Feasibility analysis of four automated equipment for operations in vineyards

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THE OHIO STATE UNIVERSITY
COLLEGE OF FOOD, AGRICULTURAL, AND ENVIRONMENTAL SCIENCES

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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

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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.

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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

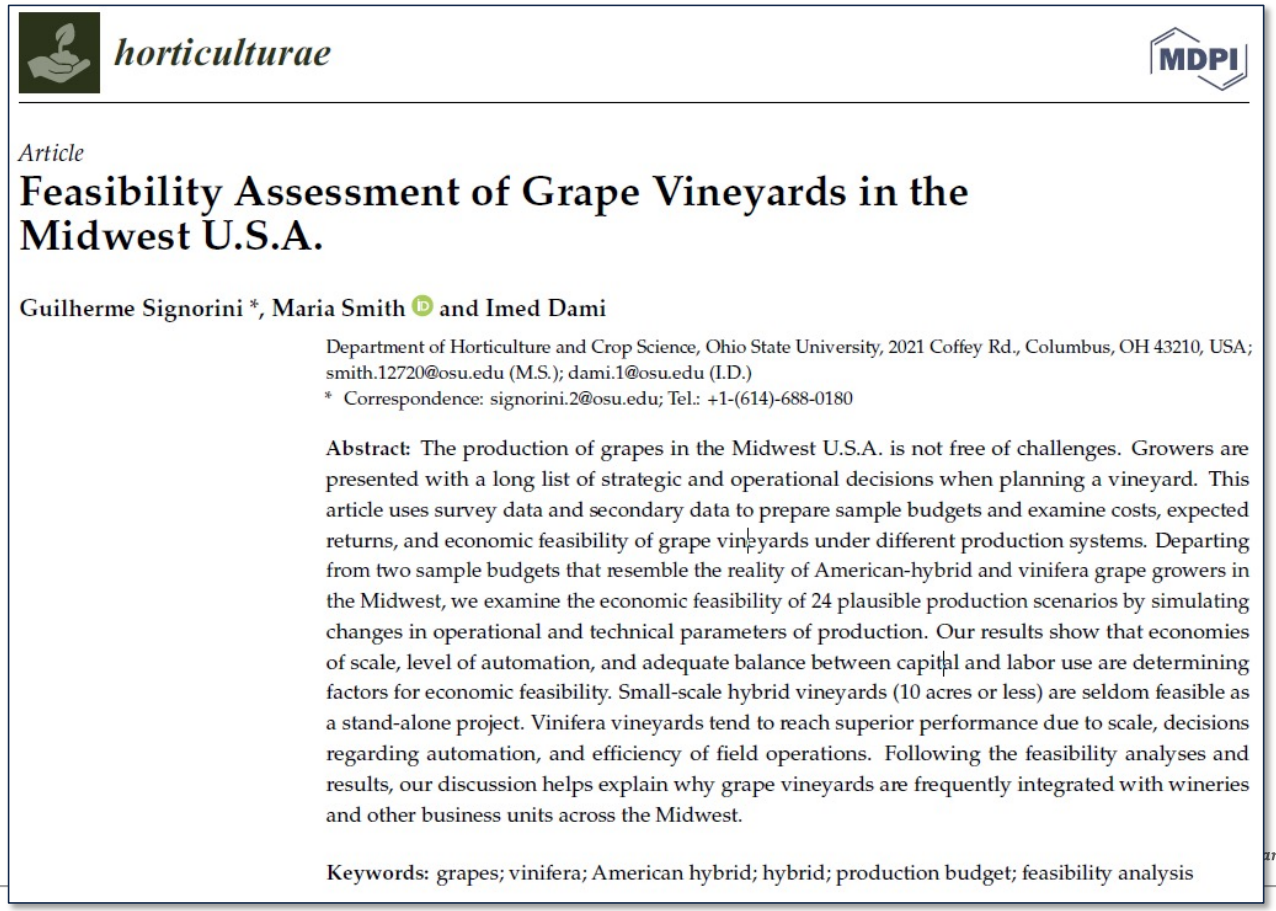
… challenging

… risky

Feasibility of vineyards depend on key factors:

- Economies of scale
- Level of automation
- Adequate balance between capital and labor

MOTIVATION FOR THE STUDY



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MDPI

Article

Feasibility Assessment of Grape Vineyards in the Midwest U.S.A.

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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

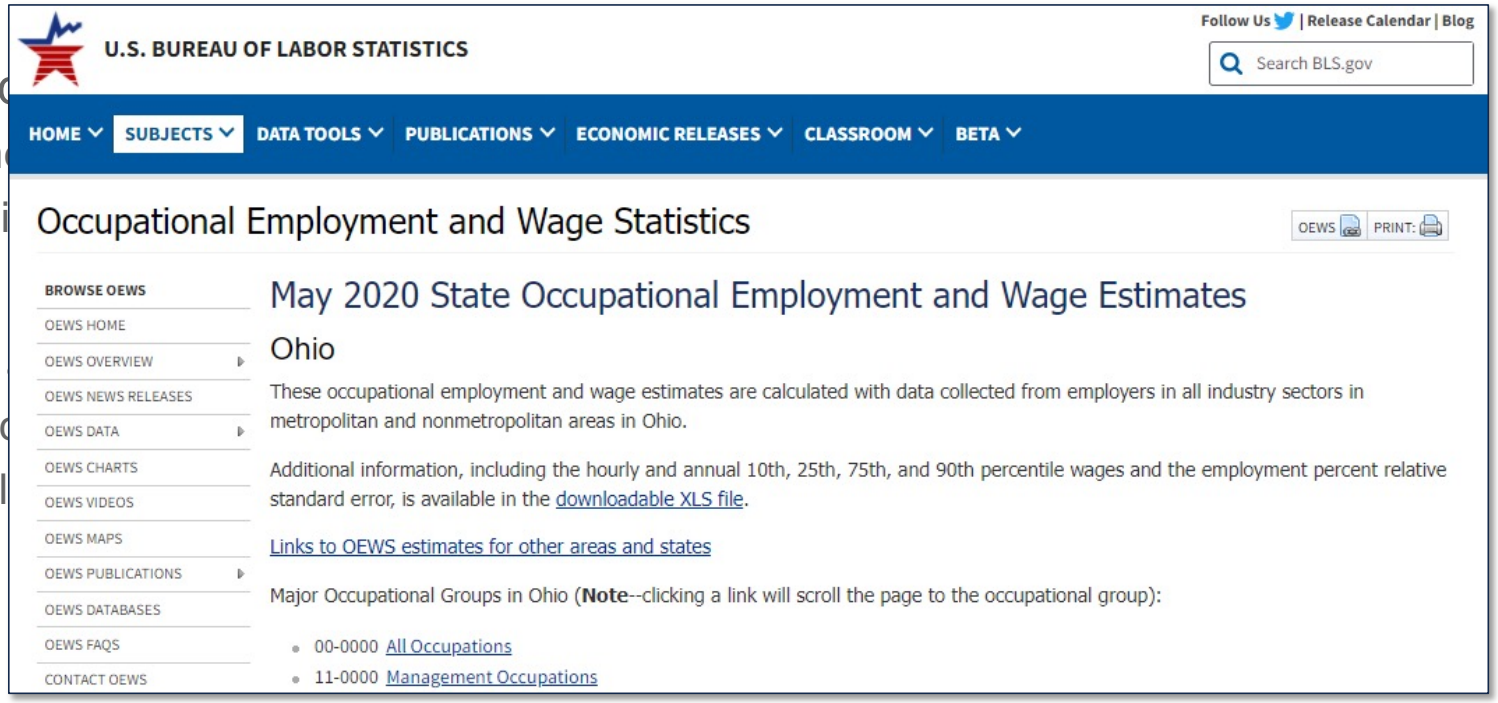
- 45 complete surveys with grape growers
- Multiple secondary sources

MOTIVATION FOR THE STUDY

For context:

Two proc
- Am
- Vini

Primary
- 45 c
- Mul



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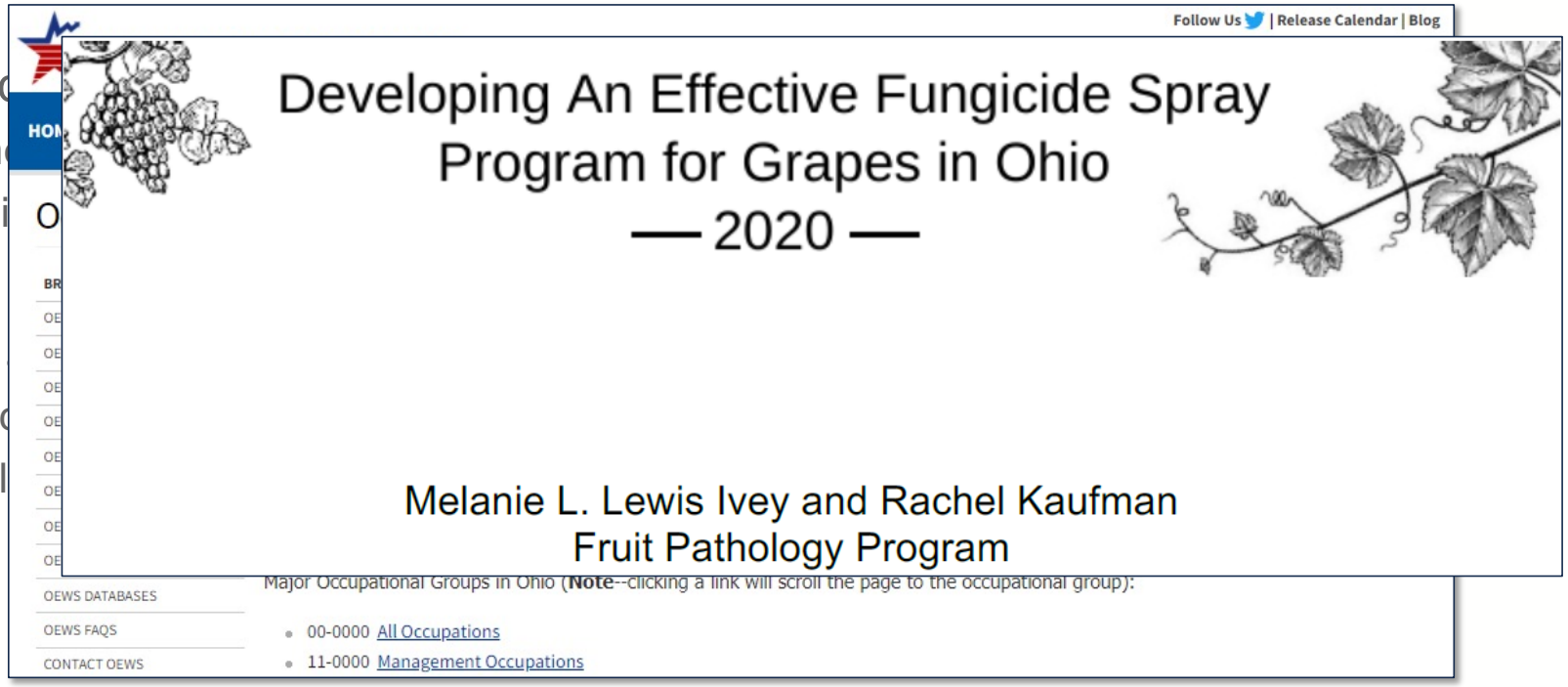

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For context:

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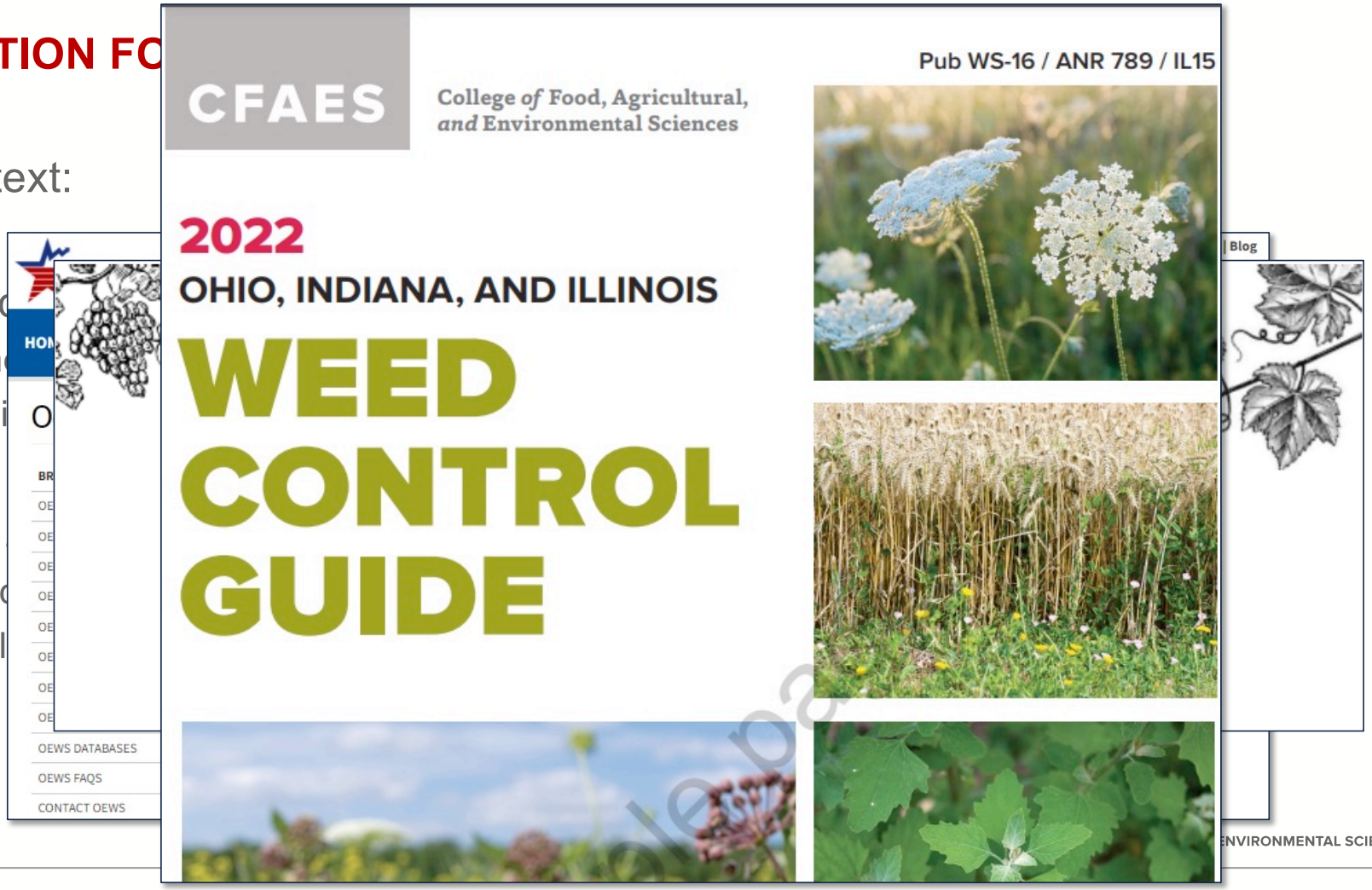
- Am
- Vini

Primary
- 45 c
- Mul



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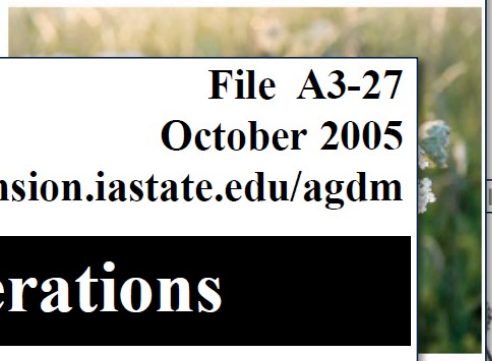

Ag Decision Maker

File A3-27
October 2005
www.extension.iastate.edu/agdm

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

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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File A3-27

Estimating the Field Capacity of Farm Machines

Ag Decision Maker

File A3-24

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 or 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 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

	Investment in Mach. & Equip		Total cost during productive years (4 through 25)	Financial Indicators
Baseline: Basic automation	$214,859.00	4,297.00 (per acre)	2,630	NPV: 17,591 / IRR: 13.7% / Payback: 12.4 / ROI: 4.09
Scenarios	Add. Investment in Mach & equip.	Add. Investment (per acre)	Reduction in T. Cost (per acre per year)	
2) Pre-pruner	+ 20,000	+ 400	99.81	NPV: 18,425 / IRR: 13.9% / Payback: 12.2 / ROI: 3.92
3) Mechanized Trimmer	+ 10,000	+ 200	188.44	NPV: 19,583 / IRR: 14.4% / Payback: 11.7 / ROI: 4.35
4) Self-propelled Harvester	+ 135,000	+ 2,300	321.04	NPV: 20,330 / IRR: 14.3% / Payback: 11.8 / ROI: 2.91
5) New Intelligent Sprayer	+ 70,000	+ 1,000	251.16	NPV: 19,671 / IRR: 14.1% / Payback: 11.9 / ROI: 3.45
6) Retrofitted Intelligent Sprayer	+ 25,000	+ 240	287.78	NPV: 20,675 / IRR: 14.8% / Payback: 11.4 / ROI: 4.64
7) All equipment	+ 235,000	+ 4,300	860.45	NPV: 25,236 / IRR: 15.4% / Payback: 10.7 / ROI: 2.80

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:

Scenarios	NPV	IRR	Payback	ROI
1) Baseline	17,591	13.7%	12.4	4.09
2) Pre-pruner	18,425	13.9%	12.2	3.92
3) Mechanized Trimmer	19,583	14.4%	11.7	4.35
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6) Retrofitted Intelligent Sprayer	20,675	14.8%	11.4	4.64
7) All equipment	25,236	15.4%	10.7	2.8

Thank you.

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