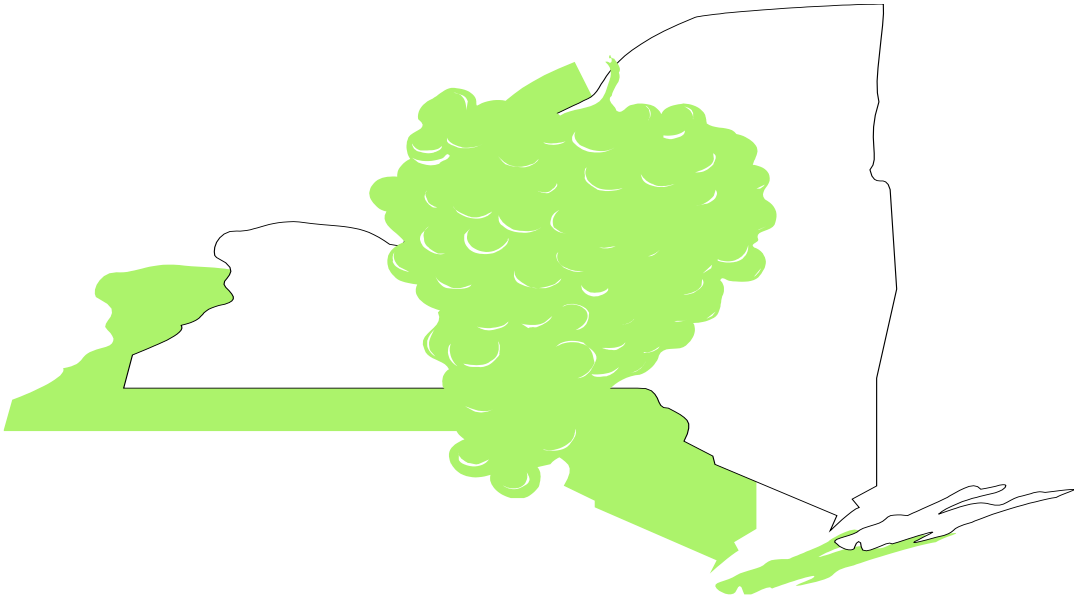
November 2015 EB 2015-12

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



Dayea Oh, Sogol Kananizadeh, Miguel I. Gómez, Tim Martinson

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

It is the policy of Cornell University actively to support equality of educational and employment opportunity. No person shall be denied admission to any educational program or activity or be denied employment on the basis of any legally prohibited discrimination involving, but not limited to, such factors as race, color, creed, religion, national or ethnic origin, sex, age or handicap. The University is committed to the maintenance of affirmative action programs which will assure the continuation of such equality of opportunity.

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

Dayea Oh, Sogol Kananizadeh, Miguel I. Gómez, Tim Martinson

Introduction

The Thousand Islands region, which encompasses 1864 islands, is located in the Canadian-US border in the Saint Lawrence River stretching for about 50 miles separating Ontario from New York. Thousand Islands first attracted wineries in the early 2000 and has since been successful in wine production.

Thousand Islands' peculiar growing condition has been home to cold hardy grapes since 2002. 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 Thousand Island region. Among all, the four top varieties are Marquette, La Crescent, Frontenac, and Brianna, which provide choices from dry to sweet.

The first winery in Thousand Island region began to function in 2003 with an inventory of 1,100 gallons of wine. Steve Conway along with his wife, Erika, first moved to the Thousand Islands region in 2002 and had a vision to transform an old farm into a winery. However the experts at Cornell, not being aware of cold hardy grapes, advised Steve not to do so since it was impossible to successfully grow grapes in harsh conditions. Contrary to their expectations, the business strived. Since then, several other wineries have been established and the region is experiencing steady growth. Today, there are about ten vineyards just in the Thousand Islands regions.

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.

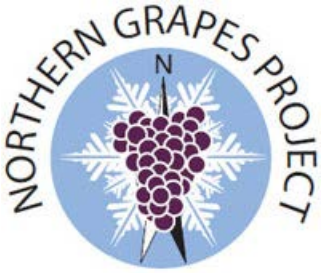
The objective of this study was to determine the cost of producing cold hardy grapes in the Thousand Islands region in a commercial size operation. Estimates of the total investment in land, machinery, vineyard establishment and development costs, and annual operating costs were developed. These estimates 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 Thousand Island 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 thus new business in the area as well, 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 Thousand Island region in their decision-making.

Appreciation is expressed to Phil Randazzo, Sue Maring, and David Fralick who served as the growers' panel for helping to establish the costs reported in this bulletin. Professor Wayne Frank Wilcox, Department of Plant Pathology and Plant Microbe Biology, provided helpful reviews of the manuscript. 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.



Methods

The methods used to construct cost estimates were a combination of 1) interviews with a panel comprised of grower representatives, and 2) economic engineering using recommended practices. In July of 2015, we met with a panel of two viticulturists and three growers/vineyard managers. The growers went through the data prepared for the most recent estimates of the cost of establishing and growing hybrid 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 Thousand Island 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 22 acres, with 20 acres planted to grapes. The other 2 acres are occupied by roads, shops, and offices, etc. The 20-acre vineyard is large enough to use vineyard machinery and equipment efficiently, but small enough to be operated as a family business, as did all the growers in the panel. 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 10' spacing (vine by row) resulting in a planting density of 622 vines per acre. There were 11 rows to an acre and rows were 400 feet long. Vine cost was estimated to average $3.75 per plant. Each year it was assumed that four percent of the vines had to be replanted. Unlike the Finger Lakes region, laser planting was not a common practice in the area, and just a normal machine planting was employed. The fee for planting was $1,100/acre.

Varieties. The 20-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 Thousand Island 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 desert 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 a 6" 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 22 wood end posts (8 ft X 5" diameter) and 22 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 two growers and a viticulturist. 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 Dr. Tim Martinson, Head of the New York State Viticulture Extension Program and faculty at Cornell University. See Table 2 in Appendix for details.

Wage Rates. Wage rates used represented the consensus of the grower panel. The rates assumed were $17.00 per hour for skilled labor (i.e. $13.08 per hour plus fringe benefits). Fringe benefits consist of workers compensation, social security, medical insurance, and other benefits. For unskilled labor, the rate was $11.50 per hour (including fringe benefits).

Harvesting & Hauling. Grapes were custom machine harvested in the fourth year and beyond. The machine harvesting rate is assumed at $95 per ton, with an additional $30 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 with the minor exceptions for a small disc, which was assumed to be used. Diesel fuel at $3.90 per gallon was budgeted for machine operations. Gasoline was charged at $3.83 per gallon (for unleaded). These were representative of prices in Central New York as of December 2013. 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 $3,000 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	2.44 tons/acre
Frontenac	1 ton/acre	2.25 tons/acre
La Crescent	1 ton/acre	2.20 tons/acre
Marquette	1 ton/acre	3.02tons/acre

Results

Grape Prices

Since the cold hardy varieties are relatively new, with the first harvest in 2003, 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 Thousand Island Region 2014, Dollars per Ton.

	Brianna	Frontenac	La Crescent	Marquette
Prices	$1,500	$1,500	$1,500	$1,800

Machinery and Buildings Costs

The investment costs and annual costs for equipment and buildings are summarized in Table 3. The machinery investment required totals $199,358 an average investment of $9,968 per acre of vineyard. The investment for a shop is estimated at $67,500, or $3,375 per acre. The grower panels we met had average shop size of 1,500 ft^2, with the construction cost estimated at $45.00 per ft^2 (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 $19,967 for machinery and $3,104 for buildings, or $998 and $151 annual costs per acre, respectively. Machinery investment would be much greater if a mechanical grape harvester was necessary.

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

Machinery and Equipment	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- 200 gallon	$15,000	$10	$1,500	$13,500	0.1113	$1,503	$30	$1,532.91
Herbicide sprayer- 50 gallon	$2,200	$10	$220	$1,980	0.1113	$220	$4.40	$224.83
RTV	$10,000	$10	$1,000	$9,000	0.1113	$1,002	$20	$1,021.94
Environmist sprayer	$6,700	$10	$670	$6,030	0.1113	$671	$13.40	$684.70
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 (used)	$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 (used)	$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	$9.60	$490.53
Bird control equipment ($100 per acre)	$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
Macrobin (X30)	$9,000	$10	$900	$8,100	0.1113	$902	$18	$919.74
Picking trays (X55)	$8	$7	$1	$7	0.1545	$1	$0.02	$1.08
Total Machine & Equipment Costs	$199,358		$19,709	$170,391				$19,967
Cost per planted acre	$9,968							$998
Buildings								
Shop (1,500 ft2 @ $45 ft2)	$67,500	$30	$0	$67,500	0.0446	$3,014	$0	$3,014
Cost per planted acre	$9,000							$150.69
Vineyard								
1 Ac. Cold Hardy Vineyard	$17,934	22	0	$17,934	0.0566	$1,016	$0	$1,016

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, five 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 six sprays during the growing season. Spray materials costs were $203.13 per acre. 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, Thousand Island Region, NY, 2015

Year	Material	Rate/acre		Price		$/acre
Year 1						
Spray 1	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Spreader	4	oz.	$20.57	gal.	$0.64
Total per spray						**$11.95**
Sprays 2-3	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Sulfur	4	lbs.	$1.20	lb.	$4.80
	Spreader	4	oz.	$20.57	gal.	$0.64
Total per spray						**$16.75**
Total for year (3 sprays)						**$45.46**
Year 2						
Spray 1	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Spreader	4	oz.	$20.57	gal.	$0.64
Total per spray						**$11.95**
Sprays 2-4	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Sulfur	4	lbs.	$1.20	Ib.	$4.80
	Spreader	4	oz.	$20.57	gal.	$0.64
Total per spray						**$16.75**
Total for year (4 sprays)						**$62.21**
Year 3						
Spray 1	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Spreader	4	oz.	$20.57	gal.	$0.64
	Assail 30SG	2.5	oz.	$703.90	gal.	$13.75
Total for year (1 spray)						**$25.70**
Sprays 2-3	Revus Top	7	oz.	$332.46	gal.	$18.18
	Spreader	4	oz.	$20.57	oz	$0.64
	Assail 30SG	2.5	oz.	$703.90	gal.	$13.75
Total per spray						**$32.57**
Total for year (2-3 sprays)						**$65.14**

Sprays 4-5	Captan 80WP	2.5	lbs.	$4.19	lb.	$10.48
	Sulfur	5	lbs.	$1.20	lb.	$6.00
	Spreader	4	oz.	$20.57	gal.	$0.64
Total per spray						**$17.12**
Total for year (4-5 sprays)						**$34.24**
Total for year (5 sprays)						**$125.1**
Years 4-25						
Spray 1	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Spreader	4	oz.	$20.57	gal.	$0.64
Total for year (1 spray)						**$11.95**
Spray 2	Mancozeb 75DF	3	lbs.	$3.77	lb.	$11.31
	Sulfur	5	lbs.	$1.20	lb.	$6.00
	Spreader	4	oz.	$20.57	gal.	$0.64
	Assail 30SG	2.5	oz.	$703.90	gal.	$13.75
Total for year (2 spray)						**$31.70**
Sprays 3-4	Revus Top	7	oz.	$2.60	oz	$18.18
	Spreader	4	oz.	$20.57	gal.	$0.64
	Assail 30SG	2.5	oz.	$703.90	gal.	$13.75
Total per spray						**$32.57**
Total for year (3-4 sprays)						**$65.14**
Sprays 5-6	Captan 80 WP	2.5	lbs.	$4.19	lb.	$10.48
	Sulfur	5	lbs.	$1.20	lb.	$6.00
	Carbaryl 4L	2	qt.	$61.38	gal.	$3.69
Total per spray						**$47.17**
Total for year (5-6 sprays)						**$94.33**
Total for year (6 sprays)						**$203.10**

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 Tim Martinson, Head of the New York State Viticulture Extension Program and faculty at Cornell University for the Thousand Island region.

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 $4,360 per acre.

Table 5: Tile Drainage Costs per acre for Cold Hardy Grapes, Thousand Islands Region, NY, 2015.

Item	Quantity		Price		Total per acre
Main line: 6" pipe	109	ft	$1.20	ft	$131
Laterals: 4" pipe	2,420	ft	$0.42	ft	$1,016
Installation	2,529	ft	$1.28	ft	$3,224
Total Drainage Construction per acre					**$4,384**

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 11 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 $2,187 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 $3,316 per acre.

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

Item	Quantity		Price		Total per acre
Wood end posts (8 ft X 5" diameter)	22	posts	$16.90	post	$368
Screw anchors (8 ft X 3" diameter)	22	posts	$11.29	post	$246
Steel grape stakes (8 ft, 3" diameter)	207	stakes	$6.00	stake	$1,245
12.5 gauge HT foilage & cordon wire	8,973	ft	$0.025	ft	$220
Gripples (8 per row, 16 rows)	87	griples	$1.25	gripple	$109
Total Trellis Construction materials					**$2,187**

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 $11,619 per acre. The largest cost in the first year is planting and trellis construction, with a total cost of $2,757 and $3,316 respectively. 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, one of the growers bought a farmland which came with the drainage system built in and where soil was already in a good state. As a result, she didn't need to install drainage system anew or lime the soil or plow the land. Our tables show the necessary activities for lands that weren't formally in use before. In year two, costs are a relatively modest $888 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 six 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 Thousand Island area for the cold hardy grapes. Total costs for the third year are $1,250 per acre.

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 $17,987 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 $1,019 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 $13,757 for site preparation and the first three years.

Table 7: Cold Hardy Grape Establishment and Development Costs
Thousand Island Region, New York, 2015

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Site Preparation							
Drainage (see table 5 for details)	Custom						$4,384
Lime (3 tons/acre)	Custom						$150
Herbicide application	Skilled	0.5	0.5	$9	$11	$30	$50
Stone removal & land maint.	Unskilled	10	10	$115	$153		$268
Soil Sampling	Skilled	0.2		$3		$6	$9
Fall fertilization	Skilled	0.6	0.5	$10	$8	$87	$105
Plowing	Skilled	3		$51			$51
Discing (2X)	Skilled	3.5	3.5	$60	$52		$111
Pickup truck	N/A				$75		$75
Total for site preparation		**17.8**	**14.5**	**$248**	**$224**	**$123**	**$5,204**
First Year							
Floating/dragging	Skilled	1	1	$17	$15		$32
Planting	Unskilled	16	16	$184	$239	$2,334	$2,757
Fertilization (banded)	Skilled	0.6	0.5	$10	$8	$7	$25
Chem. weed control -trellis	Skilled	1.25	1.25	$21	$19	$15	$55
Trellis construction (see table 6 for details)	Skilled	50	15	$850	$279	$2,187	$3,316
Cultivation (2X)	Skilled	1.2	1.2	$20	$20		$41
Spray 1	Skilled	0.4	0.3	$7	$7	$12	$25
Spray 2	Skilled	0.4	0.3	$7	$7	$17	$30
Spray 3	Skilled	0.4	0.3	$7	$7	$17	$30
Seed cover crop	Skilled	0.6	0.5	$10	$8	$11	$29
Pickup truck	N/A				$75		$75
Total for first year		**96.15**	**36.35**	**$1,133**	**$683**	**$4,599**	**$6,415**
Total for first year and site prep							**$11,619**

Table 7 continued

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Second Year							
Pruning & brush removal	Unskilled	4		$46			$46
Cordon renewal*	Unskilled	3		$35			$35
Vine Replacement	Unskilled	1	1	$12	$18	$93	$123
Chem. weed control-trellis	Skilled	1.25	1.25	$21	$21	$73	$115
Suckering	Unskilled	5		$58			$58
Cluster removal	Unskilled	5		$58			$58
Hoe around the vines	Unskilled	4	4	$46	$67		$113
Spot herbicide treatment 1	Skilled	0.4	0.3	$7	$5	$21	$33
Spot herbicide treatment 2	Skilled	0.4	0.3	$7	$5	$21	$33
Spray 1	Skilled	0.4	0.3	$7	$7	$12	$25
Spray 2	Skilled	0.4	0.3	$7	$7	$17	$30
Spray 3	Skilled	0.4	0.3	$7	$7	$17	$30
Spray 4	Skilled	0.4	0.3	$7	$7	$17	$30
Mowing (4X)	Skilled	2	2	$34	$40		$74
Roguing	Unskilled	1		$12			$12
Pickup truck (10,000 miles for 20 ac/year)	N/A				$75		$75
Total for Second Year		**28.65**	**10.05**	**$361**	**$181**	**$272**	**$888**

*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		$170			$170
Cordon tying & renewal	Skilled	10		$170		$10	$180
Brush chopping	Skilled	1.2	1	$20	$20		$41
Vine replacement	Skilled	1	1	$17	$18	$93	$128
Chem. weed control- trellis	Skilled	2.6	2	$44	$30	$73	$148
Suckering	Unskilled	4		$46			$46
Cluster removal	Unskilled	4		$46			$46
Bird control	Unskilled	3		$35	$2		$36
Spot herbicide treatment 1	Skilled	0.4	0.3	$7	$5	$21	$33
Spot herbicide treatment 2	Skilled	0.4	0.3	$7	$5	$21	$33
Spray 1	Skilled	0.6	0.5	$10	$11	$26	$47
Spray 2	Skilled	0.6	0.5	$10	$11	$33	$54
Spray 3	Skilled	0.6	0.5	$10	$11	$33	$54
Spray 4	Skilled	0.6	0.5	$10	$11	$17	$38
Spray 5	Skilled	0.6	0.5	$10	$11	$17	$38
Mowing (4X)	Skilled	2.6	2	$44	$40		$84
Pickup truck (10,000 miles for 20 ac/year)	N/A				$75		$75
Total for Third Year		**42.2**	**9.1**	**$657**	**$249**	**$344**	**$1,250**

Table 8: Summary of Establishment and Development Costs by Year
for Cold Hardy Grapes, Thousand Island Region, NY 2015

Item	Year 1	Year 2	Year 3
Revenue			
Yield per acre (tons)	0	0	1
Market price (ave. of 3 varietals)	N/A	N/A	$1,575
Total revenue	$0	$0	$1,575
Costs			
Site preparation	$5,204	$0	$0
Annual variable costs			
-Preharvest	$6,415	$888	$1,250
-Harvest (hand)+hauling	$0	$0	$275
Total Variable Costs & Site preparation	$11,619	$888	$1,525
Annual fixed costs			
-Machines & equipment amortization	$998	$998	$998
-Buildings amortization	$151	$151	$151
-Property taxes	$50	$50	$50
-Land opportunity cost	$40	$40	$40
-Office Supplies, phone, etc.	$150	$150	$150
-Insurance (fire, liability)	$190	$190	$190
-Management	$0	$0	$0
Total Fixed Costs	$1,522	$1,522	$1,522
Interest on cumulative costs (real interest rate= 2%)	$263	$316	$384
Total costs	$13,404	$2,727	$3,431
Net returns	($13,404)	($2,727)	($1,856)
Total cumulative costs	$13,404	$16,131	$17,987
Amortization of vineyard:			$1,019
Cash costs of vineyard establishment (3 Yrs.)			$13,757

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 $1,759 per acre. The most costly operations are canopy management ($249 per acre), spraying (6 times, for a total of $330 per acre, including labor, machinery and materials costs) and pruning and brush removal ($397 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, Thousand Islands 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	$195.50	$201.02		$397
Brush chopping	Skilled	1.2	1	$20.40	$20.12		$41
Trellis maintenance	Skilled	4	1	$68.00	$15.35	$30.00	$113
Cordon tying & renewal	Skilled	11.5		$195.50		$7.00	$203
Vine replacement	Skilled	1	1	$17.00	$17.75	$93.34	$128
Chem.weed control-trellis	Skilled	2.6	2	$44.20	$30.41	$9.19	$84
Soil applic of Solubor (w. herb. Spray)						$4.23	$4
Spot herbicide treatment	Skilled	0.4	0.3	$6.80	$4.56	$21.38	$33
Suckering & Shoot thinning	Unskilled	4		$46.00			$46
Bird control	Unskilled	3	3	$34.50	$1.71		$36
Spray 1	Skilled	0.6	0.5	$10.20	$10.95	$11.95	$33
Spray 2	Skilled	0.6	0.5	$10.20	$10.95	$31.70	$53
Spray 3	Skilled	0.6	0.5	$10.20	$10.95	$32.57	$54
Spray 4	Skilled	0.6	0.5	$10.20	$10.95	$32.57	$54
Spray 5	Skilled	0.6	0.5	$10.20	$10.95	$47.17	$68
Spray 6	Skilled	0.6	0.5	$10.20	$10.95	$47.17	$68
Mowing (4X)	Skilled	2.6	2	$44.20	$39.80		$84
Lime (1 in 5 years)	Skilled	0.1	0.1	$1.70	$4.75	$9.00	$15
Pickup truck	N/A				$75.00		$75
Petiole sampling ($88 for every 2 years)	Skilled	0.1		$1.70		$3.84	$6
Soil sampling (every 5 years)	Skilled	0.1		$1.70		$0.60	$2
Fall fertilization	Skilled	0.3	0.3	$5.10	$4.76	$43.50	$53
Crop insurance	N/A						$109
Total		**46**	**25.2**	**$743.50**	**$480.96**	**$425.20**	**$1,759**

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 $1,759 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, Thousand Islands Region, NY, 2015

Item	Year 1	Year 2	Year 3	Year 4+
Site preparation	$5,204			
Vines & planting	$2,788			
Trellis materials & construction	$3,316			$113
Replanting & Rouging		$134	$128	$128
Dormant pruning & removal		$46	$170	$397
Weed control	$125	$181	$213	$117
Fertilization	$25	$0		$81
Canopy management		$150	$272	$249
Disease & insect control	$86	$116	$231	$330
Mowing		$74	$125	$125
Bird Control			$36	$36
Pick-up				$75
Crop Insurance*				$109
Total Growing Costs	**$11,544**	**$700**	**$1,175**	**$1,759**

*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 $3,300 to $5,436 depending upon variety. Total costs vary from $4,757 to $4,967 per acre, also depending upon variety. It should be noted that cold hardy grapes in the Thousand Islands 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 3.5 tons per acre is the break-even yield for Brianna, Frontenac, and La Crescent. A yield of 2.96 tons per acre would be necessary to break even with Marquette.

All varieties show large losses (-$1,457 – -$1,145) given the assumed yields and prices. Only Marquette, with its higher yield and market price per ton generates profit ($469). Marquette is able to achieve profit despite highest costs because of its relatively higher prices and higher yield. 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, Thousand Islands Region, NY, 2015

Item	Brianna	Frontenac	La Crescent	Marquette
Receipts:				
Yield **target**, tons per acre	2.44	2.25	2.20	3.02
Price, $ per ton	$1,500	$1,500	$1,500	$1,800
Total receipts	$3,660	$3,375	$3,300	$5,436
Costs:				
Variable Costs:				
Growing (incl. crop insurance @$109/Ac)	$1,759	$1,759	$1,759	$1,759
Interest on operating capital	$18	$18	$18	$18
Machine Harvesting ($95/ton)	$232	$214	$209	$287
Trucking ($30/ton)	$73	$68	$66	$91
Total variable costs	$2,081	$2,057	$2,051	$2,154
Fixed Costs:				
Vineyard capital recovery	$1,019	$1,019	$1,019	$1,019
Machinery and equipment capital recovery	$998	$998	$998	$998
Buildings capital recovery	$151	$151	$151	$151
Property taxes	$50	$50	$50	$50
Land opportunity cost	$40	$40	$40	$40
Office supplies, phone, etc.	$150	$150	$150	$150
Insurance	$133	$133	$133	$133
Management	$183	$169	$165	$272
Total fixed costs:	$2,724	$2,710	$2,706	$2,813
Total costs	**$4,805**	**$4,767**	**$4,757**	**$4,967**
Profit or loss	**-$1,145**	**-$1,392**	**-$1,457**	**$469**
Breakeven price ($ /ton)	$1,969	$2,119	$2,162	$1,645
Breakeven yield (tons)	3.3	3.3	3.3	2.74

Capital Requirement

Table 12 indicates the capital investment per acre necessary to get into grape production in the Thousand Islands region, assuming a vineyard of 20 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. If a harvester is purchased, investment per acre for machinery would be considerably higher. Land costs assume a prime site with land suitable for production of grapes. Table 12 indicates that it would require $33,530 per planted acre to get a vineyard into maturity in the Thousand Islands 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, Thousand Islands Region of New York, 2015

Assets	$/acre
Land*	$2,200
Machinery & equipment	$9,968
Buildings (shop & tool shed)	$3,375
Vineyard establishment and development	$17,987
Total Investment per acre	**$33,530**

* Assumes 22 acres purchased (including support land) for 20 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 1.5 tons per acre or less and/or with low yielding cultivars, prices around $3,100 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 2.5. However, during stochastic weather changes, for example the record low in temperature in 2014, the yield can drop to as low as 1.5 ton per acre. 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, Thousand Islands 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*
1.0	$4,625	1.0	$4,611	1.0	$4,607	1.0	$4,714
1.5	$3,125	1.5	$3,116	1.5	$3,113	1.5	$3,184
2.0	$2,375	2.0	$2,368	2.0	$2,366	2.0	$2,420
2.5	$1,925	2.5	$1,919	2.5	$1,918	2.5	$1,961
3.0	$1,625	3.0	$1,620	3.0	$1,619	3.0	$1,655
3.5	$1,411	3.5	$1,407	3.5	$1,406	3.5	$1,436
4.0	$1,250	4.0	$1,247	4.0	$1,246	4.0	$1,272
5.0	$1,025	5.0	$1,022	5.0	$1,021	5.0	$1,043

*Cost at different yield levels adjusted for harvesting and hauling at $95/ton, trucking at $30/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 $1,019 (Table 11) to $717 (Table 14). In Table 14, Marquette exhibits profit at $811 per acre. The other three varieties exhibit per-acre losses that ranging from $803 to $1,115.

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

Item	Brianna	Frontenac	La Crescent	Marquette
Receipts:				
Yield target, tons per acre	2.44	2.25	2.2	3.02
Price, $ per ton	$1,500	$1,500	$1,500	$1,800
Total receipts	$3,660	$3,375	$3,300	$5,436
Costs:				
Variable Costs:				
Growing (incl. crop insurance @$109/Ac)	$1,759	$1,759	$1,759	$1,759
Interest on operating capital	$18	$18	$18	$18
Machine Harvesting ($95/ton)	$232	$214	$209	$287
Trucking ($30/ton)	$73	$68	$66	$91
Total variable costs	$2,081	$2,057	$2,051	$2,154
Fixed Costs:				
Vineyard capital recovery (minus valuable)	$717	$717	$717	$717
Machinery and equipment capital recovery	$998	$998	$998	$998
Buildings capital recovery	$151	$151	$151	$151
Property taxes	$50	$50	$50	$50
Land opportunity cost	$0	$0	$0	$0
Office supplies, phone, etc.	$150	$150	$150	$150
Insurance	$133	$133	$133	$133
Management	$183	$169	$165	$272
Total fixed costs:	$2,382	$2,368	$2,364	$2,471
Total costs	**$4,463**	**$4,425**	**$4,415**	**$4,625**
Profit or loss	**-$803**	**-$1,050**	**-$1,115**	**$811**
Breakeven price ($ /ton)	$1,829	$1,967	$2,007	$1,531
Breakeven yield (tons)	3.0	3.0	3.0	2.5

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 2002[1]. 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 Thousand Islands 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 Thousand Islands region under the assumption of prime sites, the use of recommended practices, good management, 2014 prices for inputs, and prices for grapes that reflect several quality enhancing practices such as leaf pulling, cluster removal, and limited yields. Potential investors should be reminded that the current economic climate for grape growing in the Thousand Islands region can and will change with time. 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, sine 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 grapes, which are expected to change as practice of production of these varieties 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. Most of the vineyards in the Thousand Islands are family owned and rather small in planted size compared to the other regions in the New York state, such as Cayuga Lake, Seneca Lake, or Canandaigua regions. The owners themselves or the family members often partake in production, which considerable lowers the cost of labor (which is included in our study in dollar amount). Some of the growers have also relied on volunteers for harvest for certain years which again considerable lowers the cost of labor. Since the labor costs constitute a significant portion of the production costs, wise utilization of the labor force is highly recommended.

Despite these concerns, given the growing consumption of table wine in the United States, the developing tourist trade in the Thousand Islands region, and the growing reputation of Thousand

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

Islands wine quality, 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, Thousand Islands Region, NY, 2015

	Material	Rate/acre		Price		$/acre
Year 0 (Site prep.)						
Custom herbicide	glyphosate	4.0	qt.	$7.50	qt.	$30.00
	Am.sulfate	1.7	lb.	$0.14	lb.	$0.24
Total for site preparation						**$30.24**
Year 1						
Chem. weed control- trellis	Surflan	1.25	qt.	$11.47	qt.	$14.34
	Am.sulfate	1.7	lb.	$0.14	lb.	$0.24
Total for treatment						$14.58
Total for Year 1						**$14.58**
Year 2-3						
Chem.weed control- trellis	Prowl H2O	6	qt.	$48.84	gal	$73.26
Spot herbicide treatment	glyphosate	2	qt.	$7.50	qt.	$15.00
	Am sulfate	1.7	lb.	$3.75	lb.	$6.38
Total for treatment						**$94.64**
Spot herbicide treatment	glysophate	2	qt.	$7.50	qt.	$15.00
	Am. Sulfate	1.7	lb.	$3.75	lb.	$6.38
Total for treatment						**$21.38**
Total for Year 2-3						**$232.02**
Year 4-25						
Chem.weed control- trellis	Chateau	12	fl oz.	$98.00	gal	$9.19
Spot herbicide treatment	glysophate	2	qt.	$7.50	qt.	$15.00
	Am. Sulfate	1.7	lb.	$3.75	lb.	$6.38
Total for treatment						**$30.56**
Total for years 4-25						**$30.56**

Appendix Table 2: Sample Fertilizer/Soil Program for Cold Hardy Grapes, Thousand Islands 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	$45	ton	$90.00
Fall fertilization	Muriate of Potash	300	lbs	$580	ton	$87.00
Total for year 0						**$183.00**
Year 1						
Fertilization (banded)	10:10:10	30	lbs	$0.23	lb.	$6.75
Mulch (if irrigation not installed-optional)	Round hay bales	20	bales	15.00	ea.	$300.00
Total for year 1						**$6.75**
Year 2						
(no suggested application)	N/A	N/A		N/A		N/A
Year 3						
(no suggested application)	N/A	N/A		N/A		N/A
Year 4+						
Soil application	Solubor (20%B)	2.5	lbs.	$1.69	lb.	$4.23
Fall fertilization (every 2nd year)	Muriate of Potash	300	lbs.	$580	ton	$43.50
Lime (1 in 5 years)	Lime	1	ton	45.00	ton	$9.00
Petiole sampling		0.16	acre	$24	test	$3.84
Soil sampling (every 5th year)		0.2	acre	$15	test	$0.60
Total for Year 4+						**$61.17**

Appendix Table 3: Hourly Machinery and Equipment Variable Costs, Cold Hardy Grapes, Thousand Islands 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	$9.17	$1.38	$17.40
Tractor, 45-HP	$28,000	7000	100%	$4.00	$9.17	$1.38	$14.55
Air-blast sprayer- 200 gallon	$15,000	2000	60%	$4.50			$4.50
Herbicide sprayer- 50 gallon	$2,200	2000	60%	$0.66			$0.66
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 (used)	$600	2000	60%	$0.18			$0.18
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 (used)	$28,000	2500	83%	$9.30	$8.10	$1.22	$18.61
Auger	$1,000	2000	80%	$0.40			$0.40
Replanter	$4,800	1200	80%	$3.20			$3.20
Bird control equipment ($100 per acre)	$5,000	7000	80%	$0.57			$0.57
Shop Equipment	$8,000	2500	80%	$2.56			$2.56
Pruning Shears (X5)	$250	2000	60%	$0.08			$0.08
Macrobin (X30)	$9,000	2000	60%	$2.70			$2.70
Picking trays (X55)	$8	2000	60%	$0.00			$0.00

Tractor Fuel Factors	**Factor**
Diesel	0.0438
Gasoline	0.0600

OTHER A.E.M. EXTENSION BULLETINS

EB No	Title	Fee (if applicable)	Author(s)
2015-11	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
2015-04	Building Success of Food Hubs Through the Cooperative Experience - A Case Study Perspective		Severson, R.M. and T.M. Schmit
2015-03	Census of Agriculture Highlights New York State, 2012		Bills, N. and B.F. Stanton
2015-02	Labor Issues and Employment Practices on New York Apple Farms		Baker, P., DeMarree, A., Ho. S., Maloney, T. and B. Rickard
2015-01	Working with Farm Family Businesses: Some Suggestions and Procedures for Quality Advising		Conneman, G., McGonical, J., Crispell, C. and A. Staehr

Paper copies are being replaced by electronic Portable Document Files (PDFs). To request PDFs of AEM publications, write to (be sure to include your e-mail address): Publications, Department of Applied Economics and Management, Warren Hall, Cornell University, Ithaca, NY 14853-7801. If a fee is indicated, please include a check or money order made payable to Cornell University for the amount of your purchase. Visit our Web site (*http://dyson.cornell.edu/outreach/#bulletins)* for a more complete list of recent bulletins.