Effects of Ground Speed and Conveyor Speed on Peanut Digging Losses

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INTRODUCTION
Objectives (virginia type peanuts)

- Effects of conveyor speed on digging losses
  - 80% Lagging
  - 90%
  - 100% Equal to ground speed
  - 110%
  - 120% Leading

- Effects of ground speed on digging losses
  - 2 mph
  - 3 mph
  - 4 mph
  - 5 mph
Diggers used in study
General site description

- Sand to loamy sand
- Soil Moisture: $4 \pm 1\%$ VMC

- Amadas (Champs)
- KMC (Wynn)
CONVEYOR SPEED TESTS
Conveyor speed: Literature

• Amadas
  – Set conveyor to match tractor speed (digital readout)
  – Excessive dirt in windrow = Conveyor too slow?
  – Conveyor stalls excessively = Conveyor too slow?

• KMC
  – Vine flow synchronized with ground speed and conveyor speed

• Bader, UGA
  – Chain speed slightly faster than forward speed to avoid pileup of vines ahead of pickup

• Roberson, NCSU
  – Synchronize to avoid dragging and snatching of plants
  – Optimum shaker speed is slightly faster than ground speed
Setting conveyor speed visually

Conveyor too slow

Travel Direction

Conveyor too fast
Calculating conveyor speed

• Determine length of conveyor:
  (Rod Spacing) x (# of rods) ...convert to feet

• Determine ground speed in ft/min:
  ft/min = (mph) x (88)

• Determine conveyor speed required:

  \[
  \text{Conveyor Speed [rev/min]} = \frac{\text{Ground Speed [ft/min]}}{\text{Conveyor Length [ft/rev]}}
  \]

  \[
  \text{Conveyor Cycle Time [sec/rev]} = \frac{60 [sec/min]}{\text{Conveyor Speed [rev/min]}}
  \]
Conveyor Speed Tests: Ground Speed was 3 mph

Conveyor Speeds

- 0.8 x
- 0.9 x
- 1.0 x
- 1.1 x
- 1.2 x

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Amadas Conveyor Speeds at 3mph
Amadas Conveyor Speed Tests: Champs

<table>
<thead>
<tr>
<th>Speed Level</th>
<th>Losses lb/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>80pct</td>
<td>191</td>
</tr>
<tr>
<td>90pct</td>
<td>201</td>
</tr>
<tr>
<td>100pct</td>
<td>187</td>
</tr>
<tr>
<td>110pct</td>
<td>212</td>
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<tr>
<td>120pct</td>
<td>327</td>
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</table>

Mechanical Digging Losses lb/ac
KMC Conveyor Speeds at 3mph
KMC Conveyor Speed Tests: Wynn

Mechanical Digging Losses lb/ac

<table>
<thead>
<tr>
<th>Speed</th>
<th>Losses</th>
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<tbody>
<tr>
<td>80pct</td>
<td>427</td>
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<tr>
<td>90pct</td>
<td>362</td>
</tr>
<tr>
<td>100pct</td>
<td>511</td>
</tr>
<tr>
<td>110pct</td>
<td>444</td>
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<tr>
<td>120pct</td>
<td>734</td>
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</tbody>
</table>
GROUND SPEED TESTS
Ground speed: Literature

• Amadas: “Starting speed” 2.5 – 3 mph
• KMC: 3 – 3.5 mph
  – Too fast causes bunching
  – Too slow pulls vines apart, pulling off peanuts
• Bader, UGA: 3.5 – 5 mph
• Roberson, NCSU
  – Heavy pod losses at ground speeds in excess of 4 mph
Ground Speed Tests: Conveyor Speed = Ground Speed

Ground Speeds

- 5 mph
- 4 mph
- 3 mph
- 2 mph
Amadas Ground Speeds at 100% Conveyor Speed

2 mph
3 mph
4 mph
5 mph
Amadas Ground Speed Tests: Champs

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Mechanical Digging Losses, lb/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>B</td>
</tr>
<tr>
<td>3</td>
<td>B</td>
</tr>
<tr>
<td>4</td>
<td>A</td>
</tr>
<tr>
<td>5</td>
<td>A</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Losses</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 mph</td>
<td>164</td>
</tr>
<tr>
<td>3 mph</td>
<td>187</td>
</tr>
<tr>
<td>4 mph</td>
<td>463</td>
</tr>
<tr>
<td>5 mph</td>
<td>652</td>
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</tbody>
</table>
Amadas Digging Losses as Function of Ground Speed

Slope = 232 lb/ac loss per mph above 3 mph
Amadas Economic Analysis

6-row Digger
$400/ton Revenue
$30/ac Digging Costs

Costs ($/ac)

Ground Speed (mph)

Total Costs  Dig Loss Costs  Machinery Costs

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KMC Ground Speeds at 100% Conveyor Speed

2 mph
3 mph
4 mph
5 mph
### KMC Ground Speed Tests: Wynn

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Mechanical Digging Losses, lb/ac</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>C 341</td>
</tr>
<tr>
<td>3</td>
<td>B 511</td>
</tr>
<tr>
<td>4</td>
<td>A 838</td>
</tr>
<tr>
<td>5</td>
<td>A 1147</td>
</tr>
</tbody>
</table>

Bar chart showing mechanical digging losses at different speeds.
KMC Digging Losses as Function of Ground Speed

Slope = 274 lb/ac loss per mph above 2 mph
KMC Economic Analysis

6-row Digger
$400/ton Revenue
$30/ac Digging Costs

Costs ($/ac)

Ground Speed (mph)

Total Costs
Dig Loss Costs
Machinery Costs

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# Field Capacity for Various Digging Speeds

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Capacity (ac/hr)</th>
<th>Time (hr/10 ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>2.6</td>
<td>3.8</td>
</tr>
<tr>
<td>2.5</td>
<td>3.3</td>
<td>3.1</td>
</tr>
<tr>
<td>3</td>
<td>3.9</td>
<td>2.6</td>
</tr>
<tr>
<td>3.5</td>
<td>4.6</td>
<td>2.2</td>
</tr>
<tr>
<td>4</td>
<td>5.2</td>
<td>1.9</td>
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<td>4.5</td>
<td>5.9</td>
<td>1.7</td>
</tr>
<tr>
<td>5</td>
<td>6.5</td>
<td>1.5</td>
</tr>
</tbody>
</table>

## 4-Row Diggers

<table>
<thead>
<tr>
<th>Speed (mph)</th>
<th>Capacity (ac/hr)</th>
<th>Time (hr/10 ac)</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>3.9</td>
<td>2.6</td>
</tr>
<tr>
<td>2.5</td>
<td>4.9</td>
<td>2.0</td>
</tr>
<tr>
<td>3</td>
<td>5.9</td>
<td>1.7</td>
</tr>
<tr>
<td>3.5</td>
<td>6.9</td>
<td>1.5</td>
</tr>
<tr>
<td>4</td>
<td>7.8</td>
<td>1.3</td>
</tr>
<tr>
<td>4.5</td>
<td>8.8</td>
<td>1.1</td>
</tr>
<tr>
<td>5</td>
<td>9.8</td>
<td>1.0</td>
</tr>
</tbody>
</table>

## 6-Row Diggers
Conclusions

• Best to lag (>80%) or match conveyor speed to ground speed
• Digging losses increase with ground speed: 230-270 lb/ac per mph increase (this test)
• Digging machinery costs decrease with ground speed
• Optimum ground speed for profitability minimizes sum of digging loss costs and digging machinery costs
  – Amadas Belt Conveyor / Champs = 3 mph
  – KMC Chain Conveyor / Wynn = 2 mph
Acknowledgments

- Clemson Ag Mech & Business Undergraduate Program
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