New Initiatives in the Management of Grape Sour Rot

Wendy McFadden-Smith
Tender Fruit & Grape IPM Specialist

Ministry of Agriculture, Food and Rural Affairs

Ontario

So what?

- Wineries may reject grapes when the VA exceeds their acceptance limit of acetic acid (0.20 – 0.24 g/L)
- High VA indicates the presence of microbial contaminants that are not wanted in the winery
- $$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$$
- 20% of early varieties rejected at winery
- Multiple fungicide sprays applied
- Labour costs of several passes to drop rotted fruit

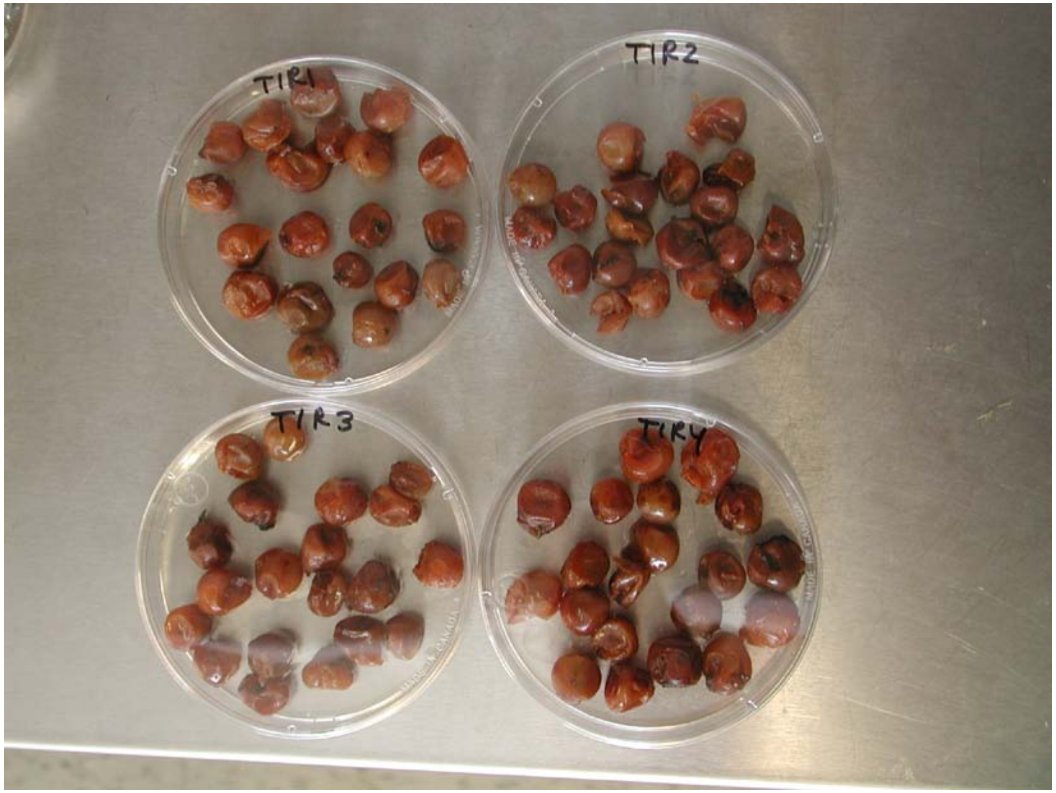
2009 Losses from Sour rot/ Elevated VA

- Crop insurance claims for vineyards
  - $1.5 M total
  - $750,000 excess rain
  - $250,000 hail

What’s causing it????

What's causing it?

- 4 sets of 20 sour rotted berries
- Flamed to remove surface organisms

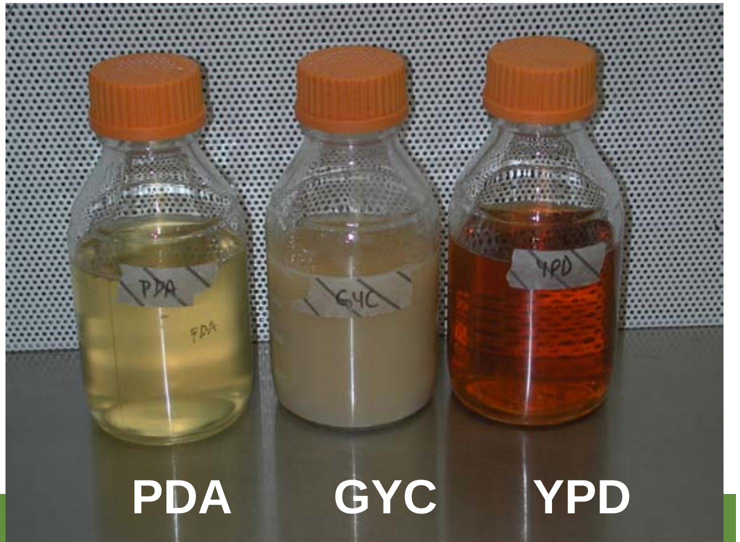


Plant, 2008

What’s causing it?

- Berries crushed, diluted juice plated onto PDA, GYC, YPD

- Plates incubated at 25 C for 48 hours



Plant, 2008

Sour Rot Severity Rating Scale

0 – no rot

1 – slight rot

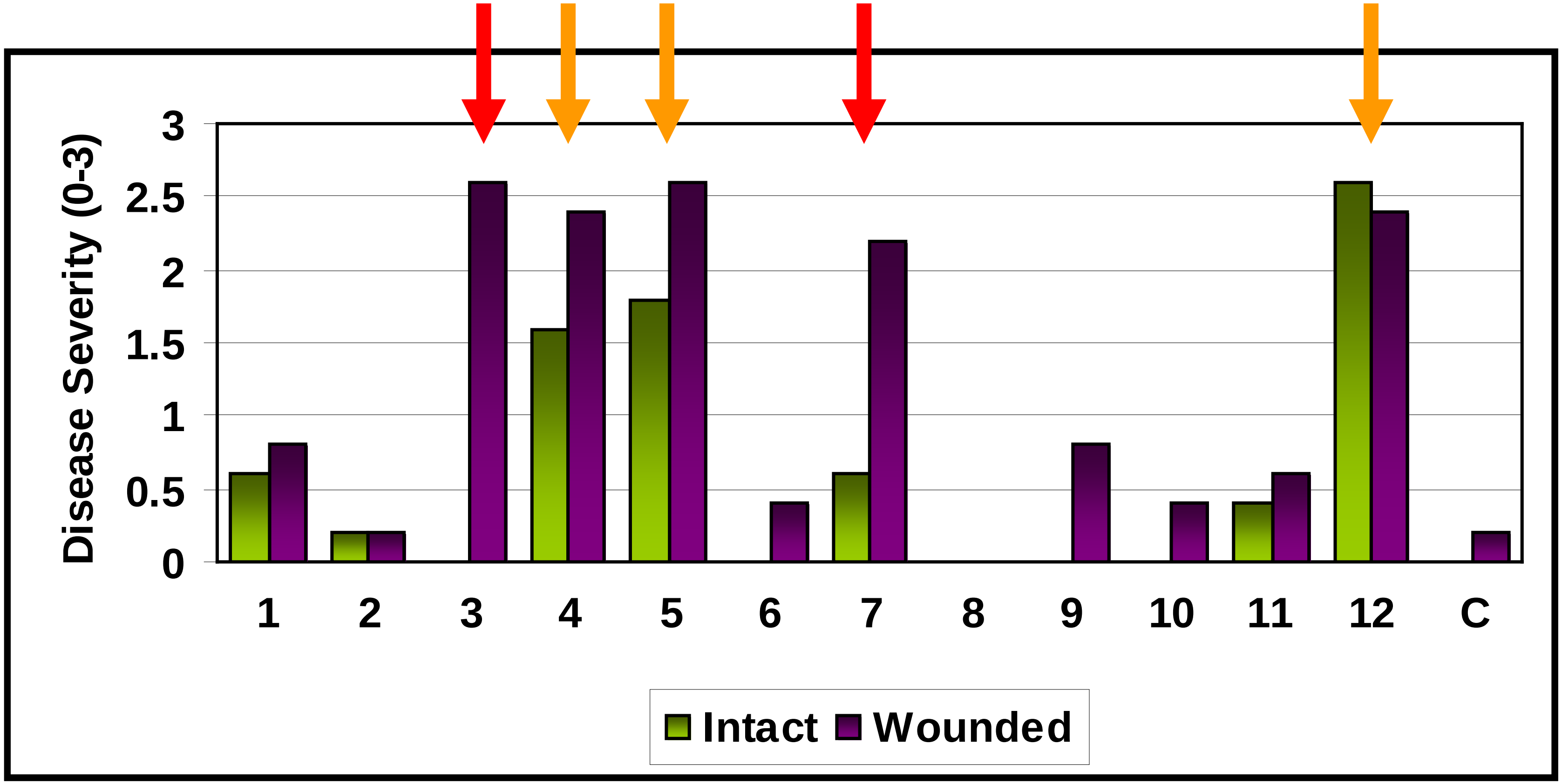
2 – moderate rot

3 – severe rot

Plant, 2008

Test berries in plastic container after 8 days. The top 4 berries in each section were intact and the bottom 4 berries were wounded.

Severity of Rot with and without Wounding



Plant, 2008

Frequency of Isolation

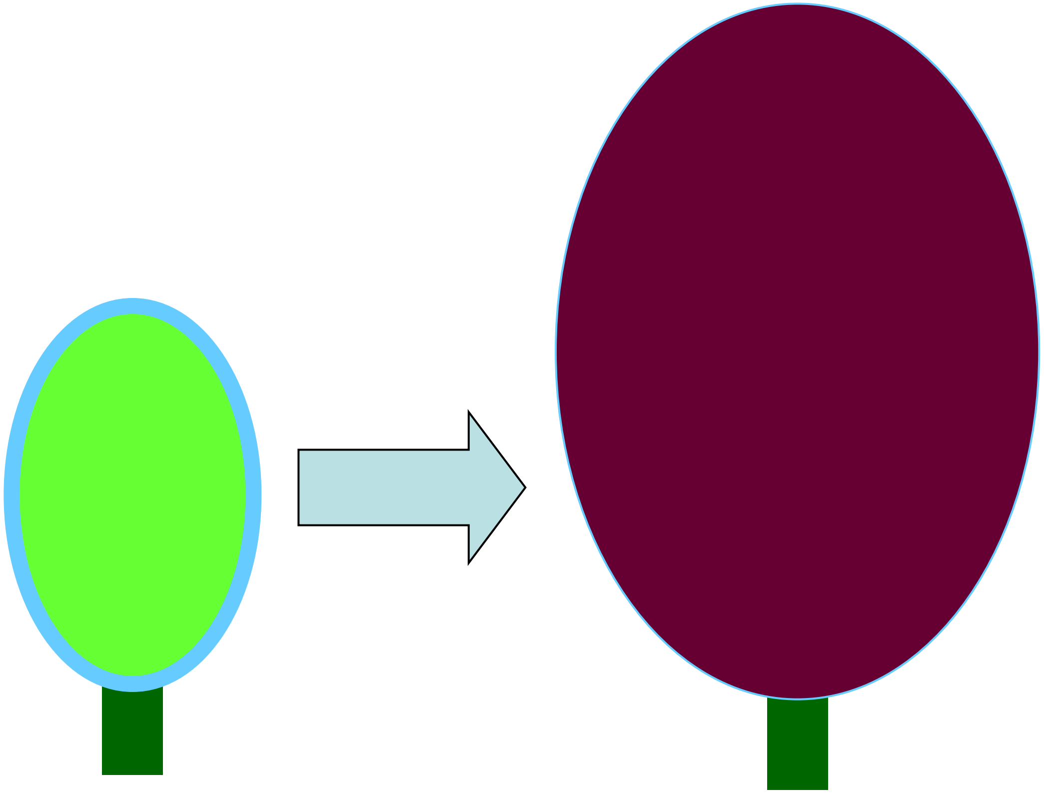
Organism		Frequency (%)
Hanseniaspora uvarum	Y	36
Candida zemplinina	Y	4
Gluconobacter cerinus	B	49.5
Gluconobacter frateurii	B	0.3

Why does it happen?

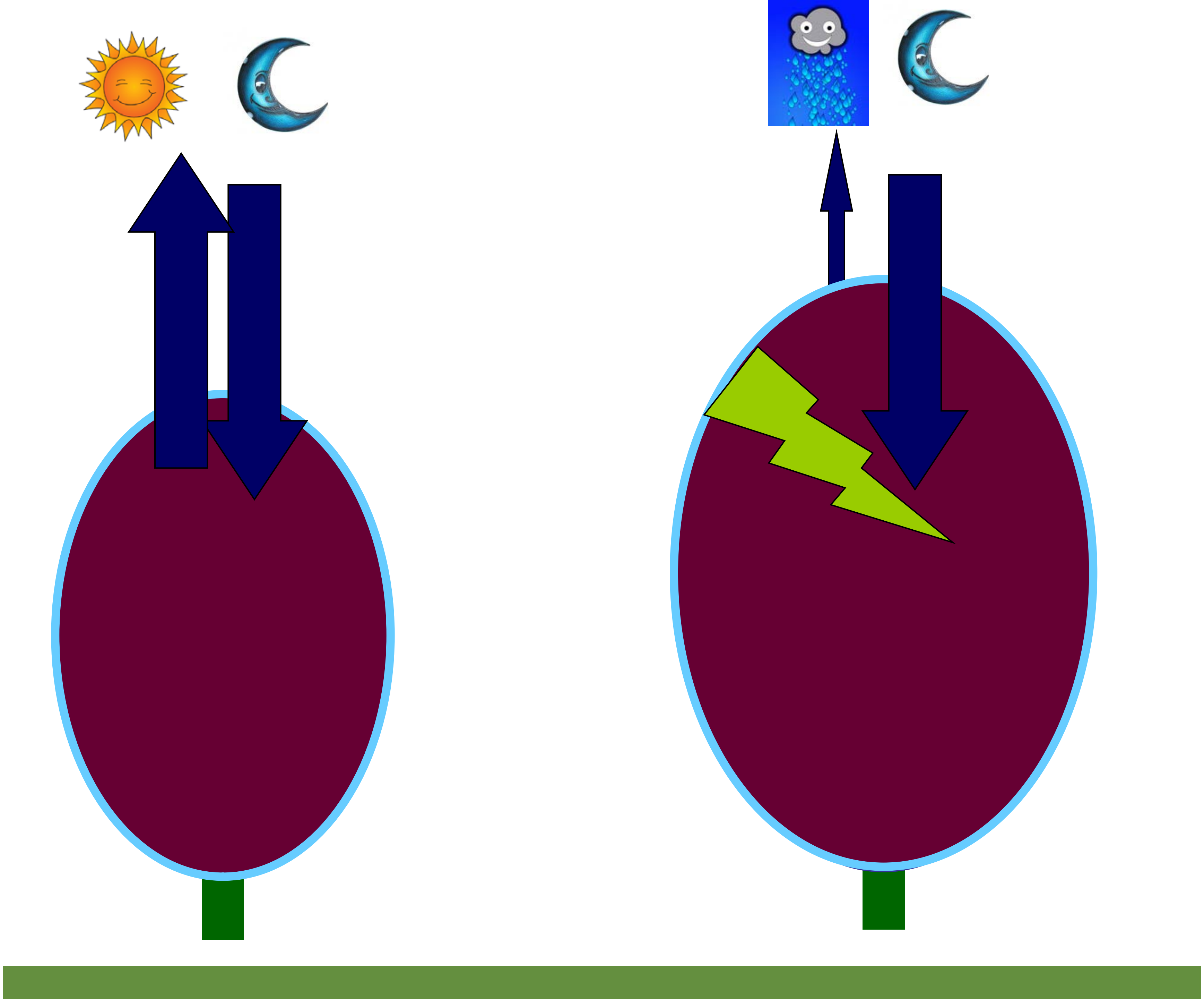
Why does it happen?

- Tight clusters/Thin skins
  - Varieties Affected
    - Pinot noir, Pinot gris, Gamay, Chardonnay, Riesling, Gewurztraminer, Baco noir

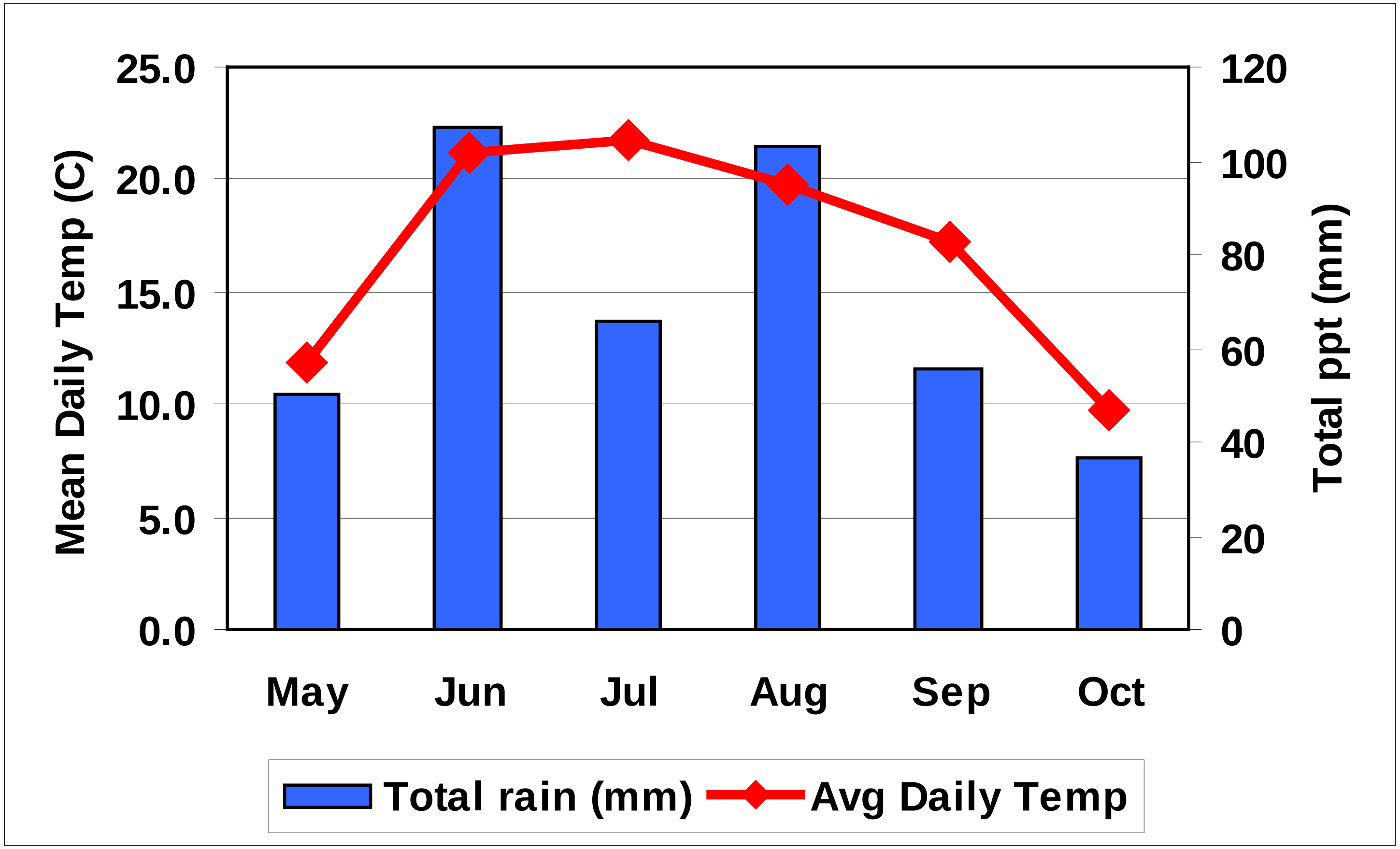
Why does it happen?



Same amount of wax per berry at pea-size and maturity



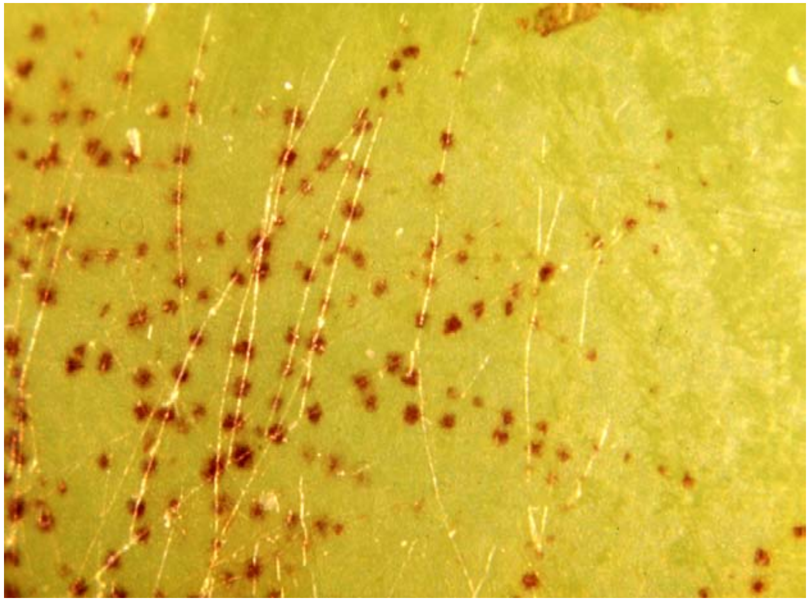
Why does it happen?



2008 Weather – SOGGY & WARM!

Why does it happen?

- Diffuse powdery mildew infections
  - Slow-growing, sparse, non-sporulating
  - Usually associated with minute patches of dead epidermal cells



Protect fruit during peak period of susceptibility, and continue protection until ontogenic resistance is fully expressed 3-4 weeks postbloom.

Mildew-free Diffuse infection

Why does it happen?

- “It is known” clusters infected with bunch rot are more prone to sour rot
- But
  - Frequently found sour rot without bunch rot sporulation
  - Frequently found sour rot in areas of clusters (shoulders) where no berry squeeze occurred
  - Very weak correlation between severity of bunch rot and sour rot in 2008 with >1000 observations in 3 Niagara vineyards

Why does it happen?

- Grape Berry Moth
  - Bunch rot frequently associated with GBM injury
  - Probably similar relationship with sour rot organisms

Factors that Promote Sour Rot

- Vinegar flies attracted by volatile compounds released during berry degradation
- Vector sour-rot organisms
  - passive transport by adults
  - transmitted throughout cluster during larval stages
  - larvae carry sour rot organisms in their gut.

What can we do about it?

Sour Rot Management

- Reduce injury
- Reduce infection by pathogens

Reduce Injury

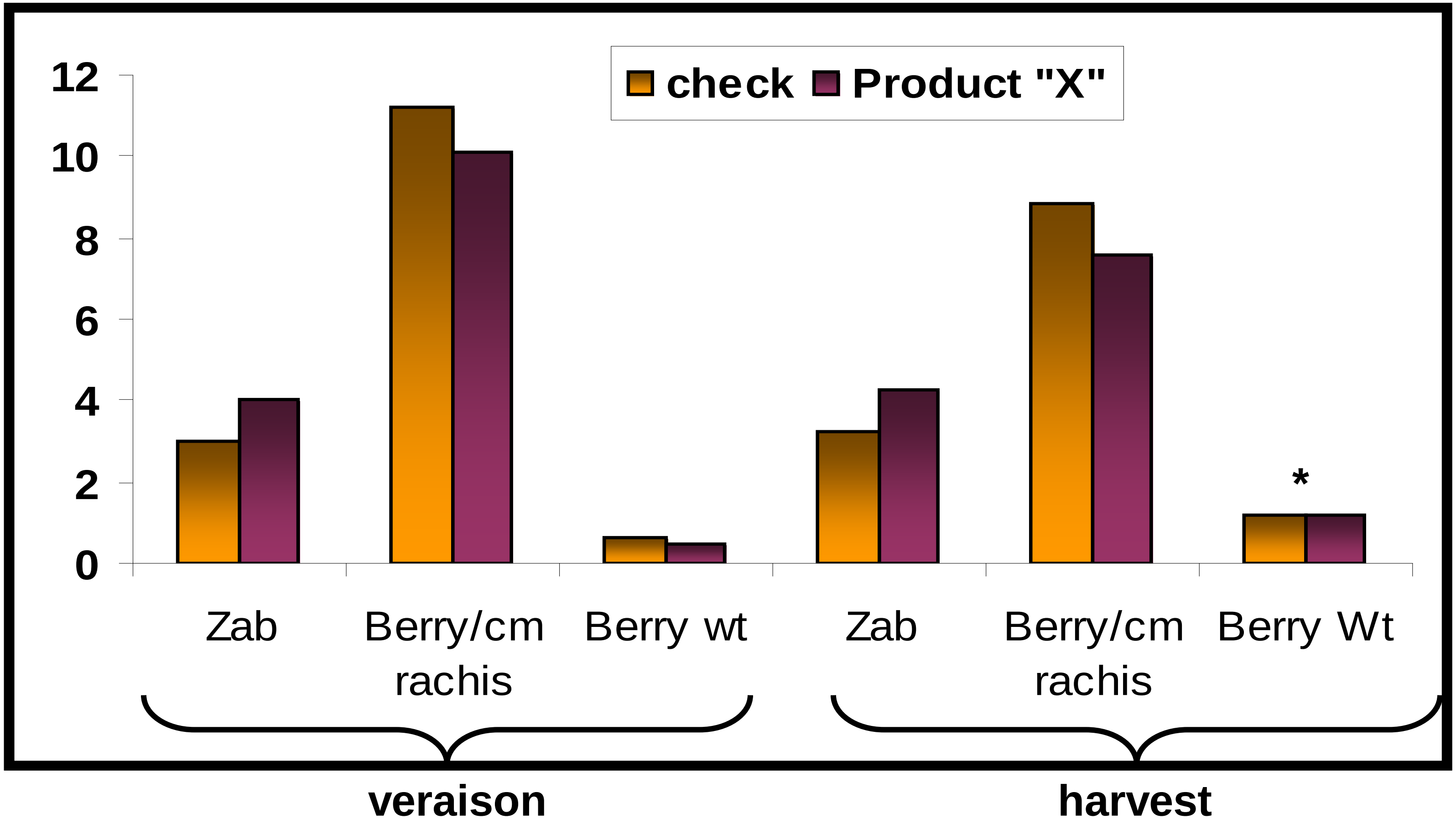
- Loosen grape clusters
  - Reduce berry squeeze
  - Thinner cuticle on berries in contact

Reduce Injury

- Loosen grape clusters
  - Gibberellic acid (GA)
    - GA + ammonium chloride at full bloom and 4 days later resulted in fewer berries/cluster & reduced splitting
    - Reduced fruitfulness following yr (esp Riesling)
  - Other compounds affecting cluster development
    - Product “X” @ 180 g a.i./ha applied at full bloom

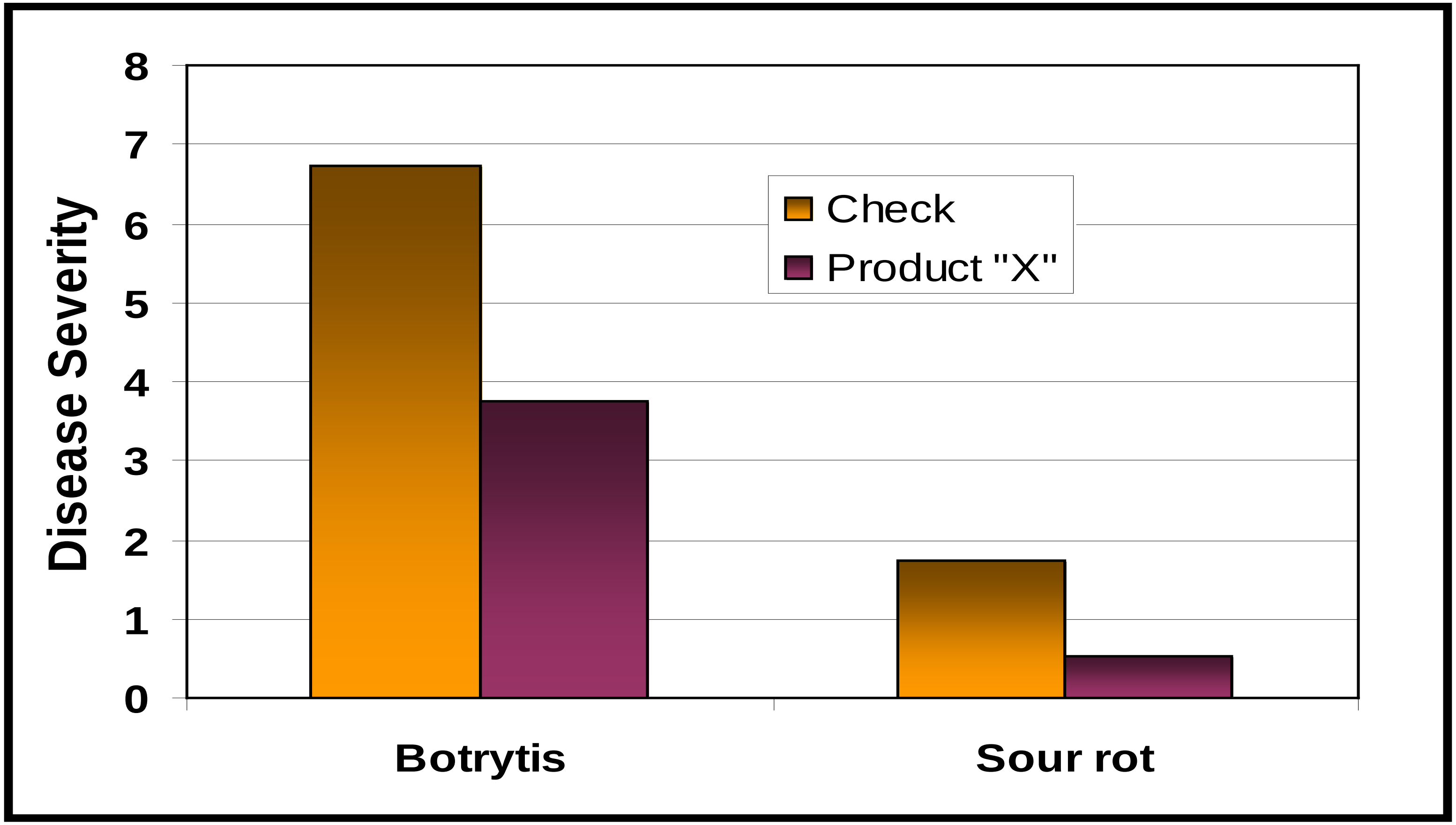
Zabadal & Dittmer Cluster Compactness Scale

Effect of Product "X" on Riesling Cluster Compactness, 2008



Similar but less pronounced effects in P. noir

Effect of "Product X" on Riesling Sour Rot, 2008



Similar but less pronounced effects in P. noir

Reduce Injury

- Loosen grape clusters
  - Bloom basal leaf removal (Hed and Travis)
    - 3-4 leaves around clusters (Vignoles) manually removed at trace bloom
    - starves clusters for photosynthate and fewer flowers set fruit.
    - looser cluster with fewer berries

Reduce Injury

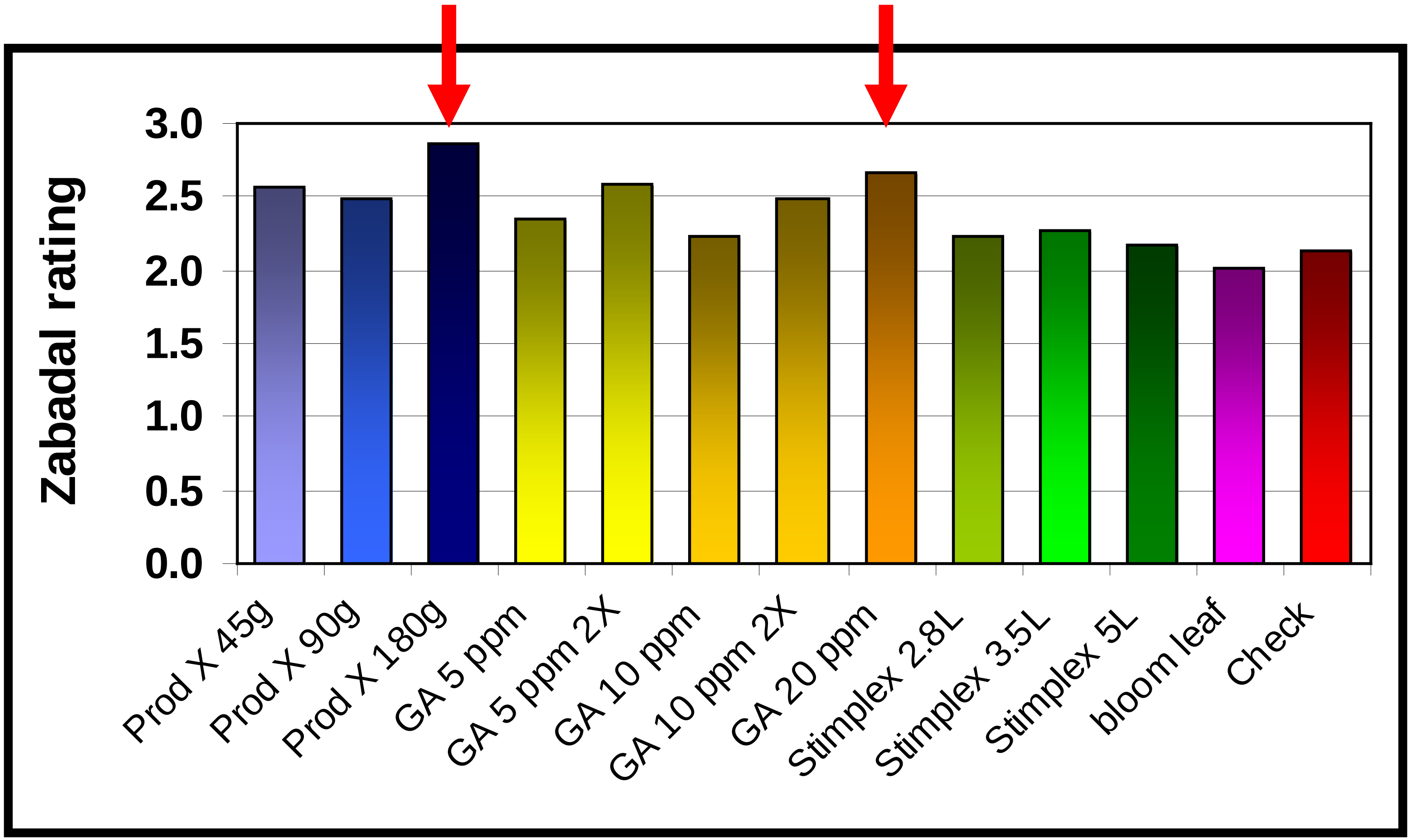
- Early leaf stripping may help reduce incidence of sour rot
  - Change berry skin and wax characteristics
  - Change cluster compactness

  - Reduce powdery mildew
  - Reduced Botrytis bunch rot

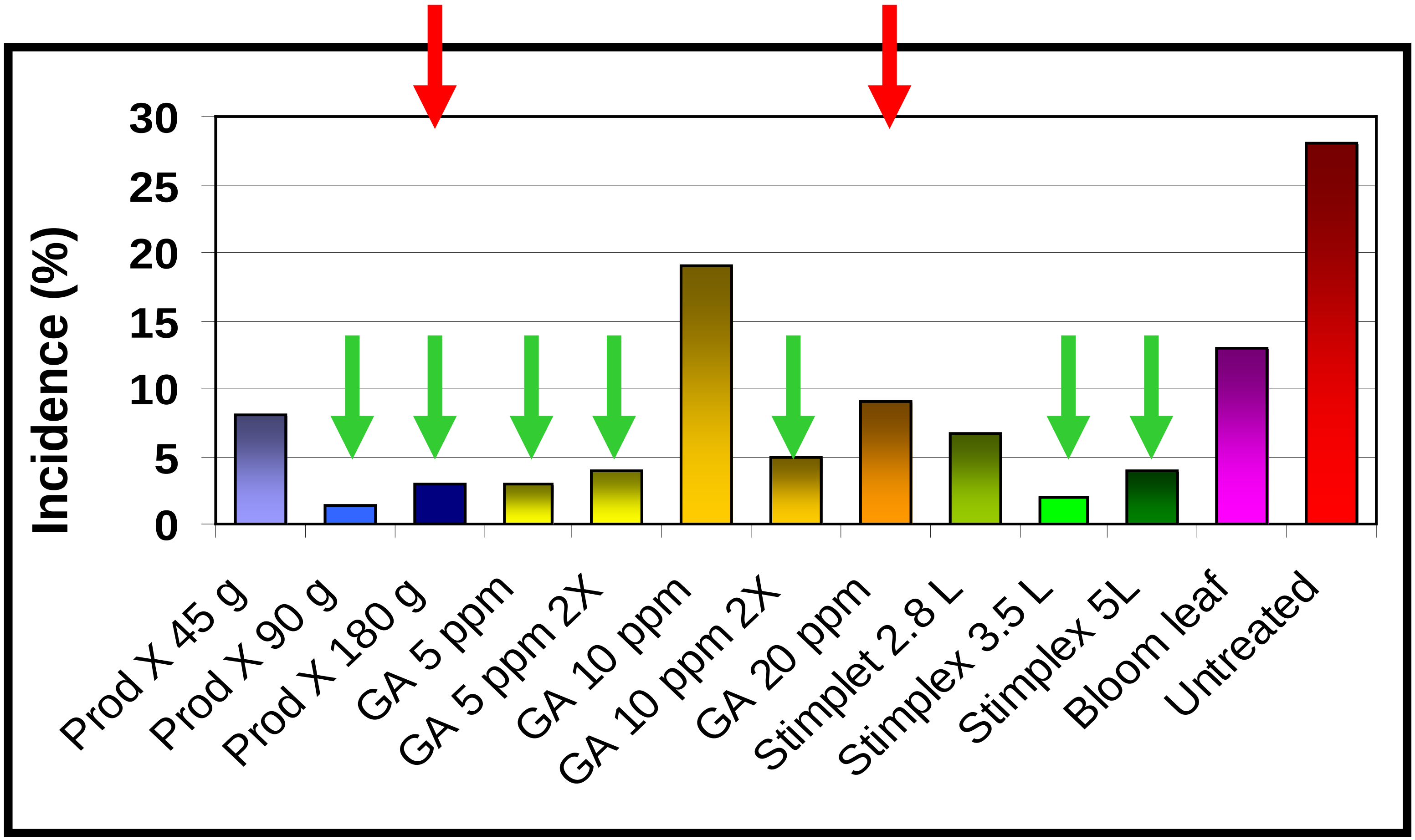
Before Bloom Leaf Removal

After Bloom Leaf Removal

Effect of Bloom Treatments on Riesling Cluster Compactness, 2009



Effect of Bloom Treatments on Incidence of Sour Rot, Riesling, 2009



No treatment with VA > 0.2 g/L

Effect of Leaf Removal on Sour Rot, Riesling & Pinot noir 2009

- Leaves removed by hand at
  - Pea-size berry
  - Veraison
- Product X @ 180 g a.i./ha + pea-size berry leaf removal
- GA 5 ppm 2X +pea-size berry leaf removal

Veraison

Untreated
No leaf removal

Veraison

Leaf removal
at bloom

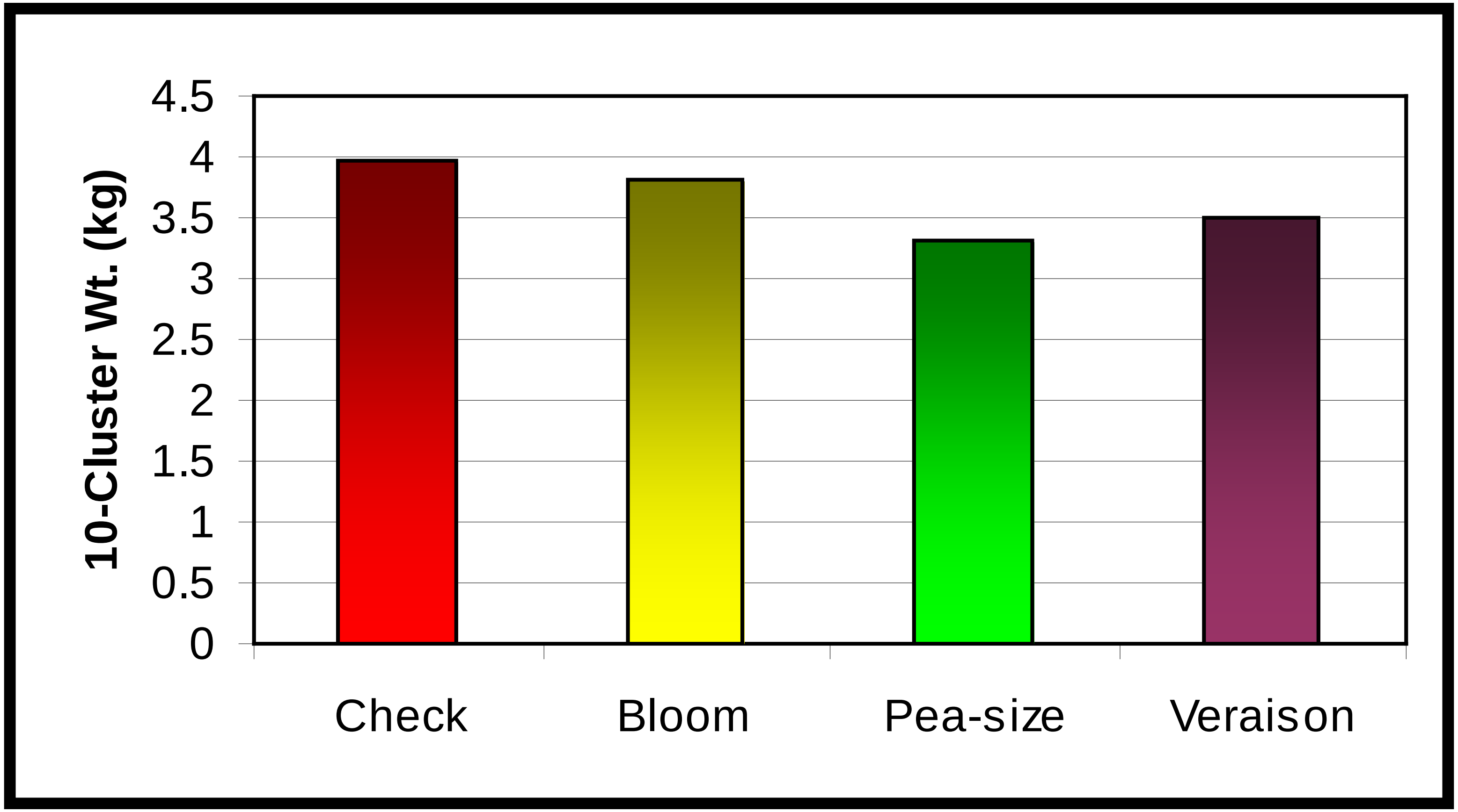
Veraison

Pea-sized berry
Leaf removal

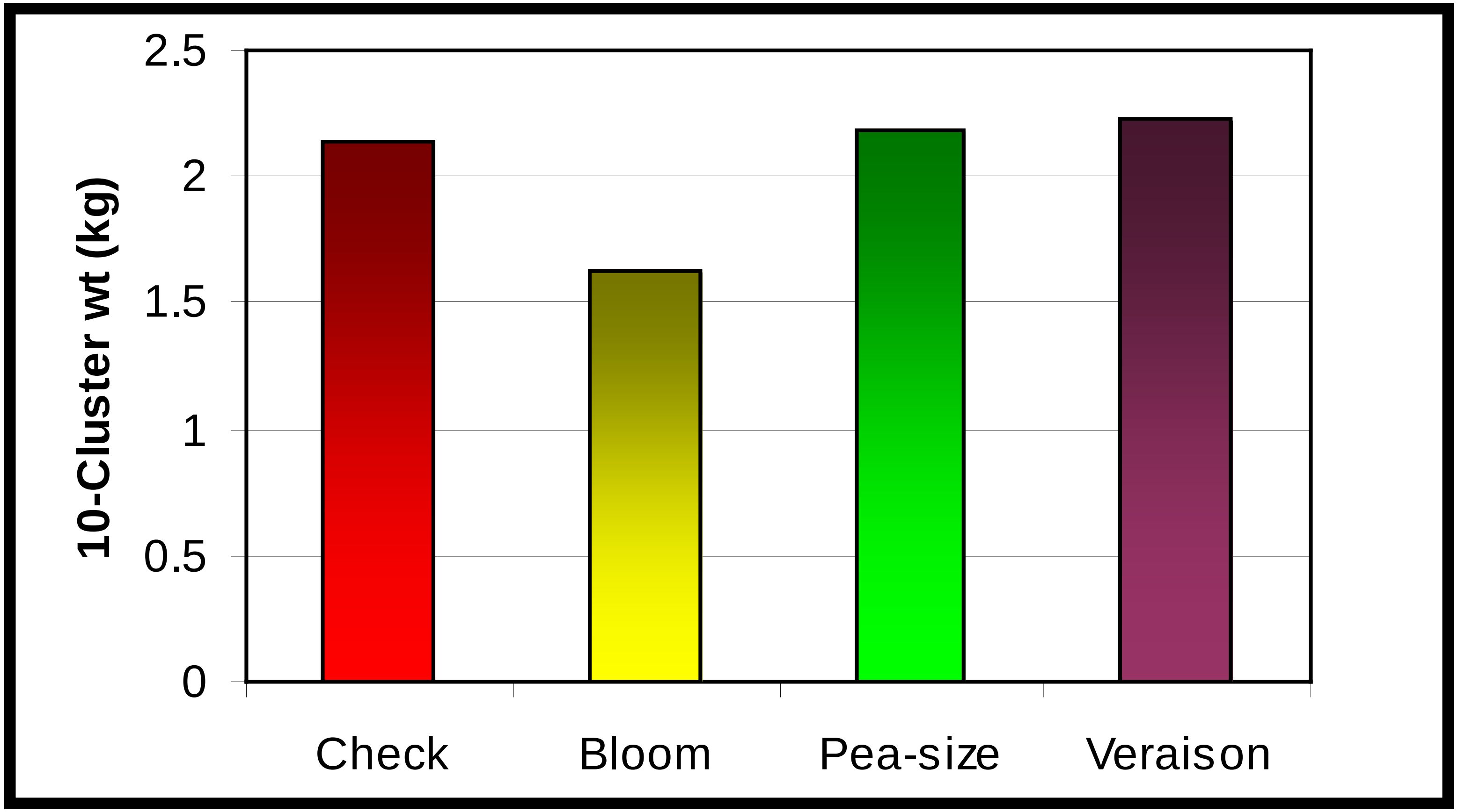
Veraison

Veraison
Leaf removal

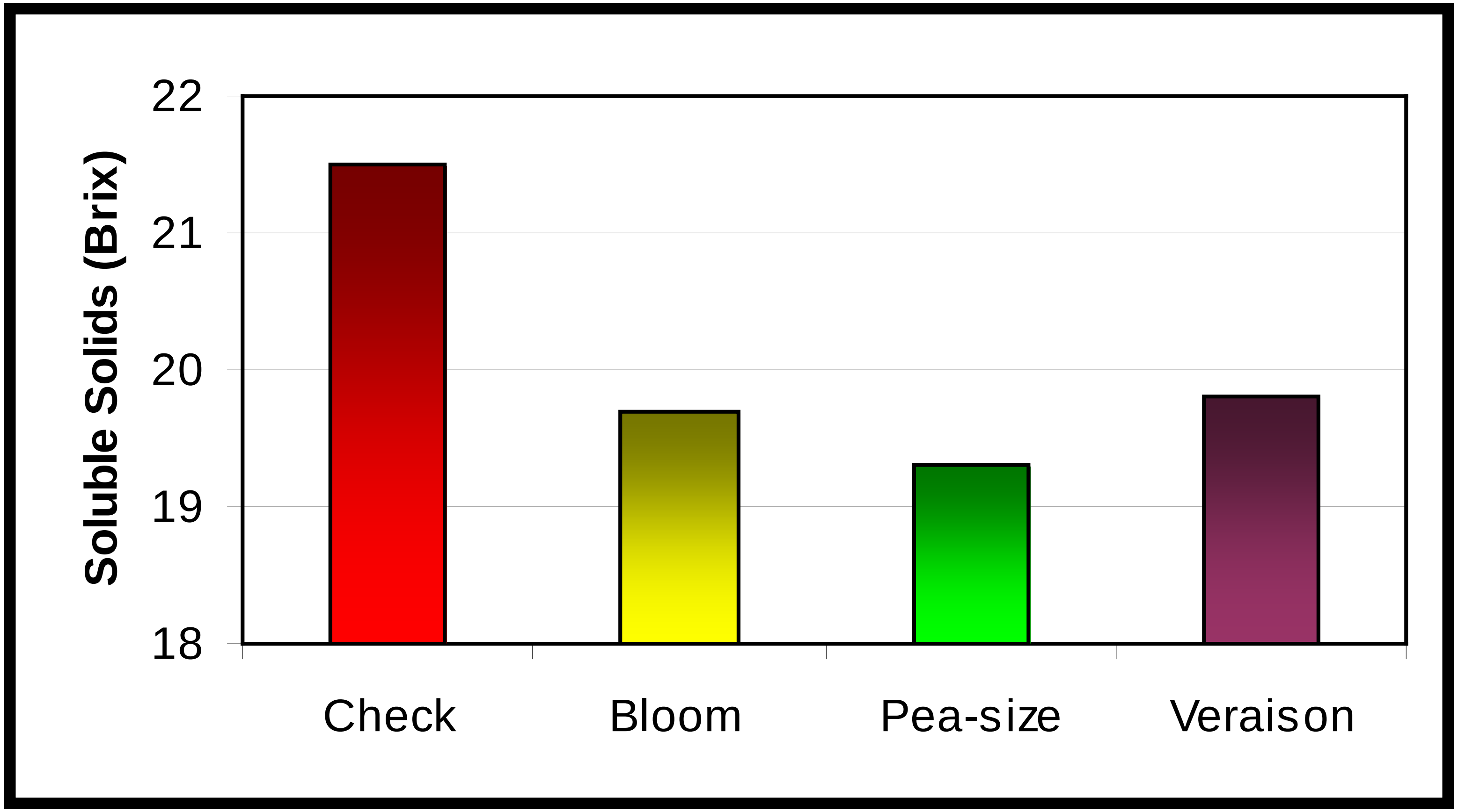
Effects of Leaf Removal Timing on Cluster Weight, Riesling, 2009



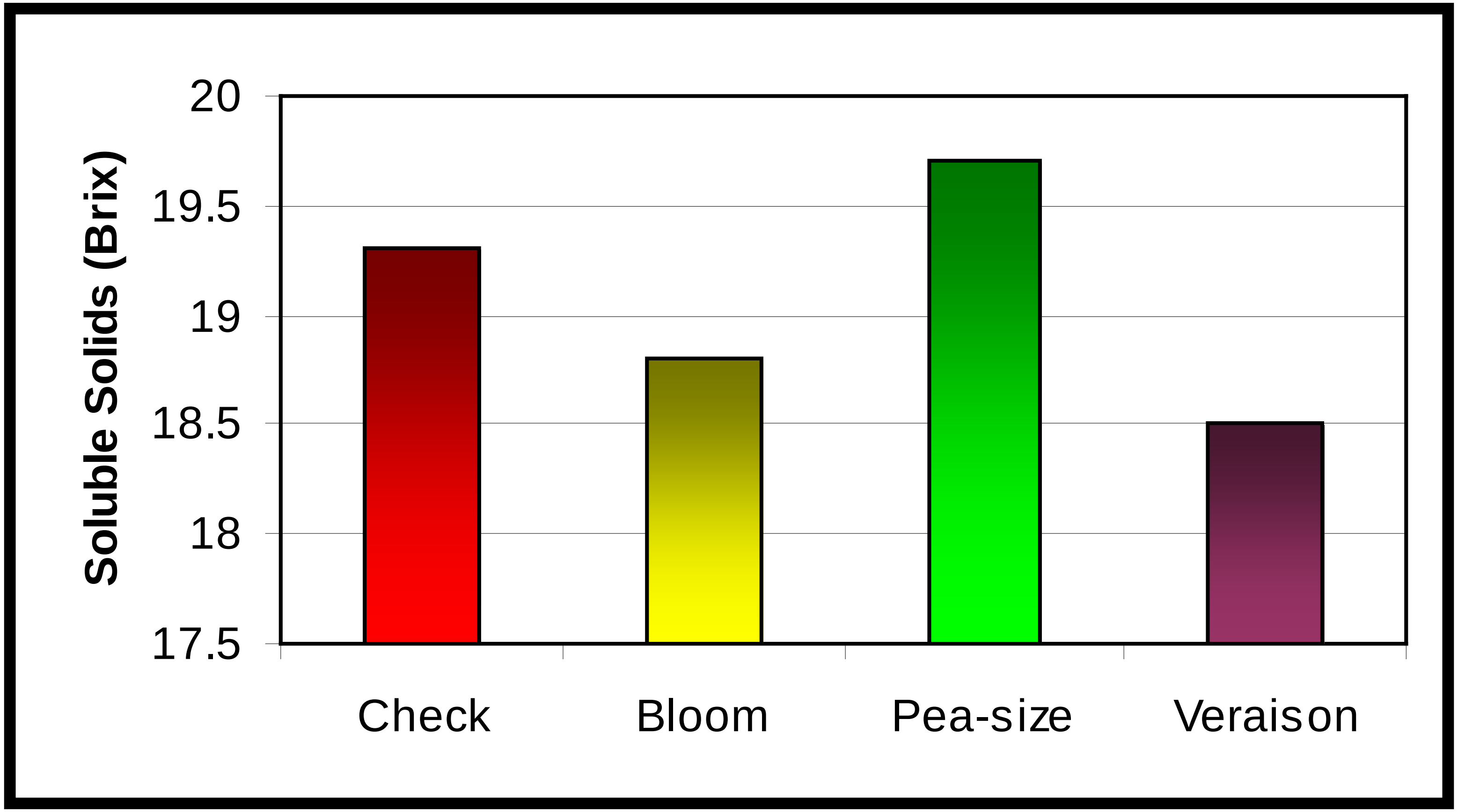
Effects of Leaf Removal Timing on Cluster Weight, Pinot noir, 2009



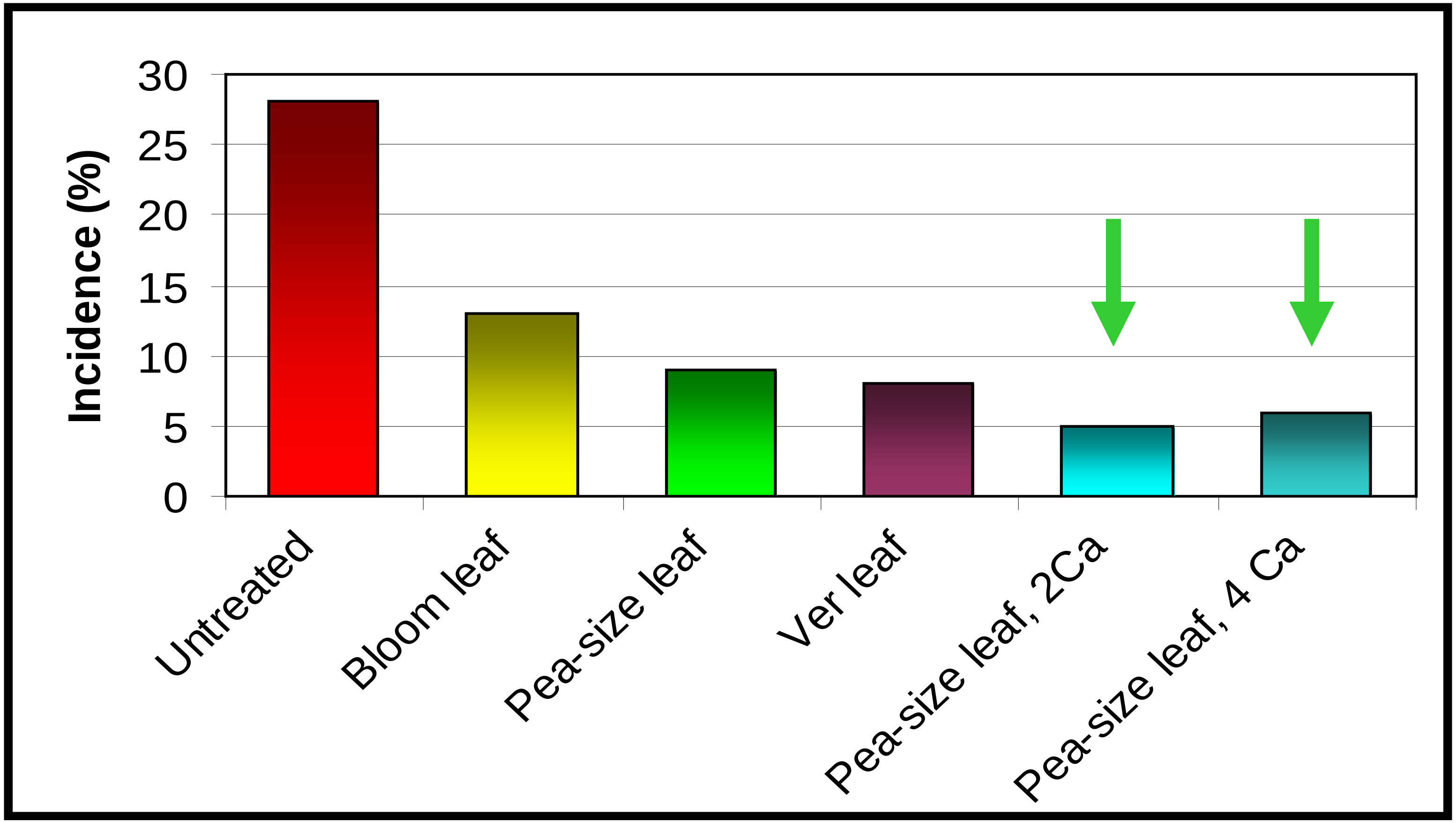
Effects of Leaf Removal Timing on Brix, Pinot noir, 2009



Effects of Leaf Removal Timing on Brix, Riesling, 2009



Effects of Leaf Removal Timing & Ca on Incidence of Sour Rot, Riesling, 2009



Very little sour rot in P. noir; no differences among treatments

Reduce Mechanical Injury

- Suggestions for Cherry Cracking
  - Physical removal of water from fruit surface
    - Helicopters, air blast sprayers
  - Osmoticum sprays
    - Mineral salts (CaCl2) applied prior to or during rain
    - Reduce absorption of water across skin
  - Protectants
    - Raingard? (non-ionic surfactant)

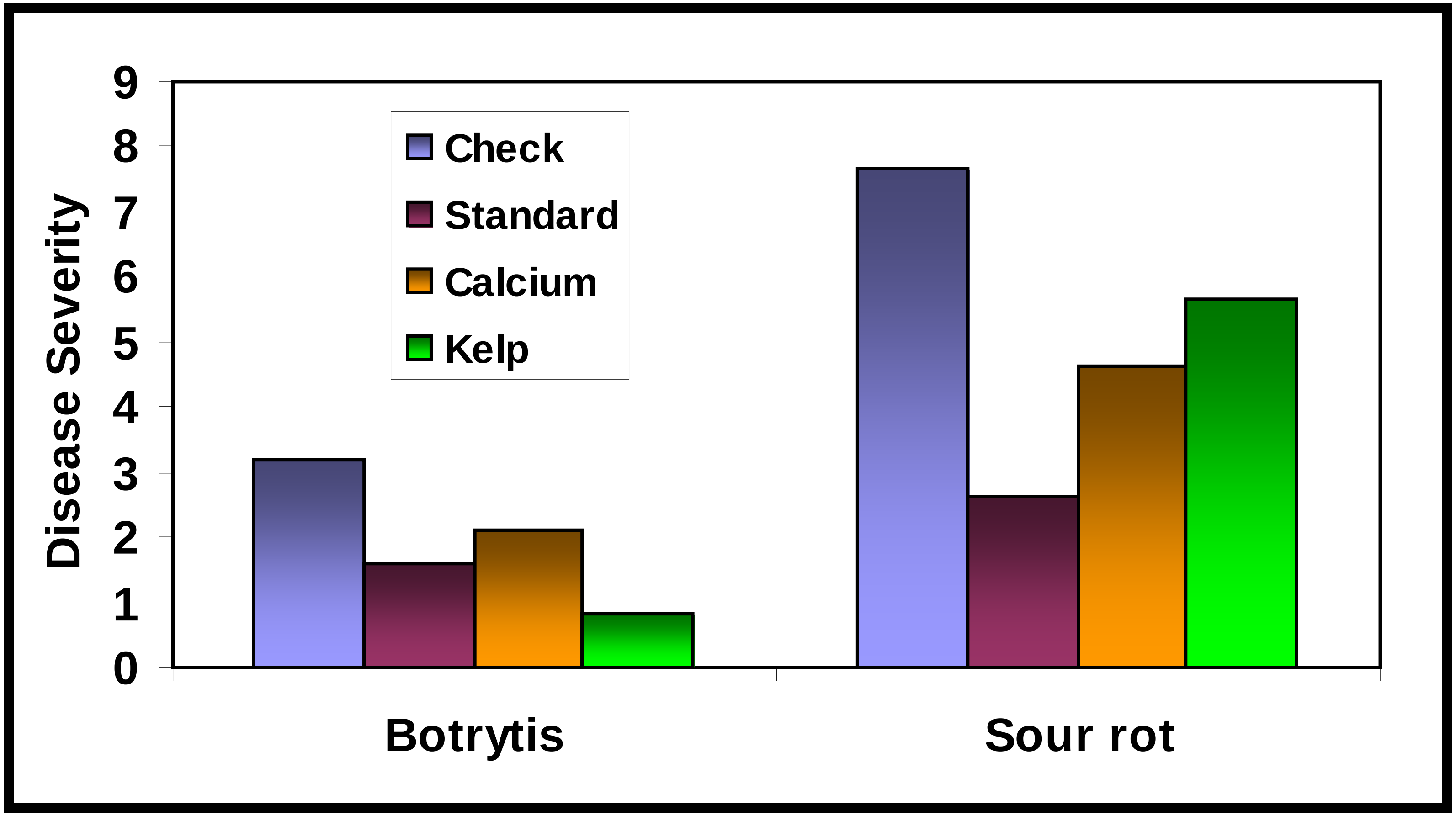
Reduce Mechanical Injury

- Suggestions for Cherry Cracking cont'd
  - Surfactants, copper, plant hormones
    - Mixed results
  - Calcium
    - Strengthen cell walls?
    - Timing between fruit set and veraison

Sour Rot Trial 1, 2008, cv. Riesling

- Riesling sprayed at cluster close, veraison, 2 wk post-veraison
  - Oligosol Ca @ 10 L/ha
  - Acadian Kelp 1 kg/1000 L
  - Standard: Scala/Elevate/Scala

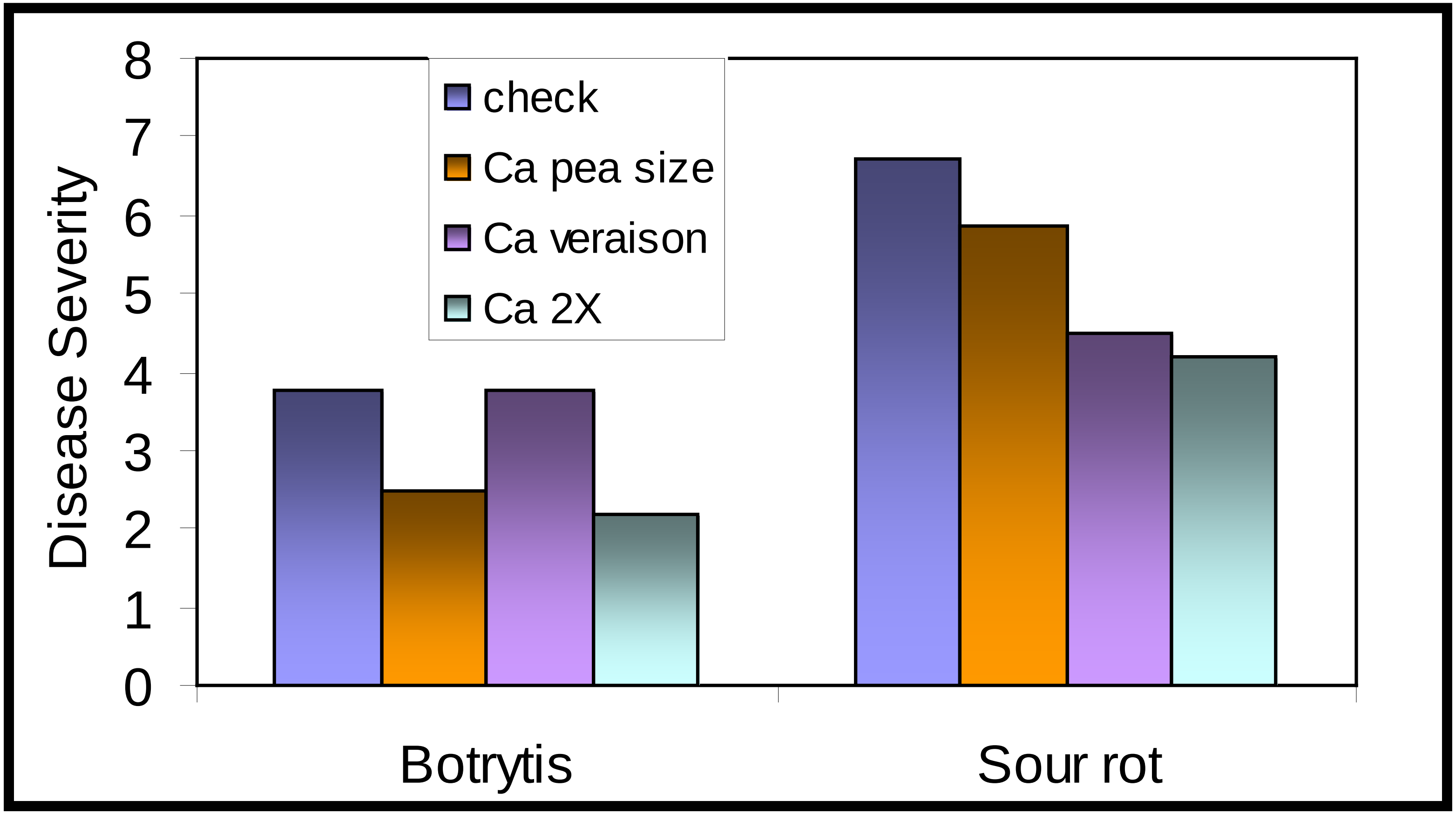
Sour Rot Trial 1, 2008, cv. Riesling



Sour Rot Trial 2, 2008, cv. Riesling

- Riesling & Pinot noir
- Oligosol Ca
  - 10 L/ha at pea-size berry
  - 10 L/ha at pea-size berry + veraison
  - 10 L/ha at veraison

Sour Rot Trial 2, 2008, cv. Riesling



Effect of Leaf Removal on Sour Rot, Riesling & Pinot noir 2009

- 2 Stopit (CaCl) + pea-size berry leaf removal
- 4 Stopit (CaCl) + pea-size berry leaf removal

Sour Rot Management

- Potassium Metabisulphite?
  - Used as anti-oxidant and anti-microbial (vs microbes) in vinification (40-60 g/tonne)
  - Rengasamy & Poole (NZ):
    - 5 kg per 1000 L water
    - Botrytis-infected berries dry out
  - Wicks (Australia):
    - 3-4 g/L KMS killed Botrytis spores & inhibited growth of germ tubes
    - If 4 g/L applied w/i 48 hr of infection, inhibits sporulation from infected berries
    - Little effect on sporulation after that

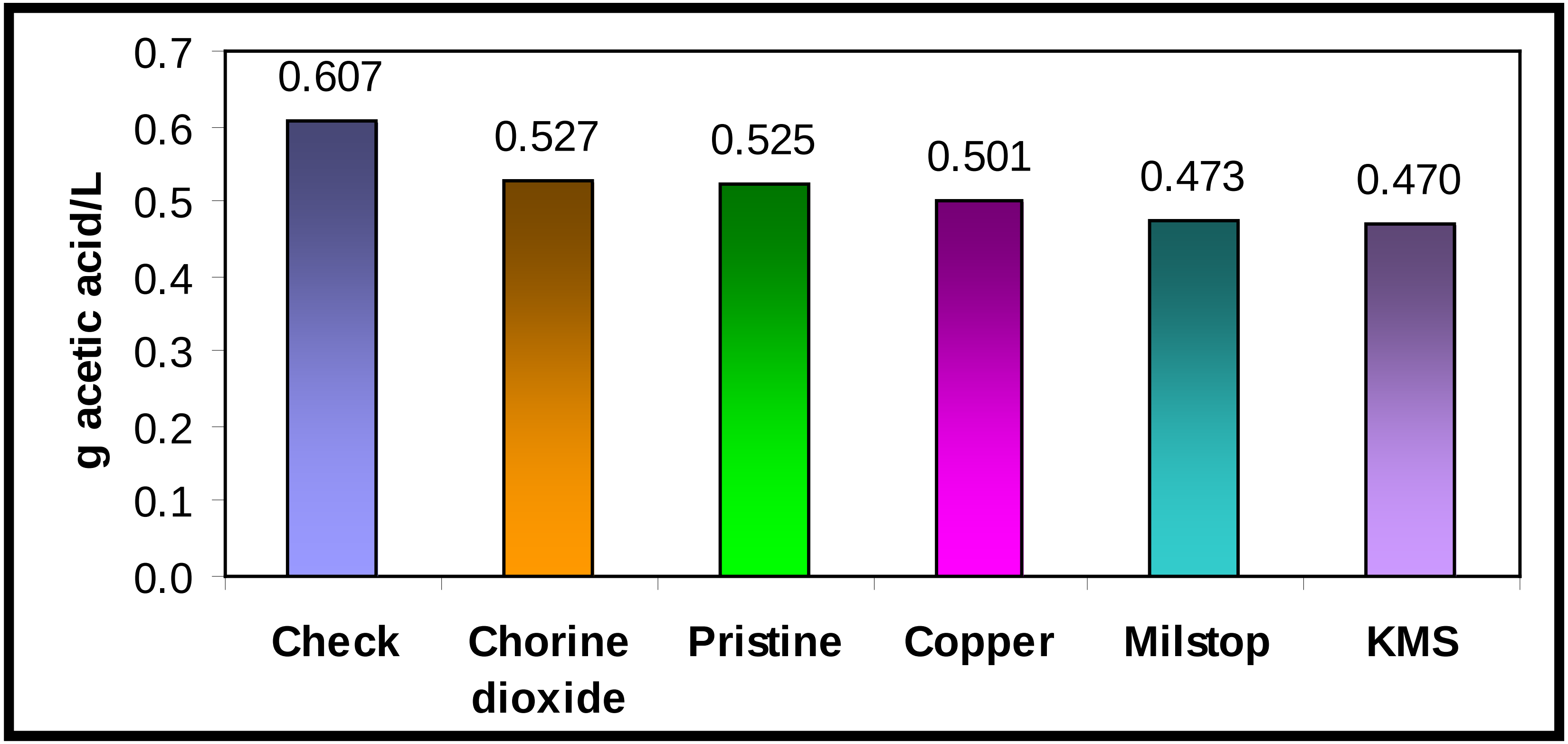
Sour Rot Management

- Potassium Metabisulphite (KMS)
  - Concerns:
    - Does it work?
    - How does it work? (anti-oxidant/anti-microbial/both?)
    - Excess sulphites & SO_2 in wine?
    - Worker/equipment exposure

Effect of Vineyard Treatments on VA, 2008

- Riesling with history of sour rot
  - Removed all clusters with more than 25% sour rot
  - Sprayed day 1
  - Collected 25 clusters per plot
  - Determined VA for each sampling date

Effect of Vineyard Treatments on VA, 2008



All treatments significantly reduced VA. Milstop and KMS reduced it more than other treatments

Timing of Sour Rot Spray, 2009

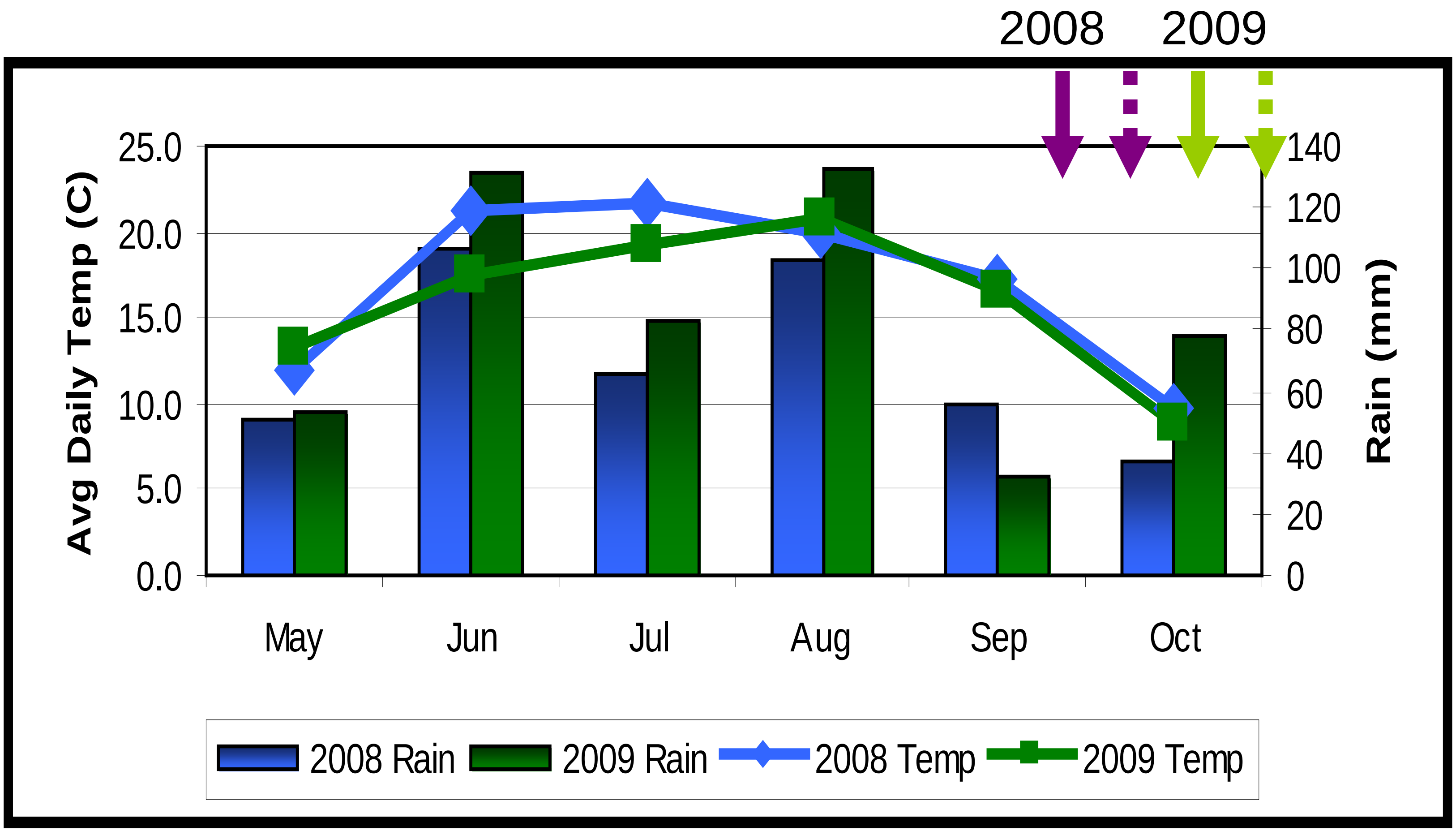
Sep 3	Sep 17	Oct 1	Oct 8	Oct 17	Oct 25
Veraison					
i	i	i	i	i	i
	i	i	i	i	i
		i	i	i	i
			i	i	i
				i	i
					i

Huber, 2009

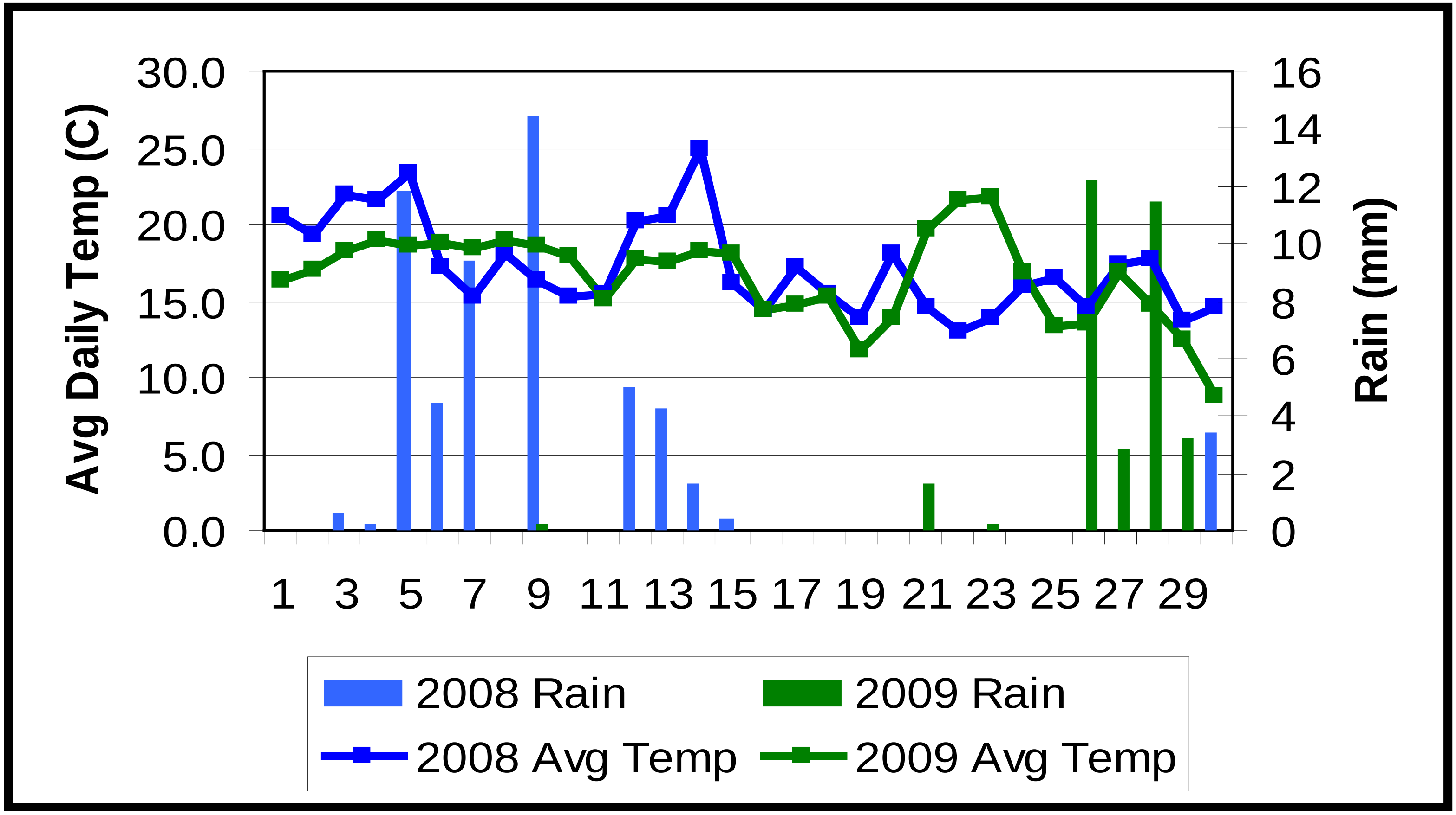
Post-Veraison Treatments, 2009

- 2 apps@ 2-wk intervals, then 4 @ 1-wk intervals (6 apps)
  - KMS @ 5 kg/1000 L
  - KMS @ 10 kg/1000 L
  - KMS @ 2.5 kg/1000 L
  - Milstop (K_2CO_3)
  - Milstop + KMS
  - Oxidate (H_2O_2)
- 2 wk intervals (5 apps)
  - Actinovate (*Streptomyces lydicus*)
  - Blight Ban A506 (*Pseudomonas fluorescens*)
  - Purshade ($CaCO_3$)
- Veraison, 2 wk post veraison, 4 wk post veraison (3 apps)
  - Vermicompost
  - Switch (cyprodonil + fludioxonil)
  - Stopit (CaCl)
- Untreated check

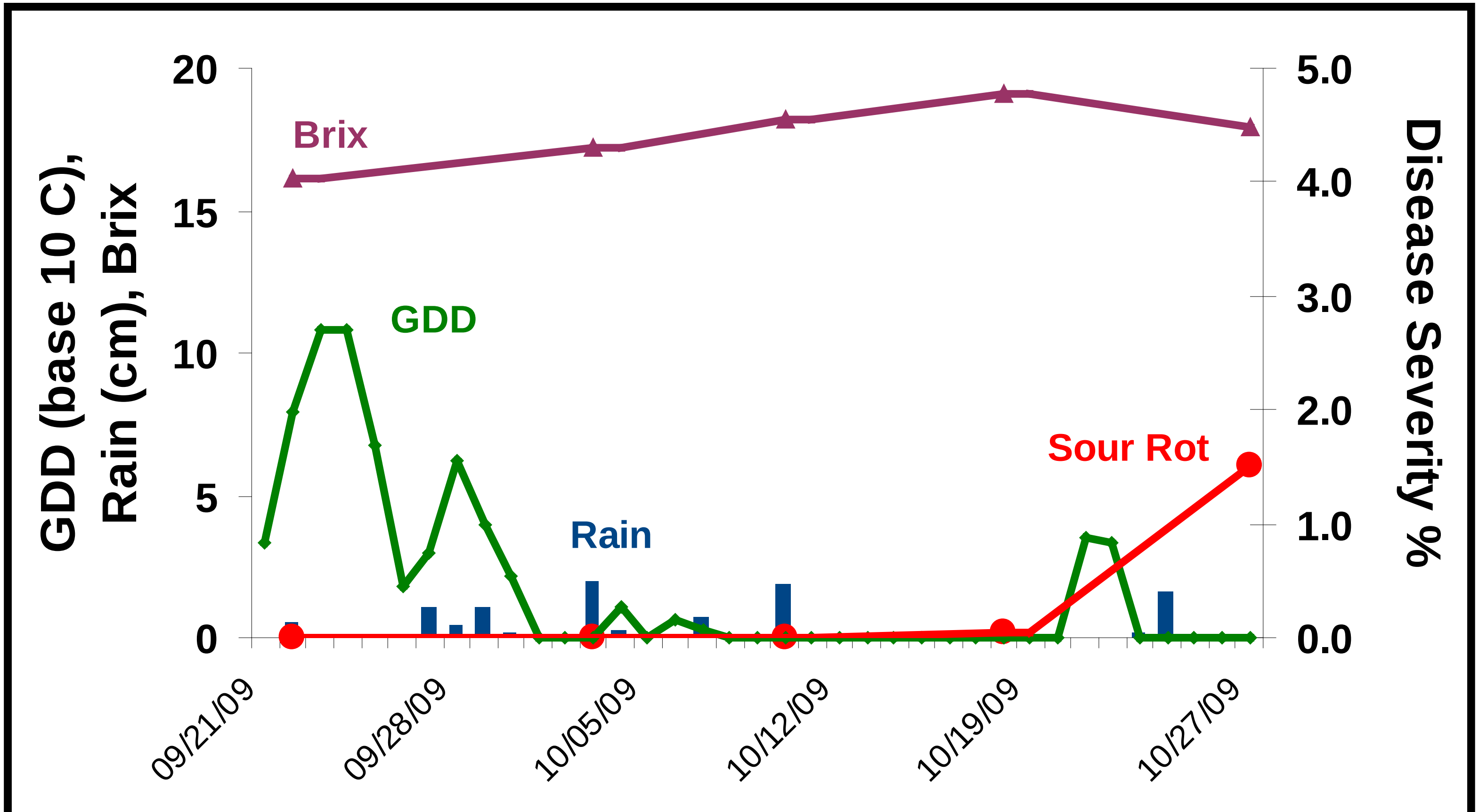
Average Daily Temperature and Precipitation, 2008 and 2009



Average Daily Temperature and Precipitation, September 2008 and 2009



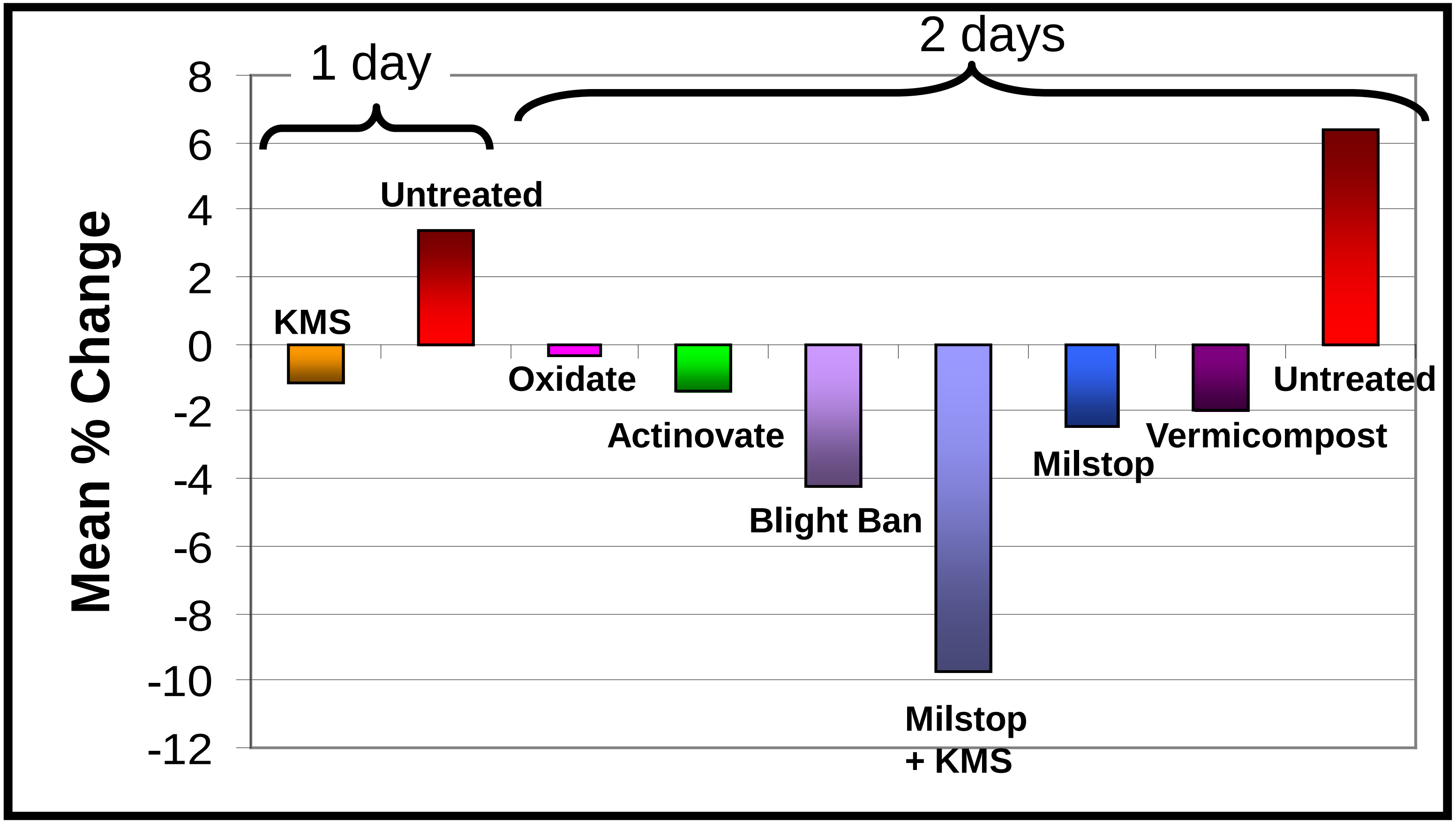
Effects of Temperature, Rain, Brix on Sour Rot Development, 2009



Effects of Post-Veraison Treatments on Berry Microflora

- Sampled fruit before and 24 hr after treatment with
  - KMS 5 kg/1000 L
  - Oxidate
  - Actinovate
  - Blight Ban
  - Milstop
  - Milstop + KMS
  - Vermicompost

Effect of Post-veraison Treatments on Yeasts, 2009



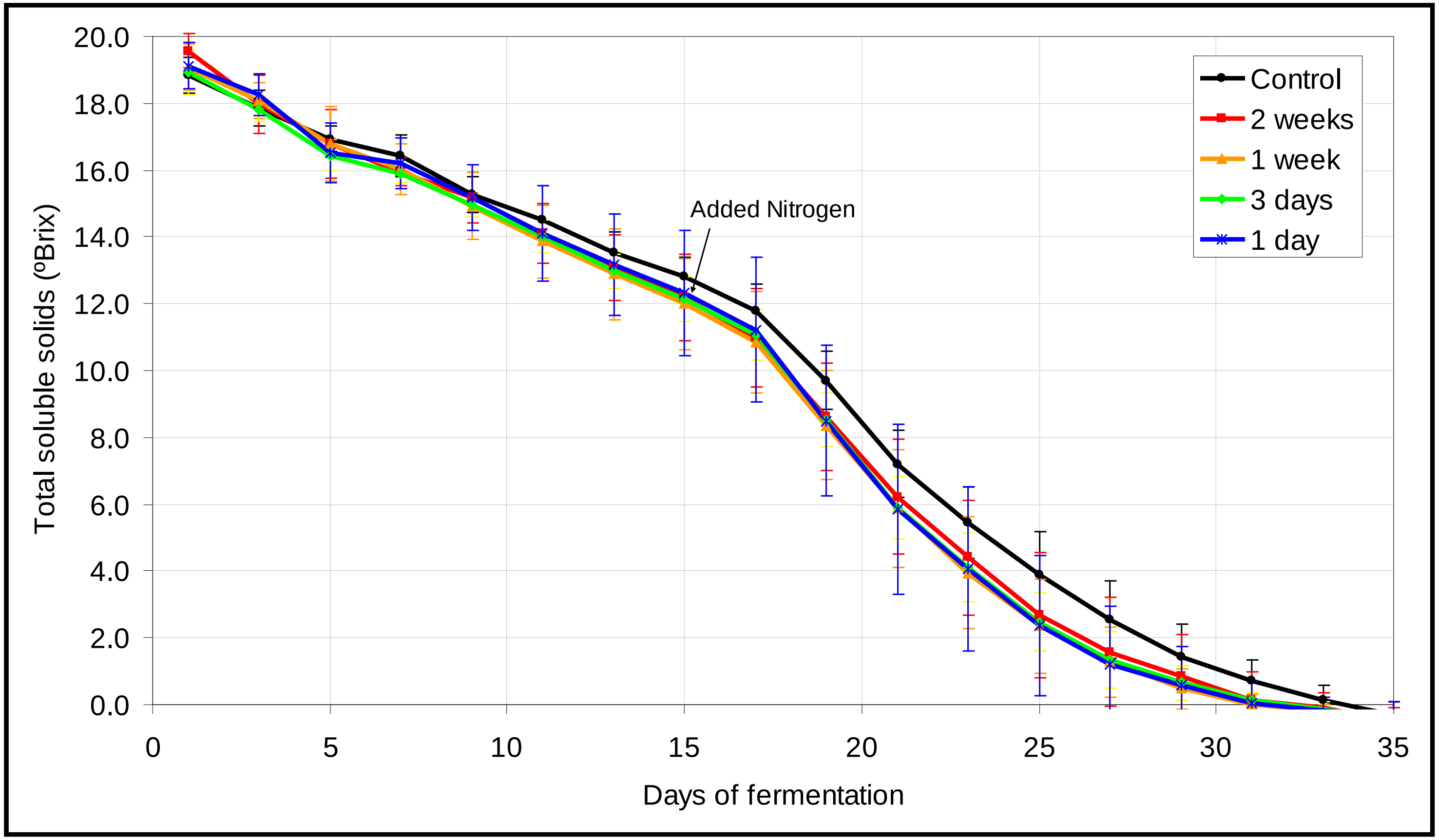
Effects of KMS on Vinification

- Treatments: 2 wk, 1 wk, 3 d, 1 d preharvest at 5 kg/1000L (5000 ppm) (2.4 kg KMS/ha)
- Each plot consisted of all rot-free fruit on 4 to 6 Riesling vines
- If no sulfur dioxide dissipated, then the expected concentration of SO_2 in the juice would be 197 mg/L (based on a crop level of 4 t/acre)

Effects of KMS on Vinification

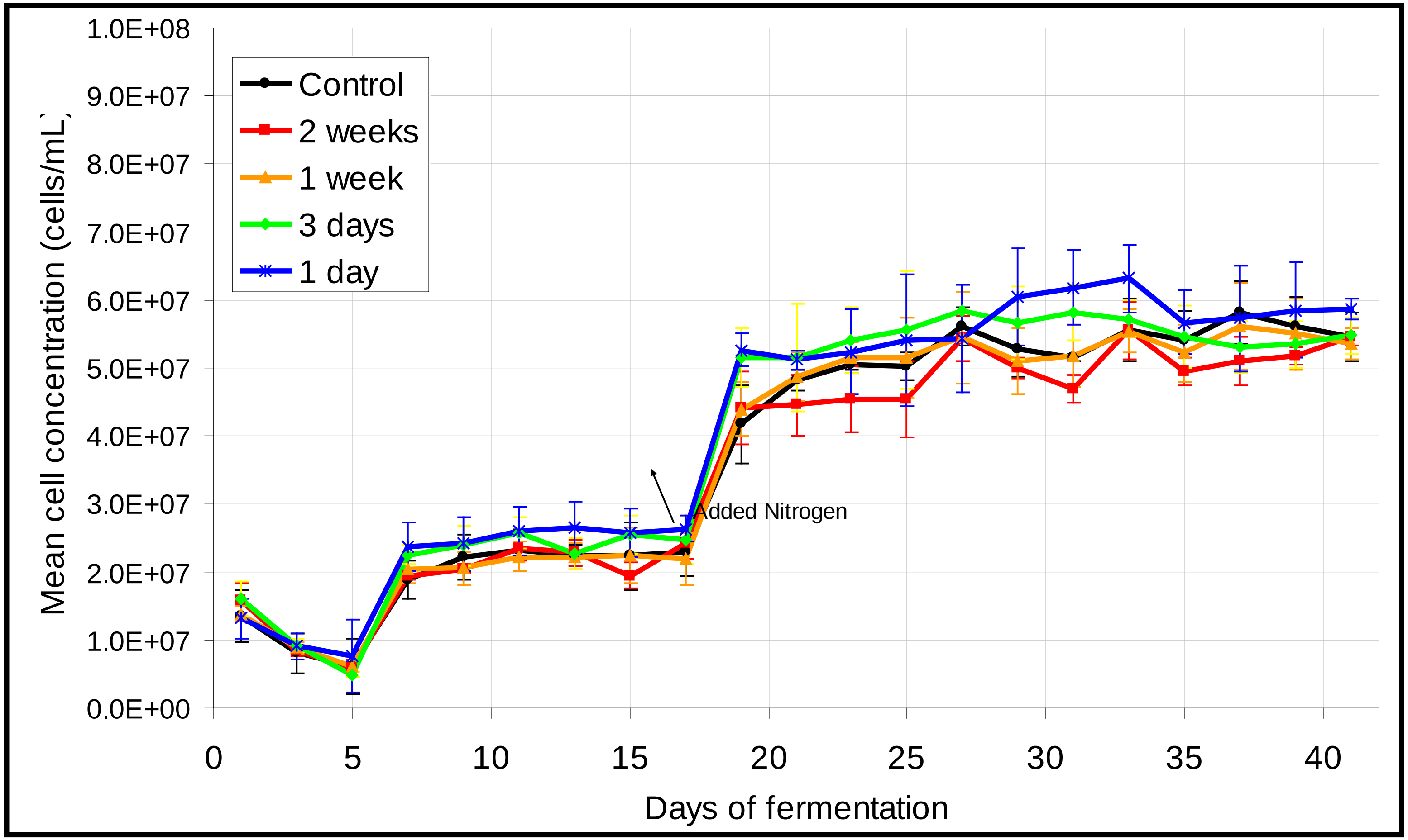
- Fermentations were sampled every other day for cell count and ºBrix until the fermentations went to dryness

Effects of KMS on Fermentation



Fermentation slower in untreated control compared to KMS

Effects of KMS on Fermentation



No effect on yeast growth

Effects of KMS on Fermentation

Table 3. Wine parameters.

Treatment	pH	Titratable acidity (g/L tartaric acid)	Residual Sugar (g/L)	Ethanol (% v/v)	Total YAN (mg N/L)	Free SO2 (mg/L)	Total SO2 (mg/L)
Control	2.86 ±0.04	9.7 ±0.2a	1.1 ±0.5	11.2 ±0.3	6.1 ±3.0	1.6 ±0.6	3.0 ±0.8
2 weeks	2.87 ±0.07	8.9 ±0.5b	1.2 ±0.5	11.3 ±0.3	7.4 ±1.5	1.7 ±0.4	3.2 ±0.8
1 week	2.82 ±0.07	8.8 ±0.3b	1.3 ±0.7	11.1 ±0.2	7.6 ±2.2	1.8 ±0.9	2.9 ±0.9
3 days	2.81 ±0.06	8.9 ±0.3b	1.6 ±0.6	10.7 ±0.4	7.3 ±0.6	1.7 ±0.5	2.9 ±0.8
1 day	2.86 ±0.11	8.8 ±0.3b	1.6 ±1.1	11.0 ±0.6	8.6 ±2.9	1.8 ±0.7	3.0 ±0.8

Mean values followed by letters are significantly different by LSD ($p<0.05$).

Very low levels of SO_2

Nsd in TA, residual sugar, ethanol

Effects of KMS on Fermentation

- KMS vineyard sprays did not adversely affect the yeast's ability to carry out the fermentation
- Sulfur dioxide sprayed in the vineyard is not detectable in juice processed from grapes only 1 day after KMS spray application
- Effects on storability of wine????

Factors that affect sour rot: Canopy management

- Improved spray penetration
- Faster drying
- Increased wax deposition
- Higher phenolic compounds in skins

Future Research

- Repeat cluster loosening treatments
  - Assess return fruitfulness
- Effects of temperature, wetness duration, Brix, cuticle/skin characteristics on infection
- Timing of treatments
- New post-veraison treatments
- Effects of treatments on organisms causing sour rot
- Interactions among causal organisms + Botrytis, powdery mildew
- Effects of treatments on cuticle and skin characteristics

Acknowledgements

- Ontario Grape and Wine Research Inc.
- Niagara Peninsula Fruit and Vegetable Growers Association
- Vincor Canada
- Schenck Greenhouses and Farms Ltd.
- Niagara Vintage Harvesters

Acknowledgements

- Dr. Debra Inglis
- Lisa Dowling
- Rhiannon Plant
- Cristina Huber
- Kathryn Hoshkiw-Tombs
- Dr. Ai-Lin Beh
- Shiri Sauday
- Paula Haag & Dr. Peter Sholberg, AAFC Summerland
- Dr. Keith Seifert, AAFC

Acknowledgements

- BASF Canada
- N.M. Bartlett
- Biosafe Systems
- Forterra Inc.
- NORAC Concepts Inc.
- Plant Products
- Bioworks Inc.