UCCE Sacramento County Chemical Bunch Rot Trials—1995

Roger Duncan, UC Viticulture Farm Advisor

Introduction:
Summer bunch rot is a very serious problem for wine grape growers in the San Joaquin Valley. Tight clustered varieties, i.e., Zinfandel, Chenin blanc, Petite Sirah, etc., are most susceptible. This disease complex usually involves sour rot in combination with *Aspergillus niger* and *Botrytis cinerea*. Other genera of fungi are involved, including *Penicillium, Cladosporium, Rhizopus,* and others. Wineries are reluctant to accept loads with even moderate levels of Aspergillus or sour rot due to off flavors produced in the wine.

Summer bunch rot is most severe in the hottest, most arid locations in the Central Valley. This is in contrast to the relatively cool North Coast and Central Coast grape growing regions where *Botrytis cinerea* is the predominant bunch rot pathogen.

Sour rot is difficult to control and is not fully understood. *Acetobacter* bacteria convert the sugar in berry juice into acetic acid, causing a sour or vinegar odor. Other bacteria and several yeast species probably play a role, as do insect vectors such as vinegar flies and dried fruit beetles. It has been suggested that sour rot results from early infections of *Botrytis cinerea* or other fungi that fail to colonize the berry but allow *Acetobacter* a port of entry. However, previous UC trials indicate that bloom sprays with iprodione, while significantly reducing Botrytis bunch rot, are not effective in controlling sour rot or *Aspergillus niger.* Trials were conducted in 1995 to determine which, if any, chemical or cultural control strategy will effectively manage the summer bunch rot complex of wine grapes conunon in the San Joaquin Valley.

Materials and Methods:
Two trials were conducted in commercial wine grape vineyards located in Sacramento County. One trial (Trial A) was conducted in a "Zinfandel" vineyard located in the Clarksburg Wine Growers Appellation (Sacramento-San Joaquin Delta area). This location is cooler than in the San Joaquin Valley and is prone to cool delta breezes at night. Bunch rot by *Botrytis cinerea* predominates in this area. A second trial (Trial B) was conducted in a "Petite Sirah" vineyard located on the east side of Sacramento County in the Lodi-Woodbridge Appellation. While not quite as hot as the southern portion of the San Joaquin Valley, this area is warmer and more arid than the Delta area and thus more prone to the summer bunch rot complex.

Both trials were arranged in randomized complete block designs with four replications of twenty-eight treatments. In each replication, treatments were applied to two vines (a center vine and adjacent half-vines, i.e., post to post). Data were collected from the center vine. Treatments included most of the chemical fungicides currently registered for use on wine grapes in California as well as several unregistered and experimental materials. Several biological control organisms were also applied. A leaf removal treatment was included in the trials. No fungicides were applied by the growers in experimental areas of these vineyards except for powdery mildew control (i.e., sulfur dust).

Chemical and biological materials suspended in water were applied with a motorized, backpack sprayer. Dust materials were applied with a "Dustin-Mizer" brand, hand-held duster. Water sensitive spray cards were placed within the canopy in the cluster zone to monitor spray coverage. Most fungicide treatments were applied at full bloom and just prior to bunch closure. Since Dithane cannot be applied after bloom, Botran 75W was applied at preclose in the Dithane treatments. The dust materials (COCS and Botran 6) were applied preclose and at veraison and were also sprayed with Botran 75W + Dithane DF at bloom.

To determine the effect of application timing on summer rot, Rovral was applied at bloom, preclose, veraison, or preharvest; bloom + preclose; bloom + preclose + veraison; or bloom + preclose + veraison + preharvest. Biological control materials were applied at bloom, preclose, and veraison at concentrations ranging from 3×10^5 to 2×10^6 cfu / ml. Leaf removal was performed ca. 3 weeks after bloom by manually removing leaves from above, below and opposite each cluster. Table 1 lists all 28 treatments.

On the date of commercial harvest, clusters were evaluated for bunch rots. All clusters from each data vine were picked into 2.5 x 1.5 x 1.0 ft plastic tubs. Twenty clusters were randomly selected (without looking) from each tub and evaluated for incidence and severity of sour rot, rots caused by *Botrytis cinerea*, *Aspergillus niger*, other fungi including *Penicillium* and *Rhizopus* spp., and total rot. Bunch rot **incidence** is the percent of sampled clusters with bunch rot. Bunch rot **severity** is the percent of rotted berries per affected cluster. Their product, **incidence x severity**, best approximates the total amount of rot in the treatment.

Results:
In both trials, the predominant bunch rot was caused by *Botrytis cinerea* (9.5% in Trial A, nontreated and 10.5% in Trial B, nontreated). Trial A had very low levels of *Aspergillus niger* and sour rot in untreated vines (1.0% and 3.9%, respectively) while levels in Trial B were moderate (7.5% and 6.1%, respectively).

Results from Trial A and Trial B were similar. In order to draw more statistically significant conclusions regarding treatment differences, data from the two trials were combined. Tables 2-5 list bunch rot levels for all treatments. Some general conclusions can be drawn from the data:

- Almost every treatment significantly reduced levels of "total rot" compared to the nontreated controls. This was because every treatment reduced levels of *Botrytis cinerea*. Botrytis was the predominant fungal pathogen in these vineyards. Chemical materials that proved most effective for controlling Botrytis in these trials were Captan, Rovral, Fluazinam, Ciba-Geigy material, Benlate + Captan, ProGibb, Dithane, and Rally. Leaf removal and several biological materials were also very effective.

- Few chemical treatments were effective against *Aspergillus niger*. Some of the most effective treatments were leaf removal and some biological control materials. Dithane, Benlate + Captan, and Botran 75W were significantly lower than the untreated controls.

However, Aspergillus levels were fairly low even in the untreated controls and therefore it is difficult to draw valid conclusions regarding treatment differences.

- Only ProGibb significantly reduced sour rot compared to the untreated control. Copper containing materials (COCS and Bravo C/M) generally did well, probably because a large part of the sour rot complex is bacterial. Botran 75W and Dithane showed some promise as did leaf removal and a few biological control materials.

- Timing of Rovral applications made little difference in rot control. Fungicide applications may be most effective if timing is based on weather conditions instead of berry development. In general, the best single application timing appeared to be at bloom. In addition, there was no advantage in multiple applications in these trials. Also in general, multiple applications of Rovral tended to have lower levels of Botrytis but higher levels of sour rot.

Comments:
It is evident that the summer bunch rot complex is a very complicated disease and is not easily controlled through applications of fungicides. Most fungicides are more effective on specific components of the complex (i.e., Botrytis or sour rot) while having little or no effect on others. All treatments significantly reduced Botrytis bunch rot. Since Botrytis is the predominant bunch rot pathogen in this area, almost all treatments reduced the amount of "total rot." However, in hotter areas where Botrytis is a much smaller part of the picture and most of the rot is sour rot and Aspergillus, many of these materials may not be effective.

It is also evident that a complex, microbiological ecosystem exists within the clusters. This is expressed when one fungicide reduces one component of the disease complex while tending to increase another. Previous bunch rot trials have also documented this shift. Other evidence is that several biological control materials were successful in reducing many of the "secondary" rots, such as sour rot and Aspergillus.

Changing the microclimate within the canopy (leaf removal) and the clusters (ProGibb) was also very successful. Based on results of these trials and trials conducted in the past, one of the most effective ways to control bunch rot in the San Joaquin Valley is by minimizing damage to the berries. ProGibb elongates and loosens the cluster architecture, thereby decreasing berry splitting and thus rot in tight clustered varieties.

The climate in Sacramento County is somewhere between the Napa/Sonoma area and the Southern portion of the San Joaquin Valley climates (Madera, Fresno, Tulare, and Kern Counties). Further testing of control measures for the summer bunch rot complex needs to be conducted in areas (and years) more conducive to this disease.

1995 Bunch Rot Trial—Table 1.

Treatments

1) Nontreated
2) Rovral 4F 2 pints - **bloom**
3) Rovral 4F 2 pints - **preclose**
4) Rovral 4F 2 pints - **veraison**
5) Rovral 4F 2 pints - **preharvest**
6) Rovral 4F 2 pints - **bloom + preclose**
7) Rovral 4F 2 pints - **bloom + preclose + veraison**
8) Rovral 4F 2 pints - **bloom + preclose + veraison + preharvest**
9) NZYM 60 ppm*
10) Botran 75W - 2.7 lbs
11) Dithane DF - 2.5 lbs at bloom, Botran 75W preclose
12) Botran 75W (2.7 lbs) + Dithane DF (2.5 lbs) at bloom, Botran 75W preclose
13) Ciba material (CGA-219417 75WP)* - 561 grams a.i.
14) Bravo C/M* - 3.5 lbs
15) Fluazinam 500F* - 6 oz
16) Rally 40 W - 5 oz
17) Captan 50 WP - 4 lbs
18) Benlate SP (24 oz) + Captan 50 WP (4lbs)
19) Botran 6 dust - 30 lbs
20) COCS 15 dust - 25 lbs
21) *Cladosporium* sp.
22) *Aureobasidium* sp.
23) *Cryptococcus laurentii*
24) *C. flavus* (89-160)
25) *C. flavus* (89-211)
26) Bacterial antagonist
27) ProGibb (7.5 ppm) - applied ca. 4 weeks before bloom
28) Leaf removal - shaded side only

*Clusters from vines treated with unregistered materials destroyed after harvest evaluation.

All materials were applied at the highest rates allowed by label.

Table 2. UCCE Sacramento County Chemical Bunch Rot Trials—1995

Roger Duncan, UC Viticulture Farm Advisor

	Total % Rot of Sampled Clusters (Incidence x Severity)	
Fungicide	**Botrytis cinerea (%)**	
Control	10.6	A
C. flavus 89-211	6.6	B
COCS[2]	6.3	B
NZYM	5.6	BC
Botran 6[2]	5.5	BC
Bacterial antagonist	4.4	BCD
Botran + Dithane[3]	4.2	BCDE
Cladosporium	4.1	BCDE
Botran	4.1	BCDEF
Bravo C/M	4.0	BCDEFG
Rovral - veraison	3.6	BCDEFG
Rally	3.4	BCDEFGH
C. flavus 89-160	2.9	CDEFGH
C. laurentii	2.8	CDEFGH
Dithane[3]	2.8	CDEFGH
Rovral - preharvest	2.4	CDEFGH
ProGibb[4]	2.0	DEFGH
Rovral - preclose	1.8	DEFGH
Aureobasidium	1.4	DEFGH
Benlate + Captan	1.2	DEFGH
Ciba (CGA-219417)	1.0	EFGH
Rovral - 4 applications[1]	1.0	EFGH
Leaf removal	0.9	EFGH
Rovral - bloom	0.8	FGH
Fluazinam	0.8	GH
Rovral - 3 applications[1]	0.7	GH
Rovral - 2 applications[1]	0.3	H
Captan	0.2	H

← Dithane Bloom Spray[3]

LSD = 3.4

Means within a column with the same letter are not significantly different by LSD test (P = 0.05).

[1]Rovral 2 applications = bloom + preclose
3 applications = bloom + preclose + veraison
4 applications = bloom + preclose + veraison + preharvest

[2]Botran + Dithane applied at bloom, COCS and Botran 6 dust applied preclose and veraison.

[3]Dithane applied only at bloom, Botran applied preclose.

[4]ProGibb applied ca. 4 weeks prior to full bloom at 7.5 ppm.

Except where noted above, all materials applied at bloom and preclose. All fungicides applied at highest rate allowed by label in equivalent of 100 gallons water per acre with a motorized backpack sprayer.

Table 3. UCCE Sacramento County Chemical Bunch Rot Trials—1995

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	Total % Rot of Sampled Clusters (Incidence x Severity)		
Fungicide	**Aspergillus niger (%)**		
Control	4.2	A	
Bravo - C/M	4.2	A B	
Rovral - 3 applications[1]	4.1	A B C	
Fluazinam	4.0	A B C D	
Captan	3.9	A B C D E	
Bacterial antagonist	3.2	A B C D E F	
Rally	3.0	A B C D E F	
C. flavus 89-211	3.0	A B C D E F	
C. flavus 89-160	2.9	A B C D E F	
Rovral - 2 applications[1]	2.7	A B C D E F	
Rovral - preharvest	2.6	A B C D E F	
Rovral - bloom	2.0	A B C D E F	
Botran 6 dust[2]	2.0	A B C D E F	
ProGibb[4]	1.9	A B C D E F	
Ciba (CGA-219417)	1.9	A B C D E F	
Rovral - 4 applications[1]	1.8	A B C D E F	
Rovral - preclose	1.8	A B C D E F	
COCS[2]	1.8	A B C D E F	
Botran + Dithane[3]	1.7	A B C D E F	
Rovral - veraison	1.7	B C D E F	
Botran	1.6	C D E F	
Aureobasidium	1.0	D E F	
NZYM	0.9	E F	
Benlate + Captan	0.8	E F	
C. laurentii	0.8	F	
Leaf removal	0.7	F	LSD = 2.53
Cladosporium	0.3	F	
Dithane[3]	0.2	F	← Dithane Bloom Spray[3]

Means within a column with the same letter are not significantly different by LSD test (P = 0.05).

[1]Rovral 2 applications = bloom + preclose
3 applications = bloom + preclose + veraison
4 applications = bloom + preclose + veraison + preharvest

[2]Botran + Dithane applied at bloom, COCS, and Botran 6 dust applied preclose and veraison.

[3]Dithaine applied only at bloom, Botran applied preclose.

[4]ProGibb applied ca. 4 weeks prior to full bloom at 7.5 ppm.

Except where noted above, all materials applied at bloom and preclose. All fungicides applied at highest rate allowed by label in equivalent of 100 gallons water per acre with a motorized backpack sprayer.

Table 4. UCCE Sacramento County Chemical Bunch Rot Trials—1995
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	Total % Rot of Sampled Clusters (Incidence x Severity)	
Fungicide	**Sour Rot (%)**	
Rovral - 4 applications[1]	7.0	A
Rally	7.0	A
Rovral - preclose	7.0	AB
Rovral - 3 applications[1]	6.9	ABC
Rovral - 2 applications[1]	5.4	ABCD
Control	5.0	ABCDE
C. laurentii	4.6	ABCDEF
Rovral - veraison	3.8	ABCDEF
Ciba (CGA-219417)	3.5	ABCDEF
Captan	3.4	ABCDEF
Botran 6 dust[2]	3.0	ABCDEF
Fluazinam	3.0	ABCDEF
Botran + Dithane[3]	2.9	ABCDEF
Rovral - preharvest	2.8	BCDEF
Rovral - bloom	2.7	CDEF
Cladosporium	2.7	CDEF
C. flavus 89-211	2.7	DEF
Benlate + Captan	2.5	DEF
Bravo C/M	2.4	DEF
NZYM	2.0	DEF
Leaf Removal	2.0	DEF
C. flavus 89-160	1.8	DEF
Aureobasidium	1.5	DEF
Dithane[3]	1.4	DEF
Botran	1.3	DEF
COCS[2]	0.8	EF
Bacterial antagonist	0.8	EF
ProGibb[4]	0.7	F

← Dithane Bloom Spray[3] (Dithane row)

LSD = 4.25

Means within a column with the same letter are not significantly different by LSD test (P = 0.05).

[1]Rovral 2 applications = bloom + preclose
3 applications = bloom + preclose + veraison
4 applications = bloom + preclose + veraison + preharvest
[2]Botran + Dithane applied at bloom, COCS and Botran 6 dust applied preclose and veraison.
[3]Dithane applied only at bloom, Botran applied preclose.
[4]ProGibb applied ca. 4 weeks prior to full bloom at 7.5 ppm.

Except where noted above, all materials applied at bloom and preclose. All fungicides applied at highest rate allowed by label in equivalent of 100 gallons water per acre with a motorized backpack sprayer.

Table 5. UCCE Sacramento County Chemical Bunch Rot Trials—1995
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	Total % Rot of Sampled Clusters (Incidence x Severity)	
Fungicide	**Total Rot[5] (%)**	
Control	20.8	A
Bravo C/M	14.9	AB
Rally	13.8	AB
C. flavus 89-211	12.0	BC
Rovral - 3 applications[1]	11.8	BC
Botran 6 dust[2]	11.3	BC
Rovral - preclose	11.2	BC
Fluazinam	10.6	BC
Rovral - 4 applications[1]	10.2	BC
NZYM	10.1	BC
COCS[2]	9.7	BC
Botran + Dithane[3]	9.6	BC
C. laurentii	9.6	BC
Rovral - veraison	9.4	BC
Bacterial antagonist	8.8	BC
Botran	8.7	BC
Rovral - 2 applications[1]	8.6	BC
Rovral - preharvest	8.2	BC
Cladosporium	8.1	BC
C. flavus 89-160	8.1	BC
Captan	8.1	BC
Ciba (CGA-219417)	7.6	BC
Benlate + Captan	5.7	C
Dithane[3]	5.5	C
ProGibb[4]	5.4	C
Rovral - bloom	5.3	C
Aureobasidium	5.1	C
Leaf removal (1 side)	5.0	C

← Dithane Bloom Spray[3]

Means within a column with the same letter are not significantly different by LSD test (P = 0.05).

[1]Rovral 2 applications = bloom + preclose
3 applications = bloom + preclose + veraison
4 applications = bloom + preclose + veraison + preharvest
[2]Botran + Dithane applied at bloom, COCS and Botran 6 dust applied preclose and veraison.
[3]Dithane applied only at bloom, Botran applied preclose.
[4]ProGibb applied ca. 4 weeks prior to full bloom at 7.5 ppm.
[5]Total rot = sum of sour rot and rots caused by A. niger, B. cinerea, Penicillium spp., Rhizopus spp. and other fungi

Except where noted above, all materials applied at bloom and preclose. All fungicides applied at highest rate allowed by label in equivalent of 100 gallons water per acre with a motorized backpack sprayer.