NORTHERN GRAPES PROJECT

Viticulture, enology and marketing for cold-hardy grapes

Northern Grapes News

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Cost of Production in Cold Hardy Grapes

Miguel Gomez, Sogol Kananizadeh, and Dayea Oh, Cornell University

The objective of this study is to determine the cost of producing cold hardy grapes in a commercial-size operation in both the Thousand Islands and Chautauqua regions of New York. Conducting such cost studies for cold hardy grapes is important because these varieties are fairly new and are gaining popularity in nontraditional vineyard regions. These estimations will benefit approximately 500 vineyards in the Upper Midwest and Northeast, helping them to become profitable, sustainable operations. The study focuses on the cultivars Marquette, La Crescent, Frontenac, and Brianna, and develops the estimates of the total investment in land, machinery, vineyard establishment and development costs, as well as annual operating costs. These estimates would help the potential growers and investors to compute and analyze the costs and profit potential for their own situations.

The Thousand Islands region stretches for about 50 miles along the Saint Lawrence River, where it forms the border between New York and Ontario, Canada. The Thousand Islands first attracted wineries in the early 2000s; today, there are about ten vineyards in the area. The second region included in the study, Chautauqua County, is located in the southwestern corner of New York, and is the westernmost of the state's counties. As one of the oldest and largest Concord grape growing region in the world, the county today has a 50 mile wine trail, includes over 30,000 acres of vineyards and is home to 24 wineries. Though the majority of the acreage is still devoted to Vitis labrusca cultivars such as Concord and Niagara, wine grape cultivars have been grown in the region since 1830.

Cost Components. In developing the production costs of cold hardy grapes in each region, basic assumptions including the vineyard layouts, grape prices and yields, wages, and overhead costs were made to characterize a representative vineyard. Each region has unique characteristics, leading to different costs of establishment and operation, as well as yields and prices. Table 1 presents the average grape prices and yields for a mature vineyard in both regions.

Table 1: Average yield and per ton price listings for selected cold hardy grapes in 2014

		Brianna	Frontenac	La Crescent	Marquette
Yield (tons/acre)	Thousand Islands	2.44	2.25	2.20	3.02
	Chautauqua	5.00	5.00	4.00	5.00
Prices ($)	Thousand Islands	$1,500	$1,500	$1,500	$1,800
	Chautauqua	$600	$600	$600	$900

To construct cost estimates, we used a combination of interviews with a panel of grower representatives and economic engineering using recommended practices. The panel graciously provided itemized cost estimates for growing grapes, which were categorized into "establishment and development costs" and "operation costs."

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Pat Brown helps prune grapes at Tug Hill Vineyard in Lowville, NY.

photo: Sue Maring, Tug Hill Vineyard

In the Chautauqua region, all varieties show moderate per acre profits ranging from $448 to $1,873 except for La Crescent, which produces a modest loss of $76. As mentioned above, fixed costs per acre are much lower in the Chautauqua region compared to the Thousand Islands. Additionally, grape yield is also higher in this region. Table 3 summarizes these finding for each variety for a mature vineyard in Chautauqua.

Table 3: Costs and returns per acre for a mature cold hardy vineyard, trained to high cordon, Chautauqua Region, NY, 2015

	Brianna	Frontenac	La Crescent	Marquette
Total receipts	$3,000	$3,000	$2,400	$4,500
Variable costs	$1,506	$1,506	$1,460	$1,506
Fixed costs	$1,046	$1,046	$1,016	$1,121
Profit or loss	$448.00	$448.00	-$76.00	$1873.00

Establishment and development costs include costs for labor, machinery and materials for site preparation in years one through three. First year costs, including site preparation, trellis construction, and planting are substantial, amounting to $11,613 per acre in the Thousand Islands region and $9,115 per acre in the Chautauqua region. The largest cost in the first year is planting and trellis construction for both regions, which amounts to $2,757 and $3,316 per acre respectively in the Thousand Islands, versus $2,245 and $2,314 per acre in the Chautauqua region. In year two, costs are relatively modest with lower spray costs and less labor required than for mature vines. Fixed costs, which consist of capital recovery for machinery, equipment, buildings, property taxes, office supplies, land charges, insurance, and management, are also calculated.

Annual growing costs for years four through 22 include pruning, brush chopping, mowing, trellis maintenance, replanting, weed control, fertilization, and insect control. In the Thousand Islands, growing costs in a typical year in a mature vineyard are estimated to be $1,750 per acre. The most costly operations are canopy management at $249 per acre, spraying at $330 per acre, and pruning and brush removal $397 per acre. In the Chautauqua region, total growing costs are lower, estimated to be $1,261 per acre. The most costly operations are similar to those in the Thousand Islands with canopy management totaling $228 per acre, spraying at $144 per acre, and pruning and brush removal at $187 per acre.

The total variable and fixed costs for both regions are shown in Tables 2 and 3; coupled with total receipts, this gives us the total returns for each variety. In the Thousand Islands (Table 2), Brianna, Frontenac, and La Crescent show large per acre losses, ranging from $1,538 to $1,226, given the assumed yields and prices. Only Marquette, with its higher yield and market price per ton, generates a profit of $389 per acre.

Table 2: Costs and returns per acre for a mature cold hardy vineyard, trained to high cordon, Thousand Islands Region, NY, 2015

	Brianna	Frontenac	La Crescent	Marquette
Total receipts	$3,660	$3,375	$3,300	$5,436
Variable costs	$2,072	$2,048	$2,042	$2,145
Fixed costs	$2,813	$2,799	$2,795	$2,902
Profit or loss	-$1226	-$1473	-$1538	$389.00

Difference in Costs. The difference in total costs of the two regions rises from many factors. The Thousands Islands region has higher grape prices but lower yields and the Chautauqua region has lower prices but higher yields. The Chautauqua region, in general, has lower costs for most components, such as land, labor, and equipment. The two regions also have differences in growing practices. For example, growers in the Chautauqua region generally do not hoe around the vines or rogue, or use any insecticides during years 0 and 1. The materials and the amount of insecticides, herbicides, and fertilizers in the two regions differ as well.

But the biggest difference lies in the way the fixed costs of the two regions affect the economics of the vineyard. As mentioned earlier in the article, the majority of the vineyard acreage in the Chautauqua region is juice grape varieties such as Concord and Niagara. Vineyards in this region tend to be larger, and most vineyards that grow cold-hardy hybrids also grow juice grapes. A representative farm in the region has 200 acres of grapes, with only 13 acres of cold-hardy varieties. If total fixed costs are divided only by the acres of cold hardy grapes, this results in unrealistically high loss. Instead, when treating the total fixed costs per acre, which includes machinery, equipment, buildings, office supplies, and insurance, the total costs are divided by the total acres of grapes, inclding varieties other than the cold-hardy hybrids.

On the other hand, the fixed costs of the vineyards in the Thousand Islands were divided by the acres planted in cold hardy grapes, since they are usually the only varieties grown. Collectively, the fact that the Chautauqua region shows less cost (and thus higher profit) can be attributed to the larger-scale production and the long history of grape production in the area, which gives the growers the advantage of economies of scale as well as "production know-hows."

Total Investment. The following two tables show the capital investment per acre necessary to start grape production in each region. Table 4 indicates that it would require $34,425 per planted acre to get a vineyard into maturity in the Thousand Islands region under the assumptions indicated above. Table 5 presents findings from the similar calculations and concludes growers in the Chautauqua region require $15,348 per planted acre to get a vineyard into maturity. The substantial investment differences between the two regions highlight the importance of developing region-specific cost studies to support production decisions. This is particularly important for cold-hardy grapes, as they are being increasingly planted in non-traditional wine regions across the country.

Table 4: Investment per planted acre of cold hardy grapes, Thousand Islands Region, NY, 2015

Assets	$/acre
Land*	$2,200
Machinery & equipment	$10,663
Buildings (shop & tool shed)	$3,375
Vineyard establishment and development	$18,187
Total investment per acre	$34,425

***** Assumes 22 acres purchased (including support land) for 20 planted acres.

Table 5: Investment per Planted Acre of Cold Hardy Grapes,Chautauqua Region, NY, 2015

Assets	$/acre
Land*	$2,308
Machinery & equipment	$1,222
Buildings (shop & tool shed)	$270
Vineyard establishment and development	$11,549
Total investment per acre	$15,384

***** Assumes 15 acres purchased (including support land) for 13 planted acres.

Future Research. In viewing the presented estimates, one should bear in mind the study assumes good vineyard sites (well-drained, productive soils with appropriate slopes for air drainage) are used and recommended vineyard practices are followed, which would result in premium quality grapes. Poorer sites and/or failure to follow optimal management practices can have a significant negative impact on the earnings estimates presented in this publication.

Potential discussions for future reports include how the participation in certain channels would affect the profit of a vineyard. For example, incorporating wine production and distribution to the vineyard business would affect the analysis. It would also be interesting to explore the impact of different grape varieties, practices such as organic production, or the impact of extreme situations including unusually harsh winter or variations in macroeconomic conditions.

The authors thank Kirk Hutchinson, Raymand Krupa, Dennis Rak, Mark Martin, and Rick Walker, who served as the growers' panel in the Chautauqua region and to Susan Maring, Phil Randazzo, David Fralick in the Thousand Islands region for helping to establish the costs reported in this bulletin. We also thank Kevin Martin, Associate Extension Educator at Penn State Extension and Business Management at Lake Erie Regional Grape Program, and Dr. Tim Martinson, Head of the New York State Viticulture Extension Program and faculty at Cornell University, for their helpful reviews of the manuscript.

Small Sprayers for the Smaller Vineyard

Andrew Landers, Cornell University

There are many growers with small vineyards who don't require airblast sprayers and have a need for spraying equipment ranging from backpack sprayers to small vertical boom sprayers. There are many important points to consider before purchasing a sprayer, not the least of which is the area to spray, the proximity of the local supplier, standard of manufacture, etc.

Canopy Sprayers

1. Backpack sprayers

Knapsack sprayers never seem to go out of style. First used in the late 1800s, today's knapsack sprayers still sport basically the same design – tank (that is carried on the back, thus freeing up the hands for spraying and pumping), pump, pump handle and hand lance (with an on/off trigger and nozzle). Knapsack sprayers are most appropriate for small acreage, up to 4-5 acres, spot spraying, or hard-to-reach targets. Unlike compression sprayers, the tank is not air-tight and is not pressurized.

Today's knapsack sprayer tanks are frequently made from polypropylene or high density polyethylene. Ultraviolet in-

hibitors are added to prevent degradation from sunlight. Tanks can also be made of stainless steel, brass or steel that has been galvanized or coated with an epoxy-resin product. However, plastic tanks are lighter than metal and offer the benefit of being molded to better fit the operator's back.

Knapsack tanks range from 2 to 5.5 gallons. Larger tanks clearly offer less frequent filling, but at the expense of added carrying weight (one gallon of water weighs 8.3 pounds). A tank should have an easy-to-read volume gauge and a large filler hole for easy filling and cleaning. When resting on the ground, the sprayer should be stable.

Carrying straps should fit comfortably on the shoulders, bearing most of the weight, and allow the tank to comfortably fit on the back and straps should be made of non-absorbent and rot-proof materials. Sprayers should also have waist straps to reduce lateral movement of the tank and to allow more of the weight to rest on the hips. Adjustable straps are a necessity and should allow for easy adjustments and unhooking.

Pumps are generally placed inside of the tank. External pumps, while easy to access for maintenance, tend to be more uncomfortable as they disrupt the tank symmetry and may cause an uneven pull on the operator's back.

Ideally, a sprayer should have a pressure control valve. If not, the constant pressure reduction during spraying will result in larger droplets as the flow rate is reduced. In such cases, it is advised to spray half the dose walking one way, recharging with the remaining dose, and then applying it in on the target from the other direction.

A pressure control valve will allow a constant pressure, and therefore uniform output, to be maintained. As spraying proceeds, pressure declines thus necessitating frequent repressurization. A pressure control valve, placed between the tank outlet and the hand lance, will allow the spray-line pressure to remain at a constant pre-set level, despite declining pressure in the tank. Often, less expensive knapsack sprayers are sold without a pressure gauge. This is short-sighted economic saving, as pressure is one of the major factors in accurate spray application. The cost of a pressure gauge will easily be paid back by the accurate application of expensive pesticides.

Sprayer hoses should be reinforced, durable, and securely attached to the tank, preferably not at the base of the tank, to avoid damage when the tank is resting on the ground. Screens/filters are essential in trapping debris and averting blockages. Generally, there are at least two filters. A larger mesh basket filter near the opening in the top of the tank will trap large debris. Progressively finer filters in the line (in the lance and/or nozzle) will trap smaller particles before spray enters the nozzle tip.

Hand lances are generally long to keep the operator as far away as possible from the spray. Long lances also allow spraying of more remote, or hard-to-reach targets. Multi-nozzle booms can also be used to increase spraying area and operator productivity.

Spray management valves (SMV) act like a diaphragm check valve. If the pressure drops to a minimum level, the valve shuts off the flow (to keep the pesticide from dripping out of the nozzle). SMVs also regulate pressure. One such valve, the CFValve TM senses both the back pressure of the nozzle and the pressure input from the pump and automatically adjusts the orifice size within the valve to maintain a constant flow. A downside of SMVs is the need to keep it scrupulously clean to prevent clogging.

Most, but not all, nozzles are appropriate for knapsack sprayers. Low pressure flat fan nozzles (regular, even, twin flat, and flooding) are commonly used along with hollow cone and low-drift nozzles.

An alternative to the hand operated backpack sprayer is an electrically operated backpack sprayer, which utilizes a small rechargeable battery. Maximum pressure is relatively low and it is easier to use than a traditional hand pump system, particularly if you have many rows of vines to spray. Similarly a small backpack sprayer fitted with a small gas engine is available. The electric version is quieter to use but you must remember to recharge the batteries otherwise spraying will be delayed. Weight is an important consideration with powered backpack sprayers.

2. Motorized knapsack mistblowers

These are ideal for vineyards where canopy penetration is required, e.g. denser, less manicured canopies, or for vineyards on top of a hill where the wind never seems to drop.

"Mistblower" is a bit of a misnomer, as the spray is not as fine as a mist. Mistblowers are ideal for vineyards, as the spray can penetrate more dense foliage than a conventional non-motorized knapsack sprayer. Small engines are preferred (about 35 cc) as they are lighter weight. A direct drive connects the engine to a centrifugal fan which is vertically attached to an L-shaped knapsack frame with vibration-absorbing mounts. The fan creates a high velocity airstream that is diverted through a 90 degree elbow and into a flexible discharge hose which terminates in a nozzle. The hose is held in front of the operator and downwind so the spray is not blown back onto the operator. Since some of the fan air is used to pressurize the tank, the tank must be airtight and leak proof.

Backack mistblowers are ideal for vineyards, as the spray can penetrate deeper into the dense canopy than non-motorized options.

photo: Andrew Landers, Cornell University

The engine speed is typically 5- 6,000 rpm, but some can be higher. Regularly check the engine speed with a tachometer, as the engine speed controls the air velocity and volume of the spray. The engine should be started before the operator puts on the knapsack. The engine should be run in full throttle with few idling periods and ear protection is recommended. Engine speed can be reduced which enables a slower airspeed to match a smaller canopy in early season.

The spray leaving the discharge tube is propelled at a high velocity. Thus, the discharge tube should not be held too closely to the target, lest the spray be blown past the target. Additionally, the air speed decays rapidly with distance. The ideal distance from the target varies with airflow from the machine. Point the spray plume slightly backwards towards the canopy to avoid walking into the spray cloud.

To ensure proper coverage, operators must walk at an even pace and close the liquid tap when they stop, to prevent overdosing of the target. They are very good at rustling the canopy and getting good penetration and deposition, but are heavy!

3. Portable engine-driven gas sprayers

If weight is a problem, and ground conditions are relatively smooth, a number of manufacturers offer a sprayer with a small tank (10-12 gallon) and gas engine. Larger capacity tanks (14-100 gallons) are often trailed and can be pulled by a lawn tractor, ATV, Gator or small tractor.

4. Small mounted sprayers

With a capacity of about 15-25 gallons, they are ideal for mounting onto the carrier rack of an ATV and use a small electric pump to provide up to 70 psi. When used with a hand-wand and a hose they can be used to spray short lengths of vine rows. The same system (providing it is thoroughly cleaned after use) is ideal for general weed control and spot spraying of weeds.

Small engine-powered sprayers such as this one can be mounted on carrier racks of ATVs.

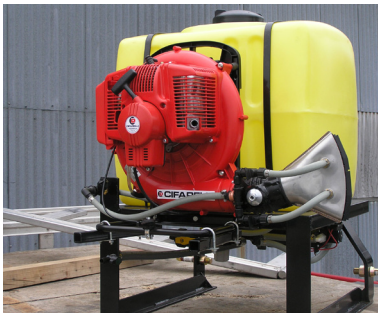


photo: Andrew Landers, Cornell University

5. Large skid mounted sprayers

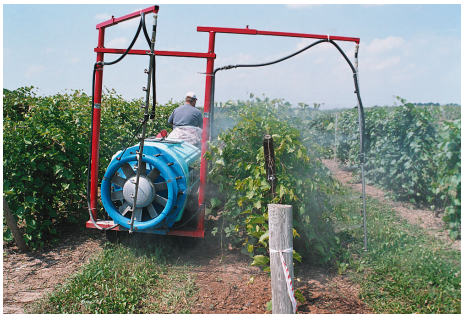
These sprayers have a tank capacity of 35-200 gallons, and electric-start gas (petrol) engine and are ideal for fitting into the back of a pick-up truck.

6. Small mounted vertical boom sprayers

Many years ago, when airblast sprayers hadn't been invented and drift was never an issue, growers would spray their vines with a vertical boom sprayer. They are relatively inexpensive and are quite controllable compared to an airblast system. The disadvantages are that they lack penetration into dense canopies and suffer from the effects of wind blowing over the vineyard. If you have well-manicured vines and can wait until the wind drops (early in the morning or late at night) then this sprayer could be considered.

A small vertical boom sprayer.

photo: Andrew Landers, Cornell University



A vertical boom conversion on an ariblast sprayer.

photo: Andrew Landers, Cornell University

7. Small mounted and trailed airblast sprayers

Very small airblast sprayers, with tank capacities up to 110 gallons and powered by small 5.5- 20hp gas (petrol) engines or small tractors are available. Larger tank capacities up to 300 gallons are also available, but great care is needed when operating them on sloping ground due to the weight of the sprayer pushing the tractor downhill. Operators should ensure that the weight of the tractor is greater than that of the full sprayer, otherwise jack-knifing might occur.

Remember the larger the gas (petrol) engine, the more important it is to buy an electric start option. Small airblast sprayers are ideal in smaller vineyards but suffer from a lack of air direction and variability in airflow– purchase sprayers with deflectors or towers to direct the air into the canopy.

Small mounted airblast sprayer.

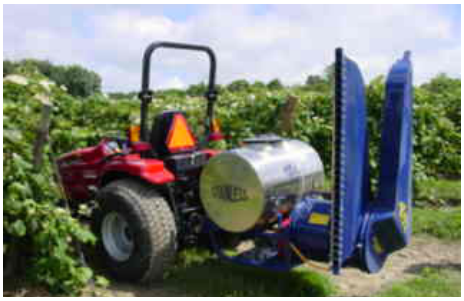


photo: Andrew Landers, Cornell University

An Overview of Herbicide Applicators

1. Backpack sprayers and small ATV mounted tank and hand-lance sprayer

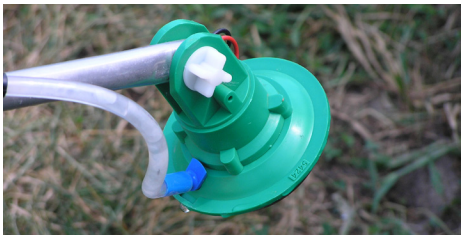
These can be used for both canopy and herbicide application BUT be very careful that there is no carry-over of herbicide residues in the sprayer tank. Therefore, wash out very thoroughly before using on a grapevine canopy.

Backack sprayers being used for weed control.

photo: Andrew Landers, Cornell University

2. Controlled droplet applicator.

The use of Controlled Droplet Applicators (CDA) will considerably reduce the need to carry vast amounts of water. A spinning disc (battery powered) will produce 95% of the same-size droplets, thus reducing herbicide rates by at least 50% and water rates by 75%. Micron Herbi and Mantis (trade names) are both hand-held CDA sprayers. ATV or tractor mounted shielded CDA sprayers such as the Environmist, based upon the Micron spinning disc system, reduce spray rates while shielding the vines from the spray. Remember you may be using a very low rate of product so will be on your own if it goes wrong!



Micron controlled-droplet application hand-held weed sprayer.

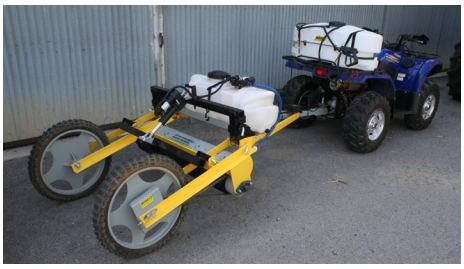
photo: Andrew Landers, Cornell University

Mantis controlled-droplet application hand-held weed sprayer.

photo: Andrew Landers, Cornell University

3. Wick wipers

Where occasional weeds and access over wet land are a problem, the use of a hand-held wick wiper is an easy-to use, effective option. A small tank, usually contained in the handle, holds the liquid, which soaks a rope wick or a sponge. The rope or sponge can then be wiped against the weeds.



Wick wiper for weed control.

photo: Andrew Landers, Cornell University

Further detailed information on vineyard spraying can be found in the book *Effective Vineyard Spraying*, obtainable at: www.effectivespraying.com.

Remaining 2016 NGP Webinars

March 8, 2016

"Cold-Hardy Grape Breeding at the University of Minnesota and North Dakota State University"

Matt Clark, University of Minnesota and Harlene Hatterman-Valenti, North Dakota State University

April 12, 2016

"Northern Grapes Project Research Results: Fungicide Sensitivity and Vine Nutrition of Cold-Hardy Cultivars"

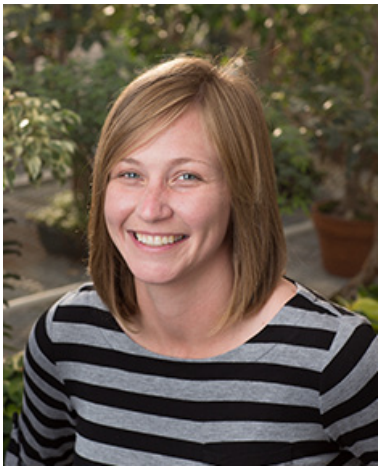
Patricia McManus, University of Wisconsin-Madison and Carl Rosen, University of Minnesota

May, 2016

"From Vine to Glass: Understanding the Flavors and Aromas of Cold-Hardy Grapes and Wine"

Anne Fennell, South Dakota State University; Adrian Hegeman University of Minnesota; and Somchai Rice, Iowa State University

NGP Team Profile: Diana Cochran



Diana is an Assistant Professor and Extension Fruit Specialist at Iowa State University. She conducts research in viticulture, pomology and hops, with the goal of reducing production costs and optimizing plant establishment. As part of the Northern Grapes Project, Diana is evaluating cold climate variety performance by conducting on-farm research and demonstration studies on training systems and canopy and crop load management.

1. Tell us a little about your background, specifically, when and how your interest in horticulture developed.
My interest in horticulture started when I was kid working in the garden with my mom. As I grew up I became interested in design and architecture and took a course that included an introduction to AutoCAD. It was this course that made me realize I could build a career around my passion for design with my love of the outdoors and I pursued a degree in Landscape Design from Auburn University. During my undergraduate program I had the opportunity to work at the research nursery and greenhouse complex that led me to pursue an advanced degree in horticulture.

2. Between your MS and PhD, you shifted from ornamental horticulture to fruit and vegetable horticulture. What prompted you to make that change?
My passion for research; I wanted to know more about food production and how I could make it more economical and profitable for consumers and growers. There is something fascinating about growing your own food that impacts not just your pocket book but your health too.

3. This is your first experience working with grapes – how different are grapes from other crops you have worked with, and what do you enjoy most about working with grapes?
I find grapes to be like any other food crop; once you learn the history, biology and ecology of the crop, you can do anything with it. Grape production fascinates me because there are many variables during production that impact the end product; controlling water to limit berry growth, sun exposure to increase flavor compounds, fertility program that influences postharvest parameters, etc.

4. In your current position, you have responsibility for all fruit crops (focusing on apples and grapes) and hops – what are some of your current research efforts?
I am working on creating an Extension program based on research. My research focuses on fertility management, weed control, water use efficiency, and production techniques across all fruit crops plus hops. The end goal is to help growers reduce cost without sacrificing quality.

5. In your opinion, what is the most exciting research-based information that will come out of the *Northern Grapes Project*?
I'm most excited about having a better understanding of plant nutrition and recommendations for cold hardy grapes. This is especially important in non-traditional growing regions. I tell people that plant nutrition is like the game KerPlunk (game goal: place sticks horizontally in a tube: place marbles on top of the sticks, and then horizontally remove the sticks one at a time until the marbles eventually fall to the bottom). When you remove a stick from the bottom (micronutrients), the marbles sitting on top will barely move. But when you remove a stick from the top (macronutrients), the marbles will shift. The more sticks (nutrients) you remove, the more the marbles shift and eventually fall to the bottom. Apply this to grapevine nutrition: when you remove or limit a micronutrient, berry quality will barely shift. But when you remove or limit a macronutrient, berry quality shifts. The more macro- or micro-nutrients you remove, the more quality issues you will have with your grapevine.

Help us evaluate the Northern Grapes Project!

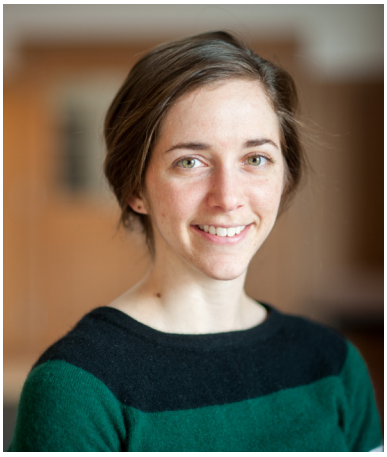
As the *Northern Grapes Project* will be wrapping up in August, we need to find out how the industry has grown and estimate the economic contribution of the cold-hardy grape and wine industry to your state's economy. This end-of-project survey asks many of the same questions as the 2012 baseline survey, and the results will help us estimate the overall impact of the project. Data from this survey will also serve as useful resources for building support and recognition for the industry.

The survey will take about 30 minutes to complete, and individual results will be confidential.

Survey Link:
https://umn.qualtrics.com/SE/?SID=SV_85JEKHqlD2Pk9zT

If you have any questions, please contact Brigid Tuck at the University of Minnesota Extension (tuckb@umn.edu).

NGP Team Profile: Anna Wallis



Anna is an Extension Associate with Cornell Cooperative Extension and the Eastern New York Commercial Horticulture Program. She is the tree fruit and viticulture extension specialist for the northeastern region of New York, and works with growers in the Champlain Valley and Upper Hudson Valley on topics including orchard and vineyard establishment and management, IPM, fruit quality and maturity, and post-harvest handling. She is also responsible for the cold-hardy grape planting at the Willsboro Research Farm.

1. You've been in your position for about a year and a half now. What do you enjoy most about it?

Any position in extension requires that you 'wear many hats,' and I love the exposure to people and information that affords me. I've jumped right into research projects and connected with faculty scientists across the northeast. I spend an extensive amount of time interacting with growers through newsletters, visits, and workshops, applying research and troubleshooting problems. As I also maintain the research vineyard in Willsboro, so while I am fairly new to grapes and wine, I've quickly learned the skills required to manage cold climate grapes. I am in contact with such a diverse and passionate group of people across the spectrum of the industry. There has been no shortage of information or people to inform and inspire my programming, to say the least!

2. You are currently "revamping" the Willsboro grape variety trial, with plans to plant up to 26 new varieties in 2017. What are some of the varieties you are currently considering, and what criteria are you using to choose which varieties to plant?

This season we removed everything but Marquette, Frontenac, Frontenac gris, and La Crescent. In the new planting, we'd like to include exciting newer varieties that have not been tested at Willsboro such as Petite Pearl, Frontenac blanc, Brianna, and others. I've also been in touch with Tom Plocher and Mark Hart about including selections from their programs. We've also considered including accessions from the Geneva germplasm repository to identify more cold hardy breeding material. There has been some interest in looking at table grape varieties, as direct marketing of produce continues to grow in Northeastern NY and growers in other areas are realizing a significant profit from these varieties. The most important characteristic for success of any of these will be cold hardiness.

3. As a graduate student, you were very involved as a teaching assistant. Tell us a little bit more about that experience and how you draw on it in your current role in extension.

A large part of my graduate work included assisting my advisor with the courses he taught. My favorite was Plant Science 101: Introduction to Horticulture, a 200-student lecture broken into lab classes of about 25 students. I managed the lab portion of the course for three years, re-writing the lab manual and designing new labs, managing a team of five teaching assistants and teaching weekly lab classes. In a way, managing the course was a lot like managing an extension program. I start by identifying educational or program needs, then I determine the best ways to meet those needs, and follow through on the implementation process.

4. When did you develop an interest in horticulture?

I have a fairly eclectic horticultural background. In high school I worked on a farm that produced greenroof plants. I loved putting in long hours outside and learning the biology of the plants and the farm. The farmer also hosted several college interns who worked on research projects; after that, I jumped at any opportunity to get exposure to horticultural work and applied research. I worked in two ecology labs, interned at an urban farm near Washington DC, and worked as a gardener at an herbal medicine garden. I became very passionate about our food system, so I sought out professors in the Plant Science department at UMD to learn more. The rest of my time in school was spent pursing entomology and plant science, studying horticulture in a tree fruit lab, doing research on sustainable agriculture, and teaching plant science courses.

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

The research on economics and marketing is especially interesting. As a new industry, we must know what investments are economical and how to make the industry visible and appealing to consumers. Many of the members of the industry are fairly new to both farming and winemaking, so knowing the best way to make smart investment and management decisions is critical. The wines are still fairly obscure to our audience, so finding the best ways to communicate our excitement about them through best tasting room practices, effective branding, understanding consumer motivations, etc., is so important to success. The economics and marketing research is obviously informed by the work being done on vineyard and winemaking. This intimate connection between all aspects of the industry is one of my favorite parts about the NGP.

Fungicide Sensitivity in Cold Hardy Wine Grapes

Patricia McManus, University of Wisconsin-Madison

Most grape growers, whether conventional or organic, rely on fungicides to control several important diseases. While some synthetic fungicides are failing because of fungicide-resistant pathogen populations, copper- and sulfur-based fungicides remain effective despite decades of use in vineyards. In grape production, copper is used primarily to control downy mildew, whereas sulfur is used primarily to control powdery mildew. Some copper- and sulfur-based products are allowed for use in organic production, and many formulations are relatively inexpensive. Thus, copper and sulfur continue to have an important place in modern grape production. Unfortunately, some grape varieties are sensitive to injury from copper and/or sulfur. Likewise, possible injury to hybrid varieties from the fungicide difenoconazole, an active ingredient in Quadris Top, Revus Top, and Inspire Super, has prompted the manufacturer to post warnings on product labels. Information on the sensitivity of "northern" wine grape varieties to copper, sulfur, and difenoconazole is limited because many of the varieties have only recently been widely planted.

Since 2012, we have conducted field trials in Madison (WMARS) and Sturgeon Bay, Wisconsin (PARS) to assess sensitivity of several northern grape varieties to copper, sulfur, and difenoconazole. Here we summarize the results from 11 trials and provide recommendations on how to use these fungicides without putting your vines at risk of injury. Significant leaf injury is not only detrimental to producing a crop, but also leads to reduced winter hardiness.

Methods. The wine grape varieties, products, and numbers of applications varied among trials, but in all in cases we used the highest fungicide rates permitted on product labels to "challenge" the vines. Copper (either Cuprofix Disperss, Cuprofix Ultra 40 Disperss, or Champ WG) and sulfur (Microthiol Disperss) were tested in all 11 trials. Difenoconazole (Inspire Super) was tested in eight trials. Fungicides were always applied alone and not mixed with adjuvants or other pesticides. This point is important, because some adjuvants and pesticide combinations enhance uptake, which might promote injury.

Foliage was rated for injury one to seven times each year (2012-2015) at approximately 2-week intervals. We used a visual scale to rate injury: 1 (= no injury); 2 (= minor speckling, spotting, marginal browning, or yellowing); 3 (=moderate speckling, spotting, marginal browning, or yellowing; 4 (= severe injury). Some examples of leaf injury are shown in the accompanying photos. A rating of 3 or greater would be noticeable and possibly alarming to growers. Because the rating system was subjective, ratings were conducted by one person in any given trial, although over the course of four years, there were three different people who rated. Individual leaves were not assessed; rather, the canopy as a whole was evaluated. The average injury rating for each fungicide on each variety on each date was compared to the rating for that variety's unsprayed control group. We did not evaluate injury to fruit, because many of our trials were conducted on young vines that were not bearing.

Defining sensitivity. The "sensitivity" alarm bells went off when 1) the average rating for a variety was 2.5 or greater AND 2) the rating was statistically significantly different from the unsprayed control. Grape leaves are subject to spotting, speckling, and yellowing from various causes (e.g., disease or nutrient deficiency), so it was critical that we used both criteria before calling a variety sensitive to copper, sulfur, or difenoconazole.

Copper. By the above criteria, the following varieties were sensitive to copper on at least one date: Brianna, Frontenac, Frontenac gris, LaCrescent, Leon Millot, Maréchal Foch, Marquette and St. Croix (Table 1). However, for LaCrescent, Marquette, and St. Croix, the criteria were met in just one trial each and only after copper had been applied six times. For Leon Millot and Maréchal Foch, the criteria were met in three trials after copper had been applied four to six times. For Brianna, the sensitivity criteria were met in seven of 11 trials, and in some cases after just one to three sprays of copper fungicide. We conclude that Brianna should not be treated with fungicides containing copper. We recommend that copper use be restricted to one or two sprays per season on Frontenac, Frontenac gris, LaCrescent, Leon Millot, Maréchal Foch, Marquette, and St. Croix.

Copper injury on Brianna leaves and fruit. The entire canopy had similar symptoms, and the overall rating was 4, severe injury.

photo: Patricia McManus, University of Wisconsin

Copper injury on Marquette. Only a few leaves in the canopy showed marginal and interveinal yellowing, and the overall rating was 2, minor injury.

photo: Patricia McManus, University of Wisconsin

Table 1: Sensitivity of cold hardy wine grape cultivars to copper fungicides.

	Vineyard (number of sprays applied)										
	2012 PARS-1 (6)	2013 WMARS-2 (3)	2013 PARS-1 (6)	2014 WMARS-1 (5)	2014 WMARS-2 (5)	2014 PARS-1 (2)	2014 PARS-2 (2)	2015 WMARS-1 (3)	2015 WMARS-2 (3)	2015 PARS-1 (6)	2015 PARS-2 (6)
Brianna	1	3	4	5	4					2	2
Frontenac	5				2						
Frontenac gris	--		--	--	2	--		--		--	6
La Crescent			6								
La Crosse											
Leon Millot		--	6	5	--		--		--	6	--
Maréchal Foch	6	--	4	5	--		--		--		--
Marquette			6								
MN 1220	--	--	--		--	--	--		--	--	--
Noiret		--		--	--	--	--	--	--	--	--
NY76		--			--		--		--	--	--
Petite Pearl	--	--	--		--	--	--	--	--		--
St. Croix	--		--	--		--		--		--	6
Valiant	--		--	--		--		--		--	
Vignoles		--		--	--		--	--	--	--	--

Black shading indicates a leaf injury severity rating of at least 2.5 and significantly different ($P < 0.05$) from the control on at least one rating date. The numbers in the black-shaded cells refer to the number of times copper was applied before a leaf injury severity rating of at least 2.5 and different from control was recorded. Gray shading indicates that the cultivar was tested in that trial, but the severity rating was less than 2.5 on all dates. No shading with "--" indicates that the cultivar was not tested in that trial.

Table 2: Sensitivity of cold hardy wine grape cultivars to sulfur fungicides.

	Vineyard (number of sprays applied)										
	2012 PARS-1 (6)	2013 WMARS-2 (3)	2013 PARS-1 (6)	2014 WMARS-1 (5)	2014 WMARS-2 (5)	2014 PARS-1 (2)	2014 PARS-2 (2)	2015 WMARS-1 (3)	2015 WMARS-2 (3)	2015 PARS-1 (6)	2015 PARS-2 (6)
Brianna			6	5	5						
Frontenac											
Frontenac gris	--		--	--		--		--		--	
La Crescent					5						
La Crosse											
Leon Millot	5	--	6	4	--		--		--		--
Maréchal Foch	5	--	3	2	--		--		--		--
Marquette											
MN 1220	--	--	--		--	--	--		--	--	--
Noiret		--		--	--	--	--	--	--	--	--
NY76		--			--		--		--	--	--
Petite Pearl	--	--	--		--	--	--	--	--		--
St. Croix	--		--	--	5	--		--		--	
Valiant	--		--	--		--		--		--	
Vignoles		--		--	--		--	--	--	--	--

Black shading indicates a leaf injury severity rating of at least 2.5 and significantly different ($P < 0.05$) from the control on at least one rating date. The numbers in the black-shaded cells refer to the number of times sulfur was applied before a leaf injury severity rating of at least 2.5 and different from control was recorded. Gray shading indicates that the cultivar was tested in that trial, but the severity rating was less than 2.5 on all dates. No shading with "--" indicates that the cultivar was not tested in that trial.

Sulfur. The following varieties were rated sensitive to sulfur on at least one date: Brianna, LaCrescent, Leon Millot, Maréchal Foch, and St. Croix (Table 2). However, for LaCrescent and St. Croix, the criteria were met in just one trial each and only after sulfur had been applied five times. For Brianna, Leon Millot, and Maréchal Foch, the sensitivity criteria were met in three trials for each variety, usually after four to six sprays, but sometimes after just two or three sprays for Maréchal Foch. We knew at the outset of our work that sulfur sensitivity had been previously documented in Maréchal Foch and its sibling Leon Millot. Our findings corroborate that knowledge. Also, those varieties served as nice "canaries in a coal mine," showing that at least in some trials, conditions were conducive to sulfur injury. We conclude that Brianna, Leon Millot and Maréchal Foch should not be treated with sulfur. We recommend that sulfur use be restricted to one or two sprays per season on LaCrescent and St. Croix.

Sulfur injury on Maréchal Foch. Most leaves had some degree of marginal browning, and the overall rating was 4, severe injury.

photo: Patricia McManus, University of Wisconsin

Sulfur injury on Leon Millot. The brown spotting along the veins was not seen on unsprayed control vines. Scattered leaves in the canopy were affected, and the overall rating was 2, minor injury.

photo: Patricia McManus, University of Wisconsin

Difenoconazole. Noiret was the only variety that met the sensitivity criteria, but that occurred in just one of the two trials that included Noiret. Varieties that were treated with difenoconazole in at least three different trials that were not sensitive: Brianna, Frontenac, Frontenac gris, LaCrescent, LaCrosse, Leon Millot, Maréchal Foch, Marquette, NY76, St. Croix, Valiant, and Vignoles. We conclude that the varieties tested, with the possible exception of Noiret, are not sensitive to difenoconazole.

Taking it to the field. How you might integrate copper, sulfur, and difenoconazole into your spray program is a topic worthy of its own newsletter article. Briefly, however, the following points should be kept in mind. First, the conclusions stated above for each fungicide are conservative; I am probably being overly cautious. You might actually "get away" with using a fungicide on a "sensitive" variety if applied just once or twice a season and/or at a lower rate. You would be much better off with a leaf injury rating of 2.5 or even 3 than you would be with a downy mildew epidemic. That said, I still would not recommend Brianna to an organic grower who needs to rely heavily on copper to control downy mildew.

We did not research the impact of weather at the time of fungicide application or in the hours following application, but this is an important consideration. In general, copper injury to plants is promoted by cool, wet weather, because the longer leaves are wet, the more that copper ions leach out of fixed copper fungicides. By contrast, the risk of sulfur injury is greater when temperatures exceed about 90 °F. Therefore, you should avoid applying copper and sulfur if these extreme conditions are forecast. The variability in how varieties reacted to copper and sulfur in our 11 trials is probably accounted for in part by differences in temperature and leaf wetness duration.

Finally, I want to reiterate that in all our trials, fungicides were applied alone and not mixed with adjuvants or other pesticides. I would not recommend use of adjuvants that enhance uptake when using copper, sulfur, or difenoconazole, and I recommend extreme caution in using them in tank mixes.

Visit us on-line at
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