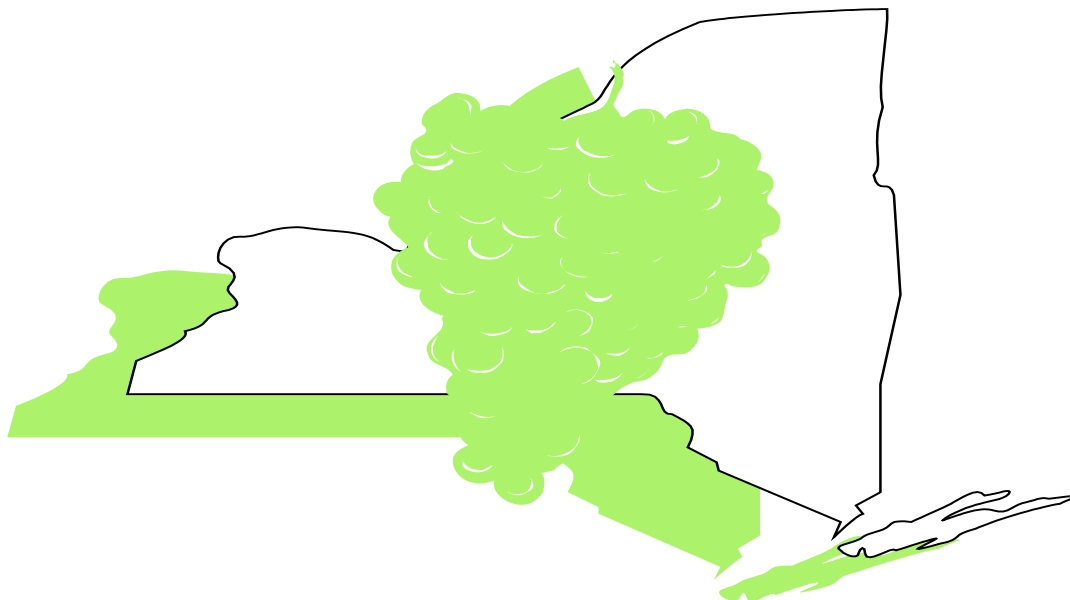


COST OF ESTABLISHMENT AND PRODUCTION OF COLD HARDY GRAPES IN THE CHAUTAUQUA REGION OF NEW YORK-2015



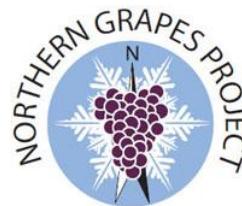
**Dayea Oh, Sogol Kananizadeh, Miguel I. Gómez,
Kevin Martin**

**Charles H. Dyson School of Applied Economics and Management
College of Agriculture and Life Sciences
Cornell University, Ithaca, New York 14853-7801**

The authors gratefully acknowledge financial support under USDA's Specialty Crops Research Initiative Program of the National Institute for Food and Agriculture, Project #2011-51181-30850: The Northern Grapes Project. This work was also work is supported by the USDA National Institute of Food and Agriculture, Hatch Project #1000982.



United States Department of Agriculture
National Institute of Food and Agriculture



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COST OF ESTABLISHMENT AND PRODUCTION OF COLD HARDY GRAPES IN THE CHAUTAUQUA REGION OF NEW YORK, 2015

Dayea Oh, Sogol Kananizadeh, Miguel I. Gómez, Kevin Martin

Introduction

The Chautauqua County, located in the southwestern corner of New York State, is the westernmost of the state's counties. Bordering Lake Erie on the north, and Chautauqua Lake in the heart of the county, Chautauqua-Lake Erie region is the oldest and largest Concord grape growing region in the world. Though most of the harvest goes into producing juice or jellies, ever since 1830 when Deacon Elija Fay made his first six gallons of wine in a cellar in Westfield, the wine-making became a growing tradition in the region.

Today, Lake Erie Wine Country, a 50 mile trail wholly dedicated to vineyards, includes over 30,000 vineyard acres and is home to twenty-four wineries. The majority of the acre consists of Labrusca such as Concord or Niagara. In the last 50 years, local production has gradually diversified from native Labrusca varieties to include French American Hybrids and Vinifera. Varieties such as whites Riesling, Chardonnay and reds Cabernet Sauvignon, Merlot, and Cabernet Franc are all important to local winery portfolios. Hybrids of both white and red prosper as well.

One of the newest varieties introduced to the region are the cold hardy grapes. Chautauqua's peculiar growing condition has drawn close cold hardy grapes since early 2000s. These are the specific type of grapes that thrive in cold climates, being able to tolerate temperatures as low as -30°F. Cold hardy grapes are viticulturally speaking outstanding, as most tend to be very disease resistant, with high immunity to downy mildew and powdery mildew. Most of the cold hardy varieties are fairly young, with La Crescent being first introduced in 2002 and Marquette as late as 2006. They were first studied at the University of Minnesota, and now are widely planted in Midwest, New England, and Quebec, as well as upstate New York including the Chautauqua-Lake Erie region. Among all, the four top varieties are Marquette, La Crescent, Frontenac, and Brianna, which provide choices from dry to sweet.

Growers who are considering planting additional cold hardy vineyards need to carefully weigh the cost of planting and establishing a vineyard and the annual cost of production of a mature vineyard against the expected yields and prices to determine whether their investment to bring a cold hardy vineyard into production will result in a profitable return. This requires an assessment of which varieties to plant on this acreage and which sites will support profitable cold hardy production.

The objective of this study was to determine the cost of producing cold hardy grapes in the Chautauqua-Lake Erie region in a commercial size operation. Estimates of the total investment in land, machinery, vineyard establishment and development costs, and annual operating costs were developed. These estimates can guide growers and potential investors to compute and analyze the costs and profit potential for their own situations. The estimates are not necessarily representative of average costs for grape production in the Chautauqua-Lake Erie area, but rather are typical costs for well-managed vineyards using recommended practices.

The yield estimates used for estimation of typical returns assume better sites (well-drained, productive soils with appropriate slopes for air drainage). We also assumed that vineyard practices were used which would result in premium quality grapes. Practices such as cluster removal of certain varieties, limit yields but contribute to higher quality wine. Poorer sites and/or failure to follow optimal management practices can have a significant negative impact on the earnings estimates presented in this publication.

As a last note, the readers should bear in mind, as these cold hardy grapes are fairly new varieties and a minority grown in the area, the data is limited in numbers. We expect to gather more data in few years and update the report. Meanwhile, we hope this study would provide fair guidance and information for potential and current growers in the Chautauqua-Lake Erie region in their decision-making.

Appreciation is expressed to Kurk Hutchinson, Raymand Krupa, Dennis Rak, Mark Martin, and Rick Walker who served as the growers' panel for helping to establish the costs reported in this bulletin. Kevin Martin, Associate Extension Educator at Penn State Extension and Business Management at Lake Erie Regional Grape Program, provided helpful reviews of the manuscript.

Methods

The methods used to construct cost estimates were a combination of 1) interviews with a panel comprised of five grower representatives, and 2) economic engineering using recommended practices. In August of 2015, we met with a panel of one specialist from Lake Erie Regional Grape Program and five growers/vineyard managers. The growers went through the data prepared for the most recent estimates of the cost of establishing and growing cold hardy grapes, and the viticulturist checked and confirmed the spray system used in the area. Consensus estimates were developed for land prices, labor requirements and wage rates for the various operations in a cold hardy grape vineyard and for a typical machinery complement for a full time commercial vineyard. As data from study on the hybrid grapes in the Finger Lakes region was available for year 2014, the panel went through the data and made recommendations for changes specific to the cold hardy grapes in the Chautauqua-Lake Erie region.

The panel also provided estimates, based on their own experience in the vineyard, of the time required to perform various vineyard operations, such as tillage, spraying, mowing, etc., and hand operations such as pruning, tying & removal, and suckering.

Land. The study assumes land was purchased at \$2,000 per acre. The size of the vineyard was decided in consultation with the grower panel. The specified size was 15 acres, with 13 acres planted to cold hardy grapes. Though the actual average planted acre of the vineyards were much bigger (200 acre), since we are only focusing on cold hardy grapes, we used the 13 acres that were dedicated to cold hardy grapes and assumed the other 2 acres are occupied by roads, shops, and offices, etc. The 13-acre vineyard is unfortunately not large enough to use vineyard machinery and equipment efficiently, so in calculating machinery and equipment costs, we use the actual 200 acres to spread out the cost evenly to the whole planted acre. The 200 acre is average land acre dedicated to grapes, no matter their variety. On the other hand, 13 acres is small enough to be operated as a family business if planned to. Some hand labor operations would be done by the growers themselves, or by hired part-time laborers.

Vineyard layout. The vineyard was assumed to be planted on a 7' X 9' spacing (vine by row) resulting in a planting density of 658 vines per acre. There were 8 rows to an acre and rows were 400 feet long. Vine cost was estimated to average \$3.00 per plant. Though replanting vines is a very common practice, the panel unanimously agreed that they do not replant any of the cold hardy grapes. Just as the Thousand Islands region, laser planting was not a common practice in the area, and just a normal machine planting was employed.

Varieties. The 13-acre vineyard was planted to the following four cold hardy varieties: Marquette, La Crescent, Frontenac, and Brianna. These four varieties were selected because they can survive the brutal winter of upstate New York such as Chautauqua-Lake Erie region and exhibit excellent potential for premium wine production. Frontenac was the very first variety planted in this region. Marquette and La Crescent were added soon after. Brianna is the newest among the four varieties. Frontenac and Marquette produce rich red wines while La Crescent and Brianna produce white wines, ranging from dry to dessert wines.

Tile Drainage. It was assumed that tile drainage was installed in the middle of every second row or 18 feet apart. The tile drainage system consisted of 4" lateral pipes running down the middle of every second row, and these lateral pipes were connected to an 8" mainline pipe that ran along the width of the vineyard.

Trellis System. It was assumed that the vines were trained using the High Cordon training system. High Cordon uses two wires, mid-level wire is set 3 to 4 feet above the ground and top wire is set at 6 feet. At maturity, one wire is adequate. The central trunk with cordon is trained to the top wire. The trellis system has 24 wood end posts (8 ft X 5" diameter) and 24 screw anchors (8 ft X 3" diameter).

Herbicides and Fertilizer/Soil Program. The sample herbicide program was developed in consultation with the advisory panel of five growers and a specialist. For details of the sample herbicide program, see Table 1 in Appendix. The sample fertilizer/soil program was developed by Hans Walter-Peterson, Extension Educator, and Finger Lakes Grape Program and confirmed by Kevin Martin, Associate Extension Educator at Penn State Extension and Business Management at Lake Erie Regional Grape Program. See Table 2 in Appendix for details.

Wage Rates. Wage rates used represented the consensus of the grower panel. The rates assumed were \$15.00 per hour for skilled labor (i.e. \$11.54 per hour plus fringe benefits). Fringe benefits consist of workers compensation, social security, medical insurance, and other benefits. For unskilled labor, the rate was \$12.00 per hour (including fringe benefits).

Harvesting & Hauling. Grapes were machine harvested in the fourth year and beyond. The machine harvesting rate is assumed at \$40 per ton, with an additional \$6.5 per ton expenses for transporting the grapes. Hauling costs are included in this rate.

Machinery. Machinery depreciation and interest were charged on the basis of prices for new equipment. Diesel fuel at \$2.55 per gallon was budgeted for machine operations. Gasoline was charged at \$3.75 per gallon (for unleaded). Hourly machinery variable costs (repairs, fuel, and lube) are shown in Table 3 of the Appendix. Hourly machinery variable costs were estimated according to American Society of Agricultural Engineers 2000 Standards.

Overhead. Annual insurance expense was estimated at 1 percent of the initial investment in buildings and machinery. Office supplies, phone, etc. were estimated at \$2,000 per year. School and property taxes were \$25 per \$1,000 of assessed value of the initial land investment.

Management Charge. A management fee of five percent of gross receipts was assessed for the vineyard. This represents the opportunity cost for the vineyard owner to manage the operation. All labor requirements were assessed as cash costs. Therefore, in situations where the owner or manager is performing vineyard tasks and managing the operation, actual cash outlays would be lower than are represented in these cost estimates.

Cost of Capital. A two percent interest charge on capital investment and operating capital was charged. This rate represents a real rate based on a seven percent nominal rate of interest and an expected rate of inflation of three percent.

Yields. Yields were specified as the long-term average attainable on suitable sites (sloping, good air drainage, somewhat well-drained with soil depth at least medium). These yields assume better than average management practices that are consistent with the attainment of premium quality hybrid wines. The management practice includes cluster removal that often decreases yields, but improves wine quality. Table 1 summarizes the yield assumptions.

Table 1: Yield Assumptions

Variety	Year 3	Year 4+
Brianna	1 ton/acre	5.0 tons/acre
Frontenac	1 ton/acre	5.0 tons/acre
La Crescent	1 ton/acre	4.0 tons/acre
Marquette	1 ton/acre	5.0 tons/acre

Results

Grape Prices

Since the cold hardy varieties are relatively new, there not much historical price data readily available. Therefore, average prices from 2014 yield are shown in Table 2. The prices in Table 2 are a reasonable indicator of price baseline for the four varieties. The panel of grape growers and vineyard managers took these prices into account when specifying the prices shown in Table 2, which are the prices used in the profitability analysis reported in this bulletin. The prices specified by the panel reflect special quality practices that are used for premium wine production.

Table 2: Average Price Listings for Selected Cold Hardy Grapes in the Chautauqua-Lake Erie Region 2014, Dollars per Ton.

	Brianna	Frontenac	La Crescent	Marquette
Prices	\$600	\$600	\$600	\$900

Machinery and Buildings Costs

The investment costs and annual costs for equipment and buildings are summarized in Table 3. As mentioned briefly in Introduction, it should be noted that cold hardy grapes are not the only grapes grown in the area and thus the assumption of 13 planted acre is not realistic in spreading out the fixed costs such as machinery and building costs. Most of the vineyard growers have planted acres of 200-500 acres, including cold hardy and the native Labrusca. Thus, in real life, their machinery investment per acre would be spread out all the planted acres and consequently be much lower. We adopt this idea and in calculating the total machinery and building costs per planted acre, use 200 acre. The investment for a shop is estimated at \$54,000, or \$270 per acre. The grower panels we met had an average shop size of 1,200 ft², with the construction cost estimated at \$45.00 per ft² (including basic amenities such as water and electricity). For substantially bigger shop sizes, much more investment for shop is required. The total annual costs for depreciation and interest amount to \$22,934 for machinery and \$2,411 for buildings, or \$115 and \$12.06 annual costs per acre, respectively.

Table 3: Machinery, Equipment, and Building Capital Recovery and Interest Costs,
Cold Hardy Grape Vineyard, Chautauqua Region, NY, 2015

<i>Machinery and Equipment</i>	Purchase Price	Years of Life	Salvage Value	Capital to be Recovered	Cost Recovery Factor	Annual Recovery	Interest on Salvage Value	Total Capital Recovery & Interest
Tractor, 62-HP, 2WD, spray cab	\$48,000	10	\$4,800	\$43,200	0.1113	\$4,809	\$96	\$4,905.31
Tractor, 45-HP	\$28,000	10	\$2,800	\$25,200	0.1113	\$2,805	\$56	\$2,861.43
Air-blast sprayer- 400 gallon	\$19,000	10	\$1,500	\$13,500	0.1113	\$1,503	\$30	\$1,532.91
Herbicide sprayer- 300 gallon	\$2,200	10	\$220	\$1,980	0.1113	\$220	\$4.40	\$224.83
Environmist Sprayer	\$6,700	10	\$670	\$6,030	0.1113	\$671	\$13.40	\$684.54
RTV	\$10,000	10	\$1,000	\$9,000	0.1113	\$1,002	\$20	\$1,021.94
Mower	\$7,800	7	\$1,114	\$6,686	0.1545	\$1,033	\$22.29	\$1,055.31
Brush chopper	\$8,500	7	\$1,214	\$7,286	0.1545	\$1,126	\$24.29	\$1,150.02
Fertilizer Spreader	\$2,000	10	\$200	\$1,800	0.1113	\$200	\$4	\$204.39
Small Disc	\$600	10	\$60	\$540	0.1113	\$60	\$1.20	\$61.32
Grape hoe/ Weed badger	\$7,500	10	\$750	\$6,750	0.1113	\$751	\$15	\$766.45
Post driver	\$4,000	10	\$400	\$3,600	0.1113	\$401	\$8	\$408.78
Vineyard Trailer	\$3,000	10	\$300	\$2,700	0.1113	\$301	\$6	\$306.58
Pickup truck	\$28,000	10	\$2,800	\$25,200	0.1113	\$2,805	\$56	\$2,861.43
Auger	\$1,000	10	\$100	\$900	0.1113	\$100	\$2	\$102.19
Replanter	\$4,800	10	\$480	\$4,320	0.1113	\$481	\$10	\$490.53
Bird control – Audio gun	\$5,000	10	\$500	\$4,500	0.1113	\$501	\$10	\$510.97
Shop Equipment	\$8,000	10	\$800	\$7,200	0.1113	\$802	\$16	\$817.55
Pruning Shears (X5)	\$250	5	\$50	\$200	0.2122	\$42	\$1	\$43.43
Harvester	\$25,000	7	\$3,571	\$21,429	0.1545	\$3,311	\$71.43	\$3,382.40
Total Machine & Equipment Costs	\$244,390		\$22,613	\$196,527				\$22,934
Cost per planted acre	\$1,222							\$115
Buildings								
Shop (1,200 ft2 @ \$45 ft2)	\$54,000	\$30	\$0	\$54,000	0.0446	\$2,411	\$0	\$2,411
Cost per planted acre	\$270.0							\$12.06
Vineyard								
1 Ac. Cold Hardy Vineyard	\$12,211	22	0	\$12,211	0.0566	\$692	\$0	\$692

Pesticide Program Spray Costs

Table 4 indicates the recommended spray program and costs for years one, two, and three (establishment), and years four through twenty-two (operation). In year three, three sprays are recommended. Beginning in year four, sprays are assumed to be approximately the same from year to year, with the necessity on average for four sprays during the growing season. Spray materials costs were \$67.72 per acre. This figure is noticeably lower than cold hardy's in the Thousand Islands region mainly due to the lower frequency of treatment (no treatment in year 1) and difference in material used (lower costs). Of course, spray programs will have to be adjusted slightly from year to year to accommodate variable weather and/or pest pressure. Pesticide application costs for labor and machinery, as well as herbicides, are developed in Tables 7 and 9 to follow.

Table 4: Sample Fungicide & Insecticide Spray Program for Cold Hardy Grapes, Chautauqua Region, NY, 2015

Year	Material	Rate/acre	Price	\$/acre
Year 2				
Spray 1	Mancozeb 75DF	3 lbs.	\$3.40 lb.	\$10.20
	Vivando	15.4 oz.	\$1.76 oz.	\$27.10
Total per spray				\$37.30
Spray 2	Leverage 360	3.2 oz.	\$1.96 oz.	\$6.27
Total per spray				\$6.27
Total for year (2 sprays)				\$43.58
Year 3				
Spray 1	Mancozeb 75DF	3 lbs.	\$3.40 lb.	\$10.20
	Total per spray			
Spray 2	Revus Top	7 oz.	\$332.46 gal.	\$18.18
	Leverage 360	3.2 oz.	\$1.96 oz.	\$0.05
	Vivando	15.4 oz.	\$1.76 oz.	\$0.21
Total per spray				\$18.44
Spray 3	Quintec	3 oz.	\$3.38 oz.	\$10.14
	Mettle (Tetraconazole)	5 oz.	\$3.23 oz.	\$16.15
Total per spray				\$26.29
Total for year (3 sprays)				\$54.93
Years 4-25				
Spray 1	Mancozeb 75DF	3 lbs.	\$3.40 lb.	\$10.20
	Total for year (1 spray)			
Spray 2	Mancozeb 75DF	3 lbs.	\$3.40 lb.	\$10.20

	Mettle (Tetraconazole)	5 oz.	\$3.23 oz.	\$16.15
Total for year (2 spray)				\$26.35
Spray 3	Reason	4 oz.	\$2.17 oz.	\$8.68
	Quintec	3 oz.	\$3.38 oz.	\$0.08
Total per spray				\$8.76
Spray 4	Leverage 360	3.2 oz.	\$1.96 oz.	\$6.27
	Mettle (Tetraconazole)	5 oz.	\$3.23 oz.	\$16.15
Total per spray				\$22.42
Total for year (4 sprays)				\$67.73

The sample fungicide and insecticide spray program was developed by Professor Wayne Wilcox, Department of Plant Pathology and Plant Microbe Biology, Cornell University, and confirmed by Kevin Martin, Associate Extension Educator at Penn State Extension for the Lake Erie Regional Grape Program.

Drainage Construction Costs

Table 5 contains an estimate of drainage construction costs. These costs are transferred to the site preparation section of the establishment and development costs (see Table 7). Costs will vary greatly from site to site depending on the soil conditions and preferences of the vineyard manager. Growers should consult with their county's Soil & Water District staff to determine the proper amount of drainage a particular site requires. This study assumed that tile drainage was placed in the middle of every second row or 18 feet apart. Costs were estimated to total \$3,904 per acre.

Table 5: Tile Drainage Costs per acre for Cold Hardy Grapes, Chautauqua-Lake Erie region, NY, 2015.

Item	Quantity	Price	Total per acre
Main line: 8" pipe	130 ft	\$1.45 ft	\$188.50
Laterals: 4" pipe	2,380 ft	\$0.38 ft	\$904
Installation	2,510 ft	\$1.12 ft	\$2,811
Total Drainage Construction per acre			\$3,904

Trellis Construction Costs

The trellis was designed for either High Cordon system. It was made up of one pair wires. Wooden line posts were used for every third vine. Rows were 400 feet long and there were 8 rows to an acre and 57 vines per row.

Table 6 contains an estimate of trellis constructions costs. The total cost for materials is estimated at \$1,809 per acre. These costs are transferred to Table 7 in the first year of establishment

and development. Labor and machinery costs for trellis establishment are also shown in Table 7. The total cost of trellis construction for materials, labor, and machinery is \$2,354 per acre.

Table 6: Trellis Construction Costs per acre for Cold Hardy Grapes, Lake Erie Region, NY, 2015.

Item	Quantity	Price	Total per acre
Wood end posts (8 ft X 5" diameter)	24 posts	\$7.00 post	\$168
Screw anchors (8 ft X 3" diameter)	24 posts	\$8.00 post	\$192
Steel grape stakes (8 ft, 3" diameter)	219 stakes	\$6.00 stake	\$1,316
12.5 gauge HT foilage & cordon wire	5,231 ft	\$0.025 ft	\$128
Staples	3 staples	\$1.74 staple	\$5
Total Trellis Construction materials			\$1,809

Establishment and Development Costs

The costs for labor machinery and materials for site preparation and in year one through three constitute the establishment and development (E&D) costs in Table 7. First year costs, including site preparation, trellis construction, and planting, are substantial, amounting to \$9,115 per acre. The largest cost in the first year is planting and trellis construction, with a total cost of \$2,245 and \$2,314 respectively. The biggest difference between first year practice in the Lake Erie region and the Thousand Islands region is that the growers in the Lake Erie region do not spray any insecticide during the first year. Thus, the costs for first year drop significantly. Additionally, site preparation and year 1 are the time periods where, depending on the kind of land that the growers bought, there exist most discrepancies. For example, if a farmland with a good drainage system is bought, there's no need to install a new drainage system. If the land is already well plowed, there's no need to remove stones or plow the land again. As a matter of fact, most of the growers in the panel bought the land with drainage system built in. The price difference between well-drained land and a land without drainage system is approximately \$1,000 in the area, and thus most of the growers end up buying land with good drainage. In year two, costs are a relatively modest \$567 per acre with lower spray costs and less labor required than for mature vines. The costs for pruning or cordon renewal are relatively low compared to later years since the vines are still growing and small. In third year, a spray program of three sprays is recommended. Hilling up and hilling down, which are common for hybrid grapes in other parts of New York, aren't commonly practiced in the Chautauqua-Lake Erie area for the cold hardy grapes. Total costs for the third year are \$982 per acre. This is again, much smaller compared to the cost in the Thousand Islands (\$1,250 per acre), because growers in the Lake Erie region do not practice replanting, and mostly because the spray programs are less costly.

The total costs for the entire E&D period (years 1-3) are summarized in Table 8. The totals from Table 7 for each of the three years are brought into the row labeled 'annual variable costs'. Hand harvesting costs are added for the third year only. Fixed costs (capital recovery for machinery and equipment and buildings, property taxes, office supplies, land charge, insurance, and management) are added. Interest, at a real rate of two percent, is added to the cumulative costs. Credit is given for the revenue from the estimated one ton of grapes per acre harvested in year three. The price of grapes in year three is the average of the three varieties produced. The total cumulative

cost for the E&D period is \$11,549 per acre. Amortized at a four percent real rate of interest for the estimated years of life from year 4 through 25 (or 22 years), the annual cost for capital recovery (interest and depreciation) is \$654 per acre. This amount was charged as a fixed cost in Table 11, which summarizes the costs and returns for a mature vineyard. Cash costs for establishment, including labor, are \$10,665 for site preparation and the first three years.

Table 7: Cold Hardy Grape Establishment and Development Costs
Chautauqua-Lake Erie Region, New York, 2015

	(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Site Preparation								
Drainage		Custom						\$3,904
Lime		Custom						\$130
Herbicide application		Skilled	0.1	0.1	\$2	\$2	\$17	\$20
Soil Sampling		Skilled	0.2		\$3		\$4	\$7
Fall fertilization		Skilled	0.6	0.5	\$9	\$7	\$87	\$103
Plowing		Skilled						\$50
Discing		Skilled						\$50
Pickup truck (10,000 miles for 13 ac/year)		N/A				\$75		\$75
Total for site preparation			0.9	0.6	\$14	\$9	\$108	\$4,339
First Year								
Planting		Skilled	10	10	\$150	\$121	\$1,974	\$2,245
Fertilization (banded)		Skilled	0.6	0.5	\$9	\$7	\$7	\$22
Chem. weed control –trellis, spot		Skilled	1	1	\$15	\$17	\$27	\$58
Trellis construction (see table 6 for details)		Skilled	20	13	\$300	\$205	\$1,809	\$2,314
Cultivation (2X)		Skilled	1.2	1.2	\$18	\$17		\$35
Seed cover crop		Skilled	0.6	0.5	\$10	\$7	\$11	\$27
Pickup truck (10,000 miles for 13 ac/year)		N/A				\$75		\$75
Total for first year			33.7	26.2	\$501	\$448	\$3,828	\$4,776
Total for first year and site prep								\$9,115

Table 7 continued

	(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Second Year								
Pruning & brush removal		Skilled	4		\$60	\$0.08		\$60
Cordon Establishment*		Skilled	2		\$30			\$30
Chem. weed control-trellis		Skilled	0.6	5	\$9	\$69	\$73	\$151
Suckering		Skilled	2		\$30			\$30
Cluster removal		Skilled	2.5		\$38			\$38
Spot herbicide treatment 1		Skilled	0.4	0.3	\$6	\$5	\$10	\$22
Spot herbicide treatment 2		Skilled	0.4	0.3	\$6	\$5	\$10	\$22
Spray 1		Skilled	0.4	0.3	\$6	\$6	\$37	\$49
Spray 2		Skilled	0.4	0.3	\$6	\$6	\$6	\$18
Mowing (4X)		Skilled	2.6	2	\$39	\$34		\$73
Pickup truck (10,000 miles for 13 ac/year)		N/A				\$75		\$75
Total for Second Year			15.3	8.2	\$230	\$125	\$138	\$567

*With a trellis system of High Cordon, the vines don't need to be tied in year 2.

Table 7 continued

	(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Third Year								
Pruning and brush pulling		Skilled	10		\$150	\$0.08		\$150
Cordon tying & renewal		Skilled	10		\$150		\$10	\$160
Brush chopping		Skilled	0.75	0.75	\$11	\$13		\$24
Vine Replacement		Skilled	1	1	\$15	\$15	\$20	\$50
Chem. weed control- trellis		Skilled	0.6	0.5	\$9	\$7	\$73	\$89
Suckering		Skilled	2		\$30	-	-	\$30
Cluster removal		Skilled	2.5		\$43			\$43
Bird control		Unskilled	0.5	140	\$6	\$50	\$21	\$77
Fertilization		Skilled	0.2	0.2	\$3	\$3	\$50	\$56
Spot herbicide treatment 1		Skilled	0.4	0.3	\$6	\$5	\$10	\$22
Spot herbicide treatment 2		Skilled	0.4	0.3	\$6	\$5	\$10	\$22
Spray 1		Skilled	0.6	0.5	\$9	\$10	\$10	\$29
Spray 2		Skilled	0.6	0.5	\$9	\$10	\$18	\$38
Spray 3		Skilled	0.6	0.5	\$9	\$10	\$26	\$45
Mowing (4X)		Skilled	2.6	2	\$39	\$34		\$73
Pickup truck (10,000 miles for 13 ac/year)		N/A				\$75		\$75
Total for Third Year			31.75	145.55	\$538	\$222	\$230	\$982

Table 8: Summary of Establishment and Development Costs by Year
for Cold Hardy Grapes, Chautauqua-Lake Erie region, NY 2015

Item	Year 1	Year 2	Year 3
Revenue			
Yield per acre (tons)	0	0	1
Market price (avg. of 4 varieties)	na	na	\$675
Total revenue	\$0	\$0	\$675
Costs			
Site preparation	\$4,339	\$0	\$0
Annual variable costs			
-Preharvest	\$4,776	\$567	\$982
-Harvest (hand)+hauling	\$0	\$0	\$200
<i>Total Variable Costs & Site preparation</i>	\$9,115	\$567	\$1,182
Annual fixed costs			
-Machines & equipment amortization	\$115	\$115	\$115
-Buildings amortization	\$12	\$12	\$12
-Property taxes	\$50	\$50	\$50
-Land opportunity cost	\$40	\$40	\$40
-Office Supplies, phone, etc.	\$10	\$10	\$10
-Insurance (fire, liability)	\$15	\$15	\$15
-Management	\$0	\$0	\$0
<i>Total Fixed Costs</i>	\$454	\$454	\$454
Interest on cumulative costs (real interest rate= 2%)	\$187	\$207	\$240
Total costs	\$9,544	\$1,016	\$1,664
Net returns	(\$9,544)	(\$1,016)	(\$989)
Total cumulative costs	\$9,544	\$10,560	\$11,549
Amortization of vineyard:			\$654
Cash costs of vineyard establishment (3 Yrs.)			\$10,665

Costs and Returns for a Mature Vineyard

Annual growing costs for years four through twenty-two are developed in Table 9. Total growing costs for a typical year in the mature vineyard are estimated to be \$1,261 per acre. The most costly operations are canopy management (\$228 per acre), spraying (4 times, for a total of \$144 per acre, including labor, machinery and materials costs) and pruning and brush removal (\$187 per acre). By year four, the well-managed vineyard will nearly have reached its full yield potential and will require approximately the same management each year for the duration of its life.

Table 9: Growing Costs, Years Four through Twenty-two, Cold Hardy Grapes, Chautauqua-Lake Erie Region, 2015

	(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Operation								
Pruning & brush pulling		Skilled	11.5	11.5	\$172.50	\$14.64		\$187
Brush chopping		Skilled	1.2	1	\$18.00	\$17.28		\$35
Trellis maintenance		Skilled	2	1	\$30.00	\$12.51	\$30.00	\$73
Cordon tying & renewal		Skilled	11.5		\$172.50		\$7.00	\$180
Vine Replacement		Skilled	1	1	\$15.00	\$14.91	\$19.74	\$50
Chem.weed control-trellis (every 5 yrs)		Skilled	2.6	2	\$39.00	\$27.43	\$1.85	\$68
Spot herbicide treatment			0.4	0.3	\$6.00	\$5.04	\$33.49	\$45
Suckering & Shoot thinning		Skilled	4		\$48.00			\$48
Bird control		Skilled	0.5	140	\$6.00	\$50.03	\$21	\$56
Spray 1		Unskilled	0.6	0.5	\$9.00	\$10.13	\$10.20	\$29
Spray 2		Skilled	0.6	0.5	\$9.00	\$10.13	\$26.35	\$45
Spray 3		Skilled	0.6	0.5	\$9.00	\$10.13	\$8.76	\$28
Spray 4		Skilled	0.6	0.5	\$9.00	\$10.13	\$22.42	\$42
Mowing (4X)		Skilled	2.6	2	\$39.00	\$34.12		\$73
Lime (every 5 yrs)		Skilled	0.1	0.1	\$1.50	\$0.71	\$4.80	\$7
Pickup truck		Skilled				\$75.00		\$75
Soil Application (every 5 yrs)		N/A	0	0	\$0.00	\$0.00	\$0.85	\$1
Petiole sampling		Skilled	0.1		\$1.50		\$3.84	\$5
Soil sampling (every 5 yrs)		Skilled	0.1		\$1.50		\$0.60	\$2
Fall fertilization (every 2 yrs)			0.3	0.3	\$4.50	\$3.91	\$43.50	\$52
Crop nutrition		Skilled	0.1		\$1.50		\$50.00	\$52
Crop insurance		N/A						\$109
Total			40.4	161.2	\$592.50	\$296.11	\$263.40	\$1,261

*Soil application doesn't require separate labor, because it is mixed with other sprays and used.

**Equipment in bird control refers to the audio gun, and the material refers to the shining tape.

Table 10 summarizes the growing, establishment, and development costs for a cold hardy vineyard. Growing costs are largest in the first year when a significant amount must be spent preparing the site, planting the vines, and constructing the trellis. Growing costs are \$1,261 per acre in years 4 through 22, and this number is transported to Table 11 to use in the computation of the costs and returns for the mature vineyard. The cost of crop insurance was added in the 2013 study at an average cost of \$109 per acre. Costs for crop insurance will actually vary a few dollars per acre depending upon the grape variety planted.

Table 10: Summary of Growing Costs for Cold Hardy Vineyard, Trained to High Cordon System, Chautauqua-Lake Erie region, NY, 2015

Item	Year 1	Year 2	Year 3	Year 4+
Site preparation	\$4,339	-	-	-
Vines & planting	\$2,245	-	-	-
Trellis materials & construction	\$2,314	-	-	\$73
Replanting & Rouging	-	-	\$50	\$50
Dormant pruning & removal	-	\$60	\$150	\$187
Weed control	\$120	\$194	\$132	\$113
Fertilization	\$22	\$0	\$56	\$119
Canopy management	-	\$98	\$233	\$228
Disease & insect control	-	\$68	\$112	\$144
Mowing	-	\$73	\$97	\$108
Bird Control	-	-	\$77	\$56
Pick-up	\$75	\$75	\$75	\$75
Crop Insurance*	-	-	-	\$109
Total Growing Costs	\$9,115	\$567	\$982	\$1,261

*Crop Insurance generally starts at the fifth year of positive production (i.e., year 8)

Table 11 summarizes the costs and returns expected from a mature vineyard. The estimated revenue per acre varies from \$-76 to \$1,873 depending upon variety. Total costs vary from \$2,476 to \$2,627 per acre, also depending upon variety. It should be noted that cold hardy grapes in the Chautauqua-Lake Erie region are grown in small scale compared to other varieties and thus require higher fixed costs.

The break-even prices and yields are shown in Table 11. A yield of 4.1 tons per acre is the break-even yield for Brianna, Frontenac, and La Crescent. A yield of 2.8 tons per acre would be necessary to break even with Marquette.

All varieties show moderate profits except for La Crescent. To put this result in perspective, it should be remembered that we assumed recommended practices throughout the model. Some growers will be able to reduce some of these costs considerably, by changing the labor used, or omitting certain unnecessary activities. As mentioned above, the initial state of the land purchased influences the cost of establishment, which is the largest cost throughout the whole growing cycle. All labor, including the owner's labor, is charged a cash wage. There is an imputed charge on all capital used.

Table 11: Costs and Returns for a mature Cold Hardy Vineyard, Trained High Cordon System, Chautauqua-Lake Erie Region, NY, 2015

Item	Brianna	Frontenac	La Crescent	Marquette
Receipts:				
Yield target , tons per acre	5	5	4	5
Price, \$ per ton	\$600	\$600	\$600	\$900
Total receipts	\$3,000	\$3,000	\$2,400	\$4,500
Costs:				
Variable Costs:				
Growing (incl. crop insurance @\$109/Ac)	\$1,261	\$1,261	\$1,261	\$1,261
Interest on operating capital	\$13	\$13	\$13	\$13
Machine Harvesting (\$40/ton)	\$200	\$200	\$160	\$200
Trucking (\$6.5/ton)	\$33	\$33	\$26	\$33
Total variable costs	\$1,506	\$1,506	\$1,460	\$1,506
Fixed Costs:				
Vineyard capital recovery	\$654	\$654	\$654	\$654
Machinery and equipment capital recovery	\$115	\$115	\$115	\$115
Buildings capital recovery	\$12	\$12	\$12	\$12
Property taxes	\$50	\$50	\$50	\$50
Land opportunity cost	\$40	\$40	\$40	\$40
Office supplies, phone, etc.	\$10	\$10	\$10	\$10
Insurance	\$15	\$15	\$15	\$15
Management	\$150	\$150	\$120	\$225
Total fixed costs:	\$1,046	\$1,046	\$1,016	\$1,121
Total costs	\$2,552	\$2,552	\$2,476	\$2,627
Profit or loss	\$448	\$448	-\$76	\$1,873
Breakeven price (\$ /ton)	\$510	\$510	\$619	\$525
Breakeven yield (tons)	4.2	4.2	4.1	2.8

Capital Requirement

Table 12 indicates the capital investment per acre necessary to get into grape production in the Chautauqua-Lake Erie region, assuming a vineyard of 13 total planted acres with an additional 2 acres for roads, buildings, and reliance on either custom hand or machine harvesting of grapes. The table uses the value of new machinery and equipment and buildings. Land costs assume a prime site with land suitable for production of grapes. Table 12 indicates that it would require \$15,348 per planted acre to get a vineyard into maturity in the Lake Erie region under the assumptions indicated above. Established growers, with depreciated vineyards, machinery and equipment, and buildings, would have lower capital investment (book value) depending upon the age of their depreciable assets.

Growers with smaller acreage will typically have higher investment costs per acre. This is due to less efficient use of the machinery complement unless these smaller growers hire some vineyard operations to be done by custom operators and/or vineyard management companies, thus giving them the possibility of buying fewer items of machinery and equipment.

Table 12: Investment per Planted Acre of Cold Hardy Grapes,
Chautauqua-Lake Erie Region of New York, 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	\$15,348

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

Sensitivity Analysis

Costs per ton of grapes and profits for Cold Hardy vineyards will vary widely due to factors such as price of land, site-specific factors, farm size, managerial ability, and labor efficiency. The cost and return estimates developed in this publication represent typical costs for well-managed vineyards producing premium quality grapes on prime sites.

The grower panel did not believe there was sufficient data to adjust costs for varietal differences. The total cost per ton, or breakeven price, is quite sensitive to yield as shown in Table 13. If yields are 3 tons per acre or less and/or with low yielding cultivars, prices around \$825 per ton would be required to break even. Even the highest prices paid in the most recent seasons would result in unprofitable production with such a low yielding scenario.

The average yield for each of these varieties is around 4.75. However, during stochastic weather changes, for example the record low in temperature in 2014, the yield can drop to as low as 3 ton per acre or lower. The ideal yield for premium wine will depend greatly on the characteristics of the given growing season and the contractual agreement between grower and winery purchasing the fruit.

Table 13: Total Cost per Ton (Breakeven Price) At Varying Yields, Cold Hardy Grapes, Chautauqua-Lake Erie Region of New York, 2015

Brianna		Frontenac		La Crescent		Marquette	
Yield (tons/acre)	Cost/ton*	Yield (tons/acre)	Cost/ton*	Yield (tons/acre)	Cost/ton*	Yield (tons/acre)	Cost/ton*
3.0	\$820	3.0	\$820	3.0	\$810	3.0	\$845
3.5	\$709	3.5	\$709	3.5	\$701	3.5	\$731
4.0	\$626	4.0	\$626	4.0	\$619	4.0	\$645
4.5	\$562	4.5	\$562	4.5	\$555	4.5	\$579
5.0	\$510	5.0	\$510	5.0	\$504	5.0	\$525
5.5	\$468	5.5	\$468	5.5	\$463	5.5	\$482
6.0	\$433	6.0	\$433	6.0	\$428	6.0	\$446
6.5	\$403	6.5	\$403	6.5	\$399	6.5	\$415

*Cost at different yield levels adjusted for harvesting and hauling at \$40/ton, trucking at \$6.5/ton

Discussion: Costs and Returns for a Mature Vineyard -An established vineyard holds positive value

Table 14 indicates the estimated annual cash flow for a mature vineyard (similar to table 11), but assuming that an established vineyard is able to partially recover selected capital investments after 22 years of operation.

In this study, we do not discuss the returns of land investment, as it is mostly case-sensitive and this is not including in the vineyard's establishment capital recovery costs in Table 11. Implicitly, the study thus assumes that land values increase by a rate equal to the real interest rate over the 22 years of operation. Instead, we assume that the trellis maintenance is done annually, so the trellis system has half of the value after 22 years. In addition, certain practices, such as drainage, lime application, land maintenance, herbicide application system do not need to be done when

starting a new production cycle, and add value to the vineyard. The costs of these activities are therefore dropped from the annual vineyard capital recovery estimates. As a result, the capital recovery costs per acre decreases from \$654 (Table 11) to \$379 (Table 14). In Table 14, all varieties exhibit per-acre profits that widely range from \$239 to \$2,188, with Marquette being the most profitable one.

Table 14: Costs and Returns for a mature Cold Hardy Vineyard-2, assuming that E&D costs can be partially recovered, Chautauqua-Lake Erie Region, NY, 2015

Item	Brianna	Frontenac	La Crescent	Marquette
Receipts:				
Yield target, tons per acre	5	5	4	5
Price, \$ per ton	\$600	\$600	\$600	\$900
Total receipts	\$3,000	\$3,000	\$2,400	\$4,500
Costs:				
Variable Costs:				
Growing (incl. crop insurance @\$109/Ac)	\$1,261	\$1,261	\$1,261	\$1,261
Interest on operating capital	\$13	\$13	\$13	\$13
Machine Harvesting (\$40/ton)	\$200	\$200	\$160	\$200
Trucking (\$6.5/ton)	\$33	\$33	\$26	\$33
Total variable costs	\$1,506	\$1,506	\$1,460	\$1,506
Fixed Costs:				
Vineyard capital recovery (minus valuable)	\$379	\$379	\$379	\$379
Machinery and equipment capital recovery	\$115	\$115	\$115	\$115
Buildings capital recovery	\$12	\$12	\$12	\$12
Property taxes	\$50	\$50	\$50	\$50
Land opportunity cost	\$0	\$0	\$0	\$0
Office supplies, phone, etc.	\$10	\$10	\$10	\$10
Insurance	\$15	\$15	\$15	\$15
Management	\$150	\$150	\$120	\$225
Total fixed costs:	\$731	\$731	\$701	\$806
Total costs	\$2,237	\$2,237	\$2,161	\$2,312
Profit or loss	\$763	\$763	\$239	\$2,188
Breakeven price (\$ /ton)	\$447	\$447	\$540	\$462
Breakeven yield (tons)	3.6	3.6	3.6	2.4

Concluding Comments

The development of Cold Hardy grapes brought a new era to the winery industries in cold climate areas where growing grapes was previously impractical due to winter damages. With the advent of varieties such as Frontenac, La Crescent, and especially Marquette, the grape production has expanded fast. According to University of Minnesota, where these varieties were developed and first produced, ever since the first cold hardy grape variety Frontenac was released in 1996, producers in 12 states have planted an estimated 5,400 acres of cold-hardy grapes and 80 percent of the 199 wineries surveyed started their businesses after 2002¹. Now the cold hardy grapes are widespread in Midwestern states; Especially in Minnesota, over 90% of the grapes grown are cold hardy varieties. The state of New York has also expanded its grape production with these new varieties, where Chautauqua-Lake Erie region is one of the many beneficiaries from this fast growing, vibrant industry.

The cost and returns estimates derived in this publication indicate results for cold hardy grapes in the Chautauqua-Lake Erie region under the assumption of prime sites, the use of recommended practices, good management, 2015 prices for inputs, and prices for grapes that reflect several quality enhancing practices. Potential investors should be reminded that the current economic climate for grape growing in the Lake Erie region can and will change with time in the long run. In some years, given the thin markets for certain varieties, a surplus situation can develop when grape yields increase or a few growers plant additional acres. As mentioned above, since the varieties are fairly new, the growers are still on the experimenting stage. Most of the growers only have few years of historical data for prices and yields of the varieties, which are expected to change as practice of production of these grapes become more standardized in the region. As the total planted acre of cold hardy grapes are currently small, with such limited acreage, a few small plantings or one large planting of these varieties can lead to a large percentage increase in grapes produced, temporarily depressing the cash market.

Other factors that might influence the estimation include the current macroeconomic conditions such as fuel prices, the potential for inflation of other inputs (especially pesticides and fertilizer), and the value of the US dollar. Over three-fourths of the wine marketed by New York farm wineries is sold directly to consumers. High prices for gasoline, especially during a recession, might limit visitors from the surrounding states from making trips to the region. The dollar is doing pretty strong right now, and it has some positive and some negative effects. To the extent producers buy special machinery or winery equipment from Europe, strong USD decreases those costs. However, on the other side, European and Australian wines cost less now, giving domestic producers less advantage price-wise.

Another point should be made on the labor used. Since the labor costs constitute a significant portion of the production costs, wise utilization of the labor force is highly recommended. Finding the most efficient labor with high productivity is crucial to maintaining a low labor cost. Varying the source of labor is also worth considering. For example, in other regions with smaller vineyards, such as the Thousand Islands region, a vineyard is often managed by the owner himself and with few other family members. This considerably lowers cost of labor. Sometimes, the growers have also relied on volunteers for harvest for certain years, which again contribute in lowering the production cost.

Given the growing consumption of table wine in the United States, the developing tourist trade in the Lake Erie region, and the growing reputation of Lake Erie wine portfolio and quality,

¹ <http://discover.umn.edu/news/food-agriculture/cold-hardy-grapes-create-401-million-economic-impact>

the long run potential appears favorable for investors who can weather the inevitable ups and downs associated with an agricultural enterprise subject to the usual vagaries of weather and market forces.

APPENDIX

Appendix Table 1: Sample Herbicide Program for Cold Hardy Grapes,
Chautauqua-Lake Erie Region, NY, 2015

	Material	Rate/acre		Price		\$/acre
Year 0 (Site prep.)						
Custom herbicide	glyphosate	4.0	qt.	\$3.10	qt.	\$12.40
	Am.sulfate	1.7	lb.	\$2.53	lb.	\$4.29
Total for site preparation						\$16.69
Year 1						
Chem. weed control- trellis	Surflan	1.25	qt.	\$12.90	qt.	\$16.13
Chem. weed control- spot	glyphosate	2.0	qt.	\$3.10	qt.	\$6.20
	Am.sulfate	1.7	lb.	\$2.53	lb.	\$4.29
Total for treatment						\$26.62
Total for Year 1						\$26.62
Year 2-3						
Chem.weed control- trellis	Prowl H2O	6	qt.	\$48.84	gal	\$73.26
Spot herbicide treatment	glyphosate	2	qt.	\$3.10	qt.	\$6.20
	Am. sulfate	1.7	lb.	\$2.53	lb.	\$4.29
Total for treatment						\$83.75
Spot herbicide treatment	glysophate	2	qt.	\$3.10	qt.	\$6.20
	Am. sulfate	1.7	lb.	\$2.53	lb.	\$4.29
Total for treatment						\$10.49
Total for Year 2-3						\$188.49
Year 4-25						
Chem.weed control- trellis (every 5yrs)	Chateau	12	fl oz.	\$0.77	fl oz.	\$1.85
Spot Herbicide Program (Applied to 1/3 planted acre)						
Pre-emergent	Alion	4	oz	\$11.67	oz	\$46.68
	Glysophate	1.5	qt	\$3.10	qt	\$4.65
	Aim	2	oz	\$6.00	oz	\$12.00
Post emergent (optional)	Glysophate+Aim	NA	NA	NA	NA	\$16.65
	Glysophate+Am.Sulf	NA	NA	NA	NA	\$10.49
	Paraquat	2	pt	\$5.00	pt	\$10.00
Total for treatment						\$33.49
Total for years 4-25						\$35.34

Appendix Table 2: Sample Fertilizer/Soil Program for Cold Hardy Grapes,
Chautauqua-Lake Erie Region, NY, 2015

	Material	Rate/acre	Price		\$/acre
Year 0 (Site prep.)					
Soil sampling- I test/5 acres, 2 depths	N/A	0.4	acre	\$15	test \$6.00
Lime (custom application)	Lime	2	tons	\$24	ton \$48.00
Fall fertilization	Muriate of Potash	300	lbs.	\$580	ton \$87.00
Total for year 0					\$141.00
Year 1					
Fertilization (banded)	10:10:10	30	lbs.	\$0.23	lb. \$6.75
Total for year 1					\$6.75
Year 2					
Crop nutrition	Nitrogen	80	lbs.	\$1,000	ton \$40.00
Total for year 2					\$40.00
Year 3					
Crop nutrition	Nitrogen	100	lbs.	\$1,000	ton \$50.00
Total for year 3					\$50.00
Year 4+					
Soil application (every 5yrs)	Solubor (20%B)	2.5	lbs.	\$1.69	lb. \$0.85
Fall fertilization (every 2nd year)	Muriate of Potash	300	lbs.	\$580	ton \$43.50
Lime (1 in 5 years)	Lime	1	ton	\$24	ton \$4.80
Petiole sampling		0.16	acre	\$24	test \$3.84
Soil sampling (every 5th year)		0.2	acre	\$15	test \$0.60
Crop nutrition	Nitrogen	100	lbs	\$1,000	ton \$50.00
Total for Year 4+					\$103.59

Appendix Table 3: Hourly Machinery and Equipment Variable Costs, Cold Hardy Grapes, Chautauqua-Lake Erie Region, NY, 2015

Item	Purchase Price	Hours of life	Total Repairs	Repairs	Fuel	Lube (15% of fuel)	Total Hourly Variable Costs
Tractor, 62-HP, 2WD, spray cab	\$48,000	7000	100%	\$6.86	\$6.70	\$1.01	\$14.56
Tractor, 45-HP	\$28,000	7000	100%	\$4.00	\$6.70	\$1.01	\$11.71
Air-blast sprayer- 400 gallon	\$15,000	2000	60%	\$5.70			\$5.70
Herbicide sprayer- 300 gallon	\$2,200	2000	60%	\$5.10			\$5.10
RTV	\$10,000	7000	100%	\$1.43			\$1.43
Environmist sprayer	\$6,700	2000	60%	\$2.01			\$2.01
Mower	\$7,800	2500	80%	\$2.50			\$2.50
Brush Chopper	\$8,500	2500	80%	\$2.72			\$2.72
Fertilizer Spreader	\$2,000	1200	80%	\$1.33			\$1.33
Small disc	\$2,500	2000	60%	\$0.75			\$0.75
Grape hoe/Weed badger	\$7,500	2000	60%	\$2.25			\$2.25
Post driver	\$4,000	2000	80%	\$1.60			\$1.60
Vineyard Trailer	\$3,000	3000	80%	\$0.80			\$0.80
Pickup truck	\$40,000	2500	83%	\$13.28	\$7.50	\$1.13	\$21.91
Auger	\$1,000	2000	80%	\$0.40			\$0.40
Replanter	\$4,800	1200	80%	\$3.20			\$3.20
Bird control audio (\$103 per acre)	\$5,000	7000	80%	\$0.36			\$0.36
Shop Equipment	\$8,000	2500	80%	\$2.56			\$2.56
Pruning Shears (X5)	\$250	2000	60%	\$0.08			\$0.08
Tractor Fuel Factors	Factor						
Diesel	0.0438						
Gasoline	0.0600						

OTHER A.E.M. EXTENSION BULLETINS

EB No	Title	Fee (if applicable)	Author(s)
2015-13	Workforce Issues: Profiles of Specialty Crop Farms in New York State		Maloney, T., Smith, M., Saputo, R. and B. Rickard
2015-12	Cost of Establishment and Production of Cold Hardy Grapes in the Thousand Islands Region of New York - 2015		Oh, D., Kananizadeh, S., Gómez, M. and T. Martinson
2015-11	Ex Ante Economic Evaluation of Technologies for Managing Postharvest Physiological Disorders		Rickard, B., Rudell, D. and C. Watkins
2015-10	Produce Procurement Study		McLaughlin, E., Park, K. and G. Hawkes
2015-09	Dairy Farm Business Summary, New York Small Herd Farms, 140 Cows or Fewer, 2014	(\$20.00)	Knoblauch, W.A., Dymond, C., Karszes, J. and R. Kimmich
2015-08	Dairy Farm Business Summary, Northern New York Region, 2014	(\$16.00)	Knoblauch, W.A., Dymond, C., Karszes, J., Howland, E., Murray, P., Buxton, S. and R. Kimmich
2015-07	Dairy Farm Business Summary, Hudson and Central New York Region, 2014	(\$16.00)	Knoblauch, W.A., Dymond, C., Karszes, J., Howland, E., Buxton, S., Kiraly, M., Kimmich, R. and K. Shoen
2015-06	Dairy Farm Business Summary, Western New York Region, 2014	(\$16.00)	Knoblauch, W.A., Dymond, C., Karszes, J., Howland, B., Hanchar, J., Petzen, J., Stoll, K. and R. Kimmich
2015-05	Dairy Farm Business Summary, New York Large Herd Farms, 300 Cows or Larger, 2014	(\$20.00)	Karszes, J., Knoblauch, W.A. and C. Dymond
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