High Quality hop Production, Low-Trellis Systems

Presented by:
John Henning
2011 Winter Hops Conference
Feb 18th, 2011

Overview

- History and early production
- Moving into the 21st Century
- Comparison tall trellis vs short trellis
- Production of conventional varieties?
- Production of “Dwarf” varieties
- USDA-ARS “Dwarf” breeding program
- Low trellis designs
- Summary

History and Early Production

- Center of diversity
- Spread throughout world
- Early use and production

Special Thanks!

- University of Vermont Extension
- Hop Research Team—USDA-ARS
  - Dan Moore—Molecular Biologist Technician
  - Student Employees—Kris Judy, Mari Stoner
  - Graduate Student—Megan Twomey
- Shaun Townsend, Oregon State University
- David Gent, USDA-ARS
- Paul Matthews, SS Steiner

Center of Diversity

China

 attachment
Early Use and Production
- Hops used as medicinal early on
- Evidence suggests early use in brewing ~ 3000 yrs ago
- Early use gathered wild hops for brewing
- First recorded "horvayrd" ~ 750 AD
- Early hop varieties: Noted location and obtained seed or cuttings
- Landraces ("Noble Hops") derived from these lines

Pre-Mechanized Harvest
- Hops were grown on tall poles
- End of season poles taken down
- Picked by hand
- Large influx from city and immigrant labor

Early Mechanization
- Hop production moved to trellis rather than poles
- Experimented with low and high trellis
- Both stationary and mechanical pickers

Early Low Trellis Designs

Early Tall Trellis Designs

Early Mechanization
Self-propelled and towed conventional pickers designed in 1930's and 40's
Self-propelled and towed low trellis pickers designed in 80's and early 90's
Hops grown on low trellis at that time were conventional hop varieties
Most efforts in USA abandoned
Example of Early Low Trellis Picker

Moving into 21st Century
- First commercial dwarf hop, 'First Gold' released 1997 by Great Britain.
- Revived interest in low trellis production
- Why were folks interested in low trellis?
- New studies w/ conventional hops

The Tall Trellis Hop Season
- Spring labor and mechanical activities
  - Land preparation or spraying cover crop
  - Pruning-established yards
  - Stringing
  - Training
  - Spraying
- Early Summer
  - Arching
  - Irrigation
  - Cultivation and/or spraying
- Mid-Summer
  - Irrigation
  - Cultivation and/or spraying
- Harvest

The Low Trellis Hop Season
- Spring labor and mechanical activities
  - Land preparation or spraying cover crop
  - Pruning-established yards
  - Stringing
  - Training
  - Spraying
- Early Summer
  - Arching
  - Irrigation
  - Cultivation and/or spraying
- Mid-Summer
  - Irrigation
  - Cultivation and/or spraying
- Harvest

New Studies on Low Trellis Hop Production.....OR

Plant Physiology 101
- Top growth point = apical meristem
- Apical meristem makes plant hormones
- Hormones stimulate stem elongation
- Hormones also stimulate flowering
- Hops need approximately 22-25 nodes before flowering initiated

How to Trick a Conventional Hop into Thinking it's a Dwarf
Onset of shortening days—stimulates changes
- Apical meristem starts shrinking
- Hormones produced change (GA reduced)
- Stem elongation slows
- Lateral branch growth stimulated
- Flower formation stimulated

Hop plants can be ‘fooled’
- Cut off tip (apical meristem)
- Source of hormones cut off
- Stem elongation reduced
- Lateral branch formation stimulated

Onset of shortening days (after Summer Solstice)
- Flower formation stimulated
- Need as many lateral branches possible
- Early fertilization to stimulate early growth!

Conventional Hops on Low Trellis
- Study: Roy Farms & Jason Perrault
- Hedge Rows ~ 8 ft apart
- Trellis 8-10 ft tall
- Plants spaced 2-3 ft apart
- Flexible mesh support

Flexible Mesh or Evenly Spaced String?
- Study: Wye College (Darby, 1999). Hops planted 45 in apart. Mesh vs hop twine
- Saw slight edge in yield using mesh
- 100% hedge coverage using mesh
- 95% hedge coverage using evenly spaced hop twine (1 ft apart).
- Hop twine required more labor; Flexible mesh more stable
Low Trellis Production

February 18th, 2011

<table>
<thead>
<tr>
<th>Item</th>
<th>Comment</th>
<th>Cost/Acre</th>
</tr>
</thead>
<tbody>
<tr>
<td>Poles</td>
<td>162 at $8.80/pole</td>
<td>$1,426</td>
</tr>
<tr>
<td>Top cable</td>
<td>5000 ft</td>
<td>$375</td>
</tr>
<tr>
<td>Bottom wire</td>
<td>5000 ft</td>
<td>$100</td>
</tr>
<tr>
<td>Top staple</td>
<td>175 (top) 162 (bottom)</td>
<td>$16</td>
</tr>
<tr>
<td>Cable clamps</td>
<td>15</td>
<td>$6</td>
</tr>
<tr>
<td>Anchors</td>
<td>230 (steel, cable, concrete, labor) 4.5/acre</td>
<td>$90</td>
</tr>
<tr>
<td>Netting</td>
<td>4540 ft</td>
<td>$980</td>
</tr>
<tr>
<td>TOTAL MATERIALS</td>
<td></td>
<td>$2,992</td>
</tr>
<tr>
<td>Ground prep</td>
<td></td>
<td>$125</td>
</tr>
<tr>
<td>Potted plants</td>
<td>$.065 / plant / 1614 pots per acre</td>
<td>$1,050</td>
</tr>
<tr>
<td>Irrigation</td>
<td></td>
<td>$1,000</td>
</tr>
<tr>
<td>Fuel</td>
<td></td>
<td>$20</td>
</tr>
<tr>
<td>Labor</td>
<td></td>
<td>$823</td>
</tr>
</tbody>
</table>

TOTAL ESTABLISHMENT COST PER ACRE $6,010

Hints for Growing Conventional Hops on Low Trellis

- Train plants first year
- Get plants growing to top fast and early (Timely N application, Early pruning)
- Once at top, trim off apical growth pts.
- Forces lateral stem development
- After harvest, leave dry stems on mesh
- Provides means for “self-training”

Yield Comparisons Low vs Tall Trellis

- Bottom line?
  - Yields using conventional hops on low trellis always lower than tall trellis
  - Yield loss ranged from 80% (Willamette) to 26% (Cascade)
  - Highly dependent upon variety!
  - Highly dependent upon environment!

Dwarf Hops or Low Trellis

- Grown on same trellis
- Do not need trimming at tops
- Shorter internodes, greater lower laterals
- Evenly placed cones from top to bottom
- Significantly higher yields
- Some newer varieties = conventional hop yields
- No true dwarf hop varieties available—yet!
Low Trellis Production

**Summary**

- Reduced yields with "Conventional hops"
- Significant labor reductions & cost
- No stringing
- No training
- Precise pesticide application—lower cost
- Easier to pick by hand!

**USDA-ARS Dwarf Breeding**

- 2006 Germplasm Exchange
- Provided "pollen" from zero-alpha males
- "Teamaker" roots
- Pioneer x 25/95/15M seeds

**USDA-ARS Dwarf Breeding**

- 150 Seedlings planted 2009. Evaluated 2010
- Approximately 60% true "dwarf" plants
- Short internode length
- Lateral branches form along length of plant
- Apical meristem stops growing ~ 2/3rds up
- Collected seed off of each female dwarf
- Each collection represents new dwarf family

**Dwarf Hops on Low Trellis**

- Only true dwarf hop varieties "controlled" by English Hop Association
- Private breeding—American Dwarf Hop Association (Based on 'First Gold') Licensed
- USDA-ARS—Public breeding program (Based on 'Pioneer')...Germplasm Exchange

**Low Trellis Designs**

- Many designs possible
- Dependent upon space
- Conventional hops grow ~ 18ft
- 18ft long growth for each hill
- Best designs don’t force plant to grow down