

Small-Scale Organic Hops Production

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E-Organic Webinar
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MICHIGAN STATE UNIVERSITY | Extension



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.

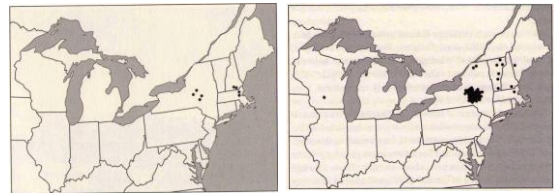
- Dutch probably 1st to bring hops to the New World in early 1600's
- Native hops could be found in woods, but Dutch law required hops to be imported
- New England colonists 1st to establish cultivated hops crops as early as 1628
- Massachusetts promoted "healthy" malted beverages
- Used imported, locally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

HOPS ARE KING!

Wherever raised in the North-West.

JUST PUBLISHED—A Treatise giving Plain Directions and the Practical Details, from the selection and Preparation of the Soil and Setting and Cultivation of the Plants, to Picking, Drying, Pressing and Marketing the Crop, as practiced in Sauk County, Wisconsin. Every Hop Grower and Farmer in the North-West should have one of these Pamphlets. By D. B. & E. O. RUDD, Practical Hop Growers of eight years' experience in said County.

Enclose Fifty Cents to GEORGE B. BURROWS, No. 100 State Street, Chicago, and he will send by return mail (post paid) a copy of this valuable work. Ten copies to one address, \$4.00; twenty copies to one address, \$7.50.

A HOP YARD

— IS —

More Profitable than a Gold Mine.

The Hop Growers of Wisconsin have averaged for the past two years from \$700.00 to \$800.00 profit per acre.

Sauk County (Wis.) English Cluster Hop Roots for sale by

Geo. B. Burrows,

THE CULTIVATION OF HOPS,

AND THE PREPARATION FOR MARKET.

BY D. B. & E. O. RUDD.

CHICAGO, ILL., 1899.



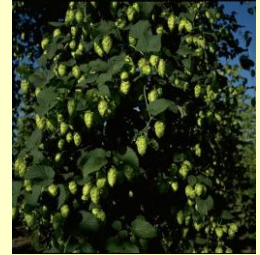
Natural History and Taxonomy

- *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.



Hop Propagation from rhizomes

Rhizomes: horizontal underground stem that emerges from plant roots



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

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SOIL AND PLANT NUTRIENT LABORATORY
EAST LANSING, MICHIGAN 48824-1325
(517) 355-0218

SOIL TEST REPORT FOR:					CONSULTANT:							
J.P.B. SIKSING SUITE 107 8527 E. GOVERNMENT CENTER DR. SUTTONS BAY MI 49882					LILLIAN/ALYCE MUEBE 8527 E. GOVERNMENT CENTER DR., #107 SUTTONS BAY MI 49882 231-256-0888							
DATE	LAB #	COUNTY	Previous Crop	ACRES	FIELD ID	SOIL						
7/29/2009	10894	Leelanau	Cherry	1/2	Hops	Mineral						
SOIL NUTRIENT LEVELS												
Soil pH 6.8		Lime Index				Below Optimum		Optimum		Above Optimum		
Phosphorus (P)		100		ppm								
Potassium (K)		102		ppm								
Magnesium (Mg)		114		ppm								
ADDITIONAL RESULTS:						Optimal Tests:						
Calcium (Ca)	CEC	% of Exchangeable Bases		Micronutrients (ppm)		B	Cu	Mn	Zn	Fe	Organic Matter %	Nitrate-N ppm
668	4.6	K	Mg	Ca								
		5.7	20.9	71.4								
RECOMMENDATIONS:												
Limestone: NONE						Tillage Depth: 6 inches						
Target pH = 6.5						% Stand: 25						
Plant Nutrients:						Micronutrient (Optional)						
Year	Crop	Expected Yield	Nitrogen (lb N/A)	Phosphate (lb P ₂ O ₅ /A)	Potassium (lb K ₂ O/A)	Boron (lb B/A)	Manganese (lb Mn/A)	Zinc (lb Zn/A)	Copper (lb Cu/A)			
1	Barley	70lbs	45	0	20	0.01						

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 cones, sucking plant juices from the cells—bronzing of leaves and reduces 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 Neonotinoid insecticides, and late-season sulfur applications.
- Can treat when average of one to two female spider mites per leaf in June and early July, or five to 10 mites per leaf after mid-July. But hop plants can tolerate much higher twospotted spider mite populations without suffering economic loss if cones are not infested.
- Spider mite populations can build rapidly, especially in hot, dry conditions, therefore monitoring is important.

Other options

- Prune extra bines in early May, stripping
- If the hops are in the burr stage, a lime sulphur spray may be applied to the whole plant.
- Predaceous insects-Arthropod Bugs/Predatory mites

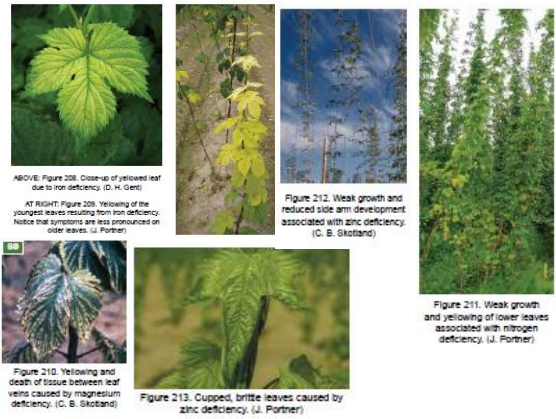
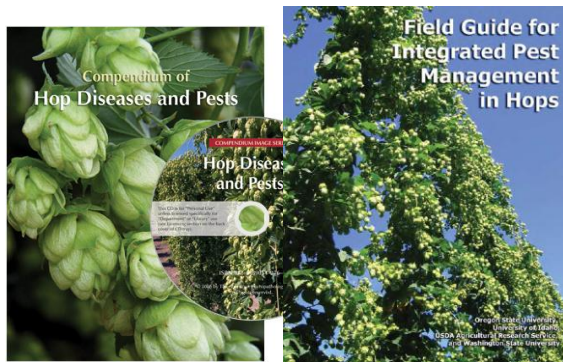
Source: <http://pm.wsu.edu/field/pdf/HopHandbook2010.pdf>



Twospotted spider mites. (D. G. James)



Spider mite webbing is associated with severe infestations. (D. G. James)



Conventional High Trellis



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

WORLD HOP ACREAGE & PERCENT SHARE (acres)

COUNTRY	2001	2002	2003	2004	2005	2006	2007	2008	2009	2010
Germany	46,965 33%	45,318 33%	40,879 32%	43,168 36%	42,404 34%	41,247 34%	41,376 33%	43,269 33%	43,802 33%	44,749 30%
UK-England	5,035 3%	4,681 3%	3,538 3%	3,354 2.7%	2,932 2%	2,609 2%	2,619 2%	2,718 2%	2,669 2%	2,669 2%
Czech Rep.	15,864 11%	14,735 11%	14,417 11%	14,420 12%	14,010 11%	13,109 12%	12,832 11%	12,664 10%	12,479 9%	12,398 10%
Europe (rest)	24,679 17%	23,616 17%	22,217 18%	20,666 17.20%	20,236 16%	19,253 17%	17,313 14%	17,236 13%	16,222 12%	16,186 13%
USA	35,891 25%	29,309 22%	28,609 23%	28,020 23.30%	29,188 24%	29,435 26%	30,911 25%	30,263 29%	40,126 30%	31,247 25%
China	11,884 8%	13,930 10%	13,931 11%	11,697 9.70%	11,846 10%	4,910 4%	13,912 11%	14,322 11%	14,322 11%	14,322 11%
World (rest)	4,139 3%	4,364 3%	3,211 3%	3,607 3%	3,354 3%	2,853 3%	3,047 2%	3,633 3%	3,991 3%	3,941 3%
World Totals	144,457	135,944	126,862	119,943	123,609	113,417	122,010	133,105	133,711	125,512

SOURCE: IHGC Economic Commission November 2010 report. Prepared by HGA.

U.S. HOP ACREAGE BY STATE (10 YEARS - IN ACRES)

YEAR	WASHINGTON	OREGON	IDAHO	TOTAL
2001	26,339	6,103	3,469	35,911
2002	20,333	5,577	3,399	29,309
2003	19,492	5,748	3,429	28,669
2004	19,382	5,107	3,253	27,742
2005	21,013	5,163	3,287	29,463
2006	21,532	5,036	2,797	29,365
2007	22,745	5,270	2,896	30,911
2008	30,595	6,370	3,933	40,898
2009	29,588	6,108	4,030	39,726
2010	24,336	4,622	2,331	31,289

U.S. AVERAGE HOP YIELD (TEN YEARS)

YEAR	WASHINGTON	OREGON	IDAHO	TOTAL U.S.
2001	1,928	1,875	1,329	1,861
2002	2,133	1,692	1,624	1,990
2003	2,050	1,826	1,536	1,903
2004	2,137	1,686	1,558	1,990
2005	1,878	1,540	1,640	1,796
2006	2,058	1,757	1,613	1,964
2007	2,049	1,811	1,417	1,949
2008	2,072	1,569	1,841	1,971
2009	2,533	1,948	1,943	2,383
2010	2,147	1,791	2,129	2,093

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

Marketing Year	SEASON AVERAGE PRICE				U.S. Production (Lbs. x 1,000)	Total Crop Value (x 1,000)
	Washington	Oregon	Idaho	U.S.		
	----- (\$ / pound) -----					
2001	\$1.81	\$2.15	\$1.59	\$1.91	66,832	\$123,843
2002	\$1.92	\$2.07	\$1.58	\$1.91	58,336	\$111,546
2003	\$1.79	\$2.32	\$1.62	\$1.86	54,565	\$101,637
2004	\$1.83	\$2.31	\$1.60	\$1.88	55,203	\$103,969
2005	\$1.86	\$2.56	\$1.63	\$1.94	52,914	\$102,818
2006	\$1.98	\$2.60	\$1.61	\$2.05	57,672	\$118,008
2007	\$2.94	\$3.31	\$2.77	\$2.99	60,253	\$179,978
2008	\$4.08	\$3.75	\$4.00	\$4.03	80,630	\$325,092
2009	\$3.54	\$3.63	\$3.75	\$3.57	94,678	\$336,375
2010	\$3.08	\$3.78	\$3.30	\$3.19	65,493	\$208,603

SOURCE: USDA-NASS. Prepared by HGA.



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



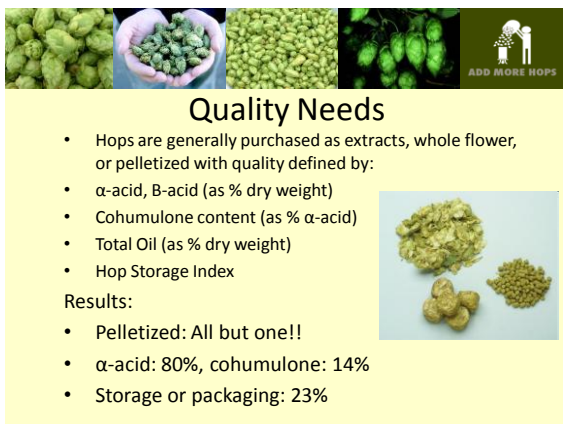
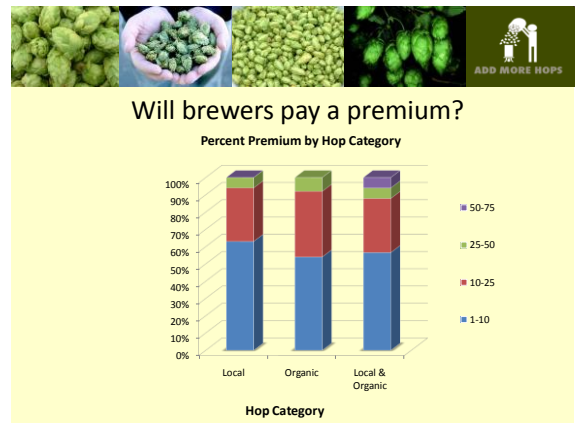
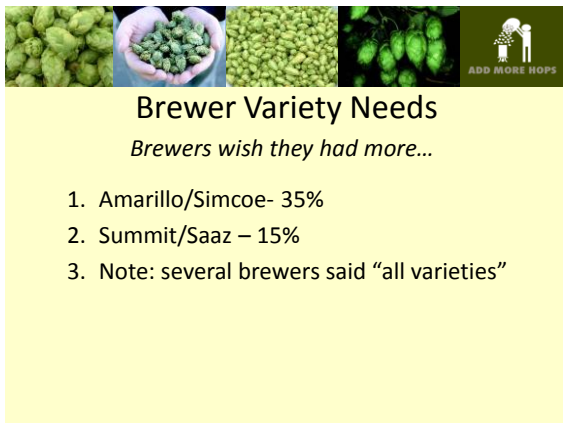
2010 National Summary

- 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.



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





Research Trials

- Investigating Hop Varieties for Michigan Production – (*Project GREEN 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

- Brewers Gold
- Cascade
- Centennial
- Crystal
- EK Golding
- Glacier
- Perle
- Santiam
- Teamaker
- Tettnanger
- Willamette

Item	Quantity/Price	Cost
Rhinomes	800 @ \$4 each	\$3,200
Poles (21 ft)	100 @ \$32 each	\$3,200
Crushed stone	4 yards	\$550
Env. earth anchors	Manta Ray and Duckbill Anchors	\$2,200
Drip irrigation	Materials	\$800
3/16-inch wire	16,000 ft @ \$8.09/ft	\$1,440
5/16-inch wire	2,000 ft @ \$8.21/ft	\$420
Hop twine	Coconut fiber	\$125
Compost	100 yards @ \$10/yard delivered	\$1,000
Misc. supplies	Wire clamps, staples, etc.	\$250
Labor	Hole auger, pole setting, wire	\$3,400
Equipment rental	Installing wire	\$800
Total		\$17,385*

*Note: This figure may be reduced with less expensive products or if a grower chooses to install the hop yard with his/her own equipment and labor.



USDA OREI Trial

- 8 Cover Crop Treatments
- 20 hop varieties



2010 NCR SARE Farmer/Rancher Grant

Objectives

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





TAKE HOME MESSAGES

- Wolf (picker) \$55,000-\$100,000
- Hammermill & Pelletizer \$8000-15,000
- Vacuum Sealer \$2000-2500
- Dryer \$12,000 +
- Energy (wet hop to pellet) \$1.50 / lb
- Cold Storage \$?????
- Annual labor for 14 acres \$6000/day
- Crew of six (2 months working 10 hour + days)
- 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

Soon to be live!

www.hops.msu.edu



Resources

Production

- Sustainable Hop Production in the Great Lakes Region. Michigan State University Extension Bulletin E-3083. January 2010. <http://www.bookstore.msu.edu/>
- A Hops Nutrient Management Guide. Oregon State University. FG 79. <http://extension.oregonstate.edu/catalog/pdf/fy/fy79>
- Cost of Establishing and Producing Hops Under Drip Irrigation in the Yakima Valley. Washington State University Extension. EB1134. <http://farm.mgo.com/edu/PDF/docs/cr/cr1134.pdf>
- Crop Profile for Hops in Oregon. <http://www.ipmcenters.org/CropProfiles/docs/hops.html>
- Growing hops in the backyard. FS 992. Rutgers Cooperative Extension. Bunka, W., and E. Dager. 2002.
- *Homebrew Hops*. 2nd edition. Revell Farm, Junction City, OR. Beach, D. 2000.
- Hop. Alternative Field Crops Manual. Cortez, P.R., E.A. Oelle, A.R. Kaminiski, C.V. Hanson, S.M. Combs, J.D. Doll, G.L. Worl, and E.S. Oplinger. 1990. Available at: www.hort.purdue.edu/newcrop/afcm/hop.html
- Hop Production. Brooks, S.N., C.E. Homer, and S.E. Likens. 1961. USDA-ARS info Bulletin No. 240. Washington, D.C.
- *Hops*. Neve, R.A. 1991.
- Hops: Botany, Cultivation and Utilization. Burgess, A.H. 1964. World Crop Books. New York: Interscience Publication.
- Hops: Organic Production. George Kuemper. <http://attra.ncat.org/attra-pub/pdf/hop.pdf>
- Oregon Crop profile. www.ipmcenters.org/CropProfiles/docs/hops.pdf
- Small scale and organic hops production. Kneen, Left Fields, British Columbia. Kneen, Rebecca. 2003. <http://www.cranapple.com/hopsManual.pdf>
- The Hop Atlas: The History and Geography of the Cultivated Plant. Barth, J., C. Klinkle, and C. Schmidt. 1994.
- *Tinged with Gold: Hop Culture in the United States*. Tomlan, M. 2002.
- USDA Named Hop Variety Descriptions. <http://www.freshops.com/hops/usda-named-hop-variety-descriptions>
- Washington Crop profile. www.tricity.wsu.edu/~cdaniels/profiles/Hops3PM.pdf



Resources

Pests and Diseases

- Compendium of Hop Diseases and Pests. Edited by Walter Mahaffee, Sarah Pethybridge and David Gent. APS Press. 2009. ISBN 978-0-89054-376-4 Available from shopgpress.org
- Field Guide for Integrated Pest Management in Hops. David Gent, James Barbour, Amy Dreves, David James, Robert Parker, Douglas Walsh. A Cooperative Publication Produced by Oregon State University, University of Idaho, USDA and Washington State University. <http://www.usahops.org/userfiles/file/Research%20Reports%20&%20Presentations/HopHandbook2009.pdf>
- Oregon State University Plant Disease Control Hops. http://plantdisease.psu.edu/plant_searchResults.cfm?search_string=hops_alpha=Select&root_text=hops

Plant suppliers

- Great Lakes Hops (Dutch Touch Growers, Inc. 616-875-7416)
- Sandy Ridge Farms, Uon Vandenhuevel. 616-218-2363. jon@annualambience.com
- Summit Plant Laboratories, Inc. (All Hamm; 800-654-1017; all@plantlabs.com; www.plantlabs.com)

Brewing Sales

- Adventures in Home Brewing. www.homebrewing.org/
- Ebrew. www.Ebrew.com
- Fresh Hops. www.freshops.com/
- HopTech. www.hoptech.com/
- Hop Union. www.hopunion.com/
- Michigan Hop Alliance. <http://michiganhopalliance.com/>
- Midwest Supplies. www.midwestsupplies.com
- Thyme Garden. www.thymegarden.com



Resources

Other Resources (organizations, farms, local processing)

- American Organic Hop Grower Association. <http://www.usorganicchops.com/AOHGA/index/index.html>
- American Hop Museum (Some information on varieties). <http://www.americanhopmuseum.org/home.htm>
- Empire Orchards-Hops and Apple Farm. <http://www.facebook.com/pages/Empire-Orchards-Hops-Apple-Farm/16133257525735>
- Gort Valley Hops. <http://www.gortvalleyhops.com/>
- Hop Growers of America, a non-profit. <http://www.usahops.org/>
- Hop Research Council. <http://www.hopresearchcouncil.org/index.html>
- Hop Union. <http://www.hopunion.com/>
- Michigan Beer Guide. <http://www.michiganbeerwebguide.com/>
- Michigan Brewers Guild. <http://www.michiganbrewersguild.org/>
- Michigan Hop Alliance. <http://michiganhopalliance.com/>
- Michigan State University Extension. www.hops.msu.edu Dr. Robert Sirrine. Statewide hops specialist. sirrine@msu.edu
- Old Mission Hop Exchange. <http://oldmissionhops.com/>
- University of Vermont Hops Project. <http://www.uvm.edu/extension/cropsall/hops>



Special Thanks



AOHGA



