



AMERICAN SOCIETY  
FOR ENOLOGY AND VITICULTURE

E A S T E R N ° S E C T I O N

*International  
Symposium on  
Sparkling Wine  
Production*



**36th Annual Conference  
July 16-19, 2012  
Traverse City, Michigan**

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

**Conference Program**

# Conference Schedule Overview

## Sunday, July 15, 2012

Preconference Board Meeting	Days Inn & Suites	4:00-6:00 pm
Conference Registration	Lobby Days Inn & Suites	6:00-8:00 pm
Welcome Reception	Days Inn & Suites	6:00-8:00 pm

## Monday, July 16, 2012

Conference Registration	Lobby Days Inn & Suites	7:00-7:45 am
Michigan Wineries & Vineyards Tour	Lobby Days Inn & Suites	7:45 am-8:45 pm

## Tuesday, July 17, 2012

Conference Registration	Hagerty Conference Center	7:00 am-4:30 pm
Continental Breakfast	Hagerty Conference Center	7:00-7:45 am
Student Paper Competition	Hagerty Conference Center	7:45 am-12:30 pm
Lunch	Hagerty Conference Center	12:30-1:30 pm
Student Paper Competition	Hagerty Conference Center	1:30-4:30 pm
View Posters	Hagerty Conference Center	2:30-3:00 pm
Oenolympics & Grazing Dinner	Days Inn & Suites	5:30-8:00 pm
Hospitality Suite	Days Inn & Suites	8:30 pm

## Wednesday, July 18, 2012

Conference Registration	Hagerty Conference Center	7:30 am-4:30 pm
Continental Breakfast	Hagerty Conference Center	7:30-8:30 am
Technical Program	Hagerty Conference Center	8:30 am-12:30 pm
View Posters	Hagerty Conference Center	10:00-10:30 am
Lunch	Hagerty Conference Center	12:30-1:30 pm
ASEV-ES Annual Business Meeting	Hagerty Conference Center	1:30-2:30 pm
Technical Program	Hagerty Conference Center	2:30-4:30 pm
Sparkling Wine Reception and Banquet	Days Inn & Suites	5:30-9:30 pm
Hospitality Suite	Days Inn & Suites	9:30 pm

## Thursday, July 19, 2012

Symposium Registration	Hagerty Conference Center	8:00-9:00 am
Continental Breakfast	Hagerty Conference Center	8:00-9:00 am
Sparkling Wine Symposium	Hagerty Conference Center	9:00 am-5:00 pm
Post-Conference Board Meeting	Days Inn & Suites	5:30-7:00 pm

## ASEV-ES Conference and Symposium Sponsors

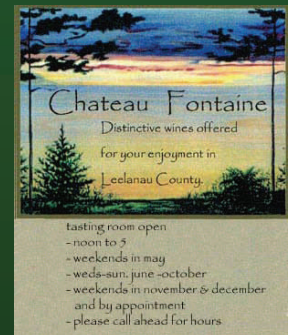
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Industry Council, Michigan State University, National Grape, Traverse Bay Economic  
Development Corporation, and Wineries of Old Mission Peninsula

# Monday, July 16, 2012

## Tour of Michigan Wineries & Vineyards

- Meet in Lobby Days Inn & Suites** 7:45 am
- Depart for Shady Lane Cellars** 8:00 am  
Adam Satchwell speak to group en route  
Vineyard Tour & Wine Tasting 8:30-9:45 am
- Depart for Willow Vineyard & Winery** 9:45 am  
Craig Cunningham speak to group en route  
Vineyard Tour & Wine Tasting 10:00-11:00 am
- Depart for Black Star Farms** 11:00 am  
Lee Lutes speak to group en route  
Winery Tour & Wine Tasting 11:15 am-12:15 pm
- Lunch at Black Star Farms** 12:15-1:00 pm
- Depart for L. Mawby** 1:00 pm  
Larry Mawby speak to group en route  
Vineyard Tour & Wine Tasting 1:15-2:30 pm
- Depart for Chateau Fontaine** 2:30 pm  
Dan Matthies speak to group en route  
Vineyard Tour & Wine Tasting 3:00-4:15 pm
- Depart for Bel Lago Vineyard & Winery** 4:15 pm  
Charlie Edson speak to group en route  
Vineyard Tour & Wine Tasting 4:30-6:00 pm
- Dinner** 6:00-8:00 pm  
Charlie Edson's house on Lake Leelanau
- Depart for Days Inn & Suites** 8:00 pm  
**Arrive Days Inn & Suites** 8:45 pm



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# Tuesday, July 17, 2012

## Welcome

7:45-8:00 am

Fritz Westover, Texas AgriLife Extension and ASEV-ES Chair Elect  
Doug Luciani, Traverse City Area Chamber of Commerce

## Student Paper Competition Oral Sessions

8:00 am-12:30 pm

Quantitative Analysis of Phytic Acid in Grape Seeds, Stems and Berries of Cabernet Franc and Petit Verdot

Zhiyu He and Brent Trela

Understanding the Relationship Between Fermentation Derived Aromas and Juice Nitrogen Composition

Mark Nisbet, Anna Katharine Mansfield, Tim Martinson, and Gavin Sacks

The Effect of Cold Soak and On-skin Fermentation on the Phenolic Content of Aromatic White Wines

Diane M. Schmitt, David C. Manns, and Anna Katharine Mansfield

Composition of Enological Nutrients and their Effect on Malolactic Fermentation

Alison Sudano and Ramón Mira de Orduña

Amino Acid Profiles and Yeast Assimilable Nitrogen in Hybrid Wine Grapes from the Eastern United States

Amanda C. Stewart and Christian Butzke

Validation Study of Stir Bar Sorptive Extraction of Ultra-trace Volatile Compounds in Wines

Yanmei Zhang and Brent Trela

## Break

10:00-10:30 am

An Investigation of the Relationship Between Ethyl Acetate Production and Osmotic Stress in *S. cerevisiae* K1-V1116 During High Brix Fermentations

Caitlin Heit and Debra Inglis

Evaluating the Role of *B. cinerea* in its Noble Form in Appassimento Wine Production using Five Post-Harvest Grape Drying Methods

Ian Bock and Debra Inglis

Management of Sour Rot in the Niagara Region

Cristina Huber, Debra Inglis, and Wendy McFadden-Smith

Late Season Sulfur Spray Persistence in the Vineyard and during Winemaking

Misha T. Kwasniewski, Wayne F. Wilcox, and Gavin L. Sacks

# Effects of Exogenous Abscisic Acid on Freezing Tolerance and Soluble Sugars in Buds of Cabernet Franc and Chambourcin Grapevines

Yi Zhang and Imed Dami

## Lunch

12:30-1:30 pm

## Student Paper Competition Oral Sessions

1:30-4:30 pm

**Vegetative Growth, Cropping Potential and Fruit Quality of Pierce's Disease Tolerant American and French-American Hybrid Bunch Grape Cultivars in Alabama**

Yilanna Hu, Elina Coneva, Edgar Vinson, J. Raymond Kessler, Jr., Jay Spiers, and Joyce Ducar

**Vineyard Floor Management with Cover Crops in a Mature Cabernet Franc Vineyard**

Sarah Bowman and Dr. Bradley Taylor

**Vines of Different Capacity and Water Status Alter the Sensory Perception of Cabernet Sauvignon Wines**

Cain C. Hickey and Tony K. Wolf

## Break-View Posters

2:30-3:00 pm

**Effects on Leaf Photosynthesis, Source Sink Relations and Fruit Quality of Late Season Application of Foliar Urea**

Letizia Tozzini and Paolo Sabbatini

**Effects of Grow Tubes and Pruning at Transplanting on Grapevine Establishment in the Upper Midwest**

John E. Stenger and Harlene M. Hatterman-Valenti

**Impact of Viticultural Practices on Fruit Quality of Cabernet Franc Grown Under Michigan Climate**

Shijian Zhuang, Randy Beaudry, and Paolo Sabbatini

## Adjourn

4:30 pm

**Oenolympics & Grazing Dinner**

5:30-8:00 pm

**Hospitality Suite**

8:30 pm

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# Wednesday, July 18, 2012

## Technical Program

8:30 am-12:30 pm

**Spatial Variation in Pruning Weight and Implications for Managing Vine Size in Concord Grapes**

James A. Taylor and Terence R. Bates

**The Effect of the Timing of Leaf Removal on the “Green” and “Fruity” Aromas and Flavours of (*Vitis Vinifera* L. Cv.) Pinot Noir Wine**

B.S. Kemp, R. Harrison, R. Sedcole, and G. L. Creasy

**Early Defoliation for Improved Yield Components and Grape Composition of *Vitis Vinifera* L. Chardonnay and Pinot Noir**

Paolo Sabbatini and Dana Acimovic

## Break-View Posters

10:00-10:30 am

**Impacts of Late-Season Fungicide Applications on Fermentation and Sensory Characteristics**

Christopher Gerling, Hans Walter-Peterson, Michael Colizzi, Luann Preston-Wilsey, Pam Raes, and Wayne Wilcox

**Cabernet Franc Grapevines Response to Root Zone Management**

Michela Centinari, Justine E. Vanden Heuvel, Anna K. Mansfield, and Taryn L. Bauerle

**Vine Responses to Potato Leafhopper at Leaf and Vine Scales: Implications for Vineyard Management**

Rufus Isaacs, Steve Van Timmeren, Marcel S. Lenz, G. Stanley Howell, James A. Flore, Pat Murad, and Paolo Sabbatini

**Strobilurin (QoI) Resistance in Populations of *Erysiphe Necator* on Grapes in Michigan**

Annemiek C. Schilder, Laura A. Miles, Timothy D. Miles, and William W. Kirk

## Lunch

12:30-1:30 pm

## ASEV-ES Annual Business Meeting

1:30-2:30 pm

## Technical Program

2:30-4:30 pm

**Finger Lakes vs. World Riesling: Defining Monovarietal Typicity across Expert and Consumer Panels**

Anna Katharine Mansfield, Diane M. Schmitt, and Mark A. Nisbet

**New Investigations Regarding 3-Isobutyl-2-Methoxypyrazine (IBMP) in Grapes and Wines: Relationship of IBMP with 3-Isobutyl-2-Hydroxypyrazine (IBHP) and Removal of IBMP from Musts using Non-Polar Sorbents**

Sarah A. Harris, Imelda Ryona, Johannes Reinhardt, and **Gavin Sacks**

**Co-pigmentation: Possible Benefits in Wine Production**

Ryan Hendricks, Paul Jenkins, **David Miller**, and Kris A. Berglund

**Evaluation of the Infection and Mortality of Crown Gall-free Grapevines under Field Conditions**

**Thomas J. Zabadal**, Bruce Bordelon, Jay Briggs, Craig Cunningham, Imed Dami, Mike deSchaaf, Erwin Elsner, Tom Fricke, Jim Longcore, Tim Martinson, Ron Nitz and Jim Travis

**Adjourn**

**4:30 pm**

**Sparkling Wine Reception**

**5:30-6:30 pm**

**ASEV-ES Banquet**

**6:30-9:30 pm**

**Hospitality Suite**

**9:30 pm**



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# Poster Sessions\*

\*Poster set up Tuesday, July 17 by 7:45 am  
Poster removal Wednesday, July 18 by 4:00 pm  
Poster authors present at breaks with poster viewing

**Efficacy of Insecticides for Control of Leaf Phylloxera**

**Bruce P. Bordelon** and Paul Howard

**Development of Berry Growth Curves in Hybrid and *Vitis Vinifera* Grapes to Enable Crop Estimation and Crop Adjustment in New York**

Jodi Creasap Gee, Dr. Terry Bates, and Hans Walter-Peterson

**Isolation and Characterization of *Agrobacterium Vitis* from Asymptomatic Concord Grapevines**

**Christopher T. Gee**

**Combined Titrametric Analysis of TA and YAN**

**Barry H. Gump**

**North Dakota State University Grape Germplasm Enhancement Project**

**Harlene M. Hatterman-Valenti**, John E. Stenger, and Tom Plocher

**The Changing World of Vineyard Arthropod Management**

**Rufus Isaacs**, Steve Van Timmeren, Keith S. Mason, Craig Roubos, Paul E. Jenkins, and John C. Wise

**Micro-oxygenation in Wine: Current Status**

Ryan Hendricks, **Paul Jenkins**, Kris A. Berglund, and Dave Miller

**Training Effects on St. Croix Grapevines in Connecticut**

**William R. Nail**

**Enlist Ahead™ - Stewardship of the Enlist™ Weed Control System**

**Brian D. Olson** and David E. Hillger

**Growing Wine Grapes in Michigan**

**Ron Perry**, Paolo Sabbatini, and James Burns

**Diagnosis of Grapevine Virus Diseases in Michigan Vineyards**

**Annemiek C. Schilder** and Jerri M. Gillett

**Late-season Chasmothecium Production and Dispersal of *Erysiphe Necator* in Michigan**

**Annemiek C. Schilder** and Laura A. Miles

**National Clean Plant Network for Grapes: Progress and Accomplishments**

**R. Keith Striegler**

**Using Choice Exercises and Mixture Designs to Optimize Nutraceutical-rich Juice Based on Health-oriented and Sensory Attributes**

Lydia J. R. Lawless, **Renee T. Threlfall**, and Jean-François Meullenet



# Thursday, July 19, 2012



## *International Symposium on Sparkling Wine Production*

Co-chairmen: Paul Jenkins and Paolo Sabbatini, Michigan State University

### **Welcome**

**9:00 am**

Paul Jenkins, Paolo Sabbatini and Tom Smith, Michigan State University  
Linda Jones, Michigan Grape & Wine Industry Council  
Larry Mawby, L. Mawby

### **New Perspectives on the Impact of Vine Balance on Grape and Wine Flavor Development**

**9:15 am**

Nick Dokoozlian, E&J Gallo, Modesto, California

### **Sparkling Wine Production in the Pacific Northwest**

**10:15 am**

Russ Smithyman, Ste. Michelle Estates, Woodinville, Washington

### **Break**

**11:15-11:30 am**

### **A Description of Sparkling Wine Production in Champagne**

**11:30 am**

Alexandre Marcoult, Institut Oenologique de Champagne, Reims, France

### **Lunch**

**12:30-1:30 pm**

### **English Sparkling Wine Research and Press Fraction Composition of Sparkling Must and Base Wine**

**1:30 pm**

Belinda Kemp, Plumpton College Wine Centre, East Sussex, England

### **Break**

**2:30-2:45 pm**

### **Winemaking Processes to Meet your Sparkling Goals**

**2:45 pm**

Includes tasting

David Munksgard, Iron Horse Vineyards, Sebastopol, California  
and

Larry Mawby, L. Mawby, Suttons Bay, Michigan

### **Adjourn**

**5:00 pm**



# Symposium Speaker Biographies

## **Dr. Nick Dokoozlian**

***Vice President, Viticulture, Chemistry and Enology, E&J Gallo Winery, Modesto, California***

Nick Dokoozlian is responsible for research and innovation in the areas of grape and wine production, including the development of growing practices which improve the yield and quality of grapes and wines, the development and application of grape and wine chemical quality metrics and the impacts of processing, fermentation and aging practices on wine composition and sensory characteristics. He is also responsible for managing external research collaborations in these areas with universities and other research agencies.

Dr. Dokoozlian is heavily involved with the advancement of grape industry research and extension outreach activities. He currently serves as the Research Chair for the National Grape and Wine Initiative, an organization dedicated to increasing the funding available for grape and wine research in the United States. He also serves on the Scientific Review Panel of the American Vineyard Foundation, as well as numerous other industry liaison committees. He is an Associate Editor for the American Journal of Viticulture and Enology, and a reviewer for several scientific journals. He is an active member of many professional and scientific societies, including the American Society for Enology and Viticulture, the American Society for Horticulture Science and the International Society for Horticultural Science.

Prior to joining E&J Gallo, Dr. Dokoozlian spent 15 years as a member of the Department of Viticulture and Enology at the University of California, Davis. In this role, he was responsible for teaching, research and statewide extension education activities for the table and wine grape industries of California. His research interests focused on the effects of cultural practices and environmental factors on grape and wine composition. Dr. Dokoozlian received his PhD in Plant Physiology from the University of California, Davis.



## **Dr. Russell Smithyman**

***Director of Viticulture, Ste. Michelle Estates, Woodinville, Washington***

Dr. Russell Smithyman received his Ph.D. in horticulture from Washington State University, and his M.S. in horticulture from Michigan State University. He currently is the Director of Viticulture for Ste. Michelle Wine Estates in Prosser, WA. Prior to this, he held the position of Research Viticulturist and then Director of Research at Ste. Michelle. Ste. Michelle Wine Estates is the fastest growing premium wine company in the U.S. Based in Washington State, the company has 4,500 acres of vineyards, as well as vineyard and winery holdings in Oregon's Willamette Valley and in Napa Valley, California. Ste. Michelle has pioneered the Washington wine industry since it was established in 1934, and today the company's portfolio includes Chateau Ste. Michelle, Columbia Crest, Domaine Ste. Michelle, Snoqualmie, Northstar, Col Solare, and Spring Valley Vineyard in Washington; Erath in Oregon; and Stag's Leap Wine Cellars, Conn Creek, and Villa Mt. Eden in Napa. Ste. Michelle Wine Estates is also the exclusive importer of Antinori, Champagne Nicolas Feuillatte, Palmes d'Or and Villa Maria wines in the United States.



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# Symposium Speaker Biographies

## **Alexandre Marcoult**

***Enologist and Director of Laboratory, Institut Oenologique de Champagne (IOC), Reims, France***

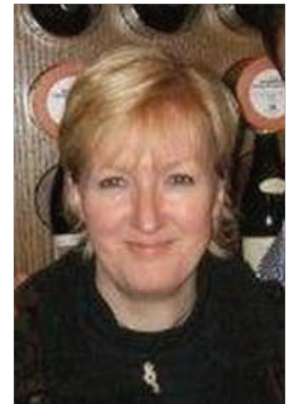
Alexandre Marcoult began his career at IOC Epernay in 1998. He was the advisor to around 90 Champagne producers. Since 2006, he has been the Director of Laboratory at IOC Reims. He also advises 45 producers with services such as samples analysis, tasting at all stages including blending tasting to build the “Cuvées” as well as description tastings to enrich presentation brochures and websites for some customers. Alexandre works with customers from harvest until the release of bottles to the market. He gives lectures about sparkling winemaking and tasting for customers in the Champagne region as well as other countries. In addition, Alexandre is sales manager of IOC in Champagne. The oenological products are sold to all Champagne producers, from small to big wineries; products include equipment, filtration, cleaning material, and so on ...He is also member of the technical commission of Winemakers Union in Champagne.



## **Dr. Belinda Kemp**

***Wine Lecturer and Wine Research Coordinator, Plumpton College Wine Centre, East Sussex, England***

Following her role as Winemaker at Nyetimber Ltd, West Sussex, Belinda Kemp received a Lincoln University International Doctoral Scholarship to study her Ph.D. in Viticulture and Oenology at Lincoln University, New Zealand in 2010 entitled “The effect of the timing of leaf removal on Pinot noir berry ripening, flavour and aroma compounds”. She completed vintages at Palliser Estate, Martinborough and Cracroft Chase, Canterbury before returning to the UK to take up her current post lecturing BSc students in Viticulture and supervising Viticulture and Oenology research projects for BSc, MSc and PhD students in the UK collaboratively with UK and European Universities.



## **David Munksgard**

***Winemaker, Iron Horse Vineyards, Sebastopol, California***

David Munksgard is a 1980 graduate of the Enology/Viticulture program at California State University, Fresno. His career started as assistant sparkling winemaker for Chateau St. Jean where he spent nine years. He then worked seven years making sparkling and still wines in the Finger Lakes of New York. As the winemaker for Iron Horse Vineyards for the past 16 years, David continues to pursue sparkling winemaking as well as producing still Chardonnay and Pinot Noir. This year, 2012, will mark David's 32<sup>nd</sup> year in winemaking.



## **Larry Mawby**

***Grape Grower and Winemaker, L. Mawby, Suttons Bay, Michigan***

Larry Mawby is a grape grower and winemaker on Michigan's Leelanau Peninsula. L. Mawby Vineyards first plantings were in 1973, and the first wines were produced in 1978. Production of traditional method sparkling wines began in 1984, and by 2000 still wine production was eliminated entirely. Tank fermented sparkling wine production began in 2003. Today the winery produces annually about 4,000 cases of traditional method wines and about 12,000 cases of tank fermented sparkling wines. In addition, custom wine production services are offered to about 12 wineries, producing traditional method, tank fermented and carbonated products.

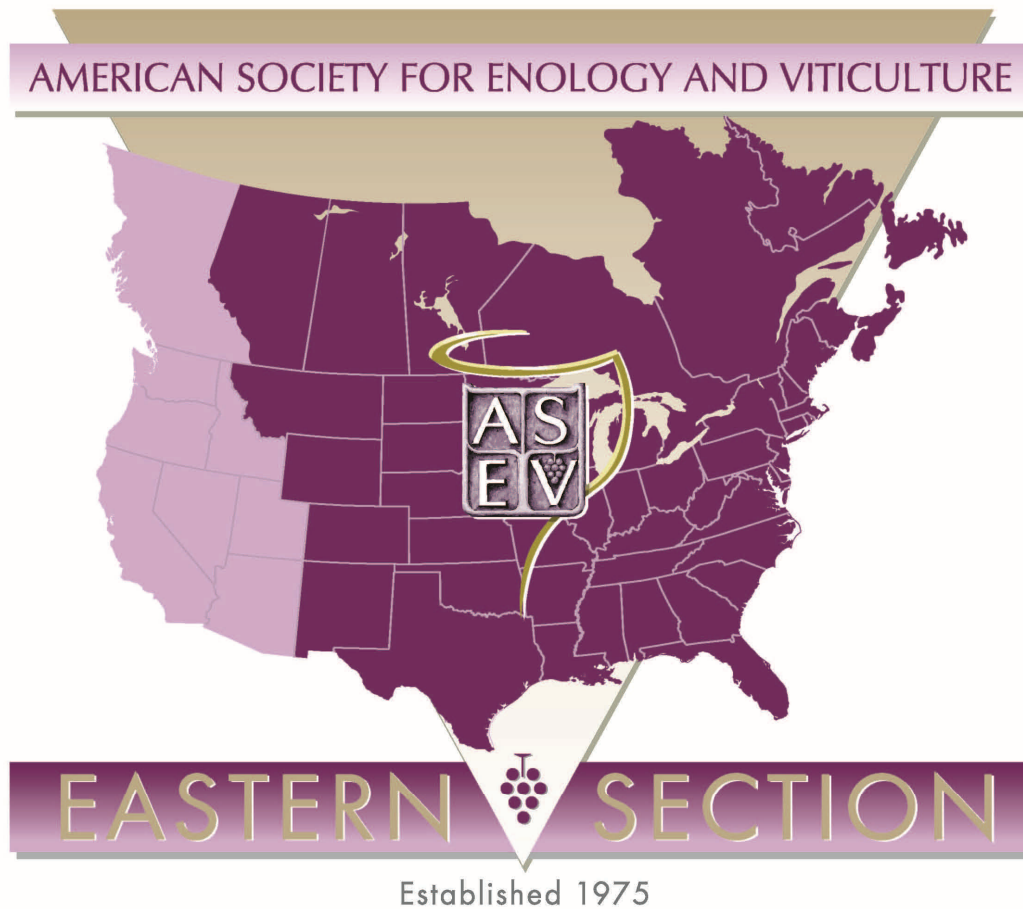


# About ASEV Eastern Section

To provide forums for the presentation, discussion, and publication (through the official journal of the ASEV) of such 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

A bylaws amendment to extend the boundaries of the Eastern Section of the ASEV was approved in 2010. The bylaws change defines the section's geographical area as encompassing all U.S. states and Canadian provinces with territory east of the Continental Divide. These areas share the diverse varieties of grapes and the often-challenging temperatures with states within the original section.



**ASEV-Eastern Section Scholarship Program supported by  
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Wine Country Organics  
Wine Packaging by Naylor  
Winery Advisory  
Zemplen Barrels

## 2012 Scholarship Recipients

Melissa Aellen (Cornell University)  
Christina Bavougian (University of Nebraska)  
Charles Frohman (Cornell University)  
Cain Hickey (Virginia Tech)  
Lindsay Jordan (Cornell University)  
Mark Nisbet (Cornell University)  
Jennifer Savits (Iowa State)  
Amanda Stewart (Purdue University)

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# Student Competition Abstracts

## Quantitative Analysis of Phytic Acid in Grape Seeds, Stems and Berries of Cabernet Franc and Petit Verdot

Zhiyu He and Brent Trela\*

Texas Tech University, Dept. of Plant and Soil Science, Box 42122, Lubbock, Texas, 79409 USA (E-mail: [trelab@albertaesthetics.com](mailto:trelab@albertaesthetics.com))

Phytic acid is a strong chelator and antioxidant naturally present in plant seeds. It has been shown to help prevent metal cation catalyzed oxidation and improve protein stability in wine although it is not a permitted additive in wine. This research was undertaken to quantify phytic acid content in grape stems and berry parts, those parts involved in the winemaking process that might contribute phytic acid to the resulting wine, and thus provide evidence that phytic acid may be an appropriate wine additive. Phytic acid was measured in grape berries and stems of Cabernet franc and Petit verdot. There were significant differences in concentration between the two varieties and among stem and berry parts. Cabernet franc and Petit verdot phytic acid contents ranged from about 14.6 to 23.4 mg in one gram of fresh berry at veraison to 9.8 to 6.9 mg/g at harvest (23.6 to 24.1 Brix) respectively. More than 80% of the phytic acid content in the grape berries for both varieties was found in the seeds, 3% to 9% was found in the skins and the remainder in the pulp. Phytic acid content on a fresh weight basis in Cabernet franc stems decreased from 36.1 mg/g at veraison, to 28.7 mg/g at the middle of maturation, and then increased to 50.5 mg/g at harvest. Results on a dry weight basis also showed similar changes in phytic acid content. Although not measured, these changes may be due to transportation and utilization of phytic acid as a phosphorous source.

## Understanding the Relationship Between Fermentation Derived Aromas and Juice Nitrogen Composition

Mark Nisbet, Anna Katharine Mansfield\*, Tim Martinson, and Gavin Sacks

\*Assistant Professor, Dept. Food Science, NYSAES Cornell University, 630 W North St., Geneva, NY 14456 USA (Email: [akm87@cornell.edu](mailto:akm87@cornell.edu))

Fusel alcohols and their acetate esters are important components of a wine's sensory profile. Their final concentration is a function of the nitrogenous compounds found in grape must, such as ammonia (AMM) and primary amino acids (PAN), known collectively as yeast assimilable nitrogen (YAN). The YAN content of New York grapes varies widely, often not meeting the concentrations required for efficient fermentation. Low nitrogen is associated with the production of sulfur off-odors, so supplementation is common. Inorganic nitrogen, added as diammonium phosphate, is the simplest and least expensive. Complex nitrogen sources are costly, and consist of hydrolyzed yeast extracts containing PAN. Fusel alcohols can arise from two different pathways; catabolism of amino acids via the Ehrlich pathway and metabolism of sugar through anabolic pathways. The relative contribution of each pathway is currently unknown. This project aims to elucidate the contribution of volatiles from catabolic and anabolic pathways under variable nitrogen concentrations utilizing gas chromatography – isotope ratio mass spectroscopy (GC-IRMS). The results will be modeled using partial least squared (PLS) regression techniques to predict the concentration of fusel alcohols and esters based on PAN concentration. The model will be validated in Riesling musts gathered from sites around New York State. This method is new to wine applications, and has the potential to allow enhancement of aroma compounds through targeted nutrition. A clearer understanding of this system will allow winemakers to fine-tune the amount and types of nitrogen supplements used, reducing costs and enhancing wine quality.

## The Effect of Cold Soak and On-skin Fermentation on the Phenolic Content of Aromatic White Wines

Diane M. Schmitt, David C. Manns, and Anna Katharine Mansfield\*

New York State Agriculture Experiment Station, Cornell University, 630 W. North Street, Geneva New York 14456 USA (Email: [akm87@cornell.edu](mailto:akm87@cornell.edu))

In aromatic white wines produced from *Vitis vinifera* and hybrid grape cultivars, phenolic compounds may contribute to color and taste. In an effort to determine the impact on phenolic concentration in aromatic white wines, replicates of Riesling, Gewürztraminer and Valvin Muscat were cold-soaked for 2, 4, 24, and 48 hours, and fermented on the skin for seven days. Samples were collected after crushing, pressing, and at the end of fermentation for quantitative analysis of phenolic compound composition using High Performance Liquid Chromatography (HPLC). The HPLC analysis revealed that gallic acid, protocatechuic acid, catechin, epicatechin, grape reaction product, *t*-caftaric acid, *c*-coumaric acid, *t*-coumaric acid, *t*-ferulic acid, and quercetin-3-glucoside were the most prevalent phenolic compounds observed. In addition, coumaric acid, ferulic acid, caffeic acid, and quercetin-3-galactosidase where found in select samples of both Riesling and Gewürztraminer wines. Ethyl esters of caffeic and coumaric acid where also found in select Riesling samples, while dihydroxybenzoic acid, sinapic acid, coumaric acid, quercetin-3-rhamnoside, and quercetin were found in select Gewürztraminer samples. Skin fermentation treatments showed the greatest increase in gallic acid, catechin, and epicatechin concentrations compared to the controls. Of the compounds analyzed, the flavan-3-ols and hydroxycinnamic acids, which contribute to bitterness and browning, are the most likely to affect wine sensory profiles.

## Composition of Enological Nutrients and their Effect on Malolactic Fermentation

Alison Sudano and Ramón Mira de Orduña\*

Department of Food Science and Technology, N.Y. State Agricultural Experiment Station, Cornell University, Geneva, NY 14456 USA (Email: [rm369@cornell.edu](mailto:rm369@cornell.edu))

In current enology, it is customary to supply musts with nutrients to prevent sluggish and stuck fermentations. Enological nutrients may be legally added in most winemaking countries and may contain yeast and yeast derived ingredients, as well as ammonium salts, and vitamins. A recent market analysis reveals over one hundred different commercial brands claiming varying compositions and enological advantages. However, in contrast to microbiological media used in laboratories, detailed compositional data about these nutrients is rarely available. This renders the evaluation of their suitability to support wine microorganisms difficult. In this study, 6 enological nutrients were subjected to a comprehensive analysis. The moisture, amino acid and vitamin profile, elemental composition, content in inorganic ammonium, primary amino nitrogen and glutathione was measured. Considerable differences were encountered between the nutrients. The elemental contents differed several-fold for some nutrients (Li, K, Ca, P, Mg, Zn, Fe, Cu) and exceeded one order of magnitude for others (Na, S, Mn). Significant differences were also found with regards to the vitamin and amino acid profiles, and the content in glutathione. Because of their tedious nutritional requirements, wine lactic acid bacteria were chosen as test microorganisms to study the nutritional quality of the products. Two *Oenococcus oeni* and one *Lactobacillus* strain were investigated in a hydroalcoholic test solution with added nutrients at two different titers ( $1 \times 10^5$  and  $1 \times 10^6$  cfu/ml). The extent of stimulation of growth by individual nutrients was found to be strain dependent. The growth supporting effect of nutrients was more pronounced at low inoculation sizes. Hence, the ability of nutrients to stimulate growth seems more relevant for spontaneous MLF. At high inoculation rates, significant malic acid had already been depleted at the onset of growth.

## Amino Acid Profiles and Yeast Assimilable Nitrogen in Hybrid Wine Grapes from the Eastern United States

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Yeast assimilable nitrogen (YAN) is an important consideration in fermentation management. The two main sources of YAN are ammonium ions and alpha-amino acids. The impact of pre-fermentation amino acid profile and concentration on aroma and flavor development in wine is an area of current research, and products have been designed to alter the amino acid profile to increase production of fruity esters by certain strains of *Saccharomyces cerevisiae*. This research operates largely under the assumption that proline and arginine are the most prevalent amino acids in wine grapes. Notwithstanding, we have observed substantially different amino acid profiles in wine grapes common to the Eastern US. Comparison of profiles from hybrid varieties with *Vitis labrusca* parentage against profiles of *Vitis labrusca* varieties suggests that amino acid profile is heritable. We are also investigating this relationship for *Vitis riparia* hybrids and *Vitis rotundifolia* (Muscadine). Amino acid profile should be considered when designing yeast nutrients for hybrid and native wine grape applications. We have also surveyed YAN in wine grapes across several Midwest and Southern states, observing a range of 89 to 938 mg/L across one vintage, over 30 grape varieties, and 4 states. For some varieties, average YAN far exceeds our previous recommendations for YAN based on initial sugar content (200, 250, 300 mg/L at 21, 23, 25 Brix, respectively). Understanding the differences in amino acid profile and total YAN concentration between hybrids and *Vitis vinifera* is essential to developing targeted fermentation management strategies.

# Student Competition Abstracts

## Validation Study of Stir Bar Sorptive Extraction of Ultra-trace Volatile Compounds in Wines

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The Stir Bar Sorptive Extraction (SBSE) technique used in this work is based on the use of polydimethylsiloxane (PDMS), an apolar sorbent polymer, as the medium of extraction of analytes in aquatic and gaseous samples. SBSE has been employed to assess various volatile compounds in enological products, such as 2,4,6-trichloroanisole (TCA), 4-ethylphenol (4-EP) and 4-ethylguaiacol (4-EG). Few validation studies of SBSE have been reported that analyze 3-isobutyl-2-methoxypyrazine (IBMP) and 3-isopropyl-2-methoxypyrazine (IPMP), which are two ultra-trace flavor compounds attributed to vegetal flavors in wines. This study adopted SBSE coupled with GC-MS in SIM mode. Three concentrations of IPMP and IBMP standards (5, 10 and 20 ng/L) were prepared in model wines. The replicated results showed satisfactory linearity (>99%) of IBMP and IPMP calibration curves and good relative standard deviation (RSD). The limit of detection (LOD) of IPMP and IBMP was 4 ng/L and 7 ng/L by peak area and 0.1 ng/L and 0.2 ng/L by peak height. The high reproducibility and recovery rate was evaluated by spiking known pyrazine standards to pyrazine free model wines and boxed wines with no detectable pyrazines. Cabernet Sauvignon wines used in this study contained 4-9 ng/L IBMP. Most samples contained IPMP lower than the LOQ. SBSE is a valid technique to analyze IPMP and IBMP in wines. The chromatographs indicate significant potential to identify and quantify many other low concentration compounds in wine. The quantification of IPMP and IBMP by peak height is recommended due to the lower LOQ and higher recovery rate.

## An Investigation of the Relationship Between Ethyl Acetate Production and Osmotic Stress in *S. cerevisiae* K1-V1116 During High Brix Fermentations

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Icewine juice is a hostile environment for conventional wine yeasts. High solute concentrations expose yeast to extreme conditions of hyperosmotic stress, leading to altered metabolism, growth and fermentation difficulties, which sometimes lead to organoleptic faults in the wine. Under these conditions, increased levels of glycerol and acetic acid are produced. Acetic acid can be further metabolized by yeast to acetylCoA, and in the presence of ethanol, can lead to the formation of ethyl acetate, a volatile compound that, like acetic acid, can negatively impact wine quality if present in sufficiently high concentrations. This study seeks to build on recent studies correlating acetic acid production to high solute fermentation conditions to examine whether acetic acid production may also be correlated to ethyl acetate evolution in Icewine fermentations. The kinetics of metabolite formation of *S. cerevisiae* K1-V1116 during the fermentation of Icewine (38° Brix) and diluted (20° Brix) juices were monitored and compared to elucidate this relationship. Although ethyl acetate production during Icewine fermentation was positively correlated to acetic acid formation ( $r=0.9580$ ,  $p<0.01$ ), lower concentrations of ethyl acetate were produced in Icewine than in dilute juice fermentations suggesting the absence of a relationship between ethyl acetate production and yeast osmotic stress response. Lower ethyl acetate corresponded to a down-regulation of yeast acetylCoA synthetase expression in the Icewine condition, indicating a lack of substrate availability for yeast catalyzed ethyl acetate formation.

## Evaluating the Role of *B. cinerea* in its Noble Form in Appassimento Wine Production using Five Post-Harvest Grape Drying Methods

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The production of full-bodied red wines in cool climates can prove challenging with the style often limited to exceptionally warm vintages. Research into factors influencing traditional appassimento wine quality using grapes ripened post-harvest has demonstrated that the concentrating effect of grape drying on sugars and flavours is accompanied by dynamic interactions between microbial and post-harvest grape metabolic activities impacting grape composition, and ultimately wine quality and style. Drawing on Noble Rot research originating in Sauternes production in Bordeaux, the current study evaluates the potential role of *B. cinerea* by studying metabolites associated with Noble and grey rots *i.e.*, glycerol and gluconic acid, respectively, throughout the drying process. Single vineyard Cabernet franc from the Niagara Peninsula, Ontario, were hand-harvested at 23°Brix and dried to 26°Brix and 28°Brix in periods ranging from 2 to 42 days using the following post-harvest drying treatments: a barn modelled on a traditional *fruttaio*; a climate-controlled chamber; a greenhouse; a repurposed tobacco kiln; and by prolonged hang-time on-vine. Temperature and humidity were monitored for each drying treatment along with metabolite changes in cluster samples throughout the timecourse. Glycerol and gluconic acid were observed to increase in cluster samples beyond that expected from the concentrating effects of water loss in all treatments, consistent with active metabolism of *B. cinerea* occurring during the drying process. Distinctive patterns of metabolite evolution and unique environmental conditions were also observed throughout the drying time course across all treatments.

## Management of Sour Rot in the Niagara Region

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Sour rot is characterized by increased volatile acidity (VA) in ripe grapes. VA is associated with spoilage organisms and wineries may reject grape crops based on their concentration of acetic acid. Our research has associated *Hanseniaspora uvarum*, *Gluconobacter oxydans*, and *Acetobacter malorum* with sour rotted grapes of several varieties in Niagara, Ontario. The pathogenicity of these organisms has been confirmed by lab assays. There is evidence of a relationship among temperature, moisture, berry ripeness and the development of sour rot. Disease management options are limited since sour rot is caused by a complex of yeast and bacteria, with symptoms developing just as grapes approach maturity. Post-veraison treatments for sour rot were investigated. Wineries routinely add potassium metabisulphite (KMS) to the surface of fruit in bins and to grape juice to kill spoilage organisms. Replicated field trials were conducted in *V. vinifera*, c.v. Riesling 2009-2011 to determine the efficacy of KMS as a fruiting-zone spray at different rates and pre-harvest timings. Potassium bicarbonate (Milstop®) was also evaluated for its efficacy against both Botrytis bunch rot and sour rot. Plots were rated for incidence and severity of sour rot and Botrytis bunch rot and VA (g acetic acid/L juice). KMS applied at 10g/L from veraison through 3 days pre-harvest was best able to reduce sour rot severity and VA compared to untreated plots. Lower rates showed less efficacy and different spray timings demonstrated variable results depending upon weather patterns. Milstop® had less impact on sour rot severity, but effectively reduced acetic acid.

## Late Season Sulfur Spray Persistence in the Vineyard and during Winemaking

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Elemental sulfur ( $S^0$ ) is an effective treatment for Powdery Mildew control. However, due to concern the  $S^0$  residues could increase hydrogen sulfide ( $H_2S$ ) in the finished wine,  $S^0$  is used sparingly late in the growing season. Recommendations for when to stop  $S^0$  spray are largely speculative, as few studies have tracked  $S^0$  persistence in the vineyard or during pre-fermentation must handling due to a lack of a routine approach to measuring  $S^0$ . To address this limitation, a simple and inexpensive assay for  $S^0$  residues was developed with a quantification range of 0.02-100 mg  $S^0$  per kg for a 5 g sample. A three-year (2009-2011) field study was conducted with two  $S^0$  spray formulations, wettable and micronized, and varying times of  $S^0$  spray cessation. A strong relationship was found between the timing of the last  $S^0$  application and  $S^0$  residue on the fruit at harvest. Cessation of spray 2 weeks prior to harvest resulted in 40-62 mg/kg  $S^0$  on harvested fruit, well above the 1-10 mg/kg limit suggested by previous studies. Cessation of  $S^0$  application 8 weeks prior to harvest resulted in < 1 mg/kg on the fruit in all years and treatments, while intermediate  $S^0$  concentrations were observed for 4 and 6-week cessation treatments. High variability of  $S^0$  persistence among years and formulations suggested that site-specific monitoring of  $S^0$  should be performed when possible. Finally,  $S^0$  residues in must were dependent on pre-fermentation practices, with must clarification resulting in a >90% reduction in  $S^0$ .

# Student Competition Abstracts

## Effects of Exogenous Abscisic Acid on Freezing Tolerance and Soluble Sugars in Buds of Cabernet franc and Chambourcin Grapevines

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The goal of this study was to improve freezing tolerance of grapevine using exogenous abscisic acid (ABA). It was hypothesized that exogenous ABA application can advance the cold acclimation process of grapevines which results in an increase of freezing tolerance. Greenhouse and field experiments were conducted where freezing tolerance (LT50) and soluble sugars of buds were measured in *Vitis vinifera* 'Cabernet Franc' and *Vitis spp* 'Chambourcin'. In the greenhouse, bud samples were collected at two, four and six weeks after ABA application. In the field, bud samples were collected monthly during the dormant season. ABA consistently increased the freezing tolerance of buds in both cultivars under greenhouse and field conditions. Furthermore, soluble sugars varied between ABA-treated and untreated buds and correlated with changes in freezing tolerance.

## Vegetative Growth, Cropping Potential and Fruit Quality of Pierce's Disease Tolerant American and French-American Hybrid Bunch Grape Cultivars in Alabama

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Experimental vineyard was established at the Sand Mountain Research and Extension Center, Crossville, AL in 2008 to evaluate the performance of Pierce's Disease (PD) tolerant American and French-American hybrid bunch grape cultivars, including 'Black Spanish', 'Blanc du Bois', 'Champanel', 'Conquistador', 'Cynthiana', 'Favorite', 'Lake Emerald', 'Seyval Blanc', 'Seyval Blanc' grafted on Coudrec 3309 ('Seyval Blanc'/3309C), 'Stover', and 'Villard Blanc'. The experimental design is a randomized complete block design with 4 replications and 4 vines per replication. Data on pruning weight, trunk cross sectional area, leaf area, and leaf chlorophyll rates were collected to determine cultivar vegetative growth. Data on yield per vine, mean cluster weight, average berry weight, and soluble solids content were measured to determine cultivar cropping potential and fruit quality. Vine shoot development, percentage of open flowers, and veraison progression were also assessed throughout the growing season. Our results suggest cultivars 'Blanc du Bois', 'Seyval Blanc' and 'Seyval Blanc'/3309C had early ripening season in 2011, while 'Cynthiana' and 'Lake Emerald' matured late. 'Black Spanish', 'Champanel', 'Cynthiana', and 'Favorite' had the largest leaf areas. 'Villard Blanc' produced the largest yield of 16.5 kg/vine and had the greatest mean cluster weight of 238.13 g. 'Champanel' produced the largest berries - 4.2 g on average, and was the most vigorously growing cultivar, based on pruning weight. Research will continue and multiple season data are going to be evaluated in order to determine the suitability of growing PD tolerant hybrid bunch grape cultivars in Alabama and the Southeast.

## Vineyard Floor Management with Cover Crops in a Mature Cabernet Franc Vineyard

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Traditional vineyard floor management in humid regions consists of mown perennial grass or mown resident vegetation in aisles. Many vineyard sites in the eastern USA have climate and soil that support excessive vine vigor and rapid growth of aisle vegetation. Frequent mowing has a negative effect on soil structure, and removes competition from vines thus promoting dense, shaded canopies and resulting in poor fruit quality and vine balance. Unmanaged aisles are not a practical option. Research is needed in the eastern USA to expand vineyard floor management options for vine vigor and weed management while maintaining soil health, vine balance, and fruit quality. Seven cover crop treatments (grower control mown fescue, chemically mown fescue, chemically mown sorghum-sudangrass, spring oats, oilseed radish, little barley *Hordeum pusillum*, downy brome *Bromus tectorum*) were established for the 2011 and 2012 growing season in a commercial Cabernet Franc vineyard (planted in 2000) in Jackson County, Ill. on a site with Alford silt loam soil. Treatments were evaluated for their effects on soil characteristics, vine vigor, vine balance, yield, fruit chemistry, ground cover, and weed control. In fall 2011, sorghum-sudangrass produced soil bulk density (sample depth 1-20 cm) that was 17% less than grower control. In 2011, oilseed radish reduced the fresh weight of shoots removed with summer hedging 34% more than grower control. Cover crop did not affect fruit chemistry or Ravaz index in 2011. Downy brome produced the most ground cover and greatest weed control at bloom time in 2011 and 2012.

## Vines of Different Capacity and Water Status Alter the Sensory Perception of Cabernet Sauvignon Wines

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Increasing fruit quality in vigorous vineyards with dense canopies is demanding of time and resources. Unfortunately, vineyards of this nature are common in humid environments. This study investigated the effectiveness with which vine capacity and water status could be regulated as well as if they related to fruit quality and wine sensory perception. Treatments were arranged in a strip-split-split plot design. Treatments (and levels) were: under-trellis groundcover (under-trellis cover crop, CC, compared to under-trellis herbicide, Herb); root manipulation (root restriction bags, RBG, compared to no root manipulation, NRM); rootstocks (comparison between 101-14, 420-A, and riparia Gloire); and differential irrigation (low water stress, LOW, compared to high water stress, HIGH). Vines grown with RBG and CC regulated vegetative growth more so than conventional treatments (NRM and Herb), resulting in 56% and 23% greater cluster exposure flux availability (CEFA), respectively. High water stress (HIGH) and RBG reduced stem water potential and discriminated less against  $^{13}C$ . Vines grown with RBG and CC consistently reduced harvest berry weight by 17 and 6% compared to conventional treatments (NRM and Herb), respectively. Estimated phenolics were consistently increased by RBG and were positively correlated with CEFA and negatively correlated with average seasonal  $\psi_{stem, md}$ , berry weight, and vine capacity. Sensory attributes were significantly distinguishable between wines produced from vines that differed in both vine capacity and water status. Treatments have been identified that can alter the sensory perception of wines, with the potential to improve wine quality.

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# Student Competition Abstracts

## Effects on Leaf Photosynthesis, Source Sink Relations and Fruit Quality of Late Season Application of Foliar Urea

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Nitrogen availability is essential for adequate grapevines canopy development and leaf photosynthetic efficiency during the season. Our objective was to study the effect of foliar urea (1%), applied at veraison, on photosynthesis and fruit quality of Chardonnay grapevines grafted on C3309 rootstock and trained to Scott Henry and VSP, in South-West Michigan. A first experiment was conducted in 2010 and 2011 to evaluate the effect of time of application: two weeks before veraison, veraison and two weeks after veraison. A second experiment was performed in 2011 to evaluate the effect of the nitrogen application at veraison after canopy was manipulated removing 0, 33% or 66% of the total leaf area. Photosynthetic rate (Pn) of leaves on fruiting zone nodes (4-6) was not affected by the foliar applications in the two experiments. Pn was instead higher in younger after treatment was applied at pre-veraison and at veraison). In vines under defoliation treatment, Pn was measured in different position of the canopy (node 4-5, node 10-15, apical nodes). Mean daily Pn was affected by the nitrogen application in the apical leaves when compared to unsprayed treatments. Compensation for leaf removal was observed at nodes 10-15, where nitrogen treatment was also effective. In conclusion, there was a positive effect of nitrogen supply on photosynthetic rate in source-limited conditions evident in leaves from the upper portion of the shoots. Nitrogen spray did not negatively impact fruit ripening but overall increased free amino acid content of berries at harvest

## Effects of Grow Tubes and Pruning at Transplanting on Grapevine Establishment in the Upper Midwest

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Field experiments were conducted to determine the effects of grow tube use and pruning at transplanting on growth and establishment of 'Prairie Star' in North Dakota and northern Minnesota. Four grow tube treatment levels (no grow tube, fall removal, full year, full year with fall lift) and two levels of pruning at transplanting (pruned and unpruned) were investigated. Vine growth was evaluated through; leaf area, stem height, average root diameter, root fragment length, root fragment surface area, root fragment volume, and number of root tips. In addition, effects on bud break date, vine survival, and hardiness were also investigated. During the first season, vines that were not pruned at transplanting had significantly more leaves per vine and total leaf area compared to vines that were pruned. Upon the second year of growth, the number of leaves and total leaf area were similar. Little difference was seen between vines pruned and unpruned at transplanting after two years. Stem height differences were detected among grow tube treatments during the first season. These differences were eliminated during the first winter due to winter dieback. Evaluation of grow tube treatments in the second season indicated that vines without grow tubes had more shoots, numbers of leaves, and total leaf area when compared to vines which were treated with grow tubes in the first season. Grow tube use may reduce vine health as growth variables were greater in vines without grow tubes after winter dieback compared to vines with grow tubes.

## Impact of Viticultural Practices on Fruit Quality of Cabernet Franc Grown Under Michigan Climate

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The acreage of *Vitis vinifera* in Michigan is steadily increasing and Cabernet Franc is the one of the most widely planted red grape variety. However, fruit maturation and quality (basic fruit chemistry, anthocyanin, phenolics and flavor compounds) of red varieties are challenged by the short and cool growing season of the Great Lakes region. Different levels of cluster thinning and basal defoliation were investigated in a complete randomized block design experiments during 2010 and 2011 at the SWMREC (Southwest Michigan Research and Extension Center, Benton Harbor, MI) on mature (20 yr-old) Cabernet Franc vines grafted on 3309C, spur pruned and trained as VSP. Vines were planted N-S with a spacing of 1.8 m in rows and 3.0 m between rows. Different levels of crop per vine were imposed at (1) fruitset, (2) pre-veraison, (3) veraison and (4) post-veraison as well as basal defoliation (nodes 1 to 6) were performed. Canopy growth (e.g shoot length, shoot diameter and leaf area per shoot and per vine) was measured weekly until veraison. Vine growth (indexed as winter pruning weight or vine leaf area) was not significantly affected by the crop load treatments as well as basic fruit chemistry at harvest. However, phenolics and anthocyanin contents were increased when crop reduction and basal defoliation were applied earlier. Flavor compounds (IBMP) were measured in the postharvest lab at MSU and impacted significantly by the timing of yield reduction and of defoliation.

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# Technical Session Abstracts

## Spatial Variation in Pruning Weight and Implications for Managing Vine Size in Concord Grapes

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Production potential in juice grape vineyards is closely related to managing vine size to an optimum level. However the level of variability in vine size within a production system, and within an individual block of grapes is not well understood. A three year study (2009-2011) of individual vine pruning weights (an estimation of vine size) was undertaken in a 0.93 ha block of Concord grapes at the Lake Erie Research and Extension Laboratory. The block is an old established vineyard block run under industry best management practices. The data was analysed using both conventional (non-spatial) and geo-statistical analysis (spatial). There was a large amount of variation found in vine size in the block in each year ( $\sigma = 0.22$  kg/m cordon or 1.15 lbs/vine). The standard deviation was almost half the optimum vine size (0.46-0.56 kg/m or 2.5-3 lbs/vine). The spatial analysis shows that ~80% of this variation occurred between neighbouring vines. This may be due to compensatory and competitive growth between adjoining vines. Only ~20% of the variation in pruning weight was spatially structured, however this was still a lot of variation. Mapping the pruning weight data with a smoothing interpolator showed strong consistent spatial trends over the three years. Mapping and managing these spatial trends should be possible with existing low-cost off-the-shelf canopy sensing systems and stratified sampling systems. Monitoring, mapping and managing the large amount vine-to-vine variation will be much more difficult and will likely require the development of higher resolution sensing and decision-support systems.

## The Effect of the Timing of Leaf Removal on the “Green” and “Fruity” Aromas and Flavours of (*Vitis Vinifera* L. Cv.) Pinot Noir Wine

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Mechanical leaf removal was applied to Pinot noir vines in a commercial vineyard in Waipara, New Zealand in the 2007-2008 and 2008-2009 growing seasons. Fruit zone treatments consisted of NLR: no leaf removal (control), LR7: leaf removal from the fruiting zone 7 days after flowering, LR30: leaf removal from the fruiting zone 30 days after flowering, LRV: leaf removal at 5% berry colour change (by visual assessment). Headspace-solid phase microextraction-gas chromatography-mass spectrometry-stable isotope dilution analysis (HS-SPME-GC-MS-SIDA) was used to analyse fourteen “green” and “fruity” volatile aroma compounds in Pinot noir wines. The “fruity” ethyl esters showed no discernible pattern between treatments but a difference between years was observed. “Green” C6 aroma compounds and “fruity” C13 norisoprenoids increased in all wines in 2009. Sensory analysis by Waipara winemakers by modified-free choice profiling found that wines from non-defoliated vines were described as having a rhubarb and lees autolysis aroma but were vegetal and candied on the palate. Wines from defoliated vines had elevated dark fruit aroma, and had more dark fruit, tannin and weight on the palate. “Fruity” aroma compounds were found to be above their odour threshold levels in all wines but “green” aroma compounds were found to be below. Free choice profiling proved to be a useful sensory analysis method which did not require panellist training and allowed experts to describe wines using their own terminology.

## Early Defoliation for Improved Yield Components and Grape Composition of *Vitis Vinifera* L. Chardonnay and Pinot Noir

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Viticulture in Michigan is limited by a cool-humid climate and as a result there is a problem of harvest season cluster-rot, especially in cultivars with compact cluster morphology. Economically important wine grape cultivars possess varying susceptibility to harvest season cluster rot and a common characteristic is the compactness of the berries held on the cluster rachis. The aim of this work was to determine whether a quantified amount of leaf removal or a temporary reduction in carbon assimilation at bloom would reduce fruit set and cluster compactness. In 2010 and 2011 different levels of basal leaf removal (4, 6, 8, 10 leaves) and timing (pre-bloom, bloom and fruit-set) were investigated at SWMREC (Southwest Michigan Research and Extension Center, Benton Harbor, MI) on mature Chardonnay and Pinot noir vines grafted on 3309C, spur pruned and trained as VSP. Vines were planted N-S with a spacing of 1.8 m in rows and 3.0 m between. Vines subjected to removal pre-bloom and bloom had an average fruit set reduction of  $\approx 30\%$  from a non-treated control in both cultivars. Reduced fruit-set was associated with a reduction in cluster compactness and harvest season rot. Significant decrease in fruit set was achieved by treatments 8 and 10 leaves removed. Although average berry weight was not affected by defoliation, average cluster weight, along with the total rachis length significantly decreased in all the treatments. Differences between cultivars were noticeable, with Chardonnay being more responsive to this technique than Pinot noir in all treatments applied.

## Impacts of Late-Season Fungicide Applications on Fermentation and Sensory Characteristics

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Due to the variable climatic nature of the growing season in New York State, an extensive spray regime is required to keep winegrapes free of disease in order to preserve optimal fruit quality. Having not evolved locally, *V. vinifera* cultivars require the most protection. While agricultural spray material pre-harvest intervals are determined to minimize potential health risks for mammals, little consideration is given to the impact of these materials on yeasts that carry out fermentation. Blocks of Riesling and Cabernet Franc in a commercial vineyard in the Finger Lakes were sprayed with captan, fenhexamid (“Elevate”) and cyprodinil (“Vanguard”) at the labeled pre-harvest interval for each material. No significant differences were found between any of the treatments for the time required to complete fermentation. Informal sensory surveys of grape and wine industry members in the Finger Lakes to this point have shown no preference for any of the given treatments or the control. These results have potential implications for winemakers and grape growers in discussions about whether or not to apply any of these fungicides just prior to harvest in order to protect fruit and wine quality.

## Cabernet Franc Grapevines Response to Root Zone Management

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The effects of five root zone management treatments (three annual cover crops, root pruning, and control) was compared on Cabernet Franc/3309C in the Finger Lakes region of New York State in 2010 and 2011. Annual ryegrass (AR), buckwheat (BW), and turnip (TP) were planted beneath the vines at bloom in 2010 and 2011. Root pruning (RP) was implemented in 2010, shortly before budbreak to one side of the vines at 0.6 m depth and 0.25 m distance from the vine trunk. The control treatment consisted of a 1 m wide vegetation-free strip maintained by cultivation. In 2010 AR, BW, and RP significantly decreased the number of actively growing shoots at veraison. In 2011 the use of AR, BW, and RP significantly improved cluster and leaf light interception as denoted by enhanced point quadrat analysis metrics compared to the control. In the same year, leaf net carbon assimilation rate was significantly lower in the AR and RP vines compared to the control. Treatments did not significantly affect the vine water status, although the stem water potential was generally lower for treated vines as compared to the control. There were no significant differences in yield components and fruit composition between treated and control vines in either year of the study. Sensory analysis of 2010 wines via projective mapping and preference testing indicated there were no pronounced impacts of the treatments on wine perception. This study is continuing in 2012.

## Vine Responses to Potato Leafhopper at Leaf and Vine Scales: Implications for Vineyard Management

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*Vitis vinifera* and some hybrid cultivars are affected by infestation by potato leafhopper, *Empoasca fabae*, having a hypersensitive response to their saliva. This leads to leaf yellowing, curling and stunted growth, and recommendations have been to apply insecticide to prevent this damage. We have investigated potato leafhopper-vine interactions in recent years and have found strong positive correlations between infestation level and symptom expression in sensitive Pinot gris vines. Investigations of the physiological basis of these symptoms indicate both stomatal and non-stomatal limitation mechanisms in the declining levels of carbon assimilation in affected tissues, and also suggest that leaves can compensate for the feeding injury after infestation. Effects of potato leafhopper on vine growth were studied in potted and field-grown vines. In potted vines, increasing infestation was correlated with declining shoot and leaf growth, and roots were smaller in vines experiencing the highest infestation levels. Experiments in vineyards were conducted in a young Pinot gris and a mature Pinot noir planting, using a factorial design where vines with high or low crop load experienced high or low potato leafhopper infestation. Over multiple growing seasons, potato leafhopper infestation caused leaf yellowing symptoms, but there was no detectable impact of this pest on vine growth or basic fruit quality. We conclude that grape cultivars are negatively affected by potato leafhopper at the time of infestation and that the early-season timing allows for compensatory growth and ripening of typical crop loads. This suggests limited need for insecticidal control of this pest in sensitive vineyards.

# Technical Session Abstracts

## **Strobilurin (QoI) Resistance in Populations of *Erysiphe necator* on Grapes in Michigan**

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In Michigan, powdery mildew, caused by *Erysiphe necator*, is primarily controlled with fungicides, including strobilurins (QoIs). Resistance to this class of fungicides has been reported previously in *E. necator* populations in the Eastern US. Among 12 *E. necator* isolates collected from five Michigan vineyards in 2008, one carried the G143A single-nucleotide mutation responsible for QoI resistance. This isolate was confirmed to be resistant in a conidium germination assay on water agar amended with trifloxystrobin at 0.001, 0.01, 0.1, 1, 10, or 100 µg/ml and salicylhydroxamic acid (100 mg/liter). The mutant isolate was able to germinate on media amended with 100 µg/ml trifloxystrobin, whereas a representative wild-type isolate did not germinate at concentrations higher than 0.1 µg/ml. In 2009, 172 isolates were collected from a total of 21 vineyards (juice and wine grapes): three vineyards with no fungicide application history (baseline sites), six research vineyards, and 12 commercial vineyards. QoI resistance was defined as an  $EC_{50} > 1$  µg/ml. Isolates from baseline sites had  $EC_{50}$  values mostly below 0.01 µg/ml, while isolates that were highly resistant to trifloxystrobin ( $EC_{50} > 100$  µg/ml) occurred in five research and three commercial wine grape vineyards at frequencies of 40 to 100% and 25 to 75% of the isolates, respectively. The G143A mutation was detected in every isolate with an  $EC_{50} > 1$  µg/ml. These results suggest that fungicide resistance may play a role in suboptimal control of powdery mildew observed in some Michigan vineyards and emphasizes the need for continued fungicide resistance management.

## **Finger Lakes vs. World Riesling: Defining Monovarietal Typicity across Expert and Consumer Panels**

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The concept of typicity has increasingly been used to define monovarietal regional wines. Holistic, top-down typicity ranking requires expert panelists, and subsequently may not coincide with bottom-up, attribute-driven consumer evaluations. In an effort to tie expert classifications of NY Finger Lakes (FL) Rieslings with a consumer-developed lexicon, a succession of sensory evaluations were performed on Rieslings from NY and four additional world production regions. Two 20-member panels, one consisting of regional wine professionals, and one of national and international wine judges, were asked respectively to judge FL and international wines for typicity using a 15cm anchored scale. A combined group of 16 wines deemed 'most typical' to the five regions was subjected to generic descriptive analysis by 14 pre-screened white wine consumers. A set of 19 descriptors, defined with attribute standards, was developed through guided consensus, and was used to assess ortho- and retronasal aroma attributes using a descriptor checklist. Both the consumer and regional expert panels also performed projective mapping on the 16-wine set. Cluster analysis of projective mapping revealed somewhat different groupings. The consumer panel split the wines into three primary groups and two pairs, grouping two NY wines with wines from the Pfalz and the remaining two in mixed pairs. In contrast, the expert panel generated four primary groupings, placing three of the four NY Rieslings with wines from the Rheingau. Initial analysis of aroma descriptors and grouping revealed no obvious correlation, suggesting that other sensory factors may play a larger role in consumer sorting.

## **New Investigations Regarding 3-Isobutyl-2-Methoxypyrazine (IBMP) in Grapes and Wines: Relationship of IBMP with 3-Isobutyl-2-Hydroxypyrazine (IBHP) and Removal of IBMP from Musts using Non-Polar Sorbents**

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Controlling final concentrations of the herbaceous smelling 3-isobutyl-2-methoxypyrazine (IBMP) is of interest to the wine industry, and two experiments were performed towards this goal. In one experiment, the behavior of a likely IBMP precursor, 3-isobutyl-2-hydroxypyrazine (IBHP), was characterized during the growing season. Following development of an improved method for IBHP measurement, IBHP and IBMP were quantified from fruit set to harvest at one site in California's Central Valley and two sites in the Finger Lakes region of New York State. IBHP was detectable at the earliest sampling point (4 weeks pre-veraison), increased to up to >800 ng/L, and started to decrease ~2 weeks after IBMP decrease began. The highest IBMP was observed at the site with the highest IBHP suggesting that IBMP accumulation is dependent on IBHP formation. In a second experiment, we investigated the effects of treating must with a non-polar sorbent (silicone) prior to fermentation. Treatment of 4 different musts with silicone pre-fermentation resulted in significant decreases of methoxypyrazines in the final wine, 53-93%, without affecting the majority of other wine volatiles.

## **Co-pigmentation: Possible Benefits in Wine Production**

**Ryan Hendricks**, Paul Jenkins, **David Miller**, and Kris A. Berglund\*

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In red wines anthocyanins exist in two forms: the red-colored flavilium ion, which is favored by low pH, and the colorless hemiacetal, which is present at more neutral pH. Naturally, only about 30% of the anthocyanins in wine exist in the colored form; however, the observed color would suggest that this ratio is apparently much higher. This higher apparent ratio, resulting in deeper color, is thought to be due to co-pigmentation, a phenomenon in which non-covalent interactions between anthocyanins and other molecules, referred to as co-pigmentation factors, stabilize the flavilium form. There are a very large number of molecules that act as co-pigmentation factors, with great variability in the strength of the co-pigmentation effect produced. A survey of 2011 vintage grapes was performed to measure the concentration of co-pigmentation factors in Michigan grapes. Ten different co-pigmentation factors were measured in the skins, seeds, and juice of over 30 grape samples. Preliminary data from this study will be presented.

## **Evaluation of the Infection and Mortality of Crown Gall-free Grapevines under Field Conditions**

**Thomas J. Zabadal\***, Bruce Bordelon, Jay Briggs, Craig Cunningham, Imed Dami, Mike deSchaaf, Erwin Elsner, Tom Fricke, Jim Longcore, Tim Martinson, Ron Nitz, and Jim Travis

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*Agrobacterium vitis*-free (Av-free) grapevines were planted in 38 locations in five states from 2005 to 2007. This presentation reports on the most recent evaluation of these vines in 2010. Twenty out of 1044 Av-free vines had been infected with Av. Twenty-eight out of 1044 Av-free vines, or 2.7% were killed. Commercially-propagated vines were planted and evaluated at the same time in some plots. Two out of 156 commercially-propagated vines or 1.3% were killed. Half of the Av-free vines were planted with a root dip suspension of the F 2/5 non-tumorigenic strain of Av and half were not. There was no apparent advantage to the F 2/5 root dip in regard to the incidence of Av infection or vine mortality. Crown gall formation on Av-free vines was observed in as little as two growing seasons after planting. This rapid infection occurred when Av-free vines were used as replants in a vineyard plagued with Av. This vineyard has a history of extensive winter injury and poorly-drained soil. The relatively rapid infection of some Av-free vines raises a question of their value. Av-free vines may be especially useful to promote vine recovery from sub-lethal episodes of winter injury on sites without a history of this pathogen.

# Poster Session Abstracts

## Efficacy of Insecticides for Control of Leaf Phylloxera

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Grape phylloxera (*Daktulosphaira vitifoliae*) is a common pest in the eastern US. The root form of the pest is controlled by grafting susceptible varieties to phylloxera resistant rootstocks or by using own-rooted hybrids and labrusca varieties with sufficient resistance. The aerial or leaf form of the pest can cause serious reduction in leaf area on highly susceptible varieties. Several new insecticides have been labeled and recommended for leaf phylloxera control. We conducted two studies: one to determine the efficacy of five insecticides when applied at the recommended timings based on vine phenology; and a second to compare the phenology based timing to a biofix model developed by the University of Arkansas. Percent leaves with galls and average number of galls per leaf were recorded at bunch closure and veraison. In the first study we found all insecticides reduced percent leaves with galls and average number of galls per leaf compared to untreated control at bunch closure, but by veraison, the single application soil drench with Admire Pro was not different from control. All other insecticide treatments reduced both percent leaves with galls and average number of galls per leaf compared to control. In the second study all insecticide treatments were significantly better than untreated control for percent leaves with galls and average number of galls per leaf. A single application of Danitol or Voliam Flexi made according to the biofix timing resulted in equal or better control than two applications made according to the phenology based timings. These results show that growers could reduce pesticide use and improve insect control by monitoring crawler emergence and following the biofix model.

## Development of Berry Growth Curves in Hybrid and *Vitis Vinifera* Grapes to Enable Crop Estimation and Crop Adjustment in New York

**Jodi Creasap Gee\***, Dr. Terry Bates, and Hans Walter-Peterson

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Seasonal berry growth curve information has been useful for mid-season crop estimation and adjustment in Concord grapevine production in the Lake Erie Region. Similar information could potentially be used in hybrid and *Vitis vinifera* grape production; however, little information exists on seasonal berry weight curves in hybrid and *V. vinifera* varieties. The purpose of this project is to establish berry weight and diameter curves for Concord and common hybrid and *Vitis vinifera* grape varieties in NY and Missouri to enable growers to estimate and potentially thin their crops accurately and non-destructively. In the Lake Erie and Finger Lakes Regions of New York, individual berries from 15 different varieties were collected weekly throughout the 2010 and 2011 seasons from 15 days after bloom through harvest. Individual berry diameters and weights were measured and recorded. Sample sizes ranged from 100 to 200 berries per sample, for berry weight measurements, and sample sizes for the berry diameter measurements ranged from 30-100 berries. For the 2010 and 2011 growing seasons, there were strong positive, linear relationships between berry weight and berry diameter for the sampled cultivars ( $p < 0.001$ ). This indicates that a non-destructive sampling and crop estimation method may be feasible by measuring berry diameters in the field to estimate berry weights. Additionally, berry weight curves have been summarized for each variety with data from the two seasons.

## Isolation and Characterization of *Agrobacterium Vitis* from Asymptomatic Concord Grapevines

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*Agrobacterium vitis*, causal agent of crown gall in grapevine, poses a significant risk to grape production in cold weather climates. This bacterial pathogen can transform host cells, directing the growth of tumors; the formation of which can ultimately lead to death of the plant. Concord grapevine (*Vitis hybrid* 'Concord') is the most widely planted genotype in the Lake Erie Grape Belt, and is typically considered to be resistant to crown gall. We assessed whether populations of *A. vitis* exist *in planta* in asymptomatic Concord vines, and, if so, whether the isolates are pathogenic. Putative *A. vitis* isolates were collected from bleeding sap and roots from a Concord block at the Penn State North East Research Lab. Isolates were identified using primers for *pehA* and confirmed by sequencing the 16S rDNA gene. Of the collected isolates, approximately 10% were *Agrobacterium*, suggesting small populations in the vines. None of the isolates characterized to date have exhibited tumorigenic activity, suggesting a lack of functional Ti plasmids, which has also been seen in isolates collected from wild *Vitis riparia* vines. These findings appear to indicate a genetic selection from genotypes with North American parentage for non-tumorigenic *A. vitis* isolates, which might indicate a possible resistance mechanism for future exploitation.

## Combined Titrametric Analysis of TA and YAN

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A modified titratable acidity (TA) procedure has been combined with the Formol analysis for yeast assimilable nitrogen (YAN) on white and red grape juice and wine samples using a two-burette setup with 0.1 M<sub>NaOH</sub> and 0.01 M<sub>NaOH</sub>. The TA was determined by direct titration of a 5.0 mL juice sample to pH 8.2 in a 30-mL beaker. Subsequently, 2.0 mL of formaldehyde (adjusted to pH 8.2) was added to the sample, which was then re-titrated to pH 8.2. The corresponding volumes of standardized NaOH were then used to calculate TA and YAN analytical results. These results were compared with corresponding results using separate and independent TA and Formol titrations. Data indicate that in a practical winery situation there are no significant differences in the results produced by the combined procedure, compared to the independent procedures. There are some significant savings in operational time.

## Traverse Bay Economic Development Corporation Sponsor of Conference Activities



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# Poster Session Abstracts

## North Dakota State University Grape Germplasm Enhancement Project

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Tourism and Agriculture are the top industries that consistently contribute to North Dakota's economy. Viticulture and the value-added industry of winemaking are agro-tourism enterprises showing great growth potential in North Dakota. One of the greatest obstacles to viticulture growth in North Dakota is the lack of viable grapevine cultivars that consistently produce commercially acceptable wine. North Dakota presents numerous challenges to viticulture, including extremely cold winter temperatures, short growing season, high pH soils, and dry conditions. Recent successes by public and private programs in other states using the wild grape, *Vitis riparia*, that is native to North Dakota, suggest that progress could be made fairly quickly. Collections of extremely hardy and early ripening *V. riparia* biotypes from around North Dakota and northwestern Montana are being characterized for fruit quality, including flavor, acidity, and polyphenol profile. These superior riparias are being crossed with extremely early ripening "quality" parents, *V. vinifera*, such as 'Perle Csaba' and 'Siegerrebe', and interspecific hybrids such as 'Solaris' and 'Burmunk' to create well-adapted, early-ripening, fully hardy, grape cultivars for North Dakota that produce quality wines. The project is utilizing conventional outdoor hybridization as well as a greenhouse culture and hybridization, so year-round crossing can occur. A collection of over 50 grape varieties and 30 North Dakota riparia selections are being maintained in greenhouse culture for this purpose. It is anticipated that adapting Tyler Kaban's accelerated grape breeding procedures to NDSU greenhouse operations will enable fruit quality assessment earlier and shorten the period from cross initiation to micro-vinification.

## The Changing World of Vineyard Arthropod Management

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Insects and mites continue to threaten grape production across the eastern United States, as demonstrated spectacularly in Michigan during the hot 2010 growing season. Potentially longer growing seasons coupled with new invasive species and increasing pesticide restrictions are likely to heighten the need for active management of grapevine arthropod pests. To balance this changing potential pest pressure, some recent advances in the tools and tactics available for insect and mite control now provide vineyard managers with improved ability to target pest populations while also minimizing negative impacts on beneficial insects or the environment. Using data from recent trials in Michigan vineyards, this presentation will focus on new insecticide classes and their performance against key arthropod pests and will highlight an online degree day model in use for improved timing of sprays against grape berry moth. The potential for greater adoption of economic thresholds and conservation biological control will be discussed as ways to reduce the need for broad-scale pesticide applications. We will discuss the integration of these various components into an effective vineyard IPM program that can meet the future needs of vineyard managers as well as the expectations of the public.

## Micro-oxygenation in Wine: Current Status

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In recent years, a new technique known as micro-oxygenation has been employed in red wine making. Adding small amounts of oxygen (< 5 mg/L/month) to a young wine has been reported to both increase positive color properties while decreasing astringency. However, results vary greatly, and have even been shown to conflict from vintage to vintage. The changes observed in these wines are due to the evolution of derived pigment molecules, from reactions between anthocyanins, which are responsible for the color of red wine, and a variety of other phenolic compounds. Two main reaction pathways have been proposed for these derived pigments: reactions that are not affected by oxygen, such as direct addition condensation reactions, and those that do depend on oxygen, such as acetaldehyde mediated reactions. Derived pigments have different absorptive properties than anthocyanins, causing shifts in maximum absorbance and absorbance ratios between wavelengths. Tannins contribute to astringency in wine; the astringency is reduced as tannins are consumed in these oxygen-dependent reactions. The complexity of the chemical environment in wine contributes to the large variability in results. Properties of the young wine, such as iron and copper concentration, tannin to anthocyanin ratio, and phenolic content, can have a marked impact on the final result of the micro-oxygenation technique. Discussion will be presented on the need for additional information to allow winemakers to make a more informed decision regarding whether micro-oxygenation is appropriate for a given wine.

## Training Effects on St. Croix Grapevines in Connecticut

**William R. Nail\***

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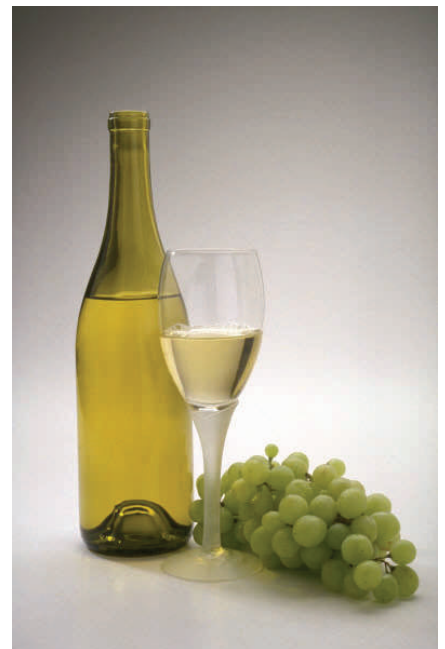
St. Croix is an *Vitis riparia*-based Swenson cultivar released in 1983. It is widely grown in the Midwest, and is one of the more popular *riparia*-based red cultivars in New England. Given its parentage, its growth habits differ from those of *V. vinifera* and traditional French-American hybrids. Vines were planted in a commercial vineyard in Connecticut to determine appropriate training systems for the region. Vines were trained to two single-canopy systems (low-wire Vertical Shoot Positioned and high-wire Hudson River Umbrella) and two divided-canopy systems (Geneva Double Curtain and Scott Henry). The trial is a randomized complete block design with four replications per training system. Vine performance and fruit quality data have been collected for three consecutive years (2009-2011). The Scott Henry vines had the highest yield in 2009, while the Geneva Double Curtain vines had the highest yield in 2010 and 2011. There were few significant differences in fruit quality among the treatments, and few significant correlations between yield and fruit quality. Most New England vineyards are relatively small, so mechanization of most vineyard activities is rare. Geneva Double curtain may be a viable option for production of St. Croix in the area despite the increased labor costs associated with it.

## Enlist Ahead™ - Stewardship of the Enlist™ Weed Control System

**Brian D. Olson\*** and David E. Hillger

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Dow AgroSciences is committed to stewardship of the Enlist™ Weed Control System being developed to help corn, soybean and cotton growers manage glyphosate resistant and hard-to-control weeds. The Enlist system confers tolerance to 2,4-D, glyphosate and quizalofop in corn and 2,4-D and glyphosate in soybeans and cotton. The in-crop postemergence herbicide solution development for the system is Enlist Duo™ that includes Colex-D™ Technology which features reduced volatility and drift potential to mitigate off-target movement of 2,4-D and glyphosate. A key component of Colex-D Technology is the new 2,4-D choline, specifically designed for reduced volatility compared to previous ester and salt forms of 2,4-D. Laboratory, small and large field research studies verified a significant reduction in vapor phase movement of 2,4-D choline compared to standard 2,4-D dimethylamine (DMA) and low-volatile ester forms. Another part of the Colex-D Technology is the patent-pending formulation designed to reduce off-target particle movement of the herbicide. Laboratory, wind tunnel and field research studies demonstrated >90% reduction in particle drift with the Enlist Duo formulation compared to a tank-mix of 2,4-D DMA + glyphosate DMA. Enlist Ahead, is a multi-faceted stewardship program for the Enlist Weed Control system that includes: Enlist Duo with Colex-D Technology and advanced education tools and training on spray application (to minimize off-target movement) and weed management. It will maintain sustainable cropping systems in corn, soybean, and cotton and promotes compatibility with other crops and cropping systems including grapes. ™Enlist, Enlist Duo, and Colex-D Technology are trademarks of Dow AgroSciences LLC. Components of the Enlist Weed Control System have not yet received regulatory approvals and are not for sale until such time.



# Poster Session Abstracts

## Growing Wine Grapes in Michigan

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Michigan has a cool climate with four American Viticultural Areas known as Fennville, Lake Michigan Shore, Leelanau and Old Mission Peninsula. Researchers and growers in Michigan have experimented with what will grow successfully in different regions of the state. The most important factors in the decision making process are climate and topography of a prospective site followed by slope-aspect and soil conditions. Michigan has a cool-cold climate with growing seasons that limit fruit ripening (growing season length averaging between 165 days in northwest Michigan and 180 days in southwest Michigan). The topography of a site associated with elevation differential, with respect to surrounding terrain, can be critical to success when growing tender varieties in this state. Michigan is a leader in the Midwest and the East in general fruit production and, specifically, grape production due primarily to its geography regarding proximity to the Lake Michigan shoreline. Michigan finds it possible to not only grow such tender crops such as peaches, sweet cherries, apricots, and tart cherries, but also *Vitis vinifera* grape varieties which are typically susceptible to winter injury. We have reviewed long term climate history and when combined with a history of fruit growing in Michigan, developed a map depicting growing areas associated with the growing success of various commercial wine grape varieties. Based on known cold hardiness threshold values for various varieties and needs of accumulated heat units for specific varieties, we have made suggestions which define which varieties have the greatest potential for commercial success in the state.

## Diagnosis of Grapevine Virus Diseases in Michigan Vineyards

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Virus diagnostic surveys were conducted in Michigan vineyards in 2010 and 2011. In 2010, a total of 155 leaf samples were taken from symptomatic grapevines on 18 farms. In 2011, 174 leaf samples were taken from 12 farms and research sites. Samples were tested by enzyme-linked immunosorbent assay (ELISA) for 12 different viruses. In 2010, over 30% of the samples tested positive for one or more viruses. Grapevine leafroll virus (strains GLRaV-1, -2, -3) and grapevine fleck virus were previously unknown in Michigan. Nematode-transmitted viruses (Tobacco ringspot virus, Tomato ringspot virus, Peach rosette mosaic virus) were also found in declining vines. In 2011, 41% of the samples were positive for one or more viruses, including Grapevine leafroll viruses 1, 2, 3, 4-9; Grapevine fleck virus, Grapevine fanleaf virus, and Tobacco ringspot virus. Some grapevines had mixed infections with up to four viruses. Grapevine fanleaf virus, a nematode-vectored virus, and GLRaV-4-9 (a mealybug/scale-transmitted virusgroup) were detected for the first time in Michigan in 2011. These results emphasize the importance of using virus-tested planting material and also suggest that soil and weed testing may be useful to assess potential risk from nematode-transmitted viruses prior to planting.

## Late-season Chasmothecium Production and Dispersal of *Erysiphe necator* in Michigan

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The production and dispersal of chasmothecia of *Erysiphe necator* were monitored on grapevines in Michigan during 2008, 2009, and 2010 to understand the dynamics of overwintering inoculum production. Differences in the overall amount of inoculum produced were observed between sites and years that are possibly related to the inherent susceptibility of the grape cultivars evaluated and to year-to-year climate variation. However, independently of the host or disease pressure, peaks in chasmothecium production as well as major dispersal events were consistently observed in mid- to late September. Every year, the number of chasmothecia was considerably higher on abaxial than adaxial surfaces of leaves; the ratio of mature to immature chasmothecia increased towards the end of the monitoring period. Positive correlations were found between the amount of rainfall (measured either in bottle traps or by a weather station) and the number of chasmothecia trapped in rainwater. However, not all correlations were statistically significant due to heavy rain in periods when ascocarps were still undergoing maturation or light rain in periods when ascocarps were fully mature and ready for dispersal. These findings can be used to optimize the timing of late-season eradication sprays to reduce inoculum potential for the following growing season in Michigan vineyards.

## National Clean Plant Network for Grapes: Progress and Accomplishments

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The National Clean Plant Network (NCPN) was established through the 2008 Farm Bill. The NCPN's mission is to provide high quality asexually propagated plant material free of targeted plant pathogens and pests that cause economic loss to protect the environment and ensure the global competitiveness of specialty crop producers. Currently, the NCPN serves the berry crop, citrus, hops, grape and tree fruit industries. The NCPN-Grapes was established at an organizational meeting in 2008 at Davis, CA. NCPN-Grapes centers are located at University of California-Davis, Washington State University, Cornell University, Missouri State University, and Florida A&M University. Additional extension efforts are being conducted by Texas A&M University. Funding to support the NCPN-Grapes has been approximately \$5.8 million from 2008-2011. Outcomes to date have been increased expansion of foundation blocks, increased acquisition and cleanup of imported and domestic selections, improved diagnostic testing for virus diseases, improved test for tumorigenic strains of *Agrobacterium vitis*, established economic studies on the value of clean grapevine material, and established education/outreach efforts. Of special significance to the Eastern and Midwestern industry, efforts are underway to produce micro-shoot tip cultured, crown gall-tested vines and make them available to growers.

## Using Choice Exercises and Mixture Designs to Optimize Nutraceutical-rich Juice Based on Health-oriented and Sensory Attributes

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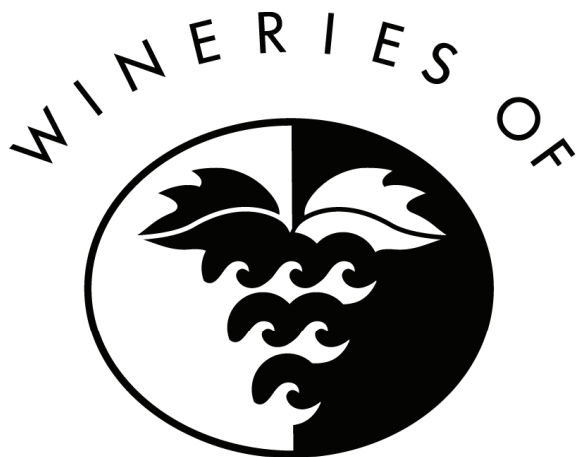
Research and development of nutraceuticals is increasing as the market expands. The potential health benefits of antioxidant-rich fruits such as açai, black cherry, blueberry, Concord grape, cranberry, and pomegranate make juices of these fruits prime functional beverages. Participants (n=1291) completed 38 choice exercises concerning their preferred juice blends, and the results were used to select three juices for optimization. Participants considered potential health information about antioxidants in each juice and their estimated acceptance of the juice blend based on sensory properties. Results showed that the black cherry (BlkCh), Concord grape (Con), and pomegranate (Pom) juice blend received the highest marginal utility (x=0.51), and choices were mostly driven by overall liking (OL) for each blending component and antioxidant information. BlkCh, Con, and Pom juices were blended according to a simplex centroid mixture design (3 primary blends, 3 secondary blends, and 1 tertiary blend). Consumers (n=100) evaluated OL before tasting, pre- and post-antioxidant information OL, purchase intent, just-about-right attributes, and familiarity with product to determine the 1) optimum formulation of the BlkCh+Con+Pom juice blend and 2) the influence of consumer characteristics and product attributes on acceptance of nutraceutical juice. The desirability function generated solutions based on pre-antioxidant (77%Con+3%Pom+20%BlkCh) and post-antioxidant (75%Con+12%Pom+13%BlkCh) OL, which followed trends of antioxidant status. The combined use of choice and mixture experimental designs concentrated research resources into the product that most likely maximized consumer utility.



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