

# Jay Hardenburg Farms / Vinehaven Vineyards

– Farm Description and Overview



*“It is not the strongest of the species that survives, nor the most intelligent that survives, it is the one that is the most adaptable to change that survives.”*



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- Charles Darwin



# Farm Description

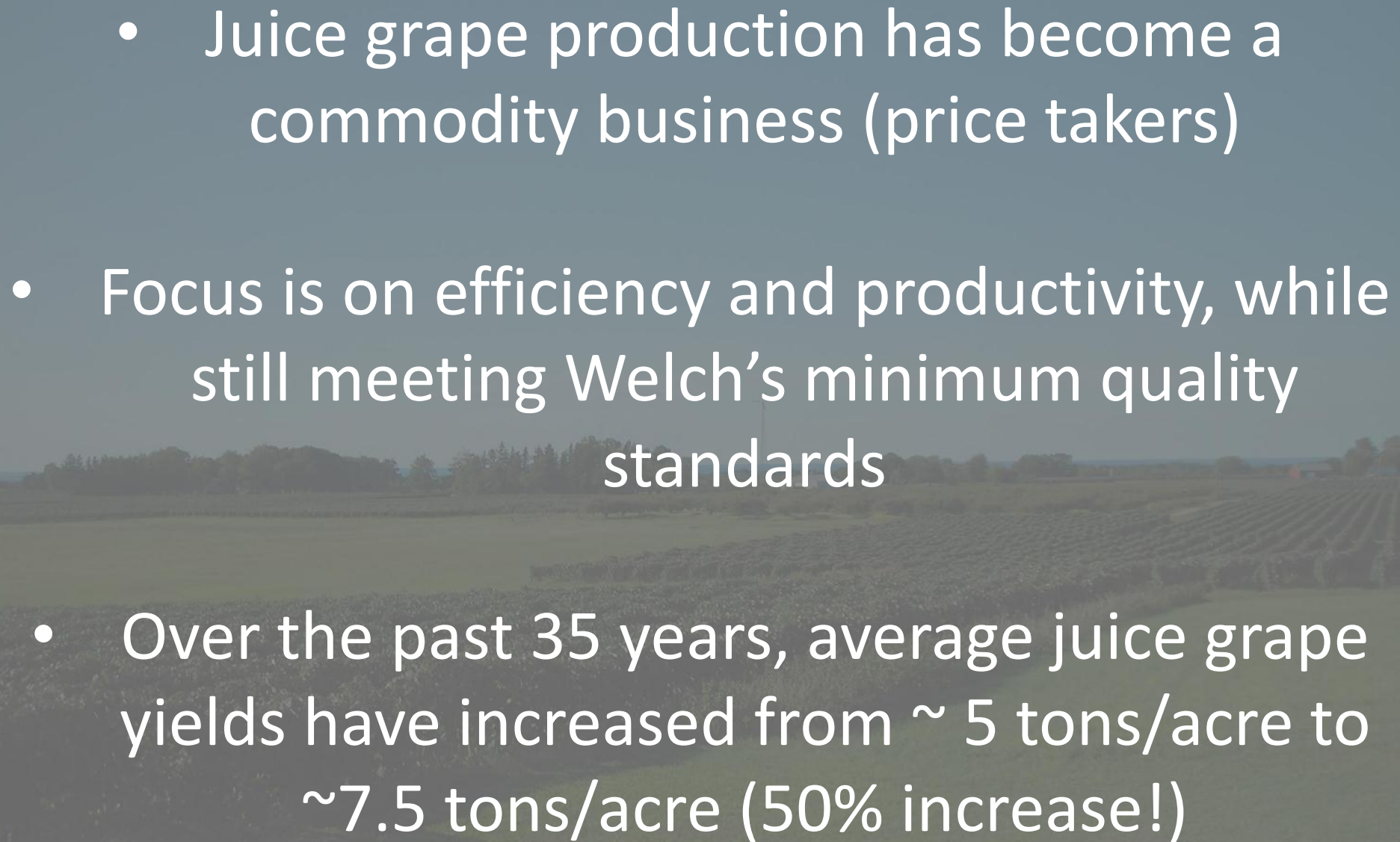
- 90-acre farm with 58.5 acres of vineyards
- Two grape varieties: Concord and Niagara
- Farm is located on the lake plain along the south shore of Lake Erie, 1.5 – 2.5 miles from the actual shoreline
- 42.4 North; 79.5 West; 765' - 810' elevation
- All acreage and production is contracted to National Grape Co-operative/Welch's

## Farm Description (cont.)

- As a member of National Grape Co-op, I am a partial owner of Welch's
- The original farm (25 acres) has been in the family since the 1850's (five generations!)
- Over most of that time, Concord grapes have been the primary farm enterprise.

## Unusual farm partnership with my younger brother John:

- Operate separate (but adjacent) 55-60 acre grape farms
- 50/50 shared equipment and harvesting partnership
- Jay hires John as a part-time farm manager

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- Juice grape production has become a commodity business (price takers)
  - Focus is on efficiency and productivity, while still meeting Welch's minimum quality standards
  - Over the past 35 years, average juice grape yields have increased from ~ 5 tons/acre to ~7.5 tons/acre (50% increase!)

# Why Concord and Niagara Juice Grapes?



1. Concord Grape introduced in 1854 – Concords were planted in the Lake Erie region by the late 1850's as table grapes!
2. Concord became the top table variety produced in just over one decade and growers prospered as Lake Erie became the leading table grape producing region in the country
3. In 1868, Clark and Hoag develop the Niagara grape variety (Concord x Cassady cross) in Niagara County, NY; introduced commercially in 1882



# Why Concord and Niagara Juice Grapes?

4. In 1869, Dr. Thomas Welch developed unfermented grape juice in Vineland, NJ.
5. Thompson Seedless grape introduced in CA in the 1880's; shipped East by the 1890's
6. Dr. Charles Welch moves his grape juice manufacturing operations from Vineland, NJ to Watkins Glen, NY in 1896, and then to Westfield, NY in 1897!
7. Lake Erie region grape acreage peaked around 1910 at over 50,000 acres of vineyards

# Why Concord and Niagara Juice Grapes?

8. The grape juice industry grew profitably and gradually replaced table grape production as CA seedless grapes overtook seeded Concord
9. The juice industry allowed many small grape farms to survive Prohibition (1919-1933) and the Depression Years
10. Farm Winery Laws passed in NY and PA in the 1960's opened opportunities for small scale, premium estate wine production.

# Why Concord and Niagara Juice Grapes?

10. 1970's: Welch's introduces 100% White Grape Juice utilizing member-grown Niagara grapes
11. 1983: The Lake Erie AVA (American Viticultural Area) was approved. (First multi-state AVA in the country.)
12. Today: Juice grape production continues to dominate in the region (roughly 2/3rds of acreage), but the wine industry is growing while juice grape production is currently declining



St. Catharines

Lockport

Rochester

Niagara Falls

Batavia

Welland

Clarence

Geneva

Buffalo

Jamestown

Olean

Bradford

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Foreground – Route 20 zone – 750' above sea level elevation;

Mid-photo/top of vineyards – Escarpment zone – 810' above sea level elevation

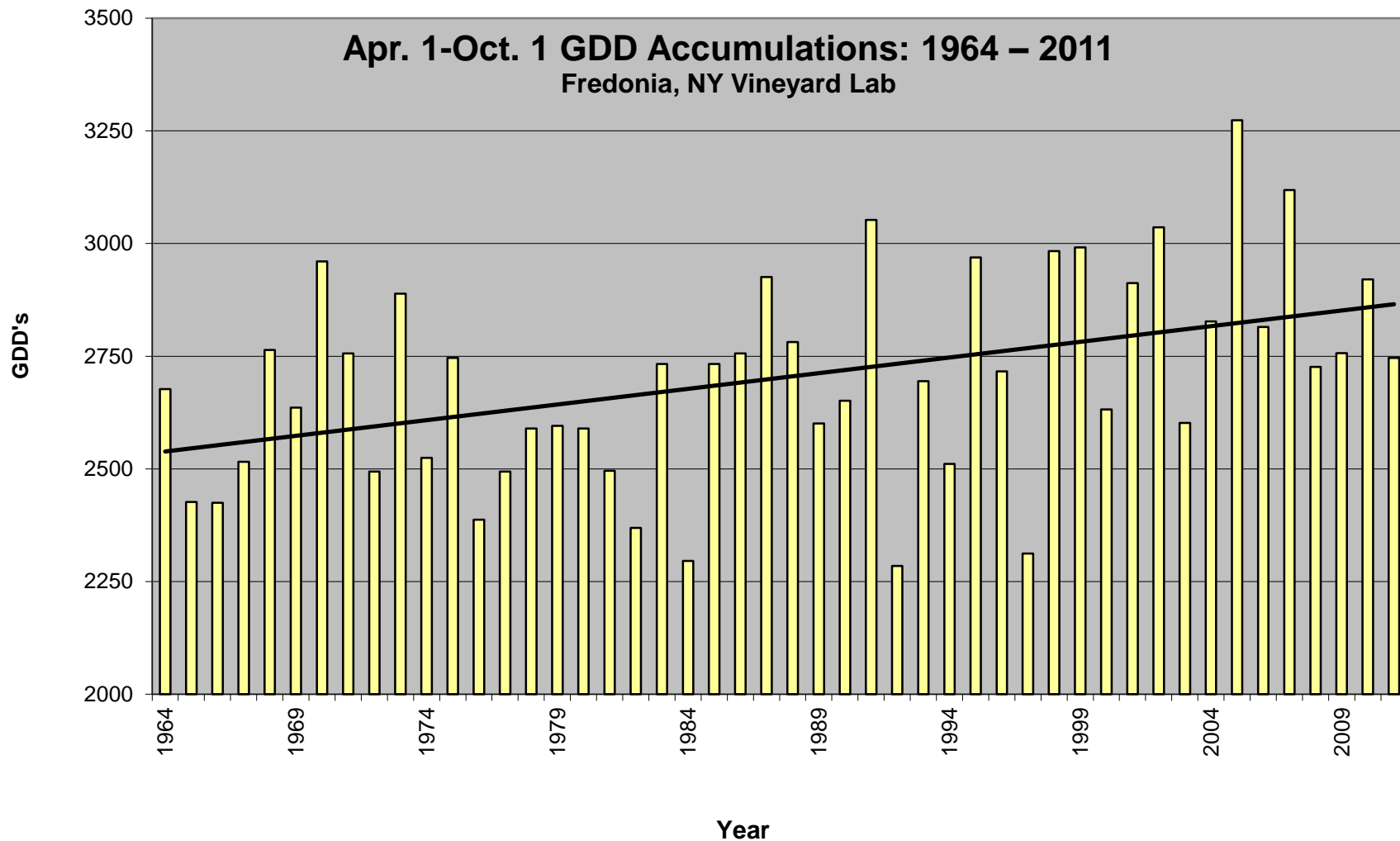
Background - top of Chautauqua Escarpment – 1100' to 1400' above sea level

# How Did We Increase Average Yields by 50% over 35 years?

**#1 Reason: Adoption of New Technologies and Better, More Sustainable Cultural Practices**

**#2 Reason: Global Warming – extended growing season and warmer temperatures from veraison to harvest**

## Apr. 1-Oct. 1 GDD Accumulations: 1964 – 2011 Fredonia, NY Vineyard Lab



Average Growing Season GDD Accumulations have increased almost 12.5% over the past 47 years at the Fredonia Vineyard Laboratory site.

# New Technologies/Sustainable Practices

1. No-till Viticulture: elimination of row middle cultivation and use of glyphosate for both between-row and in-row weeds
  - Reduced annual damage to feeder roots
  - Allowed for buildup of organic matter on the soil surface
  - Reduced soil erosion and leaching
  - Increased organic matter contributed to better vine nutrition and growth



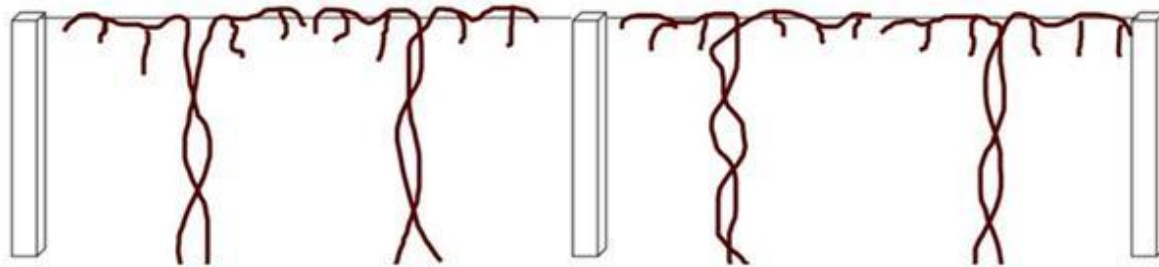


Custom Built Two-Row Vineyard Herbicide Sprayer Capable of Spraying Two Full Rows (Under-Vine and Row Centers) Simultaneously

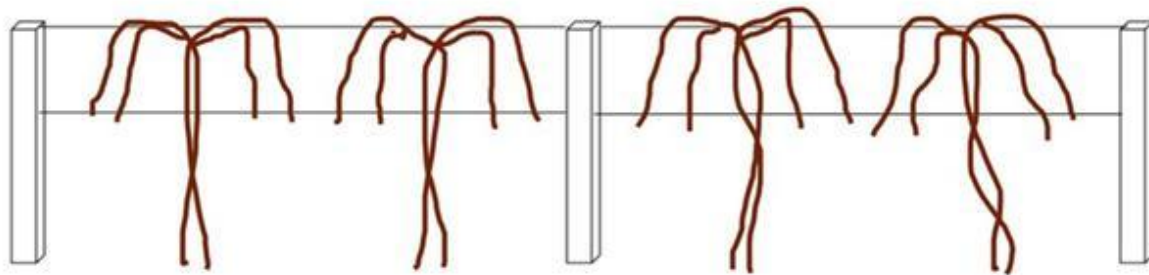
# New Technologies/Sustainable Practices

2. Conversion from Umbrella Kniffen to Top-Wire Cordon Training System
  - Reduced Hand Labor inputs, especially in tying vines and to a lesser extent in hand pruning vines
  - Provided for better distribution of fruiting buds over the entire length and width of the trellis, while maintaining good light exposure of renewal buds

High Cordon System



Umbrella Kniffen System



Vineyards were converted from Umbrella Kniffen System Training to Top-Wire or High Cordon System Training for labor efficiency and better light exposure of fruit and buds.

# New Technologies/Sustainable Practices

## 3. Integrated Crop Management / Mechanical Berry Thinning

- A crop management system designed to delay the final crop thinning decision until after the major risks of spring frost and disease infections are past
- This system was made possible by the development of mechanical berry thinning technology

# New Technologies/Sustainable Practices

## 3. Integrated Crop Management / Mechanical Berry Thinning

- System allows growers to leave up extra fruiting nodes when dormant pruning which act as “insurance” against crop losses caused by spring frost, shoot breakage due to high winds, and bloom time disease infections
- If losses do not occur, crop potential is measured 30 days after bloom and adjusted as needed by mechanical berry thinning



2002 Korvan/Oxbo Model 3016 Mechanical Grape Harvester

### Dr. Terry Bates: Crop Estimation and Thinning Table: 7/16/2003

Pounds of Fruit Removed in 1/100th of an Acre	Time of Season														Harvest
	20DAB	25DAB				30DAB	40DAB	50DAB	Veraison						
		% of Final Berry Weight													
	20	25	30	35	40	45	50	55	60	65	70	75	80	90	100
10	2.5	2.0	1.7	1.4	1.3	1.1	1.0	0.9	0.8	0.8	0.7	0.7	0.6	0.6	0.5
20	5.0	4.0	3.3	2.9	2.5	2.2	2.0	1.8	1.7	1.5	1.4	1.3	1.3	1.1	1.0
30	7.5	6.0	5.0	4.3	3.8	3.3	3.0	2.7	2.5	2.3	2.1	2.0	1.9	1.7	1.5
40	10.0	8.0	6.7	5.7	5.0	4.4	4.0	3.6	3.3	3.1	2.9	2.7	2.5	2.2	2.0
50	12.5	10.0	8.3	7.1	6.3	5.6	5.0	4.5	4.2	3.8	3.6	3.3	3.1	2.8	2.5
60	15.0	12.0	10.0	8.6	7.5	6.7	6.0	5.5	5.0	4.6	4.3	4.0	3.8	3.3	3.0
70	17.5	14.0	11.7	10.0	8.8	7.8	7.0	6.4	5.8	5.4	5.0	4.7	4.4	3.9	3.5
80	20.0	16.0	13.3	11.4	10.0	8.9	8.0	7.3	6.7	6.2	5.7	5.3	5.0	4.4	4.0
90	22.5	18.0	15.0	12.9	11.3	10.0	9.0	8.2	7.5	6.9	6.4	6.0	5.6	5.0	4.5
100	25.0	20.0	16.7	14.3	12.5	11.1	10.0	9.1	8.3	7.7	7.1	6.7	6.3	5.6	5.0
110	27.5	22.0	18.3	15.7	13.8	12.2	11.0	10.0	9.2	8.5	7.9	7.3	6.9	6.1	5.5
120	30.0	24.0	20.0	17.1	15.0	13.3	12.0	10.9	10.0	9.2	8.6	8.0	7.5	6.7	6.0
130	32.5	26.0	21.7	18.6	16.3	14.4	13.0	11.8	10.8	10.0	9.3	8.7	8.1	7.2	6.5
140	35.0	28.0	23.3	20.0	17.5	15.6	14.0	12.7	11.7	10.8	10.0	9.3	8.8	7.8	7.0
150	37.5	30.0	25.0	21.4	18.8	16.7	15.0	13.6	12.5	11.5	10.7	10.0	9.4	8.3	7.5
160	40.0	32.0	26.7	22.9	20.0	17.8	16.0	14.5	13.3	12.3	11.4	10.7	10.0	8.9	8.0
170	42.5	34.0	28.3	24.3	21.3	18.9	17.0	15.5	14.2	13.1	12.1	11.3	10.6	9.4	8.5
180	45.0	36.0	30.0	25.7	22.5	20.0	18.0	16.4	15.0	13.8	12.9	12.0	11.3	10.0	9.0
190	47.5	38.0	31.7	27.1	23.8	21.1	19.0	17.3	15.8	14.6	13.6	12.7	11.9	10.6	9.5
200	50.0	40.0	33.3	28.6	25.0	22.2	20.0	18.2	16.7	15.4	14.3	13.3	12.5	11.1	10.0

Crop Estimation Table used to estimate final crop from harvest of 1/100<sup>th</sup> acre at 25-35 days after bloom. Example shown: 80 lbs. of green fruit harvested at 25 days after bloom equates to ~37% of final berry weight or a final crop of almost 11 tons/acre.

# New Technologies/Sustainable Practices

## 4. Reduced Nitrogen Fertilization rates

- Historical Nitrogen application rates in the 1980's and 1990's of 60 lbs. to 100 lbs. N/acre
- Single spring application, often 2-4 weeks before bloom
- Cornell University research between 1990 – 2005 demonstrated that for mature Concord vines yielding an average crop of 6 tons/acre, the maximum supplemental Nitrogen needed was only 50 lbs. N /acre



# New Technologies/Sustainable Practices

## 5. Improved Spray Application Practices

- a. More accurate timing of spray applications!
  - Cluster/berry tissues most susceptible to fungal infections at or near bloom stage!
  - Immediate pre-bloom and immediate post-bloom fungicide applications are most critical to good fungal disease control
  - Know your GDD accumulation rate, your plant phenological growth stage, when to anticipate bloom for your varieties

# New Technologies/Sustainable Practices

## 5. Improved Spray Application Practices (cont.)

### b. Improved **application equipment and techniques** to improve on-target spray deposition

- Use of air-inclusion spray nozzles for herbicide applications > larger droplet size > less drift
- Use lower liquid volume, lower air volume, and lower air speed for early season canopy sprays to improve on-target deposition and reduce drift
- “Green-seeker” technology for spot herbicide spraying

# New Technologies/Sustainable Practices

## 5. Improved Spray Application Practices (cont.)

- c. Improved **knowledge of pest ecology** and life cycles
  - Grape berries start becoming resistant to new primary downy mildew infections at 28 days after bloom and to new powdery mildew infections at 21 - 24 days after bloom
  - Grape Berry Moth GDD Model: timing of GBM sprays based upon first bloom in wild grapevines plus 810 GDD's (base 47.14 degrees F.) Targets egg laying by second generation females

# Future Developments

1. Precision Viticulture – measuring and managing vineyard characteristics and performance on a sub-block (single vine??) scale

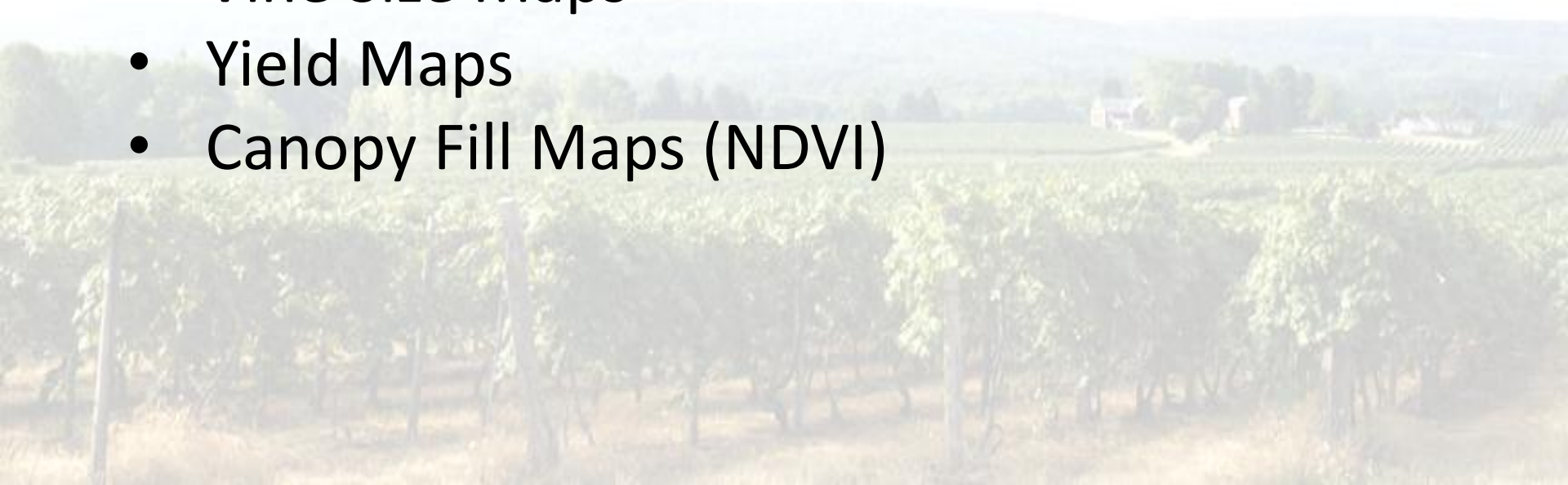
- Soil types and properties
- Soil nutrient testing – grid sampling
- Measurements of vine canopy (trellis fill) and photosynthetic potential
- Non-destructive early season crop estimation
- Harvest time continuous yield monitoring

All of these measurements will be used to calibrate variable rate fertilization, variable spray applications, differential pruning rates, etc.

# Future Developments

## 2. Geographic Information Systems (GIS)

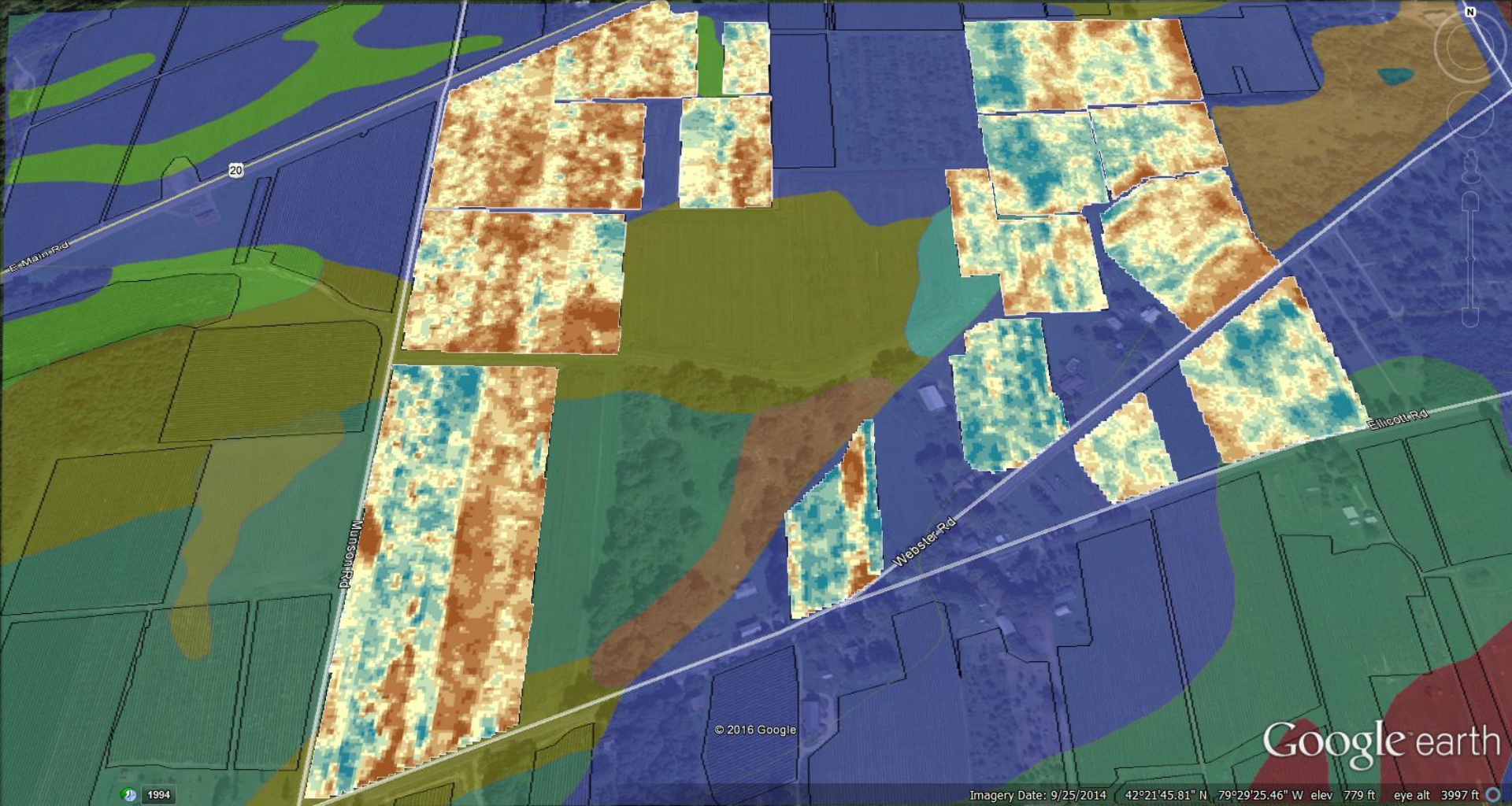
- Soil Maps
- Vineyard Elevation Maps
- Vineyard Layout / Vine Count Maps
- Drainage System (tiling) Maps
- Vine Size Maps
- Yield Maps
- Canopy Fill Maps (NDVI)



# Future Developments

## 2. Geographic Information Systems (GIS) (cont.)

- Normalized Difference Vegetation Index (NDVI) mapping
- Provides an index measure of total canopy (% trellis fill) and photosynthetic capacity (chlorophyll content of leaves)
- Can be used to map of weak spots in a vineyard; possibly an early indication of disease infection, insect infestation, or a nutrient deficiency



NDVI maps of Hardenburg Farms vineyards overlaying soil type map

Key: dark blue color – areas of full canopy and strong vine growth  
dark brown color – areas of weak canopy and vine growth

# Future Developments

## 3. Continuous Yield Monitoring

- Load Cell Yield Monitors mounted on mechanical grape harvesters
- Will provide high resolution yield maps of individual vineyard blocks, which can be correlated with maps of other measures of vine health and performance to create data for precision farming applications



