Feasibility analysis of four automated equipment for operations in vineyards

Guil Signorini – Horticulture and Crop Science
Melanie Lewis Ivey – Plant Pathology
Personal introductions

Applied economist with specialization in agribusiness management. Joined the OSU faculty in August 2020 after 5+ years in the private sector – marketing coordinator and agribusiness consultant.
Tri-way split appointment: T, R, & Ext.
• T: Ag-food value chains (UG level)
• R: Production Management and Marketing of Specialty Crops

Plant Pathologist dedicated to disease management in fruit and vegetable crops. 10+ years at OSU
40+ grants
50+ scientific and extension publications
Lead author of the Spray Program for Grapes in OH
Why am I glad to be here?

• Local wine industry is a great position to grow
  – $69 bi in sales in 2021, recovering 3.6% decrease in 2020
  – 5-year forecast: +4.3% (most likely): 2% – 6.4% annually
  – On-premise sales: +32.9% in 2021, after a -28% trend in 2020
  – Online sales: +1.2% (2015-2020)

  – Road trip and restaurant visit reports: too uncertain.
COMMON KNOWLEDGE

• Good wine begins with good grapes

• Good grapes depend on good growing conditions… and good operations.
MOTIVATION FOR THE STUDY

- Growing vinifera grapes in the Midwest is expensive
  ... challenging
  ... risky

Feasibility of vineyards depend on key factors:
- Economies of scale
- Level of automation
- Adequate balance between capital and labor
Feasibility Assessment of Grape Vineyards in the Midwest U.S.A.

Guilherme Signorini *, Maria Smith © and Imed Dami

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Abstract: The production of grapes in the Midwest U.S.A. is not free of challenges. Growers are presented with a long list of strategic and operational decisions when planning a vineyard. This article uses survey data and secondary data to prepare sample budgets and examine costs, expected returns, and economic feasibility of grape vineyards under different production systems. Departing from two sample budgets that resemble the reality of American-hybrid and vinifera grape growers in the Midwest, we examine the economic feasibility of 24 plausible production scenarios by simulating changes in operational and technical parameters of production. Our results show that economies of scale, level of automation, and adequate balance between capital and labor use are determining factors for economic feasibility. Small-scale hybrid vineyards (10 acres or less) are seldom feasible as a stand-alone project. Vinifera vineyards tend to reach superior performance due to scale, decisions regarding automation, and efficiency of field operations. Following the feasibility analyses and results, our discussion helps explain why grape vineyards are frequently integrated with wineries and other business units across the Midwest.

Keywords: grapes; vinifera; American hybrid; hybrid; production budget; feasibility analysis
MOTIVATION FOR THE STUDY

For context:

Two production budgets:
- American-hybrid (Marquette)
- Vinifera (Cabernet franc)

Primary and secondary data
- 45 complete surveys with grape growers
- Multiple secondary sources
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Developing An Effective Fungicide Spray Program for Grapes in Ohio
— 2020 —

Melanie L. Lewis Ivey and Rachel Kaufman
Fruit Pathology Program
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Fuel Required for Field Operations

The table below contains estimates of the average quantity of diesel fuel required for field operations. The estimates include only the fuel required for actual field work. No allowance is included for machine preparation or travel to and from the field. Because fuel consumption values for any particular operation vary between tractors and soil type, actual fuel requirements may differ.

Fuel requirements for tillage machines were calculated for a central Iowa loam soil. If your soil is heavier, the values in the table should be increased slightly. Values were calculated for a 7-inch plowing depth and 3- to 6-inch operating depth for other tillage machines. Field speeds were assumed to be 4 to 6 mph for all tillage operations, 5 mph for planting and spraying, 4 to 5 mph for forage harvest.
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**Estimating the Field Capacity of Farm Machines**

The field capacity of a farm machine is the rate at which it performs its primary function, i.e., the number of acres that can be disked per hour or the number of tons of hay that can be baled per hour. Measurements of estimates of machine capacities are used to schedule field operations, power units, labor, and to estimate machine operating costs.

The most common measure of field capacity for agricultural machines is expressed in acres covered per hour of operation. The effective field capacity can be used to find an average field capacity in differing terrain and weather conditions.

Effective field capacities for many implements are estimated in Table 1. Average field conditions are assumed. Not all implements are shown, particularly the wide range of combination tillage tools (strip till, vertical till, disc-subsoiler/ripper, rotary harrows, etc.). If your implement differs markedly in size, speed, or field efficiency from those listed, effective field capacity should be calculated by using the information and equations.
OBJECTIVES

- To compare the economic impact of introducing automated equipment for vineyard management
  - Baseline
  - Baseline + pre-pruner
  - Baseline + mechanized trimmer
  - Baseline + self-propelled harvester
  - Baseline + investment in a new intelligent sprayer
  - Baseline + investing in a retrofitted intelligent sprayer
  - Baseline + all equipment above
BUT WHAT IS AN INTELLIGENT SPRAYER?
BUT WHAT IS AN INTELLIGENT SPRAYER?
METHODOLOGY & DATA

• Comparative feasibility analysis

• Departed from the *Cabernet franc* production budget

• Computed four financial indicators for seven scenarios: NPV, IRR, Payback, and ROI
## RESULTS

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>Investment in Mach. &amp; Equip</th>
<th>Total cost during productive years (4 through 25)</th>
<th>Financial Indicators</th>
</tr>
</thead>
<tbody>
<tr>
<td>Baseline: Basic automation</td>
<td>$214,859.00 (per acre)</td>
<td>4,297.00 (per acre)</td>
<td>NPV: 17,591 / IRR: 13.7% / Payback: 12.4 / ROI: 4.09</td>
</tr>
<tr>
<td>2) Pre-pruner</td>
<td>+ 20,000</td>
<td>+ 400</td>
<td>99.81</td>
</tr>
<tr>
<td>3) Mechanized Trimmer</td>
<td>+ 10,000</td>
<td>+ 200</td>
<td>188.44</td>
</tr>
<tr>
<td>4) Self-propelled Harvester</td>
<td>+ 135,000</td>
<td>+ 2,300</td>
<td>321.04</td>
</tr>
<tr>
<td>5) New Intelligent Sprayer</td>
<td>+ 70,000</td>
<td>+ 1,000</td>
<td>251.16</td>
</tr>
<tr>
<td>6) Retrofitted Intelligent Sprayer</td>
<td>+ 25,000</td>
<td>+ 240</td>
<td>287.78</td>
</tr>
<tr>
<td>7) All equipment</td>
<td>+ 235,000</td>
<td>+ 4,300</td>
<td>860.45</td>
</tr>
</tbody>
</table>
DISCUSSION & POINTS FOR IMPROVEMENT

• The work presented here departs from an informed vinifera production budget while it attempts to represent the average grape grower it fails to capture the nuances of any given grower

• Results are still valid because we adopt a relative perspective – Scenario X versus Baseline

• The analysis behind the scenes can be changed to better examine the reality of any given grower

• Future work could include tunnel sprayers to the comparative analysis

• Future work could also refine the estimates for reduction of chemical use conditional on disease severity / pest pressure and ‘mode of action’ (systemic vs. contact)
CONCLUSION

Under the assumptions adopted for the production budget (baseline), and taking into consideration the points above:

<table>
<thead>
<tr>
<th>Scenarios</th>
<th>NPV</th>
<th>IRR</th>
<th>Payback</th>
<th>ROI</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) Baseline</td>
<td>17,591</td>
<td>13.7%</td>
<td>12.4</td>
<td>4.09</td>
</tr>
<tr>
<td>2) Pre-pruner</td>
<td>18,425</td>
<td>13.9%</td>
<td>12.2</td>
<td>3.92</td>
</tr>
<tr>
<td>3) Mechanized Trimmer</td>
<td>19,583</td>
<td>14.4%</td>
<td>11.7</td>
<td>4.35</td>
</tr>
<tr>
<td>4) Self-propelled Harvester</td>
<td>20,330</td>
<td>14.3%</td>
<td>11.8</td>
<td>2.91</td>
</tr>
<tr>
<td>5) New Intelligent Sprayer</td>
<td>19,671</td>
<td>14.1%</td>
<td>11.9</td>
<td>3.45</td>
</tr>
<tr>
<td>6) Retrofitted Intelligent Sprayer</td>
<td>20,675</td>
<td>14.8%</td>
<td>11.4</td>
<td>4.64</td>
</tr>
<tr>
<td>7) All equipment</td>
<td>25,236</td>
<td>15.4%</td>
<td>10.7</td>
<td>2.8</td>
</tr>
</tbody>
</table>
Thank you.

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