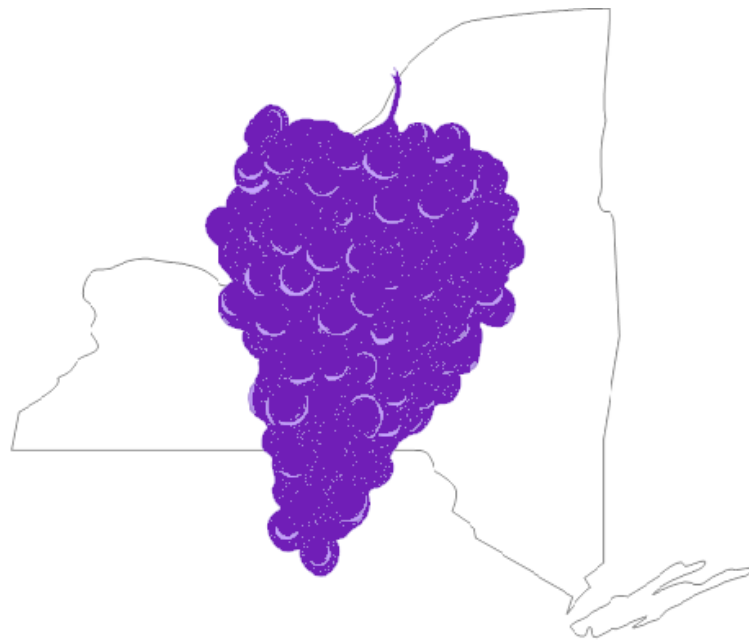


# **COST OF ESTABLISHMENT AND PRODUCTION OF COLD HARDY GRAPES IN THE CHAUTAUQUA REGION OF NEW YORK - 2019**



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### **Introduction**

Over the years the amount of wine produced in New York State has been steadily increasing, resulting in a fairly large economic impact. As of 2017 the total economic impact the wine industry had on NYS was estimated to be \$13,764,343,000<sup>1</sup> per year. However, many of these benefits are felt by second and third party stakeholders. The direct economic output of the wine industry was \$5,528,619,600 in 2017. This resulted in an estimated 62,450 jobs paying out an estimated total of \$2,379,712,400 in wages.

The Chautauqua County, located in the southwestern corner of New York State, is the western most 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, wine-making became a 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-three 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 Riesling, Chardonnay, 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 conditions have 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 -30F. Cold hardy grapes are, viticulturally speaking, outstanding. 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 Brianna, Fontenac, La Crescent, and Marquette, 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, as well as 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.

This question is complicated by the long-run nature of the investment (payback periods are in excess of ten years and can be much longer), as well as the risk from a worldwide over supply of wine grapes from significant plantings in "new world" competitors such as Australia, New Zealand, Chile, and a significant increase in Chinese grown grapes over the past decade. Although the New York industry is somewhat insulated by the small scale of its market structure in the

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<sup>1</sup> Economic Impact of Wine Industry 2017 Data, New York – The National Association of American Wineries – Wine America

premium wine sector, with most wineries selling over 50 percent of their wine through direct sales in the tasting room, wineries cannot expect to be completely unaffected if global supply outstrips demand in the future. Given the limited area planted, a small increase in planted acreage can have a relatively large impact on supply when the new acreage begins bearing.

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. Poorer sites and/or failure to follow optimal management practices can have a significant negative impact on the earnings estimates presented in this publication.

## **Methods**

The methods used to construct cost estimates were a combination of 1) interviews with a panel comprised of grower representatives, 2) economic engineering using recommended practices. In August of 2019, we met with a panel of four growers and vineyard managers. The growers reviewed the data prepared for the most recent estimates of the costs of establishing and growing *V. vinifera* grapes in the Finger Lakes Region. While the practices of growing grapes in the Chautauqua Region are significantly different than those in the Finger Lakes Region many inputs are similar such as machinery costs and chemical costs. Using previous studies of Cold Hardy grape production in the Chautauqua Region consensus estimates were developed for land prices, labor requirements and wage rates for the various operations in a Cold Hardy vineyard, and for a typical machinery complementary for a full time commercial vineyard. Furthermore, both Cornell University and Penn State University extension agents were consulted on the accuracy of the numbers and models used.

### **Land**

The study assumes land was purchased at \$3,100 per acre. This is an increase of 55% since the previous 2015 study was published. This value takes into account the possibility of having to prepare land that is not ready to be used for agricultural purposes. \$3,100 was decided as a base price per acre after consulting with Farm Credit East and discussing average sales price of agricultural land suited for grape production since 2017 in the Chautauqua Region.

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 9' X 7' spacing (row by vine) resulting in a planting density of 691 vines per acre. There were 8 rows to an acre and rows were 400 feet long. Vine cost was estimated to average \$4.25 per plant. Each year it was assumed that two percent of the vines had to be replanted due to damages caused by diseases or environmental factors. The initial planting was done using contracted GPS planting. The fee for GPS planting the vines were \$1.10 per vine, with a total of 8,983 vines being planted over 13 acres.

### **Varieties**

The 13-acre vineyard was planted to the following four Cold Hardy Grape varieties: Brianna, Frontenac, La Crescent, and Marquette. These four varieties were selected because they are well suited for the brutally cold climate of the Chautauqua region during the winter and demonstrated their ability to produce premium wine. Frontenac was the very first variety planted in the 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 third row or 27 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 vertically shoot positioned (VSP) training system. The trellis system was made up of two pairs of catch wires and two fruiting wires (for a total of six wires), a 8' x 3-4" wooden line posts at every fourth vine, four catch wire clips per line post, and a 8' x 4-5" wooden end post and anchor support post at the end of each row.

## **Herbicides and Fertilizer/Soil Program**

The sample herbicide program was developed in consultation with the advisory panel of four growers. For details of the sample herbicide program, see Table A1 in Appendix. Glyphosate spot sprays should be made using some kind of shielded sprayer to avoid contact with green tissues. The study assumes the use of an Enviromist sprayer for this purpose because of the larger acreage. The sample fertilizer/soil program was developed by Hans Walter-Peterson, Viticulture Extension Specialist, Finger Lakes Grape Program, and confirmed by Kevin Martin, Associate Extension Educator at Penn State Extension and Business Management at the Lake Erie Regional Grape Program. See Table A2 for details.

## **Wage Rates**

Wage rates used represented the consensus of the grower panel. The rates assumed were \$23.00 per hour for skilled labor (i.e. \$17.69 per hour, plus fringe benefits). Fringe benefits consist of workers compensation, social security, medical insurance, and other benefits. For unskilled labor, the rate was \$17.50 per hour (including fringe benefits). Piece rate wage rates were used for pruning the vines in years 3-22 using the rate of \$0.56 per vine. The piece rates for tying were specified at \$0.28 per vine. The pruning and tying piece rates have a base rate of \$0.45 and \$0.23 respectively with an additional 13% contracting fee and 10% unemployment benefits cost added resulting in \$0.56 and \$0.28 for the piece rate wages.

## **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 and Building Costs**

The investment costs and annual costs for equipment and buildings are summarized in Table A3. The machinery investment required totals \$307,970 which represents an average investment of \$1,540 per acre of total grape production area, this includes Concord grape production in the vineyard. The investment for a shop is estimated at \$82,500, or \$413 per acre. The shop was 1,500 ft<sup>2</sup>, and the construction cost was estimated at \$55.00 per ft<sup>2</sup> which includes basic amenities such as water, electricity, cement floors, and insulated walls.

Machinery depreciation and interest were charged on the basis of prices for new equipment with the minor exceptions for a used pickup truck. Diesel fuel at \$3.09 per gallon was budgeted for machine operations. Gasoline was charged at \$2.89 per gallon (for unleaded). These were representative of prices in West-Central New York as of August 2019. Hourly machinery variable

costs (repairs, fuel, and lube) are shown in Table A4. Hourly machinery variable costs were estimated according to American Society of Agricultural Engineers 2000 Standards.

The total annual costs for depreciation and interest amount to \$32,649 for machinery and \$4,209 for buildings, or \$163 and \$21.05 annual costs per acre, respectively. Machinery investment would be much greater if a mechanical grape harvester was necessary.

### **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 \$78 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 three percent interest charge on capital investment and operating capital was charged. This rate represents a real rate based on a five percent nominal rate of interest and an expected rate of inflation of two 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. Table 1 summarizes the yield assumptions.

Table 1: Yield Assumptions for Selected Cold Hardy Grapes, Chautauqua Region NY, 2019

Variety	Year 3		Year 4+	
Brianna	1	tons/acre	5	tons/acre
Frontenac	1	tons/acre	5	tons/acre
La Crescent	1	tons/acre	4	tons/acre
Marquette	1	tons/acre	5	tons/acre

## Results

### Grape Prices

Prices for the previous three years ending in 2019 are shown in Table 2. These averages do not take into account quality and/or quantity of grapes purchased by each processor. Since larger processors often pay less, the weighted average price is often lower than the average reported in Table 2. However, the prices in Table 2 are a reasonable indicator of price trends for the four varieties. The mean price of the four varieties were used as the price per ton when estimating revenues.

Table 2: Average Price Listings for Selected Cold Hardy Grapes, Chautauqua Region NY, 2017-2019, Dollars per Ton.

Year	Brianna	Frontenac	La Crescent	Marquette
2017	\$ 475	\$ 600	\$ 600	\$ 900
2018	\$ 475	\$ 575	\$ 575	\$ 875
2019	\$ 475	\$ 575	\$ 550	\$ 600
<b>Mean</b>	<b>\$ 475</b>	<b>\$ 583</b>	<b>\$ 575</b>	<b>\$ 792</b>

### Pesticide Program Spray Costs

Table 3.1 indicates the recommended spray program and costs for years two and three (establishment). Table 3.2 indicates the recommended spray program and costs for years 4-22 (operation). In year three, three sprays are recommended. Beginning in year four, the spray programs are assumed to be approximately the same from year to year, with the necessity on average for five sprays during the growing season. Spray materials costs were estimated on average at \$151.12 per acre from year four onwards. Fungicide applications may vary slightly among Cold Hardy cultivars due to the differences in disease susceptibility. 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 presented in Tables 6 and Table 8.

Table 3.3 shows the cost break down of the chemicals used, as well as potential additional/substitute products, in the example spray programs and lists the market price for the chemicals as well as the per unit price.



Table 3.1: Sample Spray Program for Cold Hardy Grapes for Years 2 & 3, Chautauqua Region, NY, 2019

Year	Material	Target organisms	Rate/acre	Price	\$/acre
Year 2	<b>Spray 1</b>				
	Mancozeb 75DF	Downy mildew, botrytis, anthracnose	3 lbs.	\$8.33 lb.	\$25.00
	Vivando	Powdery mildew	15 oz.	\$1.78 lb.	\$26.72
				<b>Total per spray</b>	<b>\$51.72</b>
	<b>Spray 2</b>				
Leverage 360	Grape berry moth, Japanese beetle	3 oz.	\$ 1.95 oz	\$ 5.86	
			<b>Total per spray</b>	<b>\$ 5.86</b>	
			<b>Total for year 2</b>	<b>\$57.57</b>	
Year 3	<b>Spray 1</b>				
	Mancozeb 75DF	Downy mildew, botrytis, anthracnose	3 lbs.	\$8.33 lb.	\$25.00
	Surfactant		4 oz.	\$0.33 oz	\$1.31
				<b>Total per spray</b>	<b>\$26.31</b>
	<b>Spray 2</b>				
	Revus Top	Powdery mildew, downy mildew	7 oz.	\$2.59 oz	\$18.11
	Leverage 360	Grape berry moth, Japanese beetle	3 oz.	\$1.95 oz	\$5.86
	Vivando	Powdery mildew	15 oz.	\$1.78 oz	\$0.21
			<b>Total per spray</b>	<b>\$24.18</b>	
<b>Spray 3</b>					
Quintec	Powdery mildew	3 oz	\$3.21 oz	<b>\$9.63</b>	
Mettle	Powdery mildew, black rot	5 oz	\$3.87 lb	<b>\$19.33</b>	
			<b>Total per spray</b>	<b>\$28.96</b>	
			<b>Total for year 3</b>	<b>\$79.44</b>	

Table 3.2: Sample Spray Program for Cold Hardy Grapes for Years 4 - 25, Chautauqua Region NY, 2019

Spray	Chemical	Target organisms	Measure	Unit/Acre	Cost	Spray Cost
1	Mancozeb 75DF Surfactant	Downy mildew, botrytis, anthracnose	3 lbs.		\$ 25.00	\$ 26.31
			4 oz		\$ 1.31	
2	Mancozeb 75DF Surfactant	Downy mildew, botrytis, anthracnose	3 lbs.		\$ 25.00	\$ 26.31
			4 oz		\$ 1.31	
3	Luna Experience Reason	Powdery mildew	6 oz.		\$ 35.43	\$ 44.11
		Downy mildew	4 oz		\$ 8.68	
4	Leverage 360 Mettle	Grape berry moth, Japanese beetle	3 oz.		\$ 5.86	\$ 25.18
		Powdery mildew, black rot	5 oz		\$ 19.33	
5	Quintec Ziram	Powdery mildew	3 oz		\$ 9.63	\$ 29.21
		Black rot, downy mildew, ripe rot, botrytis bunch rot	3.5 lbs.		\$ 19.58	
					<b>Total Cost</b>	<b>\$ 151.12</b>

Table 3.3: Sample Cost Key of Chemicals Use in Spray Programs for Cold Hardy Grapes, Chautauqua Region NY, 2019

Chemical	Amount	Unit	Market Cost	Cost per	Unit
Leverage 360	1	gal	\$ 249.95	\$ 1.95	oz
Luna Experience	1	qt	\$ 188.95	\$ 5.90	oz
Mancozeb 75DF	12	lb	\$ 99.99	\$ 8.33	lb
Mettle	30	oz	\$ 115.95	\$ 3.87	oz
Quintec	30	oz	\$ 96.30	\$ 3.21	oz
Reason	1	gal	\$ 277.76	\$ 2.17	oz
Revus Top	1	gal	\$ 331.17	\$ 2.59	oz
Surfactant	1	gal	\$ 41.92	\$ 0.33	oz
Vivando	1	gal	\$ 228.00	\$ 1.78	oz
Ziram	10	lb	\$ 55.95	\$ 5.60	lb

## Drainage Construction Costs

Table 4 contains an estimate of drainage construction costs. These costs are transferred to the site preparation section of the establishment and development costs (see Table 6). 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 third row (27 feet apart). Costs were estimated to total \$5,976 per acre.

Table 4: Tile Drainage Costs per acre for Cold Hardy Grapes,  
Chautauqua Region NY, 2019

Item	Quantity (ft)	Price \$/ft	Total Cost per acre
Main line: 6" pipe	29	\$ 2.50	\$ 72.50
Laterals: 4" pipe	2,723	\$ 0.45	\$ 1,225
Installation	2,752	\$ 1.70	\$ 4,678
<b>Total Drainage Construction per acre</b>			<b>\$ 5,976</b>

## Trellis Construction Costs

The trellis was designed for Vertically Shoot Positioned (VSP) vines. It was made up of two pairs of moveable catch wires and two fixed fruiting wires (a total of six wires). Wooden line posts were used for every fourth vine, and four catch wire clips were used on each post to hold the catch wires in place. Wooden anchor posts were used to support each end post. Rows were 400 feet long and there were 8 rows to an acre and vines per row.

Table 5 contains an estimate of trellis constructions costs. The total cost for materials is estimated at \$2,306 per acre. These costs are transferred to Table 6 in the first year of establishment and development. Labor and machinery costs for trellis establishment are also shown in Table 6. The total cost of trellis construction for materials, labor, and machinery is \$3,993 per acre.

Table 5: Trellis Construction Costs per acre for Cold Hardy Grapes,  
Chautauqua Region NY, 2019

VSP Trellis Construction Materials per Acre	Quantity	Price	Total per acre
Wood end posts (8 ft x 4-5" diameter)	16 posts	\$10.31 post	\$ 165
Wood anchor kit	16 posts	\$12.67 post	\$ 203
Line Post (8 ft x 3-4" diameter, every 4th plant)	145 post	\$8.07 post	\$1,170
12.5 gauge HT foliage & cordon wire (\$143 roll of 3,846 ft)	19,555 ft	\$0.037 ft	\$727
Catchwire clips (4 per line post)	580 clips	\$0.05 clip	\$29
Staples, lbs.	2.5 lbs.	\$1.99 lb.	\$5
Crimping sleeves (for joining wire ends)	37 crimps	\$0.19 crimp	\$7
<b>Total Trellis Construction Materials</b>			<b>\$2,306</b>

## **Establishment and Development Costs**

The costs for labor machinery and materials for site preparation and in years one through three constitute the establishment and development (E&D) variable costs in Table 6. First year variable costs, including site preparation, trellis construction, and planting, are substantial and amount to \$15,158 per acre. A planting density of 9' x 7' spacing (row by vine) resulting in a planting density of 691 vines per acre. The largest cost in the first year is for site preparation, for a total of \$6,831. This includes installing drainage which in total costs \$5,976. In year two, costs are a relatively modest at \$1,215 per acre with less labor required than for mature vines. In the third year, a spray program of three sprays is recommended, and hand harvesting is required to protect the young vines. Total costs for the third year are estimated at \$1,895 per acre. Note that the usage of pickup truck is estimated at 40,000 miles for a 200-acre farm per year, which is \$171 per acre (including gas and maintenances costs).

The total costs for the entire E&D period (years 1-3) are summarized in Table 7. The totals from Table 6 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 price of the four varieties produced. The total cumulative cost for the E&D period is \$21,436 per acre. Amortized at a two percent real rate of interest for the estimated years of life from year four through 22, the annual cost for capital recovery (interest and depreciation) is \$1,345 per acre. This amount was charged as a fixed cost labeled 'vineyard capital recovery' in Table 10, which summarizes the costs and returns for a mature vineyard. Cash costs for establishment, including labor, are \$18,270 per acre for site preparation and the first three years.

Table 6: Cold Hardy Grape Establishment and Development Costs, Chautauqua Region NY, 2019

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
<b>Site Preparation – Year 0</b>							
Drainage (see table 5 for details)	Custom						\$5,976
Lime (2 tons/acre)	Custom					\$100.00	\$100
Herbicide application	Custom				\$10.50	\$22.46	\$33
Stone removal & land maint.	Unskilled	10	10	\$175.00	\$149.67		\$325
Soil Sampling	Skilled	0.2		\$4.60		\$4.00	\$9
Fall fertilization	Skilled	0.6	0.5	\$13.80	\$7.72	\$100.00	\$122
Plowing	Custom						\$50
Discing (2X)	Custom						\$46
Pickup truck (40,000 miles for 200 ac/year)	n/a	n/a	n/a		\$170.86		\$171
<b>Total</b>		10.8	10.5	\$193.40	\$338.46	\$226.46	<b>\$6,831</b>
<b>First Year</b>							
Floating/dragging	Skilled	1	1	\$23.00	\$13.77		\$37
GPS vine Planting (\$4.25/vine)	Custom			\$852.00		\$2,938.57	\$3,791
Fertilization (banded)	Skilled	0.6	0.5	\$13.80	\$7.72	\$9.74	\$31
Hilling up	Skilled	1.5	1.2	\$34.50	\$23.00		\$58
Hilling up	Unskilled	1.5		\$26.25			\$26
Chem. weed control -trellis	Skilled	1.25	1.25	\$28.75	\$18.47	\$27.03	\$74
Trellis construction (see table 6 for details)	Skilled	60	16	\$1,380.00	\$306.71	\$2,306	\$3,993
Spot herbicide-hand application	Skilled	1		\$23.00		\$41.49	\$64
Cultivation (2X)	Skilled	1.2	1.2	\$27.60	\$23.00		\$51
Seed cover crop	Skilled	1	1	\$23.00	\$13.77		\$37
Pickup truck (40,000 miles for 200 ac/year)	n/a			\$852.00		\$2,938.57	\$3,791
<b>Total</b>		79.45	21.65	\$2,422.70	\$570.95	\$5,334.00	<b>\$8,328</b>
<b>Total for first year and site preparation</b>							<b>\$15,158</b>

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
<b>Second Year</b>							
Pruning & brush removal	Skilled	3		\$69.00			\$69
Tying & renewal	Unskilled	2		\$35.00		\$4.50	\$41
Vine Replacement	Skilled	2	2	\$46.00	\$43.53	\$58.77	\$148
Spring Fertilization	Skilled	0.6	0.5	\$13.80	\$7.72	\$9.74	\$31
Chem. weed control-trellis	Skilled	1.25	1.25	\$28.75	\$19.83	\$71.97	\$121
Suckering	Unskilled	2.5		\$43.75			\$44
Cluster removal	Unskilled	2.5		\$43.75			\$44
Take away (de-hilling)	Skilled	3	2.5	\$69.00	\$47.92		\$117
Hand hoe	Unskilled	4		\$70.00			\$70
Spot herbicide treatment	Skilled	0.4	0.3	\$9.20	\$4.43	\$14.46	\$28
Spot herbicide treatment	Skilled	0.4	0.3	\$9.20	\$4.43	\$14.46	\$28
Hilling up	Skilled	3	1.5	\$69.00	\$28.75		\$98
Spray 1	Skilled	0.4	0.3	\$9.20	\$8.39	\$51.72	\$69
Spray 2	Skilled	0.4	0.3	\$9.20	\$8.39	\$5.86	\$23
Mowing (4X)	Skilled	2.6	2	\$59.80	\$37.52		\$97
Rogueing	Unskilled	1		\$17.50			\$18
Pickup truck (40,000 miles for 200 ac/year)	n/a	n/a	n/a		\$170.57		\$171
<b>Total for Second Year</b>		29.05	10.95	\$602.15	\$210.93	\$231.47	<b>\$1,216</b>

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
<b>Third Year</b>							
Pruning and brush pulling (\$0.45/vine)	Custom	piece rate		\$311.14			\$387
Tying & renewal (\$0.23/vine)	Custom	piece rate		\$159.03		\$4.50	\$199
Brush chopping (1X)	Skilled	1.2	1	\$27.60	\$21.32		\$49
Vine replacement	Skilled	2	2	\$46.00	\$43.53	\$58.77	\$148
Chem. weed control- trellis	Skilled	2.6	2	\$59.80	\$29.54	\$71.97	\$161
Suckering	Unskilled	4		\$70.00			\$70
Cluster removal	Unskilled	4		\$70.00			\$70
Take away (de-hilling)	Skilled	3	2.5	\$69.00	\$47.92		\$117
Hand hoe	Unskilled	4		\$70.00			\$70
Bird control	Skilled	3		\$69.00			\$69
Spot herbicide treatment	Skilled	0.4	0.3	\$9.20	\$4.43	\$14.46	\$28
Spot herbicide treatment	Skilled	0.4	0.3	\$9.20	\$4.43	\$14.46	\$28
Spray 1	Skilled	0.6	0.5	\$13.80	\$13.99	\$26.31	\$54
Spray 2	Skilled	0.6	0.5	\$13.80	\$13.99	\$24.18	\$52
Spray 3	Skilled	0.6	0.5	\$13.80	\$13.99	\$28.96	\$57
Mowing (4X)	Skilled	2.6	2	\$59.80	\$37.52		\$97
Hilling up	Skilled	1.7	1.5	\$39.10	\$28.75		\$68
Pickup truck (10,000 miles for 50 ac/year)	n/a	n/a	n/a		\$170.57		\$171
<b>Total for third year</b>		30.7	13.1	\$1,220.90	\$429.99	\$244.70	<b>\$1,895</b>

Table 7: Summary of establishment and development costs by year,  
Cold Hardy Grapes, Chautauqua Region NY, 2019

Item	Year 1	Year 2	Year 3
<b>Revenue</b>			
Yield per acre (tons)	0	0	1
Market price (average of 4 varieties)	na	na	\$606
Total revenue	\$0	\$0	\$606
<b>Costs</b>			
Site preparation	\$6,831	\$0	\$0
Annual variable costs			
-Pre-harvest	\$8,328	\$1,216	\$1,895
-Harvest (hand)+hauling	\$0	\$0	\$300
Total Variable Costs & Site preparation	\$18,054	\$1,216	\$2,195
Annual fixed costs			
-Machines & equipment depreciation	\$163	\$163	\$163
-Buildings depreciation	\$21	\$21	\$21
-Property taxes	\$78	\$78	\$78
-Land opportunity cost	\$93	\$93	\$93
-Office Supplies, phone, etc.	\$231	\$231	\$231
-Insurance	\$20	\$20	\$20
Total Fixed Costs	\$605	\$605	\$605
Interest on cumulative costs	\$473	\$542	\$642
Total costs	\$16,236	\$2,363	\$3,443
Net returns	(\$16,236)	(\$2,363)	(\$2,836)
Total cumulative costs	\$16,236	\$18,599	\$21,436
Amortization of vineyard (in 22 years)			\$1,345
Cash costs of vineyard establishment (3 years)			\$18,270



## **Costs and Returns for a Mature Vineyard**

Annual growing costs for years four through 22 are presented in Table 8. Total growing costs for a typical year in the mature vineyard are estimated to be \$2,736 per acre. The costliest operations are canopy management (\$878 per acre), pruning and brush pulling (\$387 per acre), and spraying (5 times, for a total of \$290 per acre, including labor, machinery and materials costs). 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 summarizes the growing, establishment, and development costs for a Cold Hardy Grape 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 \$2,736 per acre in years four through 22, and this number is transported to Table 10 to use in the computation of the costs and returns for the mature vineyard. The cost of crop insurance is added at an average cost of \$109 per acre, which generally starts at the fifth year of positive production (i.e. year 8). Costs for crop insurance will actually vary a few dollars per acre depending upon the grape variety planted.

Table 8: Growing Costs, Years Four through Twenty-two, Cold Hardy Grapes, Chautauqua Region NY, 2019

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
<b>Operation</b>							
Pruning + brush pulling	Custom	piece rate		\$387.20			\$387
Brush chopping	Skilled	1.2	1	\$27.60	\$21.32		\$49
Trellis maintenance	Skilled	4	1	\$92.00	\$14.97	\$30.00	\$137
Tying & renewal	Custom	piece rate		\$193.60		\$3.15	\$198
Vine replacement	Skilled	2	2	\$46.00	\$43.53	\$58.77	\$148
Chem.weed control-trellis	Skilled	2.6	2	\$59.80	\$29.54	\$27.23	\$117
Soil applic of Solubor (w. herb. Spray)	n/a					\$6.60	\$7
Spot herbicide treatment	Skilled	0.4	0.3	\$9.20	\$4.43	\$14.46	\$28
Suckering	Unskilled	4		\$70.00			\$70
Cluster removal	Unskilled	4		\$70.00			\$70
Shoot thinning	Unskilled	6		\$105.00			\$105
Take-away (de-hilling)	Skilled	3	2.5	\$69.00	\$47.92		\$117
Bird control	Skilled	3		\$69.00			\$69
Spray 1	Skilled	0.6	0.5	\$13.80	\$13.99	\$26.31	\$54
Spray 2	Skilled	0.6	0.5	\$13.80	\$13.99	\$26.31	\$54
Spray 3	Skilled	0.6	0.5	\$13.80	\$13.99	\$44.11	\$72
Spray 4	Skilled	0.6	0.5	\$13.80	\$13.99	\$25.18	\$53
Spray 5	Skilled	0.6	0.5	\$13.80	\$13.99	\$29.21	\$57
Mowing (4X)	Skilled	2.6	2	\$59.80	\$37.52		\$97
Lime (1 in 5 years)	Skilled	0.1	0.1	\$2.30	\$4.68	\$10.00	\$17
Pickup truck (40,000 miles for 200 ac/year)	n/a	n/a	n/a		\$170.57		\$171
Shoot positioning/move catch wires (first path)	Unskilled	6		\$105.00			\$105
Shoot positioning/move catch wires (second path)	Unskilled	6		\$105.00			\$105
Mechanical leaf removal	Skilled	3.2	3	\$73.60	\$42.00		\$116
Summer pruning (2X)	Skilled	2.6	2.4	\$59.80	\$50.32		\$110
Petiole sampling (\$88 for every 2 years)	Skilled	0.1		\$2.30		\$3.84	\$6

(Unit: Acre)	Labor Used	Labor Hours	Equipment Hours	Labor Cost	Equipment Cost	Materials Cost	Total Cost
Soil sampling (every 5 years)	Skilled	0.1		\$2.30		\$0.40	\$3
Hilling-up	Skilled	1.7	1.5	\$39.10	\$28.75		\$68
Fall fertilization	Skilled	0.3	0.3	\$6.90	\$4.63	\$27.50	\$39
Crop insurance							\$109
<b>Total</b>		55.9	20.6	\$1,612.87	\$570.14	\$333.07	<b>\$2,736</b>

Table 9: Summary of Growing Costs for Cold Hardy Grapes Vineyard, Trained to a Vertically Shoot Positioned System, Chautauqua NY, 2019

Item	Year 1	Year 2	Year 3	Year 4+
Site preparation	\$6,831			
Vines & planting	\$3,827			
Trellis materials & construction	\$3,993			\$137
Replanting & Rouging		\$166	\$148	\$148
Dormant pruning & removal		\$69	\$387	\$387
Weed control	\$222	\$177	\$217	\$145
Fertilization	\$31	\$31		\$71
Canopy management		\$128	\$339	\$878
Disease & insect control		\$93	\$163	\$290
Take away & hilling up	\$84	\$285	\$255	\$185
Mowing		\$97	\$146	\$146
Bird Control			\$69	\$69
Pick-up (fuel, maintenances, etc)	\$171	\$171	\$171	\$171
Crop Insurance*				\$109
<b>Total Growing Costs</b>	<b>\$15,158</b>	<b>\$1,216</b>	<b>\$1,895</b>	<b>\$2,736</b>

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

Table 10 summarizes the costs and returns expected from a mature vineyard. The estimated revenue per acre varies from \$2,300 to \$3,960 depending upon variety. Total costs vary from \$5,343 to \$5,551 per acre by variety. The break-even prices and yields are shown at the bottom of Table 10. A yield of 13.8 tons per acre is the break-even yield for Brianna, and a yield of 7.4 tons per acre would be necessary to break even for Marquette, assuming the price per ton stays constant. Yields at these higher levels would more than likely be inconsistent with quality requirements.

Brianna shows a large loss (-\$3,096 per acre) given the assumed yield and prices. At the assumed yield and prices, all varieties exhibited negative net returns. Marquette is the closest variety to breaking even at the assumed yields and prices with a loss of (-\$1,591 per acre). To put this 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. All labor, including the owner's labor, is charged a cash wage. There is an imputed charge on all capital used.

The vineyard capital expense (establishment costs from Table 7) is written off after 22 years, which increase the fixed costs by \$1,345. In Table 13, we will discuss the scenario that vineyard holds a positive value which may be as much, or even more, than it was worth in the early years of the planting.

Table 10: Costs and Returns for a Mature Cold Hardy Grapes Vineyard - 1,  
Chautauqua Region NY, 2019

Item	Brianna	Frontenac	La Crescent	Marquette
<b>Receipts:</b>				
Yield target, tons per acre	5	5	4	5
Price, \$ per ton	\$475	\$583	\$575	\$792
<b>Total receipts</b>	<b>\$2,375</b>	<b>\$2,915</b>	<b>\$2,300</b>	<b>\$3,960</b>
<b>Costs:</b>				
Variable Costs:				
Growing costs	\$2,736	\$2,736	\$2,736	\$2,736
Interest on operating capital	\$41	\$41	\$41	\$41
Machine Harvesting (\$95/ton)	\$475	\$475	\$380	\$475
Trucking (\$30/ton)	\$150	\$150	\$120	\$150
<b>Total variable costs</b>	<b>\$3,403</b>	<b>\$3,403</b>	<b>\$3,278</b>	<b>\$3,403</b>
Fixed Costs:				
Vineyard establishment capital recovery	\$1,345	\$1,345	\$1,345	\$1,345
Machinery and equipment capital recovery	\$163	\$163	\$163	\$163
Buildings capital recovery	\$21	\$21	\$21	\$21
Property taxes	\$78	\$78	\$78	\$78
Land opportunity cost	\$93	\$93	\$93	\$93
Office supplies, phone, etc.	\$231	\$231	\$231	\$231
Insurance	\$20	\$20	\$20	\$20
Management	\$119	\$146	\$115	\$198
<b>Total fixed costs</b>	<b>\$2,069</b>	<b>\$2,096</b>	<b>\$2,065</b>	<b>\$2,148</b>
<b>Total costs</b>	<b>\$5,471</b>	<b>\$5,498</b>	<b>\$5,343</b>	<b>\$5,551</b>
<b>Profit or loss</b>	<b>-\$3,096</b>	<b>-\$2,583</b>	<b>-\$3,043</b>	<b>-\$1,591</b>
Breakeven price (\$ /ton)	\$1,094	\$1,100	\$1,336	\$1,110
Breakeven yield (tons)	13.8	10.6	10.8	7.4

## Capital Requirements

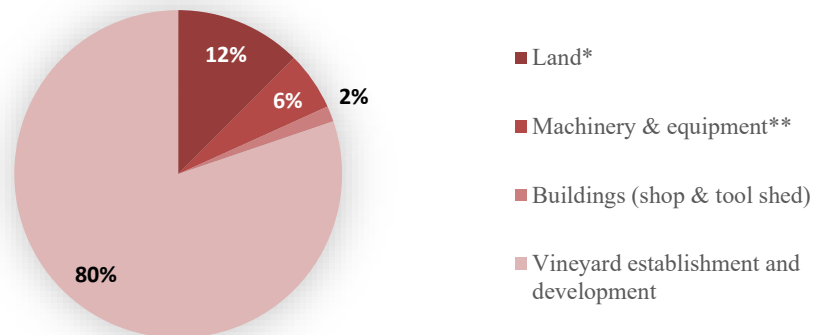
Table 11 indicates the capital investment per acre necessary to get into grape production in the Chautauqua-Lake Erie region, assuming a vineyard of 13 total planted acres with an additional 2 acres for roads, buildings, and reliance on either custom hand or machine harvesting of grapes. The table uses the value of new machinery and equipment and buildings. Land costs assume a prime site with land suitable for production of grapes. Table 11 indicates that it would require \$26,789 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. 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 11: Investment per Planted Acre of Cold Hardy Grapes,  
Chautauqua Region NY, 2019

Assets	\$/acre
Land* - specifically for planting – 13 acres	\$3,348
Machinery & equipment**	\$1,540
Buildings (shop & tool shed)	\$413
Vineyard establishment and development	\$21,489
<b>Total Investment per planted acre</b>	<b>\$26,789</b>

Chart 1: Investment per Planted Acre of Cold Hardy Grapes,  
Chautauqua Region NY, 2019



\*Assume 54 acres purchased (including support land) for 50 planted acres

\*\*Assumes all equipment is split between the 200 total acres which includes Concord production

## 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 12. If yields are 3 tons per acre or less and/or with low yielding cultivars, prices around \$1,750 per ton would be required to break even. Even the highest prices paid in the most recent seasons would result in significantly 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 12: Total Cost per Ton (Breakeven price) at Varying Yields,  
Cold Hardy Grapes, Chautauqua Region NY, 2019

Brianna		Frontenac		La Crescent		Marquette	
Yield	Cost/ton	Yield	Cost/ton	Yield	Cost/ton	Yield	Cost/ton
1.5	\$3,356	1.5	\$3,374	1.5	\$3,353	1.5	\$3,409
2	\$2,548	2	\$2,562	2	\$2,546	2	\$2,588
2.5	\$2,064	2.5	\$2,074	2.5	\$2,062	2.5	\$2,095
3	\$1,740	3	\$1,749	3	\$1,739	3	\$1,767
3.5	\$1,510	3.5	\$1,517	3.5	\$1,509	3.5	\$1,532
4	\$1,337	4	\$1,343	4	\$1,336	4	\$1,356
4.5	\$1,202	4.5	\$1,208	4.5	\$1,201	4.5	\$1,220
5	\$1,094	5	\$1,100	5	\$1,094	5	\$1,110
5.5	\$1,006	5.5	\$1,011	5.5	\$1,005	5.5	\$1,021
6	\$933	6	\$937	6	\$932	6	\$946
6.5	\$871	6.5	\$875	6.5	\$870	6.5	\$883

\*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 13 indicates the estimated annual cash flow for a mature vineyard (similar to table 10), 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 10. 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 \$1,345 (Table 10) to \$786 (Table 13). Even accounting for these changes all four varieties show a loss ranging from -\$939 to -\$2,445 per acre per year.



Table 13: Cash and Returns for a Mature Cold Hardy Grapes Vineyard - 2,  
Assuming that E&D costs can be partially recovered, Chautauqua Region NY, 2019

Item	Brianna	Frontenac	La Crescent	Marquette
<b>Receipts:</b>				
Yield target, tons per acre	5.0	5	4	5
Price, \$ per ton	\$475	\$583	\$575	\$792
<b>Total receipts</b>	<b>\$2,375</b>	<b>\$2,915</b>	<b>\$2,300</b>	<b>\$3,960</b>
<b>Costs:</b>				
Variable Costs:				
Growing costs	\$2,736	\$2,736	\$2,736	\$2,736
Interest on operating capital	\$41	\$41	\$41	\$41
Machine Harvesting (\$95/ton)	\$475	\$475	\$380	\$475
Trucking (\$30/ton)	\$150	\$150	\$120	\$150
<b>Total variable costs</b>	<b>\$3,403</b>	<b>\$3,403</b>	<b>\$3,278</b>	<b>\$3,403</b>
Fixed Costs:				
Vineyard establishment capital recovery*	\$786	\$786	\$786	\$786
Machinery and equipment capital recovery	\$163	\$163	\$163	\$163
Buildings capital recovery	\$21	\$21	\$21	\$21
Property taxes	\$78	\$78	\$78	\$78
Land opportunity cost	\$0	\$0	\$0	\$0
Office supplies, phone, etc.	\$231	\$231	\$231	\$231
Insurance	\$20	\$20	\$20	\$20
Management	\$119	\$146	\$115	\$198
<b>Total fixed costs</b>	<b>\$1,417</b>	<b>\$1,444</b>	<b>\$1,414</b>	<b>\$1,497</b>
<b>Total costs</b>	<b>\$4,820</b>	<b>\$4,847</b>	<b>\$4,691</b>	<b>\$4,899</b>
<b>Profit or loss</b>	<b>-\$2,445</b>	<b>-\$1,932</b>	<b>-\$2,391</b>	<b>-\$939</b>
Breakeven price (\$ /ton)	\$964	\$969	\$1,173	\$980
Breakeven yield (tons)	12	9.2	9.3	6.4

\*Discounting practices generally need not to be redone or remains positive salvage value

### Discussion: Projected 20 Year Cash Flows

Chart 2 shows the projected cash flows for 20 years of operations. This includes both variable and fixed costs. In year 20 it is assumed the vineyard, and all equipment associated with it, are sold off. The land is estimated to be worth \$903,223 after 20 years, and the equipment is estimated to have a salvage value of \$15,399. If the vineyard is sold at the end of 20 years of operations than cash flows end with a net positive of \$262,826. With current market conditions the vineyard's revenues do not make up the initial establishment costs even after 20 years of operations.

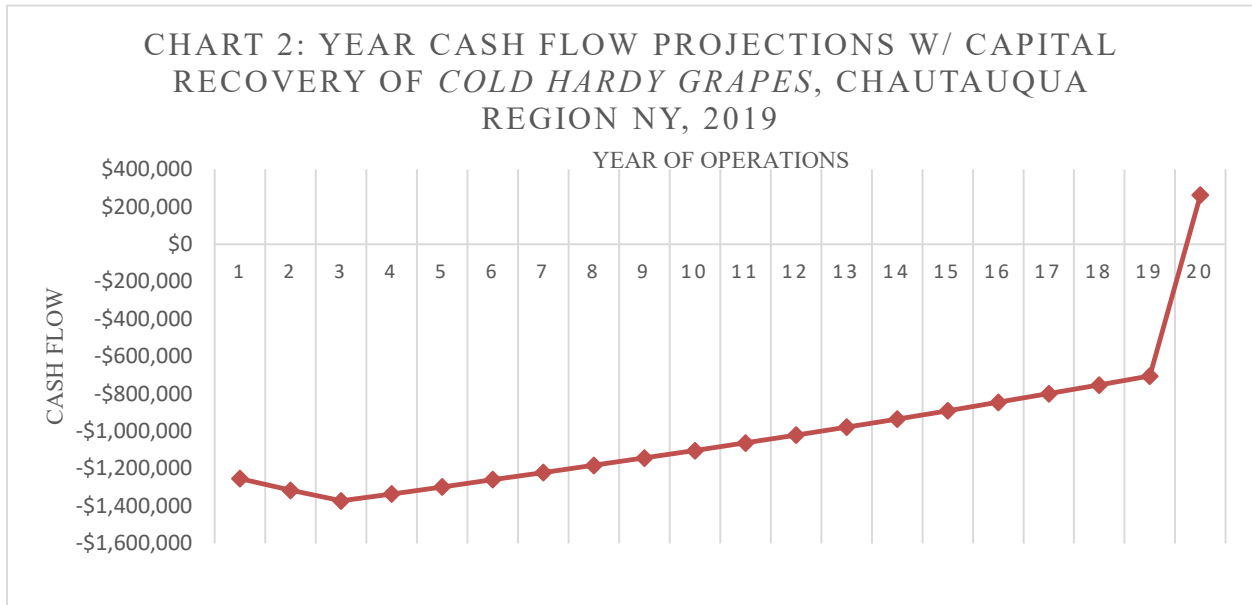
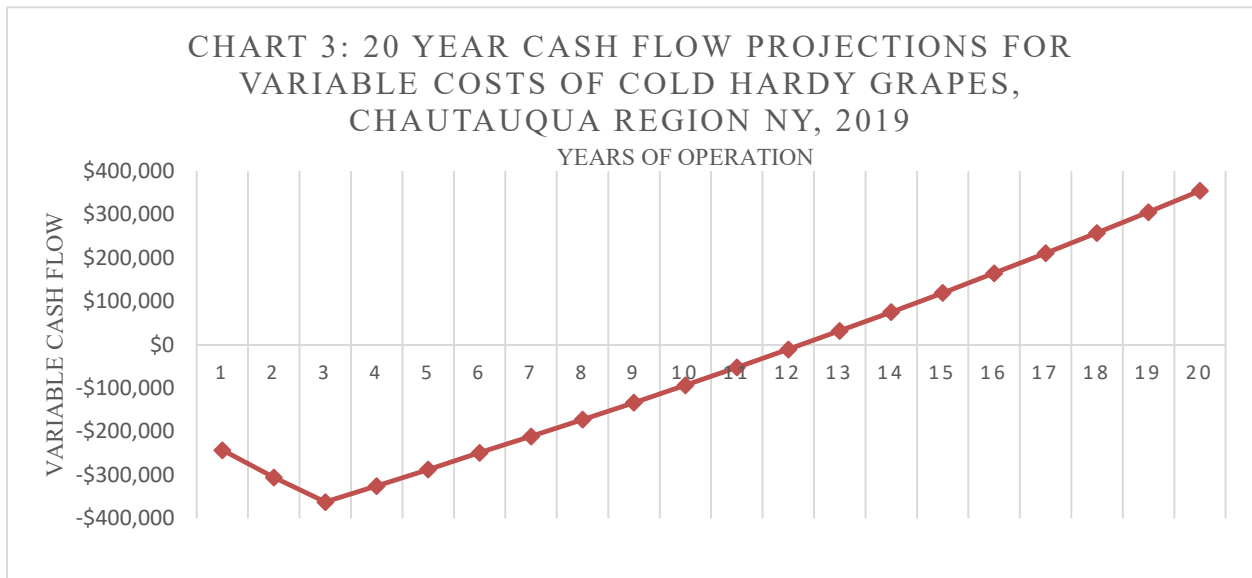


Chart 3 shows the projected cash flows for 20 years of operations in regards to variable costs assuming a 2% inflation rate. By year 12 of operations the vineyard has recovered the initial variable costs of establishment and becomes cash flow positive in regards to variable costs. By the end of 20 years of operations cash flows show a net positive of \$354,674.



## Concluding Comments

The cost and returns estimates derived in this publication indicate results for Cold Hard Grapes in the Chautauqua region of NY under the assumption of prime sites, the use of recommended practices, good management, 2019 prices for inputs, and prices for grapes that reflect several quality enhancing practices such as leaf pulling.

Potential investors should be forewarned that the current economic climate for grape growing in the Chautauqua region can change. In some years, given the thin markets for certain varieties, a surplus situation can develop when a few growers plant additional acres. The total acreage of some varieties in the Chautauqua region is quite limited. As mentioned above, since the varieties are fairly new, many 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.

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.

Nevertheless, given the growing consumption of table wine in the United States, the developing tourist trade in the Chautauqua region, and the growing reputation of Chautauqua wine quality, the long run potential may appear favorable for investors who can weather the inevitable ups and downs associated with an agricultural enterprise subject to the usual vagaries of climate and market forces. That being said, the possibility of new grape varieties that were not used in this study may give potential investors pause. Current growers have voiced concern that the grapes used in this study may be phased out in the next few decades due to new varieties being developed the potential effects of climate change.

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Appreciation is expressed to Matthew Doyle, Dave Stamp, Mark Wagner, and Dave Wiemann who served as the growers' panel for helping to establish the costs reported in this bulletin. Hans Walter-Peterson, Specialist of Finger Lake Grape Program, provided helpful reviews of the manuscript. Russel Moss, lecturer of Viticulture and Enology at Cornell University, provided valuable insights to capital changes and vineyard management.

Special recognition is extended to Mark Pisoni (M.S., Department of Agricultural, Resource, and Managerial Economics, Cornell University, 2001). While at Cornell, working on a grant funded by the New York State Department of Agriculture and Markets' "Grow New York" Program, Mark developed an Excel program which was used to develop the 2001 - 2020 Cost of Establishment and Production of *Vinifera* Grapes in the Finger Lakes publications. Mark is now viticulturist of the Pisoni Vineyards and Winery, Gonzales, California.

## Appendix

Table A1: Sample Herbicide Program for Cold Hardy Grapes, Chautauqua County NY, 2019

Year	Reason for Spray	Material	Rate/acre	Price	\$/acre	
<b>Year 0</b> Site Preparation	Custom Herbicide	Glyphosate	4 qt	\$4.00 qt	\$16.00	
		Ammonia Sulfate	1.7 lbs.	\$3.80 lb.	\$6.46	
		<b>Total per spray</b>				<b>\$22.46</b>
<b>Year 1</b>	Chem. Weed control - Trellis	Surflan	1.5 qt	\$18.02 qt	\$27.03	
		<b>Total per spray</b>				<b>\$27.03</b>
	Chem. Weed control-spot	Glyphosate	2 qt	\$4.00 lb.	\$8.00	
		Ammonia Sulfate	1.7 lbs.	\$3.80 lb.	\$6.46	
<b>Total per spray</b>				<b>\$41.49</b>		
<b>Year 2 - 3</b>	Chem. Weed control - Trellis	Prowl H20	6 qt	\$12.00 qt	\$71.97	
		<b>Total per spray</b>				<b>\$71.97</b>
	Spot herbicide treatment	Glyphosate	2 qt	\$4.00 qt	\$8.00	
		Ammonia Sulfate	1.7 lbs.	\$3.80 lb	\$6.46	
<b>Total per spray</b>				<b>\$14.46</b>		
<b>Year 4 - 20</b>	Chem weed control - trellis	Chateau	12 fl. Oz.	\$0.68 fl. Oz	\$8.11	
		Rely 280	24 fl. Oz.	\$0.80 fl. Oz	\$19.12	
	<b>Total per spray</b>				<b>\$27.23</b>	
	Spot herbicide treatment	Glyphosate	2 qt.	\$4.00 qt	\$8.00	
Ammonia Sulfate		1.7 lbs.	\$3.80 lb	\$6.46		
<b>Total per spray</b>				<b>\$14.46</b>		

Table A2: Sample Fertilizer/Soil Program for Cold Hardy Grapes, Chautauqua NY, 2019

Year	Material	Rate/acre	Price/Unit	\$/acre
<b>Year 0</b> <b>Site</b> <b>Preparation</b>	Soil sampling 1 test/5 acres, 2 depths	0.4 acre	\$ 10.00 test	\$ 4.00
	Lime	2 tons	\$ 50.00 ton	\$ 100.00
	Fall fertilization (Muriate of potash)	300 lbs	\$ 550.00 ton	\$ 82.50
<b>Total cost - year 0</b>				<b>\$ 186.50</b>
<b>Year 1</b>	Fertilization 10:10:10	30 lbs	\$ 0.32 lbs	\$ 9.74
	Mulch (if irrigation not installed - optional)	20 bales	\$ 15.00 bale	\$ 300.00
<b>Total cost - year 1</b>				<b>\$ 309.74</b>
<b>Year 2</b>	Spring fertilization (10:10:10)	30 lbs	\$ 0.32 lb	\$ 9.74
<b>Total cost - year 2</b>				<b>\$ 9.74</b>
<b>Year 3+</b>	Soil application Solubor	2.5 lbs	\$ 2.64 lb	\$ 6.60
	Muriate of potash (every 3rd year)	300 lbs	\$ 550.00 ton	\$ 27.50
	Lime (1 in 5 years)	1 ton	\$ 50.00 ton	\$ 10.00
	Petiole sampling	0.16 acre	\$ 24.00 test	\$ 3.84
	Soil sampling (every 5th year)	0.2 acre	\$ 10.00 test	\$ 2.00
<b>Total cost - year 3+</b>				<b>\$ 49.94</b>



Table A4: Hourly Machinery and Equipment Variable Costs, Cold Hardy Grapes, Chautauqua Region NY, 2019

Item	Purchase Price	Hours of life	Total Repairs	Repairs	Fuel	Lube (15% of fuel)	Total Hourly Variable Costs
Tractor, 62-HP, 2WD, spray cab	\$ 57,000	7000	100%	\$8.14	\$8.12	\$1.22	\$17.48
Tractor, 45-HP	\$ 31,000	7000	100%	\$4.43	\$8.12	\$1.22	\$13.77
Air-blast sprayer- 400 gallon	\$ 35,000	2000	60%	\$10.50			\$10.50
Herbicide sprayer- 50 gallon	\$ 3,350	2000	60%	\$1.01			\$1.01
Envirovist sprayer	\$ 7,000	2000	60%	\$2.10			\$2.10
Mower (6ft)	\$ 4,000	2500	80%	\$1.28			\$1.28
Brush Chopper	\$ 12,000	2500	80%	\$3.84			\$3.84
Fertilizer Spreader	\$ 2,500	1200	80%	\$1.67			\$1.67
Small disc (used)	\$ 3,000	2000	60%	\$0.90			\$0.90
Grape hoe	\$ 18,000	2000	60%	\$5.40			\$5.40
Post driver	\$ 5,400	2000	80%	\$2.16			\$2.16
Trailer	\$ 4,500	3000	80%	\$1.20			\$1.20
Pickup truck (used)	\$ 34,000	2500	83%	\$11.29	\$5.78	\$0.87	\$17.94
Auger	\$ 1,220	2000	80%	\$0.49			\$0.49
Mechanical hedger (used)	\$ 18,000	2000	80%	\$7.20			\$7.20
Mechanical leaf remover	\$ 35,000	2000	80%	\$14.00			\$14.00
ATV	\$ 12,000	1200	80%	\$8.00			\$8.00
<b>Tractor Fuel Factors</b>		<b>Factor</b>					
Diesel		0.0438					
Gasoline		0.0600					