Mechanical Harvesting Characteristics of Several Small Greens

J. Glancey  
D. Brown  
University of Delaware  
Carlisle Farms, Inc., Greenwood, DE  
H&S Dubois, Pittsgrove, NJ
Preventing Blade Deflection

*Continuous Blade Guide*
Harvest Recovery - Spinach

**Variety:** Vivos  
**Leaf:** Smooth  
**Yield:** 14,403 lbs/A

**Averages:**  
Uncut = 143 lbs/A  
Loose = 668 lbs/A  
Total = 811 lbs/A

**Cost Implications:**  
Price = $0.10/lb  
Loss = $81/A
Does Variety Matter?

Summary of Field Tests

<table>
<thead>
<tr>
<th>Performance Metric</th>
<th>Average Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ground Speed</td>
<td>5.5 MPH</td>
</tr>
<tr>
<td>Spinach Yield</td>
<td>14,432 lbs/A</td>
</tr>
<tr>
<td>Field Capacity</td>
<td>4.1 A/h</td>
</tr>
<tr>
<td>Throughput Capacity</td>
<td>58,500 lbs/A</td>
</tr>
</tbody>
</table>
Ongoing Work . . .

Turnip Greens

Mustard

Collards

Kale

Plant Architectures

*Measured Attributes*
- Plant Height
- Leaf Width
- Leaf Height
- No. of Leaves
- Stem Diameter
- Plant Weight
- True Population
- Harvest Loss
- Yield
The good, bad and ugly . . .

Harvest Loss Characteristics

<table>
<thead>
<tr>
<th>Small Green</th>
<th>Harvest Loss (% yield)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Spinach</td>
<td>0</td>
</tr>
<tr>
<td>Turnup</td>
<td>0</td>
</tr>
<tr>
<td>Kale</td>
<td>0</td>
</tr>
<tr>
<td>Mustard</td>
<td>0</td>
</tr>
<tr>
<td>Collards</td>
<td>0</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Trial No.</th>
<th>Kale Harvest Loss (% Yield)</th>
<th>Collards Harvest Loss (% Yield)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>2</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>3</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>4</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>5</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>6</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>7</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>8</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>9</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>10</td>
<td>0</td>
<td>0</td>
</tr>
</tbody>
</table>
What’s Causing the Loss?

![Graph showing the relationship between leaf width and harvest loss for different vegetables: Spinach, Kale, Mustard, Turnips, and Collards. The graph indicates a strong positive correlation with R² = 0.9075.]
Summary

- Once-over harvesting costs for several small greens can be reduced with a bandsaw-type cutter.
- Harvesting capacity increased.
- Harvest loss lowest for spinach and highest for collards.
- Results suggest losses are proportional to plant leaf size.
- Next phase needs to focus on better retaining cut leaves and possible changes in cultural practices.
- A universal small greens harvester not yet economically viable.

Questions?
Suggestions?
Field Test Summary

- Blade cycles in service: 400,000 +
- System initial cost: $700
- Blade cost: $65
- Retrofitable: Yes
- Safety: Yes*
- Average throughput: 3 A/h
- Maintenance interval: 20 hours
- Crop Recovery: ?
- Regrowth: ?
Stationary Guard

Reciprocating Blade

Traditional Cutting Mechanism

Spinach Harvesting
Continuous Blade Cutter
Conceptual View

- Pulley mounted on a bearing slider for adjusting blade tension
- Crowned UHMW Pulley (1 of 4)
- Idler Shaft (1 of 3)
- Linear Velocity, v
- Scalloped Steel Blade
- Driving Shaft and Pulley
- Hydraulic Motor w/ Check Valve
- Direction of Travel
- 1.1 m
- 1.6 m