

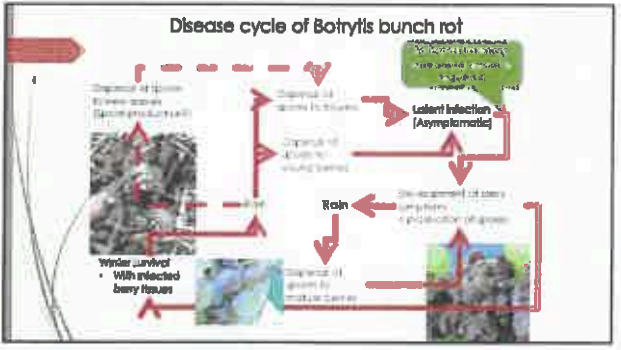
Diagnosis and Management of Late Season Fruit Rots

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Botrytis Bunch Rot





Botrytis Management

- Call for specific B.M. control tactics from one research article
- Good at questions/Conduct management
- U.S. primary event (13th in a field associated with disease development)
- Cluster management and response to protect reduce crop volume (e.g., control of flower buds and fruit) control
- Management of primary infection (e.g., in the canopy and fruit) management (with dual/triazole/sterol inhibitor)

Bottom line for Botrytis management Timing of fungicide application

- Pre-bloom: **Powdery mildew** management
- At bloom: protect flowers with one of Botrytis fungicide
- Post bloom: the major spray timings are at bunch closure (the last opportunity to deliver fungicides inside of the cluster) and at veraison (spore availability)
- Injury management (GBM, Birds)

Botrytis Management Preventative fungicide options

- Group 2: triazole (EPR12, Mafes)
- Group 7: SDHI, oxadiazole (EPR12, Mafes)
- Group 9: oxadiazole (EPR12, Mafes)
- Group 1: strobilurin (EPR12, Mafes)
- Group 3: azoxystrobin (EPR12, Mafes)
- Group 11: fenhexamid (EPR12, Mafes)
- Group 14: captafol (EPR12, Mafes)

Triazole fungicides are better for control of Botrytis than the others. They had 90% control of Botrytis in the field. The others had 50% control. The experiment was conducted in 2012 and 2013.

Known fungicide resistance issue
Botrytis gray mold (from the Baudoin lab)

Probability of resistance development,	Level of resistance if you find them
Very high risk	High
• Flint (and other Gev. 11)	• Flint
High Risk,	Moderate to high
• Pinot (and other Gev. 11)	• Pinot
Moderate	Moderate
• Cabernet Sauvignon (and other Gev. 11)	• Cabernet Sauvignon
Low to none	Low
• Merlot (and other Gev. 11)	• Merlot

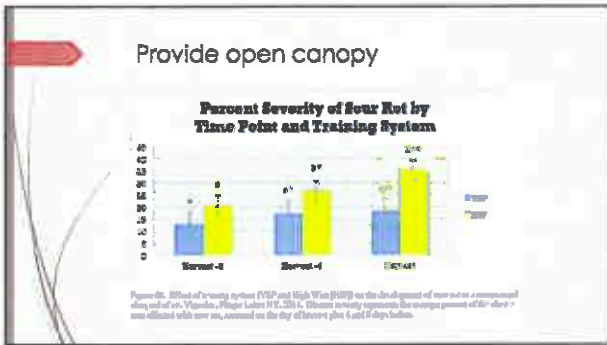
Sour rot



Photo courtesy of Megan Ha!

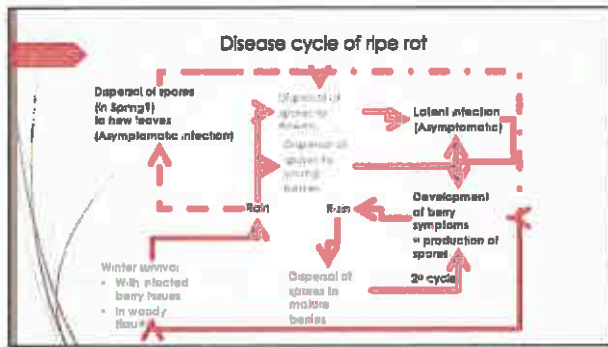
Sour rot management

- Know the signs of sour rot (soft, shriveled, and discolored grapes)
- Harvest early
- Vineyard management
 - Pruning
 - Irrigation
 - Fertilization
- Vineyard sanitation
 - Leaf removal
 - Cluster removal
 - Pruning
- Vineyard hygiene
 - Harvest hygiene
 - Harvest equipment
- Unless otherwise noted, all information provided in "sour rot" section is from research efforts done by Drs. Wayne Wilcox (Corn) and Megan Ha! (U. Missouri)



- ### Use of "fungicide" and an insecticide
- we planned to apply both Conal (fungicide) and Moxidectin (insecticide) at harvest (weekly) and prior to harvest (BIOFOS fungicide) and cover (insecticide) weekly
 - they applied these treatments weekly, however, many had complicated responsibilities (many were off for long weeks)
 - One low application of Moxidectin (2.5 fl oz) resulted in significant reduction

- ### Here's a tentative recommendation against sour rot (subject to be changed)
- Application of either Conal or Moxidectin at harvest (HW)
 - Application of Conal at harvest (HW) and Moxidectin at harvest (HW) and prior to harvest (BIOFOS fungicide) and cover (insecticide) weekly
 - Application of Moxidectin at harvest (HW) and prior to harvest (BIOFOS fungicide) and cover (insecticide) weekly
 - Add fungicide at harvest (HW)
 - Delay the combined application of Moxidectin and Moxidectin by either Conal or BIOFOS
 - Consider the use of Moxidectin at harvest (HW) and prior to harvest (HW)



Ripe rot trials 2015-17

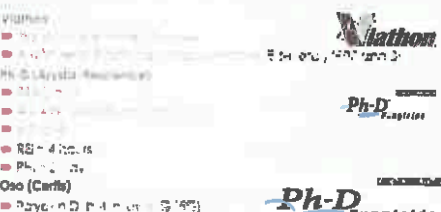
- 4 locations: Winchester, VA (ARCS), Abingdon VA (Southwest VMU)
- 3 treatments: 1) no fungicide (control), 2) fungicide (A), 3) fungicide (B)
- 2 replicates per treatment per location per year
- 2 harvests: one in the green berry period and one in the ripe berry period (Sept/Oct)
- Treatments were applied at:
 - 1) 1st harvest
 - 2) 2nd harvest

Newer fungicides tested in ripe rot trials SDHIs

- Aprovia (Syngenta)**
 - SDHI (FRAC = 7)
 - A.I. = benzovindiflupyr
 - FR = 17 days
 - PH = 51 days
- Miravis (Syngenta)**
 - SDHI (FRAC = 7)
 - A.I. = Pyraclostrobin
 - FR = 14 days (2015) and 19 days (2016)
 - PH = 51 days (2015) and 51 days (2016)

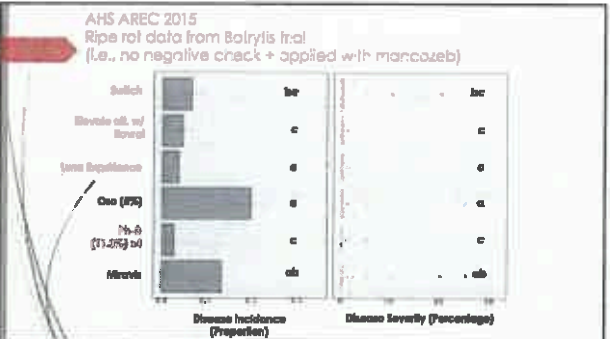
Newer fungicides tested in ripe rot trials DMI and PolyoxIn-D

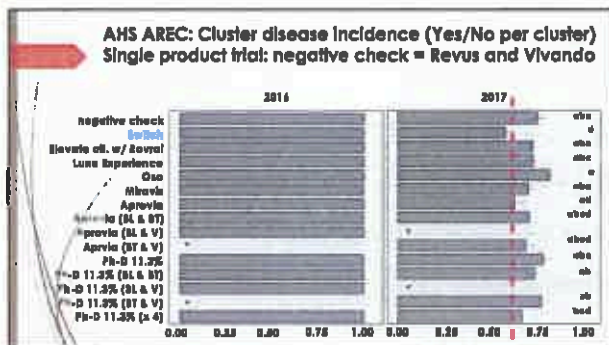
- Vitalon
- Ph-D (Carlis)
- PolyoxIn-D (Carlis)

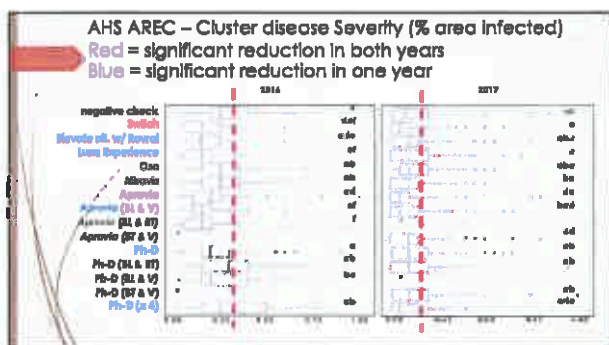


AHS AREC Spray Program

Year	Fungicide	Rate	BL	BT	V
2015	cyproconazole + iprodione	Switch® 62.5 WG	9.12	BL	BT, V
	fenhexamid etc. w/ iprodione	Elevate® 50 WDG & Korval®	17.2	BL	BT, V
	fluspyron + tebuconazole	Luna® Experience	7.5	BL	BT, V
	polyoxin-D	Oso™ SWS	19	BL	BT, V
	polyoxin-D	Ph-D®	19	BL	BT, V, LM
2016	pydiflumetofen	Miramis®	7	BL	BT, V
	benzovindiflupyr	Aprova®	7	BL	BT, V
2017	benzovindiflupyr	Aprova®	7	BL	V
	benzovindiflupyr	Aprova®	7	BT	V
	polyoxin-D	Ph-D®	19	BL	BT, V
	polyoxin-D	Ph-D®	19	BL	BT
	polyoxin-D	Ph-D®	19	BL	V







AHS field trial summary

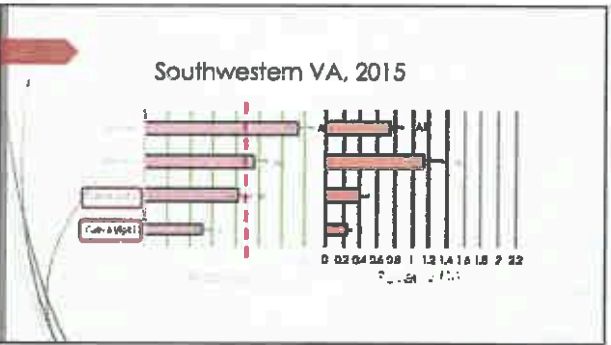
- 24 Round 1 Agrevia trials conducted in 2014 and 2017
- 24 Round 2 Agrevia trials conducted in 2014 and 2017
- Ph-D was not promising in 2014, but showed results in 2017 when it was applied with miravis
- Agrevia (alone) has a positive effect on cluster control due to the reduction of Revus

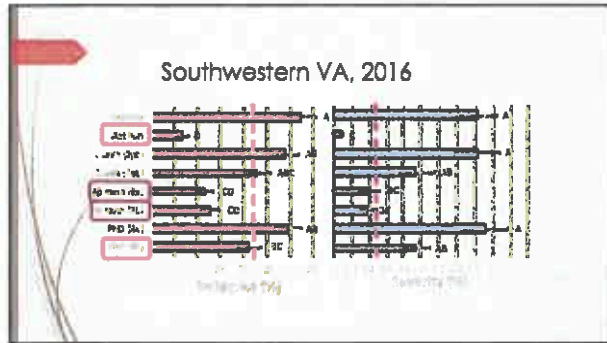
Field Trials

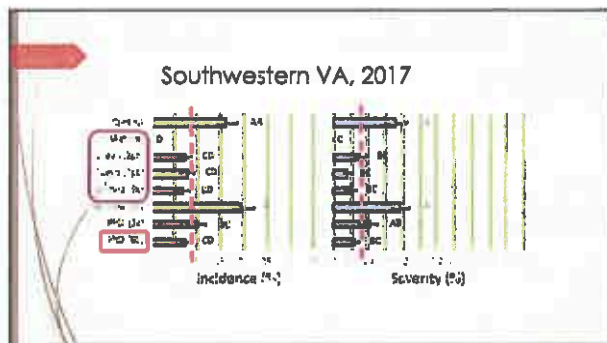
- 1.
2.
 - Treatments were applied in addition to regular fungicide applications
 - Disease assessments were conducted every 2 weeks before harvest
 - A general red near-infrared (GUMVIR) 3A594, was used for ANOVA, adjusting the binomial and normal distribution for non-integer severity response
 - Error SD was used for the mean reports

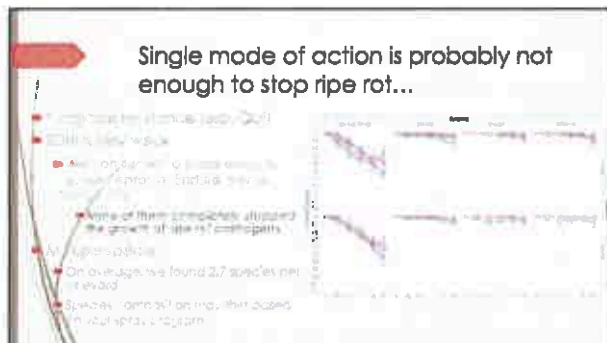
Southwestern VA spray program

ZONE		AGRICULTURE	
Treatment (rate/A, 100 gal)	Timing	Treatment (rate/A, 100 gal)	Timing
Control		Control	
Vitalon (2pt)	IL, ST, V, LM	Vitalon (2pt)	IL, ST, V
Cueva (2pt)	IL, ST, V, LM	Cueva (2pt)	IL, ST, V
Cueva (4pt)	IL, ST, V, LM	Cueva (4pt)	IL, ST, V
		Apronix (9.8 oz)	IL, ST, V
		Apronix (9.8 oz)	IL
		Pril (4.2 oz)	IL, ST, V
		YND (6.2 oz)	IL



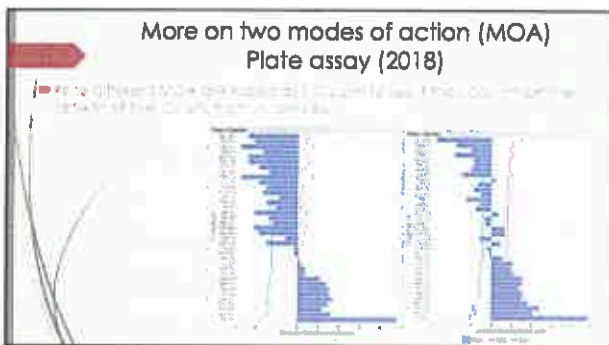






Looking for candidate product to be used in the field; plate assay
Options seem to be limited.

Active ingredient	Infr	C. albicans		EC50 ⁹⁵	Infr	C. glabrata		EC50 ⁹⁵
		EC50 ⁵⁰	EC50 ⁹⁵			EC50 ⁵⁰	EC50 ⁹⁵	
Azoxystrobin	CU	3.7 ^{**}	5.4	472.8 ⁺	probi	3.4 ^{**}	3.4 ^{**}	383.3 ⁺
Benlate	logI	1.9 ^{**}	2.2	NC ⁺	logI	1.8 ^{**}	1.8 ^{**}	NC ⁺
Captan	probi	1.8 ^{**}	1.8 ^{**}	3.0	probi	1.7 ^{**}	1.8 ^{**}	15.6
Copper hydroxide	probi	5.4 ^{**}	-3.3 ^{**}	-23.0	logI	4.0 ^{**}	2.8 ^{**}	91.6
Copper octoate	probi	2.9 ^{**}	-1.7 ^{**}	89.9	logI	3.1 ^{**}	3.1 ^{**}	65.5
Mancozeb	logI	2.5 ^{**}	-21.5	5.8	CU	2.1 ^{**}	4.1 ^{**}	11.2
Trifluoromethyl pyridone	probi	5.1 ^{**}	-2.8 ^{**}	118.9	CU	4.0 ^{**}	11.0 ^{**}	87.7
Fluconazole	CU	4.8	-1.4	1140.9 ⁺	CU	1.1 ^{**}	3.8	7.1x10 ⁹ ⁺
Trifluoromethyl	probi	3.8 ^{**}	-2.4 ^{**}	82.6 ⁺	probi	1.3 ^{**}	-2.2 ^{**}	834.0 ⁺
Benlate+trifluoromethyl	CU	6.2 ^{**}	-0.7 ^{**}	281.4	logI	1.2 ^{**}	4.2 ^{**}	238.5



Summary of 2-MOA plate assay

MOA 1	MOA 2	Fungicide	Fungicide
Azoxystrobin	Mancozeb	Aprevia	Trifluoromethyl
Captan	Tebuconazole	Captan	Tebuconazole
Fluconazole	Tebuconazole	Mancozeb	Mancozeb
Mancozeb	Trifluoromethyl	Mancozeb	Tebuconazole
Abound	Mancozeb	Abound	Mancozeb
Copper	Tebuconazole	Copper	Tebuconazole
Aprevia	Tebuconazole	Aprevia	Tebuconazole
Captan	Prephyt	Abound	Aprevia
Captan	Trifluoromethyl	Captan	Trifluoromethyl
Prephyt	Tebuconazole	Prephyt	Tebuconazole
Aprevia	Captan	Aprevia	Captan
Mancozeb	Polyox-D	Mancozeb	Polyox-D
Captan	Polyox-D	Polyox-D	Polyox-D
Copper	Mancozeb	Copper	Mancozeb
Copper	Captan	Copper	Captan
Abound	Captan	Abound	Captan
Tebuconazole	Trifluoromethyl	Tebuconazole	Trifluoromethyl
Probi	Trifluoromethyl	Probi	Trifluoromethyl

- Mancozeb, Captan, and Trifluoromethyl are commonly included
- Aprevia, tebuconazole and Trifluoromethyl are commonly included
- Copper, Captan, and Trifluoromethyl are commonly included
- Mancozeb, Captan, and Trifluoromethyl are commonly included
- Mancozeb, Captan, and Trifluoromethyl are commonly included

Not all DMI fungicides are equally effective against *Colletotrichum* species...

- For example, Captan and Phos acid are effective against *C. gloeosporioides* but not *C. longicola* or *C. trifolii* and vice versa
- Also observe different patterns of *C. longicola* resistance affecting levels of sensitivity to all tested DMI fungicides
- Thus, more investigation is necessary with our 3A isolates

Summary

- Captan and Mancozeb were effective
 - Plus, Captan effective in the ornamental plant issues
 - Consider sensitivity of some *C. gloeosporioides* to Captan
- DMIs were generally more effective
 - Applying Benzl + Phos acid seems to work in the field, especially in ornamental plant layer of captan issues
 - PhD + Phos acid
- An early DMI application (Phos acid + imazalil) + imazalil top of between seeds and top of soil
 - These values are also DMIs have any effect?
 - How about other DMIs?
- Application of Phos acid + Phos acid + imazalil + suppressed fungal growth only with captan + DMIs
 - How about other DMIs?

Mixing multiple MOA is probably the key for ripe rot management

Mixing patterns for mancozeb, captan or captan + Phos acid (captan + Phos acid + imazalil)

Moderate level of reduction	Low level of reduction	No or limited effect
<ul style="list-style-type: none"> • Aprovia (Boscovinil/Flupyr, FRAC-7) • Cueva (Copper (M1)) • Intuity (mandeshalin, (11)) • Vialthion (Phos acid (33) + tebuconazole (3)) • Switch (cyprodinil (7) + fludioxonil (12)) 	<ul style="list-style-type: none"> • Elevate (fenhexamid (7)) • alt. w/ Ravral (prodiene (21)) • PhD (polyoxin-D (19)) • Luna Experience (flucyprym (7) + tebuconazole (3)) 	<ul style="list-style-type: none"> • Endura (tebuconazole (3)) • Oso (polyoxin-D (19)) • Rally (myclobutanil (3)) • Miravis (Adepidin (7))

The same MOA provided different level of control...

Mixing partners for mancozeb/ziram or coplan (Timing: bloom, berry touch, veraison)

Moderate level of reduction	Low level of reduction	No or limited effect
<ul style="list-style-type: none"> Aprovia (Boscalid/Fluxapyroxazole) (7) Cueva (Copper) (N11) Inlity (mandipropamide) (11) Viathon (phosalone) (11) + Indoxacarb (11) Switch (copper) (11) + Radasent (11) 	<ul style="list-style-type: none"> Elevate (boscalid) (7) all w/ Rovral products (11) PhD (copper) (11) Luna Experience (flupyradifurone) (7) + boscalid (7) 	<ul style="list-style-type: none"> Endura (boscalid) (7) Oso (boscalid) (7) Kally (boscalid) (7) Miravis (Adaptin) (7)

What's next?

Developing

- New MOA's
- (MOC) development

Future

- Use into DR with a partner and field study
- Investigate the use of Cueva and Switch as a mixing partner
- Determine if the partners become active
- MOC

A new online pesticide decision support tool: GrapelPM.org

Currently, it is free for beta testers
Eventually (probably after 2021), the access fee will be charged through the Virginia Vineyard Association

GrapelPM.org current functions

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- USDA NIFA EP Grant (2014)
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- Virginia State University
- Virginia State University