

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

Botrytis cinerea is the most common form of “rot” in vineyards. *Botrytis* infection can cause many quality-degrading issues in winemaking. When working with rot-infected red fruit, the challenge is getting the positive compounds extracted from the grape skins without extracting the damaging compounds associated with rot infection. Using the tools and tips in this article will reduce the negative impact of rot infection on the finished wine.

QUALITY RISKS

- Off-aromas and flavors from the rot infection (geosmine, octenone).
- Browning from laccase enzyme activity (juice oxidation).
- Secondary infection of fruit when rot breaks berry skins.
- Settling and filtration complications due to glucans produced by *Botrytis*.
- Lower tannin content and color in finished wines.
- Mycotoxin and biogenic amines in wine.
- Increased acetic acid and gluconic acid in must.
- Reduced levels of amino acid and YAN levels in juice.
- Reduced organic acids, leading to unbalanced wine acidity.

HOW TO EVALUATE THE LEVEL OF ROT INFECTION

- Visual Inspection of fruit - estimate percent of rot.
- Laccase - reported in units/mL.
- Gluconic Acid - reported in g/L.

Before the day of harvest, a vineyard sample can be taken and analyzed in a laboratory to determine the level of rot infection. Professional wine laboratories offer tests for laccase activity, reported in units/mL, and gluconic acid analysis, reported in g/L. **LAFFORT® USA** sells **Vintessential enzymatic kits** for measuring gluconic acid at your winery with either a spectrophotometer or Chemwell Discrete Analyzer.

For a short review of the effect of different mold species and wine chemistry, read Bruce Zoecklein’s “Wine Enology Notes #161”, May 12th 2012. Virginia Tech, Wine / Enology Grape Chemistry Group (www.apps.fst.vt.edu/extension/enology/EN/161.html).

	Low rot contamination		Moderate rot contamination		High rot contamination	
Visual inspection - rot (%)	< 1	1 - 5	6 - 10	11 - 25	26 - 50	51 - 100
Laccase activity (U/mL)	0.39	0.78	2.25	6.56	8.12	15.86
Gluconic acid level (g/L)	1		2		> 3	

Note: gluconic acid measurement is recommended for must, not on vineyard samples.

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

The protocol below is outlined in chronological order, starting with the day of harvest. Each phase of winemaking is covered from grape harvesting, fermentation, and cellar aging.

PHASE 1 – VINEYARD HARVEST AND TRANSPORTATION TO WINERY

Estimate the level of rot.

Do a visual assessment or run laccase or gluconic acid analysis to estimate the level of laccase in the fruit. The rot and subsequent laccase level determine the dosage for the tools in this protocol.

Hand harvest and sort out as much mold-affected fruit as possible.

Machine-harvested fruit will have more juice in harvest bins, extracting mold character and increasing oxidation. General tips for working with machine harvested rot infected fruit:

- Add fermentation tannin, such as **TANIN VR SUPRA®**, a broad-spectrum complex fermentation tannin, to the harvest gondolas either in the vineyard or at the weigh scale. **TANIN VR SUPRA®** can be applied as a dry powder, no rehydration is required.



A non-saccharomyces yeast preparation for **BIO**Protection can be used to control unwanted indigenous microflora on botrytized grapes. **ZYMAFLORE® ÉGIDE^{TDMP}** (*T. delbrueckii* and *M. pulcherrima*) will out-compete negative microorganisms, reduce VA levels, and scavenge oxygen to protect must from oxidation. **ZYMAFLORE® ÉGIDE^{TDMP}** can be used directly on fruit in picking bins or grape-receiving hopper. **ZYMAFLORE® ÉGIDE^{TDMP}** can also be applied to harvesting equipment (harvest machine, grape transport bins, cellar equipment).

ZYMAFLORE® ÉGIDE^{TDMP} additions can be used in combination with low additions of **Potassium Metabisulfite (KMBS)**, keeping the additions below 40 ppm of KMBS. **ZYMAFLORE® ÉGIDE^{TDMP}** should **NOT** be in direct contact with KMBS.

Chitosan is ineffective for antimicrobial control at the grape or juice stage. Chitan-glucan has a fining effect, not an anti-microbial action.

PHASE 2 – FRUIT PROCESSING

2.1. General TIPS.

- Use a non-saccharomyces yeast early in fruit processing if not already added to picking bins. **ZYMAFLORE® ÉGIDE^{TDMP}** can be **dry-pitched on the fruit** at 30 - 50 ppm and will quickly begin to populate the must and out-compete the negative microflora.
- **Cool fruit temperature** will slow down laccase enzyme activity and reduce harmful oxidation reactions. Harvesting at night and/or cooling fruit before processing is recommended. Dry ice can assist in cooling fruit and protecting fruit from oxygen.
- **Protect must and juice from air/oxygen** exposure with inert gas or dry ice cover. Limiting oxygen exposure will reduce browning and aroma loss.

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

2.2. Treatments at crush pad.

The treatments in this section can be added to harvest bins, receiving grape hopper, or grape must in the tank.

- SO₂ addition - Consult the table for SO₂ dosage recommendations. Keep in mind SO₂ additions that have already been made to the fruit in the vineyard. The chart recommendations are based on the total amount of SO₂ used from the vineyard through juice settling. **Note: Do not exceed 40 ppm total SO₂ when using ZYMAFLORE® ÉGIDE^{TDMP} for BIOProtection.**
- Tannin addition - **TANIN VR SUPRA®** is formulated with highly reactive tannin for binding and inactivating laccase. It will also contribute tannin for structure and color stabilization. **TANIN VR SUPRA®** can be added to the picking bins, the hooper, or the grape must in tank. Adding **TANIN VR SUPRA®** as early as possible in fruit processing is recommended.

The treatments in this section are best added to grape must in the tank.

- Enzyme addition - Molds excrete high levels of pectins and glucans. Using a robust pectinase enzyme for pectin breakdown is essential. Extraction enzymes will quickly release tannin and anthocyanins, allowing for early pressing off moldy skins. **LAFASE® FRUIT** is a purified pectinase blend with specific active sites and will not pulverize the must.
- Yeast hull addition - **OENOCCELL®** (yeast hulls) have an absorptive capacity, binding toxins the mold and negative microflora produces. Adding a low dose can help detoxify the juice before fermentation.
- For high rot levels, consider using **LYSOZYM** to prevent unwanted lactic acid bacterial growth.
- Add **NOBILE®** alternative oak for masking "off" flavors from rot infection.

→ Fruit-forward red wine styles:

- Granular - **NOBILE® FRESH** will boost fruit flavors and mask mold character. Dosage: 2 - 3 g/L.
- Chips - **NOBILE® SWEET VANILLA** enhances midpalate weight, giving notes of toasted marshmallows and stone fruit. Dosage: 2 - 3 g/L.

→ Big structured red wine styles:

- Granular - **NOBILE® SWEET** enhances midpalate weight, and masks green or moldy character. Dosage: 2 - 3 g/L.
- Chips - **NOBILE® CHEERY SPICE** builds volume, masks green character, and adds a dark fruit profile. Dosage: 1 - 2 staves/hL.

NOTE - With moderate to high rot levels in fruit, it is recommended to process the fruit and start the *Saccharomyces* fermentation immediately. Avoid cold soak techniques, as this will allow for negative microflora to thrive.

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

Chart 1 - Quick reference for product dosage (Phase 2).

	Level of rot contamination		Low	Moderate	High
Timing	Product	Action	Dosage rates		
Transport from vineyard to winery	ZYMAFLORE® ÉGIDE ^{TDMP} - SO ₂ addition < 40 ppm	BIOProtection	30 ppm	40 ppm	50 ppm
Fruit processing at winery	SO ₂ addition	Antimicrobial & antioxidant	50 ppm	80 ppm	100 ppm
	TANIN VR SUPRA®	Antioxidant	200 ppm	400 ppm	600 ppm
First tank mixing	LAFASE® FRUIT	Tannin & color extraction, wine clarification	20 g/TON	30 g/TON	40 g/TON
	OENOCCELL®	Detoxify juice	75 ppm	150 ppm	200 ppm
	NOBILE® OAK	Mask off flavor	50 ppm	100 ppm	300 ppm
	LYSOZYME	Antimicrobial	NA	200 ppm	400 ppm

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

PHASE 3 – ALCOHOL & MALOLACTIC FERMENTATION

3.1. Yeast & nutrition.

- Use a strong aromatic fermenting yeast strain with a short lag phase. Increase the dose rate to 300 ppm or 2.5 lbs/1000 gal to help the yeast inoculation implant successfully in a challenging juice environment. Recommended yeast strains: **ZYMAFLORE® FX10**, **ZYMAFLORE® XPURE**, **ZYMAFLORE® RX60** or **ZYMAFLORE® XAROM** (any **LAFFORT® 'X-Series'** yeast strain).
- Rehydrate the yeast with **SUPERSTART® ROUGE** at 300 ppm or 2.5 lbs/1000 gal to ensure a strong fermentation finish.
- Mold-affected fruit is often depleted of YAN and other micronutrients important for healthy yeast fermentation. Measure YAN and supplement with **NUTRISTART® ORG** and **THIAZOTE® PH** as needed.

NOTE - In challenging mildew and mold years, elemental sulfur spray programs are increased. Residual sulfur on fruit can cause yeast to produce high levels of hydrogen sulfide during fermentation. Using a yeast with low hydrogen sulfide production (**ZYMAFLORE® XPURE**) will ensure a cleaner fermentation.

3.2. General fermentation TIPS.

- **Fermentation at moderate temperatures** will minimize yeast stress and aid in a fast, clean fermentation. For moderate to high rot levels, ideal fermentation temperatures are between 70 - 80° F.
- In moderate to high-level rot infection, the protein content in the must is high. The proteins bind with tannin and reduce reactive skin tannin in the must. Using a second fermentation tannin addition with **TANIN VR COLOR®** will add catechin tannin for color stabilization and build texture.
- Limit pumping over and cap punch down in high-level rot infections. Reducing maceration operations will help lower the extraction of mold compounds.
- Add a **β-glucanase enzyme** to break down glucans produced by botrytis and microorganisms. Treatment with an enzyme such as **EXTRALYSE®** at 60 - 100 ppm in the last 1/3 of alcoholic fermentation will help improve the wine's settling and filterability in the future.
- Utilizing **mannoprotein products** during fermentation will help build up the wine texture, which juice cleanup techniques may have decreased. **OENOLEES®** can be added early in fermentation at 100 - 300 ppm for improved mouthfeel.
- A shorter maceration time, or **early pressing**, can help reduce mold off-flavors in moderate to high levels of rot infection. Taste tanks regularly to evaluate mold character extraction, such as wet hay, mushroom, or sherry (oxidized) flavors.
- If hydrogen sulfide is abundant, use copper sulfate additions during fermentation. **SULFIREDOX** is a liquid 2.5% solution of copper sulfate. **See the note above about residual sulfur on fruit.
- Co-inoculation with malolactic bacteria is NOT recommended for grape must with moderate to high rot levels. A sequential inoculation with a robust strain such as **LACTOENOS® B7 Direct** or **LACTOENOS® BERRY Direct** is recommended after pressing and alcoholic fermentation completion.

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

3.3. Pressing off skins.

Pressing can be complex with moldy fruit. It is important to keep press fractions separate, tasting often during the press cycle. Drain the tank and keep the free-run wine separate. Separating an additional 'middle' press fraction from the traditional 'hard' press fraction might be necessary. The different fractions can be treated individually depending on the level of laccase, mold character, and oxidation.

The general level of mold-associated compounds: free run < middle press fraction < hard press fraction.

Protect wine in the press-pan from oxygen exposure with an inert gas cover or dry ice.

Fining addition - With moderate to high rot levels, an initial fining treatment directly after pressing will clean up the wine before malolactic fermentation. Choose a broad-spectrum fining agent or a combination of fining agents for best results.

- **POLYLACT®** (PVPP + Casein) will remove browning from oxidation. Dosage: 200 - 300 ppm.
- **GECOLL® SUPRA** (gelatin) will remove bitter phenolic compounds and clarify the wine for compact lees settling. Dosage: 30 - 50 mL/hL.
- **POLYMUST® PRESS** (PVPP + bentonite + potato protein) option for general phenolic fining. Dosage: 100 - 300 ppm.

3.4. ML Fermentation.

If malolactic fermentation is desired, **sequential inoculation** with a robust strain such as **LACTOENOS® B7 Direct** or **LACTOENOS® BERRY Direct** is recommended **AFTER** confirming the wine has completed alcoholic fermentation.

In moderate to high levels of rot, the wine could have compounds that are toxic to malolactic bacteria. Yeast hulls, **OENOCCELL®**, can be added to detoxify the must before adding the malolactic bacteria. The wine can have reduced nutrient levels, so using a nutrient such as **MALOBOOST®** can help ensure a quick, clean ML fermentation.

When malolactic fermentation is complete, it is recommended to rack wine clean off lees for moderate to high rot infection situations. The lees can contain compounds that will contribute to off-flavors. Adding back clean lees or using a lees replacement product, such as **POWERLEES®** or **OENOLEES®**, is recommended. See the next section for more details.

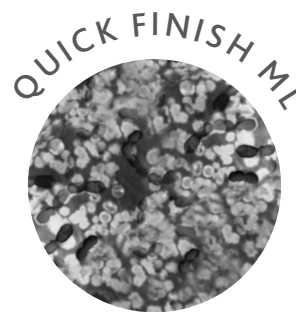
Quick Finish ML Protocol for challenging wine conditions:

Do a 12 - 16 hour rehydration for a direct inoculation strain (**LACTOENOS® B7 Direct**, **LACTOENOS® BERRY Direct**)

- Bacteria dose rate 1 g/hL.
- Water volume = 20 times the weight of bacteria.
- Wine Volume = 20 times the weight of bacteria.
- **MALOBOOST®** = 5 times the weight of bacteria.

Example for 1000 gallons of wine:

- Bacteria = 38 grams (1000 gallons = 38 hectoliters).
- Water volume = 760 milliliters.
- Wine volume = 760 milliliters.
- **MALOBOOST®** = 190 grams.
- Allow mixture to rehydrate for 12 – 16 hours.



Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

- If mold aromas and flavors persist, treatment with **GEOSORB®** might be necessary. **GEOSORB®** is a deodorizing carbon for binding compounds associated with rot and mildew. Bench trials are recommended, dosage range of 150 - 400 ppm.
- Continue to work with mannoprotein products to build mouthfeel during aging. **AUTOLEES®** and **MANNOSWEET®** can bring midpalate weight and a perception of sweetness.
- If **EXTRALYSE®** was not used during fermentation, adding at least one month before bottling is recommended. **EXTRALYSE®** is a beta-glucanase enzyme that will break down the glucans produced from mold and improve settling and wine filterability. Dosage: 60 ppm.
- If malolactic fermentation is desired, sequential inoculation with a robust strain such as **LACTOENOS® B7 Direct** or **LACTOENOS® BERRY Direct** is recommended.

Chart 3 - Quick reference for product dosages (Phase 3).

	Level of rot contamination		Low	Moderate	High
Timing	Product	Action	Dosage rates		
Yeast Inoculation	ZYMAFLORE® yeast	Fermentation	See text for options		
	SUPERSTART® Rouge	Yeast-rehydration	1.5 lbs/1000 gal	2 lbs/1000 gal	2.5 lbs/1000 gal
Fermentation nutrition	NUTRISTART® ORG	Organic nitrogen	2 lbs/1000 gal	3 lbs/1000 gal	4 lbs/1000 gal
	THIAZOTE® PH	DAP & thiamine	2 lbs/1000 gal	3 lbs/1000 gal	4 lbs/1000 gal
First 1/3 rd of fermentation	TANIN VR COLOR®	Color stabilization	100 ppm	200 ppm	300 ppm
	OENOLEES®	Mouthfeel	100 ppm	200 ppm	300 ppm
Last 1/3 rd of fermentation	EXTRALYSE®	β-glucanase enzyme	60 ppm	80 ppm	100 ppm
Post-press settling tank (choose one)	POLYLACT®	Phenolic & oxidative correction	NA	200 ppm	300 ppm
	GECOLL® SUPRA	Phenolic correction & clarification	30 mL/hL	40 mL/hL	50 mL/hL
	POLYMUST® PRESS	Phenolic correction & clarification	NA	200 ppm	300 ppm
Malolactic fermentation	LACTOENOS® B7 Direct LACTOENOS® BERRY Direct	Malolactic bacteria	1 g/hL		
	OENOCCELL®	Detoxify wine	75 ppm	150 ppm	200 ppm
	MALOBOOST®	ML nutrient	200 ppm	300 ppm	300 ppm

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

PHASE 4 – MATURATION

4.1. General wine cellaring TIPS.

Post-fermentation analysis - In the case of rot levels above 30%, analyzing the wine for residual laccase activity is recommended. If laccase is present, additional **TANIN GALALCOOL® SP** can be utilized. With **TANIN GALALCOOL® SP**, the 'SP' stands for 'soft palate', which can be added to wines without adding astringency.

Monitor VA and SO₂ levels often. It is difficult to maintain levels of free SO₂ in wine made from fruit with high laccase activity. Additional microbial protection tools are:

- **OENOBRETT®**, a chitosan product, can be added after primary and secondary fermentation is complete. **OENOBRETT®** is an effective antimicrobial that will continue protecting the wine for up to three months. The addition range is from 50 - 100 ppm.

Keep wine away from oxygen exposure. Gas any headspace and keep cooperage topped with tight bungs.

Wines produced from fruit with moderate to high levels of rot have a low oxygen consumption capacity, meaning lower antioxidant power. During cellar aging, minimize the number of wine rackings and transfers. Unfortunately, the wines will not have the aging capacity either. It is recommended to bottle early and get the wines to market.

4.2. Oxidation prevention, masking off-flavors, and rebuilding mouthfeel.

- Add **POWERLEES®**, a product rich in mannoproteins, to the wine after racking. **POWERLEES®** will build mouthfeel like traditional lees aging. Dosage: 100 - 300 ppm.
- Conduct bench trials with structure-building tannins:
 - **TANIN VR SKIN®** - grape skin tannin for building midpalate length and restoring red fruit flavors. Dosage: 50 - 150 ppm.
 - **TAN'COR® GRAND CRU** - combination tannin for building structure, restoring the wine's antioxidation power, and masking mold character. Dosage: 50 - 150 ppm.
- Oak alternatives are effective at masking off characters and building mouthfeel.
 - Fruit-forward red wines:
 - Chips - **NOBILE® BASE** or **NOBILE® SWEET VANILLA** will boost fruit flavors and build volume. Dosage: 1 - 2 g/hL.
 - Staves or Blocks - **NOBILE® 18-XBASE** or **NOBILE® ELITE** will build texture, boost fresh fruit flavors, and mask mold character. Dosage: 1 - 2 staves/hL.
 - Big structured red wines:
 - Chips - **NOBILE® DARK ALMOND** enhances midpalate weight, giving toasted barrel-aged character. Dosage: 1 - 2 g/L.
 - Staves or Blocks - **NOBILE® XTREME** builds volume and masks mold characters. Dosage: 0.5 - 1 staves/hL.
- If mold aromas and flavors persist, treatment with **GEOSORB®** might be necessary. **GEOSORB®** is a deodorizing carbon for binding compounds associated with rot and mildew. Bench trials are recommended, dosage range of 150 - 400 ppm.
- Continue to work with mannoprotein products to build mouthfeel during aging. **AUTOLEES®** and **MANNOSWEET®** can bring midpalate weight and a perception of sweetness.
- If **EXTRALYSE®** was not used during fermentation, adding at least one month before bottling is recommended. **EXTRALYSE®** is a beta-glucanase enzyme that will break down the glucans produced from mold and improve settling and wine filterability. Dosage: 60 ppm.
- **QUERTANIN®** range of oak tannins can be used to mask green or mold character, add texture, and improve wine quality. Bench trials are recommended, and the tannins can be used individually or in combination to achieve the desired wine style.

Compromised Fruit – *Botrytis* and Rot

Winemaking Protocols – Red Grapes

- If malolactic fermentation is desired, sequential inoculation with a robust strain such as **LACTOENOS® B7 Direct** or **LACTOENOS® BERRY Direct** is recommended.

Chart 3 - Quick reference for product dosages (Phase 4).

	Level of rot contamination		Low	Moderate	High
Timing	Product	Action	Dosage rates		
After fermentation - cellar aging	TANIN GALALCOOL SP®	Laccase removal	30 ppm	50 ppm	75 ppm
	OENOBRETT®	Microbial stability	NA	50 ppm	100 ppm
	FUMARIC ACID	Microbial stability	NA	300 ppm	600 ppm
	POWERLEES®	Mouthfeel	100 ppm	200 ppm	300 ppm
	TANIN VR SKIN®	Tannin & aroma correction	50 ppm	100 ppm	150 ppm
	TAN'COR® GRAND CRU	Tannin & aroma correction	50 ppm	100 ppm	150 ppm
	NOBILE® OAK	Mask off flavor	See text for options		
Preparation for bottling	GEOSORB®	Aroma correction	NA	200 ppm	400 ppm
	MANNOSWEET® or AUTOLEES®	Mouthfeel	50 ppm	100 ppm	200 ppm
	EXTRALYSE®	β-glucanase enzyme	60 ppm	80 ppm	100 ppm
	QUERTANIN® range	Aroma / flavor correction	Bench trials recommended		



LAFFORT

l'œnologie par nature

U.S.A.

LAFFORT USA - 1460 Cader Lane, Suite C, Petaluma - California 94954
(707) 775 4530 - ordersusa@laffort.com

LAFFORT & YOU