



Oregon Wine Research Institute

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2018-2019

# ANNUAL REPORT



**Oregon State**  
University

Oregon Wine Research Institute accomplishments for the fiscal year beginning July 1, 2018 and ending June 30, 2019.





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## Introduction

The Oregon Wine Research Institute (OWRI) was created in 2008 through a collaboration between the Oregon wine industry and the College of Agricultural Sciences (CAS) at Oregon State University (OSU). The goal of OWRI is to foster collaboration among its member faculty and other scientists from academic units and public institutions within and outside of OSU to enhance research effectiveness and output for the benefit of the Oregon wine industry. OWRI also provides educational outreach to the Oregon wine industry, and faculty are involved with undergraduate and graduate-level teaching and commercial extension. The industry raised almost \$2 million in start-up funds, and a virtual institute was formed with the inclusion of select faculty from the Horticulture, Botany and Plant Pathology, and Food Science departments and the USDA-Agricultural Research Service (ARS) Horticultural Crops Research Unit in Corvallis. Faculty members from the Department of Applied Economics at OSU were added in 2016. Our applied research and extension programs address current concerns of the wine industry and our fundamental research addresses tomorrow's challenges.

New knowledge and technologies derived from research are shared with stakeholders through numerous OWRI outreach efforts, and faculty engage directly with stakeholders in a variety of forums to share ideas and disseminate information.

## Mission Statement

The Oregon Wine Research Institute at Oregon State University carries out collaborative, multi-disciplinary research and engages in outreach to support the Oregon wine industry.

## Vision Statement

To best serve its mission, the Oregon Wine Research Institute will advance the economic and environmental sustainability of the Oregon wine industry. The Institute aims to strengthen financial, intellectual and physical resources of institutional and research partners. Our research will span from local to international levels.

## From the Dean

Ever since the 1950s when Hoya Yang and Ralph Garren began research in enology and viticulture, Oregon State University has been the land grant institution providing scientific and educational support to improve the quality, productivity, and sustainability of the Oregon wine industry. This long-standing partnership led to the 2008 creation of the Oregon Wine Research Institute within the College of Agricultural Sciences, which also includes our federal research colleagues at the USDA Agricultural Research Service, Horticultural Crops Research Unit. Together, OWRI scientists address near- and long-term wine industry challenges through “vine to wine” research and outreach. Understanding that wine production is as much a business as it is the cultivation of grapevines, OWRI added business and economics research to its portfolio in 2016 with a focus on the financial viability and stability of Oregon's vineyards and wineries. This report highlights the breadth of OWRI activities, which include educating the workforce of tomorrow; performing on-farm, field plot, pilot plant, and laboratory research and analysis; delivering educational workshops and providing online extension information resources; and engaging with industry practitioners to cooperatively address industry challenges. Above all, we want to highlight the people who make our research and outreach possible, both within and outside the OWRI community. For over 60 years we have been partners in the evolution and story of the Oregon wine industry, and we look forward to continuing this rewarding relationship. – *Dr. Bill Boggess, College of Agricultural Sciences Executive Associate Dean*

## Who We Are

The OWRI core faculty consists of 11 OSU and USDA-ARS faculty conducting research and performing outreach and extension, as well as teaching undergraduate and graduate level courses. The core faculty actively participate in the collective management of the institute and its resources. The USDA members serve as courtesy faculty in their affiliated OSU departments. Together, these faculty have 135 years of research experience and have dedicated all or a significant portion of their time to grape and wine research. Core faculty members contribute regularly to OWRI outreach programs and deliverables (newsletters, seminars, meetings, etc.) and serve at the discretion of the Executive Associate Dean in the OSU College of Agricultural Sciences.

### Core Faculty

- Dr. Laurent Deluc, Associate Professor, OSU Department of Horticulture, Corvallis, OR
- Dr. Alexander Levin, Assistant Professor, OSU Department of Horticulture, Southern Oregon Research and Extension Center (SOREC), Central Point, OR
- Dr. Walt Mahaffee, Research Plant Pathologist, USDA-ARS and Courtesy Faculty, OSU Department of Botany and Plant Pathology, Corvallis, OR
- Dr. Bob Martin, Research Plant Pathologist, USDA-ARS and Courtesy Faculty, OSU Department of Botany and Plant Pathology, Corvallis, OR
- Dr. James Osborne, Associate Professor and Enology Extension Specialist, OSU Department of Food Science and Technology, Corvallis, OR
- Dr. Michael Qian, Professor, OSU Department of Food Science and Technology, Corvallis, OR
- Dr. R. Paul Schreiner, Research Plant Physiologist, USDA-ARS and Courtesy Faculty, OSU Department of Horticulture, Corvallis, Oregon
- Dr. Patty Skinkis, Associate Professor and Viticulture Extension Specialist, OSU Department of Horticulture, Corvallis, OR
- Dr. James Sterns, Associate Professor, OSU Department of Applied Economics, Corvallis, OR
- Dr. Elizabeth Tomasino, Associate Professor, OSU Department of Food Science and Technology, Corvallis, OR
- Dr. Vaughn Walton, Professor, OSU Department of Horticulture, Corvallis, OR

### Associate Faculty

OWRI associate faculty collaborate with core faculty, adding value to OWRI research and extension efforts. They include the following field extension faculty:

- Richard Hilton, Senior Faculty Research Assistant, entomology, OSU Department of Horticulture, SOREC, Central Point, OR
- Dr. Clive Kaiser, Professor and Extension Tree Fruit Specialist, OSU Department of Horticulture, OSU Umatilla County Extension, Milton-Freewater, OR
- Dr. Achala KC, Assistant Professor, OSU Department of Botany and Plant Pathology, SOREC, Central Point, OR
- Dr. Jay Pscheidt, Professor and Extension Plant Pathology Specialist, OSU Department of Botany and Plant Pathology, Corvallis, OR
- Dr. Steve Renquist, Associate Professor and Extension Horticulturist, OSU Department of Horticulture, OSU Douglas County Extension, Roseburg, OR
- Dr. Ashley Thompson, Assistant Professor and Extension Horticulturist, OSU Department of Horticulture, Mid-Columbia Agricultural Research and Extension Center (MCAREC) and OSU Wasco and Hood River County Extension, Hood River, OR

## Administrative Staff

- Denise Dewey, Program Coordinator, OSU Oregon Wine Research Institute, Corvallis, OR

## Research Support

- Aubrey DuBois, Enology Faculty Research Assistant, OSU Department of Food Science and Technology, Corvallis, OR
- Joshua Price, Assistant Vineyard Manager, OSU Woodhall Research Vineyard, Monroe, OR

Profiles and research stories about OWRI faculty are available in the 2016 OWRI [stakeholder report](#) and in [faculty research videos](#) that highlight our scientists at work. The 2019 Grape Day [Proceedings](#) provide abstracts of the posters and presentations and offer a snapshot of current viticulture, enology, and economics research at OWRI.

## Research Support and Facilities

The OWRI supported two post-doctoral scholars, tuition for two graduate students, and five OWRI undergraduate student scholars in 2018-2019. Other post-doctoral scholars and students are supported by grants obtained directly by the faculty.

### Post-doctoral Scholars

- Dr. Ludwig Ring, Enology Post-doctoral scholar, OSU Department of Food Science and Technology (Qian Lab), Corvallis, OR. Project: The chemical nature of red wine mouthfeel
- Dr. Landry Roszdeutsch, Viticulture Post-doctoral scholar, OSU Department of Horticulture (Deluc Lab), Corvallis, OR. Project: Influence of scion/rootstock combination on vine vigor under high Nitrogen availability

### OWRI Undergraduate Scholars

- Mackenna Greene (Horticulture major in KC Lab), OSU Department of Horticulture, Corvallis, OR. Project: Increasing the accuracy of grapevine red blotch virus detection
- Matthew Huckins (Ecological Engineering major in Mahaffee Lab), OSU Department of Biological and Ecological Engineering, Corvallis, OR. Project: Developing automated geolocation capabilities for a weather sensor platform
- Ray Shireman (Biochemistry major in Levin Lab), Southern Oregon University Department of Chemistry, Ashland, OR. Project: Optimizing phenolics assay for fruit sampling
- Alexander Tauss (Horticulture major in Deluc Lab), OSU Department of Horticulture, Corvallis, OR. Project: Developing a trans-grafting procedure to study scion/rootstock communication in grapevines
- Karly Vial (Environmental Engineering major in Deluc Lab) – OSU Department of Chemical, Biological and Environmental Engineering, Corvallis, OR. Project: Developing an imaging methodology to quantify protein-protein interactions using microvine cells

### Facilities

- Oregon State University has been conducting research projects at Woodhall Research Vineyard for over 30 years. The research vineyard is a 14-acre property located in the foothills of the Coastal Range near Alpine, OR. The Institute currently manages five acres of grapevines that include Pinot noir, Chardonnay, Pinot gris, and Merlot cultivars where research is being conducted, and two acres of new vineyard will be planted in

2020-2021. During 2018-2019, three OWRI core and associate faculty conducted research using the site and/or its grapes. The vineyard also serves as a training location for students in the undergraduate viticulture and enology degree programs at OSU and is used by the OSU Vitis Club for training and events.

- The OSU Research Winery is a key component of the OWRI “vine to wine” approach to research. It is a functional, OLCC-licensed winery, located on the northwest side of OSU’s campus in Corvallis. During the 2018 harvest the winery processed about 5.5 tons of grapes supporting fourteen different research projects involving scientists from the departments of Food Science, Horticulture, Environmental & Molecular Toxicology, and the USDA-ARS. The winery also plays a key role in the training of enology undergraduate and graduate students.

## Faculty Research Highlights

*Below each core faculty member highlights one research project for 2018-2019.*

### **Grapevine Research**

**Dr. Laurent Deluc**, plant genomicist in the OSU Department of Horticulture, focuses on the use of genomic and genetic engineering tools to identify the genetic basis for agronomically important traits in grapevine production (e.g. fruit composition, drought tolerance and plant vigor, and disease resistance).

- **Microvine technology:** The Deluc lab uses the genetic potential of the microvine, a model system used for genetic engineering in grapevines, to understand relationships between the function of genes and performance traits in wine grape and rootstocks. Using this approach, the lab is currently characterizing four genes that might be involved in the control of the ripening onset. Other genes and proteins associated with two drought-related signals (hydraulic [aquaporin], hormone [Abscisic acid]) are also under investigation to characterize their contribution to confer drought-tolerance of grapevines. Trans-grafting methodology combining genetically engineered microvines with the micrografting procedure of traditional scions and/or rootstocks is employed to evaluate the influence of long-distance signals to the physiology of either the rootstocks or the scions in the context of drought and nutrient deficiency. The research goal is to understand how these signals contribute to rootstock/scion adaption to drought in grapevine. This trans-grafting will be used soon to conduct more targeted studies to examine the influence of these signal molecules contributing to the excessive vigor of grapevine in high nitrogen availability.

**Dr. Alexander Levin**, research viticulturist in the OSU Department of Horticulture based at the Southern Oregon Research and Extension Center (SOREC), conducts applied research to better understand grapevine-water relations, irrigation management, and the ecophysiology of grapevines. He works with other faculty to understand the impact of irrigation practices on grapevine red blotch disease, and to improve overall grape quality through best viticulture practices. He provides extension and outreach to the southern Oregon regional wine industry.

- **Improving Irrigation Management:** With increasingly scarce water resources, improved irrigation management practices are needed. Needs assessments indicate a lack of irrigation management knowledge among regional grape growers. Field trials evaluate the impact of timing and amount of irrigation on vine productivity, water use efficiency, and crop and sensory quality. The methodology and validity of commercial tools was assessed. Two years of research indicate that reducing applied water by 25-30% did not significantly reduce yields, and that grape quality was improved regardless of water deficit timing. This methodological evaluation of irrigation scheduling tools demonstrated the need to reevaluate crop coefficients and plant-based measurement tools for grapes in southern Oregon.



**Dr. Walt Mahaffee**, research plant pathologist in the USDA-ARS Horticulture Unit, conducts research that focuses on foliar pathology of grapevines. His team's research spans numerous disciplines to develop sustainable methods for managing diseases of horticulture crops and has resulted in the commercial implementation of biological control agents, disease forecasting models, and cultural practices for disease management in horticulture crops.

- Rapid detection of Fungicide resistance: Fungicide resistance to strobilurin fungicides was causing control failures of grape powdery mildew in western viticulture production regions, which resulted in complete crop loss. This has led to the development of rapid assessment techniques for strobilurin-resistant grape powdery mildew. Mahaffee's team, in collaboration with Tim Miles, Michigan State, Ioannis Stergiopoulos, UC Davis, and Michelle Moyer, Washington State University developed rapid sampling and detection methods for a genetic mutation associated with qualitative strobilurin resistance in grape powdery mildew. These methods are allowing growers to rapidly identify the presence of strobilurin-resistance in their fields and adjust fungicide selection accordingly. In 2018 over 4,000 samples were analyzed from California, Washington, Michigan, Georgia, Oregon, and British Columbia, Canada with greater than 85% of samples having strobilurin resistant grape powdery mildew detected. The rapid detection system has allowed viticulturists to reduce crop loss due strobilurin-resistant powdery mildew.

**Dr. Bob Martin** is the supervisory research plant pathologist in the USDA-ARS Horticulture Unit. His focus is on virus epidemiology of grapes and small fruits, and developing diagnostic tests and management practices. He currently leads the OWRI Red Blotch Study Team's research efforts to understand and manage this disease and seeks to improve the quality of grapevine materials by promoting sanitary vineyard practices and clean vines.

- Field transmission of grapevine red blotch virus (GRBV): GRBV is a threat to grape and wine quality in Oregon. Vector identification and transmission and biology are key to understanding the epidemiology and managing GRBV. A project was developed (2016 and 2017) to study the timing of transmission of GRBV in Oregon vineyards. Trap plants were placed in three vineyards at monthly intervals (May to October) in 2016 and four vineyards in 2017. In 2018, three trap plants that were in the vineyard from mid-July to mid-August, from the 2016 trials tested positive for GRBV using petiole tissue and bark scrapings. To identify vectors, a project was initiated in 2018 in cooperation with Dr. Jana Lee, USDA-ARS research entomologist. Insects were collected from a vineyard with a high incidence of GRBV infection every two weeks, sorted by genera, and placed on infected plants for six days to allow for virus acquisition. The insects then were fed on healthy vines for six days to allow for virus transmission. The project will be repeated in 2019 and the test plants will be evaluated for transmission over the next two years. Representative insects from each group have been preserved for identification.

**Dr. R. Paul Schreiner** is a research plant physiologist in the USDA-ARS Horticulture Unit. His work focuses on managing grapevine nutrition, mycorrhizal fungi, and other physiological parameters to improve fruit quality and increase sustainable vineyard production.

- New nitrogen guidelines for Pinot noir: The optimal nitrogen (N) requirements and tissue test guidelines used by growers to diagnose N status in Pinot noir were not fully understood. In collaboration with Drs. James Osborne and Patty Skinkis (OSU) - optimal vine N requirements were identified for Pinot noir based on productivity and must composition using a pot-in-pot vineyard that allowed for precise control of N supply. Nitrogen had a greater impact on vine shoot and leaf growth than on yield or flowering, indicating that growers can reduce N supply to limit canopy size before suffering a yield loss at the current yield targets for premium wine production. Must Nitrogen is needed by yeast to complete fermentation, known as YAN, was also strongly affected by N supply, leading to slower rates of fermentation. However, the level of YAN needed to achieve a reasonably fast fermentation was lower than previous recommendations. Tissue test guidelines

for N in leaf blades and petioles were defined so that Pinot noir producers can better achieve a good balance between controlling canopy size and crop yield and obtaining adequate must YAN levels and fermentation times.

**Dr. Patty Skinkis**, Viticulture Extension Specialist in the OSU Department of Horticulture, conducts applied research into whole plant physiology to investigate the underlying causes of vine vigor and their influence on vine balance and fruit composition. Research areas include crop load, bud fruitfulness, canopy management, and the physiological impact of grapevine red blotch virus. As the statewide extension specialist, she leads the statewide Viticulture Extension Program with other Extension faculty, develops outreach programs and technical publications for the wine industry, and she is co-chair of the Willamette Valley Viticulture Technical Group.

- Vineyard floor management has greater impact on Pinot noir vine vigor and fruit composition than crop thinning: Vigor management is a primary concern for Willamette Valley winegrape growers. A vineyard floor management trial at Stoller Family Estate Vineyard was conducted for seven years to determine the impacts of alleyway tillage or perennial grass cover crop on managing vine vigor and fruit/wine quality. The work was conducted by Dr. Patty Skinkis and graduate students Alison Reeve and Amanda Vance in collaboration with Dr. Julie Tarara (microclimate analysis), Dr. Jungmin Lee (fruit chemistry), Dr. Michael Qian (aroma chemistry), and Dr. Elizabeth Tomasino (sensory analysis). The first phase evaluated vine growth, productivity, and fruit composition based on vineyard floor management practices, and phase two evaluated crop-thinning levels once vine vigor was altered. Growing perennial grass between vine rows in a no till system is one of the most effective and sustainable ways to reduce vine vigor in the Willamette Valley, with a 20-40% reduction in canopy leaf area compared to vines that had been grown with tilled or alternately tilled alleys. Vines with reduced vigor had increased fruit and wine quality as indicated by increased color and preferred aromas in the wines compared to those grown with tilled alleys. There was greater vine growth with tilled systems, requiring more canopy management and increased production costs. The grass-no till vines did not have more water stress, and there was no need for supplemental irrigation. Although the grass-no till vines were reduced in size, they were not deficient in mineral nutrition. Crop thinning did not impact fruit composition or wine quality as much as the vineyard floor practices, suggesting that vine vigor, not crop level, is more important to fruit and wine quality. Growers can use this information to more precisely manage their vineyards for grape and wine quality.

**Dr. Vaughn Walton**, horticultural entomologist in the OSU Department of Horticulture, conducts research with a whole-systems approach to develop environmentally sustainable insect pest management products and practices through the study of insect physiology, biology, behavior, and environmental interactions. His current research focus is on spotted wing drosophila and vectors of grapevine red blotch virus. He serves on the Viticulture Extension Program team and working with growers directly to help troubleshoot pest issues in the vineyard.

- Managing insect pests without pesticides: Spotted-wing drosophila (SWD) lays eggs in damaged and intact berries of most soft-skinned wine grape varieties and feeds on damaged grapes during the harvest period. Feeding and oviposition activities increase the likelihood of vectoring spoilage bacteria, particularly when berry integrity is negatively impacted due to cracking, diseases, hail injury, or bird damage. The Walton research team, including post-doctoral research associate Dr. Valerio Rossi Stacconi and visiting scientist Dr. Gabriella Tait, recently identified volatiles of biological significance for SWD and created a food-grade matrix that is able to disrupt oviposition behavior. Data on the behavior disruptor (BD) efficacy were collected from a series of laboratory and field trials on Pinot noir grapevines. Single berries or clusters were exposed to SWD either in presence or absence of the BD. Results consistently showed a significant reduction in the absolute number of eggs laid and the number of infested clusters when the BD was applied in proximity of the fruit. Based on these findings, the



research team is developing a commercial pesticide-free product for the management of SWD. The current work will likely expand integrated pest management options to control SWD populations in commercial field settings.

### **Wine Research**

**Dr. James Osborne**, Enology Extension Specialist in the OSU Department of Food Science and Technology, focuses on wine microbiology including yeasts and spoilage organisms. He supervises the OSU research winery and the production phase of all viticulture and enology experimental wines. As the statewide extension enologist, he develops outreach programs and technical publications for the wine industry. He chairs the Willamette Valley Enology Technical Group and is currently an OWRI representative to the Oregon Wine Standing Committee for Research.

- Use of select non-*Saccharomyces* yeast to reduce spoilage issues during cold soaking: The yeast *Hanseniaspora uvarum* can cause spoilage during cold soaking by producing acetic acid and ethyl acetate. Osborne's lab investigated whether the addition of commercial cultures of non-*Saccharomyces* yeast to a cold soak could reduce this spoilage risk. Select non-*Saccharomyces* yeasts were screened for their ability to reduce *H. uvarum* growth and acetic acid production in a model system. One of the non-*Saccharomyces* yeasts, *Metschnikowia fructicola*, was then used during cold soaking of Pinot noir grapes. All non-*Saccharomyces* yeasts tested reduced *H. uvarum* growth and acetic acid production in the model system. During cold soaking of Pinot noir grapes, *M. fructicola* reduced *H. uvarum* growth and significantly decreased acetic acid and ethyl acetate production. These results suggest that the addition of non-*Saccharomyces* yeast during cold soak may be an effective method for reducing the production of ethyl acetate and acetic acid by *H. uvarum*.

**Dr. Michael Qian**, flavor and aroma chemist in the OSU Department of Food Science and Technology, conducts research to understand the chemical nature of the relationship between grapevines and the grapes and wines they produce, including the effects of off-flavors and aromas, and grapevine red blotch virus. His lab often provides the juice and wine analysis for viticulture and enology experiments.

- Pre-fermentation cold soak affects Pinot noir wine color and volatile aroma concentration: It is believed that imposing a pre-fermentation cold soak to grape must prior to alcoholic fermentation can improve the color, mouthfeel, and the aroma of the wine. In collaboration with Dr. James Osborne and graduate students Mengying Fu and Jared Johnson, Qian's lab studied the impacts of different pre-fermentation cold soak conditions on the color and aroma of Pinot noir wines. Pinot noir wines were produced from grapes that were cold soaked for six days at two different temperatures (6° or 10°C) with the addition of 0, 50, or 100 mg/L SO<sub>2</sub>. Six non-*Saccharomyces* yeast species commonly isolated from grapes, were added at the start of cold soak and their populations monitored. At the end of cold soak there were significant differences in a number of volatile compounds. There were also significant differences in the volatile aromas of the finished wines, particularly esters. All wines made from cold soaked grapes had significantly higher color and polymeric pigment content than the no-cold soak wine. The results demonstrated that the cold soak can improve the color, whereas the impact of cold soak on aroma is more complicated. The study provided evidence to the wine industry that cold soak can improve the color and result in more a complex aroma profile of the wine.

**Dr. Elizabeth Tomasino**, flavor chemist and sensory scientist in the OSU Department of Food Science and Technology, conducts research on the effects of chemical compounds on wine aroma and flavor and mouthfeel sensory characteristics. She uses sensory analysis for wine education and to understand consumer preferences.

Sensory panels hosted by her team often represent of the final step in the vine to wine continuum of research at OWRI.

- Multiple sources for red fruit aroma in Pinot noir: When evaluating how different processes in the vineyard or winery affect quality, it is beneficial to understand how the chemical composition of a wine impacts sensory qualities. Chemical targets can be used to evaluate how the processes impact sensory components. Typically, there are not strong relationships between sensory attributes in wine and chemical composition. To address this problem, a new methodology was tested to determine if there are multiple compound combinations that result in the same sensory perception, such as red fruit aroma. Sensory tests conducted to investigate fruity aromas in red wines identified seven different compound combinations that are responsible for red fruit aroma in Pinot noir, and the data will enable predictive modeling for this wine quality. Specific targets for this sensory aspect will allow winemakers to adjust processes for the specified compounds when they are attempting to achieve red fruit aroma, resulting in a more consistent product.

### ***Economics and Business Research***

**Dr. James Sterns**, agricultural economist in the OSU Department of Applied Economics, examines the dynamics of wine clubs as a direct to consumer (D-t-C) method of sale and how to optimize its performance.

- Wine club management has no clear set of “best practices” for assuring member satisfaction: Direct-to-consumer marketing is a critical component of business success for most Oregon wineries, and wine clubs are a key component of these marketing efforts. Club membership enrollments (i.e., total number in both absolute and relative terms, growth rates), member engagement (i.e., frequency and dollar value of purchases, visits or return visits to tasting rooms), member retention, and overall motivation for membership are all poorly understood challenges facing wine club managers. Working with Catherine Durham, Sterns designed and initiated a two-phased plan for conducting surveys to gather information from wine club managers and members. Phase one targeted club managers, gathering data about their wine clubs and soliciting their support to participate in the second phase – asking club members to complete an online questionnaire about their club membership. The first phase resulted in low response rates, necessitating a reconsideration of the study design. A new sampling protocol and questionnaire will be implemented in 2019. Given the centrality of direct to consumer marketing for Oregon wineries, the potential impact of identifying key success factors for more effective wine club management practices is significant.

## Current Collaborative Projects

OWRI faculty conduct multi-disciplinary projects within and outside the OWRI. Examples of active collaborative research projects during 2018-2019 are below:

Project Title	Collaborators	Project Description
Fertilization in the Vineyard or Supplement in the Winery?	Schreiner*, Lee, Osborne, Skinkis, Tomasino, and industry collaborators	This research addresses the fundamental issue of whether wine quality can be enhanced more effectively by boosting vine nitrogen status via fertilization or by maintaining low vine nitrogen status in the vineyard but boosting must nitrogen in the winery. The work is being conducted in Chardonnay and Pinot noir.
Statewide Crop Load Project	Skinkis*, Osborne, Tomasino, and industry collaborators	This long-term, collaborative research project evaluates the impacts of crop level on Pinot noir fruit and wine quality through active participatory research by vineyard and winery collaborators. The goal is to engage industry in the research process to develop a large multi-site, multi-year database of information pertaining to yield impacts on vineyards and wines from which we may develop yield management guidelines that balance wine quality and production goals.
Red Blotch Study Team	Martin*, Levin, Osborne, Qian, Skinkis, Tomasino, Walton, and industry collaborators	The Grapevine Red Blotch Study Team aims to understand the biology, transmission and impact of GRBV on plant health, and fruit and wine quality. The anticipated outputs are to develop management strategies for the vectors, to develop vineyard and winery practices that will mitigate the effect of GRBV and help maintain the sustainability of the Oregon wine industry. The RBST will develop and manage a website with the latest information developed by the team along with that from other research groups so that the industry has a single place to get the latest information on GRBV.
Rootstock and Scion Project	Deluc*, Skinkis, Schreiner	This project aims to understand the influence of rootstock-scions combination on the relationship between vine vigor and nitrogen availability in the soil. To address this important question for the Oregon Winegrape production, the team has designed two studies. The first study is a three-year experiment to evaluate, from twelve rootstock-scions combinations, the vine vigor responses to increased Nitrogen availability. The second study examines whether the genetic variability of rootstocks can affect nitrogen uptake, transport and assimilation. Overall, we hope to improve our basic knowledge on the relationships between nitrogen, rootstock/scion combination and vine vigor. Long-term applications of this project will aim to develop in the field new management practices to address vine vigor.
Wine Polysaccharide Project	Qian*, Osborne, Tomasino	This project is to understand the chemical nature of red wine mouthfeel, with a focus to study the impact of polysaccharides on red wine mouthfeel, including polysaccharide composition and molecular size distribution. This work will improve the understanding of polysaccharides on wine quality
Pinot noir crop load metrics on grape and wine quality	Qian*, Skinkis, Osborne, Tomasino and industry collaborators	This project is to study the crop load metrics on grape and wine quality, with a focus on volatile aroma compounds in wine and flavor precursor composition in grapes, and their impact on final wine quality.
Effect of grapevine red blotch disease (GRBD) on flavor and flavor precursor formation in the grape and on wine quality	Qian*, Levin, Osborne, Tomasino, Achala and industry collaborators	Investigate the effect of GRBD on grape berry development with a focus on the flavor and flavor precursor formation in the grapes as well as aroma composition in wine.

\*denotes Principal Investigator

## FY 2019 Grants and Gifts Received by Core Faculty

A total of \$2,056,055 of grant funds have been obtained by the OWRI faculty. These funds enabled the faculty to conduct research projects to create solutions for the wine industry ([Appendix 1](#)).

## Scholarly Work and Awards

- External academic presentations ([Appendix 2](#)) 15
- Research Publications ([Appendix 3](#)) 16
- Extension Publications ([Appendix 4](#)) 5
- Trade Journal Publications ([Appendix 4](#)) 1
- Patents ([Appendix 4](#)) 1
- Technology Transfer ([Appendix 4](#)) 5
- Faculty Awards
  - Bob Martin – 2018 Outstanding Industry Leadership Award, Oregon Wine Board
  - Michael Qian – 2018 Distinguished Service Award, Agricultural and Food Chemistry Division of American Chemical Society
  - Paul Schreiner – 2019 American Society for Enology and Viticulture Best Viticulture Paper (co-author with Patricia Skinkis and James Osborne)
  - Patricia Skinkis – 2018 American Society for Enology and Viticulture Extension Distinction Award
  - James Sterns – 2018 Distinguished Undergraduate Teaching Award: Ten or More Years' Experience, Agricultural and Applied Economics Association
  - Vaughn Walton – 2019 Erasmus Mundus Teaching Scholar

## Teaching and Student Training

OSU faculty teach undergraduate and graduate classes in viticulture, enology, and economics that prepare students to enter the wine industry ([Appendix 5](#) for **Credit-Courses Taught**).

Faculty also serve as advisors and mentors to undergraduate and graduate students, providing educational and research training to help students achieve their career and professional goals. OWRI faculty also supervise post-doctoral fellows, research associates, technicians and faculty research assistants working in their laboratories.

During 2018-2019, OWRI faculty trained and mentored the following:

- 35 BS Students
- 10 MS students
- 13 PhD students
- 2 Post-Doctoral
- 2 Visiting Scholars

## Industry Outreach

Outreach is a core function of OWRI. We disseminate scientifically supported research information and technology to the Oregon wine industry, and around the world, in person in fields and cellars, and via many other media. The interaction between stakeholders and faculty is vital to keeping research at OWRI current and relevant.

**Stakeholder communications** - OWRI publishes a monthly newsletter known as *OWRI Vine to Wine*, that provides research updates, news and events. The bi-annual *OWRI Viticulture & Enology Technical Newsletter* contains in-depth articles about current research.

**Seminars** - The OWRI hosts a seminar series offered each year featuring faculty and students, as well as invited speakers who address topics of interest to the Oregon wine industry. In 2018-2019, six seminars



were presented and covered a wide spectrum of topics including managing grapevine trunk diseases in vineyards, using select wine microorganisms as bio-protectants against microbial spoilage and developing economic and financial benchmarks for mechanizing northwest vineyards.

**Website** – The Oregon Wine Research Institute website is a major platform for communicating with grape and wine producers, students, and the general public. [Research summaries](#) are archived on the website.

**Extension In-person interactions** – During the year OWRI Extension faculty gave 37 external seminars, 13 workshops, 3 field days, 3 industry conferences, 22 industry tech group presentations, and 2 extension courses held in viticulture, enology, and entomology regions served within the state of Oregon.

**Events** – OWRI hosts Grape Day, an annual research meeting on the OSU campus. The event highlights current projects of OWRI faculty and invited keynote presenters based on a selected theme. Grape Day provides a networking forum for faculty, students, and industry members. The 2019 Grape Day attracted over 150 industry members and 56 faculty, students, and staff. The event theme was recent advances in viticulture, enology and wine economics research including Dr. Monica Cooper, Napa County farm advisor, UC Cooperative Extension and Dr. Tom Collins, assistant professor, WSU. There were six oral presentations and an interactive poster session that featured 30 posters during the event. [OWRI 2019 Grape Day proceedings book](#).

OWRI collaborates with academic and industry partners to host educational meetings and workshops, such as the following events held in FY 2019:

- Oregon Wine Symposium, Portland, OR (February 2019)
- Southern Oregon Grape Symposium with Rogue Valley Winegrowers Association, Central Point, OR (March 2019)
- Enology Workshop – Preventing formation of sulfur off odors during winemaking, Jacksonville, OR (June 2019)
- Red Blotch Study Team workshop, Salem, OR (November 2019)
- Viticulture and enology technical groups (Willamette Valley and Southern Oregon)

## APPENDIX 1

### Grants and Gifts Received by Core Faculty

PI and Co-PIs	Project title	Funding agency	Grant Duration	Fiscal Year Award
Moyer M, Zasada I, Schreiner RP	Impact of Plant-parasitic Nematodes on Grapevine Growth and Development in Washington	Washington State Grape and Wine Research Program	1 year	\$ 45,758
Skinkis P and Schreiner RP	Determining the impacts of dormant pruning methods and nitrogen fertilization on Pinot noir bud fruitfulness and yield	American Vineyard Foundation	1 year	\$ 51,700
Skinkis P, Osborne J, Tomasino E, McLaughlin K, and Schreiner RP	Statewide Crop Load Project: A Researcher-Industry Partnership to Understand the Yield-Quality Relationship in Cool Climate Pinot noir and Chardonnay Production	American Vineyard Foundation	1 year	\$ 47,000
Skinkis P and Martin R	Understanding symptomology and physiological effects of Red Blotch Disease in vineyards in Oregon's Willamette Valley	California Department of Food & Agriculture Pierce's Disease & Glassy-winged Sharpshooter Board	2 years (Total \$59,333)	\$ 29,667
Skinkis P	Statewide Crop Load Project Soil Mapping	Erath Family Foundation	1 year	\$ 21,493
Mahaffee WF and Stergiopoulos I	Detecting fungicide resistance in grape powdery mildew from wine, table and raisin grapes	American Vineyard Foundation	1 year	\$ 104,118
Moyer M, Mahaffee WF, Stoll R, Miles T, and Naegale R	FRAME: fungicide resistance assessment mitigation and extension network	USDA-NIFA-SCRI	4 years (Total \$4,743,734)	\$ 898,000
Mahaffee WF	Assessing the fitness costs and segregation of QoI resistance in <i>Erysiphe necator</i> populations	Oregon Wine Board	1 year	\$ 53,000
Deluc L	Determining the Role of Auxin-Response Factor 4 in the timing of ripening initiation in <i>Vitis vinifera</i>	Oregon Wine Board	1 year	\$ 56,251
Deluc L	Determining the Role of Auxin-Response Factor 4 in the timing of ripening initiation in <i>Vitis vinifera</i>	Erath Family Foundation	1 year	\$ 21,824
Deluc L	Sequencing of the Microvine Genome	Erath Family Foundation	1 year	\$ 11,047
Deluc L, Schreiner RP, Skinkis P	Understanding the influence of rootstocks-scion combination on the relationship between vigor and nitrogen supply in Pinot noir	Fermentation Initiative - Postdoctoral Research Project	1 year	\$ 100,000
Qian M, Osborne J, Tomasino E	Understanding chemical nature of red wine mouth feel	Fermentation Initiative - Postdoctoral Research Project	3 years (Total \$300,000)	\$ 100,000
Qian M	Developing Pinot noir crop load metrics that are adaptable to vineyard site and wine quality production goals II-grape and wine quality evaluation	Northwest Small Fruits Research Center	3 years (Total \$128,352)	\$ 42,780
Qian M, Levin A	Grapevine red blotch disease on flavor and flavor precursor formation in the grape and wine quality	American Vineyard Foundation	1 year	\$ 70,884
Qian M, Levin A	Effect of grapevine red blotch disease (GRBD) on flavor and flavor precursor formation in the grape and on wine quality	California Department of Agriculture	2 years (Total \$109,512)	\$ 109,512
Qian M, Qian Y	Identification of smoke odorants by gas chromatography/olfactometry and assessment of smoke odorants in grapes and wine	Oregon Wine Board	1 year	\$ 53,989
Osborne J, Curtin C, Qian M	Utilizing malolactic fermentation as a tool to prevent <i>Brettanomyces bruxellensis</i> wine spoilage	Oregon Wine Board	1 year	\$ 39,766
Osborne J, Qian M	Utilizing non- <i>Saccharomyces</i> yeast as bioprotectants during pre-fermentation cold soaking	Northwest Small Fruits Research Center	1 year	\$ 34,766
Walton V, Hilton R	Improved understanding of virus transmission of Grapevine red blotch virus	California Department of Agriculture	1 year	\$ 47,000
Walton V, Hilton R	Improved understanding of virus transmission of Grapevine red blotch virus	Oregon Wine Board	1 year	\$ 30,000
Walton V, Levin A, Hilton R, KC A	Ecobiology, Impact and Management of Grapevine Red Blotch Virus and Its Vector(s) in California and Oregon Vineyards	USDA National Institute of Food and Agriculture SCRI	4 years (Total \$350,000)	\$ 87,500
<b>Total</b>				<b>\$ 2,056,055</b>

## APPENDIX 2

### External academic presentations by Core Faculty

Faculty	Title of presentation	Presented to and where	Date
E. Tomasino	Influences of yeast product addition and fermentation temperature on changes in lipid compositions of Pinot noir wines	3 <sup>rd</sup> Edition of International Conference on Agriculture & Food Chemistry, Rome, Italy	7/23/2018
J. Sterns	The role of “institutional alertness” in the development of content for undergraduate agricultural economics courses	Annual meeting of the Agricultural and Applied Economics Association, Washington, D.C.	8/06/2018
M. Qian	Total carbohydrate composition of different molecular weight fractions in red wine	American Chemical Society: The 256 <sup>th</sup> ACS National Meeting, Boston, MA	8/19/2018
W.F. Mahaffee	Fungicide resistance in grape production	BASF, Raleigh, NC	10/18/2018
R.R. Martin	Timing of field transmission of Grapevine red blotch virus	California Department of Food and Agriculture Pierce’s Disease & Red Blotch Symposium, San Diego, CA	12/19/2018
P. Skinkis	Understanding symptomology and physiological impacts of Red Blotch Disease on vineyards in Oregon’s Willamette Valley	California Department of Food and Agriculture Pierce’s Disease & Red Blotch Symposium, San Diego, CA	12/19/2018
L. Deluc	Developing a versatile system for functional genomic studies in grapevine	Plant and Animal Genomics Conference, San Diego, CA	1/12/2019
V. Walton	Impact and spread of Red Blotch in Oregon Vineyards	University of Padova, Erasmus Mundis PhD course, Padova, Italy	1/14/2019
V. Walton	A food-grade gum for management of <i>Drosophila suzukii</i> in small and stone fruit	University of Padova Departmental Seminar, Padova, Italy	1/17/2019
E. Tomasino	Understanding the complexities of flavor perception in beer and wine	ASBC-ASEV Joint Symposium: Yeast and Fermented Beverage Flavor Survey, Sonoma Co., CA	4/24/2019
A. Levin	Deficit irrigation reduces fruit quality in GRBV-infected Pinot noir grapevines	70 <sup>th</sup> ASEV National Conference, Napa, CA	6/19/2019
P. Skinkis	Effects of Red Blotch Disease on Pinot noir under Oregon’s cool climate conditions	70 <sup>th</sup> ASEV National Conference, Napa, CA	6/19/2019
R.P. Schreiner	Nitrogen requirements of Pinot noir based on growth parameters, must composition, and fermentation behavior	70 <sup>th</sup> ASEV National Conference, Napa, CA	6/20/2019
E. Tomasino	Comparing Pinot noir Wine sensory perception and yield: A study over five vintages (2012 to 2016)	70 <sup>th</sup> ASEV National Conference, Napa, CA	6/20/2019
J. Osborne	The importance of nitrogen source: Vineyard versus winery nitrogen impacts on Chardonnay and Pinot noir wine sensory	70 <sup>th</sup> ASEV National Conference, Napa, CA	6/20/2019

## APPENDIX 3

**Research Publications** (science-based, peer-reviewed) published by OWRI core faculty recorded during 2018-2019.

Dalla Costa L, Malnoy M, Lecourieux D, **Deluc LG**, Ouaked-Lecourieux F, Thiomax MR and Torregrosa L. 2019. [The State-of-the-Art of grapevine biotechnology and new breeding technologies \(NBTS\)](#). Oeno One 53,2.

Dalton DT, Hilton RJ, Kaiser C, Daane KM, Sudarshana MR, Vo J, Zalom FG, Buser JZ and **Walton VM**. 2019. [Spatial associations of vines infected with grapevine red blotch virus in Oregon vineyards](#). Plant Dis 103:1507-1514.

East KE, Zasada IA, **Schreiner RP** and Moyer MM. 2019. [Developmental Dynamics of \*Meloidogyne hapla\* in Washington Wine Grapes](#). Plant Dis 103:966-971.

Gouthu S and **Deluc LG**. 2019. [Use of the microvine and plant gene switch system for functional studies of genes involved in the control of ripening initiation in \*Vitis vinifera\*](#). Acta Hort 1248:187-194.

**Levin A**. 2019. [Re-evaluating pressure chamber methods of water status determination in field-grown grapevine \(\*Vitis spp.\*\)](#). Agr Water Manage 221:422-429.

Levin A, Williams LE, Matthews MA. 2019. [A continuum of stomatal responses to water deficits among 17 wine grape cultivars \(\*Vitis vinifera\*\)](#). Funct Plant Biol 47:11-25.

Rosdeusch L, **Schreiner RP**, **Skinkis P** and **Deluc L**. 2019. [Developing a model system to identify the main mechanisms involved in nitrogen growth responses of grafted grapevines](#). In proceedings of the 12<sup>th</sup> International Conference on Grapevine Breeding and Genetics. Acta Hort 1248:361-368.

**Schreiner RP** and **Osborne J**. 2018. [Defining phosphorus requirements for Pinot noir grapevines](#). Am J Enol Vitic 69:351-359.

Tait G, Kaiser C, Rossi-Stacconi MV, Dalton DT, Anfora G and **Walton VM**. 2018. [A food-grade gum as a management tool for \*Drosophila suzukii\*](#). Bull Insectology 72(2):295-307.

Thiessen LD, Neill TM and **Mahaffee WF**. 2018. [Assessment of \*Erysiphe necator\* Ascospore Release Models for Use in the Mediterranean Climate of Western Oregon](#). Plant Dis 102(8): 1500-1508.

Thiessen LD, Neill TM and **Mahaffee WF**. 2019. [Formation of \*Erysiphe necator\* Chasmothecia in the Pacific Northwest United States](#). Plant Dis 103(5) 890-896.

Thompson BD, Dahan J, Lee J, **Martin RR** and Karasev AV. 2019. [A novel genetic variant of Grapevine leafroll-associated virus-3 \(GLRaV-3\) from Idaho grapevines](#). Plant Dis 103:509-518.

Twilley J, Jutzi C and **Tomasino E**. 2018. [Influence of Fermentation Temperature and Nutrient Addition on Chemical and Sensory Characteristics of Traditional Honey Wine](#). Ann Food Process Preserv 3:1022.

Wade ME, **Osborne JP** and Edwards CG. 2019. [Influence of must supplementation on growth of \*Pediococcus spp.\* after alcoholic fermentation](#). S AFR J Enol Vitic 40.

Wade ME, Strickland MT, **Osborne JP** and Edwards CG. 2019. [Role of \*Pediococcus\* in winemaking](#). Aust J Grape and Wine R 25:7-24.

Yuan F, **Schreiner RP**, **Osborne J** and **Qian MC**. 2018. [Effects of soil NPK supply on Pinot noir wine phenolics and aroma composition](#). Am J Enol Vitic 69:371-385.



## APPENDIX 4

**Extension Publications** (science-based, peer-reviewed) published by OWRI core faculty recorded during 2018-2019.

**Levin AD.** 2018. [Scheduling irrigation with a pressure chamber, Part I.](#) Oregon State University Extension Publishing PNW 712.

**Levin AD.** 2018. [Scheduling irrigation with a pressure chamber, Part II.](#) Oregon State University Extension Publishing PNW 713.

Olen B and **Skinkis P.** 2018. [Vineyard Economics: Establishing and Producing Pinot Noir Wine Grapes in the Willamette Valley, Oregon.](#) Oregon State University Oregon Agricultural Enterprise Budgets. AEB 0060.

**Skinkis P, Walton V,** Edmunds B and Bell N. 2018. "Grape Pests" *In* Pacific Northwest Insect Pest Management Handbook. Pacific Northwest Extension Publishing.

**Skinkis P,** Pscheidt J, Moretti M, **Walton V,** KC A and Kaiser C. 2019. [Pest Management Guide for Wine Grapes in Oregon.](#) Oregon State University Extension Publishing. EM 8413.

## Trade Journal Publications

**Skinkis P.** 2019. [Grapes as a nursery opportunity.](#) *The Digger.* Oregon Association of Nurseries 63(2):27-29.

## Patents

Kaiser C, **Walton V.** 2019. *Cuticle Supplement for Plant Production* (vol. PCT/US2019/021365). WO/2019/173723. <https://patentscope.wipo.int/search/en/detail.jsf?docId=WO2019173723&cid=P11-K3ETHG-13664-1>

## Technology Transfer

### ***Grape powdery mildew QoI resistance monitoring***

**Faculty:** Walter Mahaffee

Protocols for DNA sample collection, extraction and detection of genetic mutation associated with QoI fungicide resistance in *Erysiphe necator*.

## APPENDIX 5

### Credit-Courses Taught

	Course Number	Course Title	Discipline	Instructor
<b>Undergraduate courses</b>	FST 423/523*	Food Analysis	Food Science	M. Qian
	FST 466/566*	Wine Production Principles	Enology	E. Tomasino
	FST 467/567*	Wine Production, Analysis, and Sensory Evaluation	Enology	J. Osborne
	HORT 300/ENT 330	Plagues, Pests, and Politics	Entomology	V. Walton
	HORT 453*	Grapevine Growth and Physiology	Horticulture	L. Deluc
	HORT 454*	Principles & Practices of Vineyard Production	Horticulture	P. Skinkis
	HORT 481/581*	Horticulture Production Case Studies	Horticulture	P. Skinkis
	AEC 121	Discovering Agricultural and Resource Economics	Applied Econ	J. Sterns
	AEC 211	Agricultural and Food Management	Applied Econ	J. Sterns
	AEC 251	Introduction to Agricultural and Food Economics	Applied Econ	J. Sterns
	AEC 251e	Introduction to Agricultural and Food Economics (E-campus)	Applied Econ	J. Sterns
	AEC 442	Agricultural Business Strategic Management	Applied Econ	J. Sterns
	HC 407	Commodities to Cafes – Food Culture in France (short-term study abroad course in France)	Applied Econ	J. Sterns
<b>Graduate courses</b>	ENT 599	Principles of IPM	Entomology	V. Walton
	FST 607	Seminar	Food Science	J. Osborne
	FST 628	Flavor Chemistry	Food Science	M. Qian
	FST 666	Advanced Topics in Enology	Enology	E. Tomasino
	HORT 599	Special Topics: Vineyard Management	Horticulture	P. Skinkis
Universidad Internacional del Ecuador (Quito)	MBA 12 <sup>th</sup> promotion	Strategic Thinking	Management	J. Sterns

*\*also taught for graduate credit*



**Oregon State University**

**Oregon Wine  
Research Institute**

4017 Agricultural and Life Sciences Building  
Corvallis, Oregon 97331

[owri.oregonstate.edu](http://owri.oregonstate.edu)