Evaluation of fungicide programs for management of Botrytis bunch rot of grapes: 2014 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 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 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 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 28 fungicide treatment programs for control of Botrytis bunch rot in Chardonnay grapes in Napa County, California in 2014. Materials included synthetic, biological, and organic treatments. Three applications were made between May and July 2014. Overall disease pressure was low.

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: May 8 (bloom), Jun 12 (pre-close), Jul 17 (veraison). 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	Double Nikel 55 WDG	20 oz	5.7 g
3	GKC	Double Nikel LC	2 qt	19.1 ml
4	YKS	Tavano 5% SC	6.5 fl oz	1.9 ml
5	RC	K-PHITE 7LP + Tactic	3 qt + 6 fl oz/100 gal	28.7 ml + 3.5 ml
6	YG	K-PHITE 7LP + Latron B-1956	3 qt + 6 fl oz/100 gal	28.7 ml + 3.5 ml
7	BS	Isofetamid	20 fl oz	6.0 ml
8	O	Isofetamid + IB18121	8.6 fl oz +15.5 fl oz	2.6 ml + 4.6 ml
9	KS	Isofetamid + IB18121	10.3 fl oz + 15.5 fl oz	3.1 ml + 4.6 ml
10	BC	Isofetamid + IB18111	8.6 fl oz + 5.57 fl oz	2.6 ml + 1.7 ml
11	OS	Isofetamid + IB18111	10.3 fl oz + 5.57 fl oz	3.1 ml + 1.7 ml
12	RKS	Isofetamid + IB18220	6 fl oz + 3.97 fl oz	1.8 ml + 1.2 ml
13	GD	Isofetamid + IB18220	10.3 fl oz + 3.97 fl oz	3.1 ml + 1.2 ml
14	YD	Luna Experience + Syl-Coat	8 fl oz + 4 fl oz/100 gal	2.4 ml + 2.4 ml
15	YKC	Luna Tranquility + Syl-Coat	16 fl oz + 4 fl oz/100 gal	4.8 ml + 2.4 ml
16	KD	(Luna Exp then Serenade Optimum then Luna Tranquility then Serenade Optimum) + Syl-Coat	(8 fl oz then 16 oz then 16 fl oz then 16 oz) + 4 oz/100 gal	(2.4 ml then 4.6 g then 4.8 ml then 4.6 g) + 2.4 ml
17	OD	Pristine + Dyneamic	18.5 oz + 0.25% (v/v)	5.3 g + 18.9 ml
18	PKS	Pristine + Dyneamic	23.5 oz + 0.25% (v/v)	6.7 g + 18.9 ml
19	RKD	QSE-40	1.35 fl oz/25.4 gal	3.1 ml
20	YS	QSE-60	2.03 fl oz/25.4 gal	4.7 ml
21	OKS	(Sonata alt Serenade Optimum) + Kinetic	(3 qt alt 1 lb) + 0.05% (v/v)	28.7 ml alt 4.6 g + 3.8 ml
22	GKD	(Sonata alt Regalia) + Kinetic	(3 qt alt 2 qt) + 0.05% (v/v)	28.7 ml alt 19.1 ml + 3.8 ml
23	KC	(Sonata then Taegro) + Kinetic	(3 qt alt 2.6 oz) + 0.05% (v/v)	28.7 ml alt 0.7 g + 3.8 ml
24	GKS	(Sonata alt Taegro) + Kinetic	(3 qt alt 5.2 oz) + 0.05% (v/v)	28.7 ml alt 1.5 g + 3.8 ml
25	HP/K	GOP-1 Bran + GOP-1 Oil	7 oz/ 25 gal + 32 oz/ 25 gal	15.9 g + 75.7 ml
26	O/KC	Elevate (standard)	16 oz	4.6 g
27	PKS/O	OR-104 + OR Buffer	1 qt + 1 pt	9.6 ml + 4.8 ml
28	HP	Timorex Gold (at veraison, 2 apps 7d interval)	27.4 fl oz	8.2 ml
29	GS	Switch then Timorex Gold (at veraison 7d interval)	14 oz then 27.4 fl oz then 14 oz + 20.6 fl oz	4.0 g then 8.2 ml then 4.0 g then 6.2 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.

C. Trial Map

Table 2: Map layout

YKC	PKS/O	YD	O/KC
OKS	K	BS	W
BC	GKD	RKS	K
YKS	BC	KD	GKC
GKD	GD	HP	YKS
GKC	YD	OKS	RC
RC	KD	YS	YG
BS	O	GKC	BS
OS	GKC	GD	KS
GD	YG	RKD	O
HP/K	O/KC	YKC	OS
W	BS	YKS	BC
PKS/O	HP	KC	GD
RKS	OKS	KS	RKS
GKS	YKC	GKD	YD
RKD	RKS	OS	YKC
O/KC	YS	GS	KD
YG	RKD	W	HP
YS	GKS	K	GS
K	OD	PKS	OD
O	KS	RC	PKS
GS	HP/K	O	RKD
YD	KC	YG	PKS/O
KS	PKS	OD	YS
KD	YKS	BC	OKS
OD	OS	GKS	GKD
KC	RC	HP/K	KC
HP	W	O/KC	GKS
PKS	GS	PKS/O	HP/K

D. Disease and Statistical Analysis

Disease was assessed on Oct 6. Botrytis bunch rot incidence and severity were assessed in each plot by evaluating twenty five random clusters. Incidence was defined as the proportion of clusters in a plot having some Botrytis bunch rot. Severity was determined by estimating the percentage of berries in each cluster. 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 $\alpha=0.05$.

E. Weather and Disease

Figure 1: Precipitation history from May 1 to Oct 6 2014. Data are from a CIMIS station in Carneros (http://www.cimis.water.ca.gov). Five precipitation events were recorded as follows: Aug 5 (0.76 mm), Aug 24 (0.76 mm), Sep 25 (5.33 mm), Sep 26 (1.78 mm) and Sep 27 (0.25 mm).

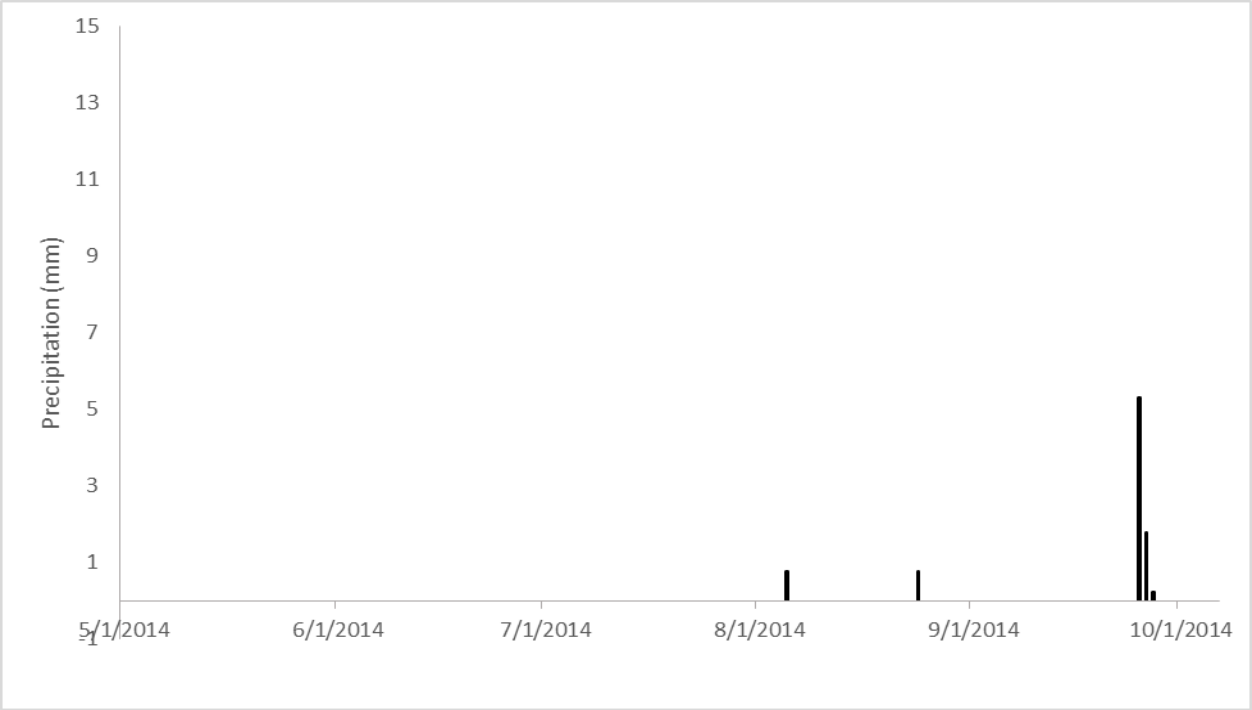
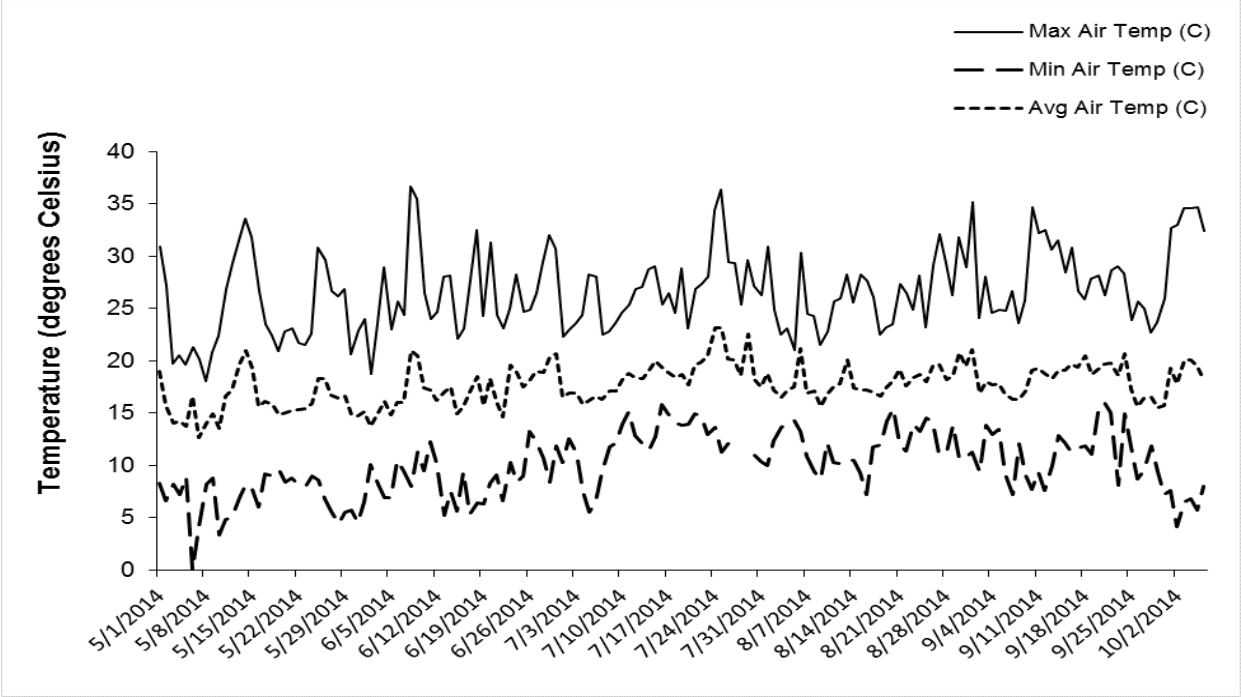


Figure 2: Air temperature history from May 1 to Oct 6 2014. Data are from a CIMIS station in Carneros (http://www.cimis.water.ca.gov).



Results

Table 3: Botrytis bunch rot 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	Disease Incidence (%)		Disease Severity (%)	
Isofetamid 10.3 fl oz + IB18121 15.5 fl oz	0.00	d	0.00	c
Isofetamid 20 fl oz	2.00	cd	0.02	c
Isofetamid 8.6 fl oz + IB18121 15.5 fl oz	2.00	cd	0.02	c
Switch 14 oz then Timorex Gold 27.4 fl oz (at veraison 7d interval)	2.00	cd	0.02	c
(Sonata 3 qt alt Taegro 5.2 oz) + Kinetic 0.05% (v/v)	4.00	cd	0.04	c
Timorex Gold 27.4 fl oz (at veraison, 2 apps 7d interval)	1.00	d	0.15	c
Elevate 16 oz (standard)	4.00	cd	0.18	c
GOP-1 Bran 7 oz/25 gal + GOP-1 Oil 32 oz/25 gal	4.00	cd	0.18	c
(Luna Exp 8 fl oz then Serenade Optimum 16 oz then Luna Tranquility 16 fl oz then Serenade Optimum 16 oz) + Syl-Coat 4 fl oz/100 gal	4.00	cd	0.19	c
K-PHITE 7LP 3 qt + Tactic 6 fl oz/100 gal	2.00	cd	0.20	c
Isofetamid 10.3 fl oz + IB18220 3.97 fl oz	2.00	cd	0.20	c
Pristine 23.5 oz + Dyneamic 0.25% (v/v)	2.00	cd	0.26	c
Pristine 18.5 oz + Dyneamic 0.25% (v/v)	5.00	cd	0.29	bc
Double Nikel LC 2 qt	1.00	d	0.30	bc
Isofetamid 10.3 fl oz + IB18111 5.57 fl oz	3.00	cd	0.30	bc
Isofetamid 6 fl oz + IB18220 3.97 fl oz	2.00	cd	0.30	bc
(Sonata 3 qt alt Taegro 2.6 oz) + Kinetic 0.05% (v/v)	7.00	bcd	0.32	bc
(Sonata 3 qt alt Serenade Optimum 1 lb) + Kinetic 0.05% (v/v)	5.00	cd	0.33	bc
QSE-40 1.35 fl oz/25.4 gal	3.00	cd	0.35	bc
Luna Experience 8 fl oz + Syl-Coat 4 fl oz/100 gal	1.00	d	0.45	bc
QSE-60 2.03 fl oz/25.4 gal	4.00	cd	0.57	bc
Luna Tranquility 16 fl oz + Syl-Coat 4 fl oz/100 gal	3.00	cd	0.60	bc
Isofetamid 8.6 fl oz + IB18111 5.57 fl oz	6.00	bcd	0.69	bc
OR-104 1 qt + Buffer 1 qt	6.00	bcd	0.78	bc
(Sonata 3 qt alt Regalia 2 qt) + Kinetic 0.05% (v/v)	13.00	b	0.87	bc
Double Nikel 55 WDG 20 oz	5.00	cd	1.31	bc
Tavano 5% SC 6.5 fl oz	4.00	cd	1.80	bc
K-PHITE 7LP 3 qt + Latron B-1956 6 fl oz/100 gal	9.00	bc	2.13	b
Untreated Control	22.82	a	4.44	a

Acknowledgements

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Appendix: Materials

Product	Active Ingredient(s) and Concentration	Chemical Class (after Adaskaveg et al. 2008)	Manufacturer or Distributor
Double Nickel LC	*Bacillus amyloliquefaciens* strain D747* (98.85%)	biological	Certis
Double Nickel 55 WDG	*Bacillus amyloliquefaciens* strain D747* (25.0%)	biological	Certis
Dyne-amic	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
GOP-1 Bran	proprietary	proprietary	N/A
GOP-1 Oil	proprietary	proprietary	N/A
IB18111	proprietary	proprietary	N/A
IB18121	proprietary	proprietary	N/A
IB18220	proprietary	proprietary	N/A
Isofetamid	proprietary	proprietary	N/A
K-Phite 7LP	potassium phosphate (56%)	phosphonates	Plant Food Systems, Inc.
Kinetic	blend of polyalkyleneoxide modified polydimethylsiloxane and nonionic surfactants (99%)	adjuvant	Helena Chemical Co.
Latron B-1956	modified phthalic glycerol alkyd resin (77.0%)	adjuvant	Dow AgroSciences LLP
Luna Experience	fluopyram (17.54%) tebuconazole (17.54%)	SDHI (7)/ DMI-triazole (3)	Bayer Crop Science
Luna Tranquility	fluopyram (11.3%) pyrimethanil (33.8%)	SDHI (7)/ AP (9)	Bayer Crop Science
OR Buffer	proprietary	proprietary	N/A
OR-104	proprietary	proprietary	N/A

Pristine	pyraclostrobin (12.8%) boscalid (25.2%)	SDHI (7)/QoI(11)	BASF
QSE-40	proprietary	proprietary	N/A
QSE-60	proprietary	proprietary	N/A
Regalia	extract of *Reynoutria sachalinensis* (5%)	natural product	Marrone Bio Innovations
Serenade Optimum	QST 713 strain of *Bacillus subtilis* (26.2%)	biological	Bayer Crop Science
Sonata	*Bacillus pumilus* QST 2808 (1.38%)	biological	Agraquest
Syl-Coat	polyether-polymethylsiloxane-copolymer and Polyethe (100%)	adjuvant	Wilbur-ellis
Switch	cyprodinil (37.5%), fludioxonil (25.0%)	phenylpyrrole (12)/ AP (9)	Syngenta Crop Protection, Inc.
Tactic	synthetic latex, 1,2-propanediol, Alcohol ethoxylate, silicone polyether copolymer (63.4%)	adjuvant	Loveland Products
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.

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.