Northern Grapes News

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Delaying Budbreak for Northern Vineyards

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A major limitation to growing grapes in the Midwest and Northeast United States is the possibility of a late spring freeze. The best practice for avoiding winter and spring freeze injury is appropriate site selection. However, in many cases, vineyards are not established in the most suitable locations. To mitigate the problems associated with freeze-prone sites, many methods to provide freeze protection have been attempted and include wind machines, overhead irrigation, and helicopters. These methods are very costly and are not economical for small growers.

Delaying bud break. An effective strategy for protecting against spring freeze in the vineyard is delaying the onset of bud break in the spring. This has been attempted and proven using various methods including the use of plant growth regulators, alginate oils and dormant oils. Dormant oils have been the most researched and shown to delay bud break between 1-20 days (Dami & Beam, 2004). Plant growth regulators such as 1-Naphthaleneacetic Acid (NAA) sprayed at 500 to 1000 ppm have also been shown to delay bud break up to 27 days.

'Edelweiss' is one of the most common wine grapes planted in Nebraska and is one of the earliest cultivars to break bud, making it highly susceptible to spring freeze. Most of the vineyards in Nebraska are less than 20 acres, and growers cannot afford to employ freeze protection methods such as wind machines or helicopters. A single application of Amigo Oil in the late winter has been shown by both researchers and growers to be a potentially suitable method for avoiding spring freeze. However, there has been no research on effects of applying multiple applications of Amigo Oil to delay bud break even further than a single application. The objectives of this study were (1) compare the effects of multiple applications of NAA or Amigo Oil to 15-year-old 'Edelweiss' grapevines in the field and within a laboratory (2) observe potential phytotoxic effects to the buds and negative effects on fruiting characteristics including: cluster number per cane, cluster weight, °Brix, pH and titratable acidity (TA), and (3) determine the most efficient and effective method for applying the NAA and Amigo Oil to the grapevines.

Study Design. This research took place in 2012 and 2013 at James Arthur Vineyards near Raymond, Nebraska. The 2012 study was designed as a pilot study to better plan the full study. Treatments were applied to 15-year-old 'Edelweiss' grapevines trained to a Geneva Double Curtain (GDC) trellis system.

In 2013, Amigo Oil at 10% (v/v) (Loveland Industries, Greeley, CO) was applied until runoff (~0.7 Liters/vine) to all of the oil treatments on January 4 and February 7 for the vines requiring two applications, and finally on March 7 to vines treated with three applications. NAA at 1000 ppm (Phyto-Technology Laboratories, Shawnee Mission, KS) was applied in the same manner on the same dates. Both spray applications were made with a specially constructed All-Terrain Vehicle (ATV) sprayer to increase spray penetration, coverage, and consistency compared to a backpack sprayer (Fig. 1). After all applications were complete, the vineyard was pruned to normal standards in the third week of March.

Figure 1. ATV sprayer modified to spray Amigo Oil and NAA to unpruned vines. An adjustable lateral and vertical support arm was attached to the front of the ATV and three flat fan spray nozzles were attached to adjustable arms that surround the cordon. The small droplets easily penetrate into the cordon area and cover all buds. The sprayer was also equipped with a tank agitator, which kept the oil and NAA in suspension, allowing more even coverage of the material.

Bud Break and Fruit Characteristics. In the spring following treatments, Amigo Oil and NAA treated vines were evaluated for bud break. Bud counts were taken every three days from May 6 to June 6 until 75% of buds had opened. Bud break was determined as stage four of the modified Eichhorn-Lorenz scale of grapevine development (Coombe, 1995). Fruit was harvested on August 21, 2013. One-hundred-berry samples were also collected and tested for pH, soluble solid concentration (°Brix), and titratable acidity (g/L).

Results

Amigo Oil. Bud break was significantly delayed by all three Amigo Oil treatments (Fig. 2). Both two and three applications of oil had the most significant effect on delaying bud break, with a total delay of five days and six days, respectively. With the two applications of oil treatment, bud break ranged from May 19-22, resulting in a delay of three to eight days when compared to the control (untreated vines). Three applications of oil had a bud break ranging from May 19-24, giving a total bud break delay of three to ten days. The single application of oil in January showed a less significant difference, with a total delay of three days. The greatest delay in bud break was achieved with two or three applications of oil; however, there was no significant difference between these two treatments, so it would make more economic sense to only make two applications.

NAA. Contrary to previous reports, there was no significant effect on bud break with any of the applications of NAA when compared to the control (Fig. 2). Total delay of bud break with NAA ranged from one application delaying bud break by 0.04 days and three applications delaying bud break by 0.5 days (Fig. 2).

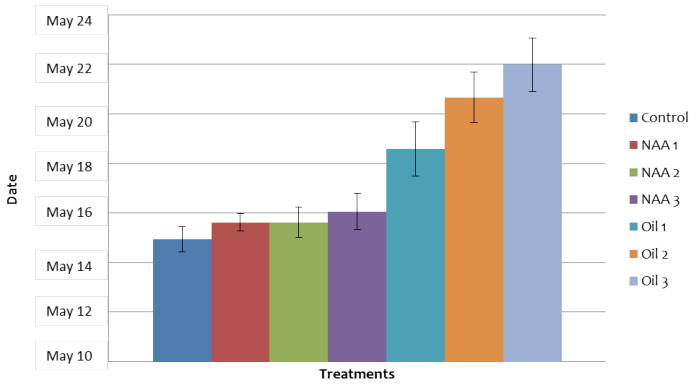

Figure 2. Mean date until 75% bud break of 'Edelweiss' grapevines when treated with one, two, or three applications of 1000 ppm NAA or 10% (v/v) Amigo Oil. 1, 2, and 3 corresponds to the number of treatments applied in January, January and February, or January, February, and March,

Rate of Bud Break. When analyzing bud break, it is important to consider the speed of bud development and opening in addition to the number of days until bud break. For instance, it is important to know what percent of the buds are open on a certain date compared to the control. In Figure 2, we see that on May 13, 50% of the buds were open on untreated vines, while only 9% of buds were open on vines sprayed three times with oil. Therefore, if a freeze event were to occur on this date, the amount of damage would be greatly reduced in a vineyard sprayed with oil. The control and the NAA-treated buds reached 10% bud break at an earlier date than the three oil treatments (Fig. 3). Further, completion of bud break (i.e., greater than 70% of buds open) occurred on May 17 in control vines, where it was delayed to May 31 (a difference of 14 days) in vines sprayed three times with oil.

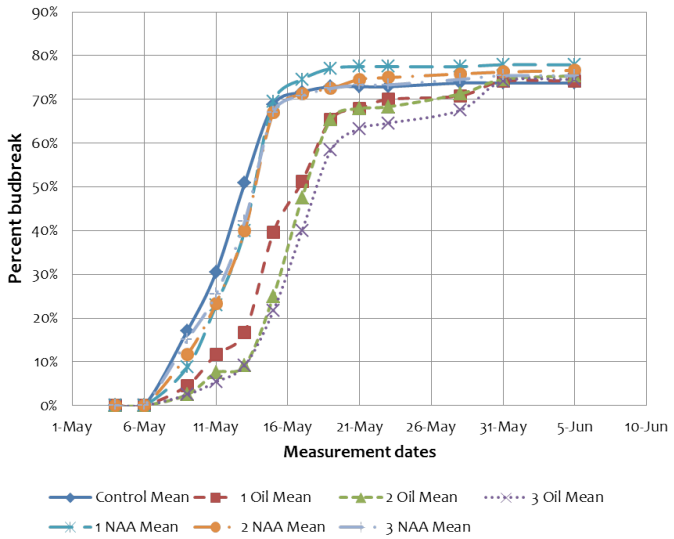

Figure 3. Plot showing the rate of bud break of one, two or three applications of 1000 ppm NAA or 10% (v/v) Amigo Oil at each measurement date. The buds of the three oil treatments developed significantly slower than that of the control and NAA treated buds.

Harvest Characteristics. In 2013, James Arthur Vineyards had one of the largest harvests on record from the treated 'Edelweiss' block. The Amigo Oil and NAA treatments had little effect on the number and weight of clusters harvested. There was some difference found between three applications of oil and the control where the total cluster weights were 4.66 lbs. and 7.23 lbs., respectively (Table 1). Although not statistically significant, there was considerable (34%) reduction of cluster weight using three applications of oil. Further research is necessary to verify these effects of three applications of oil.

Little to no difference in fruit chemistry was observed in the 100-berry samples that were collected at harvest. A small, but significant, difference was found in pH between the control (3.28) and three oil (3.12) applications. However, these numbers are within the recommendations for 'Edelweiss' fruit at harvest. There were no significant differences found between the control and any of the treatments for soluble solid content (°Brix) or TA. Soluble solids content ranged from 12.87 (control) to 13.51 (2 NAA and 2 Oil) and TA ranged from 12.02 (control) g/l to 13.76 g/l (3 Oil).

Recommendations. As a result of this research, we recommend applying 10% (v/v) Amigo Oil two times at monthly intervals, beginning in early February, to vineyards in areas prone to spring frost events and on cultivars that exhibit early bud break, such as 'Edelweiss'. Rather than the final date of bud break, growers should examine increased amount of time it takes treated vines to reach 10% bud break. Growers should also consider fabricating a specialized sprayer and mounting it to a tractor or ATV, which will improve consistency and reduce the time required to make the applications. Delaying the physiological response to increasing spring temperatures will provide a lower percentage of primary buds being injured should a spring frost occur. Research is continuing on bud break delay for grapevine cultivars important to *Northern Grape Project* vineyards.

Table 1. *Total cluster number, mean cluster number per cane, total weight of harvested clusters and mean cluster weight of the four predetermied canes on the two measured Edelweiss vines treated with one, two, and three applications of 1000 ppm NAA or 10% Amigo Oil.*

	Treatments						
	Control	**1 Oil**	**2 Oil**	**3 Oil**	**1 NAA**	**2 NAA**	**3 NAA**
Total Cluster Number	19.56 a	20.36 a	18.60 a	16.15 a	22.10 a	23.69 a	18.78 a
Mean Cluster Number per Cane	2.20 a	2.54 a	2.31 a	2.04 a	2.78 a	2.97 a	2.33 a
Total Cluster Weight (lbs)	7.23 ab	7.02 ab	7.04 ab	4.66 b	8.14 ab	8.82 a	7.77 ab
Mean Cluster Weight (lbs)	0.37 ab	0.37 ab	0.36 a	0.41 b	0.35 ab	0.42 ab	0.28 ab

*1, 2, and 3 corresponds to the number of treaments of NAA or Amigo Oil applied.

*Values with the same letter in the same row are not significantly different at $p \leq 0.05$.

Literature Cited

Coombe, B. (1995). Growth Stages of the Grapevine: Adoption of a system for identifying grapevine growth stages. Australian Journal of Grape and Wine Research, 1(2), 104-110.

Dami, I., & Beam, B. A. (2004). Response of grapevines to soybean oil application. American journal of enology and viticulture, 55(3), 269-275.

Northern Grapes Project Receives Additional Funds

Chrislyn Particka, Cornell University

The *Northern Grapes Project* received an additional $2.6 million in funding from the U.S. Department of Agriculture's Specialty Crops Research Initiative to complete the final two years of the multistate effort, which began in 2011.

In the first three years of the project, team members invested heavily in field and laboratory trials, conducted consumer and industry surveys, and provided outreach programming to an aggregate audience of more than 7,000.

"New producers are spread across twelve states, most without an established wine industry," said Dr. Tim Martinson, *Northern Grapes Project* Director. "By working together, the *Northern Grapes Project* team provides more resources to producers than would be available if each state had its own effort."

Dr. Thomas Burr, Director of the New York State Agricultural Experiment Station, said "The continued success of this project in obtaining funding is testament to the team's exceptional productivity and to how this project has impacted grape production in regions across the Northeast and upper Midwest."

"As a producer, having scientists involved is especially valuable to us as they are conducting rigorous tests to back up our hunches and our theories," said Dave Greenlee, a Project Advisory Council member and co-owner of Tucker's Walk Vineyard in Garretson, S.D. Greenlee cites trials of various trellising systems in vineyards and sensory evaluations of wines using different yeast strains in the lab. "These save us time and help us improve our products," he points out.

The grant was funded by the USDA National Institute of Food and Agriculture's Specialty Crops Research Initiative, which supports multi-institution, interdisciplinary research on crops including fruits, vegetables, tree nuts, and ornamentals. The project includes personnel from Cornell University, the Connecticut Agricultural Experiment Station, Iowa State University, Michigan State University, North Dakota State University, South Dakota State University, the University of Minnesota, the University of Nebraska, the University of Vermont, and the University of Wisconsin.

photo: Chrislyn Particka, Cornell University

Dr. Timothy Martinson speaks about the training system trials during a field day at Coyote Moon Vineyards in Clayton, NY. A variety of training systems are being evaluated in New York, Iowa, and Nebraska, in order to determine which training systems work best for the cold-hardy wine grapes. In addition to hosting trials, Coyote Moon Vineyards President Phil Randazzo serves on the Northern Grapes Project Advisory Council.

Results from the Northern Grapes Project Baseline Survey - A Series

The Role of Winery Tourists in the Cold-Hardy Wine Industry

Brigid Tuck and Bill Gartner, University of Minnesota

Editor's Note: We will be publishing a series of articles, starting here, which summarize data from the *Northern Grapes Project* Baseline Survey. This survey was completed in 2012, and several bulletins have been published, which are available on our website (http://northerngrapesproject.org/?page_id=544). This series of articles will highlight key findings and conclusions from these bulletins.

A recent series of articles in this newsletter (Vol. 2, Issue 3 to Vol. 3, Issue 3, (http://northerngrapesproject.org/?page_id=213) focused on winery tourists – their behaviors, purchasing and consumption patterns, and awareness of cold-hardy grapes. Information generated in the *Northern Grapes Project* Baseline Survey compliments this perspective by examining the role of winery tourists in the cold-hardy grape industry.

Results from the survey show how important winery tourists are to the success of cold-hardy wineries. This article will detail 1) how winery tourism drives winery sales, 2) current efforts by wineries and vineyards to increase tourism traffic, and 3) future efforts in tourism development. The results also reflect differences at the state level depending on state policies and on the how mature the industry is in the state.

Study Design: In early 2012, University of Minnesota Extension personnel conducted the *Northern Grapes Project* Baseline Survey, which included all grape growers and winery owners in the 13 states participating in the project. Two questionnaires were developed – one for commercial grape growers and one for wineries. Combined operations (a vineyard and winery) were asked to complete both surveys. The survey was deployed in early spring of 2012. Invitations to participate were sent via email to members of industry organizations in each of the states. An open link to participate in the survey was also provided and promoted through *Northern Grapes Project* communication (newsletters and webinars). In total, there were 611 total responses to the survey, a response rate of 21 percent. Of those, there were 442 useable responses. Fifty-six percent of respondents operated a vineyard only, 35 percent operated a combined vineyard and winery operation, and nine percent operated a winery only.

The number of wineries in the states included is growing rapidly. Only one of every five wineries was established before 2002 (Fig. 1). Just over one-third (37 percent) of wineries were founded between 2002 and 2007. The majority of wineries (43%) were started after 2007. The age of the winery factors into many of the measurements mentioned here.

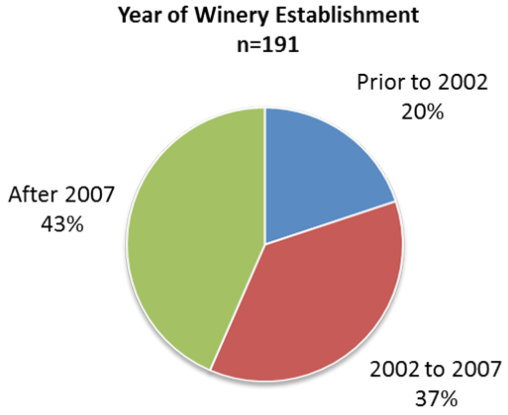

Figure 1.

Tourism is Driving Winery Sales: Survey results indicate the average winery sold 19,300 bottles of wine and that tasting room sales are a significant portion of a winery's total sales (Fig. 2). Nearly 80 percent of wineries operate a tasting room. On average, slightly more than half of an average winery's sales are directly from the tasting room to winery visitors. Approximately one-third of sales are via distributors or liquor stores. Sales to farmer's markets, restaurants, and direct-to-households are only a minor portion of sales. Sales outlets can vary significantly by state due to policies in place. Some states require that wineries sell through distributors to off-site customers whereas other states do not impose this distribution channel restriction.

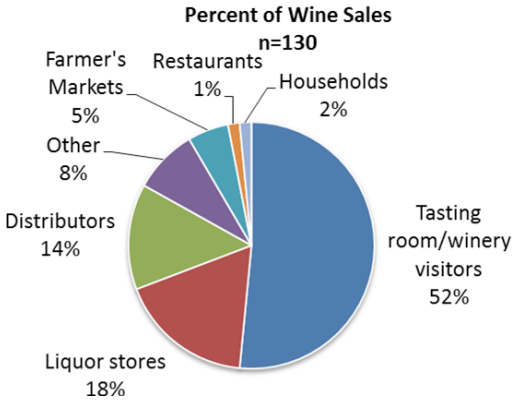

Figure 2.

While tasting rooms contribute significantly to winery sales, most wineries (70%) are located in rural areas (Fig. 3). In many states, the location in a rural area is based, in part, on the legislation that allows them to operate. In Minnesota, for example, wineries are licensed as farm wineries. Since rural areas have low population densities, it is clear wineries are drawing tasting room customers to their destination through tourism activities. Winery tourists are critical to the bottom line of most wineries in the *Northern Grapes Project* region.

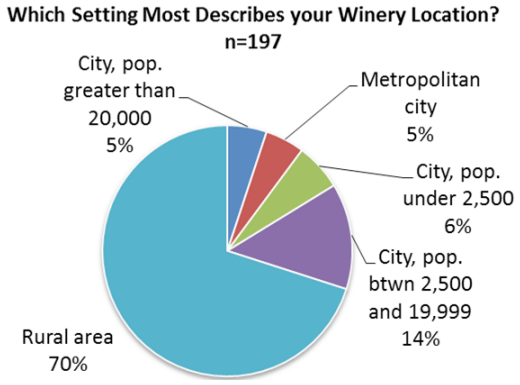

Figure 3.

Current Tourism Efforts: Wineries have begun to develop the winery experience. Wineries estimate that 42% of customers are repeat visitors, and critical to encouraging return visits is a positive tasting room experience. Of 192 respondents to the survey, 152 operate a tasting room, with just under half charging a tasting fee. On average, each tasting room served 8,000 guests. Approximately one-third of wineries also offer food. Some states restrict food sales in tasting rooms, but wineries in states that allow it have greater sales generated through their tasting rooms. Policies that allow more flexibility in tasting rooms, such as food service, are key to improving the consumer experience and generating additional sales.

Growing in popularity are wine trails, with slightly under half (49%) of wineries participating in one. Wine trail participation is increasing in states where winery development is highest. Results indicate the potential for further development of wine trails to increase tourist traffic to a winery.

Another component of tourism efforts is winery events (Fig. 4). In total, the 122 responding wineries reported 400,000 guests at winery events, including live music, weddings, tours, and grape stomps. Events drew a mix of local and non-local attendees dependent on the event type. Tour groups, for example, tend to bring a higher percentage of non-local visitors to the winery than live music events might attract. States with older wine industries, such as Michigan and New York, tend to have higher percentages of visitors from tour groups than other states, reflecting their longer collaboration with the tourism industry. States in which the winery industry is still relatively young tend to have a higher percentage of their winery events drawing from local attendees.

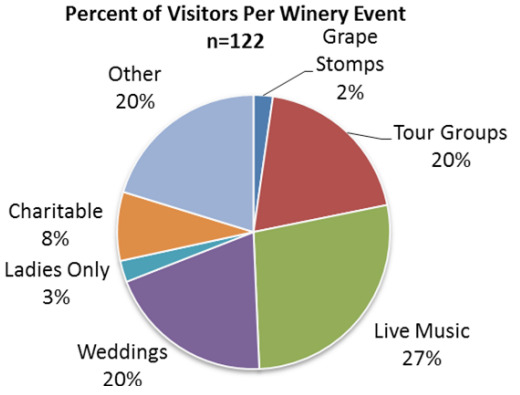

Figure 4.

Future Tourism Development: Survey results indicate collaboration may be the key to continued success in the development of winery tourism. Wineries were asked to comment on the extent they collaborate with other organizations in their region. Collaboration among wineries (through things like wine trails and state associations/councils) received the highest score. Wineries also indicated collaboration with tourism destination marketing organizations (e.g. convention and visitor's bureaus). While collaboration with other wineries and tourism destination marketers were ranked in all states as having the highest extent of collaboration, the average scores varied. In states where the winery industry is more mature (even if cold-hardy grapes are relatively new), the extent of collaboration was higher. In New York, for example, collaboration with other wineries received an average score of 3.5, which indicates a moderate level of collaboration on a scale where one equals no collaboration and five equals a great deal of collaboration. In states like Minnesota, where the responding wineries were more newly established, the collaboration with other wineries received an average score of 2.9, indicating a lower level of collaboration.

There is room to increase collaboration with tour operators, tourism attractions and recreation providers. As the cold-hardy wine industry grows, so will its ability and willingness to negotiate and collaborate with other organizations.

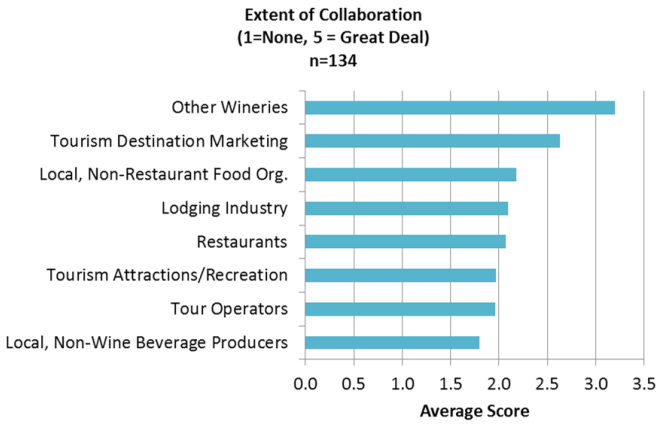

Figure 5.

Conclusions: Wineries producing wines from cold-hardy grapes are relatively new in the winery industry landscape. Evidence across states indicates the industry is beginning to mature in the states that were early adopters of cold-hardy grapes. As the industry matures, it will increase its connections with the tourism industry. These connections will be necessary to continue to increase tasting room sales, particularly for wineries in rural locations.

NGP Team Profile: Zata Vickers

Zata is a Professor in the Department of Food Science and Nutrition at the University of Minnesota. She has a 50% teaching/50% research appointment and oversees the sensory center at the university, which conducts sensory tests for people inside and outside the university. Her role in the project will be to plan and oversee the sensory testing aspects of juice and wine produced in Minnesota, including conducting the sensory tests, analyzing the data and preparing written documentation of the methods and results.

1. Your undergraduate and graduate degrees are in food science. How did your interest in food science develop?
In elementary school and high school I always enjoyed playing with recipes, especially cake, candy and cookie recipes, trying to make them 'better'. The failures were 'interesting," never frustrating. When I heard that one could major in this sort of playing with their food, and then have a career designing foods, I was smitten.

2. In addition to conducting research, you run the Sensory Center at the University of Minnesota, which relies on a trained panel. How is this panel trained?
Collectively our panelists are the 'instrument' we use to describe specific foods and wines. We first select people that have at least 'normal' taste and smell acuity, and can describe foods articulately.

We start by training them to rate the intensity of tastes and flavors. We use a 20-point taste and flavor intensity scale; each scale point is defined by a specific concentration of citric acid in water. The value of 1 is barely detectable; the value of 20 is as intense as any food is likely to be. Once people can reliably rate the intensities of these citric acid solutions, they move on to rating intensities of other taste solutions (e.g. salty or sweet), and then on to separately rating the intensities of several tastes in a mixture. From there they move to rating the intensity of each taste present in a real food product. We have a similar calibration scale for odors; that scale is a series of butanol concentrations. This training to calibrate intensity ratings of aroma, taste and flavor attributes is one training goal.

Our second goal is working with panelists to identify the different flavor, texture, and appearance attributes of a product. This comprehensive list of sensory attributes becomes what we call the product lexicon. Each term in this lexicon has a definition and, if possible, a chemical compound or another product, that 'illustrates' the meaning of the term. For example we have some violet candies that illustrate the floral aroma attribute in Frontenac wines, and we use a solution of .005% ferrous sulfate to illustrate a metallic flavor. Our current lexicon for Frontenac grape flavor has 20 terms; our lexicon for Frontenac wines has 26 terms.

3. You work on a wide range of projects and collaborate with a number of different researchers. What research do you find most interesting and why?
That is like trying to identify your favorite child. I am very fortunate to have many colleagues that are passionately interested in their research and pass their enthusiasm on to me. Designing experiments that provide the information they need as well as pushing out the boundaries of my own sensory science discipline is most satisfying.

4. From your perspective as a food scientist, what are the biggest challenges facing the cold climate grape industry?
Some of these grapes/wines are very sour! I am very happy to see that some of this project's research is directed at exactly that! We need products and strategies that both do and don't compete head-to-head with grape growing and wine making regions having centuries of experience.

5. In your opinion, what is the most exciting research-based information that will come out of the *Northern Grapes Project*?
The connections among all the parts! Within just the part that I am involved in that includes connections from flavors that people like, to the chemicals responsible for the flavors, to the growing conditions that enhance the production of those chemicals, to the genes that code for them.

NGP Team Profile: Adrian Hegeman

Adrian is an Associate Professor in the Department of Horticultural Sciences at the University of Minnesota. He studies plant metabolomics and the use of stable isotopes and mass spectrometry for methodological innovations. He is interested in comparing the metabolism of Vitis vinifera and V. riparia hybrids to understand the molecular basis for differences in grape berry color and flavor/aroma properties as well as physiological traits such as stress tolerance.

1. Tell us a little about how a guy with a PhD in biochemistry and a background in proteomics and metabolomics ended up in a horticulture department.

I originally planned to major in botany, but was given a scholarship by Dow Chemical Company that required that I declare a major in a chemistry department. So I declared a biochemistry major and began working in a lab learning how to chemically synthesize natural products from a marine organism. At some point it occurred to me that while chemical synthesis was interesting, it relied on a significant amount of trial and error and lots of toxic/explosive reagents, but that many different forms of life were able to synthesize molecules of exquisite complexity using enzymes encoded in their genes. In graduate school I wanted to learn as much as I could about how enzymes work so I studied in a mechanistic enzymology lab with Professor Perry Frey at the University of Wisconsin–Madison. At the completion of my PhD, my wife had a fairly unique job in the non-profit sector in Madison so we decided to stay put for my postdoc and move later. Since I was staying at the UW, I decided to change fields slightly to broaden my training and jumped at the chance to work in a lab run by Professor Michael Sussman studying plant genomics. In this lab I brought together my experience in biochemistry and enzymology to study the fundamentals of plant function in the (then) emerging disciplines of proteomics and metabolomics, which try to measure proteins, enzymes and metabolites of an organism at a scale comparable to an entire genome.

2. Can you tell us why you'd initially chosen botany?

Both of my parents are scientists and were on the faculty at Indiana University. Our family had a small farm that was mostly forest, but also had some pasture, an orchard, vegetable gardens, a small vineyard, and bees. We used to spend quite a bit of time exploring the woods, mushroom hunting, and looking at early spring wildflowers. My parents would point out pharmacological uses of plants like solomon's seal, fox glove, jimson weed, and ginseng. I feel a bit sheepish citing what amounts to a hobby farm as the origin of my interests in plants and phytochemistry, especially working around so many excellent people with real experience in commercial farming as I do now, but I am not sure I would have developed the same interests in plants or biology without this exposure.

3. You've been doing some work with Aveda to identify natural replacements for synthetic preservatives, and have identified some potential compounds in grapes. Can you tell us more about this?

Grape vines actually produce a pretty impressive arsenal of chemicals to help fight diseases. The cold hardy cultivars in particular produce a huge array of these chemicals partly because of the high genetic diversity that accompanied cold tolerance and disease resistance traits from wild grape species. We are currently exploring using a special extract of pruned canes as a natural preservative for personal care products in collaboration with Aveda (a subsidiary of Esteé Lauder). We are still at the earliest stages of characterizing the antifungal and antimicrobial activities of these compounds, but are excited about this novel use for prunings and the potential for adding value for growers through sale of materials that is currently a waste product of the industry.

4. You have a very different perspective when it comes to grapes compared to many of the others working on this project. What do you find most interesting about the cold-hardy cultivars, in comparison to traditional vinifera cultivars?

The traditional vinifera cultivars, though they encompass a large number of recognized varieties, are not very genetically diverse especially when compared with varieties derived from hybrid crosses. Different types of anthocyanins are found in the cold hardy hybrids - the anthocyanins in Frontenac contribute to some of the less desirable blue color, but also provide a new broader pallet of pigmentation chemistry. This becomes evident in some of the work Katie Cook has done with Frontenac Rosé, which has unprecedented color stability. I think the cold hardy cultivars are fascinating because they have such relatively high genetic diversity that makes them more chemically complex and truly novel.

5. In your opinion, what is the most exciting research-based information that will come out of the *Northern Grapes Project*?

I think that if the project can help people to celebrate the novel characteristics of the cold hardy grapes that distinguish them from the traditional vinifera cultivars, then we will begin to see great improvements in breeding, cultivation and enological practices that will truly unlock the genetic potential of these and future cold hardy cultivars

Eastern Winery Exposition & Northern Grapes Symposium

Make plans now to attend the 2015 E*astern Winery Exposition*, and *Northern Grapes Symposium* at the Oncenter in Syracuse, NY! The *Eastern Winery Exposition* is a wine industry trade show and conference designed for Eastern U.S. and Canadian wineries and vineyards. The Expo runs from March 17-19, 2015. This year, the *Northern Grapes Symposium* is being held in conjunction with the Expo, and will feature five talks given by members of the *Northern Grapes Project* team.

Visit the *Eastern Winery Exposition* website for more information - we hope to see you there!

Main website: http://easternwineryexposition.com/
Conference schedule: http://easternwineryexposition.com/conference/
Registration: http://easternwineryexposition.com/registration/

2014-2015 Northern Grapes Project Webinar Schedule

December 16, 2014
"Stuck on you – Sulfur Spray Residues in the Vineyard and Winery"
Chris Gerling and Gavin Sacks, Cornell Univ.

January 13, 2015
"Emerging Cold Hardy Wine Grape Cultivars"
Tom Plocher, Northern Winework, Inc. and Mark Hart, Mt. Ashwabay Vineyard & Orchard

February 10, 2015
"Comparing and Contrasting Vertical Shoot Positioning and Top Wire Cordon Training Systems"
Tim Martinson, Cornell Univ.; Bob Utter, Flying Otter Vineyard and Winery; and John Thull, Univ. of Minnesota

March 10, 2015
"Tannin Addition and Retention in Red Hybrid Wines"
Anna Katharine Mansfield, Cornell Univ.

April 14, 2015
"Branding Studies for Cold Climate Wines"
Bill Gartner, Univ. of Minnesota

For more information, visit http://northerngrapesproject.org/?page_id=12

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eViticulture.org
eViticulture.org is the national online viticulture resource containing the latest science-based information for viticulturists.

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Cornell University