Evaluation of fungicide programs for management of Botrytis bunch rot of grapes: 2013 field trial

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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 38 fungicide treatment programs for control of Botrytis bunch rot in Chardonnay grapes in Yountville, Napa County, California in 2013. Materials included synthetic, biological, and organic treatments. Four applications were made between May and September 2013. Disease pressure was low at the site and disease incidences were not uniform across all treatments.

Figure 1. Images of Botrytis Trial site in Yountville, Napa Co., CA. A) and B).

A **B**

Materials and Methods

A. Experimental design

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 applied with backpack sprayers. Three applications were made during the growing season: 8 May (bloom), 14 June (pre-close), 1 August (veraison) and 26 Sept (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.

B. Experimental treatments

Table 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	Switch	14 oz	4.0 g
3	GKC	Elevate	16 oz	4.6g
4	YKS	IKF-5411 + Silwet-L-77	13.7 fl oz + 0.1% (v/v)	4.1 ml + 7.6 ml
5	PKD	IKF-5411 + Silwet L-77	17.1 fl oz + 0.1% (v/v)	5.1 ml + 7.6 ml
6	YKD	IKF-5411	20 fl oz	6 ml
7	BS	IKF-5411	22 fl oz	6.6 ml
8	KS	IKF-5411 + Silwet L-77 (2x) then Switch (2x)	20 fl oz + 0.1% (v/v) (2x) then 14 oz (2x)	6 ml + 7.6 ml (2x) then 4 g (2x)
9	O	IKF-5411 + Silwet L-77 alt Switch	20 fl oz + 0.1% (v/v) alt 14 oz	6 ml + 7.6 ml alt 4 g
10	OS	Luna Tranquility + Dyneamic	16 fl oz + 0.25% (v/v)	4.8 ml + 18.9 ml
11	BC	Luna Experience + Dyneamic	8 fl oz + 0.25% (v/v)	2.4 ml + 18.9 ml
12	GD	Serenade Optimum + Dyneamic	16 oz + 0.25% (v/v)	4.6 g + 18.9 ml
13	B	(Luna Tranquility then Serenade Optimum then Luna Experience then Serenade Optimum) + Dyneamic	(16 fl oz then 16 oz then 8 fl oz then 16 oz) + 0.25% (v/v)	(4.8 ml then 4.6 g then 2.4 ml then 4.6 g) + 18.9 ml
14	Pu	(Luna Tranquility then Luna Experience then Serenade Optimum (2x)) + Dyneamic	(16 fl oz then 8 fl oz then 16 oz (2x)) + 0.25% (v/v)	(4.8 ml then 4.2 ml then 4.6 g (2x)) + 18.9 ml
15	YKC	Tavano 5% SC	13 fl oz	3.9 ml
16	KD	Tavano 5% SC	6.5 fl oz	1.9 ml
17	R	Tavano 5% SC alt Elevate	6.5 fl oz alt 16 oz	1.9 ml alt 4.6 g
18	GS	K-PHITE 7LP	3 qt	28.7 ml
19	BD	Fracture + Stylet oil then Vangard + Stylet oil then Fracture + Sylgard 309 then Vangard + Sylgard 309	24.4 fl oz + 1.0% (v/v) then 10 oz + 1.0% (v/v) then 24.4 fl oz + 0.25 % (v/v) then 10 oz + 0.25% (v/v)	7.3 ml +75.6 ml then 2.9 g + 75.6 ml then 7.3 ml + 75.6 ml then 2.9 g + 18.9 ml
20	OD	Vangard + Stylet oil then Fracture + Stylet oil then Vangard + Sylgard 309 then Fracture + Sylgard 309	10 oz + 1.0% (v/v) then 24.4 fl oz + 1.0% (v/v) then 10 oz + 0.25% (v/v) then 24.4 fl oz + 0.25% (v/v)	2.9 g + 75.6 ml then 7.3 ml + 75.6 ml then 2.9 g + 18.9 ml then 7.3 ml +18.9 ml
21	PKS	Rovral + Stylet oil(1) then Fracture + Stylet oil then Rovral + Sylgard 309 then Fracture + Sylgard 309	1 qt + 1.0% (v/v) then 24.4 fl oz + 1.0% (v/v) then 1 qt + 0.25% (v/v) then 24.4 fl oz + 0.25% (v/v)	9.6 ml + 75.6 ml then 7.3 ml + 75.6 ml then 9.6 ml + 18.9 ml then 7.3 ml + 18.9

22	OKD	Elevate + Stylet oil then Fracture + Stylet oil then Elevate + Sylgard 309 then Fracture + Sylgard 309	16 oz + 1.0% (v/v) then 24.4 fl oz + 1.0% (v/v) then 16 oz + 0.25% (v/v) then 24.4 fl oz + 0.25% (v/v)	4.6 g + 75.6 ml then 7.3 ml + 75.6 ml then 4.6 g + 18.9 ml then 7.3 ml + 18.9 ml
23	YS	Captan Gold	1.675 lb	7.7 g
24	OKS	Captan Gold	2.5 lb	11.5 g
25	GKD	MCW-710 SC	5.762 fl oz	1.7 ml
26	BKS	Captan Gold + MCW-710 SC	1.675 lb +5.762 fl oz	7.7 g + 1.7 ml
27	GKS	SynTech Experimental	60 g a.i./ha	0.65 ml
28	RKD	SynTech Experimental	80 g a,i./ha	0.85 ml
29	RKC	SynTech Experimental	100 g a.i./ha	1 ml
30	YD	SynTech Experimental	200 g a.i./ha	2 ml
31	OC	Luna Privilege	200 g a.i./ha	2.4 ml
32	OYS	Fontelis	200 g a.i./ha	3.9 ml
33	Y	Timorex Gold	0.43 qt	7.2 ml
34	G	Timorex Gold	0.65 qt	10.8 ml
35	YRD	Timorex Gold	0.86 qt	14.4 ml
36	KC	Timorex Gold + Inspire	0.43 qt + 5.25 fl oz	7.2 + 2.7 ml
37	PKC	Inspire	5.25 fl oz	2.7 ml
38	P	Inspire Super + Vangard + Dyneamic	20 fl oz + 3 oz + 0.25% (v/v)	6 ml + 0.9 g + 18.9 ml
39	RKS	Switch + Taegro + Dyneamic	14 oz + 5.2 oz + 0.25% (v/v)	4 g + 1.5 g + 18.9 ml
40	RKD/OKS	Air Blow	N/A	N/A

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.

C. Trial Map

	RKD/OKS				RKD/OKS	RKD/OKS			RKD/OKS		
RKS	YRD	G	B	GKS	GS	YD	YRD	YKS	OD	GKC	GS
YD	BC	BS	OKD	BKS	YKC	O	OD	PKC	YS	Pu	YD
BKS	OS	OKS	YKD	RKD	Y	YKD	W	OC	YKC	Y	P
B	RKD	YKC	RKS	KD	O	G	P	Y	GKS	GKD	OKD
KD	GKC	OYS	OC	GD	OS	GKC	BKS	OYS	OS	G	OYS
Pu	P	OC	BD	W	PKD	RKC	KC	GD	YKD	KD	R
GKS	YKS	YKD	OD	G	P	BC	PKD	OKS	BC	RKS	O
PKD	GKD	GS	GKC	Pu	YRD	KS	BS	RKD	KS	W	OKS
Y	PKS	RKC	OYS	PKS	YD	OS	RKS	GKD	PKS	PKC	GD
O	K	OD	BC	YKS	GKD	GKS	BD	OKD	YKS	YRD	K
YS	W	PKC	PKC	K	RKC	R	K	YS	RKC	OC	BKS
GD	KC	R	KC	BS	R	PKS	GS	KD	RKD	BD	B
BD	KS	OKD	YS	KS	OKS	YKC	B	Pu	KC	PKD	BS
1	2	3	4	5	6	7	8	9	10	11	12

D. Disease and Statistical Analysis

Disease was assessed on 21 Oct. Botrytis bunch rot incidence and severity were assessed in each plot by evaluating twenty random clusters. Incidence was defined as the proportion of clusters in a plot having some living Botrytis. Severity was determined by estimating the percentage of berries in a cluster that were 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 along with standard error were computed. Trial models were analyzed using the ANOVA Tests for data. Means comparisons were made using Student's t test at α=0.05.

E. Weather and Disease

Figure 1a. Precipitation history from 1 May to 30 October 2013. Data are from CIMIS station 121 in Dixon (http://www.cimis.water.ca.gov).

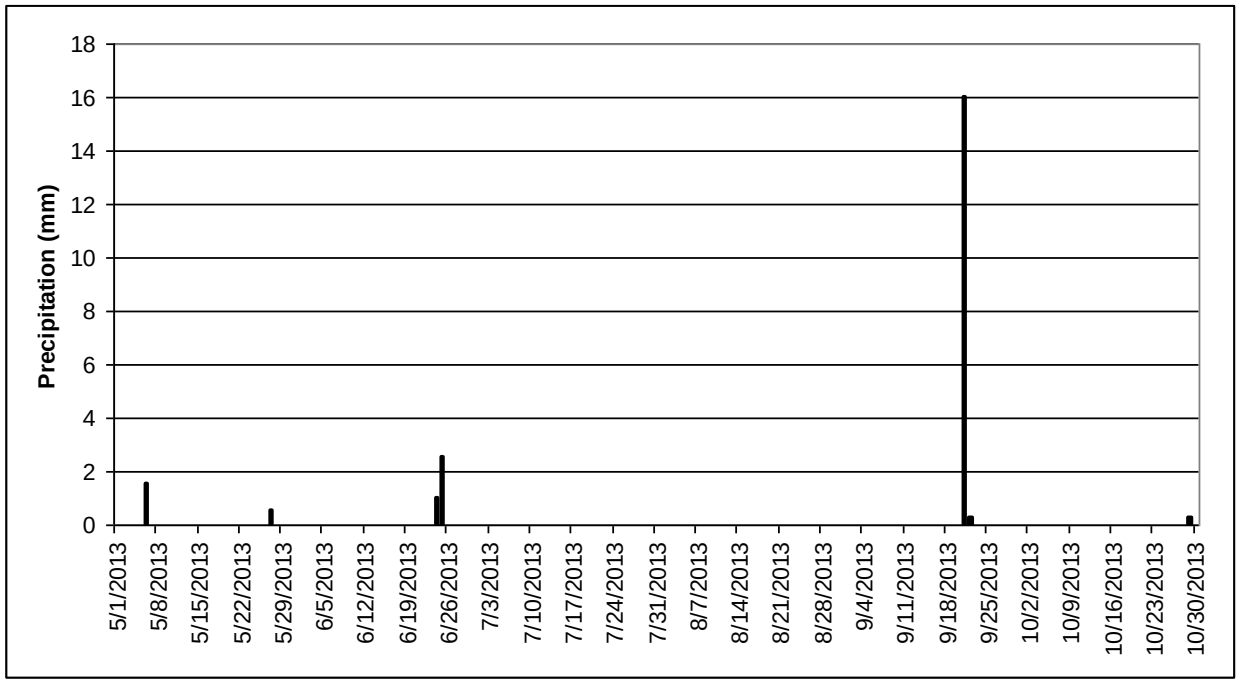
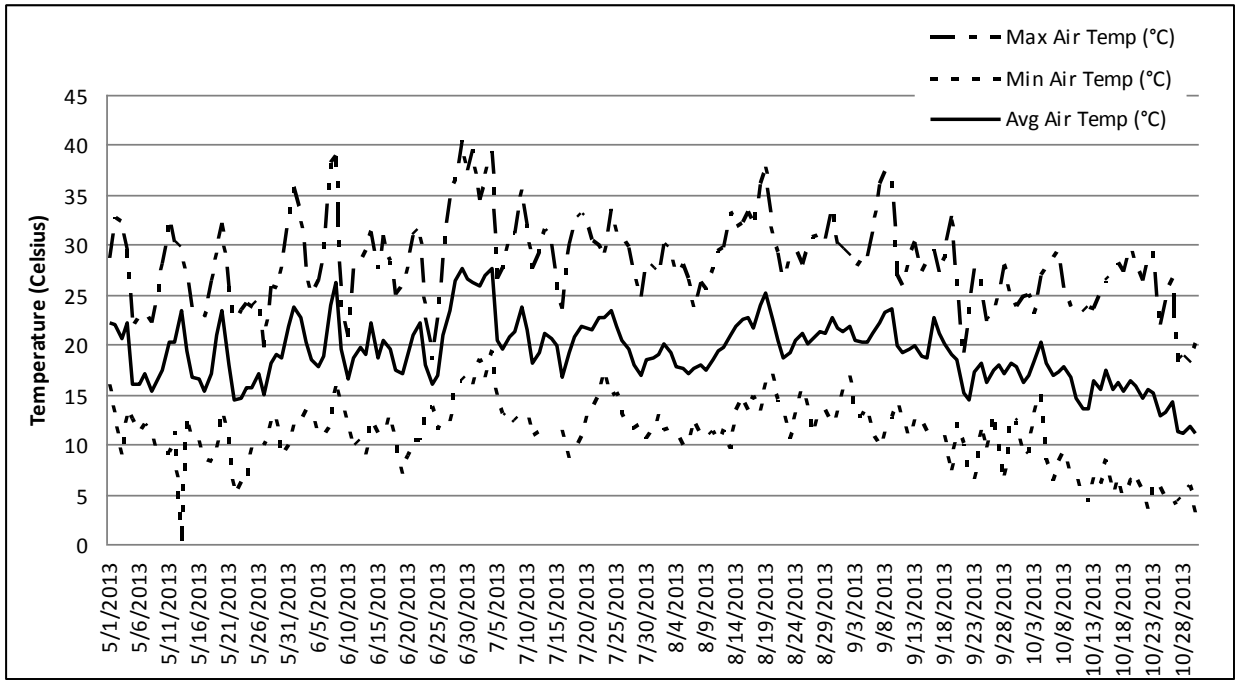


Figure 1b. Air temperature history from 1 May to 30 October 2013. Data are from CIMIS station 121 in Dixon (http://www.cimis.water.ca.gov).



Results

Table 2. Disease incidence and severity. Product names are followed by rate (per acre). Treatment means followed by the same letter are not significantly different according to Student's t test at α=0.05; alt =alternated with.

Treatment	Severity (%)		Incidence (%)	
Air Blow	3.41	a	22.50	ab
Fracture 24.2 fl oz + Stylet oil 1% (v/v) then Vangard 10 oz + Stylet oil 1% (v/v) then Fracture 24.4 fl oz + Sylgard 309 0.25% (v/v) then Vangard 10 oz + Sylgard 309 0.25% (v/v)	2.15	ab	11.25	bcde
Untreated Control	2.09	abc	30.00	a
SynTech Experimental 200 g a.i./ha	1.78	abcd	21.25	abc
Tavano 5% SC 6.5 fl oz alt Elevate 16 oz	1.24	bcd	17.50	abcde
Timorex Gold 0.86 qt	1.19	bcd	18.75	abcd
MCW-710 SC 5.672 fl oz	0.66	bcd	5.00	bcde
SynTech Experimental 60 g a.i./ha	0.66	bcd	11.25	bcde
K-PHITE 7LP 3 qt	0.50	bcd	8.75	bcde
SynTech Experimental 80 g a.i./ha	0.44	bcd	12.50	abcde
Rovral 1 qt + Stylet oil 1% (v/v) then Fracture 24.4 fl oz + Stylet oil 1% (v/v) then Rovral 1 qt + Sylgard 309 0.25% (v/v) then Fracture 24.4 fl oz + Sylgard 309 0.25%(v/v)	0.41	bcd	8.75	bcde
Fontelis 200 g a.i./ha	0.40	bcd	13.75	abcde
SynTech Experimental 100 g a.i./ha	0.39	bcd	12.50	abcde
Switch 14 oz + Taegro 5.2 oz + Dyneamic 0.25% (v/v)	0.38	bcd	7.50	bcde
IKF-5411 13.7 fl oz + Silwet-L-77 0.1% (v/v)	0.30	bcd	6.25	bcde
(Luna Tranquility 16 fl oz then Luna Experience 8 fl oz then Serenade Optimum 16 oz (2x)) + Dyneamic 0.25% (v/v)	0.28	bcd	2.50	de
Tavano 5% SC 6.5 fl oz	0.20	bcd	3.75	cde
Timorex Gold 0.65 qt	0.15	cd	8.75	bcde
Elevate 16 oz + Stylet oil 1% (v/v) then Fracture 24.4 fl oz + Stylet oil 1% (v/v) then Elevate 16 oz + Sylgard 309 0.25% (v/v) then Fracture 24.4 fl oz + Sylgard 309 0.25% (v/v)	0.14	cd	10.00	bcde
Serenade Optimum 16 oz + Dyneamic 0.25% (v/v)	0.14	cd	3.75	cde
Timorex Gold 0.43 qt + Inspire 5.25 fl oz	0.14	cd	6.25	bcde
IKF-5411 20 fl oz + Silwet L-77 (2x) 0.1 (v/v) then Switch (2x) 14 oz	0.13	cd	3.75	cde
Captan Gold 1.675 lb + MCW-710 SC 5.762 fl oz	0.13	cd	3.75	cde
IKF-5411 20 fl oz + Silwet L-77 0.1% (v/v) alt Switch 14oz	0.06	d	3.75	cde
Vangard 10 oz + Stylet oil 1% (v/v) then Fracture 24.4 fl oz + Stylet oil 1% (v/v) then Vangard 10 oz + Sylgard 309 0.25% (v/v) then Fracture 24.4 fl oz + Sylgard 309 0.25% (v/v)	0.04	d	1.25	de
IKF-5411 17.1 fl oz + Silwet L-77 0.1% (v/v)	0.04	d	3.75	cde

IKF-5411 22 fl oz	0.04	d	2.50	de
Tavano 5% SC 13 fl oz	0.04	d	3.75	cde
Luna Tranquility 16 fl oz + Dyneamic 0.25% (v/v)	0.03	d	2.50	de
IKF-5411 20 fl oz	0.03	d	2.50	de
(Luna Tranquility 16 fl oz then Serenade Optimum 16 oz then Luna Experience 8 fl oz then Serenade Optimum 16 oz) + Dyneamic 0.25% (v/v)	0.03	d	1.25	de
Luna Experience 8 fl oz + Dyneamic 0.25% (v/v)	0.03	d	2.50	de
Luna Privilege 200 g a.i./ha	0.03	d	2.50	de
Elevate 16 oz	0.01	d	1.25	de
Timorex Gold 0.43 qt	0.01	d	1.25	de
Inspire 5.25 fl oz	0.01	d	1.25	de
Switch 14 oz	0.00	d	0.00	e
Inspire Super 20 fl oz + Vangard 3 oz + Dyneamic 0.25% (v/v)	0.00	d	0.00	e
Captan Gold 2.5 lb	0.00	d	0.00	e
Captan Gold 1.675 lb	0.00	d	0.00	e

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Appendix: Materials

Product	Active Ingredient(s) and Concentration	Chemical Class (after Adaskaveg et al. 2008)	Manufacturer or Distributor
Captan Gold 80WDG	captan (78.2%)	phthalamide	Mana - Makhteshim Agan of North America, Inc.
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
Fontelis	penthiopyrad (20.4%)	SDHI	Dupont Crop Protection
IKF - 5411	proprietary	proprietary	N/A
Inspire	difenoconazole (23.2%)	DMI	Syngenta Crop Protection, Inc.
Inspire Super 2.82	difenoconazole (8.4%), cyprodinil (24%)	DMI + anilinoprimidine	Syngenta Crop Protection, Inc.
K-Phite 7LP	potassium phosphate (56%)	phosphonates	Plant Food Systems, Inc.

Inspire Super	difenoconazole (8.4%), cyprodinil (24%)	DMI, aniline-primidine	Syngenta Crop Protection, Inc.
Luna Experience	fluopyram (17.54%) tebuconazole (17.54%)	SDHI/ DMI-triazole	Bayer Crop Science
Luna Privilege	fluopyram (41.5%)	SDHI	Bayer Crop Science
Luna Tranquility	fluopyram (11.3%) pyrimethanil (33.8%)	SDHI/AP	Bayer Crop Science
Fracture	protein extracted from the plant of the genus Lupinus (20%)	natural compound	FMC
MCW-710SC	proprietary	proprietary	N/A
Rovral 4F	iprodione (41.6%)	dicarboximide	FMC
Serenade Optimum	QST 713 strain of *Bacillus subtilis* (26.2%)	biological	Bayer Crop Science
Switch	cyprodinil (37.5%), fludioxonil (25.0%)	anilino-pyrimidine	Syngenta Crop Protection, Inc.
Stylet oil	paraffinic oil (97.1%)	oil	JMS Flower Farms
Silwet-L-77	Polyalkyleneoxide modified heptamethyltrisiloxane (99.5%)	adjuvant	Helena Chemical Co.
Sylgard 309	polysiloxane (80%)	adjuvant	Dow Corning Corp
SynTech Experimental	proprietary	proprietary	N/A
Taegro 13WP	*Bacillus subtilis* Strain FZB24	biological	Syngenta Crop Protection, Inc
Tavano 5%SC	Polyoxin D zinc salt (5%)	Polyoxins	Certis USA, LLC
Timorex Gold	oil derived from the tea tree, *Melaleuca alterniflora* (23.8%)	oil	Biomor Israel Ltd.
Vangard	cyprodinil (75%)	anilino-pyrimidine	Syngenta Crop Protection, Inc.

Appendix sources: (1) Adaskaveg, et al. 2012. Efficacy and timing of fungicides, bactericides and biologicals for deciduous tree fruit, nut, strawberry, and vine crops 2012, available at http://ucanr.edu/sites/plp/files/146650.pdf (2) Gubler lab fungicide trials 2013, available at http://plantpathology.ucdavis.edu/Cooperative_Extension/Gubler/2013_Fruit_Crop_Fungicide_Trials/ (3) product-specific MSDS and/or labels.