Mobile Hops Picker & Modular Oast
Mobile Hops Picker

• Started in 2011, 2012 was our second year of use
• Design team – growers, brewers, crop specialists
• Goal: Provide efficient mechanized harvesting to multiple yards
• Bridge the gap – hand picking vs. large centralized harvesters
• Public domain design - http://www.uvm.edu/extension/cropsoil/wikis alternatively: uvm.edu search “hops wiki”, 1st link.
Mobile Hop Picker

A project of University of Vermont Extension, Vermont Agency of Agriculture and Massachusetts Department of Agricultural Resources through the USDA Specialty Crops Block Grants Program.
# Picker Design Requirements

<table>
<thead>
<tr>
<th>Feature</th>
<th>Requirement</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Capacity</strong></td>
<td>2 bine/min&lt;br&gt;8 hr/acre&lt;br&gt;10,000 lbs/day wet {2,000 lbs/day dry}</td>
</tr>
<tr>
<td><strong>Portability</strong></td>
<td>over road with standard tow hitch</td>
</tr>
<tr>
<td><strong>Safety</strong></td>
<td>similar to farm equipment&lt;br&gt;training req'd</td>
</tr>
<tr>
<td><strong>Power</strong></td>
<td>PTO / direct hydraulic</td>
</tr>
<tr>
<td><strong>Cone Damage / Loss</strong></td>
<td>&lt;5% by volume</td>
</tr>
<tr>
<td><strong>Operation</strong></td>
<td>team of two trained operators</td>
</tr>
</tbody>
</table>
Full bines enter here

Striping Section

Hops and leaves

Dribble Belts

Stripped bines exit here (far side)

And new ones are hooked on here (near side).
Improvements in 2012

- Shortened bine feed (no longer extends beyond machine)
  - Faster setup & no loss in performance with 2 person crew
Improvements in 2012

• Improved conveyor belt tracking
  – Added support rollers under belts and fencing on sides
Improvements in 2012

- Containing cones within the machine
  - Left open in the first year due to schedule, to allow troubleshooting and to see what was working and how.
  - Fences added to sides of conveyors
  - Chute added to front to prevent hops from being stripped right out of the machine
Belt speed increase resulting in better cone separation.
Main Lessons in 2012

• Logistics
  – Have to keep the machine fed (120 bines /hr)
  – Have to keep the cones shuttled to the oast

• Machine tuning / adjustment
  – Opened the front end of the stripping fingers to reduce number of stripped lateral branches
  – Stripping speed and dribble belt speed adjustment
  – Containing cones within the machine for sorting
## Prototype Cost Summary

<table>
<thead>
<tr>
<th>Item</th>
<th>Cost</th>
</tr>
</thead>
<tbody>
<tr>
<td>Trailer</td>
<td>$3,500</td>
</tr>
<tr>
<td>Frame &amp; Subframe</td>
<td>$1,800</td>
</tr>
<tr>
<td>Stripping Section</td>
<td>$4,100</td>
</tr>
<tr>
<td>Motors, Pump &amp; Hydraulics</td>
<td>$5,800</td>
</tr>
<tr>
<td>Conveyor Belts &amp; Rollers</td>
<td>$4,200</td>
</tr>
<tr>
<td>Bine Feed</td>
<td>$1,200</td>
</tr>
<tr>
<td><strong>Total Material</strong></td>
<td>$20,600</td>
</tr>
<tr>
<td><strong>Fabrication Labor</strong></td>
<td>$32,000</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>$52,600</td>
</tr>
</tbody>
</table>
## Harvester Options

<table>
<thead>
<tr>
<th>Option</th>
<th>Initial Cost</th>
<th>Crew</th>
<th>Bine per Hour</th>
</tr>
</thead>
<tbody>
<tr>
<td>Manual</td>
<td>Zero</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>Bine 3060 (Addison Hop Farm, Addison, VT)</td>
<td>$14,250</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>UVM Mobile (UVM)</td>
<td>$52,600 (prototype, labor outsourced) $35,000 (projected repeat, labor outsourced) $23,000 (projected repeat, DIY 4 weeks)</td>
<td>4</td>
<td>120</td>
</tr>
<tr>
<td>Wolf WHE140 (Four Star Farm Northfield, MA)</td>
<td>$30,000 (delivered and converted, 2 weeks labor)</td>
<td>8</td>
<td>170</td>
</tr>
</tbody>
</table>
Cost / Benefit (1 of 2)

• Assume $35,000 cost of harvester
• 120 bine/hour harvesting rate with machine
  – compared to 1.5 bine/hour manually
  – $7.25/hr wage assumed
• 6 acres harvest per year
• 1500 bines per acre
• 1 lb dry cones per bine
• Retail pricing of $10 per lb (dry)
Cost / Benefit (2 of 2)

- **Net hourly revenue:**
  - Machine $1,171 vs. $7.75 by hand

- **Per pound harvest cost:**
  - Machine $0.37 vs $4.83 by hand
  - Includes machine cost and labor
  - Per pound harvesting cost reduction of 92%

- **Net hourly profit potential:**
  - Machine $1,126 vs. $0.50 by hand
  - And few people would attempt harvesting 6 acres by hand (6000 person hours).

- **Machine simple payback period 0.43 years**
Modular Hops Oast

- Goal: Provide rapid, heated (“but not hot!”) hop drying in modular design
- Cabinet & tray design – based on an ostrich egg incubator
- PID Controlled 3,500 Watt heater and circulation / stripping fan
Dry 800 lbs wet cones per day
4’x8’x7’
Fan 24" diameter
3,250 CFM at 1,750 RPM

3" diameter Outlet

1" PVC inlets at 23" radius from fan center at the 4 corners

3" diameter inlet

3,500 Watt Heater

Thermal switches
Oast cost

Materials
Lumber-screws-hardware $493
Angle Iron for Tray Racks $208
1/3 H.P. Fan Motors (2) @ $110.00 $220
Fan Blades (2) @$78.00 (Multi-Wing) $156
Heating Elements 3000 Watt (2) @ $332.00 $664
Heating and Fan Controls $200

Total $1941

Labor 30 Hours
Drying Calculator

http://www.uvm.edu/extension/agriculture/engineering/?Page=hopscalc.html

Google: “uvm hops moisture calculator”, 1st link.

Also available as an Excel spreadsheet for offline use.