Management of Grape Summer Bunch Rot with Synthetic, Biological, and Organic Fungicides in Armstrong (2024)

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Report Summary

Summer bunch rot (SBR) of grapes is caused by multiple microorganisms, including *Botrytis cinerea*, and different species of *Aspergillus*, *Cladosporium*, and *Alternaria*[1]. The disease can also lead to the development of sour rot, which has recently been distinguished from summer bunch rot by the association of acetic acid bacteria and yeasts that confer a pungent odor to the rotting berries[2]. This report shows the results of a fungicide spray trial conducted at an experimental vineyard at the Plant Pathology Field Station of the University of California, Davis (38°31'21.3" N, 121°45'38.6" W). The trial was carried out from May to July 2024, using Chardonnay vines. Treatments were applied to runoff using mist blower backpack sprayers (Stihl SR 430). The trial had a complete randomized block design with five replicates of two vines each. Spray frequencies varied from 1 month intervals, starting on May 24th. Spraying was completed on July 17th based on the berry maturity level, and disease incidence and severity were evaluated on September 17th, 2024.

Materials and Methods

A. Experimental design

Table 1. Details of the experimental design, vine spacing, spray volumes and equipment utilized in the trial.

Experimental design	Randomized complete block design with 5 replicates		
Experimental unit	2 adjacent vines = 1 plot		
Row and tree spacing	11 ft (row) and 7 ft (vine)	Plot unit area	154 ft^2
Area/treatment	770 ft^2 or 0.0177 acre/treatment (5 replicates = 1 treatment)		
Volume water/acre	50 gallons = 0.88 gal/5 reps 100 gallons (late May) = 1.77 gal/5 reps 150 gallons (early June) = 2.65 gal/5 reps		
Equipment	Stihl SR 430 mist blower backpack sprayers		

B. Experimental treatments

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

D. Vine Management

During the application period, vines were irrigated by drip and sprinkler irrigation.

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[1] Bustamante, M. I., Elfar, K., Kuzmenko, J., Zaninovich, T., Arreguin, M., Carachure, C., Zhuang, G., Michailides, T. J., and Eskalen, A. 2024. Reassessing the Etiology of Aspergillus Vine Canker and Summer Bunch Rot of Table Grapes in California. Plant Disease 108:941-950.

[2] Hall, M. E., Loeb, G. M., Cadle-Davidson, L., Evans, K. J., and Wilcox, W. F. 2018. Grape Sour Rot: A four-way interaction involving the host, yeast, acetic acid bacteria, and insects. Phytopathology 108:1429-1442.

E. Data Collection and Statistical Analysis

Disease incidence and severity were assessed after evaluating 25 random clusters per treatment on each block (a total of 5 blocks, representing 5 replicates of each treatment). **Incidence** was assessed as the proportion of clusters showing symptoms or signs of bunch rot per treatment on each block (i.e. number of symptomatic clusters per total clusters evaluated). **Severity** was determined by estimating the area covered by bunch rot symptoms on each cluster, and percentages of each plot were then averaged. Data of incidence and severity were separately subjected to analysis of variance (ANOVA) using generalized lineal models and means were further compared using Fisher's LSD test (α=5%) in the software InfoStat version 2020. Results are shown in Table 2.

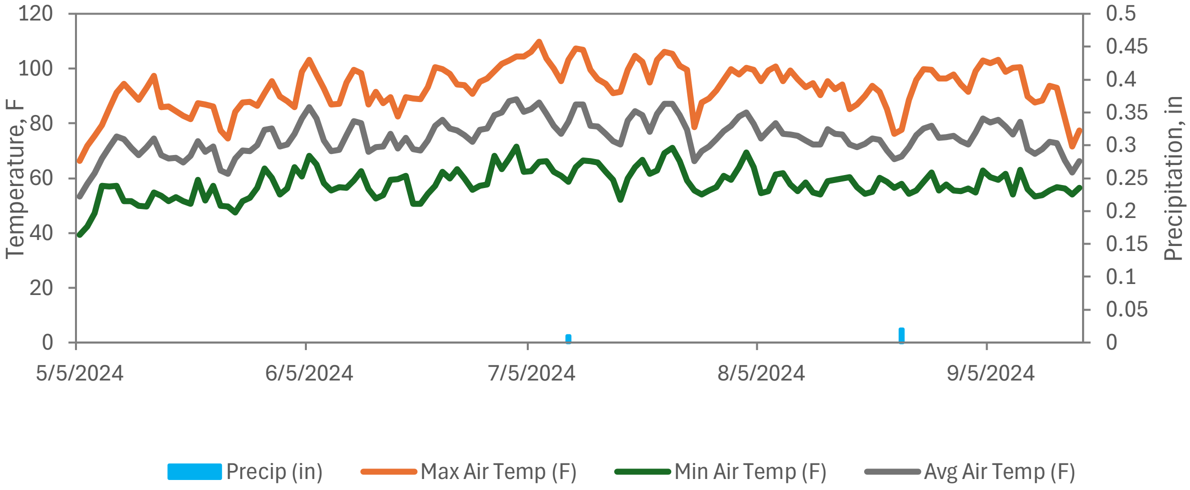

Figure 1. Average daily temperature (°C) and precipitation (mm) from May 19th to September 17th, 2024, from CIMIS, Sacramento Valley, CA.

Results

Table 2. Disease incidence and severity of synthetic fungicides and combinations of synthetic with soft chemistry products. Product names are followed by rate (per acre).

Treatment			Application interval (days)	SBR on the cluster^{Y}	
Nº	**Flag**	**Rate/A^{Z}**		**Incidence (%)**	**Severity (%)**
1	W	Untreated Control		5.6 n.s.	0.07 n.s.
2	K **(IS)**	Switch 14 oz Pristine 23 oz Elevate 16 oz	A B C	4.0	0.11
3	KD	AGS26 (FunThyme) 14 fl oz + Sylcoat 4fl oz / 100 Gal	A,B,C	4.8	0.10
4	KS	AGS26 32 fl oz + Sylcoat 4fl oz / 100 Gallons	A,B,C	6.4	0.30
5	KC	Amara 2 qts + Dyne-Amic 0.125% v/v Switch 14 oz Pristine 23 oz	A,B C D	5.6	0.14
6	O	Amara 2 qts + Dyne-Amic 0.125% v/v	A,B,C	4.8	0.16
7	OS+O	OR-536 4 lb	A,B,C	4.0	0.29
8	OC+O	OR-536 4 lb + OR-097A 16 fl. oz/100 gal	A,B,C	6.4	0.15
9	OKD	OR-536 4 lb + OR-097A 32 fl. oz/100 gal	A,B,C	6.4	0.25
10	OKS	OR-159B 64 fl oz/100 gal + OR-514 32 fl. oz/100 gal	A,B,C	8.8	0.38
11	ONS	OR-159B 128 fl oz/100 gal + OR-514 64 fl. oz/100 gal	A,B,C	8.8	0.3
12	Y	Scala DFO 17 fl oz + Dyne-Amic 6.4 fl oz	A,B,C	9.6	0.39
13	YD	Inspire Super 20 fl oz + Dyne-Amic 6.4 fl oz	A,B,C	7.2	0.21
14	YS	Scala DFO 17 fl oz + Dyne-Amic 6.4 fl oz Miravis Prime 14 fl oz + Dyne-Amic 6.4 fl oz Scala DFO 12 fl oz + Dyne-Amic 6.4 fl oz	A B C	5.6	0.27
15	YC	Inspire Super 20 fl oz + Dyne-Amic 6.4 fl oz Miravis Prime 14 fl oz + Dyne-Amic 6.4 fl oz Inspire Super 20 fl oz + Dyne-Amic 6.4 fl oz	A B C	4.0	0.04
16	YKD	ApF23002 64 fl oz + Dyne-Amic 0.125% v/v	A,B,C	5.6	0.15
17	YKS	ApF23002 32 fl oz Dyne-Amic 0.125% v/v	A,B,C	8.8	0.24
18	YKC	Mevalone 55 fl oz + OSS 0.125%v/v	A,B,C	5.6	0.16
19	YRD	SA-0650004 28 fl oz	A,B,C	3.2	0.13
20	YRS	Mevalone 55 fl oz + OSS 0.125% v/v Miravis Prime 13.4 fl oz + DyneAmic 0.125% v/v	A,C B	3.2	0.18
21	R	SA-0130310 18.5 fl oz	A,B,C	6.4	0.44
22	RD	SA-650120 41 fl oz + NIS 0.125% v/v	A,B,C	6.4	0.44
23	RS+R	Inspire Super 20 fl oz + Dyne-Amic 0.125% v/v Quintec 6.6 fl oz + Dyne-Amic 0.125% v/v Vivando 15.4 fl oz+ Dyne-Amic 0.125% v/v	A B C	8.0	0.19
24	RC+R	AgriTian	A,B	2.4	0.10
25	RKD	AgriTitan	A,B,C	4.8	0.16
26	RKS	NSTKI-028 3 lb	A,B,C	5.6	0.17
27	RKC	NSTKI-028 4 lb	A,B,C	1.6	0.08
28	G	Switch 14 oz + OxiDate 5.0 0.5% v/v Pristine 23 oz+ OxiDate 5.0 0.5% v/v Elevate 16 oz+ OxiDate-5 0.5% v/v	A B C	2.4	0.06

29	GD	Switch 14 oz OxiDate 5.0 1.0% v/v Elevate 16oz	A B C	3.2	0.11
30	GS	ApF23002 32 fl oz + Dyne-Amic 0.125% v/v Pristine 23 oz Elevate 16 oz	A B C	4.0	0.10
31	GKD	ApF23002 64 fl oz + Dyne-Amic 0.125% v/v Pristine 23 oz Elevate 16 oz	A B C	3.2	0.06
32	GKS	Switch 14 oz Pristine 23 oz ApF23002 32 fl oz + Dyne-Amic 0.125% v/v	A B C	4.8	0.15
33	GKC	Switch 14 oz Pristine 23 oz ApF23002 64 fl oz + Dyne-Amic 0.125% v/v	A B C	4.8	0.13
34	B	Switch 14 oz ApF23002 64 fl oz + Dyne-Amic 0.125% v/v	A B,C	8.0	0.22
35	BD	Miravis Prime 13.4 fl oz + Dyn-Amic 0.125% v/v Vangard 10.0 oz +Dyn-Amic 0.125% v/v Miravis Prime 13.4 fl oz + Dyn-Amic 0.125% v/v	A B C	4.8	0.13
36	BS	Miravis Prime 13.4 fl oz + Dyn-Amic 0.125% v/v Miravis Prime 13.4 fl oz +Dyn-Amic 0.125% v/v Vangard 10.0 oz +Dyn-Amic 0.125% v/v	A B C	3.2	0.06
37	BC	(AF0604-T02-101) 22.41 oz Elevate 16 oz	A,B C	4.0	0.10

[Z] Products with a '+' sign in between indicate a tank mix.

[Y] n.s. = not significant

IS=industry standard

Acknowledgments

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Appendix: Materials

Product	**Active ingredient(s) and concentration**	**Manufacturer or distributor**	**Chemical class (Frac Code)**
(AF0604-T02-101)	proprietary	Biotalys	N/A
AgriTitan	proprietary	AgriTitan	N/A
AGS26-FunThyme	proprietary	Agrospheres	N/A
Amara	proprietary	Nichino	N/A
ApF23002	proprietary	Meese	N/A
Dyne-Amic	polyalkyleneoxide modified polydimethylsiloxane, nonionic emulsifiers, methyl ester of c16-c18 fatty acids (99%)	Helena Chemical Co.	adjuvant
Elevate 50 WG	fenhexamid	Arysta LifeScience North America LLC	KRI (17)
Inspire Super	Difenoconazole + cyprodinil	Syngenta	DMI (3), AP (9)
Mevalone	proprietary	Sipcam	N/A
Miravis Prime	Fludioxonil (21.4%) + pydiflumetofen (12.8%)	Syngenta	PP (12), SDHI (7)
NIS	Adjuvent	N/A	N/A
NSTKI-028	proprietary	NovaSource	N/A
OR-159B	proprietary	Oro-Agri	N/A
OR-097A	proprietary	Oro-Agri	N/A
OR-514	proprietary	Oro-Agri	N/A
OR-536	proprietary	Oro-Agri	N/A
OxiDate 5.0	Peroxyacetic Acid (5%), Hydrogen Peroxide (27%)	BioSafe Systems	N/A
OSS	Adjuvant	N/A	N/A
Quintec	Quinoxyfen	Corteva	Aryloxyquinoline (13)
Pristine	pyraclostrobin (12.8%), boscalid (25.2%)	BASF	QoI(11)/SDHI (7)
SA-0130310	proprietary	Sipcam	N/A
SA-0650004	proprietary	Sipcam	N/A
SA-650120	proprietary	Sipcam	N/A
Scala	Pyrimethanil (54.6%)	Bayer CropScience	AP (9)
Serenade ASO	*Bacillus subtilis* qst 713 (26%)	Bayer CropScience	microbial (44, NC)
Switch	cyprodinil (37.5%), Fludioxonil (25.0%)	Syngenta	AP (9)/ Phenylpyrroles (12)
Syl-Coat	polyether-polymethylsiloxane-copolymer and polyether-100%	Wilbur-Ellis	adjuvant
Vangard	Cyprodinil	Syngenta	AP (9)
Vivando	Metrafenone	BASF	U-08

Summer bunch rot/sour rot and Aspergillus Vine Canker of Grapevine

Current Management Options

Marcelo I. Bustamante[1], Karina Elfar[1], Thomas Zaninovich[1], Carlos Carachure[1], George Zhuang[2] Justin Tanner[3] and Akif Eskalen[1],
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BACKGROUND: Summer bunch rot (SBR) is a disease complex affecting grapes caused by multiple organisms such as *Botrytis cinerea, Aspergillus tubingensis*, *A. carbonarius*, *A. niger*, *Alternaria* sp. *Cladosporium* sp., *Rhizopus* sp., and *Penicillium* sp. (Fig. 1-2). Ripening berries (> 8° Brix) are susceptible to infection by these fungi that frequently enter through injuries caused by insects or birds, mechanical injury (especially during mechanical leaf removal), or scars caused by powdery mildew (Fig. 3). SBR is more prevalent in the warmer areas of central and southern San Joaquin Valley, whereas Botrytis bunch rot (only by *Botrytis* spp.) is more common in the cooler northern San Joaquin Valley and coastal production areas. Recently, sour rot (or melting decay) has separately been characterized from SBR, differing by the presence of yeasts and acetic acid bacteria that produce a vinegar-like smell. Both yeast and bacteria can be spread by vinegar fruit flies (*Drosophila*) that are attracted to the rotting clusters (Fig. 2B). By the time sour rot has developed, it is often difficult to determine the primary cause.
Our studies have shown that these Aspergillus species associated with SBR can also cause Aspergillus vine canker (AVC) on grapevine wood (Fig. 4), a disease different from common grapevine trunk diseases. A single vine can harbor multiple *Aspergillus* species located on different parts of the vine, including the trunk, cordon, and spurs.

SYMPTOMS: Summer bunch rot can be recognized by masses of black, brown, or green spores on the surface of the berries (Fig. 2, 3), leakage of berry juices, and the presence of vinegar flies. Symptoms include hairline cracks in the berry skin, watery discoloration of berries, and general berry breakdown. Decay continues to develop slowly under cold storage conditions.
Aspergillus vine canker can be easily distinguishable by their premature senescence of leaves during the fall, while healthy vines are still green (Fig. 4A). Black sporulation at the surface and underneath the bark of affected tissues is very common (Fig. 4D). Internally, a brown discoloration is evident in the xylem near the margin of the cankers (Fig. 4B), whereas the areas under the sporulation show necrosis and black discoloration near the bark (Fig. 4C). In severe cases, the canker can girdle most of the vascular area.

LIFE CYCLE: Botrytis overwinters as sclerotia in mummified berries on the vine, ground, or 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 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.

MANAGEMENT: Canopy management practices such as shoot thinning, hedging, and leaf removal can be used to manage canopy density when appropriate. Removal of basal leaves immediately after berry set can significantly reduce disease incidence and severity. In warmer growing areas, excessive leaf removal may result in sunburned fruit. This condition worsens when leaves are removed later in the season, especially on canopies with southern and western afternoon exposures. Our laboratory annually examines the efficacy of fungicide treatment programs to prevent and control these complex diseases using synthetic, biological, and organic fungicides. Results from these trials can be found on our lab website at https://ucanr.edu/sites/eskalenlab


Figure 1. Summer bunch rot symptoms on table grape

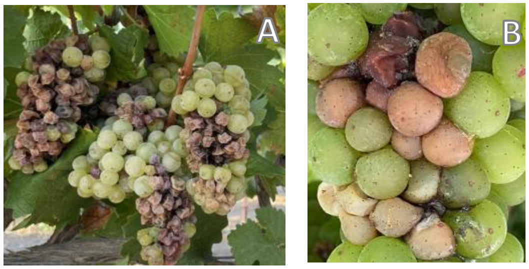

Figure 2. Summer bunch rot symptoms on wine grape (A). Sour rot and fruit flies (B).

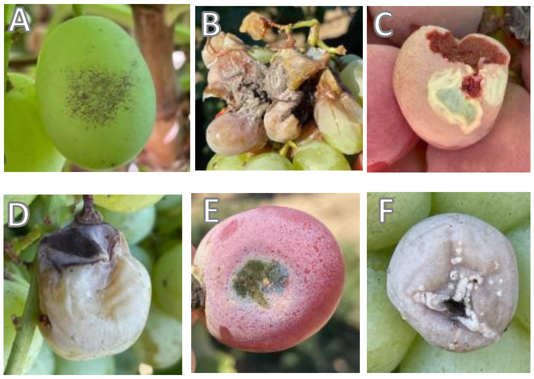

Figure 3. Various summer bunch rot/sour rot symptoms on berries (B-F). Powdery mildew scar (A), Botrytis (B), Penicillium (C), Aspergillus (D), Cladosporium (E), yeast (F).

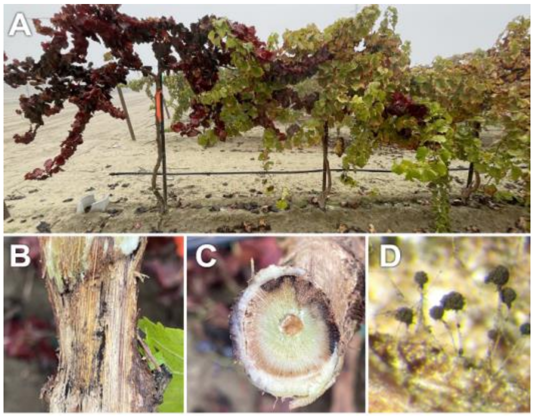

Figure 4. Symptoms of Aspergillus Vine Canker of grapes in California. Premature senescence of the canopy during the fall (A). Sporulation on cankered tissue (B). Cross-section of a trunk showing cankers (C). Sporulation of black aspergilli on decayed berries (D).