The Science of Wine

Viticulture & Enology

World Class • Face to Face

www.wine.wsu.edu

Thomas Henick-Kling

Professor of Enology
Director of Viticulture & Enology Program

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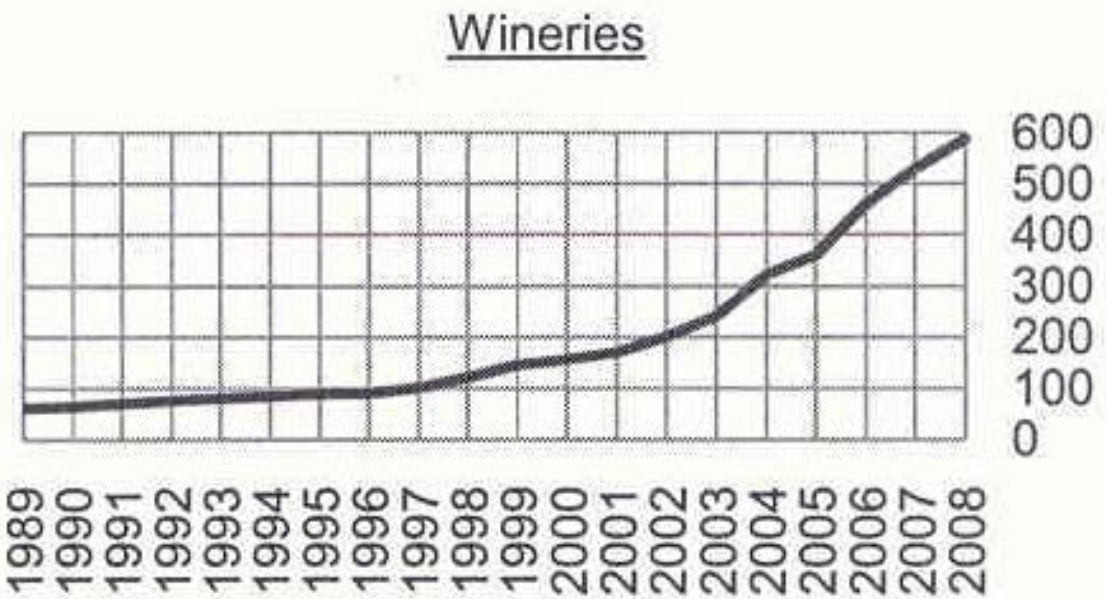
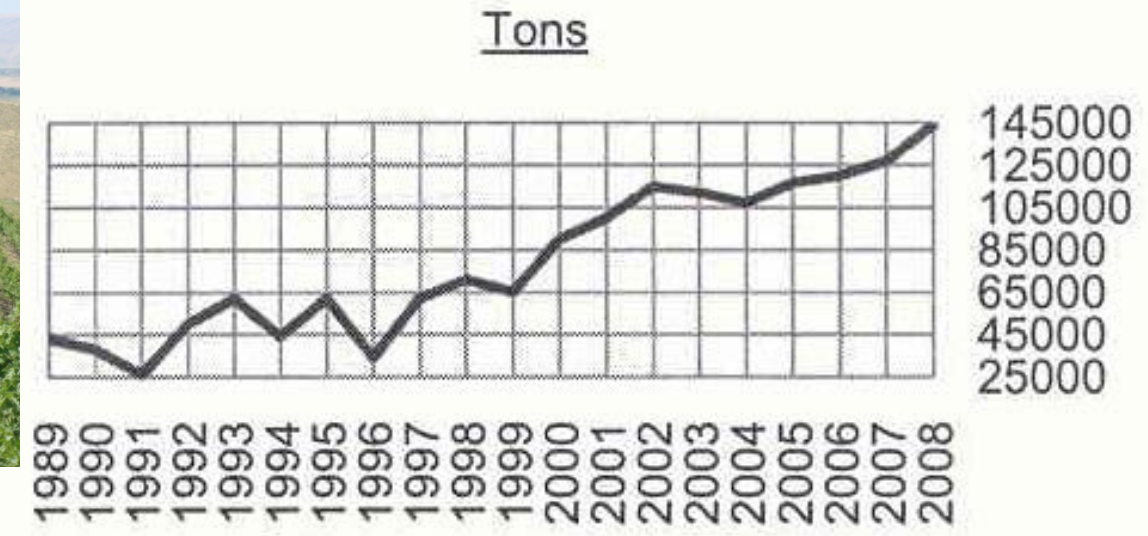
Growth of Washington Wine Industry





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Wine Grapes utilized

	2007	2008	2009	2010
WA	127,000	145,000	156,000	160,000
NY	24,000	26,000	30,700 (wine grapes)	
NY	-	-	84,000 (total utilized for wine)	
OR	38,600	34,700	37,000	
CA	3,288,000	3,055,000	3,440,000	

Price per ton

WA	954	1,030	988
NY	223	266	271
OR	1,880	2,050	2,050
CA	564	609	502

Value of utilized production (x1,000 dollars)

WA	121,158	149,350	163,020
OR	72,568	71,135	75,850
CA	1,855,122	1,859,150	1,726,880

Washington is the second largest producer of premium wine in the United States. More than 700 licensed wineries and approximately 40,000 acres of wine grapes

Goal is to triple the economic impact by 2020 from approximately over $3 billion to $10 billion.

This would have a significant economic impact:

<u>Overall Economic Impact by 2020</u>
$10 billion to the state of Washington
$15 billion to the US

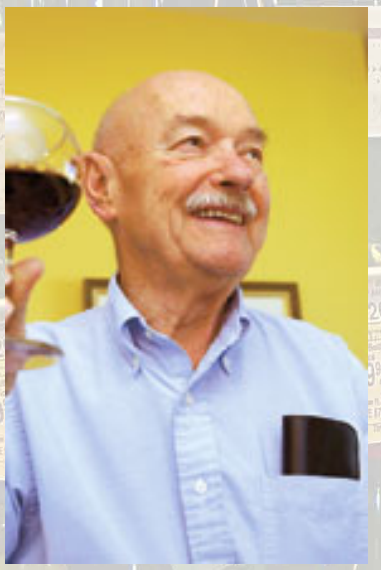
<u>Employment</u>
Employment would grow from 19,000 jobs *to 57,000 jobs,* with payroll increasing from $579 million *to $1.737 billion*

<u>Taxes</u>
$145 million in state and local taxes would increase *to $435 million*
$269 million in federal taxes would increase *to $807 million*
$58 million in taxes in other states would increase *to $174 million*

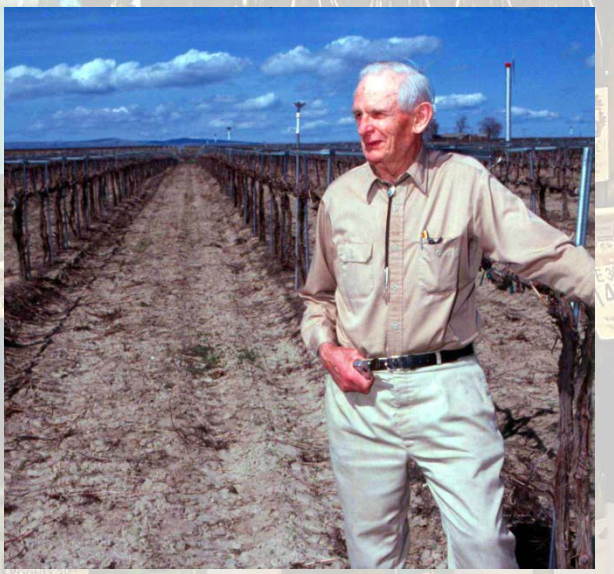
Wine Research at WSU

Started in the 1960s with WSU research leaders:

Chas Nagel,
Food scientist



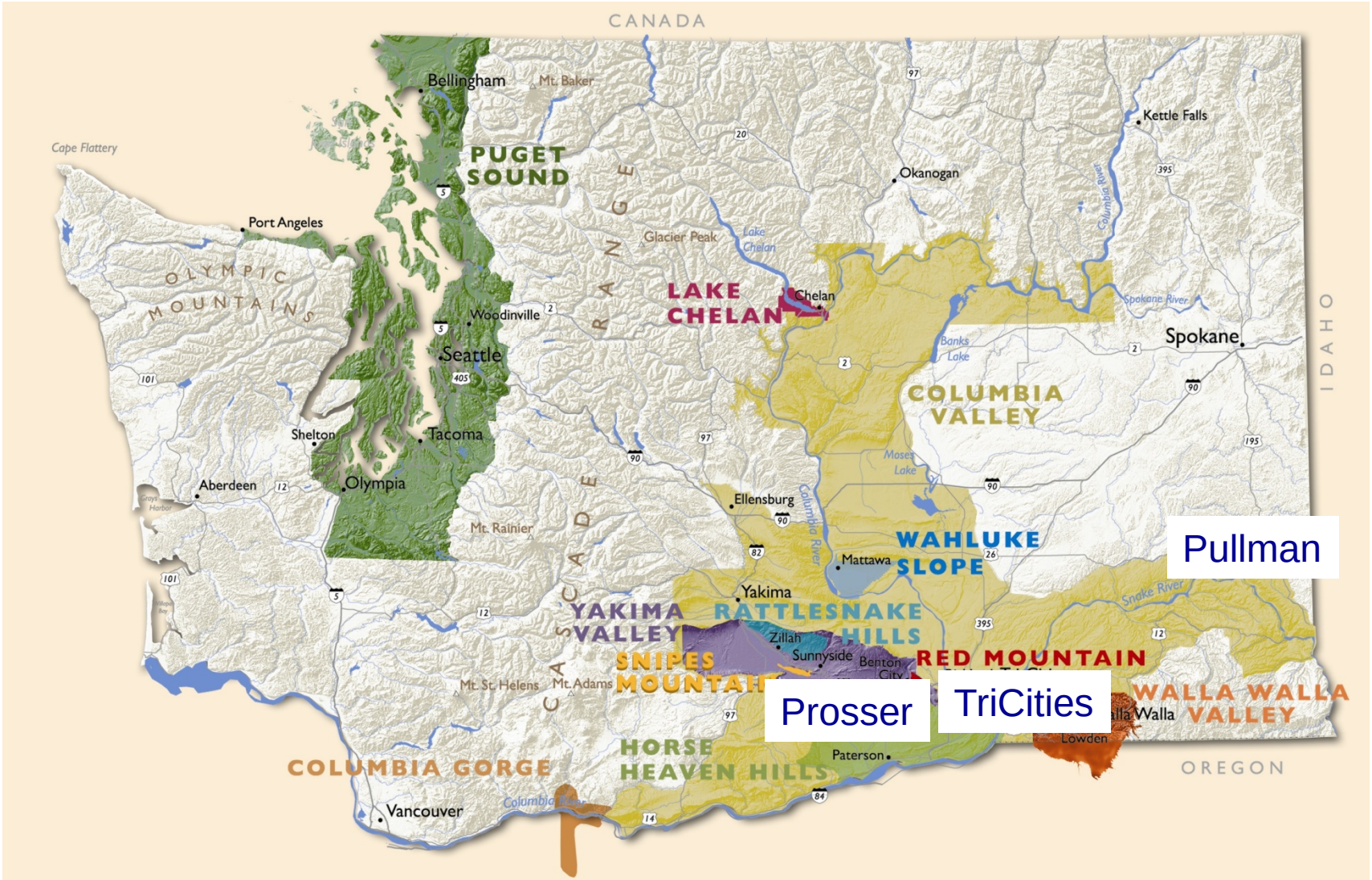
Walter Clore,
Horticulturist



in collaboration with industry pioneers, including:

- Ch. Ste. Michelle
- Columbia Winery
- Red Willow
- Champoux
- Sagemoor
- Hogue
- and others

WSU Viticulture & Enology Research and Education



A Vintage Partnership
National and International Collaborations

- UC Davis
- Cornell University
- Oregon State University

- Germany
- France
- Switzerland
- Italy
- Australia

Washington State's geography offers many different growing environments: sites

Opportunity for creating distinct, high quality products

Research priorities identified by the Washington wine & grape industry

Viticulture & Enology:

Task 1: Vineyard Development

Task 2: Plant Improvement

Task 3: Water Management

Task 4: Pest and Disease Management

Task 5: Mechanization

Task 6: Plant Health and Nutrition

Research priorities – continued:

Task 7: Processing – Receiving Practices Affecting Grape and Wine Quality

Task 8: Enology Research Priority – Phenolic Management

Task 9: Enology Research Priority – Microbiology

Task 10: Enology Research Priority – Stabilization/Clarification

Task 11: Enology Research Priority – Product Quality/Sensory Measurement

Task 12: Technology Transfer, Education

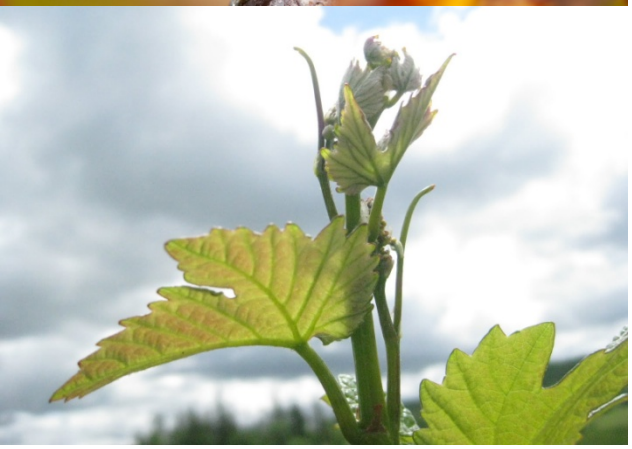
Wine Flavor and Sustainability

- Grape vine response to environment
  - vine physiology - water and heat
  - vineyard management and fruit quality
  - vine and grape diseases
  - grape vine genetics - adaptation to the environment
    genetic diversity

- Soil quality
  - vine nutrition and fruit quality
  - sustainability

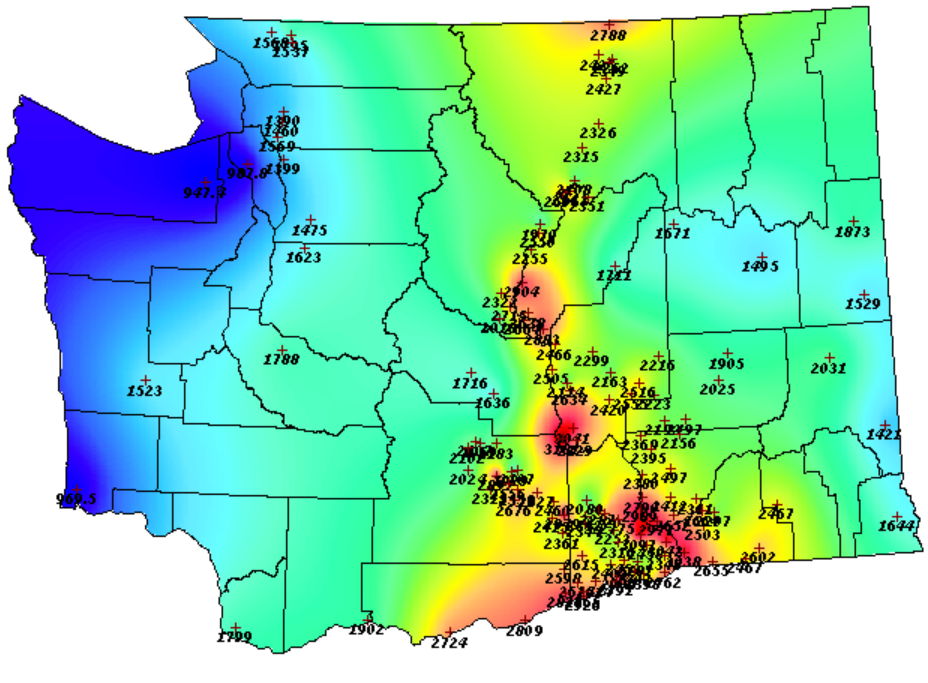
- Water management for grape yield and quality
  - controlled deficit irrigation
  - water cycle and water quality in the vineyard
  - climate change and water allocations

Site & Cultivar Interaction



Cabernet Sauvignon, Merlot, Syrah, Cabernet Franc, Malbec, Sangiovese, Pinot Noir, Lemberger, Grenache, Cinsault, Mourvèdre, Petit Verdot, Zinfandel, Barbera, Nebbiolo, Counoise, Graciano

Riesling, Chardonnay, Sauvignon Blanc, Semillon, Pinot Gris, Viognier, Gewürztraminer, Muscat, Müller-Thurgau, Siegerrebe, Chasselas, Grüner Veltliner, Roussanne, Marsanne,



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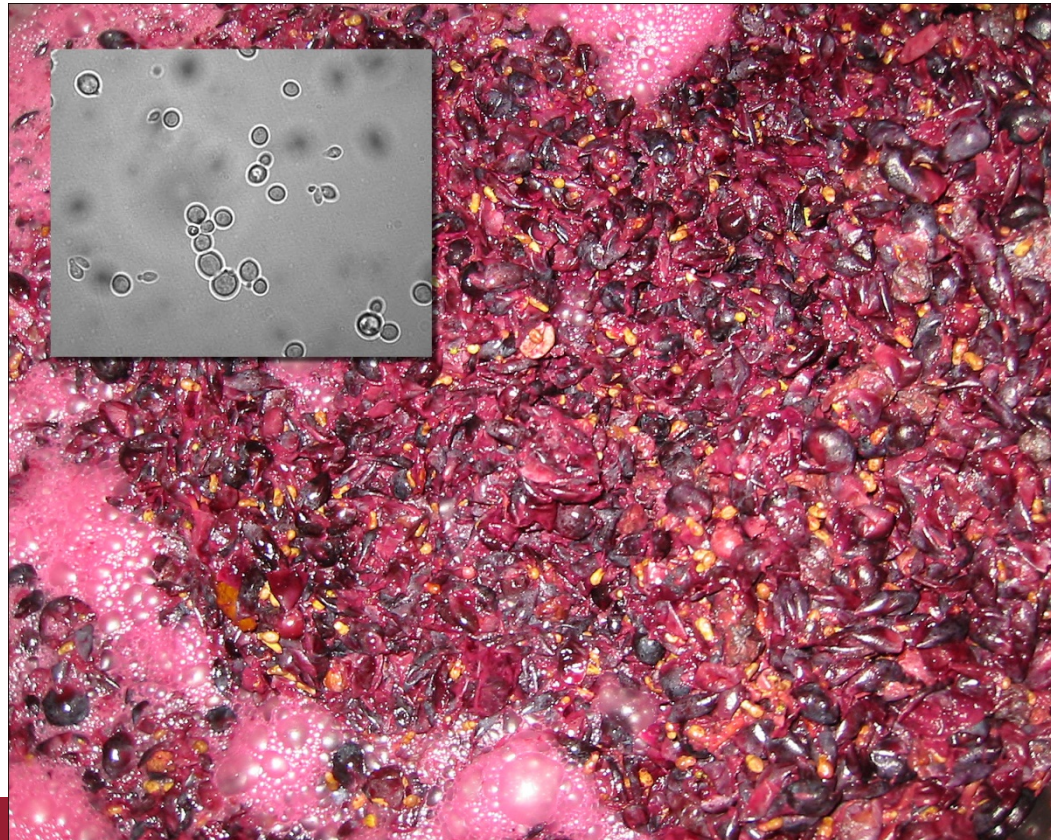
Free of defects • Varietal Flavors • Regional Flavors

- Cultivar Section
  - matching cultivar and site
  - matching cultivar and vineyard management
- Fruit Quality
  - flavor development in the fruit
  - microbial quality
- Vinification and Wine Aging
  - fruit processing
  - fermentation control
  - fermentation tank design
  - temperature control
  - microbiological control
- Sensory science and Consumer studies

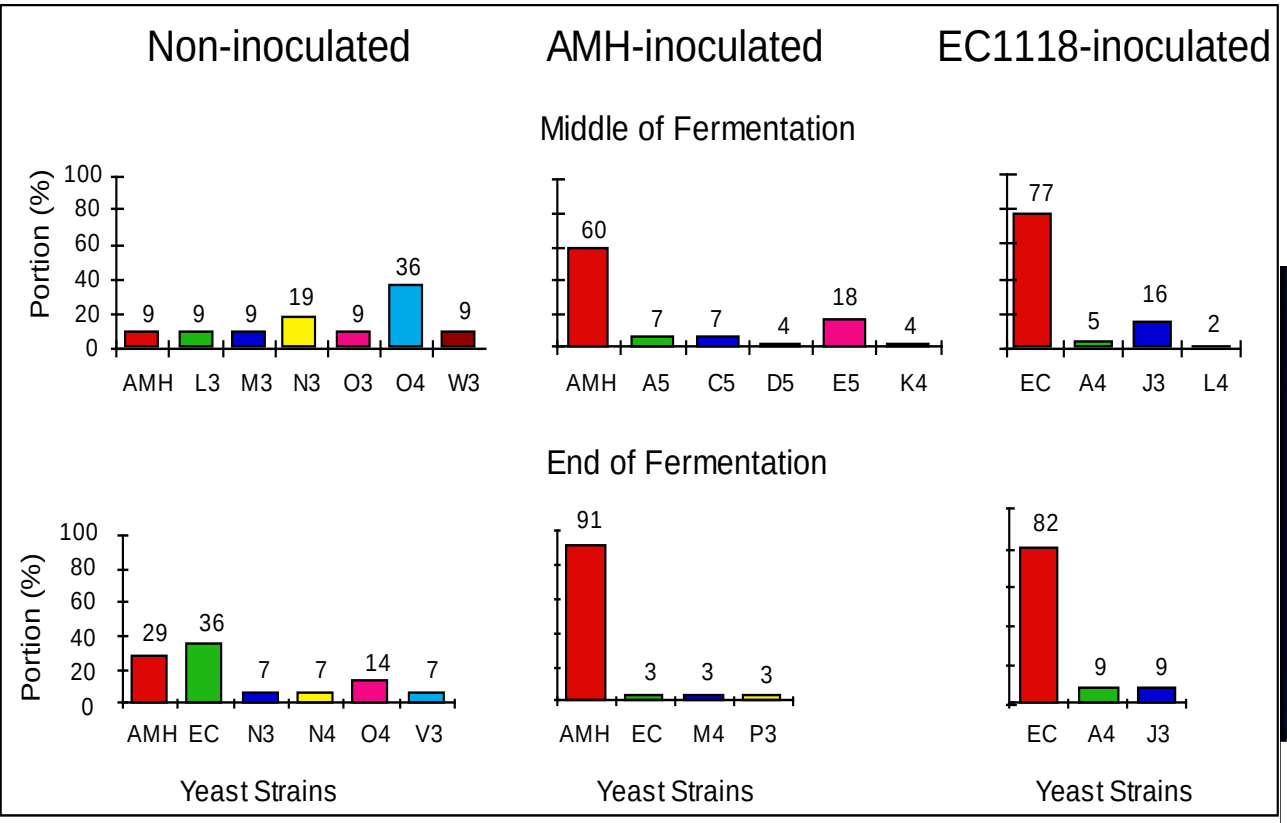
Typicity and microbial diversity

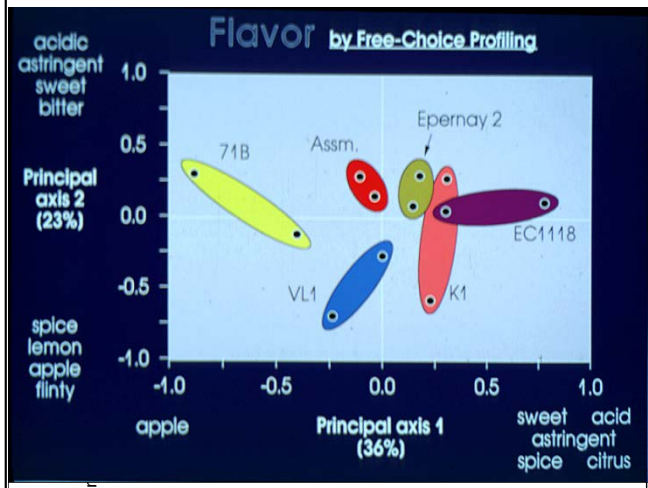
Expression of local and grape varietal flavors

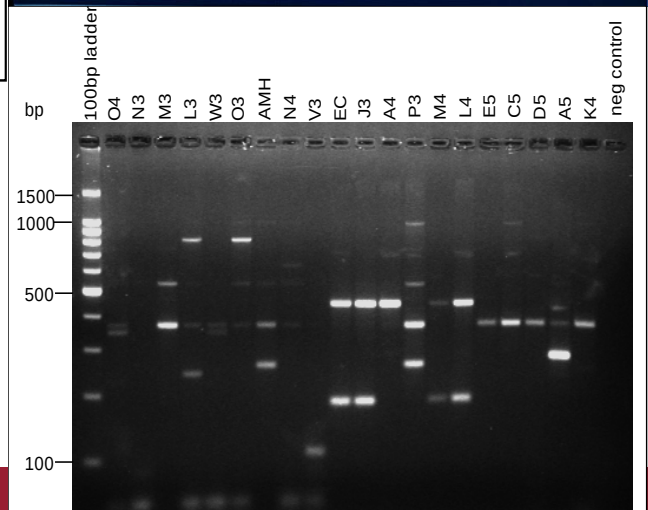
through management of
indigenous microorganisms and
selected starter cultures



Selected yeast and indigenous yeast







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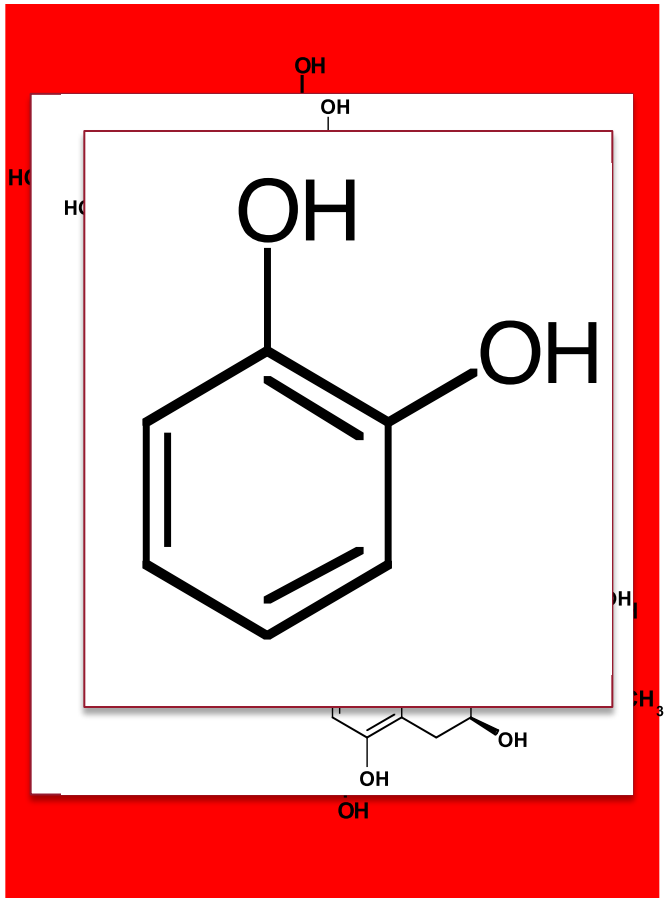
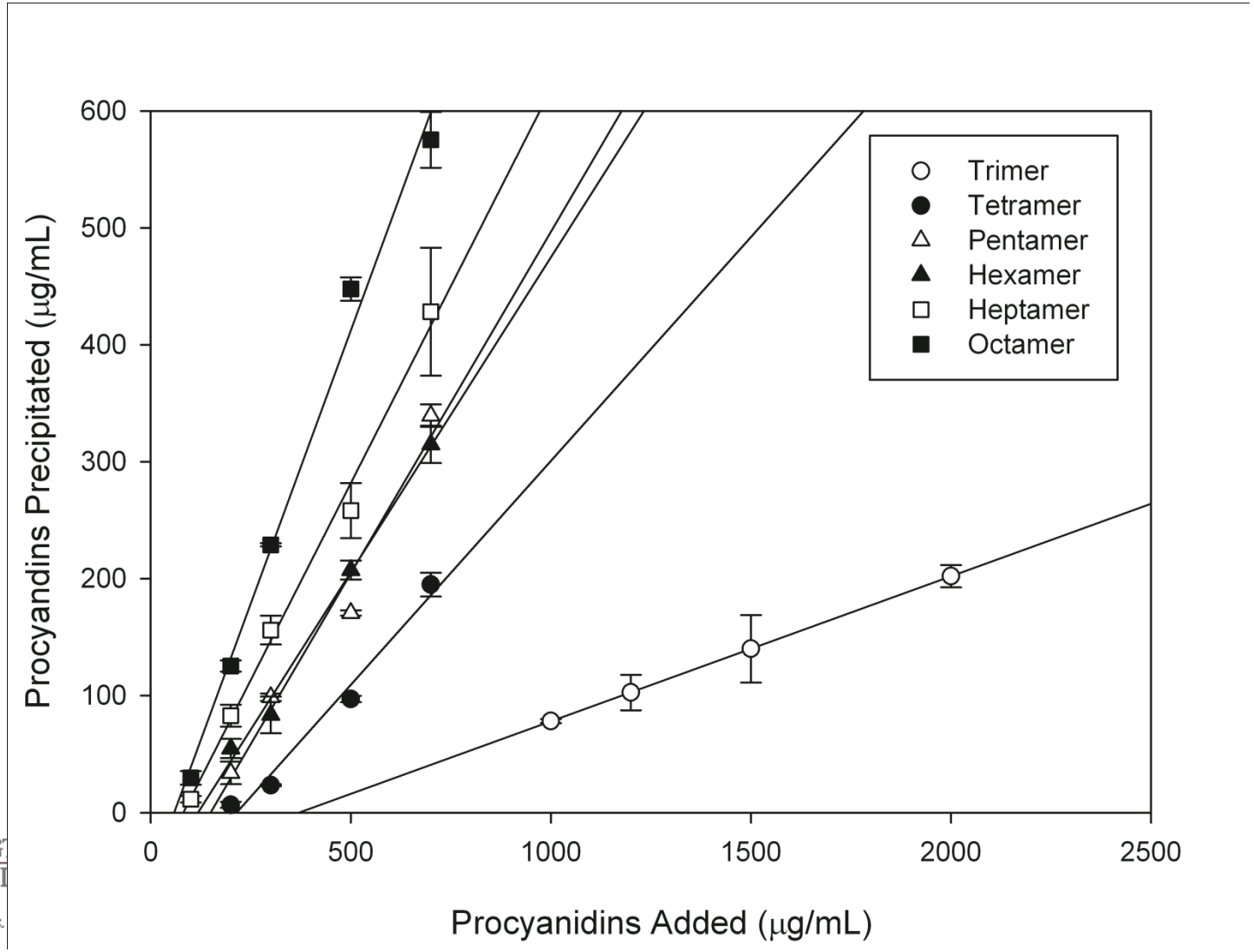
Importance of Phenolics

- Phenolics have important sensory impacts on wine
- Several Classes of Wine Phenolics
  - Color: Anthocyanins, polymeric pigments
  - Bitterness: Catechins (flavan-3-ols)
  - Astringency: Tannins (proanthocyanidins)
  - Antioxidant: ortho-dihydroxylated phenolics

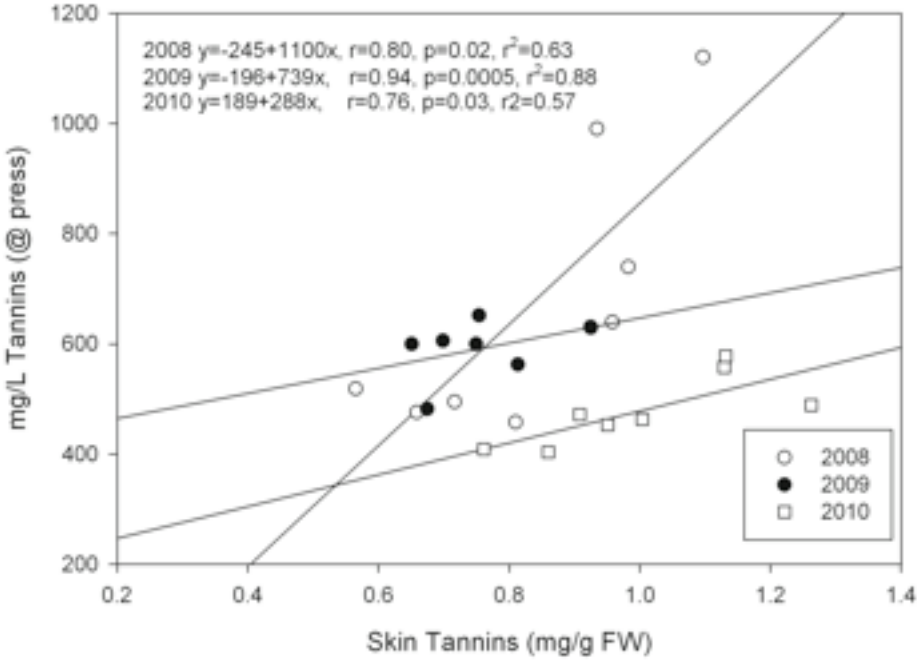


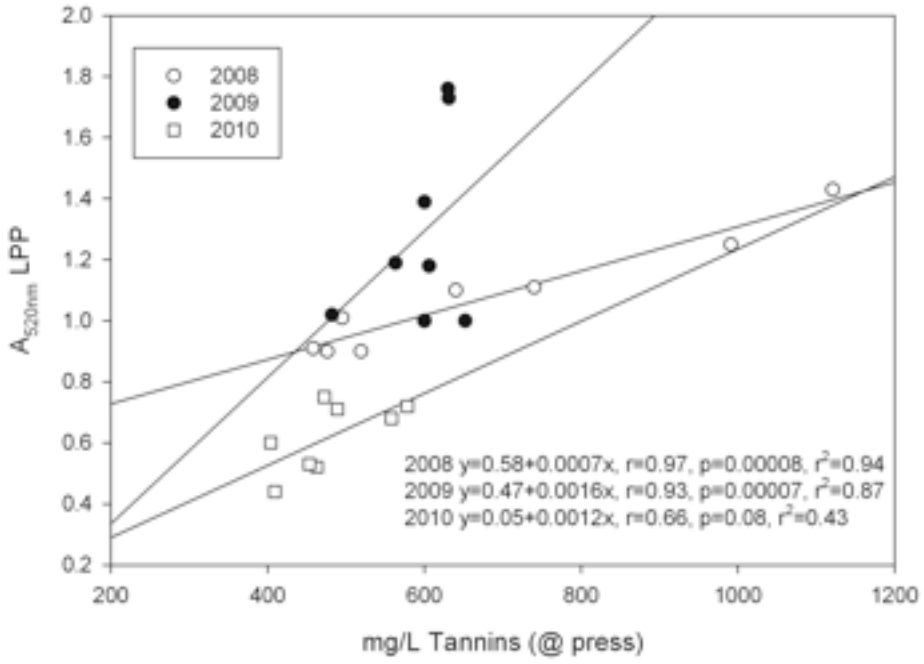
Precipitability of Procyanidins

Sensory impact

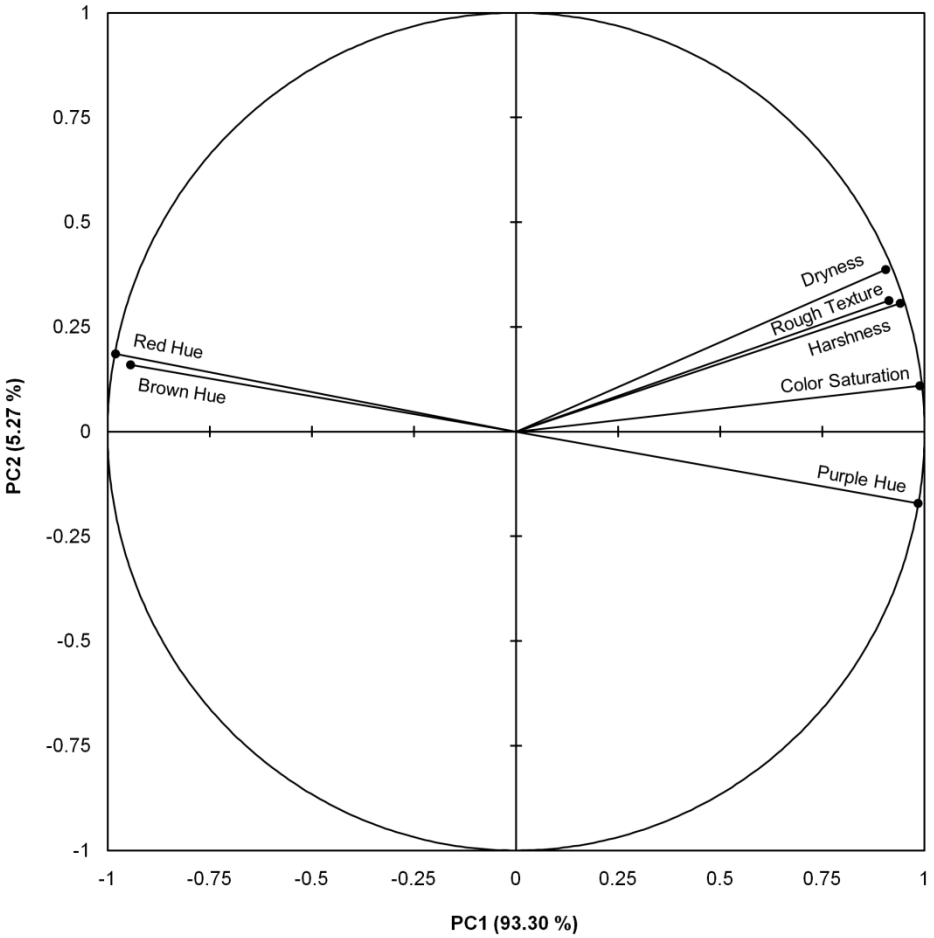


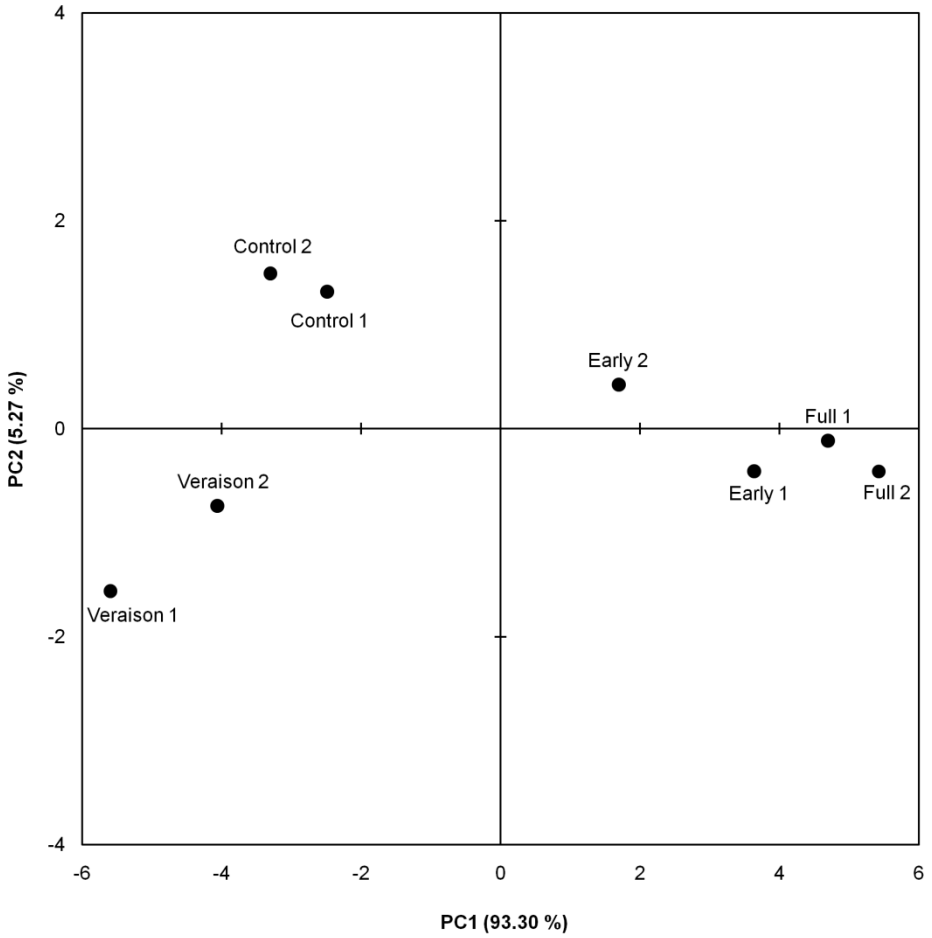
Skin Tannin and Wine Tannin Relationship





- Skin Tannins have significant relationship with wine tannins.
  - The Extraction Varies by Vintage
- Wine Tannins have significant relationship with LPP
  - LPP Amount Varies by Vintage
  - Skin Tannin has relationship with LPP

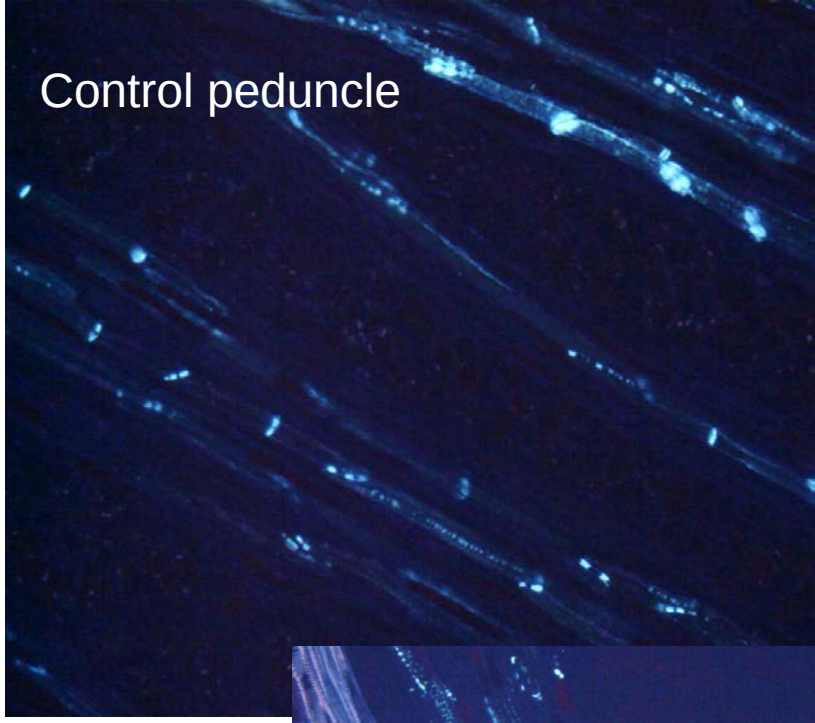




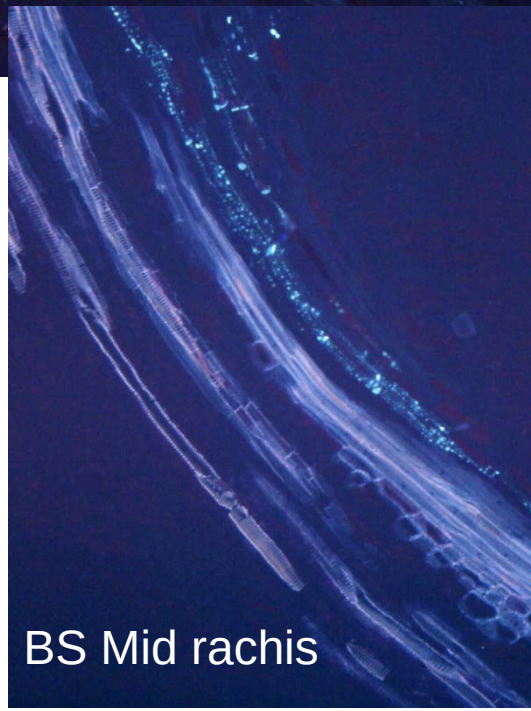
- Full and Early Deficit wines are more purple, more saturated and more harsh (astringent)
- Control and Véraison less saturation, more red, less harsh (véraison less so than control)

Dr Jim Harbertson

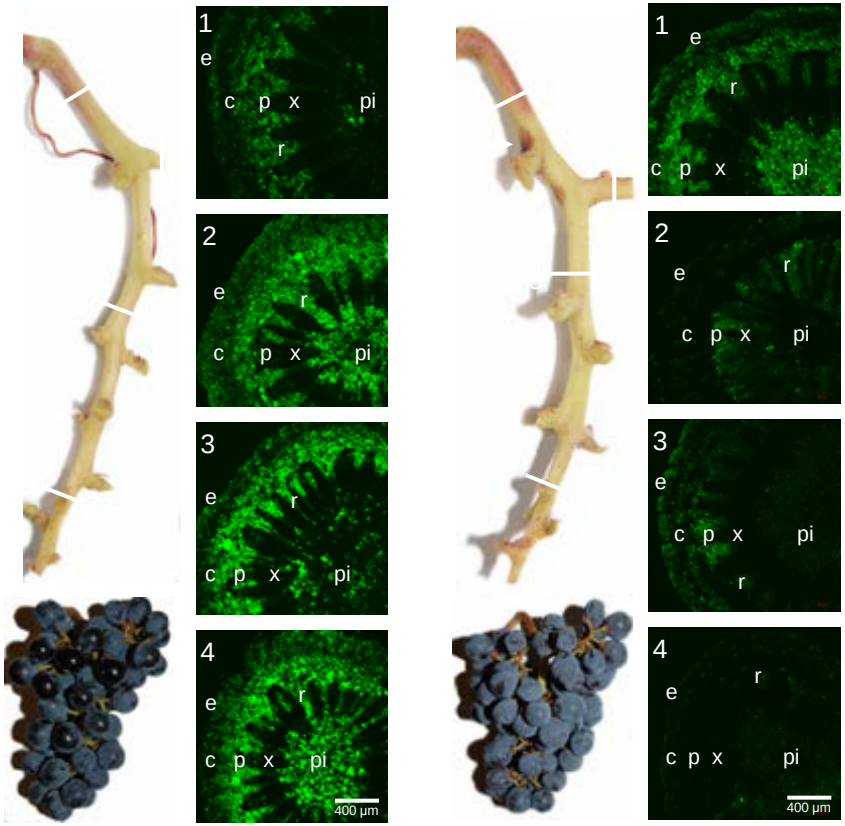
Berry Shrivel and Bunch Stem Necrosis – Dr Markus Keller

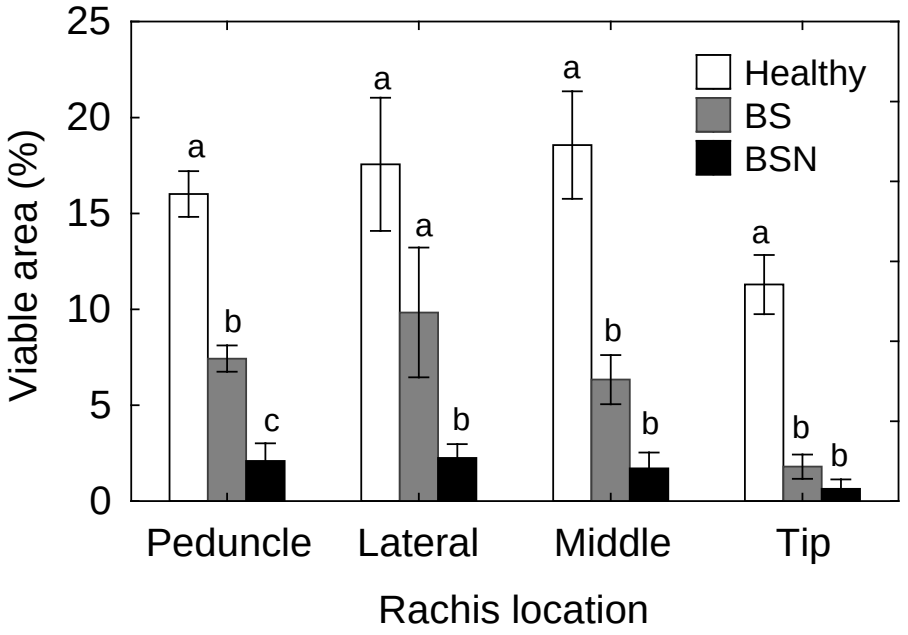


Berry Shrivel



Dr Bhaskar Bondada





- Dead internal rachis tissues with both BS and BSN
- BSN usually developed near tip of BS clusters
- All BS clusters had (some) BSN by end of season
- Early BSN (bloom) did not increase BS or BSN

Grapevine leafroll virus
Vine performance cv. Merlot

2010 season

Parameter	Healthy	Infected
# bunches/vine	83.5 ± 4.00	69.3 ± 2.50 **(-17.00%)**
Yield/vine (kg)	3.84 ± 0.73	3.25 ± 1.47 **(-15.36%)**
Pruning wt (kg)	0.29 ± 0.05	0.28 ± 0.08 **(-5.05%)**
Sugar content (ºBrix)	25.2 ± 0.15	23.7 ± 0.25 **(-5.6%)**

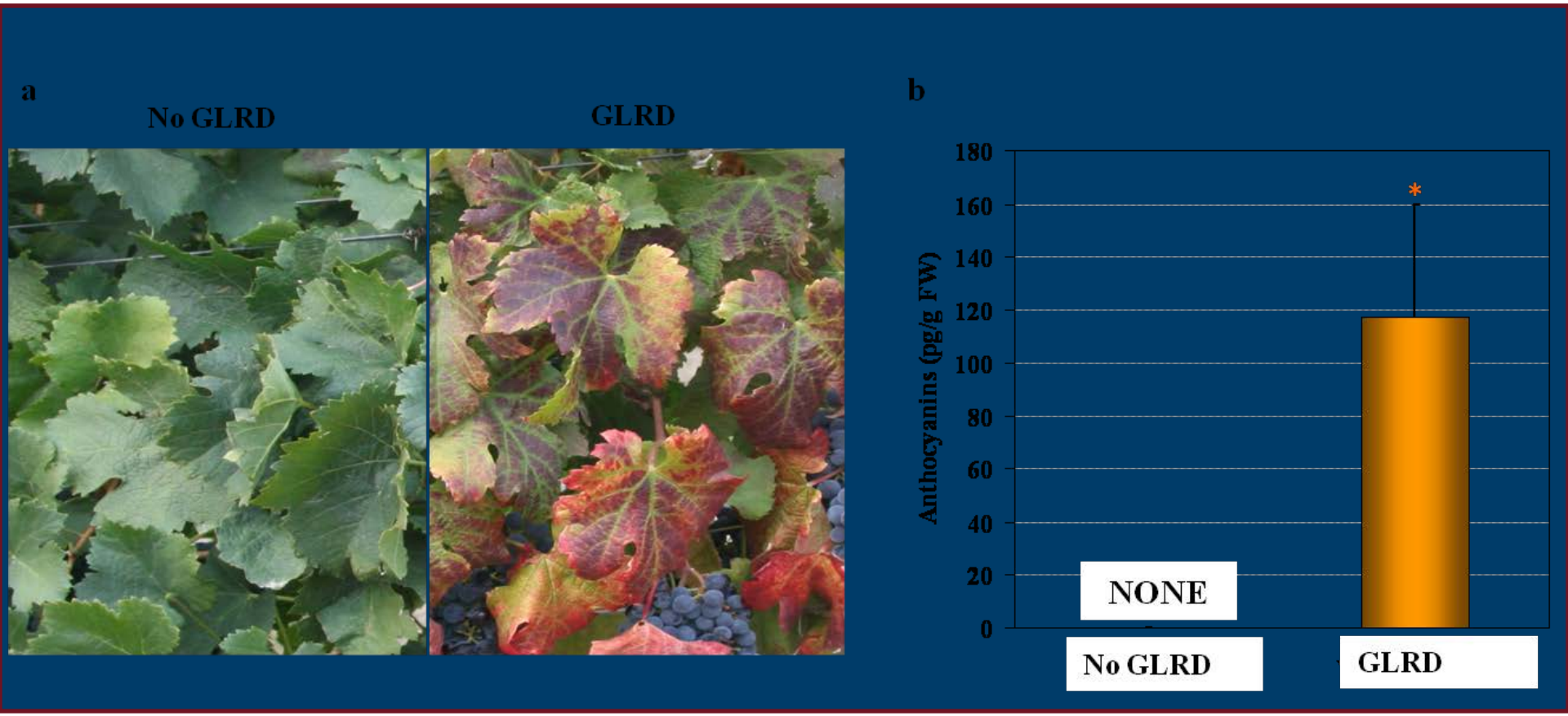
Vine performance cv. Merlot

	Pre-*véraison*	Post-*véraison*
Healthy		
Infected		

Fluorescence (Fv/Fm)	0.00%	-10.10%
Net Photosynthesis	+5.91%	-29.92%
Transpiration	+4.45%	-14.31%

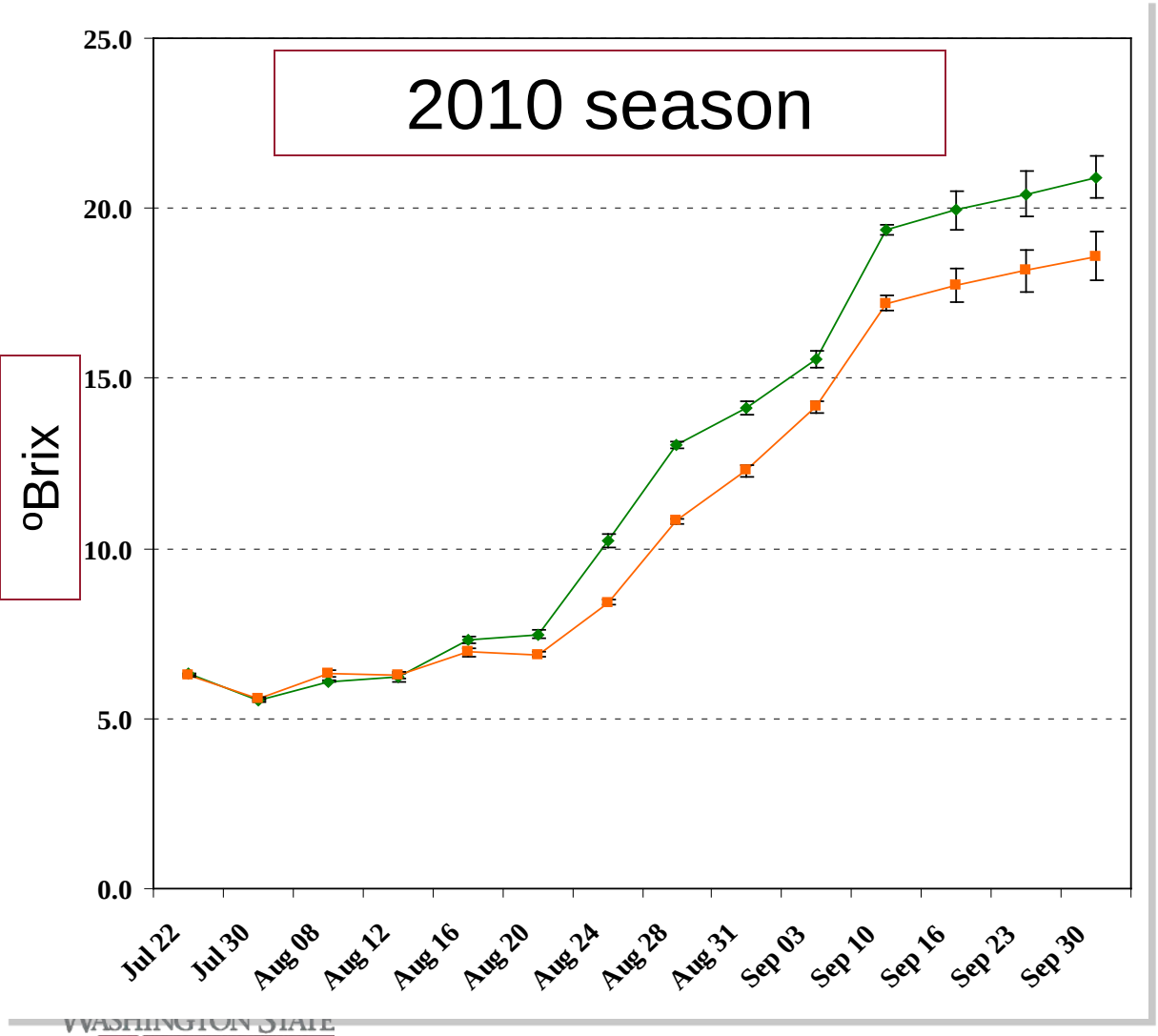
Grape Leafroll Virus – Dr Naidu Rayapati

Up-regulation of anthocyanins



Grape Leafroll Virus – Dr Naidu Rayapati

Impacts of GLRD on berry sugars (cv. Merlot)

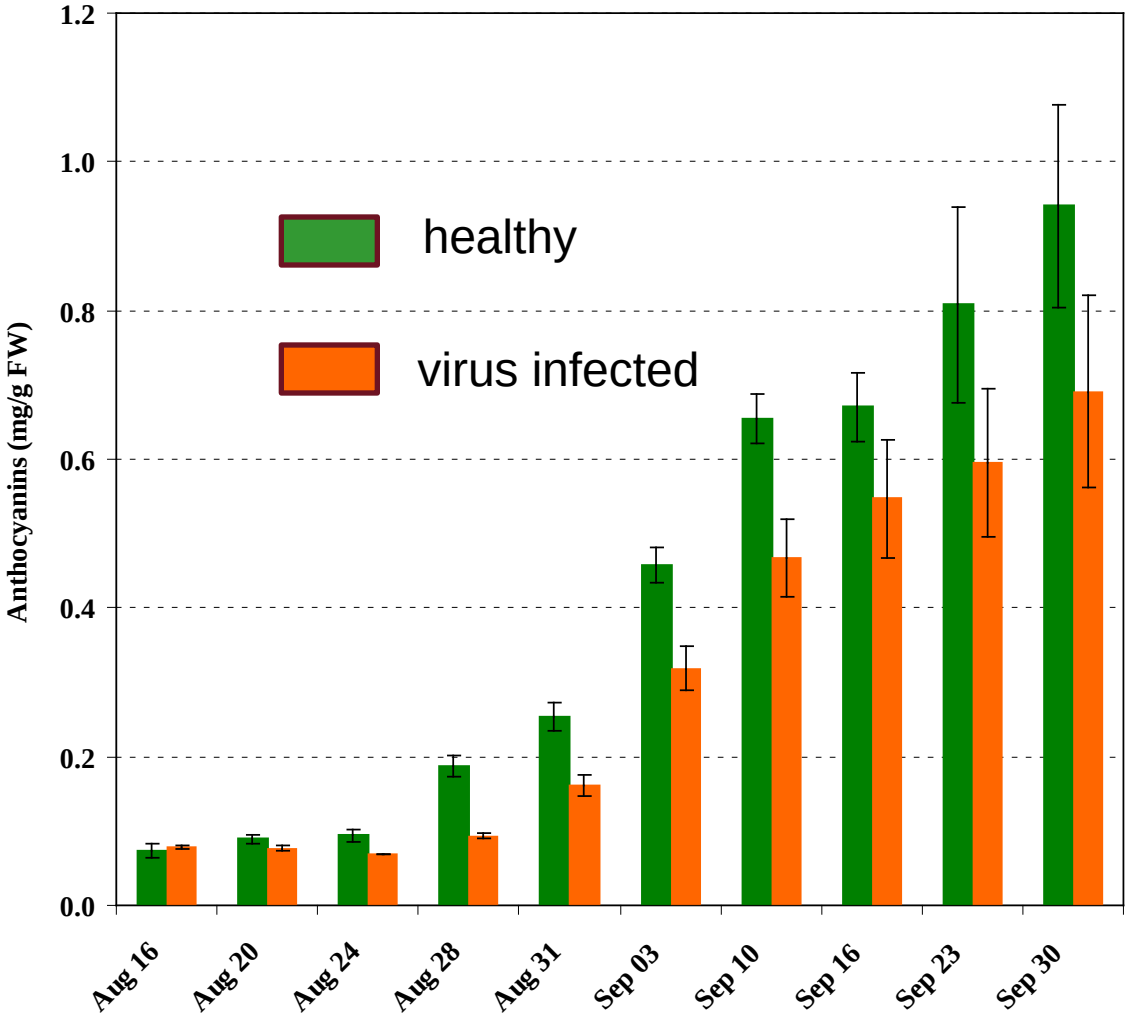


Sample date	Change over healthy (%)
Jul 22	-0.63
Jul 30	1.45
Aug 08	3.61
Aug 12	0.96
Aug 16	-4.66
Aug 20	-8.02*
Aug 24	-17.77**
Aug 28	-17.30**
Aug 31	-13.03**
Sep 03	-9.00*
Sep 10	-11.25**
Sep 16	-11.13**
Sep 23	-10.97**
Sep 30	-11.09**

* = $p < 0.05$; ** = $p < 0.001$

Grape Leafroll Virus – Dr Naidu Rayapati

Impacts of GLRD on total anthocyanins (cv. Merlot)



Sample date	Change over healthy (%)
Aug 16	6.55
Aug 20	-13.95
Aug 24	-26.87*
Aug 28	-50.47**
Aug 31	-36.14*
Sep 03	-30.36*
Sep 10	-28.47*
Sep 16	-18.37*
Sep 23	-26.42*
Sep 30	-26.57*

* = $p < 0.05$; ** = $p < 0.001$

Impact of GLRD on wine quality (cv. Merlot)

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Impacts of GLRD on wine quality attributes (cv. Merlot)

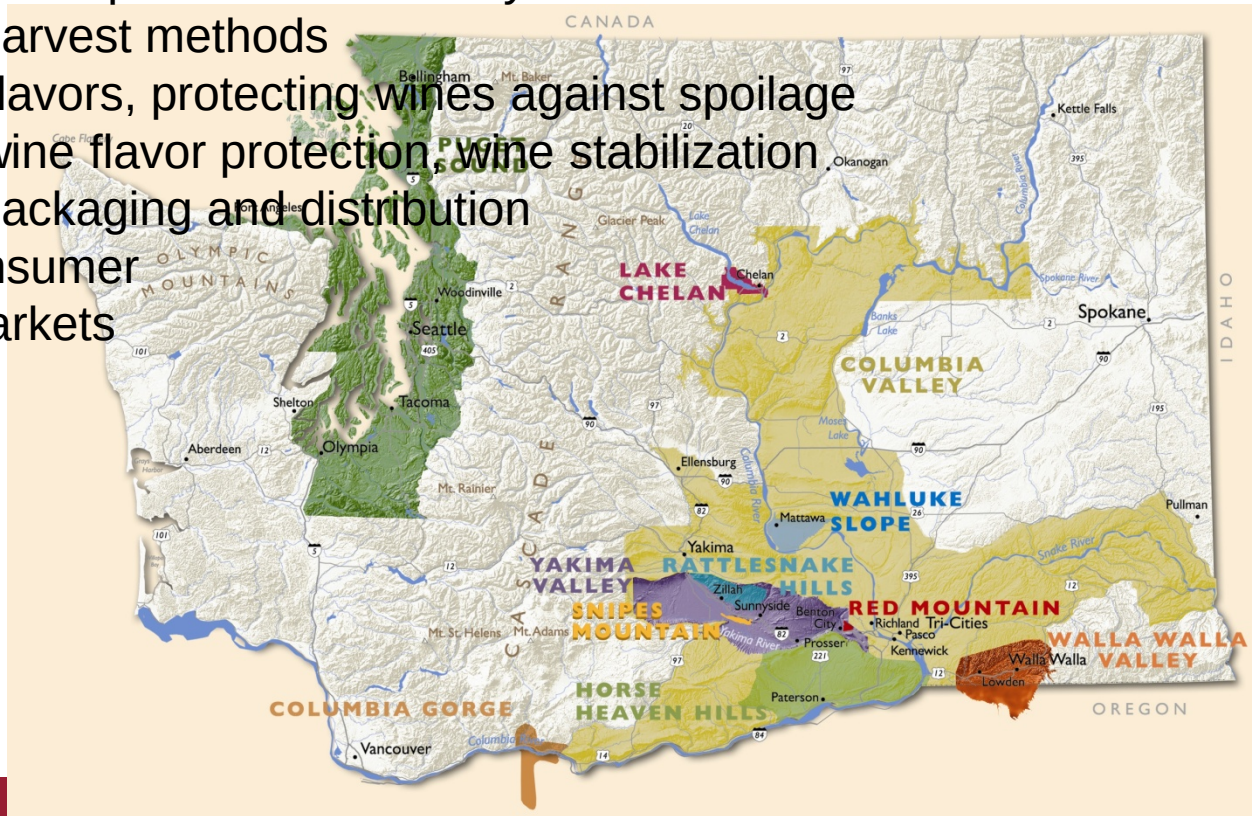
Parameter	% decrease (-) or increase(+) over control (GLRD-free)
Berry skin tannins	- 13.08
Seed tannins	+ 4.08
Fruit anthocyanins	- 15.76
Wine anthocyanins	- 13.09
Tannins in wine	- 26.69
Wine phenolics	- 14.69
Large polymeric pigments	- 16.74
Small polymeric pigments	- 16.91
Wine pH	- 1.27
Wine titratable acidity	- 4.08
Alcohol content of wine	- 13.06

Sensory evaluation: green, vegetative flavors in wines made from virus infected fruit

The Future

Better plant material
Better site selection
Better match of cultivar x site x vineyard management practice
Better vineyard management: water, macro- and micronutrients
More consistent fruit quality
Better prediction of yield and fruit quality
Better plant protection – detection methods, biological control
Winemaking methods better adapted to WA wine styles
- improvements in harvest methods
- selecting desired flavors, protecting wines against spoilage
- new methods for wine flavor protection, wine stabilization
- improvements in packaging and distribution

Better understanding of consumer preferences and diverse markets



Supporting the Viticulture & Enology Program at WSU in Prosser, Tri-Cities, and Pullman

Program Needs

Facilities

- research laboratories and offices
- class rooms
- research & teaching winery
- research $ teaching vineyards
- $25.2 mio

Endowed Chair

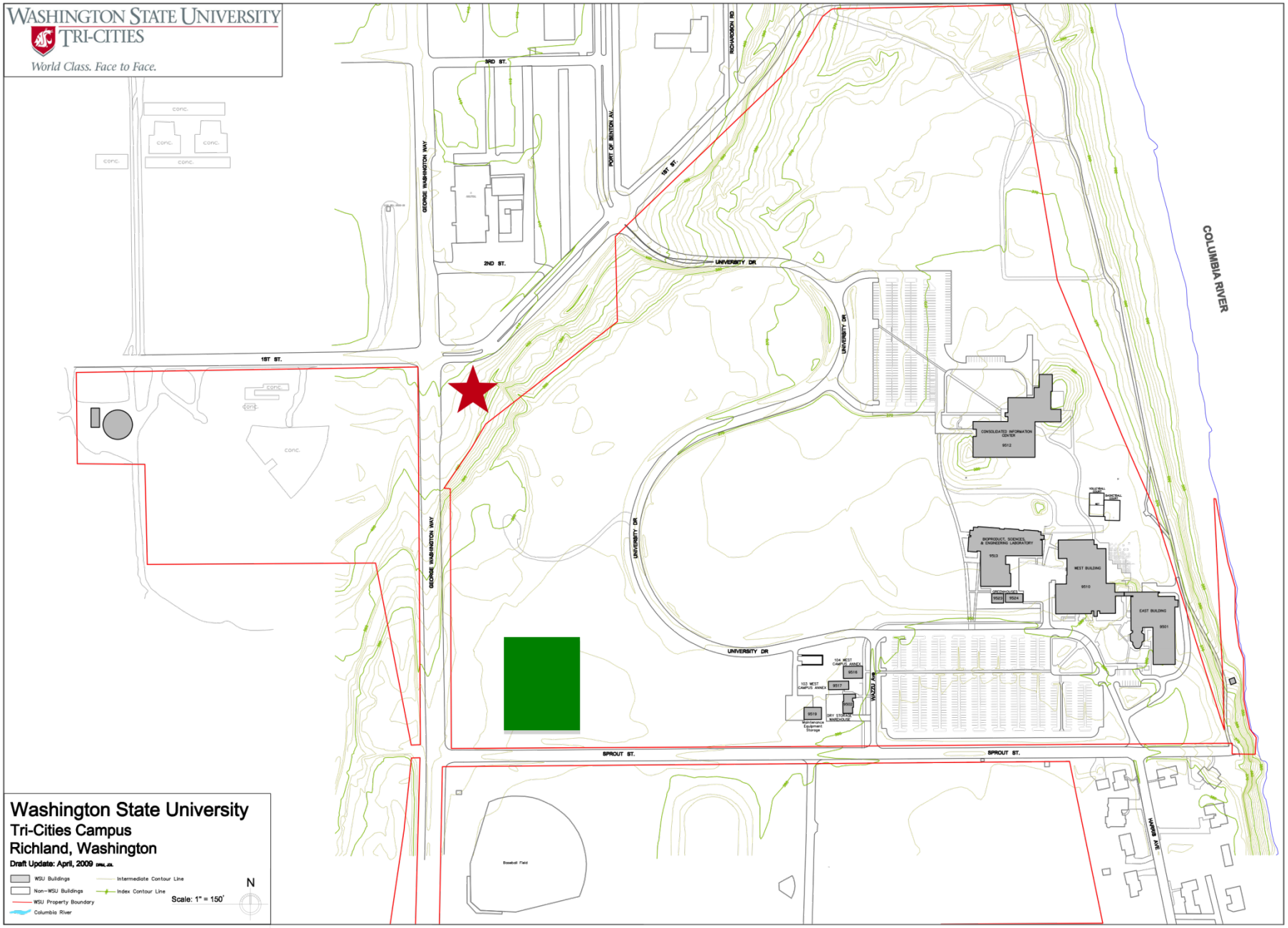
- $3 mio

Scholarships & Funds for Visiting Scholars

- $2 mio

Operating Funds

- $5 mio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COLUMBIA RIVER
SPROUT ST.
CONSOLIDATED INFORMATION CENTER
9512
BIOPRODUCT, SCIENCES, & ENGINEERING LABORATORY
9513
WEST BUILDING
9510
EAST BUILDING
9501
Baseball Field
HAWKS AVE
Washington State University
Tri-Cities Campus
Richland, Washington
Draft Update: April, 2009
WSU Buildings
Non-WSU Buildings
WSU Property Boundary
Columbia River
Intermediate Contour Line
Index Contour Line
Scale: 1" = 150'
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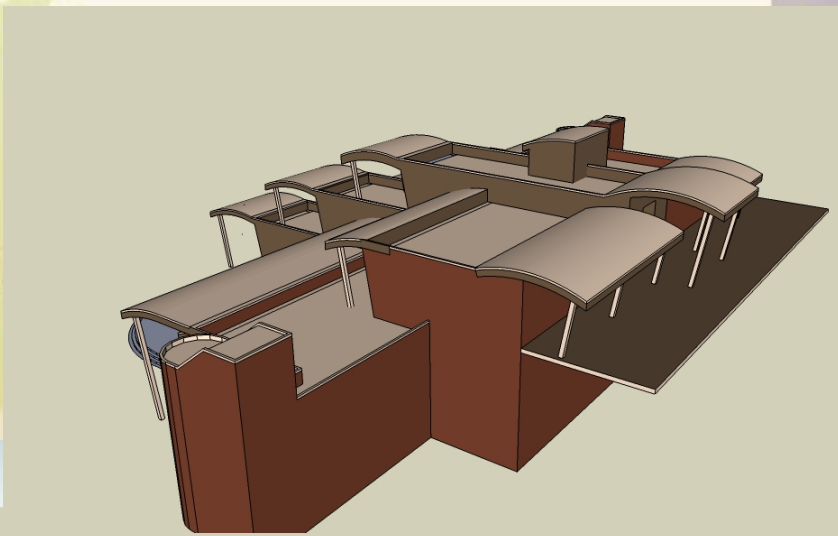
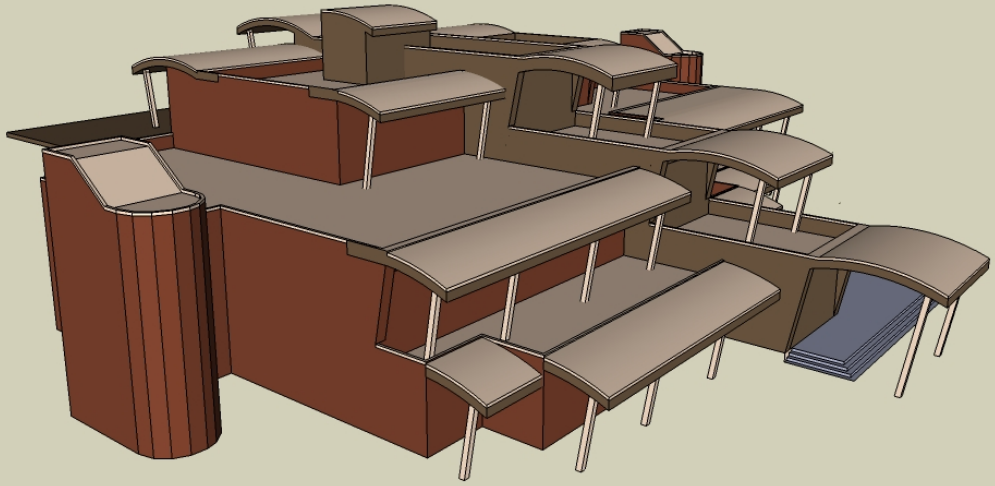
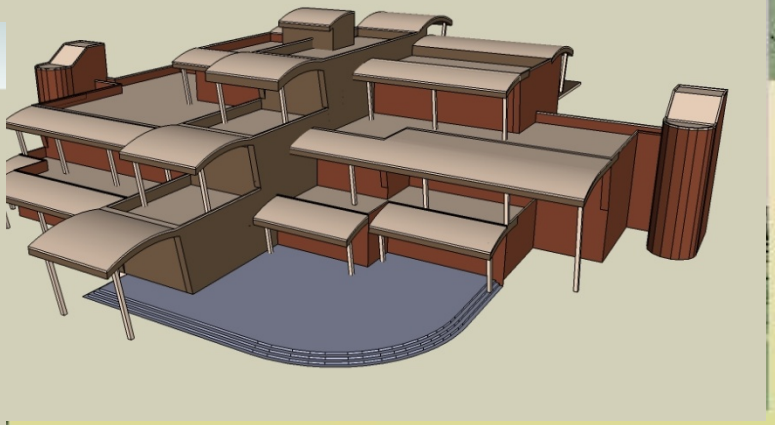
WSU Tri-Cities Wine Science Center







TERRENCE L. THORNHILL
ARCHITECT

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