Economic Considerations of Precision Horticulture

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An Economist’s Prophecies

“It’s déjà vu All Over Again!”

“I Really Didn’t Say Everything I Said”

“When You Come to A Fork in The Road – Take It!”

“The Future Ain’t What it Used to Be!”

Yogi Berra
What can UAS technology do for your business?
Count fruit – precision thinning
  increase % of larger fruit
  increase % of higher quality fruit
  minimize alternate bearing
  – yield estimation
    increase harvest efficiencies
    profit from better marketing strategies
    reduce cold storage issues

Canopy management – year to year consistency in yields

Fertility management – precision application of N₂

Water management – water is the current conflict between agriculture and non-agricultural populations
How much does it cost?

*Cost Minimizer*

What benefits can I expect to receive?

*Profit Maximizer*
The Profit Maximization Concept:

Suggests that You Will Invest Money on Inputs to Increase Revenues as Long as the Incremental Revenues are Over and Above the Incremental Costs!

Cost Minimization vs. Profit Maximization

Law of Diminishing Returns

Output of Corn vs. Units of Nitrogen
Cost Minimization vs. Profit Maximization

Production Function

Gala Packout Assumptions – 60 bins per acre

Returns to Grower After Variable Costs
Before
$22,800
Gala Packout Assumptions – 60 bins per acre
A 10% Increase in Larger Fruit Size

Returns to Grower After Variable Costs
Before After
$22,800 $23,067 = $267

Gala Packout Assumptions – 60 bins per acre
A 10% Reduction in Culls to Grade 1 Fruit

Returns to Grower After Variable Costs
Before After
$22,800 $23,514 = $714
Honeyscrisp Packout Assumptions – 60 bins per acre

Returns to Grower After Variable Costs
Before $18,076

Honeyscrisp Packout Assumptions – 60 bins per acre
A 10% Increase in Larger Fruit Size

Returns to Grower After Variable Costs
Before $18,076
After $18,162 = $86
Honeycrisp Packout Assumptions – 60 bins per acre
A 10% Reduction in Culls to Grade 1 Fruit

Returns to Grower After Variable Costs
Before After =
$18,076 $22,678 $4,602

Mechanical Harvesting in Precision Horticulture

Mechanical Harvesting in Precision Horticulture

Minimum Wage Rates – Projected and Actual – for Washington State, 2004 to 2025

Capital Investment Analysis

A budgeting procedure that assesses the potential profitability of a long-term investment.

Financial Concepts used to Evaluate Investments

- Net Present Values (NPV)
- Internal Rate of Return (IRR)
- Break-even Year to Cash Flow
Key Factors in Mechanization of Apple Harvest

- Return to the Grower
- Cost of Mechanized Machine
- Single Pick v Multiple Pick Variety (bins harvested per hour)
- Mix of Varieties over Harvest Season
- Training System (field efficiency)
- Total Harvested Acres per Machine

Key Factor in Any Equipment Investment Analysis

Field Capacity (Efficiency)

Field efficiency is defined as the percentage of time the machine operates at its full rated speed and width while in the field.

Turning and idle travel;
Operating at less than full width;
Handling fertilizer, chemicals, water or harvested materials;
Cleaning clogged equipment;
Machine adjustment;
Lubrication and refueling during the day;
Waiting for other machines;
Waiting for repairs to be made.
Field Efficiency In Other Agricultural Field Operations

<table>
<thead>
<tr>
<th>Field efficiency</th>
<th>Range (%)</th>
<th>Typical (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tillage &amp; planting</td>
<td>70-90</td>
<td>85</td>
</tr>
<tr>
<td>Moldboard plow</td>
<td>70-90</td>
<td>85</td>
</tr>
<tr>
<td>Heavy-duty disk</td>
<td>70-90</td>
<td>85</td>
</tr>
<tr>
<td>Row crop planter</td>
<td>50-75</td>
<td>65</td>
</tr>
<tr>
<td>Grain drill</td>
<td>55-80</td>
<td>70</td>
</tr>
<tr>
<td>Harvesting</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corn picker sheller</td>
<td>60-75</td>
<td>65</td>
</tr>
<tr>
<td>Combine</td>
<td>60-75</td>
<td>65</td>
</tr>
<tr>
<td>Mower</td>
<td>75-85</td>
<td>80</td>
</tr>
<tr>
<td>Mower (rotary)</td>
<td>75-90</td>
<td>80</td>
</tr>
<tr>
<td>Miscellaneous</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fertilizer spreader</td>
<td>60-80</td>
<td>70</td>
</tr>
<tr>
<td>Boom-type sprayer</td>
<td>50-80</td>
<td>65</td>
</tr>
</tbody>
</table>

Source: ASAE standards, 2004

Key Factor in Any Equipment Investment Analysis

**Acres per Hour**

<table>
<thead>
<tr>
<th>Equipment Speed</th>
<th>×</th>
<th>Width of Operation</th>
<th>×</th>
<th>Field Efficiency</th>
</tr>
</thead>
</table>

8.25

(relationship of rods in a mile and square feet per acre)
Estimated Acres per Hour for Mechanical Harvest Operation

\[
\frac{1.0 \text{ mph} \times 12 \text{ feet} \times 30\%}{8.25} = 0.44 \text{ Ac/Hr}
\]

Estimated Acres per Hour for Mechanical Harvest Operation

\[
0.44 \text{ acres per hour} \times 20 \text{ hours per day} = 8.80 \text{ acres/day}
\]

\[
8.80 \text{ acres/day} \times 25 \text{ days of harvest} = 220 \text{ total acres per season}
\]
### Estimated Acres per Hour for Mechanical Harvest Operation

<table>
<thead>
<tr>
<th>MPH</th>
<th>Field Efficiency</th>
<th>Acres/ Hour</th>
<th>Total Acres</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.0</td>
<td>30%</td>
<td>0.44</td>
<td>220</td>
</tr>
<tr>
<td>1.5</td>
<td>30%</td>
<td>0.65</td>
<td>325</td>
</tr>
<tr>
<td>1.0</td>
<td>40%</td>
<td>0.58</td>
<td>290</td>
</tr>
<tr>
<td>1.5</td>
<td>40%</td>
<td>0.87</td>
<td>435</td>
</tr>
<tr>
<td>1.0</td>
<td>50%</td>
<td>0.73</td>
<td>365</td>
</tr>
<tr>
<td>1.5</td>
<td>50%</td>
<td>1.09</td>
<td>545</td>
</tr>
<tr>
<td>1.0</td>
<td>60%</td>
<td>0.87</td>
<td>435</td>
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<tr>
<td>1.5</td>
<td>60%</td>
<td>1.31</td>
<td>655</td>
</tr>
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</table>
Tall spindle Gala 6th leaf 70 Bin Acre
5th leaf: on its way to 100 Bin / acre

Bi-axe planting in Chelan, with 55 Bin per Acre crop in 2013
Establishing a New Gala Orchard, 1,089 TPA, 12’ Centers
Begin Prod. in Year 3, Full Prod. w/ 65 BPA in Year 6, $300/Bin

Hand Harvest
Net Present Value $22,842
(8% Discount Rate)
Establishing a New Gala Orchard, 1,089 TPA, 12’ Centers
Begin Prod. in Year 3, Full Prod. w/ 65 BPA in Year 6, $300/Bin

- $400,000 for a Mechanical Harvester Machine
- Spread Costs over 100 acres for a $4,000 per acre cost
- Life of Machine is 10 Years (obsolesce/depreciated)
- Replace Machine in 10 Years
- Purchase Mechanical Harvester in Year 4 & 14
- Salvage Value of $40,000 in Year 13 & $100,000 in Year 20
- Maintenance & Repairs = 5% of purchase price ($200/acre)
- All costs are inflated at 3% annually

<table>
<thead>
<tr>
<th>Year</th>
<th>Hand Harvest NPV</th>
<th>Machine NPV</th>
</tr>
</thead>
<tbody>
<tr>
<td>2014</td>
<td>$22,842</td>
<td>$29,935</td>
</tr>
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(8% Discount Rate)
Establishing a New Gala Orchard, 1,089 TPA, 12’ Centers
Begin Prod. in Year 3, Full Prod. w/ 65 BPA in Year 6, $300/Bin

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<th>Year</th>
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<td></td>
<td>Hand Harvest</td>
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<tr>
<td></td>
<td>$22,842</td>
</tr>
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(8% Discount Rate)

Economic Considerations of Precision Horticulture

Takeaways
✓ Technology (i.e. AUV’s) will benefit apple producers more than any other sector in agricultural (high input-high output; market product by size and grade characteristics)

✓ With that said, not all apple blocks will benefit from precision technologies equally, more will benefit than others (yields, varieties, packout, training system)

✓ It is critical to know your production, packout and input costs on a block-by-block basis to allocate resources to those blocks that will generate the most profits
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<tr>
<td><strong>Takeaways</strong></td>
</tr>
<tr>
<td>✓ Returns to the Grower is still #1</td>
</tr>
<tr>
<td>✓ Do not focus on the cost of mechanized machine!</td>
</tr>
<tr>
<td>✓ Single pick v multiple pick Variety does matter (bins harvested per hour)</td>
</tr>
<tr>
<td>✓ Mix of varieties over harvest season, key to maximizing the capacity of the machine</td>
</tr>
<tr>
<td>✓ The training system is key to field efficiency, which impacts the total harvested acres per machine</td>
</tr>
</tbody>
</table>