Small-Scale Organic Hops Production

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Leelanau County, MI

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Michigan Hop Alliance

E-Organic Webinar
November 15, 2011

Outline

- History
- Natural History and Taxonomy
- Characteristics and Growth Habits
- Production and Growing Requirements
- Pests and Diseases
- Trellising and Processing
- Economics, Market Trends, Brewer Needs
- Research Trials
- Resources

Hops Gain a Foothold in The U.S.

- Dutch probably 1st to bring hops to the New World in early 1600’s
- Native hops could be found in woods, but Dutch law required hops to be imported
- New England colonists 1st to establish cultivated hops crops as early as 1628
- Massachusetts promoted “healthy” malted beverages
- Used imported, locally grown and wild hops

Source: Tinged With Gold, Tomlan, 1992

Hops Gain a U.S. Foothold

1839

1859

Each dot represents 100,000 bales (1 bale = 200 lbs. dried hops)

Source: Tinged With Gold, Tomlan, 1992

Hops Gain a U.S. Foothold

1879

1899

By 1920's majority of production had moved west

Source: Tinged With Gold, Tomlan, 1992
Natural History and Taxonomy

- *Humulus* is the genus of herbaceous climbing plants that most likely originated in China, but is indigenous to temperate areas of the northern hemisphere including Asia, Europe, and N. America.
- *Humulus* is one of two genera in the Cannabinaceae family, the other being *Cannabis*.
- Though there are three distinct species *H. lupulus*, *H. japonicus*, and *H. yunnanensis* all commercial hops are of the *Humulus lupulus* (common hop) species.

What are Hops?

- Hops are dioecious, perennial plants that produce annual bines from an overwintering rhizome.
- Trichomes
- Only the female flower “strobile” or “cone” is desirable for use in beer production.
- Cones (0.5-4 in.) light green, papery, contain Lupulin glands, home to alpha and beta acids, and essential oils.

Lupulin

- Essential oils: contribute to aroma
- Soft resins: beta acids, and the all important alpha acids.

Site and Soil Requirements

- Hops require long day lengths
- Specific chilling requirements (winter temperatures below 40°F for 1-2 months) that are rarely satisfied below 35 degrees latitude.
- Climate: minimum of 120 frost free days
- Full day sun (8+ hours)
- Good air circulation and drainage to avoid mildew problems
- Sandy loam or well-drained loamy soil
- Poorly drained, strongly alkaline or saline soils should be avoided
- Very shallow bedrock and very shallow water tables to be avoided

Planting, Thinning, Training, Stripping

- Planted in spring
- Spacing and plants per acre
- Thinning
- Training: Two bines trained up each of the two coconut fiber support strings in a clockwise direction.
- Stripping at 7-8 ft, the lowest 2-3 feet of leaves and lateral branches are generally removed (stripping).
- Stripping can be accomplished manually, chemically, or with livestock.
Hop Growing Requirements: Fertility

- Soil Test Before planting
- Tissues Tests and Soil tests
- Recommended fertilization rates:
  - Nitrogen (N) = 120-140 lbs/acre
    - Mid-April with urea (40-0-0) every 2-3 weeks then later come in with triple 16
    - End in late-June
  - No more than 25 lbs/acre at one time
  - Phosphorous (P) = 60-100 lbs/acre
  - Potassium (K) = 100 lbs/acre (potash)

Organic Hop Growing Requirements: Fertility

Options
- Manure and compost
- Leguminous cover crops
- Bone meal, feathermeal, bloodmeal, kelp, etc.

Hop Growing Requirements: Irrigation

NWMHRS
- RAM Pressure compensating with emitters (.42 g/hour) every 2 ft.
- May-September
- AT LEAST 4 HOURS/DAY & UP TO 8 HOURS PER DAY

Pests and Diseases

- Hop aphid (Phorodon humuli)
- Downy mildew (Pseudoperonospora humuli)
- Spider Mites (Tetranychus urticae)
- Powdery mildew (Podosphaera macularis)
- Apple Mosaic Virus
- Hop Stunt Viroid

Spider Mites

- Spider mites damage hop plants by feeding on leaves and stems, sucking plant juices from the cell membranes of leaves and stems, plant vigor.
- Monitor weekly, beginning in mid to late May.
- Provide plants with adequate but not excessive nitrogen fertility and water.
- Reduce dust, especially in hot, dry weather.
- Treat to prevent cone infestations using foliar-applied miticides.
- Avoid the use of pyrethroid, organophosphate, carbamate, and neonicotinoid insecticides, and late-season sulfur applications.
- Can treat when average of one to two female spider mites per leaf in late June and early July, or five to 10 mites per leaf after mid-July. But hop plants can tolerate much higher infestations of spider mite populations without suffering economic loss if cones are not infested.

Other options
- Prune extra bines in early May, stripping
- If the hops in the burr stage, a lime sulfur spray may be applied to the whole plant.
- Predacious insects (Anthocorids) may be used as a control.


1/15/2011
Aphid control

Aphids (Phorodon humuli) - but other aphids as well.
- Biological control - Ladybird beetles, Lacewing, Agphid Midge (Aphidivortex Aphantomyza)
- Begin monitoring in May when daytime temperatures exceed 58°F.
- Avoid excessive application of nitrogen.
- Intervene early to prevent aphid establishment in hop cones.
- Rotate chemical classes to avoid resistance.
- Use selective pesticides that preserve natural enemies.
- Monitoring should begin when daytime minimum temperatures exceed 58°F to 60°F. A comprehensive economic threshold does not exist for hop aphid. Most growers apply a pesticide when an average five to 10 aphids per leaf are observed before flowering. Generally, aphids are not tolerated after flowering; control with pesticides is difficult once aphids infest cones.

Powdery Mildew

- Powdery mildew is caused by the fungus Pseudoperonospora humuli
- Extremely readily spread at all stages.
- Good sanitation in the hopyard is key.
- Bines with signs of the infestation should be cut and burned away from the hopyard before the hops can be harvested.
- Striping off the lower leaves of the bines also helps get rid of any early spores.
- Training and pruning the vines so that adequate sunshine and air are admitted to the entire plant will help control the outbreak of Powdery Mildew.
- Avoid heavy doses of nitrogen fertilizer or uncomposted manure - more succulent tissue is more susceptible.
- Sulfur-based fungicides control this disease, and can be applied as soon as the first spots of mold are seen on the leaves.
- Works best as a preventative though
- Be careful that liquid sulfur formulations do not include wetting agents prohibited by organic regulations.

Downy Mildew

- The single most devastating disease in Western hop yards.
- Hop Downy Mildew (Pseudoperonospora humuli) is specific to hops.
- Typically first noticed as the young bines grow out in spring
- Powdery Mildew. (D. H. Gent)
- Basal aphids. (D. G. James)
- Downy mildew on leaves. The leaf discoloration is due to sporulation by the pathogen. (D. H. Gent)
- Downy mildew on leaves. The leaf discoloration is due to sporulation by the pathogen. (D. H. Gent)

New Zealand Example

- Organic producers use dried blood and bone meal and bone fertilizers
- They also use liquid organic fertilizers
- Rock phosphate and lime (to lower acidity)
- Natural dolomite is used for Mg
- TSSM-controlled with predator mites
- Grass, oats, and clover in alleys-mow and blow into rows (oats mulched, then grass mowed every 5 days) clover feeds sheep and sheep also eat hop suckers.

Based on PNW data
- S=susceptible
- MS=moderately susc.
- MR=moderately resist.
- R= resistant
- U=unknown
Conventional High Trellis

- 3' x 8', 9', or 12'
- Labor Reduction
- Lower Establishment Cost
- Lower yields
- Ill-adapted varieties

Important to build a Solid Trellis!!

Short Trellis

- 3' x 8', 9', or 12'
- Labor Reduction
- Lower Establishment Cost
- Lower yields
- Ill-adapted varieties
Global Trends

U.S. HOP ACREAGE BY STATE (4 YEARS - IN ACRES)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>WASHINGTON</th>
<th>OREGON</th>
<th>IDAHO</th>
<th>TOTAL</th>
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<tbody>
<tr>
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<td>8,159</td>
<td>9,489</td>
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<tr>
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<td>22,310</td>
<td>5,537</td>
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<td>2006</td>
<td>21,332</td>
<td>5,436</td>
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<tr>
<td>2007</td>
<td>22,765</td>
<td>3,716</td>
<td>2,906</td>
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<tr>
<td>2008</td>
<td>19,392</td>
<td>6,376</td>
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<tr>
<td>2009</td>
<td>20,358</td>
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<tr>
<td>2010</td>
<td>24,336</td>
<td>4,622</td>
<td>2,531</td>
<td>31,489</td>
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U.S. HOP AVERAGE YIELD (TEN YEARS)

<table>
<thead>
<tr>
<th>YEAR</th>
<th>WASHINGTON</th>
<th>OREGON</th>
<th>IDAHO</th>
<th>TOTAL</th>
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<td>1,877</td>
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<td>2002</td>
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<td>1,624</td>
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<td>2004</td>
<td>1,579</td>
<td>1,696</td>
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<td>2010</td>
<td>2,467</td>
<td>1,791</td>
<td>2,529</td>
<td>6,785</td>
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Global Trends

WORLD HOP ACREAGE & PERCENT SHARE (acres)

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<th>COUNTRY</th>
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<th>2003</th>
<th>2004</th>
<th>2005</th>
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<td>43,358</td>
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<td>40,268</td>
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<td>4,000</td>
<td>3,700</td>
<td>3,500</td>
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<td>3,000</td>
<td>2,800</td>
<td>2,600</td>
<td>2,400</td>
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<td>Czech Rep.</td>
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<td>14,700</td>
<td>14,500</td>
<td>14,300</td>
<td>14,100</td>
<td>13,300</td>
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<td>18,500</td>
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<td>14,000</td>
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<tr>
<td>China</td>
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<td>13,000</td>
<td>13,000</td>
<td>11,000</td>
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<td>Total</td>
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<td>151,800</td>
<td>144,800</td>
<td>141,800</td>
<td>138,800</td>
<td>135,800</td>
<td>132,800</td>
<td>129,800</td>
<td>126,800</td>
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</table>

Source: USDA Economic Research Service November 2010 report. Prepared by USDA.

U.S. HOPS: SEASON AVERAGE PRICE & TOTAL CROP VALUE

<table>
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<tr>
<th>Marketing Year</th>
<th>Washington</th>
<th>Oregon</th>
<th>Idaho</th>
<th>U.S. Production</th>
<th>Total Crop Value</th>
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<tr>
<td></td>
<td>(cents)</td>
<td>(cents)</td>
<td>(cents)</td>
<td>(cents)</td>
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<tr>
<td>2001</td>
<td>$1.81</td>
<td>$2.43</td>
<td>$1.59</td>
<td>$1.91</td>
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<td>2002</td>
<td>$1.92</td>
<td>$2.97</td>
<td>$1.50</td>
<td>$1.83</td>
<td>$113,843</td>
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<td>2003</td>
<td>$1.79</td>
<td>$2.32</td>
<td>$1.82</td>
<td>$1.84</td>
<td>$101,637</td>
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<tr>
<td>2004</td>
<td>$1.93</td>
<td>$1.31</td>
<td>$1.60</td>
<td>$1.68</td>
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<td>$1.83</td>
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<td>2006</td>
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<td>$2.60</td>
<td>$1.84</td>
<td>$2.02</td>
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<td>2007</td>
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<td>$3.35</td>
<td>$2.77</td>
<td>$2.84</td>
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<td>$2.51</td>
<td>$2.63</td>
<td>$118,717</td>
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<tr>
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<td>$3.78</td>
<td>$3.40</td>
<td>$3.69</td>
<td>$120,467</td>
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</table>

Source: USDA/HASS Prepared by USDA

2010 National Summary

- Washington growers produced 80% of the U.S. hop crop.
- US Production 65 mill lbs. down 31% from 2009
- Acreage decreased 42% in ID, 24% in OR, and 18% in WA
- Zeus and Columbus/Tomahawk were the leading varieties in Washington, accounting for 38%
- In Oregon, Nugget and Willamette accounted for 62% of the State’s hop production.

2010 ESTIMATED COST OF PRODUCING HOPS IN THE YAKIMA VALLEY, WASHINGTON STATE

- 2009-29,588 acres in WA State (79% of US Production)
  “Washington hop acreage is expected to decline 30% in the next few years, a consequence of a worldwide oversupply. As a result, the economic climate for Washington hop producers is currently in chaos.”
  Source: USAhops.org

NOSB RULING

- On October 28, 2010, the National Organic Standards Board unanimously voted in favor of the removal of hops from section 205.606 of the National List of Approved and Prohibited Substances, effective January 1, 2013
- Organic beer will have to be made with organic hops starting in 2013
Market Potential

New Planned Breweries 2011

beervanabuzz.blogspot.com

Brewer Variety Needs

Top five varieties used by brewers

1. Cascade - 65%
2. Centennial - 50%
3. Perle/Saaz/Simcoe - 30%
4. Columbus/N. Brewer/Tettnanger - 25%
5. EK Golding/Willamette - 20%

50% noted Cascade as #1 variety

Brewer Variety Needs

Brewers wish they had more...

1. Amarillo/Simcoe - 35%
2. Summit/Saaz - 15%
3. Note: several brewers said “all varieties”

Will brewers pay a premium?

Percent Premium by Hop Category

Quality Needs

Hops are generally purchased as extracts, whole flower, or pelletized with quality defined by:

- α-acid, β-acid (as % dry weight)
- Cohumulone content (as % α-acid)
- Total Oil (as % dry weight)
- Hop Storage Index

Results:

- Pelletized: All but one!!
- α-acid: 80%, cohumulone: 14%
- Storage or packaging: 23%
Research Trials

- Investigating Hop Varieties for Michigan Production – (Project GREEEN Research Station Variety Trial)
- Plant Breeding and Agronomic Research for Organic Hop Production Systems- Organic Research and Extension Initiative Grant with WSU, MSU, UVM (On-Farm)
- Meeting the Growing Demand for Organic Hops: Low-Trellis Organic Hop Production in the Great Lakes Region - Michigan Hop Alliance on-farm trial

Conventional Hop Variety Trial

NW and SW Station Hop Variety Trial

<table>
<thead>
<tr>
<th>Variety</th>
<th>Quantity/Price</th>
<th>Cost</th>
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</thead>
<tbody>
<tr>
<td>Brewers Gold</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Cascade</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Centennial</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Crystal</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>EK Golding</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Glacier</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Perle</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Santiam</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Teamaker</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Tettnanger</td>
<td>300'</td>
<td>$3,200</td>
</tr>
<tr>
<td>Willamette</td>
<td>300'</td>
<td>$3,200</td>
</tr>
</tbody>
</table>

USDA OREI Trial

- 8 Cover Crop Treatments
- 20 hop varieties

2010 NCR SARE Farmer/Rancher Grant

Objectives
1. Determine the growth habits, yields, quality, and market potential of the hop cultivar “Summit” on a low-trellis system under Great Lakes growing conditions.
2. Assess the effects of understory nitrogen fixing cover crops on soil quality, soil nitrogen levels, hop leaf nitrogen, and weed control.
3. Conduct a cost/benefit analysis of low-trellis vs. hi-trellis organic hop production systems.
TAKE HOME MESSAGES

- Wall (picker): $50,000-$100,000
- Harvester/Loader: $8000-$15,000
- Vacuum Sealer: $2000-
- Dryer: $12,000
- Energy (vac hop technique): $1.50 lb
- Cold Storage: $77777
- Annual labor for 1 acre: Combine (2 months at $600/day)

- Quality is crucial
- Hi initial and annual costs with questionable returns
- Don’t underestimate the amount of labor required
- Need for picking and processing equipment if you plant >1/2 acre
- Will most likely need a price premium to do organic

Resources

Production
- Hop Production, Breeding, C. E. Hanson, and S. M. Combs. 1993. Available at: [www.hopunion.com](http://www.hopunion.com)

Pests and Diseases
- Oregon State University Plant Disease Control. Hops. [http://plantdisease.ippc.orst.edu/plant_searchResults.cfm?search_str=hop&host_alpha=Select&host_text=hop&index=2](http://plantdisease.ippc.orst.edu/plant_searchResults.cfm?search_str=hop&host_alpha=Select&host_text=hop&index=2)
- Heritage Hops. [http://www.americanhopmuseum.org/home.htm](http://www.americanhopmuseum.org/home.htm)

Special Thanks
- Michigan Hop Research Council. [http://www.michiganhopresearchcouncil.org](http://www.michiganhopresearchcouncil.org)
- Summit Plant Laboratories, Inc. [http://www.summitplant.com](http://www.summitplant.com)
- Daniel Kuepper. [http://www.michiganbeer.com](http://www.michiganbeer.com)
- Thyme Garden. [http://www.thymegarden.com](http://www.thymegarden.com)

Resources

- Web sites:
  - http://www.michiganhopalliance.com
  - [http://www.hopresearchcouncil.org/index.html](http://www.hopresearchcouncil.org/index.html)
  - http://www.hopunion.com
  - [http://www.americanhopmuseum.org/home.htm](http://www.americanhopmuseum.org/home.htm)
  - [http://www.hopresearchcouncil.org/index.html](http://www.hopresearchcouncil.org/index.html)
  - [http://www.michiganbeer.com](http://www.michiganbeer.com)

- Other Resources (organizations, forms, local processing):
  - Empire Hops: [http://www.empirehops.com](http://www.empirehops.com)
  - Michigan Hop Union: [http://www.hopunion.com](http://www.hopunion.com)
  - Michigan Hop Research Council: [http://www.michiganhopresearchcouncil.org](http://www.michiganhopresearchcouncil.org)
  - Michigan Hop Alliance: [http://www.michiganhopalliance.com](http://www.michiganhopalliance.com)
  - Thyme Garden: [http://www.thymegarden.com](http://www.thymegarden.com)

- Special Thanks
- Thyme Garden. [http://www.thymegarden.com](http://www.thymegarden.com)

- Resources

- Special Thanks
Beer is living proof that God Loves Us and wants us to be Happy

~Benjamin Franklin