Evaluation of fungicide programs for management of Botrytis bunch rot of grapes: 2011 field trial

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Report Summary

Bunch rot of grapes is caused by *Botrytis cinerea*, a fast-growing pathogen infecting numerous crops of commercial value. Bunch rot can potentially lead 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 ground or on canes. The disease can 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 humidities exceeding 90% and temperatures between 15-27°C (Flaherty et al. 1992, Bulit and Dubos 1988, Gubler et al. 2008). 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 32 fungicide treatment programs for control of Botrytis bunch rot in Clone 4 Chardonnay grapes in Carneros, Napa County, California in 2011. Materials included synthetic, biological, and organic treatments. Four applications were made between June and September 2011.

Materials and Methods

The field trials were conducted using complete randomized block designs, with plots consisting of 2 adjacent vines (11 ft row spacing and 5 ft vine spacing). Each treatment consisted of 4 replicates (0.0101 acres). Fungicides were tank mixed and applied with backpack sprayers. Four applications were made during the growing season: 15 June (bloom), 12 July (pre-close, berries pea-sized), 25 August (veraison) and 30 September (pre-harvest). Each application was made in 200 gallons/acre of water (2.0 gallons/treatment). Other pesticides were applied between bloom and harvest by the commercial vineyard managers for control of powdery mildew and vine mealy bug.

Disease was assessed on 13 October 2011, near the date of harvest in the commercially-grown block. Twenty to thirty clusters were evaluated in each plot for bunch rot symptoms (visible mycelium, slip skin and purpling of berries). Disease incidence (calculated as the percentage of infected clusters per plot) was averaged over the four reps in each treatment. Disease severity (percentage of symptomatic berries) was assessed for each plot by averaging severity estimates for each rated cluster; then calculating the mean for all four reps in each treatment.

Table 1. Trial 1 Experimental fungicide treatments. "alt" = alternated with; "FP" = formulated product

No.	Flag	Product(s)	FP[1]/Acre	FP/Treatment
1	W	Untreated	none	none
2	K	Pristine + Sylgard 309 then Elevate + Vivando + Sylgard 309 then Pristine + Sylgard 309 then Vangard + Sylgard 309	23 oz + 3 fl oz/100 gal then 1 lb + 12.8 fl oz + 3 fl oz/100 gal then 23 oz + 3 fl oz/100 gal then 10 oz + 3 fl oz/100 gal	6.6 g + 1.8 ml then 4.6 g + 3.8 ml + 1.8 ml then 6.6 g + 1.8 ml then 2.9 g + 1.8 ml
3	LG	Pristine + Sylgard 309 then Vangard + Vivando + Sylgard 309 then Pristine + Sylgard 309 then Elevate + Sylgard 309	23 oz + 3 fl oz/100 gal then 10 oz + 12.8 fl oz + 3 fl oz/100 gal then 23 oz + 3 oz/100 gal then 1 lb + 3 fl oz/100 gal	6.6 g + 1.8 ml then 2.9 g + 3.8 ml + 1.8 ml then 6.6 g + 1.8 ml then 4.6 g + 1.8 ml
4	YKS	IKF -5411	20 fl oz	6.0 ml
5	Y	IKF-5411	22 fl oz	6.6 ml
6	YKD	Elevate then Serenade Max (3x)	1 lb then 2 lb	4.6 g then 9.2
7	BS	Elevate then QRD 146 (3x)	1 lb then 12 oz	4.6 g then 3.5 g
8	KS	Elevate then QRD-146 (3x)	1 lb then 1lb	4.6 g then 4.6
9	O	Elevate then QRD-146 (3x)	1 lb then 20 oz	4.6 g then 5.7
10	OS	Elevate then QRD-146 (3x)	1 lb then 24 oz	4.6 then 9.2 g
11	BC	Antica	0.5 %(v/v)	38 ml
12	GD	Antica	1.0 % (v/v)	76 ml
13	B	Antica	1.5 %(v/v)	114 ml
14	Pu	Antica	2.0 %(v/v)	152 ml
15	PKD	Elevate	16 oz	4.6 g
16	KD	Switch + Dyneamic	14 oz + 0.25%(v/v)	4.0 g + 18.9 ml
17	P	Inspire Super + Dyneamic	20 fl oz + 0.25% (v/v)	6.0 ml + 18.9 ml
18	GS	Vangard + Dynamic	10 oz + 0.25% (v/v)	2.9 g + 18.9 ml
19	BD	V-10135 4.00 SC	0.188 lb ai/A	1.8 ml
20	KC	V-10135 4.00 SC	0.375 lb ai/A	3.6 ml
21	PKS	V-10135 .83 CS (different than below)	0.188 lb ai.A	8.7 ml
22	OKD	V-10135 .83 SC	0.188 lb ai/A	8.7 ml
23	YS	Elevate	24 oz	5.9 g
24	OKS	Rovral (2x) then Vangard 75 then Pristine	1 qt (2x) then 10 oz then 12.5 oz	9.6 ml then 2.9 g then 3.6 g
25	PKC	V-10135 4.00 SC then Rovral then Vangard then Pristine	.188 lb ai/A then 1 qt then 10 oz then 12.5 oz	1.8 ml then 9.6 ml then 2.9 g then 3.6 g
26	BKS	Rovral (2x) then V-10135 4.00 SC then Pristine	1 qt (2x) then .188 lb ai/A then 12.5 oz	9.6 ml then 1.8 ml then 3.6 g
27	GKS	Incognito 85 WDG	.8 lb	3.7 g
28	RKD	Incognito 85 WDG	1.2 lb	5.5 g
29	RKC	Oxidate + Serenade ASO	1% (v/v) + 3 qts	76 ml + 28.4 ml

Table 2. Trial 2 Experimental fungicide treatments. "alt" = alternated with; "FP" = formulated product

No.	Flag	Product(s)	FP[1]/Acre	FP/Treatment
1	BC/OS	Ph-D (ARY416-01)+ Elevate + Nufilm P	6.2 oz + 16 oz + 8 fl oz/100 gal	1.8 g + 4.6 g + 4.8 ml
2	BC/B	Ph-D (ARY416-01) + Nufilm P	6.2 oz + 8 fl oz /100 gal	1.8 g + 4.8 ml
3	B/OS	Ph-D organic (ARY 416-02) + Nufilm P	6.2 oz + 8 fl oz/100 gal	1.8 g + 4.8 ml

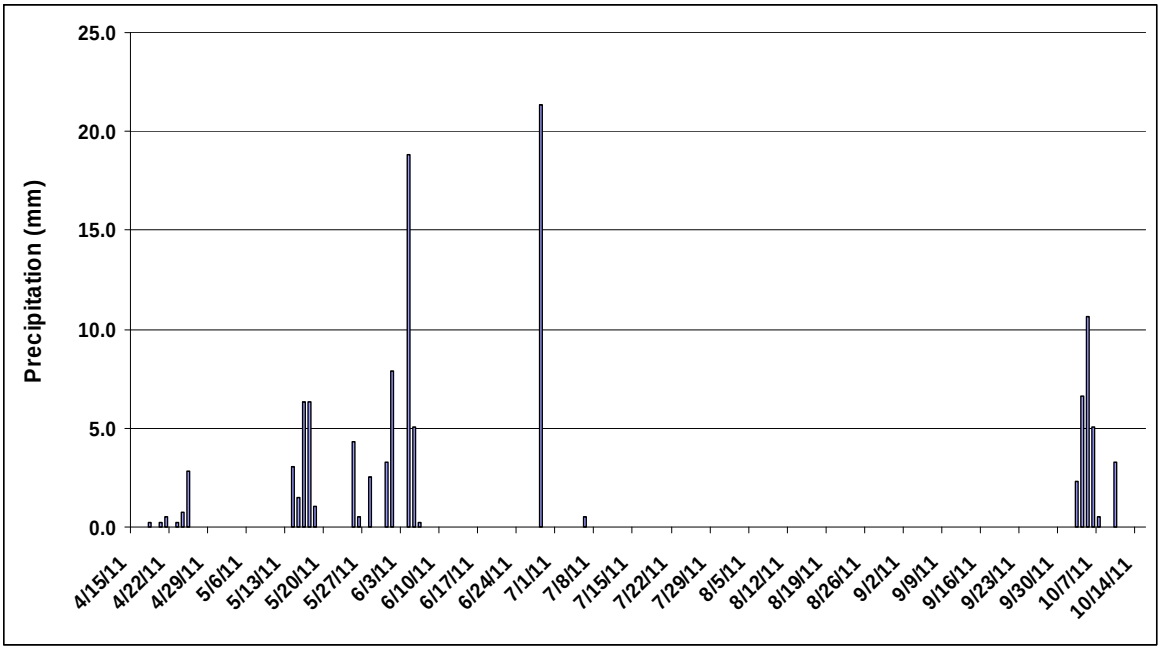
Note: The treatments described in this report were conducted for experimental purposes only and crops treated in a similar manner may not be suitable for commercial or other use.

Figure 1. Layout of plots in the experimental area.

BC/OS	BC/B	B/OS	BC/OS	B/OS	BC/B	BC/B	B/OS	BC/OS	B/OS	BC/OS	BC/B
O	KS	YS	BKS	BS	YKS	YKS	O	LG	PKD	LG	PKS
YKD	BKS	PKD	KC	KS	K	Y	OKS	Pu	BC	RKD	OS
OS	W	GS	P	OKD	OKS	B	YS	BKS	Y	KS	YKC
Y	RKC	OKD	RKC	YS	PKS	GKS	K	KC	YS	OKD	PKC
GKS	BC	P	GKS	GD	W	KD	GD	PKS	BD	W	KC
LG	BD	KC	OS	PKC	Pu	BC	W	YKD	GD	B	Pu
Pu	OKS	YKS	B	BD	Y	RKC	GS	BD	OKS	K	O
PKC	RKD	K	O	KD	PKD	P	OS	YKC	BKS	GS	GKS
YKC	BS	KD	GS	YKD	YKC	BS	OKD	PKD	BS	YKS	KD
PKS	B	GD	LG	BC	RKD	KS	RKD	PKC	P	YKD	RKC
Row	12	11	10	9	8	7	6	5	4	3	2	1

Results and discussion

Figure 2. Precipitation history from 15 April to 15 October 2011 near the trial location. Data are from CIMIS station 109 in Carneros (http://www.cimis.water.ca.gov).



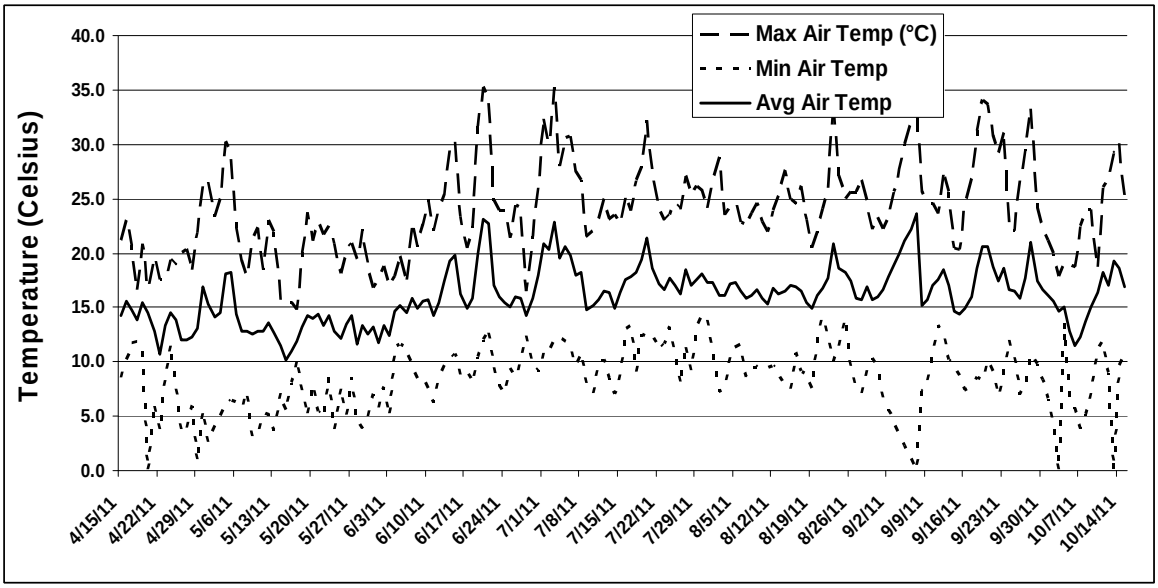


Table 1. Botrytis incidence (means). Product names are followed by rate (per acre). Treatment means followed by the same letter are not significantly different according to Fisher's protected LSD test at α=0.05.

Treatment	Disease Incidence (%)	Means Comp.
Elevate, 16 oz	61.0	e
Switch, 14 oz + Dyneamic, 0.25% (v/v)	62.0	de
IKF - 5411, 22fl oz	63.0	de
IKF - 5411, 20fl oz	74.0	cde
Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Vangard, 10 oz + Vivando, 12.8 fl oz + Sylgard 309, 3 fl oz/100 gal then Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Elevate, 1 lb + Sylgard 309, 3fl oz/100 gal	77.0	bcde
Incognito 85 WDG, .8lb	81.0	abcd
Incognito 85 WDG, 1.2 lb	84.0	abc
Elevate, 24 oz	84.0	abc
Elevate, 1 lb then QRD-146 (3x), 1lb	86.0	abc
V-10135 .83 CS, 0.188 lb ai/A	87.0	abc
Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Elevate, 1 lb + Vivando, 12.8 fl oz + Sylgard 309, 3 fl oz/100 gal then Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Vangard, 10 oz + Sylgard 309, 3fl oz/100 gal	87.0	abc
V-10135 4.00 SC, 0.375 lb ai/A	90.0	abc
Elevate, 1 lb then Serenade Max (3x), 2 lb	91.0	abc
Vangard, 10oz + Dyneamic 0.25% (v/v)	92.0	abc
V-10135 .83 SC, 0.188 lb ai/A	92.0	abc
Oxidate, 1% (v/v) + Serenade, 3qts	92.0	abc
Elevate, 1 lb then QRD-146 (3x), 24 oz	92.0	abc
Inspire Super, 20 fl oz + Dyneamic, 0.25% (v/v)	94.0	ab
Antica, 1.0% (v/v)	95.0	ab
Antica, 2.0% (v/v)	96.0	ab
Antica, 1.5% (v/v)	96.0	ab
V-10135 4.00 SC, 0.188 lb ai/A	97.0	a
V-10135 4.00 SC, 0.188 lb ai/A then Rovral, 1qt then Vangard, 10 oz then Pristine 12.5 oz	98.0	a
Elevate, 1 lb then QRD-146 (3x), 20 oz	98.0	a
Elevate, 1 lb then QRD 146 (3x), 12 oz	98.0	a
Untreated	99.0	a
Rovral, 1 qt (2x) then V-10135 4.00 SC, 0.188 lb ai/A then Pristine, 12.5 oz	99.0	a
Antica, 0.5% (v/v)	99.0	a
Rovral, 1 qt (2x) then Vangard, 10 oz then Pristine, 12.5 oz	100.0	a

Table 2. Botrytis severity (means). Product names are followed by rate (per acre). Treatment means followed by the same letter are not significantly different according to Fisher's protected LSD test at α=0.05.

Treatment	Disease Severity %	Means Comp.
Switch, 14 oz + Dyneamic, 0.25% (v/v)	3.50	j
IKF - 5411, 22fl oz	10.30	ij
Elevate, 16 oz	11.98	hij
Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Vangard, 10 oz + Vivando, 12.8 fl oz + Sylgard 309, 3 fl oz/100 gal then Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Elevate, 1 lb + Sylgard 309, 3fl oz/100 gal	12.63	ghij
Elevate, 24 oz	13.78	ghij
Elevate, 1 lb then Serenade Max (3x), 2 lb	14.98	fghij
Incognito 85 WDG, .8lb	16.25	fghij
IKF - 5411, 20fl oz	16.60	fghij
Elevate, 1 lb then QRD-146 (3x), 20 oz	20.10	efghij
Incognito 85 WDG, 1.2 lb	21.20	efghij
V-10135 4.00 SC, 0.375 lb ai/A	22.43	efghij
Elevate, 1 lb then QRD-146 (3x), 24 oz	23.93	efghi
Oxidate, 1% (v/v) + Serenade, 3qts	25.17	efghi
Antica, 2.0% (v/v)	26.10	efghi
V-10135 4.00 SC, 0.188 lb ai/A then Rovral, 1qt then Vangard, 10 oz then Pristine 12.5 oz	27.93	defghi
V-10135 .83 CS, 0.188 lb ai/A	28.15	defghi
Inspire Super, 20 fl oz + Dyneamic, 0.25% (v/v)	28.23	defghi
Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Elevate, 1 lb + Vivando, 12.8 fl oz + Sylgard 309, 3 fl oz/100 gal then Pristine, 23 oz + Sylgard 309, 3 fl oz/100 gal then Vangard, 10 oz + Sylgard 309, 3fl oz/100 gal	29.05	defghi
Vangard, 10oz + Dyneamic 0.25% (v/v)	29.15	defghi
Antica, 1.5% (v/v)	29.38	defgh
Elevate, 1 lb then QRD-146 (3x), 1lb	30.38	cdefgh
Elevate, 1 lb then QRD 146 (3x), 12 oz	31.08	cdefgh
Rovral, 1 qt (2x) then V-10135 4.00 SC, 0.188 lb ai/A then Pristine, 12.5 oz	32.95	cdefg
V-10135 4.00 SC, 0.188 lb ai/A	33.45	cdef
V-10135 .83 SC, 0.188 lb ai/A	38.93	bcde
Untreated	46.50	abcd
Antica, 1.0% (v/v)	48.80	abc
Antica, 0.5% (v/v)	53.23	ab
Rovral 1 qt (2x) then Vangard, 10 oz then Pristine, 12.5 oz	62.00	a

Table3. Trial 2 Botrytis incidence (means). Product names are followed by rate (per acre). Treatment means followed by the same letter are not significantly different according to Fisher's protected LSD test at α=0.05; alt=alternated with.

Treatment	Disease Incidence (%)	Means Comp.
Switch, 14 oz + Dyneamic, 0.25% (v/v)	46.5	b
Ph-D (ARY416-01), 6.2 oz + Elevate, 16 oz + Nufilm P, 8 fl oz/100gal	42.5	ab
Ph-D (ARY416-01), 6.2 oz + Nufilm P, 8 fl oz/100gal	95.0	a
Ph-D organic (ARY 416-02), 6.2 oz + Nufilm P, 8 fl oz/100gal	95.4	a
Untreated	99.0	a

Table 4. Trial 2 Botrytis severity (means). Product names are followed by rate (per acre). Treatment means followed by the same letter are not significantly different according to Fisher's protected LSD test at α=0.05; alt=alternated with.

Treatment	Disease Severity (%)	Means Comp.
Switch, 14 oz + Dyneamic, 0.25% (v/v)	3.5	b
Ph-D (ARY416-01), 6.2 oz + Elevate, 16 oz + Nufilm P, 8 fl oz/100gal	13.6	b
Ph-D (ARY416-01), 6.2 oz + Nufilm P, 8 fl oz/100gal	36.3	a
Ph-D organic (ARY 416-02), 6.2 oz + Nufilm P, 8 fl oz/100gal	42.5	a
Untreated	46.5	a

Acknowledgements

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Appendix: Materials

Product	Active ingredient(s) and concentration	Class	Manufacturer or Distributor
Antica	**lactic acid (10%)**	**N/A**	**Ahcil Laboratories**
Dyneamic	**polyalkyleneoxide modified polydimethylsiloxane, nonionic emulsifiers, methyl ester of C16-C-18 fatty acids (99%)**	**adjuvant**	**Helena Chemical Co.**
Elevate	**fenhexamid (50%)**	**hydroxyanilide**	**Arysta Life Science**
IKF - 5411	**proprietary**	**N/A**	**N/A**
Incognito 85 WDG	**thiophanate-methyl (85%)**	**MBC**	**Makhteshim-Agan of North America**
Inspire Super	**difenoconazole (8.4%), cyprodinil (24%)**	**DMI, aniline-primidine**	**Syngenta Crop Protection, Inc.**
Oxidate 2.0%	**hydrogen dioxide (27%)**	**N/A**	**BioSafe Systems LLC**
Ph-D	**polyoxin-D (11.3%)**	**chitin synthesis inhibitor**	**Arysta Life Sciences**
Ph-D Organic	**proprietary**	**N/A**	**Arysta Life Sciences**
Pristine	**pyraclostrobin**	**QoI-strobilurin + carboximide**	**BASF**
QRD 146	**proprietary**	**N/A**	**AgraQuest Inc.**
Rovral	**iprodione 500g/kg**	**dicarboximide**	**Bayer**
Serenade ASO	***bacillus subtilis* QST 713 (1.34%)**	**biological - microbial**	**AgraQuest, Inc.**
Serenade MAX	***bacillus subtilis* QST713 (14.6%)**	**biological - microbial**	**AgraQuest Inc.**
Switch	**cyprodinil (37.5%), fludioxonil (25.0%)**	**anilino-pyrimidine**	**Syngenta Crop Protection, Inc.**
Sylgard 309	**polysiloxane (80%)**	**adjuvant**	**Dow Corning Corp**
Vangard	**cyprodinil (75%)**	**anilino-pyrimidine**	**Syngenta Crop Protection, Inc.**
Vivando	**metrafenone (300g/L)**	**N/A**	**BASF**
V-10135	**N/A**	**N/A**	**Valent**