Dealing with Apple Summer Diseases in the Mid-Atlantic region

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Apple Diseases

- Summer diseases are part of a broad spectrum that requires successful season-long management
- Early season
  - Scab
  - Mildew
  - Rusts
  - Fire blight
- 'Summer' diseases
  - Brooks spot, black pox
  - Sooty blotch / fly speck
  - Rots (frogeye leaf spot/black rot, bitter, white, others)
  - Glomerella leaf spot; maybe as early as May 1?
  - Alternaria leaf blotch (Red Delicious)

2nd cover as a transition spray
(4 weeks after petal fall)

- Try to control every disease early in its season
- Scab should have been controlled earlier
- Any additional rust infection inconsequential
- Mildew active till growth stops on susceptible cvs.
- Summer disease activity increases

  - Brooks spot infection
  - Glomerella and Alternaria leaf blotch are active
  - Sooty blotch and fly speck at ~250 accumulated wetting hours starting 10 days after petal fall
  - Rots (frogeye leaf spot/black rot, bitter, white, etc.)
  - 77-day PHI for EBDC's. Use as allowed for summer diseases on late ripening cultivars

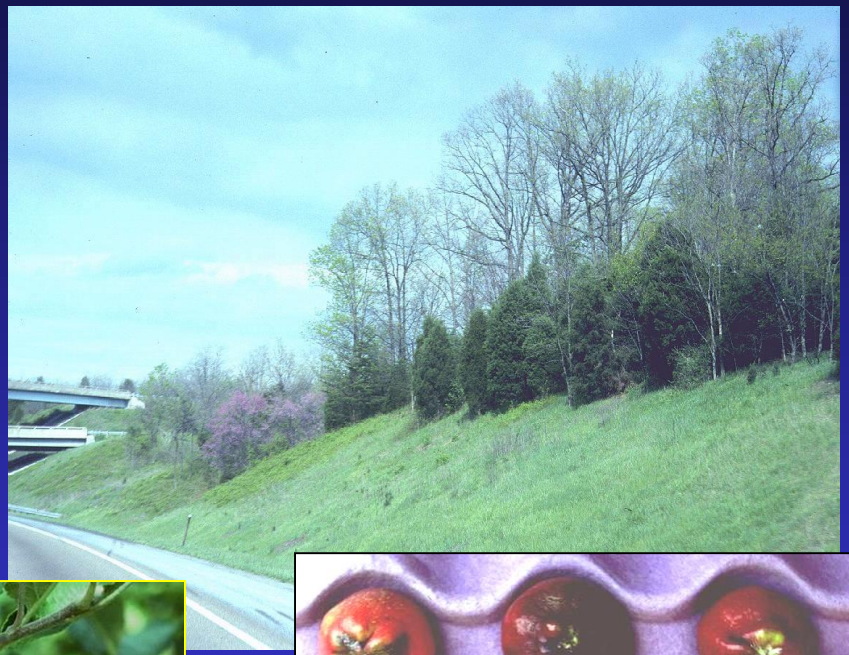
Scab

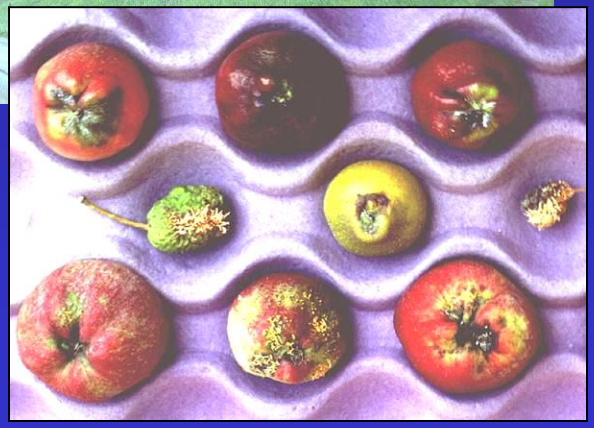
- Leaf symptoms
- Fruit symptoms

- **Cracking promotes fruit rots**
- Resistance to SIs, QoIs
- SDHI sensitivity?
- **Impact on season-long fungicide selections?**

Rusts

- Local disease pressure
- Alternate host- red cedar
- Control with SIs,
  EBDCs, ziram
- **QoIs, SDHIs not very effective**



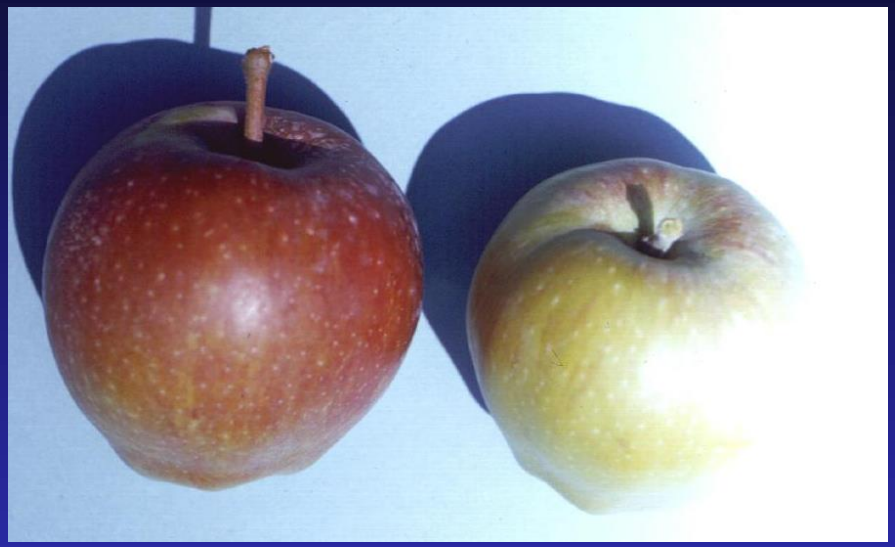


Fire blight

- Overwinters in cankers in tree
- Primary blossom infection during warm weather and wetting during bloom
- Use streptomycin at bloom as needed, based on risk
- Hailstorms, etc. in May-June, aggravate secondary epidemics
- **Dead twigs and fruit mummies in the tree can become a rot inoculum source within six weeks after fireblight infection**

Moldy core

- Premature ripening of fruit
- Mostly on Red Delicious
- Caused by as many as 14 different wet weather fungi
- Control with broad spectrum fungicides from early bloom to 2nd cover



Frogeye leaf spot / Black rot

Fig. 22. Frogeye leafspot, caused by the black rot fungus, on 'Delicious' leaves. (Courtesy T. B. Sutton)

- Infection as early as pink, on flower petals
- Can appear sooner than scab
- Symptoms often close to inoculum source (mummies, dead twigs, etc. or brush pile)
- Requires good protectant program from spring to harvest

Fig. 23. Pimplelike lesions characteristic of apple black rot on a young 'Golden Delicious' apple. (Courtesy T. B. Sutton)

Fig. 24. Black rot lesion on the calyx end of a 'Golden Delicious' apple. (Courtesy T. B. Sutton)

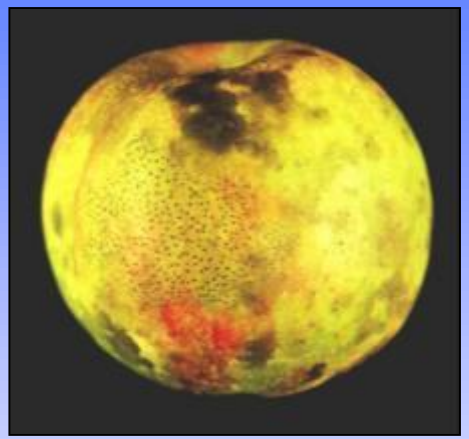
Brooks spot

- Wet weather fungus
- Shallow spots, mostly on sepal end of fruit
- Dark green spot on green fruit; purple on red fruit

- Infection occurs at 2nd cover; shows up in mid summer
- Control with EBDCs, Topsin M, captan, ziram, and strobilurins (Flint and Sovran and newer combinations).
- Cameo very susceptible

Sooty blotch and flyspeck

- Different fungi (>60 species); often appear together on the same fruit; (but no fungicide resistance yet)

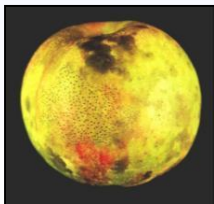


- Wild blackberry and other waxy barked plants are alternate hosts

  Develop in relation to accumulated wetting hours after petal fall; 250 AWH action threshold

- AWH accumulation in an orchard is correlated to elevation; (scout lower areas first)

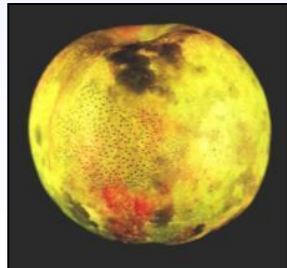
Wetting hour accumulation related to elevation, Virginia Tech AREC 2015-16



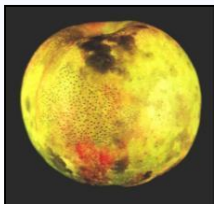
Wetting hour accumulation at Virginia Tech AREC

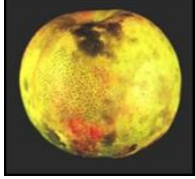
Elevation (ft)	Accumulated wetting hours, starting 10 days after petal fall (14 May)							
	2015				2016			
	1 Jun	24 Jun	27 Jul	31 Aug	1 Jun	20 Jun	18 Jul	30 Aug
983	98	256	444	576	116	218	341	511
952	103	288	486	673	128	248	419	675
909	150	368	687	973	172	257	555	901
	Acc. hr /ft of elevation 31 Aug= 5.5				Acc. hr /ft of elevation 30 Aug= 5.4			

AWH accumulation is related to elevation;
(may differ some with wetting due to rain vs. dew)



Wetting hour accumulation and SBFS symptoms
Virginia Tech AREC 1999-2000





Summer disease incidence on NE-183 cultivars in relation to harvest date and accumulated wetting hours, 1999 vs. 2000. Virginia Tech AREC, Winchester VA

	1999						2000				
Cultivar	harv. date	wet hours	sooty blotch	fly speck	rots	Cultivar	harv. date	wet hours	sooty blotch	fly speck	rots
Pristine	7/29	290	0	0	0	Pristine	7/17	489	26	12	0
Sunrise	8/12	307	0	0	0	Sunrise	8/3	646	54	12	2
Ginger Gold	8/16	321	0	0	0	Ginger Gold	8/11	721	100	18	34
Sansa	8/18	325	0	0	0	Sansa	8/11	721	20	1	1
Arlet	8/30	419	0	0	0	Arlet	8/21	768	37	1	0
Honeycrisp	8/30	419	0	0	0	Honeycrisp	8/21	768	71	17	15
Golden Sup.	9/8	489	8	2	0	Golden Sup.	8/21	768	83	12	12
NY 75414-1	9/9	498	0	0	0	Fortune	9/5	912	100	98	30
Pioneer Mac	9/9	498	6	2	0	NY 75414-1	9/5	912	93	73	12
Senshu	9/15	533	48	30	0	Senshu	9/5	912	100	81	13
Yataka	9/27	609	24	14	0	Pioneer Mac	9/5	912	100	76	1
Creston	9/27	609	38	20	0	G. Delicious	9/8	936	100	78	46
Fortune	9/27	609	20	0	2	Braeburn	9/29	1088	100	34	12
G. Delicious	10/1	653	52	10	26	Yataka	9/29	1088	100	39	31

Five reps. Cumulative wetting hours as rainfall or dew starting ten days after petal fall.

Some earlier varieties escaped SBFS/rot infection in 1999, but most were infected in 2000.

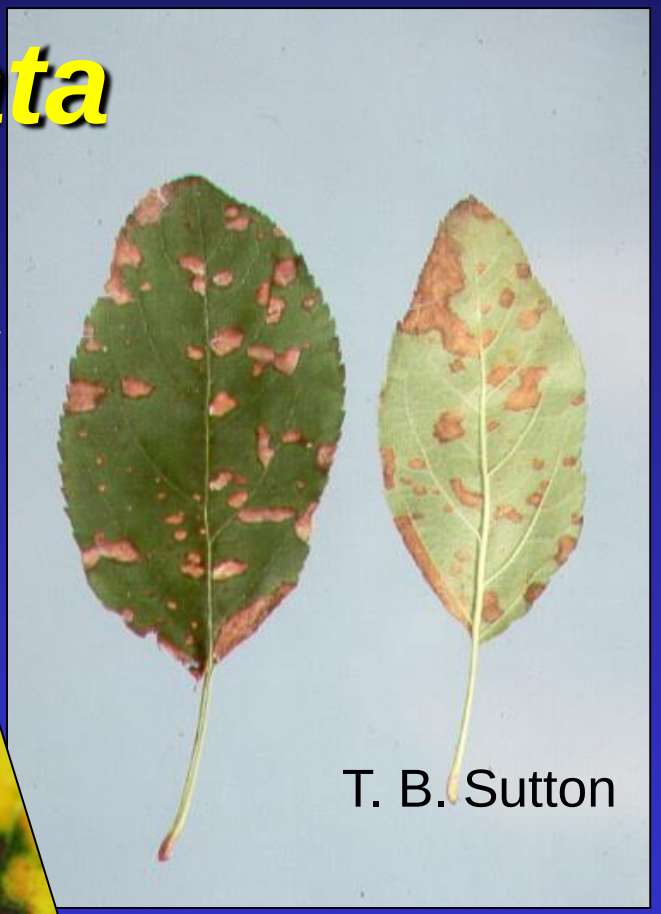
Alternaria leaf blotch

- Can cause severe defoliation and poor Red Delicious fruit quality
- Aggravated by mites
- Improved control by Sovran and Flint - start in late May
- Increased potential for resistance? No more than 4 apps./yr
- Break up schedule with other fungicides (Captan + ProPhyt)
- PHI's: Sovran – 30 days;
  Flint/ Luna S.- 14 days
  Pristine/Merivon- 0 days

Glomerella leaf spot

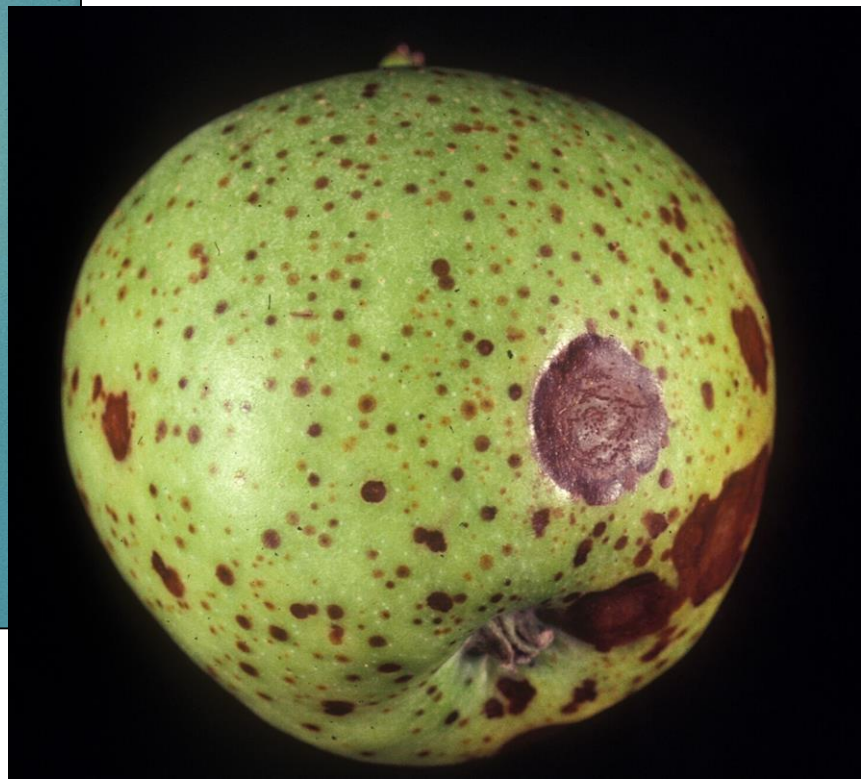
Glomerella cingulata

Typical early GLS
← symptoms on Gala→



Probably secondary enlargement and concentric rings caused by other fungi→

Glomerella fruit spot symptoms

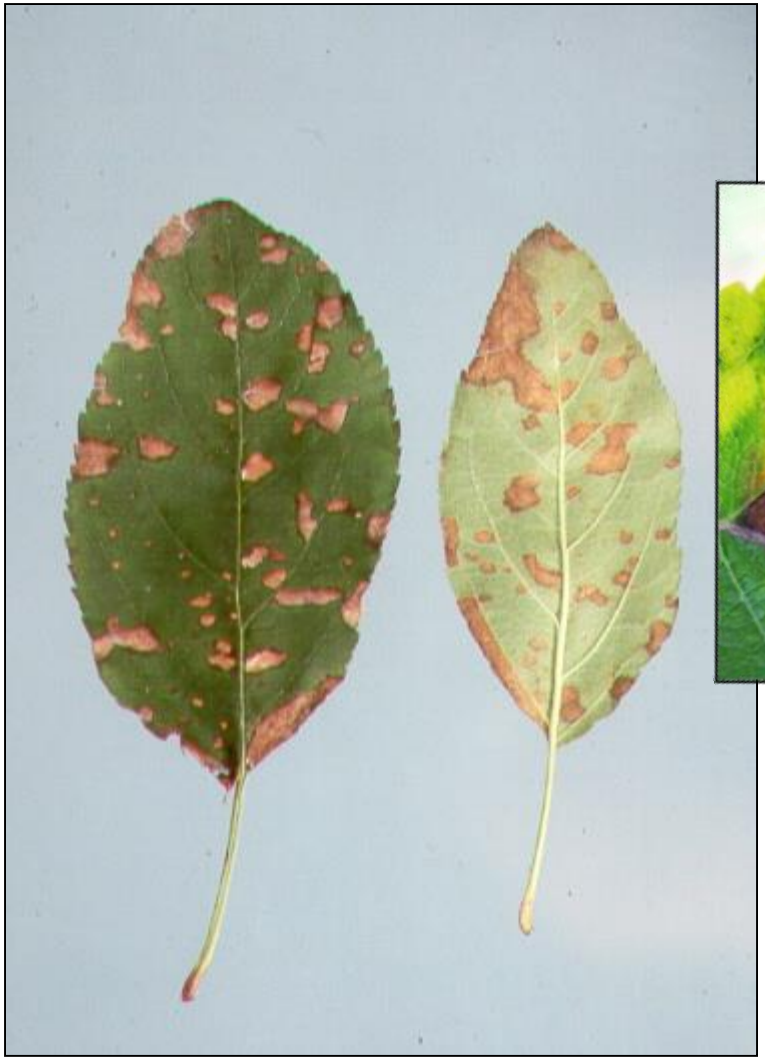


Some lesions look like typical bitter rot;
others remain small


Glomerella Susceptibility
Golden Delicious vs. Red Delicious

M. Saunders

Glomerella leaf spot

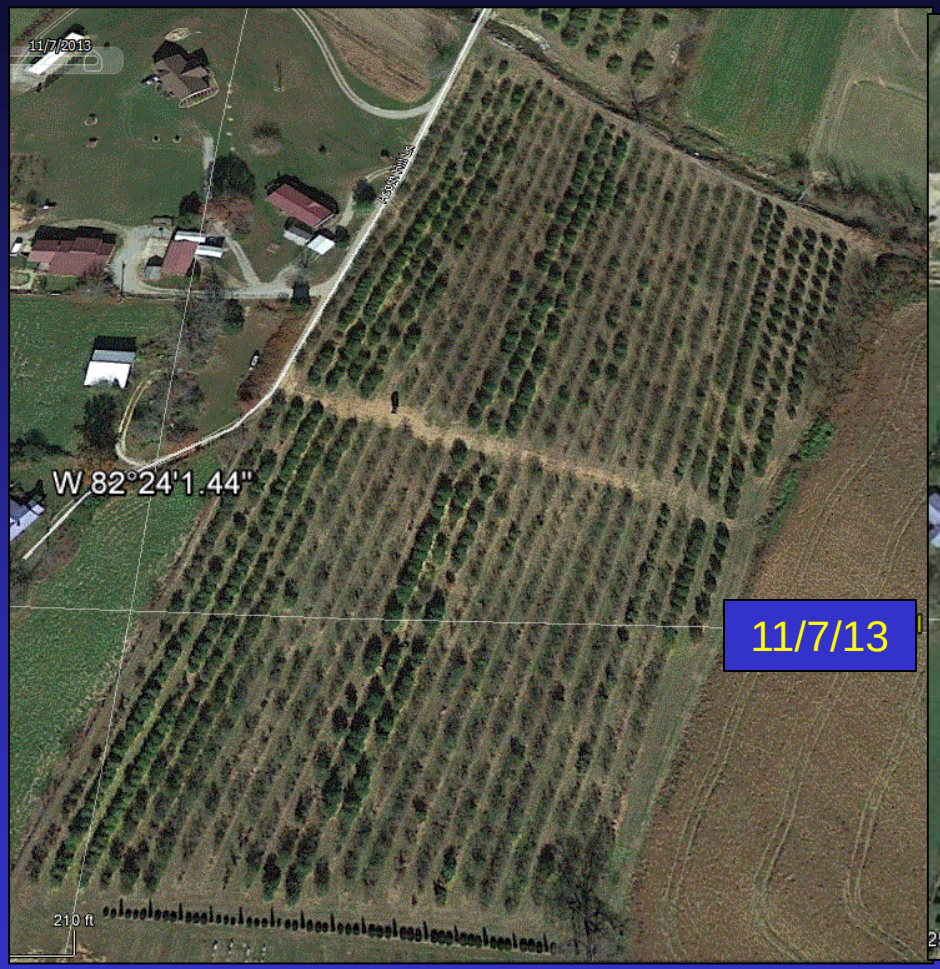


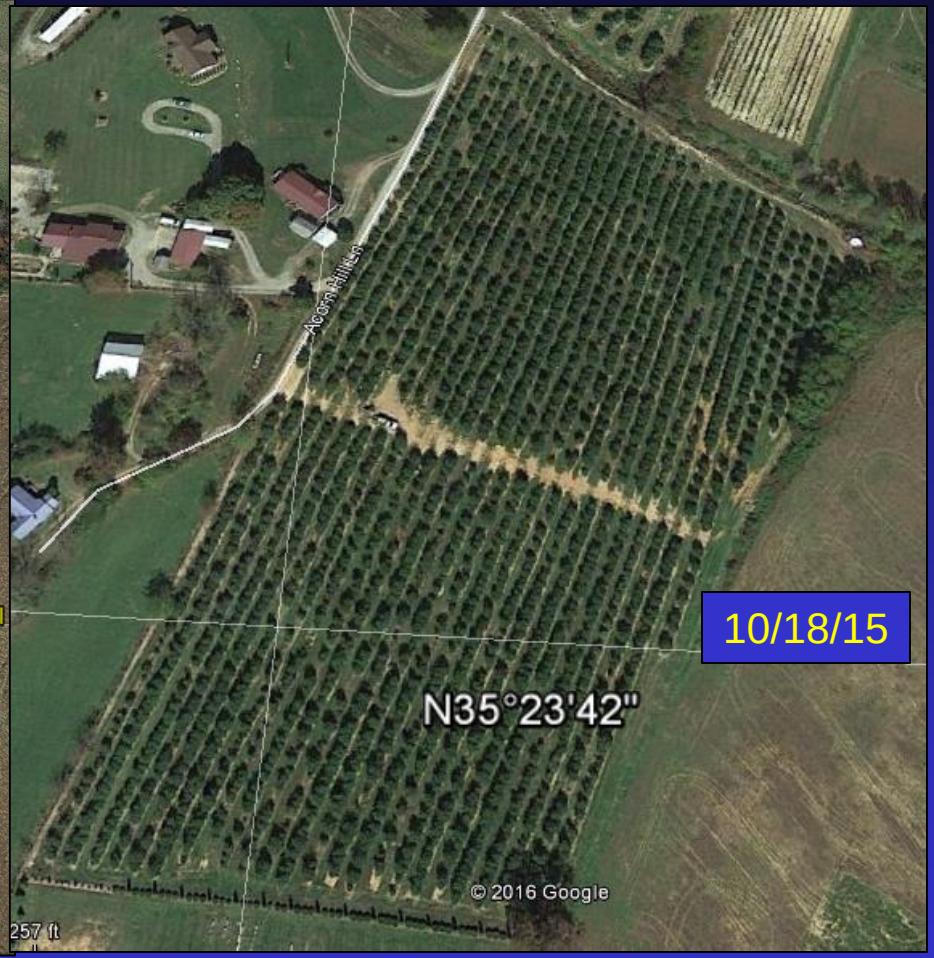
Necrotic leaf blotch

- Typically affects older leaves on Golden Delicious shoots
- Suppress with EBDCs, Ziram, or ZnO spray

Can occur on the same leaf on Golden Delicious

NC Glomerella test site, 2014





Defoliated trees in Nov 3 2013 (left) were Gala; ones with foliage were either Fuji or Ginger Gold. Better control / less problem Oct 18 2015.

Rots

Bitter rot

- Warm wet weather fungus (70°F+)
- Can appear as early as June
- Can cause serious fruit drop (Granny)
- Requires a good protectant program from early summer to harvest
- Thiophanate methyl ineffective

Peach anthracnose

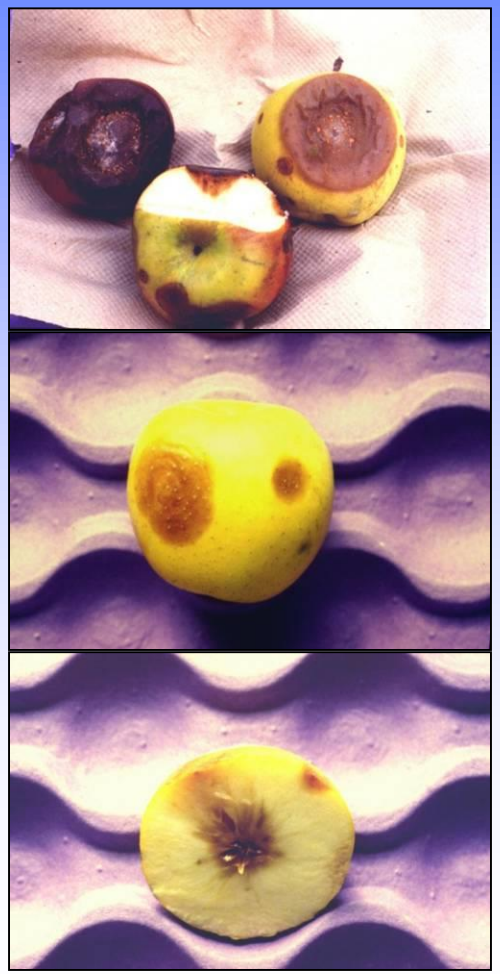
- Caused by *Colletotrichum*, the same fungus that causes bitter rot on apples
- Note concentric rings and low growing fungus (compared to brown rot)
- Recommended fungicides: Captan, Pristine/Merivon
- QoI resistance confirmed by Schnabel et al in SC

Rot identification

- Bitter rot identified by pinkish spore masses and cone-shaped growth into the fruit; V-shaped lesion in cross-section.

- Botryosphaeria (white or Bot rot), left, on Golden Delicious; bitter rot on right.

- Same fruit in cross-section. Bot rot grows as a cylinder to the core; bitter rot as a cone.



White or Bot rot

- Often starts as a red spot

- Progresses into a very mushy rot

- Reduce inoculum levels
- Control with Thiophanate-methyl or Flint, Sovran, or Merivon, Pristine + protectant

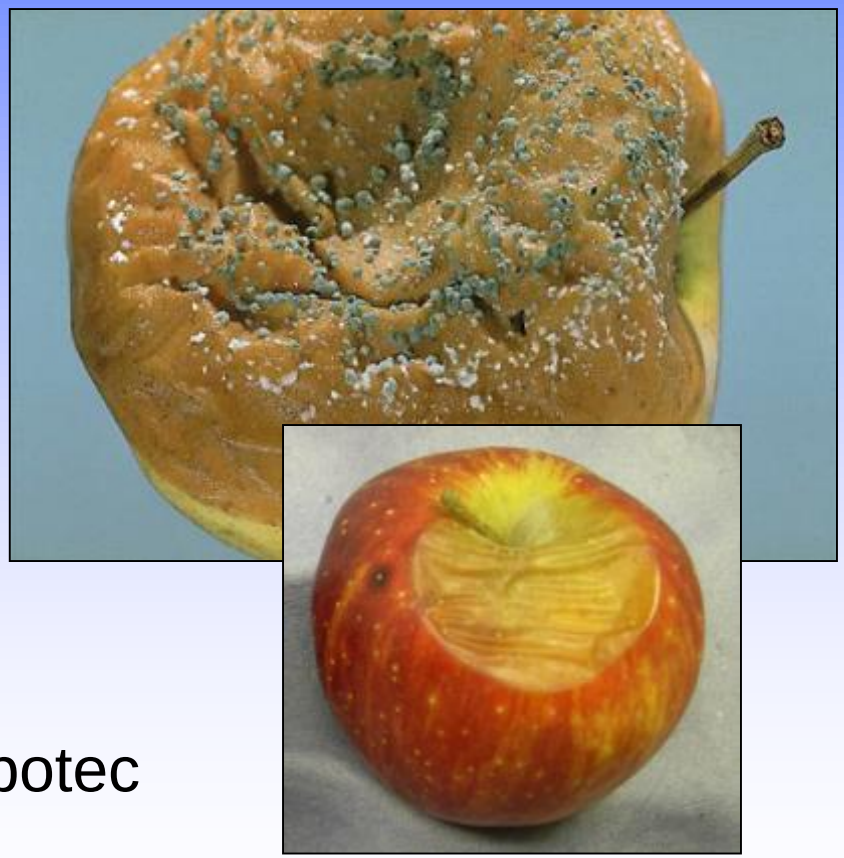
Phomopsis rot

- Usually in the stem end cavity; shows up during storage

- Note gas pocket caused by production of carbon dioxide
- Control with general broad spectrum protectant program through late season
- May have 10-25% of non-treated fruit infected

Blue mold

- Common drench tank, storage and packing house contaminant
- Often resistant to fungicides
- Sanitation is essential
- Two newer fungicides registered for control- Scholar and Penbotec
- Resistance now reported to Penbotec



Timing for summer disease management

- (Early season diseases)
  scab, rusts, mildew, fire blight
- Brooks spot, black pox: 2nd - 4th cover
- Sooty blotch/flyspeck: approx. 2nd cover- harvest
- Black rot: pink - harvest
- Bitter rot: 2nd cover- harvest
- White rot (Bot rot): 2nd cover- harvest
- Alternaria leaf blotch: 3rd cover - late covers
- Glomerella leaf spot: ~May 15?
- Blue mold and Alternaria rot, etc.: pre-harvest and in storage

Improved Cultural Practices for Better Summer Disease Management

1. Prune trees to improve spray coverage and shorten drying time. Includes removing and keeping vines out of the tree.
2. Disease inoculum reduction:
   - Remove prunings, cankers, dead wood from the trees.
   - Remove fruit mummies from the trees when feasible. (Remove mummies separately after pruning).
   - Control fireblight to reduce fruit rot fungus build-up on cankers. Recognize blighted shoots as a warning to tighten the spray interval.
   - Where feasible, remove alternate hosts (brambles, honeysuckle, etc.) from areas inside the orchard.

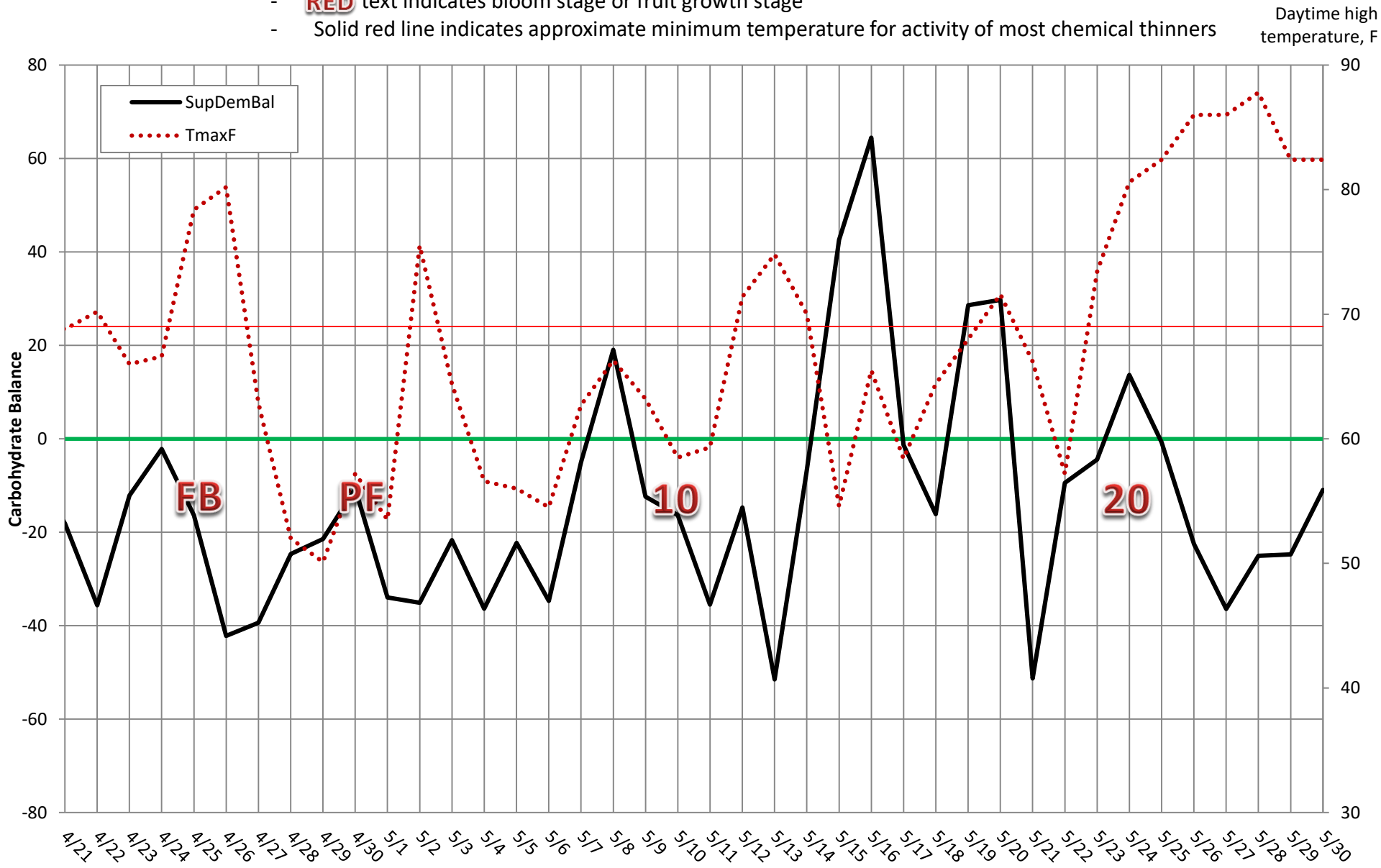
Improved Cultural Practices for Better Summer Disease Management

3. Avoid thinning with NAA or 6BA under cool conditions that cause pygmy fruit retention on cultivars such as Honeycrisp, Golden Delicious, spur Reds, Gala, Fuji and Granny Smith.

“Thinning mummy” - a source of rot inoculum

2016 Apple Chemical Thinning Season

- RED text indicates bloom stage or fruit growth stage
- Solid red line indicates approximate minimum temperature for activity of most chemical thinners



Applying NAA/6BA at temperatures below the red line may cause more pygmy fruit and potential rot inoculum sources!

J. Schupp, PSU, 2016

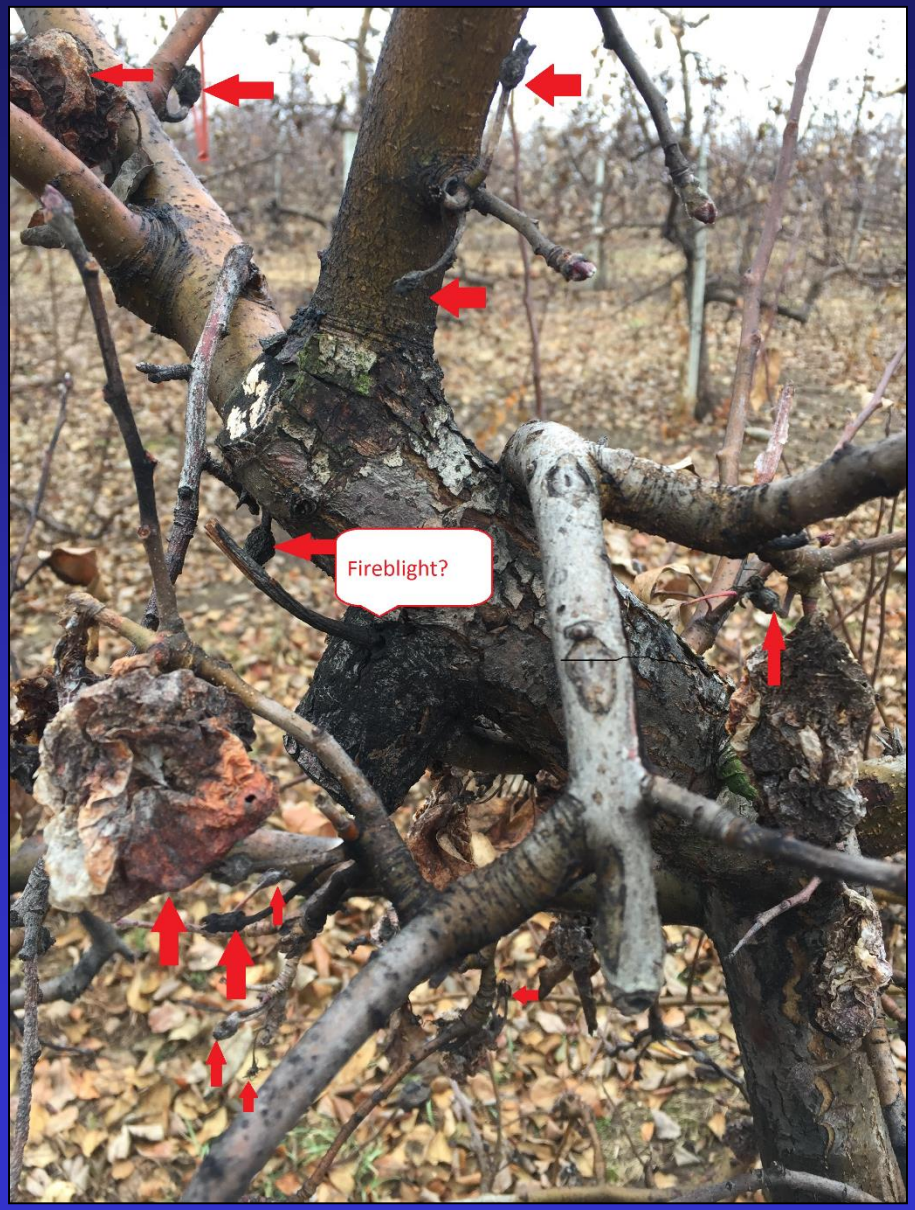
Honeycrisp mummies

Mummies from fire blight inoculations

Quince rust mummies

Various inoculum sources on Honeycrisp

Various inoculum sources on Honeycrisp



Improved Cultural Practices for Better Summer Disease Management

3. Avoid thinning with NAA or 6BA under cool conditions that cause pygmy fruit retention on cultivars such as Honeycrisp, Golden Delicious, spur Reds, Gala, Fuji and Granny Smith.
4. Optimize tree nutrition to improve wound and canker healing, thereby reducing rot inoculum sources.
5. Use calcium sprays to control cork spot to reduce bitter rot build-up on affected fruit and subsequent spread to healthy fruit (especially Red Delicious, York and Honeycrisp).
6. Prevent insect damage to reduce fruit susceptibility to rots.

Improved Cultural Practices for Better Summer Disease Management

7. Scout disease-prone areas regularly and frequently.
   Some orchard areas tend to have chronic problems.
   Some areas may have a likely inoculum source. Sooty blotch and flyspeck usually appear first as light symptoms in lower, foggy areas.
8. Try to stay ahead of problems common to some cultivars:
   - Sooty blotch is easiest to detect on Golden Delicious.
   - Some cvs. weigh down under a heavy crop load late in the season, making thorough spray coverage difficult.
     Try to maintain better control through early summer months to compensate for this problem later.
     Examples: Rome, Granny Smith

Apple summer diseases

An IPM Program for Summer Diseases of Apple

- Disease concerns
- Management considerations
- Season-long disease spectrum
- Fungicides and control
- Determines long-term fungicide needs
- (and fungicides' useful longevity)

Some classes of apple fungicides at risk for development of resistance

Chemical class	Compound	Trade name(s)
Strobilurin (Qol) (Group 11)	kresoxim-methyl	Sovran
	trifloxystrobin	Flint
	pyraclostrobin + boscalid (not a strobilurin)	Pristine
Carboxamide (SDHIs) (Group 7)	boscalid + pyraclostrobin (not a carboxamide)	Pristine
	penthiopyrad	Fontelis
	fluopyram + trifloxystrobin	Luna Sensation
	fluopyram + pyrimethanil	Luna Tranquility
	fluxapyroxad + pyraclostrobin	Merivon
	benzovindiflupyr	Aprovia
Benzimidazole	thiophanate-methyl	Topsin M
Guanidine	dodine	Syllit, Cyprex
Sterol inhibitors (SI, DMI) (Group 3)	fenarimol	Rubigan
	myclobutanil	Rally (Nova)
	triflumizole	Procure
	fenbuconazole	Indar
	difenoconazole	Inspire Super
	flutriafol	Topguard
(Group 9)	pyrimethanil	Scala, Penbotec
	cyprodinil + difenoconazole	Inspire (Super)

http://pubs.ext.vt.edu/456/456-419/456-419.html (See pp. 36-37, 2017)

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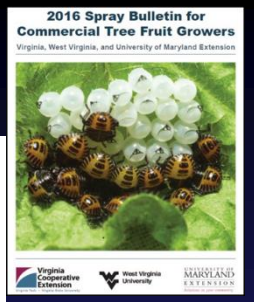


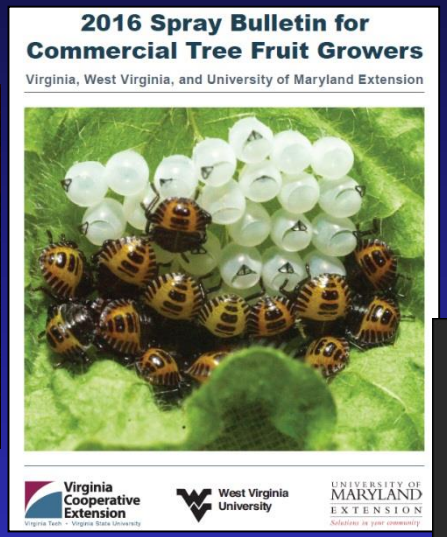
Table 6. Effectiveness of Apple Fungicides (cont.)

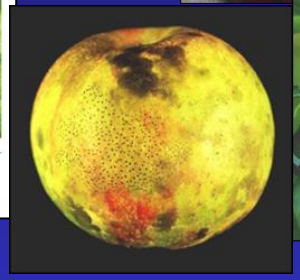
Fungicide	Rate/100 gal dilute	Scab	Powdery Mildew	Rusts	Brooks Spot	Black Rot	White Rot	Bitter Rot	Sooty Blotch & Fly Speck	Fruit Finish: Golden Delicious	Fruit Finish: Red Delicious
Procure 50WS+ Ziram 76DF	3 oz + 1 lb	E[1]	G	E	F	-	-	-	-	G	G
Rally 40WSP + Captan 50W	1.25 oz 1 lb	E	E	E	F	-	-	-	-	G	G
Rally 40WSP+ Mancozeb 75DF	1.25 oz + 1 lb	E	E	E	G	-	-	-	-	G	G
Rally 40WSP + Polyram	1.25 oz + 1 lb	E	E	E	F	-	-	-	-	G	G
Rally 40WSP + Ziram 76DF	1.25 oz + 1 lb	E	E	E	F	-	-	-	-	G(?)	G(?)
Scala 5SC + Mancozeb 75DF	5 fl oz/A 3.2 lb/A	G	N	F	-	-	-	-	-	G(?)	G(?)
Serenade Max	1-3 lb/A	S	F	F	F	-	-	-	S	F	F
Sovran 50WG + Mancozeb	4.0 oz/A 3lb	E	G-E	F-G	G-E	?	G	G(?)	E	G	G(?)
Stylet Oil	1-2 gal	F	F	F	F	-	-	-	S	F	F
Sulfur	2-3 lb	F	G	N	N	N	N	N	S	G	F
Sulfur	5 lb	G	G	N	N	N	N	N	S	F	F
Syllit 3.4F	8 fl oz	E	N	N	F	N	N	N	F	F	G
Topguard 1.04SC + Captan 50W	3.2 fl oz + 1 lb	G	E	E	-	-	-	-	-	-	-
Topguard 1.04SC + Mancozeb 75DF	3.2 fl oz + 1 lb	G	E	E	-	-	-	-	-	-	-
Topsin-M 70W + Captan 50W	2-3 oz + 1 lb	?[1]	G	N	E	E	E	F	E	G	G
Topsin-M 70W + Mancozeb 75DF	2-3 oz + 1 lb	?[1]	G	F	E	G	G	G	G	G	G
Topsin-M 70W + Polyram 80DF	2-3 oz + 1 lb	?[1]	G	F	E	G	G	G	G	G	G
Topsin-M 70W + Ziram 76DF	2-3 oz + 1 lb	?[1]	G	F	G	G	G	F	E	G	G
Vangard 75WG+ Mancozeb 75DF	3 oz/A+ 3 lb/A	G	N	F	-	-	-	-	-	G?	G?
Ziram 76DF	2 lb	F-G[2]	N	G	G	F	F	G	G	G	G

E = excellent; generally good disease control under heavy disease pressure; G = good; good control under moderate disease pressure; F = fair; fair control under moderate disease pressure; S = slight; some control under light disease pressure; N = none; little or no effect on indicated disease; (?) [illegible] not applicable

Fungicide options?

Questions/comments???





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