Evaluation of fungicide programs for management of bunch rot of grapes: 2020 field trials

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Report Summary

Bunch rot of grape berries causes economic loss to grape and wine production worldwide. The organisms responsible are largely filamentous fungi, the most common of these being *Botrytis cinerea* (gray mold); however, there are a range of other fungi responsible for the rotting of grapes such as *Aspergillus niger*, *Alternaria sp.*, *Cladosporium herbarum*, *Rhizopus arrhizus*, *Penicillium* sp., and others (Summer Bunch Rot or Sour Rot) (Smith et al. 2016, Steel et al 2013) Bunch rot of grapes caused by *Botrytis cinerea* by 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., 2015). 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 22 fungicide treatment programs (Table 2) for control of Bunch rot in in Riesling grapes at Wilson Vineyards in Clarksburg in 2020. Materials included synthetic, biological, and organic treatments.

Materials and Methods

A. Experimental design

Table 1. Experimental design

Experimental design	Completely randomized design with 5 replicates		
Experimental unit	3 adjacent vines = 1 plot		
Row and tree spacing	11 ft (row) and 5 ft (vine)	Plot unit area	165 ft^2
Area/treatment	825 ft^2 or 0.01956 acre/treatment (5 replicates = 1 treatment)		
Fungicide Applications, Volume water/Acre	A Bloom, May 15th, 100 gallons = 1.5152 gal/5 reps B pre-close, June 15th, 150 gallons = 2.2727gal/5 reps C veraison, July 28th, 150 gallons = 2.2727gal/5 reps		
Equipment	Stihl SR 450 Backpack Sprayers		

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 2. Experimental fungicide treatments

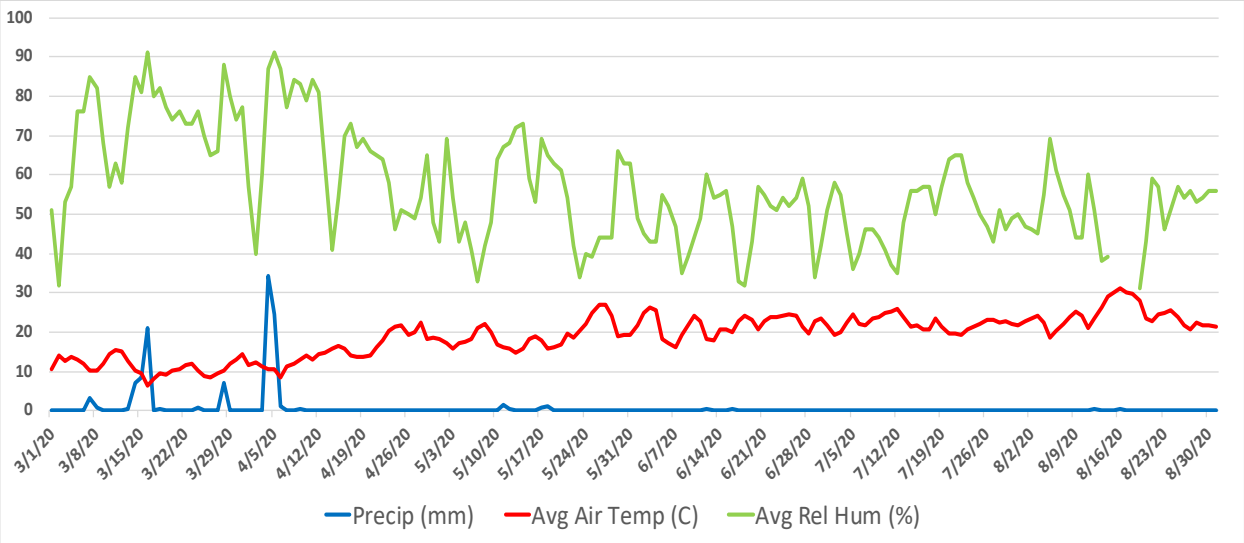
Flag	Treatment	Application rate (100 ga per acre)	Frequency
W	Control		
KD	JMS Stylet	1 %	ABC
KS	Rango/	160 fl oz	AC
	Switch/	14 oz	B
KC	Rango/	160 fl oz	AC
	Terramera Biological + Nu Film/	0.8 % + 16 fl oz	B
YKS	Pristine	23 oz	ABC
YKC	Luna Experience	8.6 fl oz	AC, B
YRD	Elevate 50WDG/	16 fl oz	AC
	Pristine	23 oz	B
R	Stargus + NuFilm	64 fl oz + 0.125 %	ABC
RKD	Stargus + NuFilm	128 fl oz + 0.125 %	ABC
RKS	Stargus + NuFilm	64 fl oz + 0.125 %	A
	Luna Experience + NuFilm/	8.6 fl oz + 0.125 %	BC
RKC	Stargus + NuFilm /	64 fl oz + 0.125 %	A
	Miravis Prime + NuFilm	13.4 fl oz + 0.125 %	BC
GKS	EXP14 500 ai/ha	1272.57 gr	ABC
B	EXP14 750 ai/ha	1908.86 gr	ABC
BS	Luna Experience + Sylcoat/	8.6 fl oz + 4 fl oz	A
	Luna Tranquility + Sylcoat/	14 fl oz + 4 fl oz	B
	Scala + Sylcoat	18 fl oz + 4 fl oz	C
BC	SP2480 + NuFilm/	25 fl oz + 0.125 %	A
	SP2480 + Howler + Capsil	25 fl oz + 7.5 gr/l + 6 fl oz	BC
BKD	Parade + Dyne-Amic	3.1 fl oz + 0.25 %	ABC
BKS	Circadian sunrise	2 fl oz	ABC
BKC	WE1891-1 + Sycoat	2.5 lb + 4 fl oz	ABC
Pu	PerCarb	3 lb	ABC
P	OxiDate 5.0 + Kinetic	0.39 % + 0.125 %	ABC
PKD	Miravis prime + NuFilm/	13.4 fl oz + 0.125 %	A
	Vangard + NuFilm/	10 oz + 0.125 %	B
	Miravis prime + NuFilm	13.4 fl oz + 0.125 %	C
PKS	Miravis prime + NuFilm/	13.4 fl oz + 0.125 %	A
	Inspire super + NuFilm/	20 fl oz + 0.125 %	B
	Miravis prime + NuFilm	13.4 fl oz + 0.125 %	C

C. Vine Management

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

D. Weather

Daily temperature, relative humidity and precipitation data from March 1 to August 31 2020 from CIMIS station (Ryde 243) in Sacramento Valley, CA.



E. Trial Map

R1	R2	R3	R4	R5	R6
x	x	x	x	x	x
x	9 - Y	x	x	x	x
22 - BC		x	x	x	x
	x	x	x	x	1 - W
26 - Pu	x	x	x	19 - GKS	
	x	2 - K	10 - YKD		21 - BS
7 - OKD	14 - YRS				
	9 - Y	1 - W	24 - BKS	8 - OKS	26 - Pu
16 - RKD		27 - P	6 - GKC	27 - P	7 - OKD
8 - OKS	13 - YRD	5 - KC	29 - PKS	4 - KS	5 - KC
21 - BS	10 - YKD	6 - GKC	17 - RKS	15 - R	5 - KC
28 - PKD	17 - RKS	16 - RKD	5 - KC	25 - BKC	16 - RKD
18 - RKC	26 - Pu	14 - YRS	23 - BKD	2 - K	8 - OKS
12 - YKC	28 - PKD	17 - RKS	24 - BKS	17 - RKS	3 - KD
9 - Y	14 - YRS	18 - RKC	25 - BKC	12 - YKC	15 - R
14 - YRS	11 - YKS	11 - YKS	13 - YRD	27 - P	24 - BKS
	x				
4 - KS	x	25 - BKC	10 - YKD	15 - R	27 - P
23 - BKD	29 - PKS	20 - B	13 - YRD	13 - YRD	28 - PKD
18 - RKC	9 - Y	22 - BC	4 - KS	13 - YRD	1 - W
22 - BC	23 - BKD	1 - W	17 - RKS	16 - RKD	20 - B
24 - BKS	21 - BS	8 - OKS	29 - PKS	7 - OKD	15 - R
4 - KS	19 - GKS	10 - YKD	19 - GKS	7 - OKD	20 - B
21 - BS	7 - OKD	3 - KD	22 - BC	21 - BS	x
					x
25 - BKC					x
	16 - RKD	18 - RKC	2 - K	1 - W	5 - KC
6 - GKC	25 - BKC	26 - Pu	6 - GKC	27 - P	11 - YKS
14 - YRS	19 - GKS	12 - YKC	11 - YKS	3 - KD	22 - BC
26 - Pu	3 - KD	19 - GKS	24 - BKS	20 - B	29 - PKS
x					
2 - K	18 - RKC	6 - GKC	11 - YKS	23 - BKD	2 - K
29 - PKS	3 - KD	9 - Y	4 - KS	23 - BKD	28 - PKD
28 - PKD	10 - YKD	8 - OKS	15 - R	12 - YKC	20 - B
R1	R2	R3	R4	R5	R6

F. Data Collection and Statistics

Disease was assessed on August 27th 2020. Bunch rot (Botrytis Bunch Rot and Sour Rot) 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 bunch rot. 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.

Table 3. Disease incidence and severity. 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; /= followed by.

Pictures	Treatments	Flag	Mean Incidence (%)	Mean Severity (%)
Pictures	**Pristine 23 oz**	YKS	20.0 a	1.5 n.s.
Pictures	**Luna Experience 8.6 oz +Sylcoat 4 fl oz/100 gal/ Luna Tranquility 14 oz + Sylcoat 4 fl oz/100 gal / Scala 18 oz +Sylcoat 4 fl oz/100 gal**	BS	28.0 ab	2.6
Pictures	**EXP14- 500 ai/ha**	GKS	31.2 abc	2.6
Pictures	**EXP14- 750 ai/ha**	B	32.8 abc	2.8
Pictures	**Stargus 64 oz + NuFilm 0.125% / Luna Experience 8.6 oz + NuFilm 0.125%**	RKS	32.8 abc	3.2
Pictures	**JMS Stylet 1% v/v**	KD	32.8 abc	3.4
Pictures	**WE1891-1 2.5 lb + Sylcoat 4 fl oz**	BKC	32.8 abc	2.7
Pictures	**Stargus 64 oz + NuFilm 0.125% / Miravis Prime 13.5 oz + NuFilm 0.125%**	RKC	33.6 abc	3.7
Pictures	**Elevate 50WDG 16 fl oz / Pristine 23 oz wt**	YRD	33.6 abc	2.5
Pictures	**Circadian sunrise 2 oz/gal**	BKS	34.4 bc	3.2
Pictures	**Stargus 128 oz + NuFilm 0.125%**	RKD	35.2 bc	3.4
Pictures	**Luna Experience 8.6 fl oz**	YKC	36.8 bcd	4.9
Pictures	**Parade 3.1 fl oz + Dyne-Amic 0.25 % v/v**	BKD	37.6 bcd	2.6
Pictures	**Miravis prime 13.4 fl oz + NuFilm 0.125 v/v / Vangard 10 oz + NuFilm 0.125 v/v / Miravis prime 13. 4 fl oz+ NuFilm 0.125 v/v**	PKD	39.2 bcd	5.9
Pictures	**Miravis prime 13.4 fl oz +NuFilm 0.125 v/v/ Inspire super 20 fl oz+ NuFilm 0.125 v/v/ Miravis prime 13. 4 fl oz+ NuFilm 0.125 v/v**	PKS	40.0 bcd	3.7

Pictures	**PerCarb 3 lbs/100 gal**	Pu	40.8 bcd	3.6
Pictures	**Rango 160 fl oz / Switch 14 fl oz**	KS	40.8 bcd	4.3
Pictures	**Stargus 64 oz + NuFilm 0.125%**	R	40.8 bcd	4.0
Pictures	**Rango 160 fl oz / Terramera Biological 08% v/v + Nu Film 16 fl oz**	KC	42.4 cd	3.8
Pictures	**SP2480 8 oz + NuFilm 0.125 v/v / SP2480 8 oz+ Howler 7.5 g/L+Capsil 6 fl oz/100 gal**	BC	43.2 cd	3.3
Pictures	**OxiDate 5.0 0.39% v/v + Kinetic 0.125% v/v**	P	44.0 cd	5.0
Pictures	**Control**	W	44.8 cd	5.8

ns = not significant at $P = 0.05$. Data were arcsine $\sqrt{(x/100)}$ transformed before the analysis but the nontransformed data are presented.

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Appendix: Materials

Product	Active ingredient(s) and concentration	Manufacturer or distributor	Chemical class (Frac Code)
Circadian Sunrise Horticultural	corn oil + peppermint oil	Circadian Crop Sciences	N/A
Dyne-Amic	polyalkyleneoxide modified polydimethylsiloxane, nonionic emulsifiers, methyl ester of c16-c18 fatty acids (99%)	Helena Chemical Co.	Adjuvant
Elevate 50WDG	fenhexamid (50%)	Arysta Lifescience	KRI(17)
Inspire Super	difenoconazole (8.4%), cyprodinil (24.1%)	Syngenta Crop Protection, Inc.	DMI-triazole (3)/AP(9)
JMS Stylet-Oil	paraffinic oil (97.1%)	JMS Flower Farms, Inc.	Oil
Kinetic	polyalkyleneoxide modified	Helena Chemical Company	N/A
Luna Experience	fluopyram (17.54%), tebuconazole (17.54%)	Bayer CropScience	SDHI (7)/DMI-triazole (3)
Luna Tranquility	pyrimethanil (32.61%), fluopyram (10.87%)	Bayer CropScience	AP(9)/ SDHI (7)
Miravis Prime	fludioxonil (21.4%), pydiflumetofen 12.8%)	Syngenta	Phenylpyrroles (12)/ SDHI (7)
NuFilm P	pinene polymers, petrolatum, alkyl amine ethoxylate	Miller	N/A
OxiDate 5.0	hydrogen peroxide 27.1 + peroxyacetic acid 5%	Biosafe systems	N/A
Parade (Pyraziflumid)	pyraziflumid	Nichino America	SDHI(7)
PerCarb	sodium carbonate peroxyhydrate (85%)	Biosafe systems	N/A
Pristine	pyraclostrobin (12.8%), boscalid (25.2%)	BASF	QoI(11)/SDHI (7)
Rango	cold pressed neem oil	Terramera Inc.	N/A
Scala	pyrimethanil (54.6%)	Bayer CropScience	AP(9)
SP2480	Proprietary	N/A	Proprietary
Stargus	*Bacillus amyloliquefaciens* strain f72	Marrone Bio Innovations	Biological
Switch	cyprodinil 37.5% + Fludioxonil 25.0%	Syngenta	AP(9)/ Phenylpyrroles (12)
Syl-Coat	polyether-polymethylsiloxane-copolymer and polyether-100%	Wilbur-Ellis	adjuvant

Terramera Biological	cold pressed neem oil (52%) octanoid acid (25%)	Terramera Inc.	N/A
Vangard	cyprodinil (75%)	Syngenta	AP(9)
WE1819-1	proprietary	Wilbur Ellis	N/A
EXP14 500 ai/ha	proprietary	Biotalys	N/A
EXP14 750 ai/ha	proprietary	Biotalys	N/A