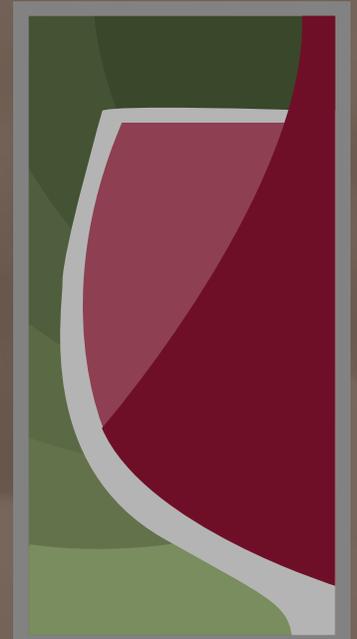




# American Society for Enology and Viticulture- Eastern Section

*Symposium on Advances in  
Red Wine Production:  
Berry to Bottle*



**ASEV-ES**  
WINSTON-SALEM, NC  
2013

**38th Annual Conference**  
**July 15-18, 2013**  
**Winston-Salem, North Carolina**

<http://www.asev-es.org/>

**Conference Program**

# Conference and Symposium Overview

## Sunday, July 14, 2013

Preconference Board Meeting	Embassy Suites Ardmore 2	4:00-6:00 pm
Conference Registration	Embassy Suites Pavilion Foyer	6:00-6:30 pm

## Monday, July 15, 2013

Conference Registration	Embassy Suites Pavilion Foyer	6:30-7:00 am
NC Wineries & Vineyards Tour	Meet in Embassy Suites Lobby	7:00 am-5:00pm

## Tuesday, July 16, 2013

Conference Registration	Embassy Suites Pavilion Foyer	7:00 am-3:00 pm
Continental Breakfast	Embassy Suites Grand Pavilion	7:00-8:00 am
Student Competition and Flash Talks	Embassy Suites Grand Pavilion	8:00 am-12:30 pm
Lunch	Embassy Suites Grand Pavilion	12:30-1:30 pm
Technical Program and Flash Talks	Embassy Suites Grand Pavilion	1:30-4:10 pm
View Posters	Embassy Suites Grand Pavilion	4:10-4:30 pm
Oenolympics & Grazing Dinner	Embassy Suites Grand Pavilion	5:30-8:00 pm

## Wednesday, July 17, 2013

Conference Registration	Embassy Suites Pavilion Foyer	8:00 am-3:00 pm
Continental Breakfast	Embassy Suites Grand Pavilion	8:00-9:00 am
Technical Program	Embassy Suites Grand Pavilion	9:00 am-12:30 pm
Lunch	Embassy Suites Grand Pavilion	12:30-1:30 pm
ASEV-ES Annual Business Meeting	Embassy Suites Grand Pavilion	1:30-2:30 pm
Technical Program	Embassy Suites Grand Pavilion	2:30-4:30 pm
Sparkling Wine Reception and Banquet	Embassy Suites Grand Pavilion	5:30-9:30 pm

## Thursday, July 18, 2013

Symposium Registration	Embassy Suites Pavilion Foyer	7:30-8:30 am
Continental Breakfast	Embassy Suites Grand Pavilion	7:30-8:30 am
Symposium on Red Wine Production	Embassy Suites Grand Pavilion	8:30 am-12:00 pm
Lunch	Embassy Suites Grand Pavilion	12:00-1:00 pm
Symposium on Red Wine Production	Embassy Suites Grand Pavilion	1:00-4:30 pm
Post-Conference Board Meeting	Embassy Suites Ardmore 2	4:30-6:30 pm

## ASEV-ES Conference and Symposium Sponsors

*(Sponsors are recognized throughout the program)*

ARTon Products, Eastern Winery Exposition, Lallemand, Inc., National Grape, Nomacorc®, and Scott Laboratories

# Monday, July 15, 2013

## Tour of North Carolina Wineries & Vineyards

Meet in Embassy Suites Lobby	7:00 am
<b>Depart for Surry Community College</b> Vineyard Tour and Winery Tour 8:15-9:30 am	7:15 am
<b>Depart for Raffaldini Vineyards &amp; Winery</b> Vineyard Tour and Wine Tasting 10:15-11:30 am	9:30 am
<b>Depart for Jones vonDrehle Vineyards &amp; Winery</b>	11:30 am
<b>Lunch at Jones vonDrehle Vineyards &amp; Winery</b> Vineyard Tour and Wine Tasting 1:00-2:00 pm	12:00– 1:00 pm
<b>Depart for RayLen Vineyards &amp; Winery</b> Vineyard Tour and Wine Tasting 3:00-4:15 pm	2:00 pm
<b>Depart for Embassy Suites</b>	4:15 pm
Arrive at Embassy Suites	5:00 pm



Learn it. Do it.

# Tuesday, July 16, 2013

## Welcome

8:00-8:10 am

Fritz Westover, Vineyard Team, CA and ASEV-ES Chair

Jodi Creasap Gee, Kent State University, OH and ASEV-ES Chair Elect

## Student Paper Competition Oral Sessions

8:10 am-9:40 am

Exploration of "Savory" Wine Aroma via Descriptive Analysis and Gas Chromatography-Olfactometry

**Alyssa M. Beatty** and Christian E. Butzke

Acetic Acid and Ethyl Acetate Production During High Brix Fermentations: Effect of Yeast Strain

**Caitlin Heit** and Debra Inglis

Tannin Extractability in Cool Climate Cultivars: Variability and Regional Discrepancies

**Lindsay F. Springer**, Emily Defnet, and Gavin L. Sacks

Impact of Cluster Thinning on Maturity and Grape Quality of Seyval Blanc, and Hybrid Grape Varieties Grown in Quebec

**Catherine Barth**, Martine Dorais, Gaëlle Dubé, Paul Angers, and Karine Pedneault

## Flash Talks-Poster Summaries

9:40-10:00 am

Wine Aroma: Identifying Sensory Drivers for Consumer Overall Liking

Aimee Hasenback, **Renee T. Threlfall**, and Han-Seok Seo

The Effects of Canopy Management Strategies on Fruit Quality of 'Frontenac' and, 'La Crescent' Grapes in Central Iowa Vineyards

**Dylan P. Rolfes**, Gail R. Nonnecke, and Paul Domoto

Impact of Thinning and Training Mode on the Vine and Grape Quality for Four Varieties in Quebec, Canada

**Caroline Provost**, Erik Schulz-Schomburgk, and Richard Bastien

Efforts at Improving the Sensitivity of MLF Paper Chromatography

**Barry H. Gump**

## Break/View Posters

10:00-10:30 am

## Student Paper Competition Oral Sessions

10:30 am-12:30 pm

*V. vinifera* Water Dynamics in the Southeast: Observations and Modeling

**Adam Howard**, Gill Giese, John Havlin, Sara Spayd, and Josh Heitman

Using Under-Vine Groundcovers as a Sustainable Alternative to Herbicide in Cool Climate Riesling

**Lindsay Jordan**, Thoman Björkman, Anna Katharine Mansfield, and Justine Vanden Heuval

Evaluation of Seven New Grape Varieties from the Cross of Norton and Cabernet Sauvignon

**Heather McCallister**, Susanne Howard, and Wenping Qiu

Ecology of Yeasts and Acetic Acid Bacteria Associated with Grape Sour Rot in the Niagara Region

**Cristina Huber**, Debra Inglis, and Wendy McFadden-Smith

Mesoscale Capability/Suitability Model-*V. vinifera* Vineyard Site Selection Case Roehampton Co., NC

**John W. Nowlin**

## Lunch

12:30-1:30 pm

## Technical Program

1:30-3:00 pm

Nebraska Viticulture 2012: A Challenging Season for Herbicide Damage

**Paul E. Read** and Stephen J. Gamet

Using NDVI Images to Reduce Required Sample Sizes in a Vineyard

**James M. Meyers** and Justine E. Vanden Heuvel

Effects of Partial Vertical Canopy Division on Yield , Pruning Weight, and Fruit Chemistry of Favorite Winegrapes

**Fritz Westover** and Louise Rice

## Break/View Posters

3:00-3:30 pm

## Flash Talks-Poster Summaries

3:30-4:10 pm

Green Grafting Allows Timely Rapid Increase of New, Virus Indexed Cultivars in Northern Climates

**K. Helen Fisher**, Brian Piott, Wayne Brown, Steven Trussler, Wes Wiens, and Jamie Slingerland

Characterization of the Flavor Profile of Norton (*Vitis aestivalis*) Grapes at Different Stages of Maturation

**Nicole E. Doerr**, Susanne Howard, Wenping Qiu, Misha T. Kwasniewski, and Reid J. Smeda

Evaluation of Composition Attributes and Postharvest Storability of Arkansas Muscadine Genotypes

Derek Barchenger, John R. Clark, and **Renee T. Threlfall**

A Novel Two Panel Evaluation System for Commercial Wines

**Stephen D. Menke**, Julie A. Reiling, and Susan E. Cuppett

Viticultural Performance of Chardonnay Grapevines is Altered By Grapevine Vein Clearing Virus and Vine Decline Disease

**R. Keith Striegler**, Eli A. Bergmeier, Wenping Qiu, Fatima Osman, R. Andy Allen, Jackie L. Harris, Sue Sim, and Shae S. Honesty

Two years into the SCRI Northern Grapes Project: What Have We Accomplished?

**Timothy E. Martinson** and Chrislyn Particka

Correlation Between Instrumental Extraction Force and Perceived Extraction Difficulty for Wine Bottle Closures

**Sara Morrison-Rowe**, Katherine Glasgow, Stephenie L. Drake, and Chris Pernell

eViticulture: A Multi-Faceted International Platform for Viticulture Outreach

**Eric T. Stafne**

## View Posters

4:10-4:30 pm

## Adjourn

4:30 pm

## Oenolympics & Grazing Dinner

5:30-8:00 pm

# Wednesday, July 17, 2013

## Technical Program

9:00-10:30 am

Scion-rootstock Interaction and Impact on Vine Growth, Phenology and Cold Hardiness

**G. Stanley Howell** and Paolo Sabbatini

Assessing Grapevine Cold Hardiness Status Using Cane Morphology Indicators

**Paolo Sabbatini** and G. Stanley Howell

Growing Season Weather Impact on Vine Hardiness in Ontario

**Kevin W. Ker**, James Willwerth, and Ryan Brewster

## Break/View Posters

10:30-11:00 am

## Technical Program

11:00 am-12:30 pm

Training System and Rootstock Impact Yield and Fruit Composition of Arandell (Includes tasting)

**Justine E. Vanden Heuvel**, Steven D. Lerch, and James M. Meyers

Timing Exogenous Tannin Additions for Optimal Retention in Hybrid Red Wines

**Anna Katharine Mansfield**, Lauren M. Thomas, and David C. Manns

Flavor of Hybrid Grapes for Winemaking: A Survey of the Main Varieties Grown in Quebec (Canada) for Red Wine Production

**Karine Pedneault**, Amélie Slegers, and Paul Angers

## Lunch

12:30-1:30 pm

## ASEV-ES Annual Business Meeting

1:30-2:30 pm

## Technical Program

2:30-4:00 pm

Impacts of Natural Yield Variance on Wine Composition and Sensory Quality of *Vitis vinifera* cvs. Riesling and Cabernet Franc

Lee Baker, **Andrew Reynolds**, Frederick Di Profio, Mary Jasinski, Susanne Kögel, and Gary Pickering

## Break/View Posters

3:00-3:30 pm

Interactive Effect of Regulated Deficit Irrigation and Skin Contact Time in Washington State Cabernet Sauvignon Wines

L. Frederico Casassa, Richard C. Larsen, Christopher W. Beaver, Maria S. Mireles, Markus Keller, William R. Riley, Russell Smithymen, and **James F. Harbertson**

Effect of Foliar Nitrogen and Sulfur Applications on Grape-derived Volatiles and Aroma Profile of Petit Manseng (*Vitis vinifera* L.) using Descriptive Analysis

**Molly K. Kelly** and Bruce W. Zoecklein

## Adjourn

4:30 pm

## Sparkling Wine Reception

5:30-6:30 pm

## ASEV-ES Banquet

6:30-9:30 pm

# Thursday, July 18, 2013

## *Symposium on Advances in Red Wine*

### *Production: Berry to Bottle*



**ASEV-ES**  
WINSTON-SALEM, NC  
2013

#### **Welcome**

Sara Spayd, North Carolina State University  
Fritz Westover, Vineyard Team, CA and ASEV-ES Chair

**8:30 am**

#### **Latest News on Red Wine Varieties for Warm Climates**

Diego Barison, NovaVine, Santa Rosa, CA

**8:45 am**

#### **Canopy Management Advances for Red Wine Grapes**

Tony Wolf, Virginia Tech, Blacksburg, VA

**9:30 am**

#### **Break**

**10:15-10:30 am**

#### **Stuck and Sluggish Fermentations**

Michael Jones, Scott Laboratories, Petaluma, CA

**10:30 am**

#### **Phenol 101**

James Kennedy, California State University, Fresno, CA

**11:15 am**

#### **Lunch**

**12:00-1:00 pm**

#### **Improving Red Wine Color and Phenols**

James Harbertson, Washington State University, Prosser, WA

**1:00 pm**

#### **Red Wine Phenols in North Carolina**

Sara Spayd, North Carolina State University, Raleigh, NC

**1:45 pm**

#### **Break**

**2:30-3:00 pm**

#### **Panel Discussion: Issues in Red Wine Production in the Southeast**

Includes tasting

Mark Friszolowski, Childress Vineyards, Lexington, NC

Stephen Haskill, Villa Appalachia, Floyd, VA

Doug Seitz, Rocky Top Wine Trail, Pigeon Forge, TN

**3:00 pm**

#### **Adjourn**

**4:30 pm**

# Symposium Speaker Biographies

## Diego Barison

*NovaVine, Santa Rosa, California*

Diego Barison was born and raised in Calamandrana in the middle of the wine country in Piedmont, Italy. His family has always been in the wine industry, and owns a grapevine nursery. While he attended Agricultural High school in Asti, he was already working with an Aziende agricole associate producer of La VIRANDA Brand. In 2000, he started his own grapevine nursery, Vivai Diego Barison, in which he integrated innovative technology and began clonal section in Piedmont vineyards. He worked in the Harvest for Cantina Sociale di Calamandrana, Gruppo Italiano Viniand Cooperative Regional Vins the Champagne. In 2005, Diego graduated from the University of Turin and Fesia Group, with a major in agronomy completing a Master Thesis at the French ITV, Institute for the Research on Vineyard and Wine on Young vines decline. He came in the USA partnered with a French nursery to open and develop their USA Grapevine Nursery in California. As a General Manager, he was in charge of production and sales. By 2009, the nursery was producing 1.2 million grapevines and was becoming an active player on the wine industry in the United States as well as in Mexico. In 2010, he accepted an offer with NovaVine and assisted the company in reaching its important goals of gaining market share on the high end of the wine market in Napa, Sonoma and the East Coast, as well Mexico and Canada. Since 2010 he has been producing Barolo wine in Castiglione Falletto on the Bussia cru. In 2013, he will be a coauthor of the VITIBOOK, viticulture technical field book than include Clone of varieties of grapes grown in United States.



## Dr. James Harbertson

*Associate Professor of Enology, Washington State University, Irrigated Agriculture Research and Extension Center, Prosser, Washington*

James Harbertson received his bachelor's degree in biochemistry and doctorate in agricultural chemistry from the University of California at Davis. Jim's research focuses on the phenolic compounds found in grapes and wine and their biochemical and chemical changes during grape ripening, winemaking and aging. He recently designed a research scale winery at WSU Prosser and revamped the Enology laboratory with new instrumentation and personnel. Jim is an active volunteer for the American Society of Enology and Viticulture serving as a board member for three years and now serves as the secretary/treasurer. Jim has organized symposiums, workshops and seminars in California and Washington. Jim and his wife Eileen live in Prosser with their son Andrew (3.3 years old).



## Michael Jones

*Fermentation Specialist, Scott Laboratories, Petaluma, California*

Michael came on board with Scott Laboratories in 2007 with over 35 years of winemaking experience under his belt. Since then he shared his wealth of knowledge with North America by traveling extensively to trade shows and seminars throughout the country, many times as a speaker. A UC Davis graduate, Michael has lived and worked in Burgundy, France and the Hunter Valley, Australia. Domestically, Michael built his experience at Novavine, Hanzell Vineyards and Caymus Vineyards. He also spent 19 years at Domaine Chandon where he put on a multitude of hats and was involved with the vineyards, operations, winemaking, laboratory and was part of the team that established the Wine Education program. Prior to his start in the wine industry, Michael spent a year traveling cross-country by freight train, stopping to work on a shrimp boat in the Gulf of Mexico, pitch hay in San Antonio and sell art in New Orleans.



**Scott Laboratories**  
**Sponsor of a Symposium Speaker**

# Symposium Speaker Biographies

## **Dr. James Kennedy**

***Professor and Chair, Department of Viticulture and Enology and Director, Viticulture and Enology Research Center, California State University, Fresno, California***

James Kennedy is most widely recognized for his research on improving our understanding of grape and wine tannin chemistry, with the primary goal being the improvement of red wine astringency quality. Dr. Kennedy has published extensively as an author or co-author in peer-reviewed journals, grape and wine industry publications, and proceedings. He has contributed numerous book chapters on grape and wine phenolic chemistry and has co-edited a book on the chemistry of red wine color.

Dr. Kennedy received his Bachelor's degree in Chemistry and his Ph.D. in Agricultural and Environmental Chemistry, both from the University of California, Davis, and has worked in the wine industry (Ridge Vineyards). After receiving his PhD, Dr. Kennedy conducted postdoctoral research on grape and wine phenolic chemistry at the University of Adelaide in South Australia before becoming a faculty member at Oregon State University where he was instrumental in developing the Enology and Viticulture option in their Food Science program. Upon leaving Oregon State University, Dr Kennedy worked at the Australian Wine Research Institute as their Research Manager for Chemistry before becoming Chair and Director at Fresno State. He is a Fulbright Scholarship recipient, conducting research at the University of Bordeaux. In recognition of his research accomplishments, the American Chemical Society-Division of Agricultural and Food Chemistry awarded Dr. Kennedy with its Young Scientist Award in 2008. He serves as an Associate Editor for the *American Journal of Enology and Viticulture* and is a contributing editor for *Practical Winery and Vineyard*. Kennedy currently sits on the Board of Directors and is First-Vice President for the American Society for Enology and Viticulture. Kennedy also sits on the Board of Directors for the California Raisin Marketing Board, and the San Joaquin Valley Winegrowers Association.



## **Dr. Sara Spayd**

***Extension Viticulturalist and Professor of Horticultural Science, North Carolina State University, Raleigh, North Carolina***

Sara E. Spayd has been at N.C. State University since 2006. Prior to her arrival at NCSU, she spent 26 years as Extension Enologist and Food Scientist at Washington State University, Prosser. She earned her BS in Horticulture from NC State and her MS and PhD in Food Science from the University of Arkansas. Dr. Spayd's research has focused on improving wine quality by improved grapevine management, including nitrogen fertilization, irrigation and canopy management. She teaches General Viticulture at the undergraduate and graduate level, both on campus and by distance education. Dr. Spayd served as President of the American Society for Enology and Viticulture. She received Best Viticulture Paper awards for three of her research publications from the American Society for Enology and Viticulture and was recognized for industry service by the North Carolina Associate of Winegrape Growers, Washington State Grape Society and the Washington Association of Winegrape Growers.



## **Dr. Tony Wolf**

***Professor of Viticulture, Virginia Tech, Blacksburg, Virginia***

Tony Wolf have been employed by Virginia Tech since 1986. His graduate education included a MS at the Pennsylvania State University and a PhD at Cornell University. Research interests include aspects of cold stress physiology, adjusting vineyard management to optimize grape and wine quality, cultivar and clone evaluations, and various aspects of grape pathology. Dr. Wolf also conducts viticulture extension programs statewide and regionally, and has participated in study travels in France, Italy, China, Australia, New Zealand, Uruguay and the Republic of Serbia. He has served as an Associate Editor of the American Journal of Enology and Viticulture, and has served as a director, secretary, and chairman of the American Society for Enology and Viticulture's Eastern Section. He has authored over 50 scientific papers and was senior author of the Mid-Atlantic Winegrape Growers Guide (1995) and principal author and editor of the Wine Grape Production Guide for Eastern North America (2008). His awards include Virginia Tech's Alumni Award for Extension Excellence (2009) and Virginia Tech's College of Agriculture and Life Science's "Andy Swiger Land Grant Award" (2011). In addition to his viticultural responsibilities, Dr. Wolf has served as Director of Virginia Tech's AHS Agricultural Research and Extension Center in Winchester since January 2004.



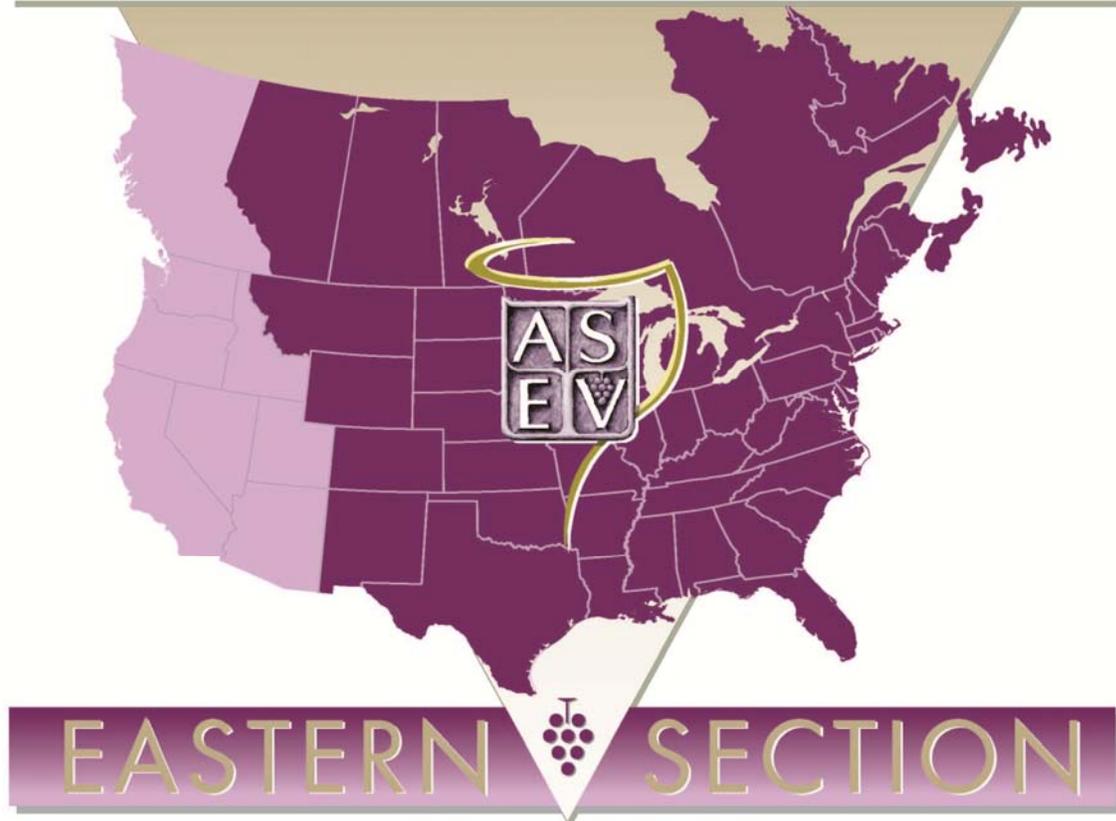
# About ASEV-Eastern Section

To provide forums for the presentation, discussion, and publication (through the official journal of the ASEV) of research and technology developments for the advancement of wines and the solution of problems of specific interest to the enology and viticulture of grapes grown in the Eastern United States and Canada.

## ASEV-Eastern Section Regions

The ASEV-Eastern Section's geographical area includes all U.S. states and Canadian provinces with territory east of the Continental Divide.

AMERICAN SOCIETY FOR ENOLOGY AND VITICULTURE



Established 1975

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## **2013 Scholarship Recipients**

Sarah Bowman (Southern Illinois University)

DeAnna D'Attilio (Virginia Tech)

Aimee Hasenbeck (University of Arkansas)

Cain Hickey (Virginia Tech)

Dylan Rolfes (Iowa State University)

Jennifer Savits (Iowa State University)

Lindsay Springer (Cornell University)

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# Student Competition Abstracts

## Exploration of “Savory” Wine Aroma via Descriptive Analysis and Gas Chromatography-Olfactometry

Alyssa M. Beatty and Christian E. Butzke\*

Department of Food Science, Purdue University, 745 Agriculture Mall Drive, West Lafayette, IN 47907, USA ([butzke@purdue.edu](mailto:butzke@purdue.edu))

The practice of extended bottle aging to increase wine quality is traditionally carried out by both wine producers and négociants as well as wine collectors. Mainly red wines are anaerobically bottle-aged to increase complexity of sensory characteristics particularly aroma by nose and retro-nasally, flavor by mouth, and tannin-related mouthfeel. Past research on the evolution of red wine aroma during aging has mainly focused on characters related to wood aging, such as coconut and vanilla, or those related to the release of grape-derived, sugar-bound precursors due to acid or enzymatic hydrolysis. The latter reactions result in enhanced fruity and floral aromas plus bottle-aging notes such as leather or tobacco. This research investigates the origin of wine sensory characteristics generally described as “savory” or umami-type. The most common savory aromas used to describe aged red wines in the scientific and consumer literature include beef broth, bacon, cured and grilled meats, and soy sauce. It is postulated that Maillard reactions, a chemical reaction between a reducing sugar and compounds with free amino groups, can occur long-term under wine-like conditions (relatively low pH and storage temperature, aqueous solution) though at much slower reaction rates to produce such savory aromas over the course of years or even decades of aging. In this study, professional wine judges were employed to select a range of commercial wines that display particular savory aromas. Subsequently, the use of a trained descriptive analysis panel was utilized to evaluate in detail a subset of the wines identified. The goal was to compare the tasting abilities of trained panelists to those of wine competition judges, and to generate savory aroma profiles for the wines. Subsequently, the wines with the highest intensity savory notes will be analyzed via gas chromatography-olfactometry (GC-O) to identify the contributing aroma compounds. Based on established Maillard reaction products in the enology literature, several compounds related to savory, umami-type aromas will be screened for, including 2-acetylthiazole, 2-acetyl-2-thiazoline, 4-methylthiazole, 2,4-dimethylthiazole, 2,4,5-trimethylthiazole, 2-methyl-3-furanthiol, and 2-furanmethanethiol.

## Acetic Acid and Ethyl Acetate Production During High Brix Fermentations: Effect of Yeast Strain

Caitlin Heit and Debra Inglis\*

Cool Climate Oenology and Viticulture Institute, Brock University, St. Catharines, ON L2S 3A1, Canada ([dinglis@brocku.ca](mailto:dinglis@brocku.ca))

Increasing sugar contents in grape musts subject wine yeasts to higher osmotic stress during alcoholic fermentations. Under high osmolarity in ice wine musts, yeast cell growth can be inhibited, target alcohol levels may not be attained and metabolic by-products of stress responses such as glycerol and acetic acid may impact wine composition. The further metabolism of acetic acid to acetylCoA by yeast in alcoholic fermentations facilitates the biosynthesis of ethyl acetate, a volatile compound that can further impact wine composition. When present in sufficient concentrations, ethyl acetate and acetic acid affect the organoleptic properties of wine and may cause the volatile acidity (VA) levels to exceed legal limits. In Ontario and elsewhere, the high brix musts associated with Icewine and appassimento wine production pose challenges in the management of VA. In this study, a natural isolate of *Saccharomyces bayanus* and commercial *S. cerevisiae* strains K1-V1116 and EC-1118 were investigated to evaluate their differences in acetic acid and ethyl acetate production in Icewine (38°Brix) and appassimento-type must produced using kiln-drying (27°Brix). The *S. bayanus* strain produced significantly less acetic acid per gram of sugar metabolized than K1-V1116 (in Icewine juice) and EC-1118 (in appassimento must), which is consistent with past studies demonstrating that acetic acid production is yeast-strain dependent. *S. bayanus* also demonstrated trends consistent with lower ethyl acetate production compared to the *S. cerevisiae* strains. Future research may indicate it is a candidate for the management of VA in high brix fermentations, provided adequate wine quality and ethanol content can be achieved.

## Tannin Extractability in Cool Climate Cultivars: Variability and Regional Discrepancies

Lindsay F. Springer, Emily Defnet, and Gavin L. Sacks\*

New York State Geneva Experimentation Station, Food Research Laboratory, Geneva, NY 14456, USA ([els9@cornell.edu](mailto:els9@cornell.edu))

Red wines produced from cool climate interspecific hybrid grapes are described as being particularly low in astringency, and increasing wine tannin content is a valuable target for grape breeders and winemakers. However, it is not known if low wine tannin is derived from lacking tannin in the grape berries, or manifests due to poor tannin extraction during winemaking. To investigate this, 6 interspecific hybrid grape varieties (Baco noir, Leon Millot, Marechal Foch, DeChaunac, Corot noir, and Noiret) and 6 *V. vinifera* varieties (Pinot noir, Lemberger, Sangiovese, Cabernet Sauvignon, Cabernet franc, and Merlot) were harvested across two locations in the Finger Lakes region of New York and fermented similarly. The concentration of protein precipitable tannin in wines produced from interspecific hybrids was significantly lower than those produced from *vinifera* grapes (91 vs 248 mg/L CE,  $p < 0.05$ ). In agreement with other studies, total grape tannin by weight was poorly correlated with wine tannin ( $r^2 = 0.18$ ), suggesting that differences in tannin extractability are responsible for wine tannin disparity. Cell wall material from skins and flesh of the 12 grape varieties was investigated for tannin binding; material from the skin of hybrid grapes bound an average of 2-4 fold more tannin than corresponding material from *vinifera* grapes. Tannin in commercial red wines from the Finger Lakes region was measured and found to be lower than reported values from the West Coast. Commercial wines produced from interspecific hybrid grapes had significantly lower tannin content than those produced from *vinifera* cultivars (61 vs 255 mg/L CE,  $p < 0.05$ ).

## Impact of Cluster Thinning on Maturity and Grape Quality of Seyval Blanc, and Hybrid Grape Varieties Grown in Quebec

Catherine Barthe, Martine Dorais, Gaëlle Dubé, Paul Angers, and Karine Pedneault\*

Centre de développement bioalimentaire du Québec, La Pocatière, QC, Canada, G0R 1Z0 ([karine.pedneault@cdblq.net](mailto:karine.pedneault@cdblq.net))

Cluster thinning is a well-known cultural practice used to enhance maturity and fruit quality in vigorous crops such as hybrid grape varieties. Seyval blanc, one of the main variety grown in Quebec for wine production, is known to be particularly fruitfull and vigorous. In order to optimise fruit quality for winemaking, we evaluated the impact of cluster thinning on grape maturity and quality. Three crop load levels (100%, 70% and 40% cluster thinning) and three maturity levels (pre-maturity, maturity and post-maturity) were tested on Seyval blanc vines grown in the South-West area of Quebec (Canada) during 2012. Physiological data (leaf area to fruit ratio, yield per plant, cluster weight, berry fresh weight) were measured, and grape maturity and quality were evaluated using quality attributes (total soluble solids, titratable acidity, pH, yeast assimilable nitrogen, YAN), phenolic composition (total flavonoids, total hydroxycinnamic esters), and berry sensory analysis, using a trained sensory panel. At the maturity stage, cluster average weight and berry fresh weight were significantly higher at higher cluster thinning levels (148 and 259 g/cluster and 1.92 and 2.01 g/berry at 100% and 40% crop load, respectively). Maturity levels showed significant differences between samples in titratable acidity, which was significantly lower in 40% cluster-thinned vines at the latest maturity stage, and YAN, which was significantly higher in these grapes compared to other treatments. Total hydroxycinnamic esters and total flavonoids levels in grape juice were not significantly affected by crop load treatment, neither maturity. Berry sensory analysis showed that skin resistance increased significantly with maturity.

## *V. vinifera* Water Dynamics in the Southeast: Observations and Modeling

Adam Howard\*, Gill Giese, John Havlin, Sara Spayd, and Josh Heitman

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As North Carolina wine grape (*V. vinifera*) production intensifies, water management guidelines should be developed. Grape yield and composition, and consequently wine quality, are greatly influenced by the water regime under which the grapes were produced. Despite the importance of water management, related research in the Southeast is extremely limited. This region has unique soils and climate, differing considerably from other established wine regions where water management practices have been developed. NC vineyards are often equipped with permanent irrigation systems for vine establishment and occasional watering; however, rainfall generally exceeds evapotranspirative demand. It is known that water stress can enhance grape quality. A field experiment was initiated in 2011 at Dobson, NC with a goal of inducing vine stress and assessing corresponding soil moisture conditions. Experimental treatments with and without rainfall exclusion were established for two hydraulically dis-similar cultivars, Grenache and Syrah. Monitoring included soil volumetric water content, grape leaf stomatal conductance, and stem potential; basic grape chemistry analysis was also performed. While some treatment differences were significant, desirable stress levels were not attained. Measured climatic and soil physical properties data were utilized as inputs for soil hydrology modeling with Hydrus-1D. Observed soil and plant parameters from the field experiments were used to assess the accuracy of the model. Modeling efforts will be expanded to include sites throughout the Southeast using existing climatic databases. Frequency and severity of historical drought conditions will be identified, assisting growers in decisions regarding grape planting sites and irrigation management.

# Student Competition Abstracts

## Using Under-Vine Groundcovers as a Sustainable Alternative to Herbicide in Cool Climate Riesling

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Given the rising concerns of herbicide resistance, runoff, and environmental contamination coupled with increased consumer desire for sustainably-produced wine, many wine grape growers are considering alternatives to herbicide use in vineyards. In the Northeastern U.S., cover crops are generally grown between rows while an herbicide strip is maintained under vines to reduce competition for water and nutrients. Under-vine treatments were established in the 2011 and 2012 growing seasons in a block of Riesling (cl. 198)/S04 vines in a commercial vineyard in the Finger Lakes region of New York state. In a randomized complete block design, four under-vine ground covers were tested: natural vegetation that emerged through the season, cover crops of buckwheat and annual rye grass planted in a 1-m strip directly under vines at the start of the growing season, and the conventional weed-free strip beneath vines maintained with glyphosate. After harvest, grapes were fermented in duplicate using standard white wine procedures. No significant differences were found in pruning weight, yield, berry size, or midday stem water potentials among treatments. Juice characteristics from the four treatments including Brix, titratable acidity, yeast assimilable nitrogen, and pH were not significantly different. When subjected to multidimensional scaling analysis, treatments were found to significantly impact the perceived aromatic properties of the wines. Using under-vine vegetation to replace conventional herbicide sprays may be a viable method of vineyard floor management in cooler climates, however the impacts of these under-vine treatments on the aromatic properties of the resulting wines requires further investigation.

## Evaluation of Seven New Grape Varieties from the Cross of Norton and Cabernet Sauvignon

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Norton is a North American grape variety with genetic background of mainly *Vitis aestivalis*. It is resistant to many major fungal diseases, and yields a quality crop with minimum fungicide input. Norton is also distinct from *V. vinifera* varieties in other viticultural traits including low rooting percentage of hardwood cuttings. Cabernet Sauvignon is a variety of *V. vinifera* known for superior wine quality, but it is highly susceptible to fungal diseases. In 2005 Norton and Cabernet Sauvignon were crossed to produce 95 F1 progenies. Seven progenies were selected for further evaluation. Resistance to grapevine powdery mildew (*Erysiphe necator*) and rooting percentage were evaluated for the seven selections. Powdery mildew resistance was assessed on detached leaves. To evaluate rooting percentage, thirty dormant cuttings of each progeny were dipped in 1% 3-Indolebutyric acid (IBA), and another 30 were not treated, and placed into soil beds that were maintained at 22°C. The results suggest that two of the progenies, NorCab17 and NorCab65, are the least susceptible to powdery mildew. The data of rooting tests indicate that the ability to root varies among the seven progenies. The four selections NorCab6, NorCab28, Norcab43, and NorCab60 share Cabernet Sauvignon's trait of high rooting percentage. These findings will help determine the suitability of Norton-Cabernet Sauvignon hybrids as commercial wine grapes in the future.

## Ecology of Yeasts and Acetic Acid Bacteria Associated with Grape Sour Rot in the Niagara Region

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Sour rot is a late-season bunch rot impacting the quality of wine grapes. In Niagara, Ontario, it shows economic impact particularly in years when heavy precipitation promotes infection. Sour rot is characterized by fermentative breakdown of the grapes, leading to discolored and disaggregated tissues that ooze and smell of acetic acid and ethyl acetate. Through molecular identification and pathogenicity assays conforming to Koch's postulates, *Hanseniaspora uvarum*, *Gluconobacter oxydans*, and *Acetobacter malorum* were shown to cause sour rot. Infection is promoted by injury to the grape skin, yet in the assays, acetic acid bacteria have been observed to enter non-injured grapes around the pedicel. Lab assays have confirmed that the rate of infection and severity of disease is promoted by higher temperatures up to 25°C, as well as by ripeness. As grapes ripen, there are fluctuations in the natural population of microbial epiphytes, and timecourse sampling of *V. vinifera*, c.v. Riesling and c.v. Pinot Noir has revealed that the sour rot-associated yeast and bacteria are only prevalent in the population once the symptoms of disease are detected. Samples taken from across the region indicate that the microbial population dynamics in diseased grapes cannot be predicted by location or cultivar, but may be impacted by cultural practices. Population samples were taken before and after the application of two treatments being researched for sour rot management, potassium metabisulphite (KMS) and potassium bicarbonate (Milstop®). Lab assays are being pursued to confirm the potential for KMS to reduce the number of acetic acid bacteria.

## Mesoscale Capability/Suitability Model - *V. vinifera* Vineyard Site Selection Case Rockingham Co., NC

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The North Carolina wine industry is growing at a fast pace; many new vineyards are being planted with European varieties. *Vitis vinifera* varieties, in general, are the most challenging species of grape grown, and the cost of vineyard establishment is high. The challenges of growing *V. vinifera* in this region are primarily due to the warm, humid climate which encourages the presence of many insect pests, as well as a broad host of viral, bacterial, and fungal diseases. When these risks are considered alongside the possibilities of late spring frost and heavy rain from harvest time tropical systems, it is apparent that there is a need for a system which helps mitigate these risks. The model produced in this research was designed to help guide site selection for *V. vinifera* vineyards in the North Carolina Piedmont. The area of interest for this case study is Rockingham County, North Carolina. The primary goal is to give the prospective grape grower every opportunity for success by choosing the best possible place to establish a vineyard. This is accomplished using a model based on the science of Geographic Information Systems (GIS) along with predictive geophysical parameters. The model consists of four physical sub-model composites which represent the capability/suitability of: climate, land cover, soil, and topography. Using the concepts of map algebra, the four sub-model composites are combined to produce the final output that summarizes the physical site suitability of the study area at a spatial resolution of ten meters.

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# Technical Session Abstracts

## Nebraska Viticulture 2012: A Challenging Season for Herbicide Damage

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Observation of injury symptoms related to damage from volatile herbicides such as 2,4-dichlorophenoxyacetic acid (2,4-D) is a common occurrence in Midwest vineyards. This damage varies in its severity, with grapevines generally recovering from the injury with more or less healthy regrowth following the damaging incident. However in extreme cases, significant epinasty, leaf and flower deformation and subsequent loss of yield can occur. Fruit quality and yield loss are especially noticeable if the incident occurs during early shoot growth and at cap-fall (anthesis) of the inflorescence. 2012 presented a unique combination of circumstances that led to exceptionally serious damage in a large number of vineyards in Nebraska. First, the winter of 2011-2012 was one of the mildest on record and secondly, unusually warm temperatures in the spring led to grapevine bud break taking place three or more weeks earlier than the average bud break date for Nebraska. Two separate herbicide drift incidents occurred that damaged our NE-1020 planting at Dove Landing Vineyard, east of Lincoln. The first incident occurred during flowering of earlier cultivars and the second occurred midway between cap-fall and veraison. 'Sabrevois', MN 1235 and 'Marquette' sustained the most damage, while 'Chambourcin', 'Sauvignon Blanc', 'Vidal Blanc' and MN1258 were the least affected. 'Frontenac', MN 1220, 'Valiant' and 'Saint Croix' exhibited intermediate symptoms. It is not clear whether the minimal damage observed for the least affected genotypes was because they broke bud later than the others or were they more tolerant of the ravages related to herbicide drift? Another anomaly seems to be the fact that although 'Sabrevois' was rated to be the most seriously damaged, it had one of the highest pruning weights measured in early 2013. One year's observation of herbicide damage is not sufficient to rank the several genotypes for tolerance to herbicide drift, but it does provide the basis for continuing evaluation and possible future ranking of herbicide tolerance.

## Using NDVI Images to Reduce Required Sample Sizes in a Vineyard

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Imaging technologies such as normalized difference vegetation index (NDVI) promise to improve the precision and efficiency of vineyard practices, but are handicapped by data analyses that have been designed around classical statistical models. We have previously demonstrated that statistical models which were developed to manage unknown field variability can be inefficient when variability is well documented, as is the case in a modern vineyard in which variables are imaged and sampled at very high spatial resolutions. We have adapted a previously developed sampling optimization model that was originally based on manually collected enhanced point quadrat analysis (EPQA) canopy data to analyze aerial NDVI images for the purposes of quantifying vineyard spatial structure and computing optimal vineyard sampling protocols. Aerial NDVI imagery from two Washington State Riesling vineyards, captured at a resolution of 0.5 square meters per pixel, was analyzed. Using multivariate optimization, the new sampling model determined the most efficient protocols capable of accurately capturing canopy variability as expressed by the NDVI images. Although the relatively coarse resolution of the NDVI images (compared to EPQA) could not differentiate among individual vine organs, optimized sampling protocols derived from the images reduced sample size requirements by up to 54% when compared to random sampling.

## Effects of Partial Vertical Canopy Division on Yield, Pruning Weight, and Fruit Chemistry of Favorite Winegrapes

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Training systems with divided canopies are often utilized to increase potential yields in medium to high vigor sites: average cane weights greater than 35 g or greater than 0.5 kg/m pruning weight. The Pierce's disease tolerant grape variety, Favorite, was evaluated on a medium vigor site using two training systems in the Gulf Coast of Texas. Vines were grown on north-south row orientation using a traditional vertical shoot positioned (VSP) training system and one vertically divided (VD) on the west side of the canopy. Vines were spaced 2.4 m between vines and 3.0 m between rows. The upper canopy was pruned to 16.4 nodes per meter of cordon and the lower canopy on the VD vines was maintained at 8.2 nodes per foot. Yield, pruning weight, average cane weight and berry composition (Brix, titratable acidity, and pH) were measured over a five-year period. Crop adjustments were made at 50% veraison in some years, removing clusters most lagging in maturity to result in average yields of 10.7 kg/vine (VSP) and 12.7 kg/vine (VD), with the lower canopy of the VD vines bearing between 27-34% of the total crop. Yield per vine was 23%, 32%, 10% and 10% greater in VD vines in years 1-4 respectively and 13% less than VSP in year 5. Crop loads (yield/cane pruning weight) were generally between 6 and 14, and were greater than 20 in two years when clusters were not thinned. In addition to increased cluster numbers and crop yield, VD training decreased cane weights per meter of cordon and average cane weights, with downward canes having the lowest average cane weights and fruit with lowest average cluster size. Fruit was harvested at similar Brix values, with differences in Brix, pH, and titratable acidity among treatments or between upper and lower canopies generally not significant.

## Scion-rootstock Interaction and Impact on Vine Growth, Phenology and Cold Hardiness

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The scion-rootstock interaction was analyzed to test: 1) the primary viticultural effect of root system on the vigor of the scion and 2) the interaction between the environment and above-ground vine parameters. A 2X3 factorial experiment employed phylloxera resistant cultivars Marechal Foch (Kuhlmann 188-2 - Foch) and Vidal blanc (Vidal-256 - Vidal) as: a) reciprocally grafted; b) own-rooted; and c) self-grafted vines. The impact of root and scion cultivar was evaluated on growth and productivity parameters: a) onset of spring growth; b) timing of veraison and harvest; c) bud and cane cold hardiness, d) yield components and e) basic fruit chemistry. The two cultivars are phenotypically different. Bud burst for Vidal is 12-14 days later than Foch and harvest is 4-6 weeks later. Bud and wood cold hardiness of Foch is greater than in Vidal and Foch is less vigorous than Vidal. Results suggest that genetically complex factors of phenology, while variable under different annual environmental conditions, were under the primary control of the scion cultivar. The effect of the scion cultivar on fruit composition was confounded and could rather be explained by differences in yield and variability of the harvest dates between the two cultivars. Data imply that many proposed influences of rootstock on the scion are not valid; some of the effects (e.g. basic fruit quality) are too confounded with yield to make a precise judgment, and many are secondary in nature as result of vine vigor influences shoot number/vine and subsequent shoot density.

## Assessing Grapevine Cold Hardiness Status Using Cane Morphology Indicators

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The ability to withstand exposures to freezing temperature during the dormant season is an economically critical component of grapevine physiology in cold viticultural regions. The physiology of the process is complex and involves genetic components variably expressed in different environments of culture; our challenge in vine culture is to create vine growing conditions that maximize the expression of this genetic background. Systematic evaluations of vine tissue hardiness over the dormant season involve specialized equipment, time and labor. The objective of this work was to associate morphological characteristics of canes and their frequency distribution on grapevines with the ability of cane, bud and perennial wood tissues to survive freeze stresses throughout the winter. Characteristics most predictive of hardiness were: 1) periderm color, indicating leaf and shoot exposure during the growing season; 2) shoot vigor for that cultivar with both internode diameter and length as components; 3) persistent lateral status; and 4) number of mature nodes on the cane. Cane variations of each of these types exist in every canopy and can influence a given tissue hardiness value up to 15 C. The key to assessing their utility for hardiness is the frequency of each cane variation within a given canopy. Results demonstrated that different levels of vine hardiness (bud, cane and perennial wood) are linked to cane morphology and the impact of cultural practice (e.g. crop level, rootstock choice, training system choice, canopy management, vineyard floor management, nutritional program, etc.) are assessed by a frequency distribution of the desired cane characteristics.



# Technical Session Abstracts

## Growing Season Weather Impact on Vine Hardiness in Ontario

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Grapevine cold hardiness can be affected by a multitude of factors - both due to genetic profiles and limitations but also the interaction of the environment with vine growth and development over the growing season. Data has been collected from multiple cultivars (*V. vinifera* - mature vines >10 years of age, trained to VSP and crop balanced) in the Niagara region of Ontario measuring the levels of acclimation, maximum winter hardiness and deacclimation using programmable freezers with sampling from prior to leaf drop to bud break each dormant season. Weather data (thermal and precipitation) along with key development stages were recorded for all growing seasons for each cultivar. For the growing seasons 2008-2012 and subsequent dormant periods, vines (within a cultivar) showed extremely similar levels of maximum hardiness achieved regardless of prior growing season but the rate of acclimation was influenced by temperature and precipitation. Growing seasons with low precipitation and higher than average temperatures from veraison to harvest resulted in earlier vine acclimation and achievement of maximum hardiness earlier in the dormant period than those grown in seasons with wet cold ripening periods for fruit. Rate of deacclimation was more dependent on the weather conditions in late dormancy and did not appear to be influenced by prior season growing conditions.

## Training System and Rootstock Impact Yield and Fruit Composition of Arandell

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Arandell is a mid-season, highly disease-resistant red wine grape released by Cornell University in 2013. A trial to determine the impact of training system (low cordon with vertical shoot positioning (VSP) vs. high wire cordon (HWC)) and grafting (own-rooted vs. grafted onto 3309C) on yield and fruit composition was initiated in 2008 in Geneva, NY. Vines were planted on 9x7 ft spacing in a split-plot design with training system as the main plot. Yield was not impacted by training or grafting in 2010 or 2011, but by 2012 vines grafted to 3309C produced 2.4 kg more per vine than own-rooted vines as a result of increased clusters per vine. Own-rooted vines produced fruit that was approximately 1.2° lower in soluble solids compared to grafted vines in 2010 and 2011, and 0.6 and 1.0 g/L higher in TA in 2011 and 2012, respectively. The impact of training system on fruit composition was variable among years. Grafting onto a moderate vigor rootstock is recommended for Arandell to produce higher yields and hasten fruit ripening, but cluster thinning may be required in some years.

## Timing Exogenous Tannin Additions for Optimal Retention in Hybrid Red Wines

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Red hybrid wines are often characterized as having low tannins, likely due to lower initial tannin concentrations and higher grape solid sorption capabilities than *Vitis vinifera*. While hybrid wines are often amended with exogenous tannin additions, high sorption activity may bind additives, limiting their effectiveness. To assess the impact of addition timing on tannin retention, the maximum recommended concentration of a grape-derived tannin product was included at various points during processing of Maréchal Foch, Arandell, and Corot noir wines. Following fractionation via solid-phase extraction and high-performance liquid chromatography, the phenolic profiles of wines made with additions before, during, and after alcoholic and malolactic fermentation were examined. Arandell, a hybrid winegrape released from the Cornell Grape Breeding program in 2013, was also characterized for the first time. While all wines were found to be low in overall tannin concentration, additions made later in wine processing, when fewer grape solids were present in the wine, favored greater concentrations of tannins in the final product. Later additions also favored greater mean degree of polymerization (mDP), though mDP averages for all cultivars were still relatively low (<6.0). HPLC analysis of the commercial additive suggested that it contained only 23.4% total tannin, lower than previously reported, with an mDP of 6.93. These results correspond to earlier work suggesting that tannin addition rates developed for *V. vinifera* may be too low to effect sensory differences in hybrid wines.

## Flavor of Hybrid Grapes for Winemaking: A Survey of the Main Varieties Grown in Quebec (Canada) for Red Wine Production

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Quebec's wine industry principally relies on hybrid grape varieties, including French, cold hardy, and Elmer Swenson's varieties. Despite a significant increase in Quebec's wine quality, the lack of knowledge on hybrid grapes varietal flavor prevents further improvement in this respect. Therefore, in order to characterize the main red varieties grown in Quebec, and evaluate their potential for winemaking, we sampled Frontenac, Marechal Foch, Marquette, Sabrevois, St.Croix in different vineyards, at commercial harvest. To comply with some differences in maturity levels, samples were pooled in two groups, according to the number of accumulated growing-degree days (GDD, based on 10°C) at harvest: 1200-1300 GDD, and 1300-1410 GDD. Samples were analyzed for physiological and technological parameters, free aroma profile (GC-MS-SPME, 65 compounds) and berry descriptive sensory analysis (10 descriptors). Frontenac reached the highest total soluble solids level (25.1°Brix) after 1300 to 1410 GDD while St.Croix and Sabrevois showed the lowest levels (18-19.4°Brix) in both groups. As expected, Frontenac, which was not fully ripe before 1300 GDD, showed a particularly high titratable acidity level (20.9 g eq. tartaric acid/L) in samples harvested between 1200 and 1300 GDD. Berry sensory showed significant differences between samples for berry color, berry acidity, seed hardiness, and seed aroma. Regarding aroma profiles, Marechal Foch showed the highest level of green compounds, while Marquette harvested between 1300 and 1410 GDD showed the highest level of  $\beta$ -damascenone. Sabrevois and St.Croix were characterized by high levels of short fatty acid esters such as ethyl butanoate, ethyl isobutyrate and ethyl 2-butenate.

## Impacts of Natural Yield Variance on Wine Composition and Sensory Quality of *Vitis vinifera* cvs. Riesling and Cabernet Franc

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This study investigated the impacts of natural varying yields on wine composition and sensory quality of Riesling and Cabernet franc. The sites were chosen based on their representation of five different VQAO sub-appellations. A grid pattern was developed for each vineyard block with a sentinel vine being chosen for data collection at each grid intersection (72-84 sentinel vines per site). All cultural practices, including pruning and canopy management were consistent within each vineyard block. Vine yields were divided into categories of "low", "medium", and "high" at harvest. All resulting wines were analyzed for pH and titratable acidity (TA) and the Cabernet franc wines were also analyzed for color hue and intensity, anthocyanins, and total phenols. All replicate wines were initially subjected to a sorting task to confirm sensory differences between wines produced from different yield categories and between different sites. All wines were thereafter subjected to descriptive analysis. Yield appeared to be determined mostly by the number of clusters/vine, and was also associated with larger berries and higher Ravaz indices. Low yield Cabernet franc wines had higher color, anthocyanin and total phenols. Natural yield variance tended to have little to no effect on pH and TA for both Cabernet franc and Riesling. The sensory sorting task was effectively determined differences between high and low yield wines. Five aroma and eight flavor attributes for the Riesling and three aroma and six flavor attributes for the Cabernet franc differed amongst the different yield categories in the descriptive analysis. High yield Riesling wines were associated with lower intensity of fruit characteristics and higher mineral or floral attributes. Cabernet franc vines with higher yield, vine size, and clusters/vine produced wines with higher bell pepper characteristics and less fruit characteristics. Sub-appellations had an effect on the wine sensory profile. The Lincoln Lakeshore (north) and Niagara Lakeshore Riesling vineyards were associated with higher mineral characteristics, the Four Mile Creek location had more apple/pear characteristics, and the St. Davids Bench, Beamsville Bench and Lincoln Lakeshore (south) vineyards were highest in fruit and citrus characteristics. Cabernet franc vineyards located on the Beamsville Bench and the Four Mile Creek sub-appellations were highest in bell pepper aroma, the Lincoln Lakeshore (north) vineyard was associated with more earthy character, and the Lincoln Lakeshore (south) sub-appellation was associated with more cooked fruit character. Increasing yield in Cabernet franc reduced concentration of sec-butyl methoxypyrazine (SBMP) and increased isobutylmethoxypyrazine (IBMP). IBMP increased with increased crop level in three vineyards (Beamsville Bench, Lincoln Lakeshore north, Lincoln Lakeshore south).

# Technical Session Abstracts

## Interactive Effect of Regulated Deficit Irrigation and Skin Contact Time in Washington State Cabernet Sauvignon Wines

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A Cabernet Sauvignon vineyard was subjected to four RDI regimes: I) 100% replenishment of evapotranspiration (100% ET<sub>0</sub>), II) 70% ET<sub>0</sub>; III) 25% of ET<sub>0</sub> until véraison, followed by a 100% replenishment of ET<sub>0</sub> until harvest; and IV) 25% of ET<sub>0</sub>. To study the interaction between RDI alternatives and maceration length, two vineyard replicates were designated as controls (C, 10-day skin contact) and two as extended maceration (EM, 30-day skin contact). The size distribution, concentration and composition of wine proanthocyanidins (PAs) and flava-3-ols were characterized. Additionally, a trained panel generated a descriptive analysis of the wines. The maceration length imparted a larger effect on most chemical and sensory parameters and determined a balanced extraction from skin and seeds in control wines, and an enhanced extraction from seeds (~ 73%) in EM wines. The size distribution of the wines' PAs revealed two major peaks as a function of concentration at mDP 2 (22-27% of total PAs mass) and 6-7 (12-17% of total PAs mass), and was found to follow a Rayleigh-type, non-normal distribution. The RDI 100% ET<sub>0</sub> treatment resulted in wines with lower ratings of color, fruity aromas and mouthfeel attributes. The wines of the 70% ET<sub>0</sub> and 25/100% ET<sub>0</sub> treatments were defined by red and black fruit aroma and the 25% ET<sub>0</sub> treatment generated wines with higher purple component and saturation. Control wines were more purple, saturated and with enhanced black and red fruit aromas. EM wines were less saturated, with higher ratings for brown component, oxidized character, astringency and bitterness. Bitterness ratings increased along with the flavan-3-ol content of the wines. Astringency ratings increased along with the total PA content of the wines, and, to a lesser extent, with the content of monomeric flavan-3-ols, the latter implying that a relatively high concentration (> 288 mg/L) monomeric flavan-3-ols may elicit astringency.

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## Effect of Foliar Nitrogen and Sulfur Applications on Grape-derived Volatiles and Aroma Profile of Petit Manseng (*Vitis vinifera* L.) using Descriptive Analysis

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Nitrogen fertilization has been reported to effect grape composition and therefore, wine quality. Characterization of the wine aroma profile of Petit Manseng associated with nitrogen vineyard treatments was evaluated. Treatments included (1) control without nitrogen or sulfur applications, (2) 30 kg/ha (calcium nitrate) applied to soil just after flowering, (3) 10 kg/ha of nitrogen (urea) in two foliar applications prior to véraison and (4) 10 kg/ha of nitrogen (urea) and 5 kg of sulfur (micronized sulfur) in two applications prior to véraison. Harvest samples from treatments underwent acid or enzyme hydrolysis of precursor fractions. Solid phase microextraction (SPME) and gas chromatography-mass spectrometry (GC/MS) analysis identified 27 free aroma and flavor compounds and 52 bound compounds. Lactones and fatty acids were the major components of the free fractions while bound fractions had higher concentrations of alcohols, esters and terpenes compared to the free fraction. With nitrogen fertilization, acid and enzyme hydrolysis showed reduced concentrations of some higher alcohols and fatty acids. Acid hydrolysis released more terpenes with nitrogen treatments versus enzymatic hydrolysis. Ester content was increased in both acid and enzyme hydrolysis fractions in nitrogen treated vines. For descriptive analysis of wines, eight trained panelists described aroma, flavor, texture/mouthfeel and aftertaste attributes. Principal component analysis (PCA) of aroma attributes showed 23.5% of the variation from PC1, while flavor-by-mouth and texture/mouthfeel attributes showed 26.3% of the variation from PC1. The aim of this study was to determine the influence of fruit nitrogen levels on the aroma and flavor profile of Petit Manseng.



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# Poster Session Abstracts

## Wine Aroma: Identifying Sensory Drivers for Consumer Overall Liking

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Wine odors play a critical role in consumer perception of wines and can provide wine producers more product insight. Consumer and descriptive sensory analysis were used to 1) determine overall liking of wine odors, 2) identify wine odor attributes, and 3) determine drivers of overall liking for wine odors. A commercial white wine was used to create five wine treatments [control (no added odor), acetaldehyde-spiked, diacetyl-spiked, linalool-spiked, and 2,4,6-trichloroanisole (TCA)-spiked]. Consumers (n=89) evaluated overall liking of wine odors using a nine-point hedonic scale. The linalool-spiked wine (6.4) scored higher than acetaldehyde-spiked wine (6.0), diacetyl-spiked wine (6.0), control (5.8), and TCA-spiked wine (4.6). Descriptive panelists (n=10) identified and scaled 24 odor attributes in the wines. Significant wine odors included sulfur, moldy/musty, caramelized, honey, leather, and dirty socks. TCA-spiked wine had the highest moldy/musty and leather odors. Diacetyl-spiked wine had the highest caramelized and honey odors. Moldy/musty wine odor was negatively correlated to overall liking ( $r=-0.92$ ). Principle component analysis (PCA) explained 67% of the variability in the descriptive data. The first dimension accounted for 35% of the variability and was linked with earthy, citrus, yeast, leather, moldy/musty, and caramelized descriptive terms, while the second dimension accounted for 32% of the variability and was linked with acetone, oxidized, petroleum, and green grass descriptive terms. TCA corresponded with the first dimension, whereas diacetyl and linalool corresponded to the second dimension. Using consumer and descriptive analysis can provide a deeper understanding of the consumer perception of wine odors for the formulation of future products.

## The Effects of Canopy Management Strategies on Fruit Quality of 'Frontenac' and 'La Crescent' Grapes in Central Iowa Vineyards

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The development of *Vitis riparia* hybrids has allowed the expansion of the wine industry into the Upper Midwest. These northern hybrid cultivars are more vigorous than traditional *V. vinifera* hybrids and fruit characteristics often present challenges to the wine maker. During maturation, the fruit tend to retain high levels of acids, exhibit a rapid rise in pH, possess a different profile of malic to tartaric acid than other hybrids, and wines from these grapes often have an "herbaceous" character. These characteristics have been also associated with grapes grown in overly-shaded canopies. The objective of this study is to determine the effect of canopy management strategies on light penetration and fruit quality of northern hybrid wine grapes. In 2012 'Frontenac' and 'La Crescent' vines, grown at commercial vineyards in Iowa, on a high wire cordon system, were used for the study. Treatments included all combinations of non-count shoot thinning, shoot positioning, and lateral shoot removal in the fruiting zone. The treatments were replicated four times in a completely randomized design. Measurements were taken on required labor to perform the practices, light intensity (PAR) within the canopy, yield, and fruit quality indices. Fruit quality parameters included soluble solids, pH, titratable acidity, as well as citric, tartaric, malic, succinic, lactic, and acetic acid concentrations, and glucose and fructose concentrations. Differences between treatments for required labor, PAR, soluble solid concentrations, and the ratio of malic to tartaric acid were evident.

## Impact of Thinning and Training Mode on the Vine and Grape Quality for Four Varieties in Quebec, Canada

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In Quebec, the short growing season and the difficulty in reaching the maturity of some varieties are major concerns for growers. The thinning technique consists to reduce the number of clusters per plant to allow those remaining optimal development. The main objective is to measure the impact of thinning on the vine and grapes for three training modes and four hardy grape varieties grown in Quebec. The varieties studied are: Frontenac, Marquette, St-Croix and Louise Swenson. These varieties are all conducted in three modes: Cordon Royat 18", Cordon Royat 30", and Top Wire Cordon 60". Three thinning levels were applied: 8, 12 and 16 buds. The following agronomic parameters were recorded in 2012: lignification, berry weight, cluster weight, number of cluster and yield. The values of sugar content, pH and titratable acidity were also noted at harvest. The results show that the varieties respond differently to different treatments. The lignification is generally affected by the training mode, but not by the thinning. At harvest, berry weight of the four varieties is affected by the training mode, while the clusters weight, the yield and the number of clusters per plant are more affected by thinning. With regard to the chemical properties of grapes, some trends are observed in function of the training mode, but the thinning does not seem to affect these parameters. The evaluation of the effect of thinning and training modes may provide information to help Quebec winemakers to reach grape maturity and to improve the profitability of Quebec wineries.

## Efforts at Improving the Sensitivity of MLF Paper Chromatography

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Malolactic fermentation (MLF) is common to all wine-producing areas of the world. In this secondary fermentation L-malic acid is enzymatically de-carboxylated (loss of CO<sub>2</sub>) by bacteria to form L-lactic acid. MLF is easily monitored by paper chromatographic separation where one seeks the absence of a malic acid spot. Visual resolution for malic acid is reported to limit at approximately 100 mg/L, while many winemakers prefer a level of 15 to 30 mg/L malic acid to consider their wine "safe". Sensitivity improvement techniques include 1) multiple spotting using a hair drier to keep spots compact and refilling the capillary to add to original spot, and 2) Looking into alternative indicator systems (Methyl Red - Methylene Blue, Phenolphthalein, Iodine, Bromocresol green with Ammonia). Examples of improved sensitivity will be shown to demonstrate that one should be able to see 50 mg/L malic acid.

## Green Grafting Allows Timely Rapid Increase of New, Virus Indexed Cultivars in Northern Climates

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The introduction of new grape cultivars is often hampered by restricted volumes of clean, virus indexed propagation material. In 2009, a small number of dormant, indexed hardwood cuttings of three Italian cultivars was received by a Niagara-based winery, presenting this exact dilemma. The plants required for the winery's proposed field planting exceeded that which was feasible from the immediately available, indexed hardwood cuttings for 2 of the 3 cultivars. The time delay to bulk up the scion wood suitable for dormant bench grafting using an outdoor planting would also result in a reduced virus status. Green grafting with available greenhouse grown rootstock of similar virus status was proposed as an alternative. Two cultivars (Corvina and Rondinella) were planted as own rooted cuttings in a peat-based soilless medium and grown in a secure greenhouse, while the third (Molinari) was propagated traditionally using hardwood bench grafts with clean, commercially available rootstock. The two indoor cultivars were grafted using two techniques - cleft and mini-Omega - as hand tied, single node, green shoot grafts. Test grafts were prepared in 2009 using available green materials to test grafting, callusing and suckering protocols. In 2010 and 2011, the following scion/rootstock, green graft combinations were made: Rondinella/SO4, Rondinella/C3309, Corvina/SO4, Corvina/C3309. Young vines were overwintered in the greenhouse at 5°C. The traditional hardwood grafts were field planted in spring 2010, the 2010 green grafts planted in 2011 and the 2011 green grafts planted in 2012. Vines began producing in 2012 with semi-commercial production planned for 2013. Field losses and winter injury have been minimal and grafts unions strong and healthy. Grafting in both 2010 and 2011 was 95% successful when performed in late spring/early summer, but less than 50% when performed in September. In addition, C3309 required much less suckering after callusing than SO4. Vine size, trunk health and field populations are to be collected in March 2013.



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## Characterization of the Flavor Profile of Norton (*Vitis aestivalis*) Grapes at Different Stages of Maturation

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Norton is an interspecific hybrid in its parentage and is an economically important wine grape cultivar for the Midwest and Eastern grape industry. Norton's disease resistance and lack of "foxy" aroma make this an interesting cultivar for breeding new cultivars. However, Norton berries tend to retain high levels of malic acid, titratable acids (TA), potassium, and exhibit an alkaline pH. Despite Norton's current economic importance, limited research has been conducted to characterize berry flavor and color development. In 2012, a study was initiated using established six year old grapes from Mountain Grove, Missouri. Samples were collected at seven different stages of maturation to track development of sugar and acid concentrations, as well as phenolic compounds. The accumulation of soluble solids ( $^{\circ}$ Brix) was linear through berry maturation and peaked at 106 days after flowering (DAF). At the final harvest date, 120 DAF, no change in Brix was measured; soluble solid values were  $22.75 \pm 1.14$  and  $22.32 \pm 1.19$  for 106 and 120 DAF, respectively. Changes in TA, total sugars, and anthocyanins (flavonoid for color development) also were measured through berry maturation.

## Evaluation of Composition Attributes and Postharvest Storability of Arkansas Muscadine Genotypes

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A major limiting factor in muscadine grape (*Vitis rotundifolia*) commercialization is deterioration during storage. One solution for extending market seasons and preventing market saturation for fresh muscadines could be the release of new cultivars with improved postharvest storability. The composition attributes and postharvest storability were evaluated on eight muscadine cultivars and nine breeding selections grown at the University of Arkansas Fruit Research Station. The objective of the study was to identify muscadine genotypes with potential for commercialization and postharvest storability. Muscadines were hand harvested and evaluated weekly for 4 weeks. The initial berry volume among muscadine genotypes ranged from 84.9 to 240.9 cm<sup>3</sup>, titratable acidity (TA) ranged from 2.1 to 4.8 g/L, pH ranged from 3.1 to 3.9, soluble solids ranged from 16.6% to 27.3%, firmness ranged from 5.9 to 10.4 N, L\* value ranged from 27.4 to 96.8, chroma ranged from 2.1 to 18.5, and hue ranged from 5.1 to 311.6. Hue, TA, and pH of the muscadines did not change during storage. However, firmness and berry volume decreased while weight loss and decay increased during storage, but varied by genotype. Due to less decay, less weight loss, and greater firmness during storage, the bronze genotypes AM 03 and 'Summit' and the black genotypes AM 28, 'Southern Jewel', and 'Supreme' had the highest potential for postharvest storage, while the bronze genotypes 'Fry' and 'Tara', and the black genotypes AM 04 and 'Ison' had the least potential. These findings identified superior postharvest genotypes and aid in providing postharvest handling parameters.

## A Novel Two Panel Evaluation System for Commercial Wines

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Quality evaluations for commercial wine sales are difficult. Chemical tests give good statistics, but have uncertain relationship to consumer tastes. Blind tests by hedonistic judging panels have uncertain precision and are too expensive to do enough repetitions for statistical validity, but do provide a greater correlation to consumer tastes. To resolve this problem a two panel system was created. One panel was trained to recognize precise concentration ranges of various aroma fault chemicals and correlate those to consumer acceptance by subtracting points for aroma faults from a faultless ideal score. This panel could disqualify a wine at a certain level of subtractions from the ideal score. The other panel did a hedonistic evaluation by aroma, taste, visual, and mouth feel characteristics, using a modified Davis 20 point scale. This panel could not alone disqualify a wine. The two scores were added together and the total compared to a qualifying score set at several levels. The consistency of scoring for each panel for all wines, including commercial control wines of two kinds, was ascertained.

## Viticultural Performance of Chardonal Grapevines is Altered By Grapevine Vein Clearing Virus and Vine Decline Disease

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Grapevine Vein Clearing Virus and Vine Decline Disease is a serious problem in vineyards in the Midwest and Upper South. In 2009, a new virus was identified from symptomatic vines and found to be associated with the disease. This virus, Grapevine Vein Clearing Virus (GVCV), was the first DNA virus discovered in grapevines. GVCV testing was conducted in a Chardonal vineyard located near Rocheport, MO. This enabled the establishment of a population of vines which tested positive and negative for GVCV. These vines were monitored for viticultural performance during the 2009-2011 seasons. Yield and vegetative growth were reduced in vines testing positive for GVCV. Basic fruit composition (percentage soluble solids, pH, and titratable acidity) was generally not negatively impacted in vines with GVCV. Vine mortality increased over time in vines with GVCV. Practical aspects of management of GVCV in the vineyard will be discussed.

## ARTon Products Donation of Glassware



# Poster Session Abstracts

## Two years into the SCRI Northern Grape Project: What Have We Accomplished?

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The Northern Grapes Project is a Coordinated Agriculture Project (CAP) funded by the Specialty Crops Research Initiative, addressing three SCRI focus areas of production (viticulture), distribution and processing (enology) and consumers and markets. Research and extension goals are to optimize viticultural, winemaking, and marketing practices to enhance quality and acceptance of wines made from cold-hardy grapes released since 1996 by the University of Minnesota and private breeders. In its first season, the project team established 49 field trials at 12 universities and several commercial vineyards, produced 203 fermentation lots, and completed a baseline survey of grape and wine production and a tasting room customer satisfaction survey. Outreach to date has included 12 Northern Grapes webinars, six newsletters, 40 presentations and 25 field days, reaching over 1850 participants.

## Correlation Between Instrumental Extraction Force and Perceived Extraction Difficulty for Wine Bottle Closures

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Peak extraction force is commonly used to characterize the mechanical performance of wine closures. There have been no rigorous studies performed to correlate instrumental extraction data with the sensory experience of closure extraction. In this study, the peak extraction force and total work required to extract a wine closure were measured instrumentally and compared to perceived difficulty measurements collected through sensory evaluation methods. Twenty-two closure types representing different materials (synthetic, natural cork based) and manufacturing methods (injection molded, extruded and agglomerated) were evaluated. Results showed a poor correlation ( $R^2=0.03$ ) between peak extraction force and perceived difficulty and a good correlation ( $R^2=0.82$ ) between total work energy and perceived difficulty.

## eViticulture: A Multi-Faceted International Platform for Viticulture Outreach

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The eViticulture website ([www.eviticulture.org](http://www.eviticulture.org)) was developed by the Grape Community of Practice (GCoP) as a portal to grape-related information in the eXtension system. Members of the eXtension Grape Community of Practice are dedicated to delivering research-based, peer reviewed material for all viticulturists via eViticulture. This online platform gives extension and research viticulturists the opportunity to present information to their community of interest in a variety of different methods.

eViticulture attracts an international audience by using traditional methods (e.g. written articles in English and Spanish), but also new outreach methods such as video, webinars, and social media. Since the GCoP first launch their content, about 500,000 page views have been collected. Many specialists working in the Northern Grapes and Accelerating Grape Cultivar Improvement (VitisGen) projects are also members of the GCoP, thus enhancing the breadth of knowledge on the topics of cold hardy grape growing and grapevine genetics. eViticulture provides collaborators with a national and international web presence that enhances the outreach potential for their project. For example, all Northern Grapes webinars are advertised and accessible through eViticulture. It also facilitates a collaborative work environment where members can create learning opportunities that are science-based and peer-reviewed in an online format. An added benefit is that online traffic is monitored and can be reported to members for development of project impact assessment. Overall, eViticulture is an effective extension tool available to anyone with expertise in viticulture who wishes to engage in outreach on a national and international scale.



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