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Merit Award Presentation Summary

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Multidisciplinary Work in Viticulture and Enology Takes Villages

I thank the Board of the American Society for Enology and Viticulture for the honor of receiving the Merit Award. The more it sunk in that I was to receive this award and give this presentation, the more intimidating it became. However, I knew immediately the topic I wanted to cover and even how I wanted to cover it. Multidisciplinary studies are critical to agricultural research and, I would argue, are particularly important to our industry. The impacts of where vines are planted, what vines are planted, and how the vines are managed on fruit composition, quality, ripening, and ultimately, on wine quality have been widely studied. Although much research has already been conducted, changes in the environment, management tools, emerging production areas, and market demands make necessary the need for continued multidisciplinary research, extension, and educational programs in viticulture and enology.

I want to put a bit of a twist on approaching multidisciplinary industry, research, and education efforts for the viticulture and enology community using the context of villages. I hope that you will consider how problems have been approached as a group or a team of people in the villages of your life and career. Each village has its own stories and is usually connected by roads that often remain connected for the lifetime of the village, with movement along those roads in both directions.

First, we need a common understanding of the word "village." When preparing this presentation, I did the standard "Google search" for the term "village." On a sociological website, I found what I think is a concept that can be used for a metaphorical village, at least for the purpose of this presentation.

> *"The village is a community whose members have a sense of "we feeling." Their relation is intimate. Their customs, conventions and culture are common. They are having a strong community feeling."*
>
> (http://www.sociologydiscussion.com/village-community/9-main-characteristics-of-a-village-community/2606)

In research, extension, and education, we usually create metaphorical villages with these customs, conventions, and culture as both a whole, large village and groups within the village. Additionally, we each occupy, or have occupied, more than one metaphorical village and likely more than one at a time. Each village will have elders, a leader or group of leaders, skilled specialists, and a larger group that helps to facilitate the work needed to maintain or advance the village. I had the privilege to study, work, and play within several villages of the grape and wine world.

I want to tell you about a couple of my villages and a few of the stories and the people involved. There will be data, but I really want to weave the stories of how people and projects came together and how one project led to another. There are three villages, each with their own members, that I want to cover today, with some overlap. These villages are family, graduate school, and Washington State University. Some villages will have more discussion than others. I promise to talk about research, extension, and education within the concept of the multidisciplinary approach, but will also talk about the villages. In my wrap-up, I also want to express my concerns for the future of these types of efforts.

Family Village in North Carolina

I grew up on a 350-acre farm in the middle of nowhere in southeastern North Carolina. We finally got a telephone when I was in about eighth grade. We primarily raised highbush blueberries, before they were a superfood. We grew other assorted crops on the higher ground. Eventually, my Dad planted muscadines when I was in high school, and that is when I caught the grape bug. This was despite the fact that my first "viticulture" job was sticking cuttings, alongside Lula Mae Simpson, in a burlap-enclosed propagation facility in late June, with 100% relative humidity. During my last summer as an undergraduate at North Carolina State University (NCSU), I graduated to helping the crew train vines. I also sprayed the 40 acres every 10 to 14 days after my father developed an allergy to Benlate®.

Sometimes the spray schedule tightened up a bit—as in you just pull out of the last row when a big thunderstorm rolls in and dumps a couple of inches. You get back up and start all over again the next morning.

Research and Extension were a part of my family village for as long as I can remember. I was exposed to on-farm collaborative research and to Extension from childhood on. NCSU conducted research on the family farm, and the local county extension agent visited. My Dad provided space, facilities, and labor to help with research programs and served as a leader in both the blueberry and muscadine industries of North Carolina. I was always interested in science. My mother encouraged us girls, there are three of us, to do and be whatever we wanted. Science was not thought of much for girls in the 1960s. However, my Mom put up with ant farms, collections of rocks, shells, leaves, and whatever else one can collect, and provided me with a subscription to a science kit of the month in the summers and a chemistry set one year for Christmas. I believe getting to know those faculty members and their work affected my future career interests. Of course, we have four NC State alums in the family.

University of Arkansas Village

So how does a farm gal from North Carolina end up in Arkansas working with Justin Morris? Justin somehow found his way to my Dad's farm with an Arkansas grower who wanted to plant muscadines. So, they came to pick my Dad's brain. As I've already indicated, our farm was literally in the middle of nowhere, and it was lunch time. As my mother had done on occasions with some of the NC State faculty, she provided a quick shrimp boil. It was so successful that Mom had to go back into the freezer to cook another bag. My Mom's remark was that she had never seen one human being eat so many shrimp! Somewhere along the way, Mom happened to mention that I wanted to go to grad school. Of course, Justin said to have me contact him if I was interested. I do not think Justin had the car door closed before my Mom called me. The rest is history. I had found the road to my next village.

Of course, Justin did not quite know what he had gotten into when I showed up January 1975. I also have to say I don't think I knew what I had gotten into! I was Justin's first female graduate student. I could not have had a better mentor or friend. I was drafted a number of times into Morris family activities. I remain good friends with Justin's wife Ruby and their son Mike.

The University of Arkansas Food Science Department was a young and small department. Many of the faculty, including Dr. Kattan (the department head) and Drs. Buescher, Davis, and Gonzalez, welcomed me and others into their homes for a holiday dinner or a day at the lake. I was fortunate to be a part of the department at a time when it was easier for faculty and graduate students to interact socially as well as academically. We formed bonds that very much supported my graduate school village.

For any graduate students in the audience, the students that you now see on a day-to-day basis, you may not see so much after graduation. However, as soon as you see each other again, your ties together as a village will be rejoined. Unfortunately, some of those gatherings will become more bitter sweet as they will more frequently occur to mourn the loss of a village elder/mentor, as was the occasion when many of Justin's students gathered for his memorial service. Don Cawthon, June Borque, Mike Lanier, Keith Striegler, and I all worked with Justin between 1975 and 1980 on grapes during his development of a mechanized production system. We also had connections with students in the neighboring villages of the Weed Science Department and the Horticulture and Forestry Department, including the late Keith Patterson.

Students from other schools that are at this meeting are your contemporaries. In the future, you may have state, regional, and/or national projects with them. Take time to get to know students that are not in your specific village because tomorrow they may be in one of your villages. For me, some of these folks included Ron Perry, who was a student at Texas A&M and then faculty at Michigan State, and the late Jim Wolpert, who as most of you know, was a student at Michigan State.

I will briefly bring up my grad school research because it is a road that connects to my Washington State villages. I think the links will become apparent. For my MS degree, I worked on the interactive effects of irrigation × crop level × nitrogen on the performance of Concord grapevines. At the time of publication in the mid-1970s, the paper from this research was either the first or second paper published on the irrigation of Concord. We worked closely with Welch's, which then had a juice plant in northwest Arkansas. At the time, low yields were an issue due to the hot and often droughty conditions of this area. Fruit would ripen in mid-August, usually the first week of classes. The first killing frost in the area was on average sometime in mid- to late October, so a delay in harvest was not a big issue. Yield increased with irrigation, nitrogen fertilization, and higher node numbers with balance-pruning. More information can be found in Spayd and Morris 1978 and Morris et al. 1983.

Not many people in this audience realize that Justin conducted research on anything other than grapes. However, he also had major research efforts on mechanization of strawberry and blackberry production. For my PhD, I switched gears to work on the impact of once-over mechanical harvest on strawberry and strawberry jam quality, with a focus on anthocyanins. The day before my PhD defense, I had the opportunity to defend my work to Mr. Tim Smucker.

During my last semester, I also had a totally spontaneous opportunity to discuss one-on-one the importance of agricultural mechanization research with our first-term Governor, Bill Clinton. That was an experience you don't count on everyday!

I am not going to discuss the strawberry research other than to first say that paper chromatography is extremely tedious. Secondly, I learned a lot about anthocyanin reactions with aldehydes when painters put a fresh coat of oil-based paint on the walls.

Washington State Villages

I will shift to my Washington villages, where I worked the longest and have the greatest number of ties. When I started in 1980, I was not sure if, let alone how much time, I would be spending on grapes and wine. I was hired to conduct fruit and vegetable research. I started 10 weeks after the eruption of Mount St. Helens. So at the time I moved, the only things people thought of in regard to Washington State were Mount St. Helens and rain. My mother could not believe that I would move to any place that had active volcanoes. When I returned to North Carolina, the occupants of my Washington villages could not believe that I would live anywhere with hurricanes and tornadoes.

Now, before you talk about the Washington wine village(s), you have to know where the village is. I spent much of my career having to explain that when I said Washington State, we were not growing grapes on the banks of the Potomac River. Additionally, no, we do not grow a lot of Pinot noir, that is in Oregon. Yes, there are deserts in Washington where it does not rain all of the time.

Washington Industry Village

A little bit of history. It is handy to have a concept of village size, development, and the cast of characters in each of the villages within the larger village of Washington. When I started in Washington, there were 15 wineries and 4500 acres of winegrapes. About 15 years later, we had about 60 wineries and about 20,000 acres of winegrapes. When I left in 2006, there were more than 300 wineries and acreage was about 30,000. I must have been holding things back because in the 13 years since I left, winery numbers have grown to in excess of 900 and acreage north of 50,000. In the 1980s in Washington, the industry and Washington State University (WSU) already had a very tight relationship. Unlike many developing wine industries, we started with many people that had BS, MS, or PhD degrees in viticulture or enology from either UC Davis or Cal State Fresno. Others had degrees in chemistry or microbiology that were complementary to the industry. Information was readily shared within the industry; there was a true pioneering spirit, and everyone knew everyone else.

Working with members of industry in helping to set research, extension, and education priorities was an important part of my career in Washington. I believe that the very close interaction between industry and WSU faculty and staff is unique. When I was at WSU, we were sought out for input by, and we accepted input from, industry. Many of the research findings that I will discuss were adopted by industry before we ever had the opportunity to get the results in print. In some ways, it was scary fast!

In the first 10 or so years, there was a very solid core group of people in the Yakima Valley and a few in Walla Walla. We were all in our early careers in the grape and wine industry. We all learned from and leaned on each other. I start with the industry village because without it there would be no Sara Spayd—Assistant, Associate, or Full Professor; nor me as ASEV President and certainly no me as the Merit Award Recipient. I will quickly reel off names because they are all important. There are others who came later that were important, but these people were the core of my developing industry village.

I have to single out some folks. Kay Simon (Chinook Wines) gave me a graduate education in winemaking and sensory characteristics while I was on the job, becoming my best friend in the process. Clay Mackey (Chinook Wines) is always a steady, no-nonsense viticulturist. Wade Wolfe (Hogue Cellars), the now senior viticulturist in Washington, led the research funding committee for more years than Carter has pills (that is a southern thing). These folks were also part of a group of the fledgling Washington wine industry that would gather for wine tastings to learn what others were doing by tasting Washington wines against the wines of the United States and the world. Others in that group, in no particular order, were: Rob Griffin (Hogue Cellars), Brian Carter (Apex Cellars), Mike Wallace (Hinzerling Vineyards), David Forsyth and Co Dinn (Hogue Cellars), Dick Boushey (Boushey Vineyards), the Williams and Holmes families (Kiona), Tricia and David Gelles (Klipsun Vineyards), Joy Andersen and Doug Gore (Chateau Ste. Michelle), Max Zellweger (Lagguth), Gary Figgins (Leonetti), Rick Small (Woodward Canyon), Jerry Bookwalter and Tom Thorsen (Sagemoor Farms), the late David Lake (Columbia), Mike Sauer (Red Willow Vineyards), Don and Linda Mercer (Mercer Ranch), Shiels Family (Cote Bonneville), and the late Stan Clark (Covey Run Winery/Walla Walla Community College).

Industry organizations are an important part of a wine village. I had the opportunity to work with a lot of great people. The Washington Wine Institute and the Washington Wine Commission share an executive director. I primarily worked with three of the executive directors—Lila Gault, Simon Siegl, and Steve Burns—on technical aspects of the industry that had legislative impacts, and I testified before the Washington State House of Representatives Finance Committee on the impact of WSU programs on the industry. Grower organizations provided a platform for extending results. I worked with Deb Heintz of the Washington State Grape Society, which is the oldest of the organizations with a focus on juice grapes as well as winegrapes. My first several meetings of the Washington Association of Winegrowers were attended by the 30 to 40 winegrowers in the state. I understand the meetings are now attended by over 1000 folks involved in the industry. I had the pleasure to work with Executive Director Vicky Sharlau as a member of the education committee.

Washington Research Village

Elders. Every village needs village elders. I was very fortunate that the four founders of the WSU viticulture and enology efforts were still living during much of my time at Prosser. I counted Drs. Charles Nagel and Walt Clore and Mr. George Carter as good friends and mentors. I did not know Mr. Vere Brummund, but had the opportunity to meet him when I hosted an "old" wine tasting at Prosser and invited the folks

who had grown the grapes and made the wine for the tasting. Vere was a home winemaker and worked as Walt's technician. Vere tended the grapes that had been on station since the 1930s and made use of some of the fruit. He was the one who convinced the teetotaling Oklahoman, Walt Clore, to try his wine. The rest is history.

Faculty. I had many great research colleagues at WSU. My closest and longest collaborators were Drs. Charles Nagel (Food Science), Ray Folwell (Agricultural Economics), Bob Evans (Irrigation Engineer), Bob Wample (Viticulture), Bob Stevens (Soils), and Charles Edwards (Food Science). More recent research collaborations were with the new faculty that were added to the program with either WSU or USDA: Drs. Markus Keller (Viticulture), Jim Harbertson (Enology), Julie Tarara (Micrometerology-USDA), and Carolyn Ross (Food Science). I collaborated with a number of other faculty from disciplines including Entomology, Plant Pathology, Chemical Engineering, and the Fisheries Department (Radiology) on various research projects.

Staff. Staff are a critical part of a research village. More and more, technicians are supplanted by graduate students or post-docs. Yes, graduate education is important, but for long-term projects, technicians are important for program continuity. I had a number of great technicians over the years and worked with techs from collaborating programs. I've selected a few to list and feature here. I have to highlight the one who left us way too soon. My first technician, Cindy Lafer Robert, died after about 6 weeks in the ICU and about 10 weeks after her wedding. Cindy was 27 and I was 29. It was my second harvest season at WSU. I had the help of an experienced, hourly employee with the lab and small scale winemaking who worked some with George Carter. My lesson learned was that there are harder things in life to go through than obtaining tenure and promotion, as well as to not sweat the small stuff. David Mee (my program) and John Ferguson (Tarara program) were integral for the light and temperature research papers as well as Barb Zimmermann and Maria Mireles, both from my program. Lonny Hayrynen and Barb Seymour (my program) and Marty Kroeger and Mike Mahan (Evans program) were critical for the nitrogen and irrigation projects. Lynn Mills (Wample/Keller – viticulture) contributed to many projects.

Industry. The Washington Wine Advisory Board, as it was known while I was at WSU, was composed of viticulture, enology, and nursery representatives. This Board read, sat through presentations, and made recommendations for funding proposals and results from principal investigators. The work was unpaid and likely tedious. I thank all those who served on the Board through the years.

Nitrogen fertilization research. In about 1981, Gary Ballard, who was then a viticulturist with Chateau Ste. Michelle, identified a need for information on nitrogen fertilization of grapes in Washington. The original request was for work on Cabernet Sauvignon. However, in the winter of 1978-1979, extreme winter cold decimated the Cabernet Sauvignon vines at Cold Creek where we would have been working. We settled on working with Riesling, which is more cold tolerant and had a full stand of vines in that area. We worked in an eight-acre block at the Cold Creek Vineyard that was drip-irrigated. The year prior to initiating the study, we applied half-rates of the four nitrogen (N) rates. The full rates of 0, 56, 112, and 224 kg N/ha were applied through fertigation for the three-year study.

Bob Evans and I worked with an aerial photograph of the eight-acre block to lay out the study to maximize uniformity within replications. We had the luxury of five rows per treatment within a replication. We utilized 10 to 15 vines from the innermost row for all data collection. Bob Evans insured proper setup of the fertigation, which was then handled by Chateau Ste. Michelle (CSM) staff. We drafted Wample for the cold hardiness work, Stevens for interpretation of nutrient composition, Nagel for fermentation studies, and later, Edwards to look at volatile composition of the wines. We could not have done the research without the full cooperation of CSM, which included harvest assistance.

We were fortunate that the soils had little to no organic matter and nitrogen. So, we were able to look at the very low end of vine nutrition, which is difficult to find in most field studies. In the first year of the study, we had a petiole nitrate content range of about 100 mg N/kg tissue for the controls all the way up to about 10,000 mg N/kg in one plot at the 224 kg/N rate. This range wreaked havoc on Dr. Tim Righetti's tissue analysis lab at Oregon State where the analyses were conducted. We found that for Riesling, yield peaked at about 1000 mg N/dw kg petiole tissue. So, if yield is your concern with regard to N vineyard status for Riesling, this level was essentially satisfied at the 56 kg N rate. With regard to vegetative growth, pruning weight continued to increase with increasing bloomtime petiole nitrate concentration. Dormant pruning weights had not peaked even at high rates of N fertilization. We harvested at an equivalent soluble solids concentration of about 21%. Increasing N delayed harvest and increased fruit pH, total N, FAN, and ammonia concentrations. To assure complete fermentation of a 21% soluble solids, the literature indicates that a minimum of 140 mg YAN/L is required. This concentration was only achieved at the highest rate of N fertilization. More details and results of this project can be found in Spayd and coauthors (references 4, 6, 7, 10, and 11).

The nitrogen fertilization research at Cold Creek made me wonder where the industry stood with regard to nitrogen status in juice. I discovered that Joy Andersen-Bagge, who was the lab manager at Columbia Crest Winery, a CSM winery, was routinely running amino acid profiles of juices from tank samples from individual vineyards in eastern Washington over a couple of vintages. CSM very kindly shared this information so that we could get a snap shot. Samples were pooled by variety for mean, standard error, and range statistics. Across all 12 varieties sampled (six white and six red), 39% contained less than 150 mg total free α-amino N/L of juice, 58% contained less than 200 mg total free α-amino N/L of juice, and 90% contained less than 400 mg free α-amino N/L of juice (Spayd and Andersen-Bagge 1996).

Irrigation studies. When you live in a region that receives 170 to 230 mm of precipitation per year, it is pretty obvious

that irrigation research is needed. So what does a grapevine need?

- Sufficient moisture and nutrients to sustain growth;
- Adequate light exposure to provide carbohydrates for growth and storage;
- Some type of support to accomplish good light distribution in the canopy;
- Ability to ripen fruit sufficiently to attract birds to disperse seeds.

In the late 1980s, Walt Clore and I were invited to visit the site of a vineyard that was planted in about 1880 in Union Gap, Washington (near Yakima). The vine's permanent wood was likely at snow-line (mid-calf), and shoots had grown up into old growth sagebrush. There was some fruit scattered through the canopy. The vine had pretty good leaf exposure to sunlight and a not unreasonable degree of growth, considering it had not been watered or fertilized in at least 50 years. So, this vine was surviving and producing ripened fruit with no intervention by a human. Management of water, nutrients, and all of the other factors that go into producing a commercial harvest of grapes depends on the goals of the grower and the winemaker who will utilize the fruit.

So what about winegrape grower attitude in 1980-1983 in eastern Washington when Bob Evans and I began discussing the need for irrigation research? The attitude among winegrape growers about irrigation in the early 1980s was, "I get 3 acre-feet of water per year. If I don't use it, I'll lose it." What could go wrong? Vines looked more like haystacks than grapevines in vineyards that were managed with that attitude. Harvest was delayed and fruit acidity was elevated in a region known for high acid content fruit and wines, due to shading. The resulting wines tended to be vegetative. Not all vineyards were managed in this manner, but many were. Research on irrigation and other aspects of vine management was needed.

Bob Evans and I established a three-acre block in the spring of 1983 after receiving funding from the newly minted Wine Research Advisory Board. At the time, both of us were baby PhDs still working towards tenure in the WSU Village! We would not even implement our first treatments until we were in the last stages of the tenure vote. However, we felt the work was critical. Bob Wample became an integral part of the project once he moved over from Pullman.

At the time we initiated the study, I had never heard the phrase "reduced deficit irrigation." I guess that was what we were trying to master at the time. We had a number of people tell us that it was not possible to manage water that closely on a long-lived fruit crop. Our first attempts were to water at 90% replacement to veraison and then dial back. We had some response to water management in this fashion, but we did not have the degree of control we were looking for. Fortunately, Bob Wample traveled to Australia between the third and fourth year of treatment imposition. He returned with the idea to start with a full gas tank of water in the spring and let the vines draw down the moisture level. His crew monitored shoot growth so that application of supplemental water began when internode length was diminishing. In all instances, water applications for the three levels that we dubbed Low, Medium, and High were about 30%, 60%, and 90% replacement of ET, respectively.

I thought crop level and irrigation level interactions would be important based on the work that I had done on Concord vines in Arkansas. It is much easier to adjust crop levels in Concord vines than in European winegrapes. I will just leave it at that. For the final three years of the study, along with the new irrigation regime, we adjusted crop level by leaving either one or two clusters per count shoot or doing no cluster removal on count shoots.

The three varieties in the study were selected based on their susceptibility to cold injury, with the order of higher to lower cold hardiness being Riesling, Cabernet Sauvignon, and Chenin blanc. We collected yield, pruning weights, and fruit composition data from all three varieties. However, I focused the wine production on Cabernet Sauvignon based on industry input. I will present a selection of results from Cabernet Sauvignon in 1995, the final year of the study.

Of the three varieties, fruit yield from Cabernet Sauvignon vines was the least responsive to irrigation regime despite expected differences in berry weights due to irrigation (increasing with increased applied water). Again, we harvested at equivalent soluble solids concentrations—23% for Cabernet Sauvignon and 21% for both white varieties. As the amount of water and crop increased, harvest was delayed. One curious finding was that in some vintages, Cabernet Sauvignon berry color from the higher crop and irrigation level had higher berry color than the lower crop, lower irrigation berries. Wines were made from the fruit and subjected to descriptive analysis by a trained panel composed of members of the WSU-Prosser faculty and staff. Dr. Hildegarde Heymann of UC Davis joined our research village on this project by kindly doing the statistics on our descriptive analysis data. Aromatics of wines from the treatments had some small differences, with the exception of the wines from the very highest-yielding vines. These wines separated out from all other wines. For the high irrigation-high crop level treatment, the aromatics of those wines were described as more green olive, cooked cabbage, and stemmy than wines made from the other eight treatments. In a later study, I ran descriptive sensory evaluation of wines from an irrigation study that Bob Wample and Russ Smithyman conducted using Sauvignon blanc vines. We found a similar shift in aromatics towards vegetativeness with higher irrigation levels. Data from these studies remain unpublished.

Light and temperature effects research. An idea proposed for my original Master of Science research at the University of Arkansas was to look at light and temperature effects on Concord grape composition. I remembered the observation of unexplained higher color in berries from high nitrogen-fertilized vines, particularly from high crop and irrigated vines. Additionally, there was the matter of the higher color of Cabernet Sauvignon berries from higher-cropped vines. Both instances seemed to go against carbon pool availability for secondary metabolite production. What was going on?

In the early to mid 1990s, Washington growers began dialing back on water and nitrogen applications as we learned more

about vine management. However, some growers dialed back more than necessary. The old saying "If a little is good, more is better" was reversed to "If reasonable is good, then even less is better" seemed to come into play for awhile. Additionally, canopies shifted from the sprawl to vertical shoot-positioned with a lot of leaf removal on both sides of the canopy. I began to see a lot of sunburn on fruit on the west side of canopies as soon as air temperature reached about 35°C. This occurred for both white- and red-fruited cultivars.

Dr. Julie Tarara joined the USDA in Prosser with a degree in micrometeorology. I dredged up memories of the role of temperature on enzyme activity and its role on anthocyanin biosynthesis and degradation from grad school. Julie, along with her technician, John Ferguson, developed a system to help us separate out light from temperature effects on anthocyanins in Merlot berries (Tarara et al. 2000).

First, to document the color difference phenomenon, we looked at temperature and color of east-exposed, west-exposed, and shaded berries. Regardless of air temperature, exposure of fruit to light increased fruit temperature by 8 to 10°C. In the morning, the temperature of exposed fruit on the east side of the canopy is warmer than west canopy-exposed fruit, and vice versa in the afternoon. Ambient air temperatures in the afternoon are typically much higher than in the morning. So, not only were west-side canopy fruit warmer in the afternoon, exposed-fruit temperature was much warmer in the afternoon than the exposed-fruit temperature measured in the morning. We extracted whole berries in acidified ethanol from shaded, east-exposed, and west-exposed clusters. We could see visual differences in the color of the extracts that matched what the spectrophotometer numbers told us. The east-exposed clusters' extract had the deepest color and the highest total anthocyanin content of the three treatments. There was no difference in color between shaded and west-exposed fruit (Spayd et al. 2002).

Second, we used the system developed by Tarara-Ferguson to impose varied temperature treatments on differently exposed clusters. A quick recap of the system: berries were used as the thermostats to control treatment temperatures. The temperature of shaded berries was used to control the temperature of sun-exposed berries on the west side of the canopy. So, in the afternoon, cooled air lowered the temperature of sun-exposed clusters. Conversely, berries on west-canopy clusters were used to manage the temperature of shaded clusters (hot air was blown on shaded clusters) to bring the shaded clusters to the temperature of the exposed clusters. Within a replication, all treatments were imposed on clusters on the same vine (Tarara et al. 2000).

Clusters that were heated went through veraison about two weeks later than clusters that were cooled. We saw similar differences in the onset of veraison due to aspect on leaf-removed vines, with earlier veraison on the east side of the canopy than on the west side. At harvest, soluble solids concentrations of all samples were equal. However, sun-cooled fruit and control east-exposed fruit had the highest total anthocyanin concentration of all treatments. Total flavonols, that have a UV-light sensitive enzyme in their biosynthetic pathway, were higher in all instances in exposed fruit (Spayd et al. 2002).

Additionally, there was an increased proportion of the acylated anthocyanins in the berries exposed to higher temperatures. The acylated pigments are more stable in wine. However, it must be noted that the actual concentration of these compounds in berries is much, much lower than the non-acylated pigments (Tarara et al. 2008).

So, how do these studies answer the question of higher anthocyanin concentrations in fruit from Concord vines receiving the high-N treatment and the Cabernet Sauvignon berries from the high irrigation-high crop level vines? One possible answer, or at least partial answer, is that these treatments pushed fruit ripening to later in the growing season when both daytime and nighttime temperatures are more conducive to anthocyanin accumulation.

WSU Extension Certificate Village

The certificate program developed from the need to educate an influx of non-academically trained folks who either had already started a winery, were starting a winery, or wanted to start one. Washington was and still is small enough that one bad bottle of wine from Washington can affect everyone's sales. The WA Wine Commission granted Jack Watson and I $24,000 to start the program. I told them at the time the program would be designed to be self-sustaining; it was and has been since inception. Teresa Beaver is now the full-time coordinator for the program.

With arm twisting, promises to make it as painless as possible, and the help of Mr. Jack Watson, the Benton/Franklin County Extension Agent, the original certificate program village was amassed. Some of the faces are the same and a few were added, including Trent Ball from Yakima Valley Community College and Anke Freimuth, wine consultant. This is a mix of faculty for the two separate certificates. As more faculty were hired, Jim Harbertson and Mercy Olmstead joined the program while I was still at WSU. I believe that Dr. Thomas Henick-Kling and Dr. Tom Collins assist with instruction.

A grouping of classes was termed a unit, not a course. The viticulture certificate had units in grape production, vine anatomy and physiology, soils, entomology, economics, virology, fungal and bacterial pathogens, and fruit and wine composition/winemaking. The enology certificate had units in fruit and wine chemistry, winery operations, wine microbiology, winemaking, sensory evaluation economics, and basic viticulture.

The original programs were $1999 for viticulture and $2999 for enology. The first iterations of the programs were face to face at WSU Prosser on Saturday mornings for three hours each week. Units were offered in succession. The cohorts were comprised of 25 students each and lasted for 18 months. There were also three mandatory weekend-long camps for both the certificate programs to provide for hands-on applications. Students paid their own travel costs for the camps. Subsequent class offerings were offered online. I believe the cohort size was increased to 30, and now the programs start a new cohort every

year, rather than every other year. Students are still required to participate in the three camps at WSU-Prosser.

Since its inception, 663 students have completed the program. Three hundred and thirty eight students were from Washington, 273 students were from 34 other states and the District of Columbia, 50 students were from six Canadian provinces, and two students were from Middlesex, England. After Washington, British Columbia, California, and Oregon were next highest contributors of students to the programs. Preference was given to Washington students.

I left WSU in 2006. By that time, we were starting to build a waitlist for both programs. After I left, it reached a peak of at least 300 for each program. The number per cohort was bumped up to 30, and some of the units were released for self-study without contact with faculty. This helped bring the waitlist down, plus other universities began offering similar cohesive programs. I must add that at the time the program was developed, UC Davis was offering numerous individual certificate classes.

Conclusion

You've seen a glimpse into some of the villages of my life and career. I've had the opportunity to interact in research, extension, and education with many other disciplines as well as with other colleagues in viticulture and enology. I do not have time to talk about my other villages—NC State and the grad students, undergraduate interns, and high school students who became members of one or more of these villages. Also, I have not discussed all of the multistate interactions I've had over my career—not enough time.

Finally, I want to express my concern(s). It is obvious to me that it is becoming more and more difficult to conduct the types of research and even extension programs that I have discussed. Academic administration and even we faculty members are too often more focused on the reign of publish or perish than on encouraging the development of integrated, multiyear research programs.

Programs that can churn out papers in weeks or months outpace solid research that requires multiple years of repeated vineyard or fermentation studies. There has been an explosion of minor journals that are fed by short-term or single-aspect studies done primarily to publish a paper. I've used one once or twice out of necessity to publish something. Many of those counting did not care about the content or the differences in effort between major multidisciplinary, years-long projects and short-term, churned-out papers. This is more likely true of departments with little focus on perennial woody plants.

With diminishing state and iffy federal funding, it is very much the onus of industry to find ways to support viticulture and enology research. I was lucky that, in Washington, a high premium was placed on not only research but also on extension, and now, education. Though the bulk of wine and grapes are produced by large corporate entities, it is the vast number of small growers and winemakers who get the attention of government reps—more votes. Keep pushing.

ASEV Village

I cannot conclude without again thanking the ASEV. I also want to say that I thoroughly enjoyed working with each member of the Board of Directors, the Executive Committees, and the professional staff of the ASEV, particularly Lyndie Boulton and Dan Howard. Serving in the various capacities of the Board provided me the opportunity to learn more about grapes and wine but, more importantly, to make many new friends with whom I hope to remain in touch in my retirement.

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