 4 ozs per acre 14 Day PHI, 12 Hour REI. 32 oz/acre max.
- Procure (50WS)- Labeled at 4 to 8 ozs per acre 7 Day PHI, 12 Hour REI
- Rubigan (1E)- Label Prebloom 2-3 fl.oz/acre, Postbloom 4-5, Summer Sprays 5-6. Maximum 19 fl. oz/acre
- Package Mixes- Numerous Products Now Package-Mixed with SI products; Quadris Top, Inspire Super, Revus Top, Luna Experience

Strobilurin Fungicides

- Also Known As Qol Compounds
- Extremely Broad Spectrum Activity
- Excellent Protectant Activity
- Excellent Anti-sporulant Activity
- Little or No Kick-back Activity
- Also Locally Systemic
- Single Gene Resistance Mechanism

Phosphorous Acid (Phosphonate) Materials

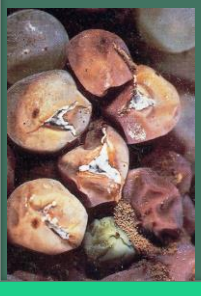
- Plant Nutrients Containing Phosphoric Acid are Not Effective
- Locally Systemic
- Excellent Post-Infection Control with Limited Eradicant & Protectant Activity
- They **Are** Prone to Resistance

Other Chemistries

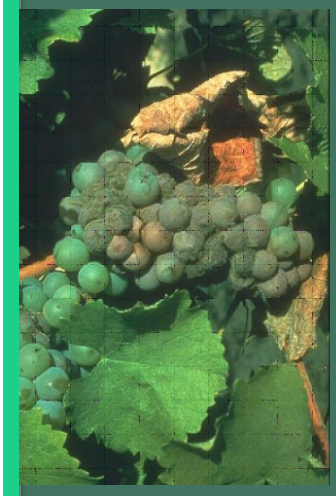
- Powdery Mildew Only
  - Vivando (U8)
  - Quintec (13)
  - Presidio (43)
  - Boscalids (7)

Bunch Rot Organisms



Botrytis cinerea



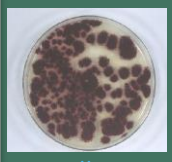
Although the fungus grows well only in berries that are ripening, young fruit also can become infected through attached blossom parts, and perhaps through scars left by the fallen caps. Such infections remaining latent (dormant) until some of them resume activity and rot the berries as they start to ripen.

Botrytis Materials

- Vanguard- Locally Systemic, Some Post-Infection Activity, Prone to Resistance
- Scala- Similar Efficacy With Vanguard
- Switch - cyprodinil + fludioxonil
- Elevate- Protectant product with no "reach-back" activity
- Strobilurins- Some Effectiveness, good Anti-sporulation activity
  - ☺ Flint ☞ 😐 Sovran ☞ ☹ Abound

Characteristics of Other Bunch Rots & Molds

Alternaria alternata



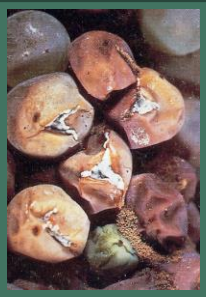
Aspergillis niger

- Organisms are Ubiquitous
- Opportunistic Invaders
- Often Enter Through Mechanical Injury
  - GBM
  - Hail
  - Bird Pecks
  - PM Infections
  - Cracking Due to High Moisture Status

Cladosporium spp.

Other Organisms

- Variety Selection?
- Irrigation Strategy?
- Material Selection & Timing



Penicillium spp.

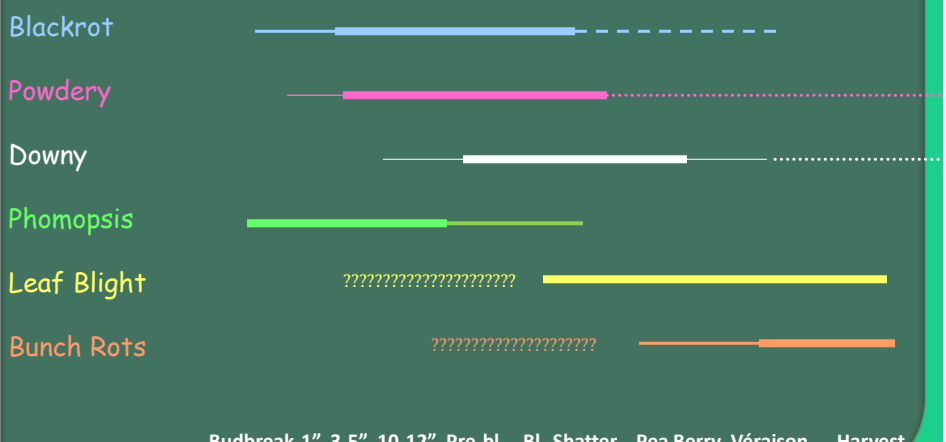
Greeneria uvicola
Bitter Rot

Rhizopus spp.

Cladisporium, Aspergillis , Alternaria, Botryosphaeria, Colletotricum

Conventional Wisdom is that Multi-site Toxin Fungicides are the Best Materials Available for Control
Mancozebs, Captan

Periods of Greatest Fruit/ Rachis Infection Potential



Available at the Texas A&M Agrilife Bookstore

2016 Texas Grape Pest Management Guide

TEXAS A&M AGRILIFE EXTENSION

Fungicide- common name, trade name	Phomopsis cane and leaf spot	Anthracnose	Black rot	Downy mildew	Powdery mildew	Leaf Blight	Summer Rot Complex	Botrytis bunch rot	Fungicide Group	REI (hours)	PHI (days)
azoxystrobin (Abound)	++	+++	++++	++++	++++	++	+	+	11	4	14
azoxystrobin + difenoconazole (Quadris Top)	++	+++	++++	++++	++++	++	+	+	11, 3	12	14
boscalid (Endura)	0	?	0	0	++++	0	0	++/++++[a]	7	12	14
boscalid + pyraclostrobin (Pristine)	+++	++++	++++	++++	++++	++	++	++/++++[a]	7, 11	TVSL[b]	14
calcium polysulfide (limed sulfur)	?	++++	0	0	+	0	0	0	N/A	48	dormant only
captan (Captan, Captec)	++++	+	+	+++	0	0	++	+	M4	TVSL[b]	0
cyazofamil (Ranman)	0	0	0	+++	0	0	0	0	21	12	30
cyprodinil (Vangard)	0	0	0	0	+?	0	0	++++	9	12	7
cyprodinil + difenoconazole (Inspire Super)	0/+?	+	++++	0	++++	?	0	+++	9,3	12	14
cyprodinil + fludioxonil (Switch)	0	0	0	0	0	0	+++	+++	19,12	12	7
dihydrogen potassium phosphate (Nutrol)	0	0	0	0	++	0	0	0	N/A	4	0
fenamidone (Reason)	0	?	0	++++	0	0	?	0	11	12	30
fenarimol (Rubigan, Vintage)	0	0	++	0	+++	0	0	0	3	24	21
fenhexamid (Elevate)	0	?	0	0	+	0	0	++++	17	12	0
fixed copper (several formulations) and lime	+	0	+	+++	++	0	0	0	N/A	TVSL[b]	TVSL[b]
fluopicolide (Presidio)	0	0	0	++++	0	0	0	0	43	12	21
fluopyram + tebuconazole (Luna Experience)	+	?	+++	0	++++	?	?	++++	7, 3	TVSL[b]	14
iprodione (Rovral)	0	0	0	0	0	0	0	+++	2	48	7
kresoxim-methyl (Sovran)	++	++	++++	++	++++		++	++	11	12	14
mancozeb (Dithane, Manzate, Penncozeb)	++++	++	+++	+++	+	0	+++	0	N/A	24	66
mandipropamid (Revus)	0	0	0	++++	0	0	0	0	40	4	14
mandipropamid + difenoconazole (Revus Top)	0/+?	0	++++	++++	++++	?	0	0	40, 3	12	14
mefanoxam + mancozeb (Ridomil Gold MZ)	+	0	+	++++	0	0	0	0	4, M	48	66
mefanoxam + copper hydroxide (Ridomil Gold Copper)	+	0	0	++++	0	0	0	0	4, M1	48	42

Three to Five Inch Shoot Growth

Phomopsis cane and leaf spot	This is a critical spray for control of rachis infections on susceptible varieties in wet springs. On highly susceptible varieties, this can also be an important time to prevent the establishment of infections on young berry stems, which can move into the fruit and rot them later in the season. The maximum rates of the listed products should not be necessary at this growth stage IF sprays are thoroughly applied.			
		Captan 50W	2-4 lb	
	OR	Captan 80WDG	1.25-2.5 lb	
	OR	Captec 4L	1-2 qt	
	OR	Dithane DF, *or* Dithane M45, *or* Manzate 75DF, Penncozeb 75DF	2-4 lb	
	OR	Dithane F-45	1.6-3.2 qt	
Black rot	Black rot sprays are rarely needed this early in the season unless serious disease occurred the previous year and warm, wet conditions are anticipated well before the next spray.			
		Dithane DF, *or* Dithane M45, *or* Manzate 75DF, *or* Penncozeb 75DF	2-4 lb	
	OR	Dithane F-45	1.6-3.2 qt	
	OR	Rally 40WSP	3-4 oz	Inspire Super, Orius, Revus Top, Tebuzol, and Rally have some protective activity but are most effective when applied after the start of an infection period . The duration of post-infection activity is incompletely characterized, but sprays applied up to 3-7 days after the start of an infection period
	OR	Orius 45DF *or* Tebuzol 45DF	3-4 oz	
	OR	Revus Top 4SC	7 fl oz	

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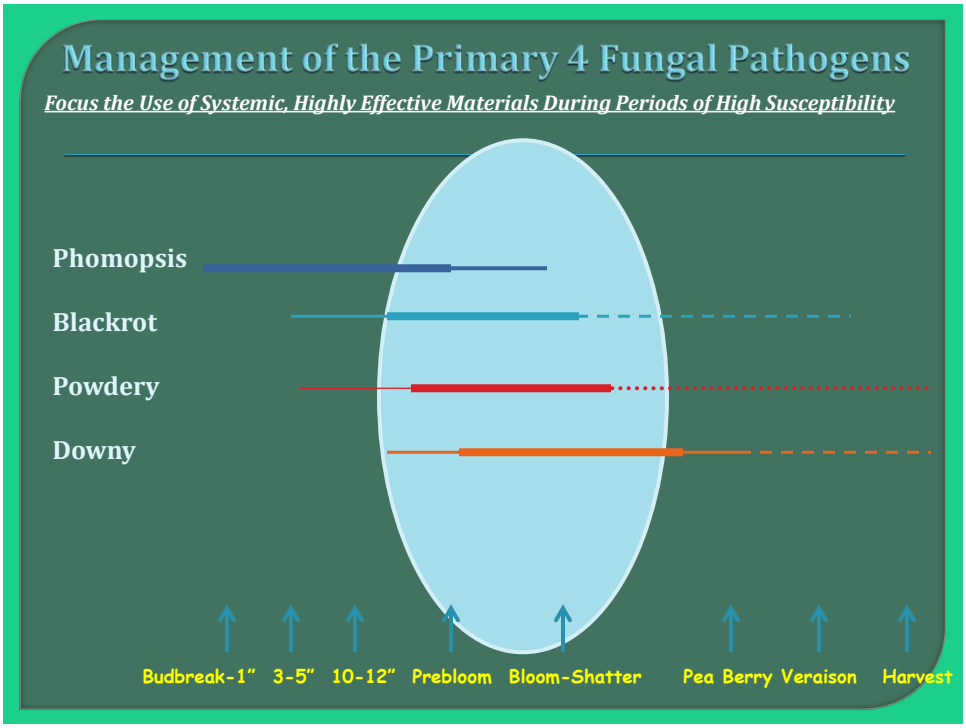
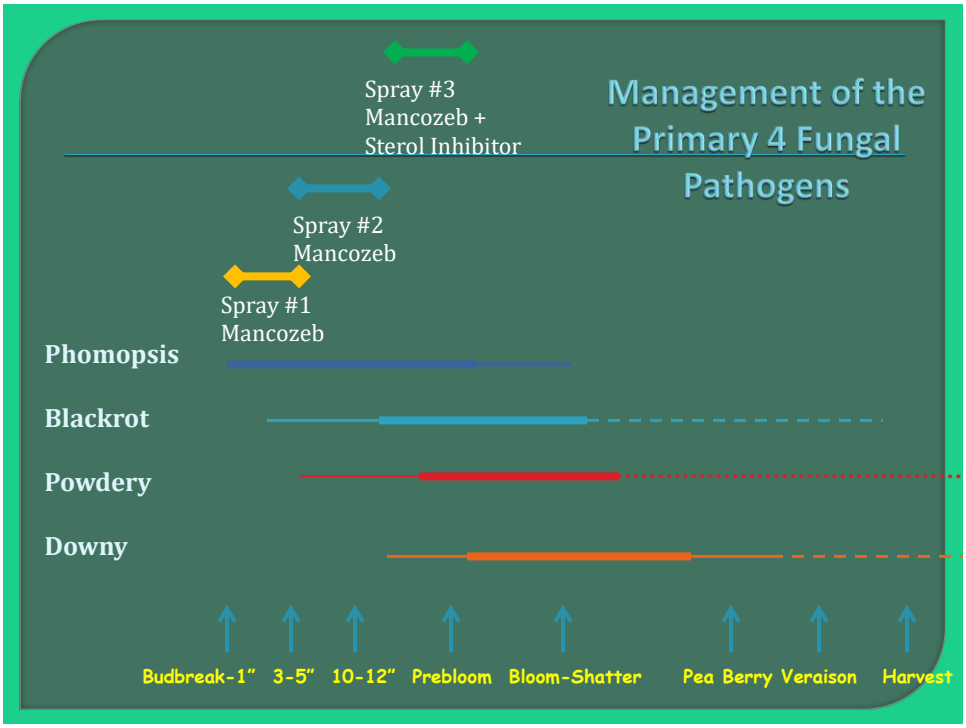
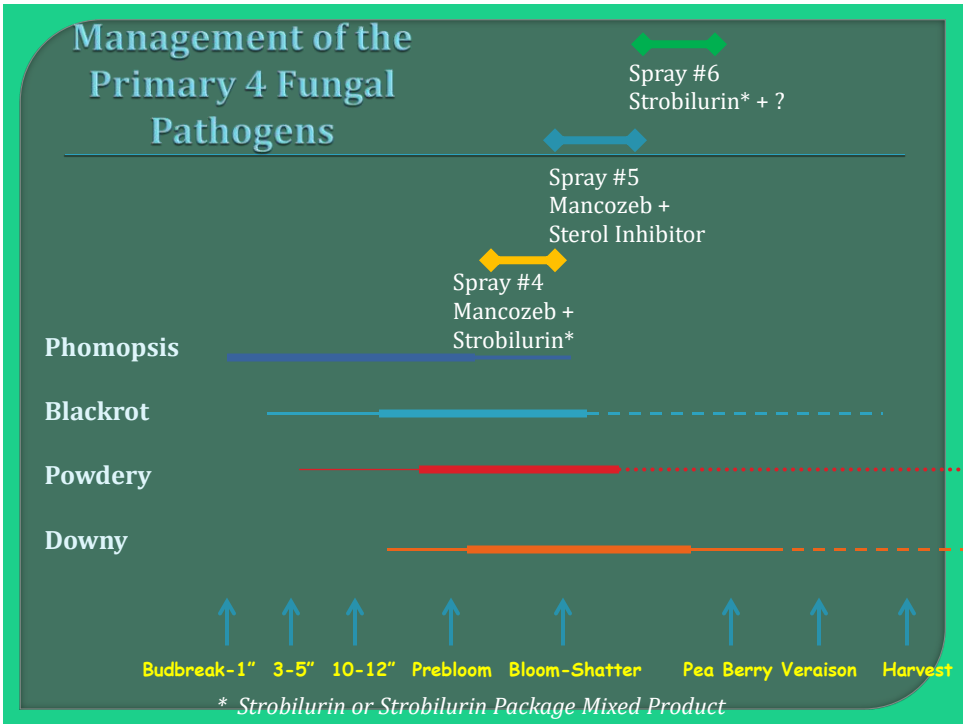



Management of the Primary 4 Fungal Pathogens
Spray #3 Mancozeb + Sterol Inhibitor
Spray #2 Mancozeb
Spray #1 Mancozeb
Phomopsis
Blackrot
Powdery
Downy
Budbreak-1"
3-5"
10-12"
Prebloom
Bloom-Shatter
Pea Berry
Veraison
Harvest


Management of the Primary 4 Fungal Pathogens
Spray #6 Strobilurin* + ?
Spray #5 Mancozeb + Sterol Inhibitor
Spray #4 Mancozeb + Strobilurin*
Phomopsis
Blackrot
Powdery
Downy
Budbreak-1"
3-5"
10-12"
Prebloom
Bloom-Shatter
Pea Berry
Veraison
Harvest
* Strobilurin or Strobilurin Package Mixed Product

Effectively Applying Fungicides

- #1 Leading Cause of Spray "Failure" is Poor Coverage
- Fungicide Efficacy Usually Tested With 100 gpa Water Rates

- And If You Are Thinking About Putting in a Vineyard….