



Total Quality Focus Projects
Funded through the New York Wine and Grape Foundation
2007 and 2008



2007: Delivering timely information across NY during the harvest season to increase wine quality.

2008: Continuing and expanding *Veraison to Harvest* newsletter coverage of fruit ripening in New York. *Tim Martinson (Hortic. Sci. Geneva), Chris Gerling, Ben Gavitt (Food Sci. Tech. Geneva), Jodi Creasap and Terry Bates (Lake Erie Grape Program), Hans Walter-Peterson (Finger Lakes Grape Program), Steve Hoying and Steve McKay (Hudson Valley Fruit Extension), Alice Wise, and Libby Tarleton (Long Island Grape Program).* Eight (2007) to nine (2008) weekly newsletters were produced from September through October to highlight the ripening progress of key varieties throughout NY and provide harvest and winemaking information to NY vintners and grape growers. Each issue contained current analytical information on key fruit maturity indicators (brix, pH, titratable

acidity) from 60 vineyards throughout NY. The newsletter was delivered electronically to a circulation of about 1000 industry e-mail addresses in Lake Erie, Finger Lakes, Hudson Valley, Long Island, and Northeast New York regions, as well as the statewide Enology Extension list. Newsletters posted at:

<http://blogs.cce.cornell.edu/grapes/07-veraison-to-harvest-archive/>

<http://blogs.cce.cornell.edu/grapes/08-veraison-to-harvest-newsletter/>

2007: Efficacy of insecticides in managing the root form of grape phylloxera on own-rooted *V. vinifera*.

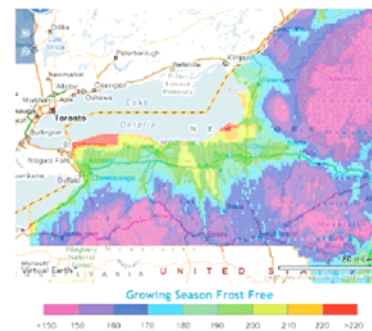
2008: Growing Phylloxera-Susceptible grapes on their own roots in cool climates: costs and benefits *Greg Loeb (Entomology, Geneva), Rick Dunst, Ted Taft Jr. (CLEREL, Portland), Peter Cousins (USDA, Geneva), and Terry Bates (Hortic. Sci. Fredonia).* The root form of grape phylloxera, an aphid-like insect native to the eastern US, is very harmful to *V. vinifera* grapes, and resistant rootstocks are the main method to control phylloxera damage. However, the management costs associated with hilling up and taking away soil under the trellis to cover and protect the graft zone are significant - and tillage leaves soil subject to the risk of erosion on sloped vineyard sites. Therefore we have started looking for alternative, insecticide-based, approaches to managing grape phylloxera that might allow growing own-rooted *vinifera* under some circumstances. Currently we are testing two compounds at two study sites: one is a new planting of own-rooted Riesling at the new Cornell Viticulture Research Facility in Portland, NY and the other is at Sawmill Creek Vineyard on Seneca Lake where Cabernet Sauvignon and Pinot Noir were 'layered' on their own roots. Results indicate that the insecticides do reduce abundance of phylloxera galls on roots but we are still assessing the impact on vine growth.

2007: First Comprehensive Winemaker and Grower Oriented Quality Analysis of New York State Wines *Garvin Sacks and Ramón Mira de Orduña (Food Sci. Tech., Geneva).* As the New York State wine and grape industries continue to improve their quality and reputation, a detailed knowledge of the chemical composition of these wines will become increasingly valuable. Many chemical compounds with sensory and health relevance have been recognized in wine, and excessively high or low concentrations of these compounds could compromise the further growth and success of the New York grape and wine industry. Because wine chemistry is a reflection of winemaking practices and grape quality, data on the concentrations of these components will be useful to winemakers, growers, and research/extension efforts. To establish a wine chemistry database, we obtained over 200 wines from 52 New York State wineries. Each wine was given a random 5 digit code upon receipt to protect the anonymity of the winery. We have thus far completed a survey of several chemical parameters (acids, residual sugar, fusel alcohols, acetaldehyde, monoterpenes, methoxypyrazines, volatile phenols) associated with wine quality. Preliminary results have been posted on the Wine Census website, and will be further presented at regional workshops in 2009-2010. These results have already been used to guide future research and extension projects. In summary, establishment of the Wine Census database will support winemakers as they address current and future grape growing and winemaking challenges and encourage further, sustainable growth of the industry. Results are posted at: <http://www.grapesandwine.cals.cornell.edu/research/census/>

2007: Develop a protocol and a database for assessing vineyard soil health to improve juice/wine quality and vine productivity Lailiang Cheng (Hortic. Ithaca), Terry Bates, Tim Martinson, Steve Hoying (Hortic. Sci. Geneva), David Wolfe (Hortic. Ithaca), Harold Van Es (Crop and Soil Sci. Ithaca), Alice Wise (CCE - Long Island), and Hans Walter-Peterson (CCE-Finger Lakes Grape Program). Over several years, the Cornell Soil Health Work Team developed protocols and databases for assessing soil health in vegetable and field crops. They are offering a soil health test package to growers, which includes assessment of soil physical and biological characteristics, along with traditional chemical analysis. However, very little data have been collected from vineyards and other perennial crops. The objective of this project was to establish a database for vineyard soils that includes meaningful soil physical, biological and chemical tests for vineyard management. We collected a total of 346 soil samples from 83 vineyards across New York State—and found greater differences in the range of values for aggregate stability, active carbon, and potentially mineralizable nitrogen in vineyard soils than has been previously reported for vegetable soils in New York. We also found substantial differences in soil health values for the different regions of the state. These data will be used to develop scoring functions for these non-traditional soil measurements, which will provide the first database for assessing vineyard soil health in New York. This will allow for widespread soil quality monitoring, thereby optimizing vineyard soil management practices to improve juice/wine quality and sustain vineyard productivity.

2007: An interactive vineyard site evaluation and selection system for New York.

Alan Lakso (Hortic. Sci., Geneva), A. DeGaetano (Earth and Atmospheric Sci., Ithaca), T. Martinson (Hortic. Sci. Geneva), R. Seem (Plant Pathology, Geneva), S. Hoying (Hortic. Sci. Highland Lab, Hudson Valley), T. Bates (Hortic. Sci., Fredonia Laboratory), H. Walter-Peterson (CCE-Finger Lakes Grape Program), A. Wise (CCE-Suffolk Co, Long Island), D. Piwinski & K. Kwasnowski (Institute for Application of Geospatial Technologies, Auburn, NY). The goal of the project was to develop an interactive web-based site evaluation system for NY State that would allow prospective growers to obtain in one place all the available basic information on sites (climate, soil and topography) needed to support sound site selection decisions. High-resolution long-term temperature climatology for the grape-growing regions of NY (growing degree days, length of growing season, and fraction of years with minimum temperatures below -5, -10 and -15°F) was generated by the Northeast Climate Center at Cornell. This long-term climate data was compiled with up-to-date digital databases of aerial photography, topography, and NRCS soils to develop an interactive, easy-to-use web site. This site allows users to search at any resolution with Virtual Earth® mapping, and access all the available data and supporting information about a site as well as educational information on site selection and links to additional pertinent information. All data on a site can be downloaded to a site report. The site (<http://arcserver2.iagt.org/vll/Default.aspx>) is being currently being tested by extension and industry before public release.



2007: Improving the quality of hybrid grapes and wine. Justine Vanden Heuvel (Dept. Hortic. Sci & Horticulture), Gavin Sacks (Dept. Food Sci. Tech, Geneva), Tim Martinson (Dept. Hortic. Sci. Geneva), Terry Acree (Dept. Food Sci. Tech, Geneva) & Qun Sun (Grad. Food Sci. Tech., Geneva). Hybrid grapes are grown throughout the Northeast, however bottle prices of hybrid wines tend to be low due to a detrimental “hybrid” character that has not been identified. This project aims to improve the quality of hybrid grapes and wine through improved canopy management. Research sites on Foch, Noiret, and Corot noir were established in 2007 and 2008 to determine whether shoot thinning, cluster thinning, leaf removal, and/or harvest date can reduce detrimental “hybrid” character. While wines from 2007 have demonstrated few differences among treatments, we have made progress towards identifying key chemical compounds that may be involved in “hybrid” character. This work is currently being funded by a NYFVI grant.

2007: Regional seminars on grape quality and viticulture. Andrew Reynolds (Brock University, Ontario) and Tim Martinson (Hortic. Sci. Geneva). Dr. Andrew Reynolds, Professor of viticulture at Brock University's Cool Climate Oenology and Viticulture Institute, located on the Niagara Peninsula of Ontario, presented a series of seminars and vineyard visits at five locations in New York during the 2007 field season. Talks featured a summary of Dr. Reynolds' research over the past 20 years focused on vineyard practices (canopy management, cropping level management) that are linked to wine quality. Seminars were given at Highland (Hudson Valley), Glenora (Finger Lakes), Lockport (Niagara Co.), Dunkirk (Chatauqua co), and Riverhead (Long Island). Dr. Reynolds also provided a consulting report detailing observations made at vineyard field visits during the project.

2007: The Effect of Soil pH and Rootstock on the Wine Quality of Riesling and Traminette, Terry Bates, Hans Walter-Peterson (Hort. Sci. Fredonia Lab), Ben Gavitt (Food Sci. Tech. Geneva) and Tim Martinson (Hortic. Sci. Geneva). Acidic soils in New York vineyards cause vine mineral nutrient imbalances, poor vegetative growth, and decreased fruit and wine quality. Viticulture research over the past ten years has investigated options to improve vineyard productivity and fruit quality with respect to soil acidity and environmentally sound vineyard nutrient management. One multi-factor viticulture

field experiment conducted at the Cornell Vineyard Laboratory in Fredonia, NY has investigated the interaction of four rootstock systems and two levels of soil acidity on the nutrition and productivity of four grape varieties: Traminette, Noiret, Riesling, and Cabernet Sauvignon. While this multi-year viticulture experiment has been funded through local, state, and federal funds and has yielded valuable information up to the point of fruit harvest, the Total Quality Focus program allowed for the Riesling and Traminette fruit to be processed into wine for further sensory evaluation. This type of research is important to the New York grape industry because it identifies how vineyard attributes such as soil nutrient availability and root activity influence final wine quality and it offers management options to grape growers to improve wine quality in the vineyard.

2007: The Effect of Crop Load on Concord Juice Quality: Accumulation of Primary and Secondary Metabolites from Veraison to Harvest, Terry Bates (*Hortic. Sci. Geneva*), Lailiang Cheng (*Hortic. Ithaca*), and Hans Walter-Peterson (*Lake Erie Grape Extension*).

Recent research has used vine size manipulation, pruning severity, and mid-season crop adjustment to alter Concord crop load and to measure final juice quality. However, "juice quality" in these studies has been restricted to the primary metabolites of juice soluble solids, titratable acidity, and total color. These juice quality measurements are good indicators of how the juice will taste and look (i.e. sweet and dark purple). However, a variety of polyphenols and anthocyanins contained in Concord juice are being used to promote the health benefits of Concord products. We analyzed Concord juice for over thirty secondary metabolites and found correlation between vineyard imposed crop load levels and 12 different polyphenols and anthocyanins. Many of these metabolites are strong antioxidants and add to the overall health benefit of Concord grape juice. Therefore, this research is important because it shows how crop load management in the vineyard can increase the level of beneficial compounds in grape juice and add value to New York produced Concord grapes.



2007: Effects of late-season fungicide sprays on wine quality. Wayne F. Wilcox (*Plant Pathology, Geneva*); Gavin Sacks (*Food Science & Technology, Geneva*); Alice Wise (*Cornell Cooperative Extension, Long Island*). Questions concerning the effects of late-season use of sulfur fungicides on wine quality arise repeatedly every year, yet we have absolutely no regional data to draw upon for answers. Excessive sulfur in musts is associated by winemakers with hydrogen sulfide production (resulting in reduced, 'stinky' wines). This project addressed winemaker concerns about late-season sulfur sprays by 1) determining the amount of sulfur residues on grape berries following various field applications, and 2) quantifying hydrogen sulfide generation following vinification of musts 'spiked' with different levels of elemental sulfur. Intensive field application up to the day of harvest produced a maximum of 3.6 mg/liter of sulfur residues in the musts, with levels decreasing

with the number of sulfur applications and the time interval between the last spray and harvest. These levels are below those reported to be associated with hydrogen sulfide production in California, and suggest that even late-season sulfur sprays may have little effect on the winemaking process in NY wineries

2008: Effects of Crop load and Fermentation Conditions on the Quality and Economic Sustainability of New York State Riesling Justine Vanden Heuvel and Trent Preszler, (*Hortic. Sci. Geneva, Hortic. Ithaca*), Gavin Sacks and Ramòn Mira de Orduña, (*Food Sci. Tech. Geneva*), Todd Schmitt, (*Appl. Econ. & Management, Ithaca*). While optimal cropload varies to some extent with growing conditions and grape varieties, in general a well-balanced vine will have a cropload ratio (yield divided by pruning weight) between 5 and 10. However, cluster thinning is unique among viticultural practices because it presents growers with a complex decision in which two seemingly disparate considerations – vine physiology and economics – are pitted against one another, with potentially beneficial and deleterious consequences existing simultaneously. It is not clear from any existing research whether the costs associated with cropload adjustment result in justifiably significant enhancements to flavor and aroma attributes of the finished wine. This study is being conducted in collaboration with Pete Saltonstall at King Ferry Winery. The objective is to understand the response of Riesling grapevines in the Finger Lakes to varying levels of cropload. Specific cropload effects being studied are vine health, fruit composition, wine quality, production costs, and consumer willingness-to-pay for resulting wines. Results will be merged under one utility-theoretic behavioral choice framework called the "Cropload Economic Index," intended to enhance judgment certainty among growers seeking to optimize their Riesling yields.

2008: Improving Quality of Concord and Niagara Juices from Harvest to Consumer. Olga I. Padilla-Zakour, Gavin Sacks, Meera Iyer, Passaporn Siricururatanana (*Food Sci. Tech. Geneva*). This project directly addresses grape postharvest management and processing conditions that affect the quality of the most predominant grape juices produced in New York State, Concord and Niagara. We studied the key factors that influence the quality of Concord and Niagara juices from harvest through bottling, focusing on attributes that determine their marketability and consumer acceptance, such as "green" flavors, color, phenolic content and antioxidant capacity. For Concord juice, the most odor-active green leafy volatile (GLV) displayed significantly lower levels in juice with increasing ripeness of the grapes. During processing, the greatest levels of

GLV were observed immediately upon grape crushing. The GLV levels were 3-6 times greater in hot break juices than in hot press, indicating that ripeness and hot pressing are key factors to minimize the green flavors in Concord juice. Niagara juice prepared from machine harvested and hand-picked grapes did not show significant differences in any quality parameters. Ascorbic acid (500 ppm) treated juices had similar or better quality compared to sulfite treated (80 ppm) juices. In addition, compared to DE filtration, membrane filtration (0.45, 0.2, and 0.01 μm) resulted in similar or better quality juices. Hot-break treatment at 170-180°F resulted in higher total phenol concentration with similar quality to other treatments. Shelf-life studies for up to 6 months are being conducted for selected juice treatments.



2008 Evaluation of Alternative Pest and Weed Management Programs in a *Vinifera* Vineyard.

Alice Wise, Libby Tarleton (Long Island Hortic. Res. Ext. Center), Wayne Wilcox (Plant Pathology, Geneva). Two projects were conducted in the research vineyard at the Long Island Horticultural Research and Extension Center, Riverhead. A tractor mounted Edwards under trellis mower was evaluated as a means of managing vegetation in that area. Mowing only was compared to glyphosate only as well as mowing plus a single glyphosate. Year one data indicates no impact, positive or negative, on Merlot vines and fruit. It is likely however that impacts on vine size, fruit composition,

cluster architecture, and yield may occur after two or more years. Cost of this practice will also be a factor. A second trial compared four fungicide-insecticide regimes in a Chardonnay block: conventional, one that emphasized reduced risk products, and two almost-organic regimes. The almost-organic regimes did produce marketable fruit, however, there were losses to phomopsis, black rot and powdery mildew. Vines also incurred more insect damage. We hope to maintain these projects through several more seasons as long term impacts will be important to gauge.

2008 Influence of Microclimate and Mesoclimate on Herbaceous-smelling Methoxypyrazines, and Identification of Related Compounds Responsible for Vegetal Character in Red Wine. *Gavin Sacks (Food Sci. Tech., Geneva), Justine Vanden Heuvel (Hortic. Sci. Geneva & Horticulture, Ithaca), and Justin Scheiner (Graduate Student - Horticulture).*

Producing wines with consistent and desirable flavor profiles is essential for establishing and maintaining wine consumer loyalty. The methoxypyrazines (MPs) are class of aroma compounds produced by grapes and associated with unripe and green aromas in red wines. High MP levels in red wines are considered undesirable by consumers but their selective removal is not currently feasible. Our current work has focused on determining the vineyard conditions that best predict eventual MP concentration. During the 2008 growing season, we monitored MP concentrations and growing conditions (e.g. water availability, sunlight, temperature) at multiple sites in New York State (Lake Erie, Finger Lakes and Long Island). We will also be measuring the correlation of site to other compounds associated with both ripe and unripe aromas. Finally, we have produced wines from each vineyard site under identical conditions; these wines will be submitted to sensory analysis to attempt to correlate aroma profile to aroma chemistry and growing conditions. Our results will be presented to stakeholders in 2009 at grape grower and winemaker workshops, and should lead to both refined practices for reducing herbaceous aromas in red wines and improved vineyard site selection.

2008: Natural preservative systems to improve the microbiological quality of grape juice.

Randy W. Worobo & Olga Padilla-Zakour (Food Sci. Tech, Geneva). Traditional preservative systems that rely on potassium sorbet and sodium benzoate are ineffective in preventing the growth of preservative resistant spoilage yeast (*Zygosaccharomyces*) and the use of traditional preservatives in juices have decreasing consumer acceptance. The primary objective of this proposal is to evaluate “natural” antimicrobials (preservatives) and combinations that target the inhibition or elimination of spoilage microorganisms and improve the microbiological quality of pasteurized and carbonated Niagara and Concord grape juices. Results of the study will assist in developing new guidelines for the use of natural compounds and processing aids to preserve and extend the shelf life of grape juices without the use of benzoate, sorbate, and sulfites.

2008: Suitability of Yeast Bacterial Co-inoculations for Red Vinifications in New York State. *Ramón Mira de Orduña*

(Food Sci.Tech. Geneva). New York wine regions share a predominantly cool climate. Viticulture and winemaking under these conditions are cost and care intensive and thus, increased consideration has to be given to careful practices that maintain product quality across the value chain. Under these challenging winemaking conditions, malolactic fermentation (MLF) problems are often encountered. MLF is of great importance in the production of all red and some white wines and leads to biological wine deacidification. Inhibition of MLF by various factors (temperature, alcohol concentration, acidity) may lead to secondary vinification problems and subsequent wine quality degradation or market penetration delays. We have studied simultaneous alcoholic and malolactic fermentations in the production of a key red variety, New York Pinot Noir. The study included the comprehensive analysis of the fermentation kinetics and key chemical and biochemical key wine parameters. We were able to show that co-inoculation of yeast and bacteria is a suitable alternative to the traditional, consecutive vinification of red wine over a wide pH range. The new method allows to reduce the incidence of problem fermentations and does not affect final wine quality. In addition, the new method allowed to reduce overall vinification durations by 10-35 days. Results from this study have already been implemented in industrial sized winemaking trials at a local winery and will also be submitted for publication and presented at the New York State Wine Industry Workshop.