High Quality hop Production, Low-Trellis Systems

Presented by:
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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
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
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 “hopyard” ~ 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

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

How to Trick a Conventional Hop into Thinking it's a Dwarf
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
• 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

Shephard et al., 2000
Hop plants can be “fooled”
- Cut off tip (apical meristem)
- Source of hormones cut off
- Stem elongation reduced
- Lateral branch formation stimulated

Shephard et al., 2000
Onset of shortening days (after Summer Solstice)

- Flower formation stimulated
- Need as many lateral branches possible
- Early fertilization to stimulate early growth!

Shephard et al., 2000
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
Conventional Hops on Low Trellis

- Flexible mesh = 6 – 8 in squares
- Top support = strong steel cable
- Bottom support = strong wire
- Poles = add 3 ft for underground
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
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<th>Item</th>
<th>Comment</th>
<th>Cost/Acre</th>
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<tr>
<td>Poles</td>
<td>162 at $8.80/pole</td>
<td>$ 1,426</td>
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<tr>
<td>Top cable</td>
<td>5000 ft</td>
<td>$ 375</td>
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<tr>
<td>Bottom wire</td>
<td>5000 ft</td>
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<tr>
<td>Top staple</td>
<td>175 (top) 162 (bottom)</td>
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<td>Cable clamps</td>
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<td>Anchors</td>
<td>$20 (steel, cable, concrete, labor)- 4.5/acre</td>
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<td>Netting</td>
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<td>TOTAL ESTABLISHMENT COST PER ACRE</td>
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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 on Low Trellis
Dwarf Hops on 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!
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
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
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
Short 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!