Final Report: Evaluation of fungicide programs for management of Botrytis bunch rot of grapes: 2019 field trials

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University of California Cooperative Extension,
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Report Summary

Bunch rot of grapes caused by *Botrytis cinerea* is a fast-growing pathogen infecting numerous crops of commercial value. Bunch rot leads to a reduction in the yield and quality of table, raisin, and wine grapes, with high economic losses in some locations or years (Flaherty et al. 1992). Botrytis overwinters as sclerotia in mummified berries on the vine or ground or on dormant canes. The disease may first appear as shoot blight following frequent spring rains; flowers can become infected during bloom (Bulit and Dubos 1988). In infected fruits, disease symptoms are latent until late in the season. As sugar concentration increases in the berry, the fungus resumes growth and infects the entire fruit, often resulting in berry splitting and sporulation on the fruit surface (Flaherty et al. 1992). Free water is a requirement for the pathogen, and favorable conditions include humidity's exceeding 90% and temperatures between 15-27° (Bulit and Dubos 1988, Gubler et al. 2008, Steel et al., 2011). Along with leaf removal and other cultural controls, good spray coverage with a synthetic fungicide is currently the most effective form of disease management.

We examined the efficacy of 20 fungicide treatment programs (Table 1) for control of Botrytis bunch rot in Chardonnay grapes at Cuvaison Estate Wines, Walsh Vineyards in Napa in 2019. Materials included synthetic, biological, and organic treatments.

Materials and Methods

A. Experimental design

The field trial was conducted using completely randomized design, with each plot consisting of 2 adjacent vines (6 ft row spacing and 6 ft vine spacing). Each treatment consisted of 5 replicates. Fungicides were applied with backpack sprayers. Unless instructed otherwise (see Table 2 for application history), three applications were made during the growing season: May 29th (bloom), June 26th (prebunch), July 24th (veraison).

Experimental design	Complete randomized block design with 5 replicates.
Experimental unit	2 adjacent vines = 1 plot
Plot area	110 ft2 (row spacing = 6 ft, vine spacing = 6 ft)
Area/treatment	550 ft2 (5 reps x 2 vines = 1 treatment) 0.0126 acre/treatment
Volume water/acre	50 gallons (pre-bloom to pea-sized berries) =0.63 gallons/5 reps 100 gallons (late April,) = 1.26 gallons/5 reps, 150 gallons (late May) = 2.52 gallons/5 reps
Application method	Milwaukee 2820 Backpack Sprayer and custom-made experiment sprayer.

B. Experimental treatments

The treatments described in this report were conducted for experimental purposes only and crops treated in a similar manner may not be suitable for commercial or other use.

Table 1: Experimental fungicide treatments.

Trt. No.	Flag	Treatment Name	Application rate (per acre)	FP/5 Reps (50 ga/a (A) 100 ga/a (B) 150 ga/a (C)	Timing
1	YD	Pyraziflumid SC + DYNE-AMIC	3.1 fl oz + 0.25% v/v	0.6 ml and 5.95 ml (A) 1.2 ml and 11.9 ml (B) 2.4 ml and 23.8 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
2	GKC	Fervent + 0.125 % v/v	8.5 fl oz	1.6 ml (A) 3.2 ml (B) 6.4 ml (C)	14 days
3	RS	Luna Tranquility	14oz	2.6 ml (A) 5.2ml (B) 10.5ml (C)	14 days
4	W	Untreated	-	-	-
5	BC	Luna Tranquility + Syl-Coat	14oz + 4 oz	2.6 ml and 0.75 ml (A) 5.2 ml and 1.5 ml (B) 10.5 ml and 3 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
6	O	HML32	1L/100L	0.06 ml (A) 0.12 ml (B) 0.24 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
7	YKD	NS1	1% v/v	23.8 ml (A) 47.6 ml (B) 95.2 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
8	PU	NS2	1% v/v	23.8 ml (A) 47.6 ml (B) 95.2 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
9	KC	#1: Miravis Prime #2: Elevate,	#1: 13.4 fl oz #2: 1lb #3: 13.4 fl oz	#1: 10 ml #2: 11.2 ml #3: 10 ml (A)	A(Bloom) B(Prebunch) C(Veraison)

		#3: Miravis Prime		#1: 20 ml #2: 22.4 ml #3: 20 ml (B) #1: 30 ml #2: 33.6ml #3: 30 ml (C)	
10	PKC	#1: Switch. #2: Elevate, #3: Miravis Prime	#1: 14 oz #2: 1lb #3: 13.4 fl oz + Add adjuvant 1% v/v	#1: 1.75 ml #2: 2.8 ml #3: 1.75 ml (A) #1: 3.5 ml #2: 5.6 ml #3: 5ml (B) #1: 7 ml #2: 11.2 ml #3: 10 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
11	BS	#1: Miravis Prime #2: Elevate, #3: Switch	#1: 13.4 fl oz #2: 1lb #3: 14 oz	#1: 2.5 ml #2: 2.8 ml #3: 2.5ml (A) #1: 5 ml #2: 5.6 ml #3: 5ml (B) #1: 10 ml #2: 11.2 ml #3: 10 ml (C)	A(Bloom) B(Prebunch) C(Veraison)
12	OKD	Deacon 7 (Part 1,2,3)	10% v/v	Only (C) 348 ml (Part 1), 348 ml (Part 2), 14.2 ml (Part 3) (C)	C(Veraison)
13	YS	GCM	12 fl oz	2.23 ml (A) 4.46 ml (B) 8.92 ml (C)	A(Bloom) B(Prebunch) C(Veraison)

C. Maps

→ NE
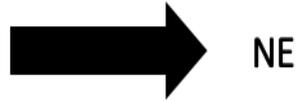
	Rep 1					Rep 2					Rep 3					Rep 4					Rep 5					
4	GS	OKD	X	K	YS	YD	BS	PU	YKD	O	KC	GD	PKS	RS	GKC	PU	GD	O	OKD	KC	YKD	B	BS	RS	W	YKD
3	B	W	YKD	BS	GD	RS	OC	P	PKC	GS	GS	YD	BC	OKD	K	YD	BC	P	KC	PU	YS	O	X	PU	OC	GKC
2	PKS	PKC	PU	RS	BC	GKC	B	X	GD	W	PKS	B	PKC	KC	YS	W	RS	GKC	GS	PKC	WXW	KC	BC	PKSXXPKS	X	X
1	P	KC	OC	O	GKC	K	YD	OKD	BC	YS	OC	BS	P	O	YKD	YS	OC	PKS	B	BS	GS	P	OKD	X	GD	PKC

Row 2 (continued): X | X | X | YD | K

KEY:
X=UNUSED VINE
S=STRIPE
D=DOT
C=CHECKERED
PU=PURPLE
P=PINK
B=BLUE
G=GREEN
O=ORANGE
Y=YELLOW
K=BLACK
W=WHITE

D. Application History: Trial 1

Table 2: Experimental fungicide application history.

Treatment No.	Treatment	May 29	June 26	July 10	July 24
1	Pyraziflumid SC + DYNE-AMIC	x	x		x
2	Fervent + 0.125 % v/v	x	x		x
3	Luna Tranquility	x	x		x
4	Untreated Control	x	x		x
5	Luna Tranquility + Syl Coat	x	x		x
6	HML32	x	x		x
7	NS1	x	x		x
8	NS2	x	x		x
9	Miravis Prime, Elevate, Miravis Prime	x	x	x	x
10	Switch, Elevate, Miravis Prime	x	x		x
11	Miravis Prime, Elevate, Switch	x	x		x
12	Deacon 7 (Part 1,2,3)				x
13	GCM	x	x		x

E. Vine Management

During the application period, vines were irrigated by drip irrigation. Sucker shoot removal and leafing were done during the duration of trial.

F. Data Collection and Statistics

Disease was assessed on October 2nd 2019. Botrytis incidence and severity were assessed in each treatment by evaluating twenty-five random clusters. Incidence was defined as the proportion of clusters in a plot having some living powdery mildew. Severity was determined by estimating the percentage of area of a cluster that was infected; the severity value of all clusters was then averaged to give a plot-wide estimate of disease severity. Mean incidence and severity values for each treatment were computed. Trial models were analyzed using the ANOVA Tests for data. Means comparisons were made using Fisher's LSD with α=0.05. Deacon 7 part 1, 2, 3 exhibited phytotoxicity on berries.

Table 1. Disease incidence and severity in trial 1. Product names are followed by rate (per acre) and the frequency of application. Treatment means followed by the same letter are not significantly different according to Fisher's LSD at α=0.05; alt = alternated with; fb = followed by.

Treatment	Flag	Mean Severity (%)		Mean Incidence (%)	
Miravis Prime, 13.4 fl oz fb Elevate, 11 lb, fb Miravis Prime, 13.4 fl oz, Bloom, Prebunch, Veraison	KC	0.57	C	14.23	E
Switch, 14 oz fb Elevate, 11 lb fb Miravis Prime, 13.4 fl oz, Bloom, Prebunch, Veraison	PKC	0.95	C	16.69	DE
Luna Tranquility, 14 oz + Syl-Coat, 4 oz, Bloom, Prebunch, Veraison	BC	1.26	C	22.21	BCDE
Fervent + 0.126 5 v/v, 8.5 fl oz, 14 days	GKC	1.35	C	30.95	BC
Miravis Prime, 13.4 fl oz fb Elevate, 11 lb, fb Switch, 14 oz, Bloom, Prebunch, Veraison	BS	1.36	C	21.24	CDE
NS1, 1% v/v, Bloom, Prebunch, Veraison	YKD	1.69	C	24.49	BCDE
HML32, 1L/100L, Bloom, Prebunch, Veraison	O	1.89	C	29.03	BC
Pyraziflumid SC, 3.1 fl oz + DYNE-AMIC, 0.25% v/v, Bloom, Prebunch, Veraison	YD	1.90	BC	33.42	BC
Luna Tranquility, 14 oz, 14 days	RS	1.90	C	23.48	BCDE
NS2, 1% v/v, Bloom, Prebunch, Veraison	Pu	2.04	C	22.17	CDE
GCM, 12 fl oz, Bloom, Prebunch, Veraison	YS	2.42	ABC	28.90	BCD
Untreated control	W	4.32	A	33.03	BC
Deacon 7 Part 1,2,3, 10% v/v, Veraison	OKD	4.42	A	48.84	AB

Fig 1. Botrytis infected cluster from untreated control (right) and pesticide applied cluster (left).

Acknowledgements

References

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Appendix

Product	Active Ingredient(s)	Manufacturer or distributor	Chemical class (after Adaskaveg et al. 2008)
Deacon 7 (part 1+2+3)		Sandia National Laboratories	N/A
DYNE-AMIC	Methyl esters of C16-C18 fatty acids, Alkylphenol ethoxylate,Polyalkyleneoxide modified polydimethylsiloxane	BASF	N/A
Elevate 50 WDG	Fenhexamid (10%)	Arysta LifeScience	-17
Fervent	Isofetamid (25%), Tebuconazole (18.2%)	Summit Agro USA	(3) & (7)
GCM	Bacillus velezensis	N/A	N/A
HML32	Potassium Bicarbonate (26.4%)	Henry Manufacturing	N/A
Luna Experience	Fluopyram (17.54%), Tebuconazole (17.54%)	Bayer CropScience	SDHI (7)/DMI-triazole (3)
Luna Tranquility	Pyrimethnail (32.61%), Fluopyram (10.87%)	Bayer CropScience	SDHI (7)/AP(9)
Miravis Prime	Fludioxonil (21.4%), Pydiflumetofen (12.8%)	Syngenta	SDHI (7) (12)
NS1	Potassium soap	Henry Manufacturing	N/A
NS2 (Protector)	Pure base soap	Henry Manufacturing	N/A
Pyraziflumid SC	Mineral oil (98%)	Petro-Canada	Oil
Switch	Cyprodinil (37.5%), Fludioxonil (25%)	Wilbur-Ellis	Inorganic (M2)
Sylcoat	Polyether-polymethylsiloxanecopolymer and Polyether (100%)	Syngenta Crop Protection	anilinopyrimidine (9)/phenylpyrrol (12)