OREGON WINE RESEARCH INSTITUTE

VITICULTURE & ENOLOGY

TECHNICAL NEWSLETTER

WINTER 2021

Welcome to the Winter 2021 Newsletter

This edition contains research updates and a comprehensive list of publications summarizing research conducted by faculty of the Oregon Wine Research Institute at Oregon State University. Dr. Elizabeth Tomasino, OSU associate professor, and Quynh Phan, OSU doctoral candidate, open the newsletter with an article on Pinot noir wine lipid composition. Dr. Vaughn Walton, OSU professor, reports on the invasive pest, spotted lanternfly (SLF), recently found in the Willamette Valley, that may pose a threat to crops in Oregon. We wrap up the newsletter with a list of new publications authored by Oregon Wine Research Institute researchers.

This issue is posted online at the OWRI website https://beav.es/Jbv. Learn more about our research and outreach programs and access core faculty contact details here.

Cheers,
The OWRI Team

Determining Pinot noir wine lipid composition, impacts on mouthfeel, and use of lipids to predict wine origin

Quynh Phan, doctoral candidate, OSU
Dr. Elizabeth Tomasino, associate professor (enology), OSU

Lipids are organic compounds that are fatty acids or fatty acid derivatives and are soluble in organic solvents. They exist as macromolecules in wine and are known to have significant impacts on mouthfeel of many foods; thus, they could contribute to wine mouthfeel. While there has been much research investigating the phenolic composition of wines and their link to astringency and other mouthfeel perception, little work has explored other potential mouthfeel compounds such as lipids. The concentration and composition of wine lipids may be affected by environmental factors of the vineyard. It is known that different wine regions have differing climatic conditions that may lead to differences in lipid composition of grapes and wines.

In this issue:

Editorial Team

Denise L. Dewey
Lead Editor
Oregon Wine Research Institute
denise.dewey@oregonstate.edu

Dr. Patty Skinkis
Viticulture Editor
Oregon Wine Research Institute
patricia.skinkis@oregonstate.edu

Dr. James Osborne
Enology Editor
Oregon Wine Research Institute
james.osborne@oregonstate.edu

Oregon State University

Even though the amount of lipids in wine is not abundant compared to other foods, the lipid content of wines can alter wine quality in numerous ways (Beltran et al. 2008). Lipids are critical nutrient sources for yeasts that contribute to the success of wine fermentation. They are building blocks for yeast cell membranes and impact yeast ethanol tolerance. In addition, lipids impact yeast metabolism and wine aroma production. For instance, a wine produced from synthetic grape must without lipids contained fewer aroma compounds and more volatile acidity than wine made from real grape must containing lipids.

Environmental factors and climate conditions during the growing season can significantly impact lipid composition, affecting final wine characteristics (Van Leeuwen and Darriet 2016). The chemical composition of a given wine is determined by a complex interplay of different chemical compounds. Research on wine lipid composition, in particular, may contribute to understanding how wines can be distinguished based on grape variety, winemaking style, geographical origin, and climate conditions.

To explore this idea, we studied the lipid composition of Pinot noir wines from different regions and examined the impacts of lipids on wine mouthfeel perception. Forty-eight commercial single-variety Pinot noir wines from 2016 were selected from the leading Pinot noir regions worldwide, including Oregon, California, Burgundy, and New Zealand. Total lipids were extracted using the Bligh-Dyer extraction method. The total lipids were then analyzed using liquid chromatographic-mass spectrometry to profile different lipid classes. Discriminant analysis and random forest approach were used to explore the pattern of lipid composition in these Pinot noir wines.

A total of 222 individual lipids were identified in the wines, spanning 11 lipid classes: lysophosphatidylethanolamine (LPE), lysophosphatidylcholine (LPC), phosphatidylcholine (PC), phosphatidylethanolamine (PE), cholesterol ester (CE), monoacylglycerol (MG), diacylglycerols (DAG), triacylglycerol (TG), free fatty acids (FFA) and phosphatidylglycerol (PG). The total lipid content was not different across the four regions (Figure 1). However, the lipid composition for each region was different (α=0.05).

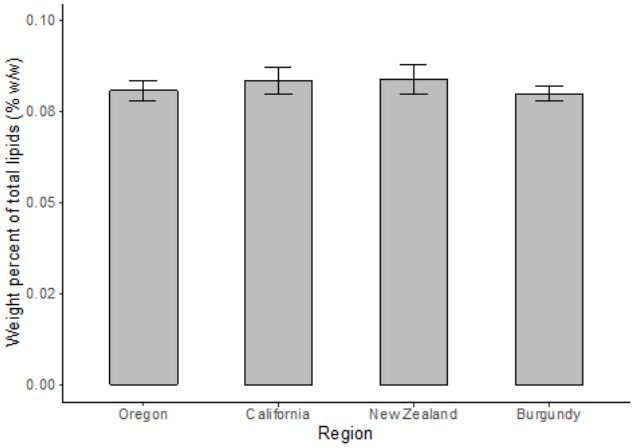

Figure 1. Average percentage (w/w) of total lipids extracted from commercial Pinot noir wines produced in Oregon, California, New Zealand, and Burgundy.

The percentage of lipids (weight basis) found in the Pinot noir wines (0.08%) was lower than those measured in other grape varieties (Riesling, Niagra, Catawba, DeChaunac, Cabernet Sauvignon, and Seyval), ranging from 0.15% to 0.24%. The main lipid classes found in the Pinot noir wines include lipids found in both grapes and yeast. In this study, the four lipid classes with the highest concentrations are TG, FFA, PC, and DG. While total lipids were not different, each region's lipid composition was different (α=0.05). This difference was anticipated, as the final amounts of lipids extracted from wine should be lower than the total lipid content found in grape berries and yeast cell walls due to the amphiphilic nature of lipids. It would be interesting to track lipid composition in grapes and then in corresponding wines in the future.

Random forest analysis was used to determine the 58 essential lipids important for the wine place of origin classification (Figure 2). Oregon wines tended to have higher relative amounts of lipids than the other regions of the wines studied. Nine lipids were found at higher relative concentrations for Oregon wines, while the other regions only had two or three lipids found at higher relative concentrations. The linear discriminant analysis also showed that the 58 essential lipids contributed to 87.7% of the difference in the wines (Figure 3). Our result shows promise for developing a region of origin classification and lipids as wine markers for a region of origin. However, a much larger set of wines from additional locations would

be needed to further this classification work and strengthen the proposed hypothesis.

While we cannot compare lipids found in Pinot noir wine to other work presently, we know that lipids are impacted by environmental conditions, such as viticultural and winemaking practices. Grape berry lipid composition can be altered based on heat during grape ripening (Arita et al. 2017). Lipid compositions of grapes grown in cool climates showed higher concentrations of unsaturated fatty acids than those grown in warmer climates (Kuiper 1968). Beyond this, there is little information known about wine lipids produced in different climatic regions.

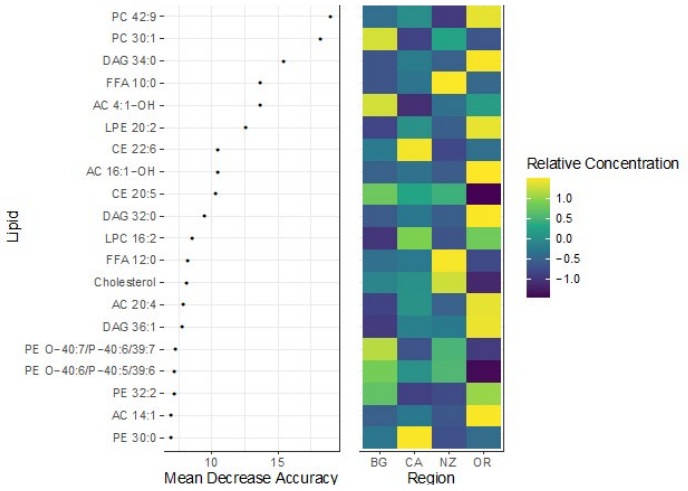

Figure 2. Variance of Importance (VIP) for lipids that contribute the greatest variance to the classificatin of Pinot noir wines from 4 regions (NZ=New Zealand, CA=California, BG=Burgundy, OR=Oregon). Relative concentrations for each region are also shown as yellow for higher concentrations, dark blue for lower concentrations.

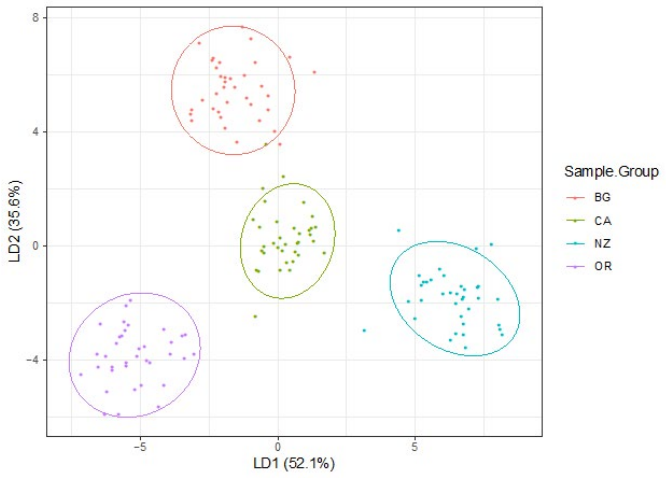

Figure 3. Linear discriminant analysis of lipids in Pinot noir wines by region of origin (NZ=New Zealand, CA=California, BG=Burgundy, OR=Oregon) and 95% confidence ellipses.

Differences in Pinot noir clones may also result in differences in lipids due to differences between grape tissue composition and size and compounds in seeds (Grncarevic and Radler 1971). Proportions of Pinot noir cultivar waxes, including fatty alcohols, oleanolic acid ($C_{30}H_{48}O_3$, triterpenoic acid), hydrocarbon, wax esters, and fatty acids, were found to change significantly during fruit development, and the wax lipid compositions differed among clones (Commenil et al. 1997).

We know that some of the lipid composition differences found to classify the different regions in our study may also contribute to the mouthfeel of wine. Therefore, we conducted a sensory trial using food grade lipid products (TG, MD/DG, PG, and a mix of all 3) added to a model wine solution at high concentration (maximum measured in wine) to see if the lipids directly impacted mouthfeel perception. Eighty-four wine consumers participated in the sensory panel during October 2020 at Oregon State University in Corvallis, Oregon. The OSU Institutional Review Board approved the study. To remove any possible influence of aroma, participants wore nose clips during the sensory analysis. The TG, MD/DG and mix of all three lipids were not different from the control, but the PG treatment was found to differ from the control. This result was surprising, as the amount of lipids in wine is very low compared to other lipid-based foods such as dairy products. While the PG added sample was different in triangle tests, further descriptive analysis could not pinpoint the mouthfeel characteristic that was related to PG lipids. This suggests that the content of PG lipids was somewhere between its detection threshold and perception threshold. There was enough to make a wine taste different but not at high enough concentrations to alter a specific characteristic. It will be interesting to see how lipids alter mouthfeel combined with other wine components, such as phenolic compounds.

The concentration of wine lipids is relatively low, less than 0.1% w/w in wine. However, lipid composition has great potential in distinguishing wine characteristics. Grapes, yeasts, winemaking techniques, and environment contribute to the overall wine quality. Changes in any of those factors are reflected in primary and secondary

compounds in the final product. In this study, we proposed the use of lipidomic data to identify wines produced from different regions. The outcome of this work could be further developed for wine authentication purposes, an important issue that has been studied but has yet to be solved. Also, by focusing on the key lipid compounds that are important in classify wines, we could potentially reduce the amount of time used in future chemical analysis of lipids.

This project was funded by a gift from E&J Gallo Winery.

Literature Cited

Arita K, Honma T, Suzuki S. 2017. Comprehensive and comparative lipidome analysis of *Vitis vinifera* L. cv. Pinot noir and Japanese indigenous *V. vinifera* L. cv. Koshu grape berries. PLOS ONE 12(10):e0186952.

Beltran G, Novo M, Guillamón JM, Mas A, Rozés N. 2008. Effect of fermentation temperature and culture media on the yeast lipid composition and wine volatile compounds. Int J Food Microbiol 121:169-177.

Commenil P, Brunet L, Audran J-C. 1997. The development of the grape berry cuticle in relation to susceptibility to bunch rot disease. J Exp Bot 48:1599-1607.

Grncarevic M, Radler F. 1971. A review of the surface lipids of grapes and their importance in the drying process. Am J Enol Vitic 22:80-86.

Kuiper PJC. 1968. Lipids in grape roots in relation to Chloride Transport. Plant Physiol 43:1367-1371.

Van Leeuwen C and Darriet P. 2016. The impact of climate change on viticulture and wine quality. J Wine Econ. 11(1):150-167.

Pest Alert: Spotted lanternfly is an invasive insect that may be of key economic importance in Oregon

Dr. Serhan Mermer, postdoctoral associate, OSU
Dr. Gabriella Tait, postdoctoral associate, OSU
Dr. Jana Lee, research entomologist, USDA-ARS
Dr. Man Yeon Choi, research entomologist, USDA-ARS
Joshua Vlack, entomologist, ODA
Dr. Helmuth Rogg, director of plant program area, ODA
Jake Bodart, entomologist, ODA
Heather Leach, extension educator, PSU
Linda Brewer, faculty research associate, OSU
Dr. Vaughn Walton, professor, horticultural entomologist, OSU

The Oregon Department of Agriculture (ODA) found a single dead adult spotted lanternfly (SLF, *Lycorma delicatula*, Hemiptera: Fulgoridae) in the Willamette Valley on two separate occasions during fall 2020. These finds are concerning to multiple high-value crops grown in Oregon, including wine grapes. The reason for concern is that SLF secretes honeydew that causes fungal growth on leaves, reducing photosynthesis. With severe infestations, SLF can cause plant tissue dieback and death. This article is written to inform you of this insect and provide details on where to report findings. We also provide identification and symptoms, lifecycle, host plants, and currently known methods of control.

Reporting and current USA distribution

Early detection is vital to the control of SLF. If you find an insect or egg case suspected to be SLF, you should collect it and immediately report it to ODA through the online reporting email (pestreport@oda.state.or.us) to mitigate potential future damage. Place the insect or egg case into a container of alcohol to kill and preserve it. If you do not have alcohol, you can use alcohol-based hand sanitizer. Take a picture of the suspected SLF, once it is killed (to prevent escape), and submit to ODA. It is important to record where you found the insect and include the following information: date, where it was found (e.g., species of tree, or structure if it is an egg case), collector's name, phone number, collection location including state, county, and address or nearest intersection (e.g., GPS coordinates, if available). This insect currently falls under quarantine since no known establishment has been recorded in Oregon.

Host range and plant symptoms

SLF is a planthopper that is native to Southern China, Taiwan, and Vietnam. It has spread to Japan, South Korea, and the United States (Barringer and Ciafré 2020). SLF was first recorded in the USA in Berks County (September 2014), Philadelphia, PA, and is currently found in

Pennsylvania, New Jersey, Virginia, and Delaware.

SLF has a broad host range, including various species of grape, stone fruit, apple, ornamentals, maple, poplar, lilac, and birch (Urban 2020). A key host is the tree-of-heaven, *Ailanthus altissima* (Dara et al. 2015). Nymphs and adults are phloem feeders. They suck sap from young stems and leaves, which can cause the withering of whole trees. SLF reduces photosynthesis, weakens the plant, and eventually contributes to the host plant's death. Feeding can also cause the plant to weep or ooze, resulting in fermented odors. Wounds will leave a grayish-black trail along the trunk. The insect secretes large amounts of honeydew. Both the oozing wounds and honeydew promote sooty mold that can coat leaf surfaces and fruits, thus interfering with photosynthesis and reducing plant growth, crop yield, and fruit quality, weakening the plant, and may cause eventual death (Han et al. 2008). Honeydew secretion often attracts other insects, including yellow jackets, hornets, bees, ants, and flies. Blackened soil and even mold patches, appearing as a yellowish-white mat, may also form at the plant's base.

Life cycle

SLF has one generation per year, consisting of four nymphal stages before the adult stage, and it overwinters as egg masses (Figure 1). Eggs hatch in spring, with the first instar nymphs appearing in May-June. Mating typically starts in late August, and egg-laying occurs from September to November or until the first killing freeze.

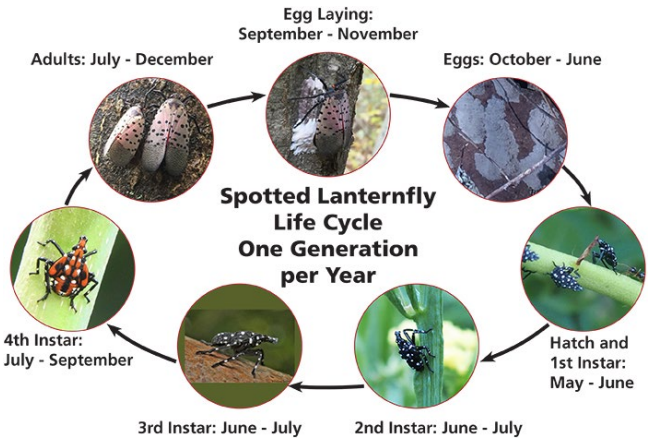

Figure 1. SLF lifecycle. (Figures: Egg laying, Hatch and 1st instar, 2nd instar, Adults: Emelie Swackhamer, Penn State University, Bugwood.org; Eggs: Lawrence Barringer, PA Dept. of Agriculture, Bugwood.org; 3rd instar: Dalton Ludwick, USDA-ARS/Virginia Tech; 4th instar: Richard Gardner, Bugwood.org).

Pest introduction pathways

The most likely pathways of SLF introduction into a geographical area are linked to the presence of egg masses moving on plants, wood products, and inert objects (Figure 2A). The egg masses are difficult to see. Various pathways are listed from high to low likelihood of causing pest introduction, including the following:

- known woody host plants that have trunk/stem diameter greater than ⅓ inch
- woody plants with a diameter greater than ¼ inch
- round wood and sawn wood
- wood packaging material
- man-made items/inert objects (e.g., pots, trellis systems)
- wood chips
- processed wood residues (except sawdust and shavings, the bark of a size exceeding 1 x 1 inch).

Materials originating from known infested areas have a higher risk of having these egg masses.

Identification

Eggs: This is the critical life stage most likely allowing SLF to be distributed unknowingly by humans. Females can lay one or two egg masses, each containing 30-60 eggs laid in rows (Figure 2A). Egg clusters are covered with a creamy-white, putty-like substance that becomes pinkish-gray as it dries. After a few weeks, the covering turns tan and starts to crack, resembling a splotch of mud (Figure 2B). Depending on the substrate, egg masses can be well camouflaged. Eggs are laid in masses on trees, under bark, on rusty metal, plastic yard objects, cars and trailers, outdoor grills, cushions, pallets, stone, and many other surfaces. They lay eggs on any hard, smooth surface, including rusty metal at high population densities (Liu 2019). Old egg masses appear as rows of 30-50 brownish seed-like deposits in 4-7 columns on the trunk, roughly 1 inch in length (Keller et al. 2020).

Nymphs: The first three instars have a black body and legs with white spots. Generally, the first instar nymph is ¼ inch long, black with white spots (Figure 3). Second and third instar nymphs are black with white spots. The fourth instar nymph has red coloration with white spots and can be up to ¾ inches in length. Fourth instar nymphs molt

and become adults that are approximately 1 inch in length (Dara et al. 2015).

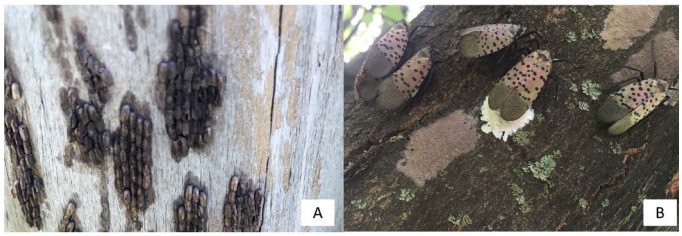

Figure 2. Closeup of spotted lanternfly egg cluster without protective covering (top). Photo by T. Leskey. Adult spotted lanternfly laying eggs on a trunk, showing older egg clusters, left and right and newly laid egg clusters, middle (B). Photo by E. Swackhamer.

Figure 3. Key distinguishing characters of spotted lanternfly nymphal life stages. The first to third instar nymphs are black with white spots (left). Fourth instar nymph has a red coloration with white spots (right). Photo by S. Ausmus.

Adults: Both sexes superficially resemble a moth with a wider abdomen. Adults are often confused with some moths due to the strikingly colored hindwing and size (Figure 4A). Females have a reddish color at the tip of the abdomen (Figure 4B). These insects can aggregate on vines and excretions can cause black sooty mold on stems and leaves (Figures 5 & 6). Spotted lanternfly females are 0.8 to 1 inch from head to the end of the folded wing; males are slightly smaller (Dara et al. 2015). Antennae are short and orange with needle-like tips. Head and legs are dark brown to black. Forewings (tegmina) are greyish, with black spots, and hind wings are banded black and white anteriorly and deep red posteriorly. Tips of the wings show a network of veins (reticulated). The abdomen is yellowish with incomplete black bands. Leg length is ~⅔ inch.

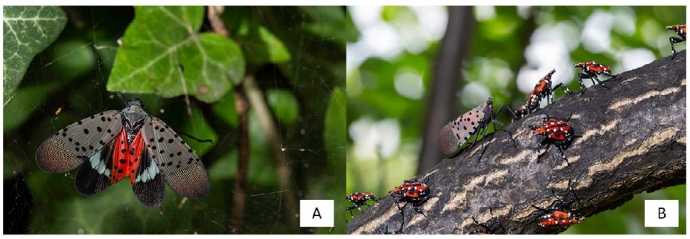

Figure 4. Spotted lanternfly adult (A) with open wings and (B) folded wings, resting on trunk. Photo by S. Ausmus.

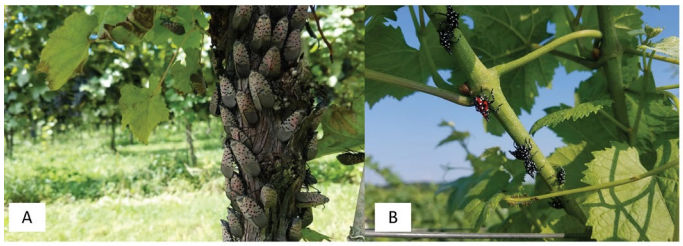

Figure 5. Spotted lanternfly adult aggregation on trunks (A), and nymphs on new growth of grapevines (B). Photo by H. Leach.

Figure 6. Honeydew from spotted lanternfly feeding. Photo by S. Ausmus.

Chemical control

Chemical control is only necessary once a pest population is known. Currently no insecticides effective on SLF are registered in Oregon. As soon as there are live SLF finds in OR, ODA will apply for emergency registration of effective compounds.

SLF poses a significant economic risk to many crops in Oregon. Prevention is the best cure. Be sure to report findings of the insect if/when you see them, and work with your local state agencies in order to limit infestation and spread through Oregon. Be sure to look closely if you know that you have shipments of plants, wood, or inert products (see list above) from affected states.

For more information:

- Spotted Lanternfly Alert: Pennsylvania Department of Agriculture https://www.agriculture.pa.gov/Plants_Land_Water/PlantIndustry/Entomology/spotted_lanternfly/SpottedLanternflyAlert/Pages/default.aspx
- Spotted Lanternfly: Pennsylvania State University https://extension.psu.edu/spotted-lanternfly
- Spotted Lanternfly: USDA National Invasive Species Information Center https://www.invasivespeciesinfo.gov/terrestrial/invertebrates/spotted-lanternfly
- Spotted Lanternfly: USDA Animal and Plant Health Inspection Service https://www.aphis.usda.gov/aphis/resources/pests-diseases/hungry-pests/the-threat/spotted-lanternfly/spotted-lanternfly

Literature Cited

Barringer L and Ciafré CM. 2020. Worldwide feeding host plants of spotted lanternfly, with significant additions from North America. Environ Entomol 49:999-1011.

Dara SK, Barringer L, Arthurs SP. 2015. *Lycorma delicatula* (Hemiptera: Fulgoridae): A new invasive pest in the United States. J Integr Pest Manag 6.

Han JM, Kim H, Lim EJ, Lee S, Kwon Y-J, Cho S. 2008. *Lycorma delicatula* (Hemiptera: Auchenorrhyncha: Fulgoridae: Aphaeninae) finally, but suddenly arrived in Korea. Entomol Res 38:281-286.

Keller J, Rost J, Hoover K, Urban J, Leach H, Porras M, Walsh B, Bosold M, Calvin D. 2020. Dispersion patterns and sample size estimates for egg masses of spotted lanternfly (hemiptera: Fulgoridae). Environ Entomol 49:1462-1472.

Leach H, Biddinger DJ, Krawczyk G, Smyers E, Urban JM. 2019. Evaluation of insecticides for control of the spotted lanternfly, *Lycorma delicatula*, (Hemiptera: Fulgoridae), a new pest of fruit in the Northeastern U.S. Crop Prot 124:104833.

Liu H. 2019. Oviposition substrate selection, egg mass characteristics, host preference, and life history of the spotted lanternfly (Hemiptera: Fulgoridae) in North America. Environ Entomol 48:1452-1468.

Research publications

Results of research are published in peer-refereed academic journals, peer-reviewed reports, or books, which validates the scientific work of the authors. The following articles describe research conducted by members of the Oregon Wine Research Institute at Oregon State University.

Plant pathology and entomology

Daane KM, Yokota GY, Walton VM, Hogg BN, Cooper ML, Bentley WJ, Millar JG. 2020. Development of a mating disruption program for a mealybug, *Planococcus ficus*, in vineyards. Insects 11(9):635.

Levin AD and KC AN. 2020. Water deficits do not improve fruit quality in *Grapevine Red Blotch Virus*-infected grapevines (*Vitis vinifera* L.). Front Plant Sci 11:1292.

Rossi-Stacconi MV, Tait G, Rendon D, Grassi A, Boyer G, Nieri R, Walton VM. 2020. Gumming up the works: Field tests of a new food-grade gum as behavioral disruptor for *Drosophila suzukii* (Diptera: Drosophilidae). J Econ Entomol 113(4):1872-1880.

Rota-Stabelli O, Ometto L, Tait G. Ghirotto S, Kaur R, Drago F, González J, Walton VM, Anfora G, Rossi-Stacconi MV. 2020. Distinct genotypes and phenotypes in European and American strains of *Drosophila suzukii*: implications for biology and management of an invasive organism. J Pest Sci 93:77-89.

Warneke B, Thiessen LD, Mahaffee WF. 2020. Effect of fungicide mobility and application timing on the management of grape powdery mildew. Plant Dis 104(4):1167-1174.

Warres B, Breeden S, Wrikles J, Severns P, Brannen PM, Rogers D, Covington R, Mahaffee WF, Neil T. 2020. Fungicide comparisons for powdery mildew management in a fungicide resistant Erysiphe necator population, 2019. Plant Dis Manag Rep 14:PF014.

Viticulture

King BA, Shellie KC, Tarkalson DD, Levin AD, Sharma V, Bjorneberg DL. 2020. Data-driven models for canopy temperature-based irrigation scheduling. Transactions of the ASABE 63(5):1579-1592.

Enology

Johnson J, Fu M, Qian M, Curtin C, Osborne JP. 2020. Influence of select non-*Saccharomyces* yeast on *Hanseniaspora uvarum* growth during prefermentation cold maceration. Am J Enol Vitic 71:278-287.

Sereni A, Phan Q, Osborne J, Tomasino E. 2020. Impact of the timing and temperature of malolactic fermentation on the aroma composition and mouthfeel properties of Chardonnay wine. Foods 9:802.

VISIT. DISCUSS. LEARN MORE.

Office: **541-737-3620**
Email: **owri@oregonstate.edu**

Connect with faculty:
owri.oregonstate.edu

Come see us at the OSU campus in Corvallis: **oregonstate.edu**

Oregon State University
Oregon Wine Research Institute