

Olericulture – Hort 320

Lesson 16, Hops and Mint

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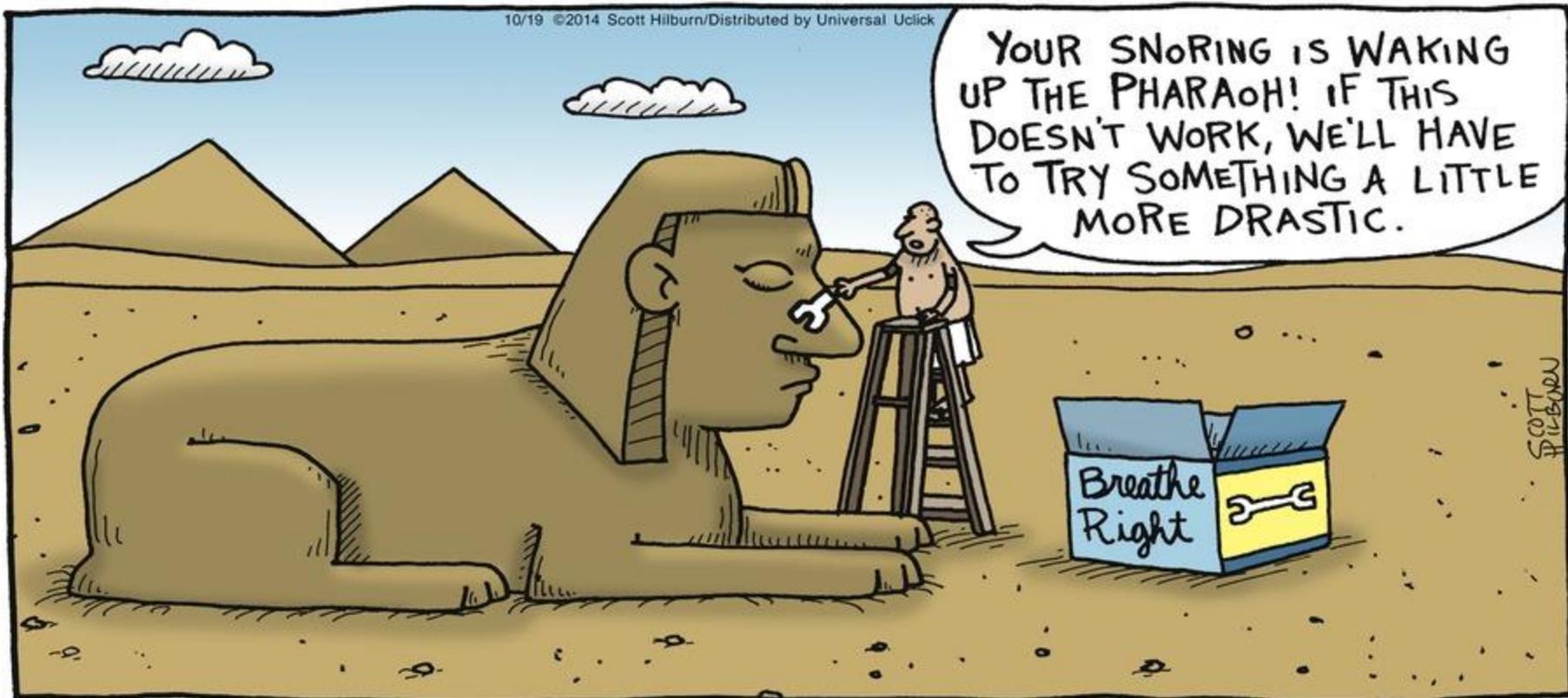


1. PEPPERMINT *Mentha piperita*
2. WATER MINT *M. aquatica*
3. MAGNOLIA MINT *M. sylvestris*
4. COMMON MINT *M. arvensis*
5. SPANISH MINT *M. spicata*
6. PEPPY MINT *M. pulegioides*

THE ARGYLE SWEATER

BY SCOTT HILBURN

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Hops

Taxonomy

Dicotyledon

Family: Cannabaceae

Genus & species: *Humulus lupulus* L.

Related species: Hemp, marijuana



COMMON HOP
Humulus lupulus L.
NETTLE FAMILY

Hops

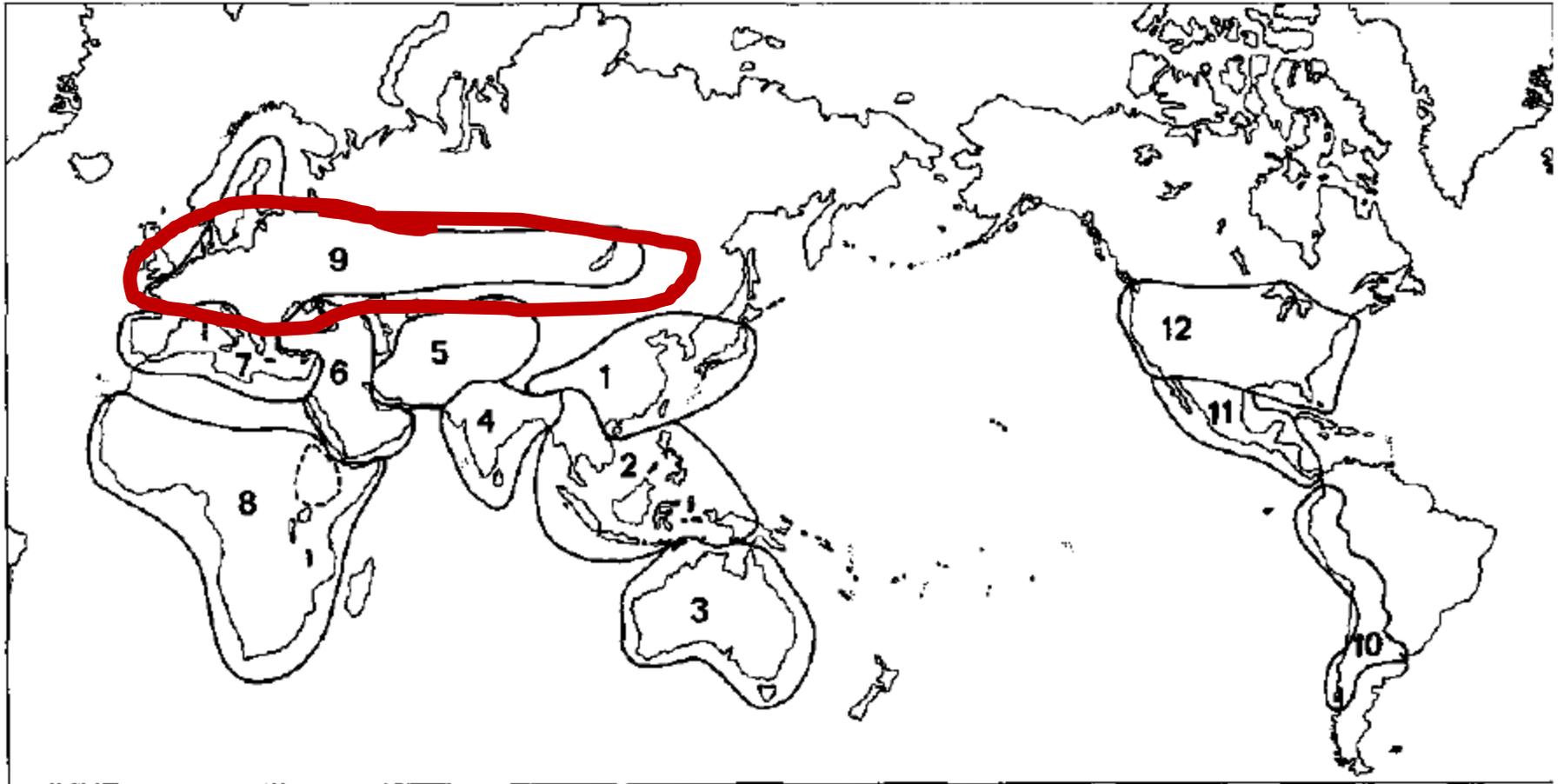
Origin & History

Center of origin has been reported as the Mediterranean or China centers

Purdue claims hops are from the “Eurosiberian Center of Diversity”



Hops



Megacentres of cultivated plants of Zhukovsky (1968)

Hops

Origin & History

Earliest recorded mention of hops in Pliny the Elder's Naturalis Historia (~77-79 AD)

Earliest mention of cultivation in 736 AD in Hallertau region of Germany

Earliest recorded use of hops in beer in 822 in Picardy region of France

Germany did not begin using hops in beer until mid-12th century

Hops

Botany



Thought to be 3, maybe 4, species of hops

H. lupulus L. (Common hop)

H. yunnanensis Hu. (Yunnan hop)

H. scandens (Lour.) Merr. (Japanese hop)

H. americanus Nutt. (American hop)

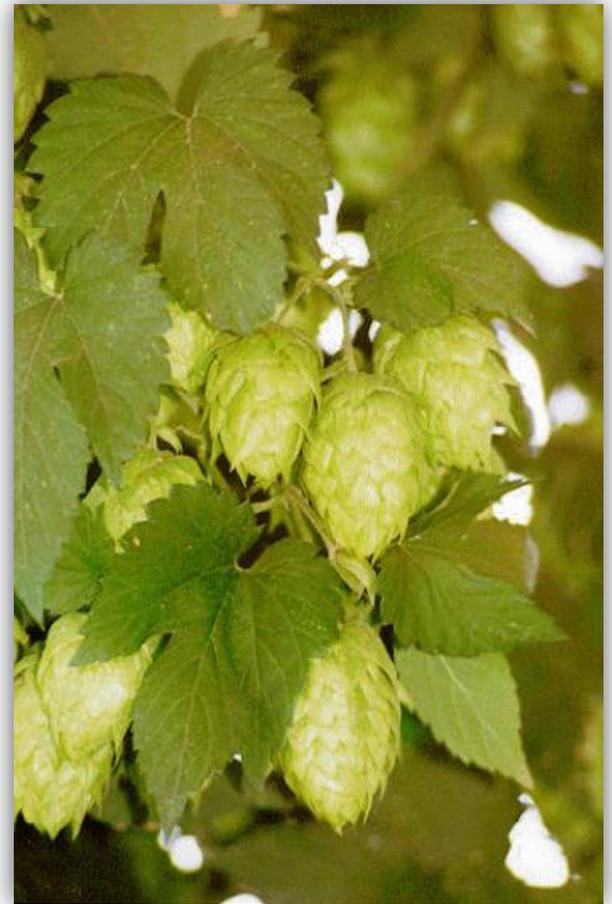
Within common hop, probably 5 varieties:

lupulus, *cordifolius*, *lupuloides* (*H. americanus*),
neomexicanus, *pubescens*

Hops

Botany

Dioecious



Hops

Botany

Perennial, climbing vine

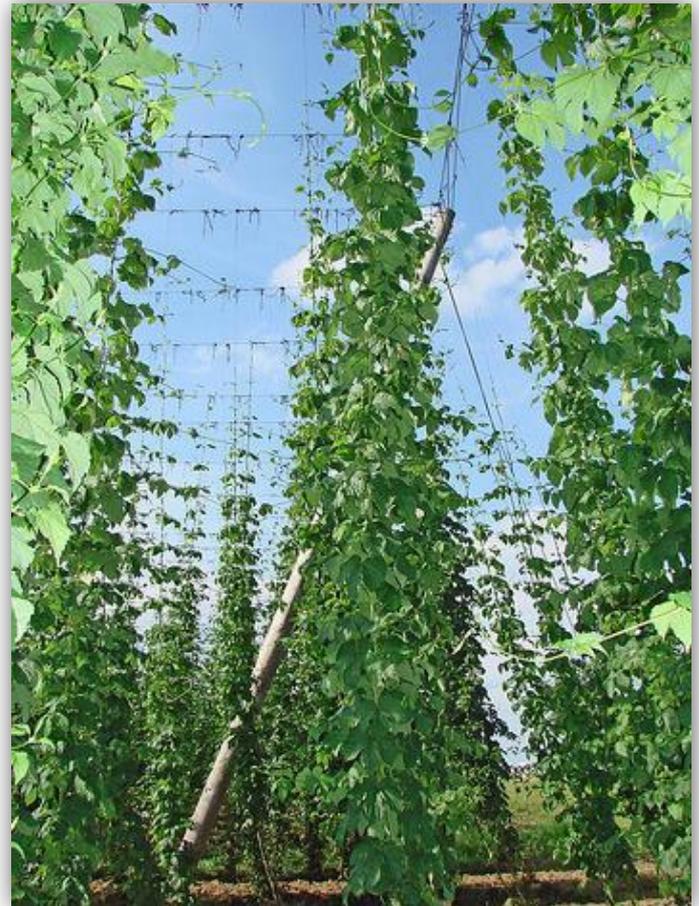
Annual above ground

Perennial below ground

Allows for clonal propagation

Support system required for
cultivation

Photoperiod sensitive

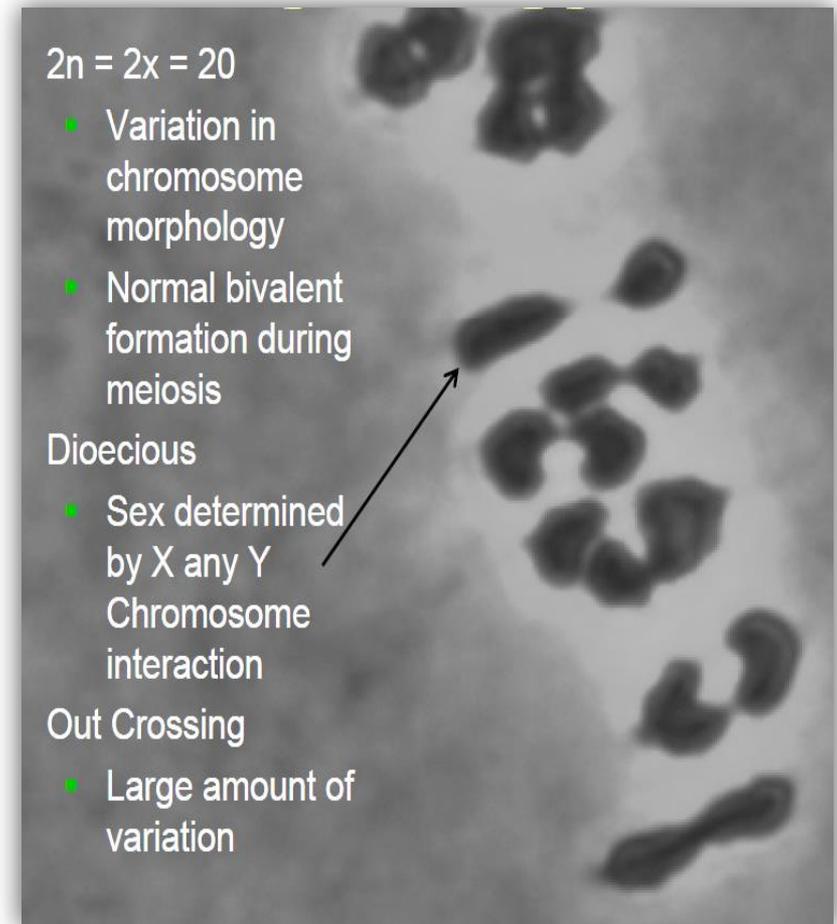


Hops

Genetics

Generally diploid

Triploid cultivars are seedless
Higher value



Hops

Annual vs. Perennial

Above-ground portion of stem is annual, dies off at dormancy

Root is perennial, survives low winter temps, requires a dormant period

Plant produces rhizomes

Buds become new stems

Easily propagated from cuttings



Hops

Propagation

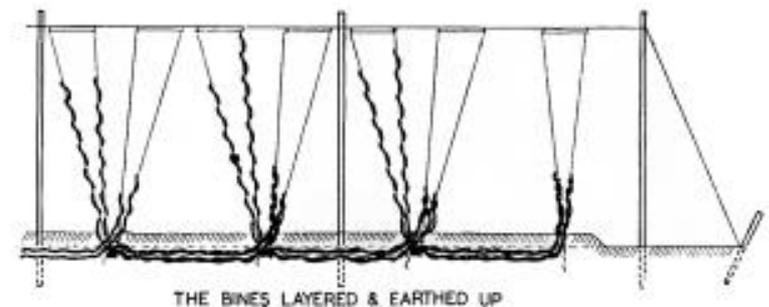
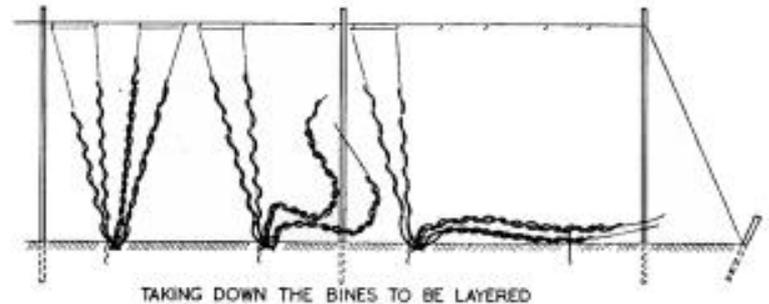
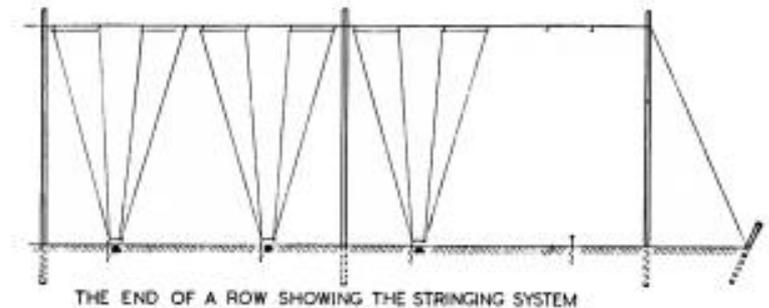
Propagation for commercial production is entirely vegetative

Root cuttings

Layering

Softwood cuttings

Resulting plants are genetically identical to parent material



Hops

Trellising

Wild hops climb on companion species

In cultivation a trellis system is used

Trellis 15' to 25' high

Plant spacing at 3.5'x14' –or– 7'x7'

889 plants per acre

Alternative systems exist for low trellising

Vines wrap around the string clockwise

Due to phototropism and thigmotropism



Hops

Dioecious nature

Separate male and female plants

Only necessary when grown from seed

Commercial value derived entirely from female plant

Strobiles or “cones”

Male plants used for breeding/
hybridization only



Hops

Cones

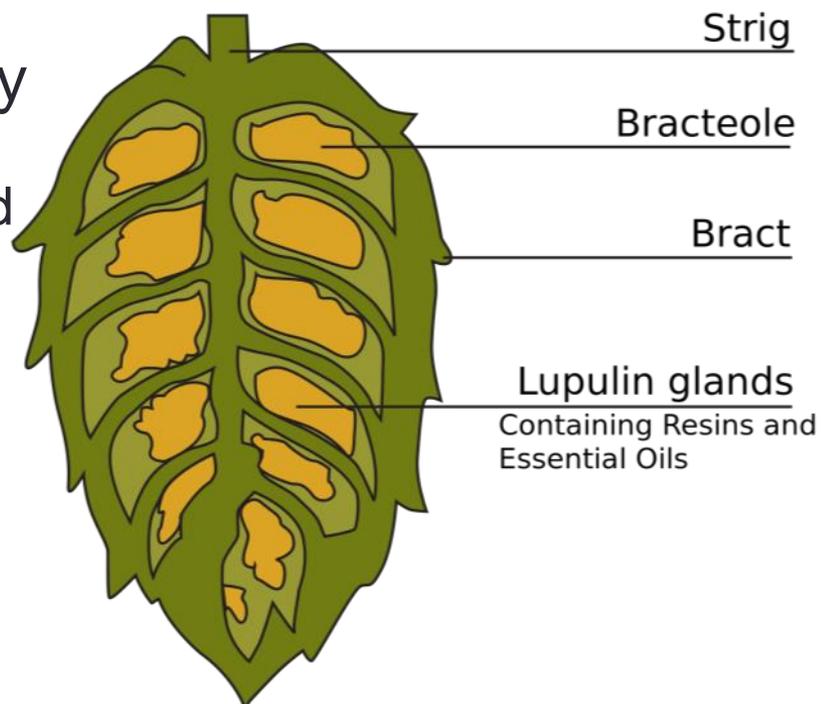
Strobiles, or cones, produce commercially important chemistry

Cones contain lupulin glands (modified vine hairs)

Lupulin glands produce over 100 compounds that contribute to aroma

Soft resins: alpha and beta acids

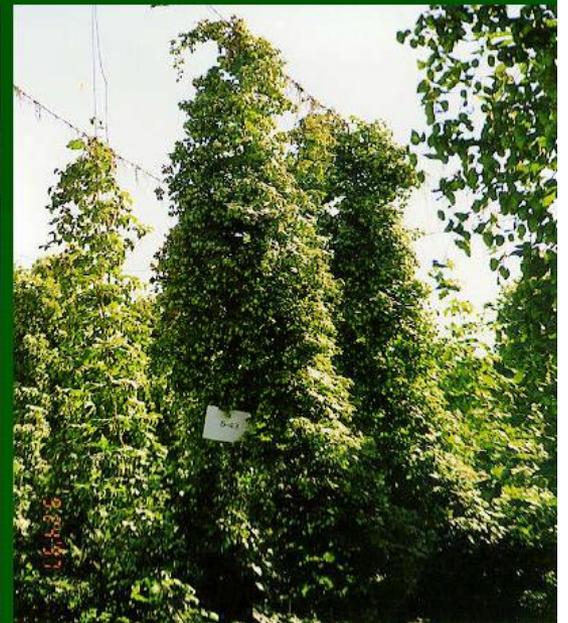
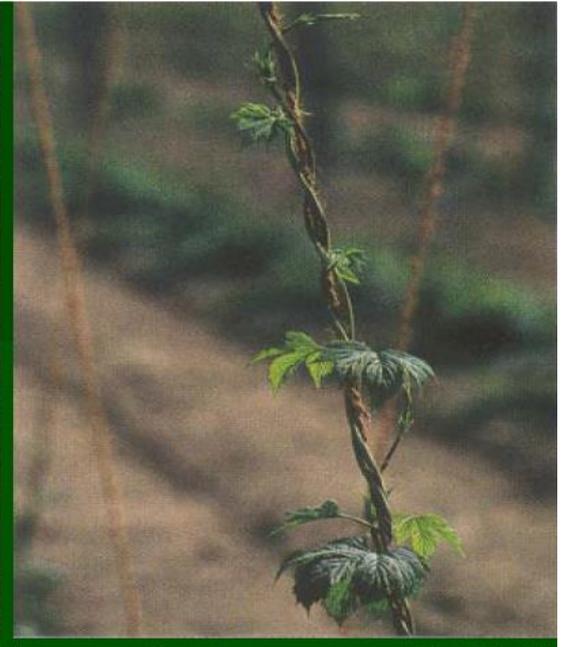
Lupulin accounts for 20-30% of cone weight



Hops

Lupulin glands





Hops

Physiological/production stages

Main stages of growth

Dormancy

Spring regrowth

Vegetative growth

Reproductive growth

Preparation for dormancy



Hops

Dormancy

October through February

Late summer the plant allocates starches to storage roots

Starch is converted to soluble sugars

Sugars necessary for Spring regrowth



Hops

Dormancy

October through February

Compost applications

Tillage

Prepping new vineyards



Hops

Spring regrowth

March through May

Plant utilizes soluble sugars to emerge from dormancy

Initial regrowth is rapid producing vines unsuitable for crop production

Plant relies almost entirely on energy reserves through May, when starch and sugar levels hit bottom

Hops

Spring regrowth

March through May

Pruning to maximize consistency for training

Weed control

Dry fertilizer

Twining

Training

Timing is cultivar specific and critical

Target 3 vines per string

Irrigation begins



Hops

Photoperiod sensitivity

Under a critical number of light hours (more accurately it is the length of the dark period)-floral initiation.

Also node dependent.

Over the critical amount, vegetative growth.

In shorter day areas, flowering occurs as soon as the node requirement is met-yield not maximized.

In longer day areas-vegetative growth is maximized prior to shortening days of mid to late summer.

Hops

Vegetative growth

May through July

Two phases:

May - June/July:

Primary growth in main vine
and leaves

July:

Lateral production



Hops

Vegetative growth

At 3', apical bud contains initial cells for lateral branches

At 12', apical buds of vine and laterals have cells for flowering branches

At 16', cone braches have been fully determined in laterals



Hops

Vegetative growth

Critical phase for crop success

Plants' reserves are spent

Ultimate yield determined during vegetative growth

Aggressive management of plant health

Maximize health while keeping the plant growing



Hops

Vegetative growth

Controlled growth, internode length is key

Internode length too long = brushy top crop

Internode length too short = maximized lateral number and even distribution

Control growth by:

- Pruning

- Nutrient management

- Crossing fingers – you cannot control the weather

Hops

Vegetative growth

Monitor, monitor, monitor

Pest/disease/weed control

Irrigation

Fertility



Hops

Physiological/production stages

Main stages of growth

Dormancy

Spring regrowth

Vegetative growth

Reproductive growth

Preparation for dormancy



Hops

Reproductive growth

End of July, floral production begins

Plants redirect energy to cones

Photosynthetic capacity maximized

At maturity, cones weight \approx 50% of above ground dry matter

Cannot increase cone #, manage for cone weight and resin/oil



Hops

Preparation for dormancy

August through September

Photosynthate production exceeds plant needs

Excess transported to roots

Root dry weight and starch content peak by October

Short days and cooler temperatures trigger transition and dormancy



Hops

Harvest

Vines cut and transported to picker

Or, use field strippers

Cones separated from vines

Cones dried 8-12 h to 10% moisture

Dry cones cooled for 12-24 h

Baled and transported to cold storage



Hops

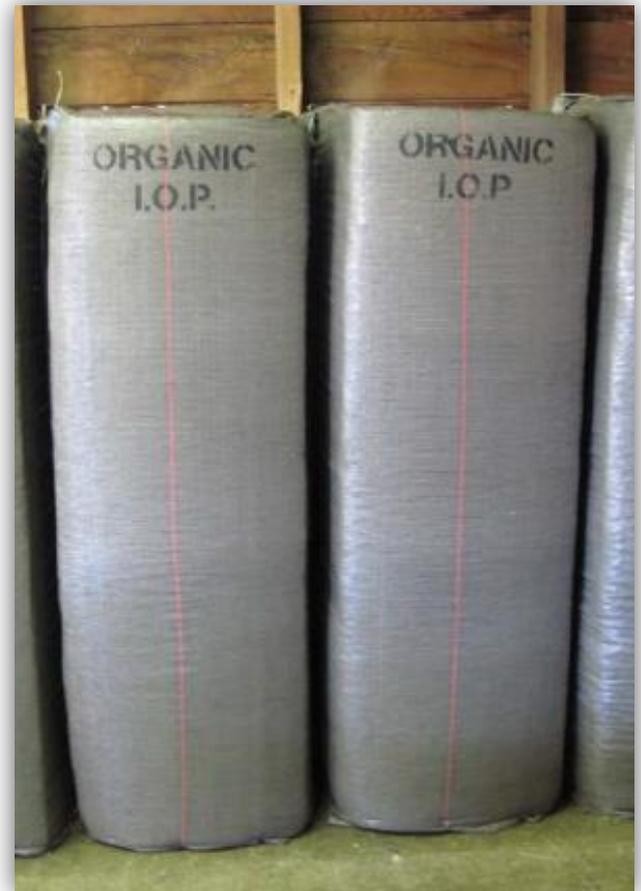
Harvest

Mechanization improves economic outcomes

Cones mechanically sorted from leaves and vine

Cones dried w/ forced air (50 cfm/ft²) at 130-150 °F

Compressed into 200 lb bales @ 10-12 lb/ft², requiring 5.5 yds burlap



Hops

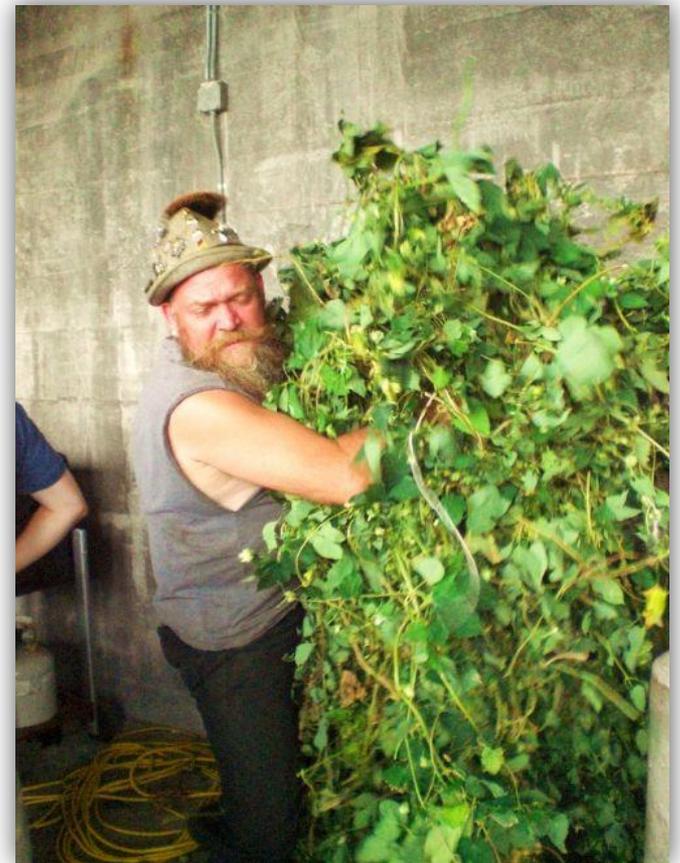
Production summary

Understand stages of development to properly manage crop

Each stage of growth is unique

Yield determined as early as April or May

Many factors are cultivar specific



Hops

Varietal issues

Realize MAXIMUM genetic potential

Maximum genetic potential cannot be achieved in all environments

So, select or breed varieties for the environment



Hops

How important is this?

- Hop Supply Chain: Each link on the supply chain affects subsequent links.
 - The efficiency of a hop has a corresponding impact on the chain.

Breeding Program

New Varieties



Farm

Cost/Acre

Yield

Harvest Alpha

Return to grower



Processing

Storage

Pellet Recoveries

Extract Recoveries

Shipping



Breweries

Efficiency

Quality

Flavor

Cost

Hops

Aroma vs. Alpha

Hops sold into two distinct markets:

Alpha/Bitters:

- Processed hops

- Yield measured in weight of Alpha acids per acre

- Typically high alpha varieties

Aroma:

- Minimal processing

- Yield measured in pounds per acre

- Typically aroma varieties

| Variety | Acid range (Alpha %) | Flavor perception |
|-----------------|----------------------|---|
| Amarillo® | 8-10% | A flowery, citrus-like aroma with medium bittering value that is gaining acceptance as a substitute for Cascade due to its hardy nature. |
| Cascade | 4-7% | Flowers, citrus & spice with grapefruit the noticeable fragrance quite often. This medium aroma balances the low bittering value. Very popular hop among craft brewers. |
| Centennial | 8-11% | Flowers & citrus most evident. A medium aroma with mid to high bittering value makes it a dual purpose choice. |
| Chinook | 11-13% | A pine forest washed with exotic spice and infused with grapefruit. This alluring aroma and a high bittering value has gained this hop full respect from craft & major brewers. |
| Columbus | 14-17% | High on the bittering scale yet also valued for its oil content creates a hop that is an interesting dichotomy of sharp and herbal. |
| Crystal | 3-5% | Genteel, continental lady meets American belle with a delicate blend of spices and flowers. Low bittering value adds to the charm. Craft brewers love her style. |
| Fuggle | 4.0-5.5% | Classic English aroma hop with moderate bittering value. Pleasant wood and fruit tones will have you heading off to the hunt. Tally-ho, old boy! |
| Hallertau | 5-6% | Named for its origins in the Hallertauer region of Germany, this is a noble aroma hop with ever-so-subtle flower and spice fragrances defining its “über alles” superiority. Very low bittering value. |
| Kent Golding | 3-5% | The refined older English gentleman with his flowery tones that have produced some of England’s best bitters. |
| Liberty | 2-6% | American cousin to Hallertau with very similar flower and spice characteristics. Best used as a finishing hop in German-style lagers. |
| Magnum | 12-17% | A German thoroughbred with limited Pacific Northwest plantings. Prized for its high bittering value, the aromatic nature is one of spice and citrus. |
| Mosaic® | 11-13% | New in 2012! Simcoe's daughter with earthy, grassy, herbal, citrus, cedar, tropical, spice and stone fruit notes adding to the pine-based pungency! A complex modern gal! |
| Mt. Hood | 4-5% | Hybrid of Hallertau with similar mild flower/spice aroma characteristics with a hint more of the forest. “Clean” commonly describes it. |
| Northern Brewer | 7-11% | A plucky American filly found herself an affable English suitor and the happy union was this well-adapted hop with its neutral, clean aroma and slightly higher-than-average bittering value. Dual purpose. |
| Nugget | 11-16% | Strong herbal/slight spice aroma and high bittering value (along with desirable growing traits) has brought this hop variety to the forefront of the industry. |
| Perle | 7-8% | A palate-pleaser with its moderate, clean bittering qualities and refreshing, spicy aroma. |
| Saaz | 3-5% | The Old World steadfast standby made famous by Pilsner Urquell possesses the aromatic blend of earth and spice notable in European nobles. Low bittering value. |
| Simcoe® | 12-14% | A hop variety less than 10 years old that is quickly finding its way into the hearts of bitter-loving craft brewers. Intense pine aroma adds to the fresh, youthful vigor. Dual purpose but generally considered a bittering hop. |
| Sorachi Ace | 13-16% | A Japanese winner by all counts with its powerful lemon aroma, high bittering value and flavorful personality. |
| Sterling | 6-9% | Herbs and spices dominate, flowers and citrus around the fringes. Moderate bittering values with a mix of Saaz and Mt. Hood properties. |
| Summit (Dwarf) | 17.5–19.5% | Quite new on the scene (2003) but the consensus is very positive with its “peak” bittering value coupled with robust citrus notes of orange, tangerine and grapefruit. Receiving accolades as an ideal hop for the ultimate Pale Ale. |
| Warrior | 14.5- 17.0% | Its high bittering value and very mild aroma offers new dimensions to IPA & Double IPA brewers. |
| Willamette | 4-6% | The king of aroma hops in the U.S. with its modest bittering value and the joyous harmony of flowers, fruit, earth and spice. |

Hops

| WASHINGTON | 2009 | 2010 | 2011 | 2012 | 2013 |
|-------------------------|---------------|---------------|---------------|---------------|---------------|
| Ahtanum | * | * | * | 176 | 211 |
| Apollo | 747 | 827 | 885 | 874 | 685 |
| Bravo | 335 | 414 | 593 | 528 | 466 |
| Cascade | 2,019 | 1,728 | 2,108 | 2,693 | 4,237 |
| Centennial | 298 | 357 | 641 | 1,478 | 1,869 |
| Chinook | 384 | 443 | 572 | 1,215 | 1,415 |
| Citra® (HBC 394) | 98 | 113 | 239 | 538 | 1,296 |
| Cluster | 501 | 392 | 482 | 546 | 802 |
| Columbus/Tomahawk® | 4,858 | 3,401 | 2,947 | 2,523 | 2,336 |
| Crystal | * | * | * | 154 | 214 |
| El Dorado® | * | * | * | * | 82 |
| Galena | 2,412 | 1,920 | 1,415 | 954 | 440 |
| Glacier | 70 | 61 | 44 | 56 | 98 |
| Golding | 42 | * | * | * | 105 |
| Mosaic™ (HBC 369) | * | * | * | * | 382 |
| Millennium | 557 | 555 | 403 | 397 | 420 |
| Mt. Hood | 96 | 62 | 95 | 120 | 168 |
| Northern Brewer | 92 | 94 | 159 | 120 | 170 |
| Nugget | 1,028 | 829 | 861 | 875 | 395 |
| Simcoe® (YCR 14) | 183 | 237 | 495 | 940 | 1,298 |
| Summit™ 2 | 3,238 | * | 2,477 | 2,721 | 2,844 |
| Super Galena | 839 | 886 | 990 | 959 | 779 |
| Tettnanger | * | * | * | 76 | 95 |
| Vanguard | * | * | * | 59 | 76 |
| Willamette | 2,719 | 1,734 | 894 | 692 | 522 |
| YCR-4 - Palisade® | 351 | 373 | 308 | 264 | 132 |
| YCR-5 - Warrior® | 301 | 296 | 260 | 195 | 180 |
| Zeus | 6,544 | 4,440 | 4,159 | 3,253 | 3,277 |
| Experimental | * | * | * | * | 258 |
| Other* | 1,212 | 5,174 | 2,293 | 2,634 | 1,810 |
| Total Washington | 28,924 | 24,336 | 23,320 | 25,040 | 27,062 |

Hops

| IDAHO | 2009 | 2010 | 2011 | 2012 | 2013 |
|---------------------|--------------|--------------|--------------|--------------|--------------|
| Apollo | * | * | * | * | 314 |
| Bravo | * | * | * | * | 130 |
| Cascade | * | * | * | * | 628 |
| Centennial | * | * | * | * | 57 |
| Citra® (HBC 394) | * | * | * | * | 19 |
| Chinook | * | * | * | * | 324 |
| El Dorado® | * | * | * | * | 14 |
| Super Galena | * | * | * | * | 278 |
| Zeus | * | * | * | * | 548 |
| Experimental | * | * | * | * | 5 |
| Other Varieties | * | * | * | * | 1059 |
| Total Idaho | 4.030 | 2.331 | 2.265 | 2.423 | 3.376 |
| OREGON | | | | | |
| Cascade | 152 | 122 | 263 | 346 | 423 |
| Centennial | * | * | * | 208 | 249 |
| Fuggle | * | * | * | * | 91 |
| Golding | * | * | * | * | 194 |
| Liberty | * | * | 108 | 83 | * |
| Magnum | * | * | 64 | 58 | 104 |
| Mt. Hood | 158 | 188 | 214 | 226 | 221 |
| Nugget | 1,773 | 1,356 | 1,438 | 1,619 | 1,667 |
| Perle | * | * | 98 | * | 55 |
| Sterling | 101 | 87 | 86 | * | 122 |
| Super Galena | 177 | 134 | 241 | 175 | 155 |
| Tettnanger | * | * | 70 | 61 | * |
| Willamette | 2,469 | 1,452 | 779 | 905 | 553 |
| Experimental | * | * | * | * | 35 |
| Other Varieties | 934 | 1,283 | 841 | 789 | 917 |
| Total Oregon | 5.764 | 4.622 | 4.202 | 4.470 | 4.786 |

Hops

U.S. HOP PRODUCTION BY STATE AND VARIETY (FIVE YEARS)

| STATE & VARIETY | HOP PRODUCTION (POUNDS) | | | | | 2012-13 |
|---------------------|-------------------------|------------|------------|------------|------------|---------|
| | 2009 | 2010 | 2011 | 2012 | 2013 | % +/- |
| Total Idaho | 7,829,100 | 4,962,600 | 5,454,100 | 4,227,600 | 5,876,000 | 38.99% |
| Total Oregon | 11,018,800 | 8,277,600 | 8,019,400 | 8,425,300 | 8,549,100 | 1.47% |
| WASHINGTON | | | | | | |
| Ahtanum | * | * | * | 262,000 | 347,500 | 32.63% |
| Apollo | 2,196,900 | 2,297,400 | 2,440,400 | 2,320,600 | 2,050,000 | -11.66% |
| Bravo | 803,000 | 1,062,300 | 1,547,200 | 1,397,400 | 1,433,600 | 2.59% |
| Cascade | 4,280,300 | 3,291,800 | 4,121,300 | 4,993,000 | 7,300,000 | 46.20% |
| Centennial | 444,000 | 639,400 | 899,400 | 2,001,000 | 2,905,200 | 45.19% |
| Chinook | 698,500 | 869,600 | 982,800 | 2,064,200 | 2,812,300 | 36.24% |
| Citra® (HBC 394) | 81,900 | 218,100 | 433,100 | 721,900 | 1,820,300 | 152.15% |
| Chuster | 1,187,400 | 807,500 | 973,300 | 1,073,000 | 1,562,000 | 45.57% |
| Columbus/Tomahawk | | | 22,400 | 5,751,700 | 6,006,100 | 4.42% |
| Crystal | | | * | 182,300 | 275,300 | 51.01% |
| El Dorado® | | | * | * | 144,400 | |
| Galena | | | 76,200 | 1,662,000 | 866,300 | -47.88% |
| Glacier | | | 96,000 | 81,800 | 123,300 | 50.73% |
| Golding | | | * | * | 106,000 | |
| Mosaic™ (HBC 36) | | | * | * | 652,800 | |
| Millennium | | | 32,400 | 800,800 | 951,600 | 18.83% |
| Mt. Hood | | | 79,600 | 151,700 | 195,000 | 28.54% |
| Northern Brewer | | | 70,000 | 173,100 | 213,500 | 23.34% |
| Nugget | 2,117,700 | 1,498,800 | 1,695,100 | 1,468,700 | 762,800 | -48.06% |
| Simcoe® (YCR 14) | 391,100 | 402,400 | 880,800 | 1,578,000 | 2,183,400 | 38.37% |
| Summit™ 2 | 8,700,568 | * | 6,702,506 | 5,670,311 | 5,326,600 | -6.06% |
| Super Galena | 2,673,100 | 2,323,100 | 3,010,600 | 2,536,400 | 2,190,300 | -13.65% |
| Tettnanger | * | * | * | 76,200 | 71,700 | -5.91% |
| Vanguard | * | * | * | 75,500 | 102,500 | 35.76% |
| Willamette | 3,956,100 | 2,340,900 | 1,350,000 | 940,400 | 647,100 | -31.19% |
| YCR-4 - Palisade® | 967,400 | 906,800 | 789,100 | 622,100 | 368,300 | -40.80% |
| YCR-5 - Warrior® | 635,100 | 526,300 | 535,900 | 383,800 | 390,400 | 1.72% |
| Zeus | 22,164,500 | 11,890,300 | 10,695,900 | 7,775,900 | 9,635,700 | 23.92% |
| Experimental | * | * | * | * | 402,900 | |
| Other* | 1,899,232 | 10,184,400 | 2,774,094 | 3,832,419 | 3,071,900 | -19.84% |
| Total Washington | 72,991,800 | 52,252,400 | 51,308,100 | 48,596,300 | 54,918,800 | 13.01% |
| Total United States | 91,839,700 | 65,492,600 | 64,781,600 | 61,249,200 | 69,343,900 | 13.22% |

IDAHO: 8.5%
OREGON: 12.3%
WASHINGTON: 79.2%
PNW TOTAL: 100%

SOURCE: USDA-NASS and ADHA. Prepared by HGA.

* included in the category "Other" to avoid disclosure of individual operations.

2 A production estimate for Summit provided by the American Dwarf Hop Association is provided as a separately reported variety in this chart, deducting that amount from the "Other" production reported by NASS for 2009, 2011, and 2012.

Hops

IHGC AROMA ACREAGE (FIVE YEARS)

| COUNTRY | AROMA ACREAGE (IN ACRES) | | | | | 2012-13 |
|---------------|--------------------------|--------|--------|--------|--------|---------|
| | 2009 | 2010 | 2011 | 2012 | 2013 | % +/- |
| Australia* | 67 | 79 | 119 | 128 | 158 | 23.08% |
| Austria | 474 | 460 | 479 | 477 | 462 | -3.11% |
| Belgium | 126 | 126 | 148 | 175 | 173 | -1.41% |
| China* | 1,433 | 1,433 | 946 | 853 | 494 | -42.03% |
| Czech Rep. | 12,316 | 12,215 | 10,791 | 10,413 | 10,045 | -3.54% |
| France | 1,108 | 983 | 897 | 877 | 770 | -11.41% |
| Germany | 23,673 | 23,844 | 23,569 | 22,489 | 21,733 | -3.36% |
| New Zealand | 568 | 568 | 655 | 655 | 712 | 8.68% |
| Poland | 1,905 | 1,008 | 1,008 | 988 | 897 | -9.25% |
| Romania | 183 | 158 | 151 | 151 | 156 | 3.28% |
| Russia* | 376 | 855 | 208 | 208 | 208 | 0.00% |
| Serbia* | 84 | 84 | 84 | 84 | 84 | 0.00% |
| Slovakia | 581 | 566 | 549 | 529 | 430 | -18.69% |
| Slovenia | 3,581 | 3,210 | 3,168 | 2,634 | 2,797 | 6.19% |
| South Africa* | 0 | 0 | 0 | 0 | 0 | 0.00% |
| Spain | 0 | 0 | 0 | 0 | 0 | 0.00% |
| Ukraine* | 1,589 | 1,663 | 1,268 | 853 | 932 | 9.28% |
| UK - England | 2,002 | 2,010 | 1,984 | 1,965 | 1,820 | -6.92% |
| USA | 13,425 | 10,811 | 11,921 | 15,558 | 19,996 | 28.53% |
| IHGC Total | 63,450 | 60,082 | 57,940 | 59,082 | 61,829 | 4.65% |

SOURCE: IHGC Economic Commission annual reports.

*Countries with partial provided report updates for the IHGC. Missing figures were used from previous reports or from IHGC estimates. Numbers may not total exactly due to rounding and standard/metric conversions.

Hops

IHGC ALPHA ACREAGE (FIVE YEARS)

| COUNTRY | ALPHA ACREAGE (IN ACRES) | | | | | 2012-13 |
|---------------|--------------------------|--------|--------|--------|--------|---------|
| | 2009 | 2010 | 2011 | 2012 | 2013 | % +/- |
| Australia* | 1,203 | 1,028 | 1,006 | 988 | 741 | -25.00% |
| Austria | 54 | 79 | 94 | 94 | 106 | 13.16% |
| Belgium | 334 | 334 | 297 | 215 | 217 | 1.15% |
| China* | 12,889 | 12,889 | 10,070 | 9,108 | 6,919 | -24.04% |
| Czech Rep. | 183 | 183 | 161 | 131 | 133 | -11.48% |
| France | 99 | 111 | 156 | 163 | 146 | -10.61% |
| Germany | 20,228 | 20,906 | 20,248 | 18,397 | 17,162 | -6.72% |
| New Zealand | 420 | 371 | 284 | 247 | 222 | -10.00% |
| Poland | 3,613 | 3,361 | 3,361 | 2,471 | 2,187 | -11.50% |
| Romania | 428 | 425 | 428 | 445 | 450 | 1.11% |
| Russia* | 168 | 183 | 133 | 133 | 133 | 0.00% |
| Serbia* | 82 | 82 | 82 | 82 | 82 | 0.00% |
| Slovakia | 0 | 0 | 0 | 0 | 0 | 0.00% |
| Slovenia | 168 | 138 | 178 | 91 | 94 | 2.70% |
| South Africa* | 1,189 | 1,216 | 1,216 | 1,216 | 1,216 | 0.00% |
| Spain | 1,156 | 1,211 | 1,260 | 1,260 | 1,194 | -5.29% |
| Ukraine* | 808 | 588 | 297 | 208 | 203 | -2.38% |
| UK - England | 667 | 623 | 766 | 633 | 598 | -5.47% |
| USA | 26,300 | 20,436 | 17,866 | 15,249 | 15,444 | 1.28% |
| IHGC Total | 69,969 | 64,162 | 57,900 | 51,152 | 47,247 | -7.63% |

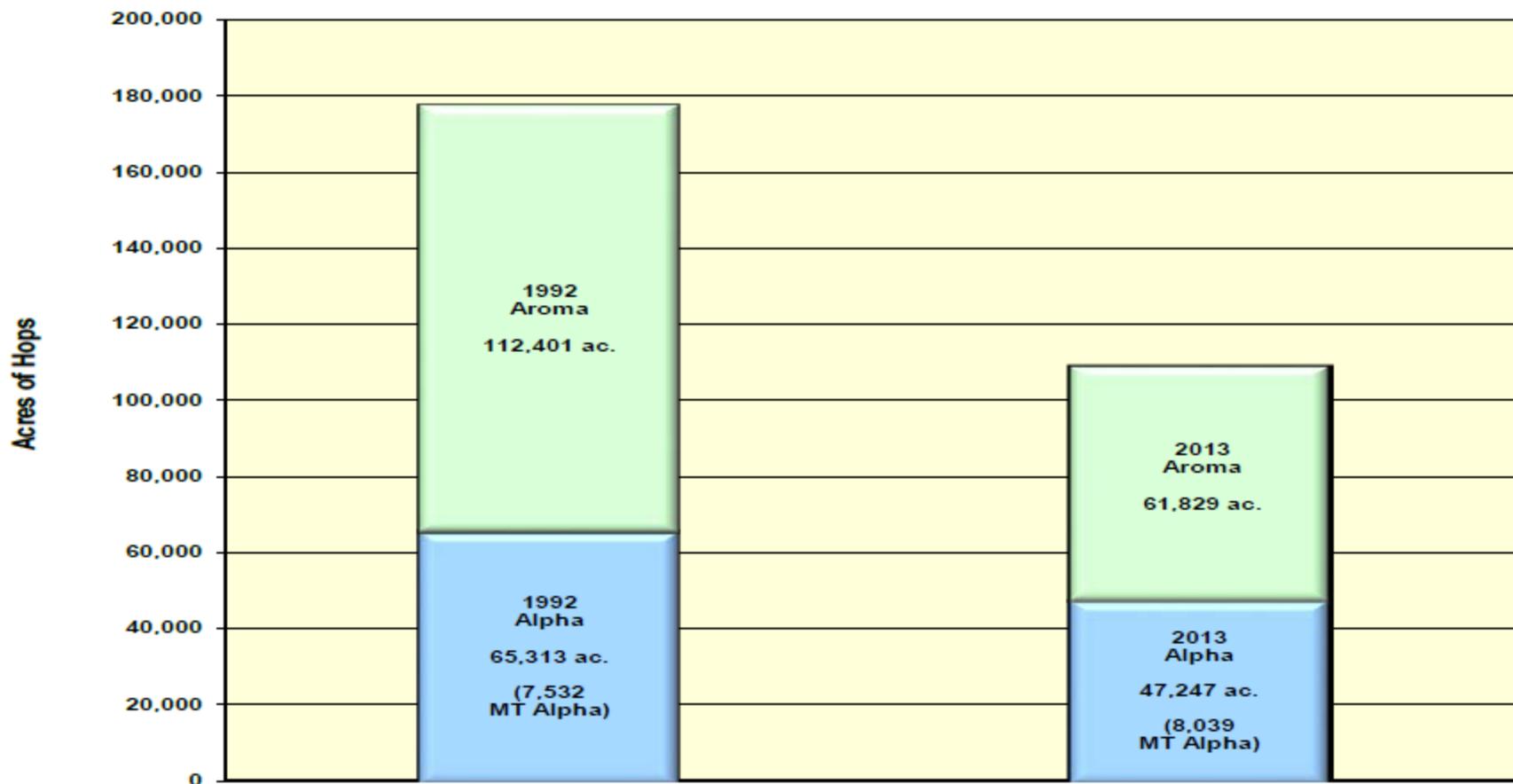
SOURCE: IHGC Economic Commission annual reports.

*Countries with partial provided report updates for the IHGC. Missing figures were used from previous reports or from IHGC estimates.

Numbers may not total exactly due to rounding and standard/metric conversions.

Hops

COMPOSITION OF WORLD HOP ACREAGE - 1992 VERSUS 2013



SOURCE: IHGC November Reports. Prepared by HGA.

Hops

U.S. IMPORTS OF HOPS (FIVE YEARS)

(In pounds; extract converted at 4:1 ratio)

| 2012/13 Rank | Country | 2008/09 | 2009/10 | 2010/11 | 2011/12 | 2012/13 |
|--------------|--------------------|-------------------|------------------|------------------|------------------|------------------|
| 1 | Germany | 8,133,073 | 4,753,166 | 4,673,359 | 4,483,541 | 5,401,987 |
| 2 | United Kingdom | 804,026 | 792,782 | 858,700 | 1,008,174 | 1,328,065 |
| 3 | Australia | 1,533,976 | 569,013 | 372,802 | 720,250 | 634,490 |
| 4 | China | 2,205 | 13,669 | 1,764 | 0 | 544,983 |
| 5 | New Zealand | 292,553 | 369,274 | 559,533 | 668,221 | 333,780 |
| 6 | Czech Republic | 130,514 | 162,481 | 76,721 | 136,246 | 283,735 |
| 7 | Slovenia | 372,361 | 397,493 | 102,956 | 95,019 | 113,097 |
| 8 | France | 136,246 | 202,384 | 16,535 | 45,636 | 23,810 |
| 9 | Canada | 0 | 0 | 1,764 | 78,925 | 14,991 |
| 10 | Poland | 7,275 | 9,700 | 1,984 | 12,346 | 11,684 |
| 11 | Switzerland | 0 | 0 | 8,818 | 0 | 4,409 |
| 12 | Ethiopia | 661 | 0 | 2,425 | 4,409 | 2,205 |
| 13 | Italy | 19,401 | 0 | 882 | 8,818 | 2,205 |
| 14 | Argentina | 882 | 0 | 882 | 1,102 | 1,764 |
| 15 | South Africa | 0 | 0 | 0 | 0 | 882 |
| 16 | Israel | 0 | 882 | 0 | 0 | 0 |
| 17 | Venezuela | 0 | 0 | 0 | 0 | 0 |
| 18 | Hong Kong | 0 | 0 | 0 | 0 | 0 |
| 19 | Belgium-Luxembourg | 48,502 | 9,700 | 16,755 | 0 | 0 |
| 20 | Thailand | 0 | 0 | 0 | 0 | 0 |
| 21 | India | 0 | 0 | 0 | 0 | 0 |
| 22 | Vietnam | 0 | 0 | 0 | 0 | 0 |
| 23 | Somalia | 0 | 1,543 | 0 | 0 | 0 |
| 24 | Japan | 0 | 0 | 0 | 0 | 0 |
| 25 | Spain | 0 | 0 | 0 | 0 | 0 |
| | Grand Total | 11,481,674 | 7,282,089 | 6,695,879 | 7,262,688 | 8,702,086 |

Source: USDA Foreign Agricultural Service - Global Agricultural Trade System, <http://www.fas.usda.gov/gats/default.aspx>.
Prepared by Bryant Christie Inc.

Hops

U.S. HOP EXPORTS, TOP 40 COUNTRIES (2007/08 through 2012/13)

(In pounds; extract is converted to fresh hop equivalent at a ratio of 4:1)

| 2012/13 Rank | Country | 2008/09 (Sep-Aug) | 2009/10 (Sep-Aug) | 2010/11 (Sep-Aug) | 2011/12 (Sep-Aug) | 2012/13 (Sep-Aug) |
|--------------|--------------------|-------------------|-------------------|-------------------|-------------------|-------------------|
| 1 | Mexico | 9,408,227 | 8,070,903 | 8,553,274 | 5,096,867 | 9,029,252 |
| 2 | United Kingdom | 5,594,671 | 6,214,610 | 6,928,247 | 6,799,717 | 7,173,842 |
| 3 | Germany | 10,149,862 | 5,988,196 | 4,161,005 | 5,560,940 | 5,132,802 |
| 4 | Belgium-Luxembourg | 8,837,229 | 8,637,931 | 8,307,238 | 5,503,179 | 4,627,723 |
| 5 | Brazil | 4,905,285 | 5,345,769 | 3,950,684 | 4,755,591 | 4,056,505 |
| 6 | Venezuela | 687,181 | 718,927 | 1,682,788 | 1,224,888 | 2,895,992 |
| 7 | China | 2,303,169 | 4,039,089 | 3,205,080 | 2,223,803 | 2,862,702 |
| 8 | Colombia | 2,379,008 | 3,252,039 | 3,210,151 | 2,243,424 | 2,223,362 |
| 9 | Japan | 2,259,738 | 2,440,958 | 2,754,455 | 1,626,130 | 1,815,948 |
| 10 | Canada | 5,077,907 | 4,071,497 | 2,036,410 | 1,950,430 | 1,788,390 |
| 11 | Korea, South | 1,197,771 | 1,738,124 | 1,541,693 | 1,253,989 | 1,173,961 |
| 12 | Australia | 1,263,910 | 1,507,521 | 917,784 | 1,342,174 | 1,070,344 |
| 13 | Hong Kong | 1,077,399 | 1,319,026 | 2,119,083 | 1,441,823 | 1,046,755 |
| 14 | Argentina | 921,532 | 947,326 | 1,231,282 | 1,091,950 | 985,907 |
| 15 | Peru | 1,487,679 | 1,144,199 | 1,075,194 | 1,075,635 | 949,751 |
| 16 | Dominican Republic | 714,518 | 591,280 | 861,566 | 762,138 | 766,547 |
| 17 | Chile | 821,883 | 503,977 | 635,593 | 614,428 | 741,855 |
| 18 | Philippines | 841,725 | 1,399,715 | 836,654 | 679,244 | 600,760 |
| 19 | South Africa | 259,925 | 426,815 | 578,713 | 506,843 | 427,035 |
| 20 | Russia | 582,020 | 1,205,708 | 589,296 | 488,544 | 416,012 |
| 21 | Ecuador | 585,989 | 1,089,745 | 466,719 | 442,688 | 398,596 |
| 22 | India | 646,616 | 879,644 | 523,377 | 158,953 | 395,950 |
| 23 | Vietnam | 741,194 | 1,027,354 | 963,200 | 553,581 | 385,368 |
| 24 | Ireland | 318,127 | 37,920 | 298,947 | 369,495 | 349,433 |
| 25 | Guatemala | 115,522 | 386,691 | 463,853 | 316,804 | 287,262 |

Hops

QUESTIONS?





LONG DAY AT THE PLANT, DEAR?

YOU BETTER BELIEVE IT! I MUST'VE EATEN 30 ROSE PETALS TODAY!

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10/8

AT THE APHIDS'

Mint

Taxonomy

Dicotyledon

Family: Lamiaceae

Genus & species: *Mentha piperita* L. (peppermint)
Mentha spicata L. (spearmint)

Related species: Thyme, rosemary, oregano, basil, lemon balm, purple deadnettle, lamb's ear, and many, MANY more.



Mint

Origin & Distribution

Center of origin Mediterranean or Turkey-Iran

Current distribution is worldwide, widely naturalized in metropolitan regions.



Mint

Origin & History

Earliest recorded mention of peppermint use in Egypt (~1550 BCE)

Human cultivation probably started long before

Early Romans thought mint would improve intelligence

Earliest mention of use in Europe in 1240 in Iceland



Mint

Botany

Thought to be dozens of species of mint

At least 10 commercially significant hybrids

Mint oils are extracted from whole plant, though leaf tissue is maximized in production



Hops

Botany

Low-growing (1-3 ft) perennial herb

Spreads via rhizomes

Extremely fast growing

Prefers moist, shaded conditions

Home growers should consider growing mints in containers to prevent escape



Mint

Propagation

Propagation for commercial production is entirely vegetative

Resulting plants are genetically identical to parent material

Propagules are “dibbled” into field at 1.5 ft in-row spacing, and spread vigorously



Mint

Mint oil production

Grows best above 41st parallel

State-certified propagules used for planting

Requires near-constant moisture

Whole plants harvested in 2nd year

Oil yields of ~ 76 lb/acre



Mint

Harvest

July 4 through September

Plants are windrowed and dried in-field (as hay)

Dried hay is put into specialized wagons

Wagons are connected to steam extractor and mint hay steamed in the wagon.

Mint



Note wheel

Mint

Distillation

Steam distillate (from wagons)
transferred to separator.

Oil floats on water and is skimmed
off

Transferred to 55 gallon drums and
shipped



Mint

Uses of mint oil

One 55-gallon drum (400 lbs) will produce

400,000 tubes of toothpaste

5,000,000 sticks of gum

20,000,000 mint candies



Mint

Uses of mint oil

In reality:

55% goes to toothpaste

30% goes to gum

10% goes to candies

5% goes to other random stuff



Mint

Washington mint industry

#1 in mint oil production

\$69.7 million production

1,121 Washington jobs

\$46.7 million in wages

\$57.7 million value added

\$150.9 million total impact

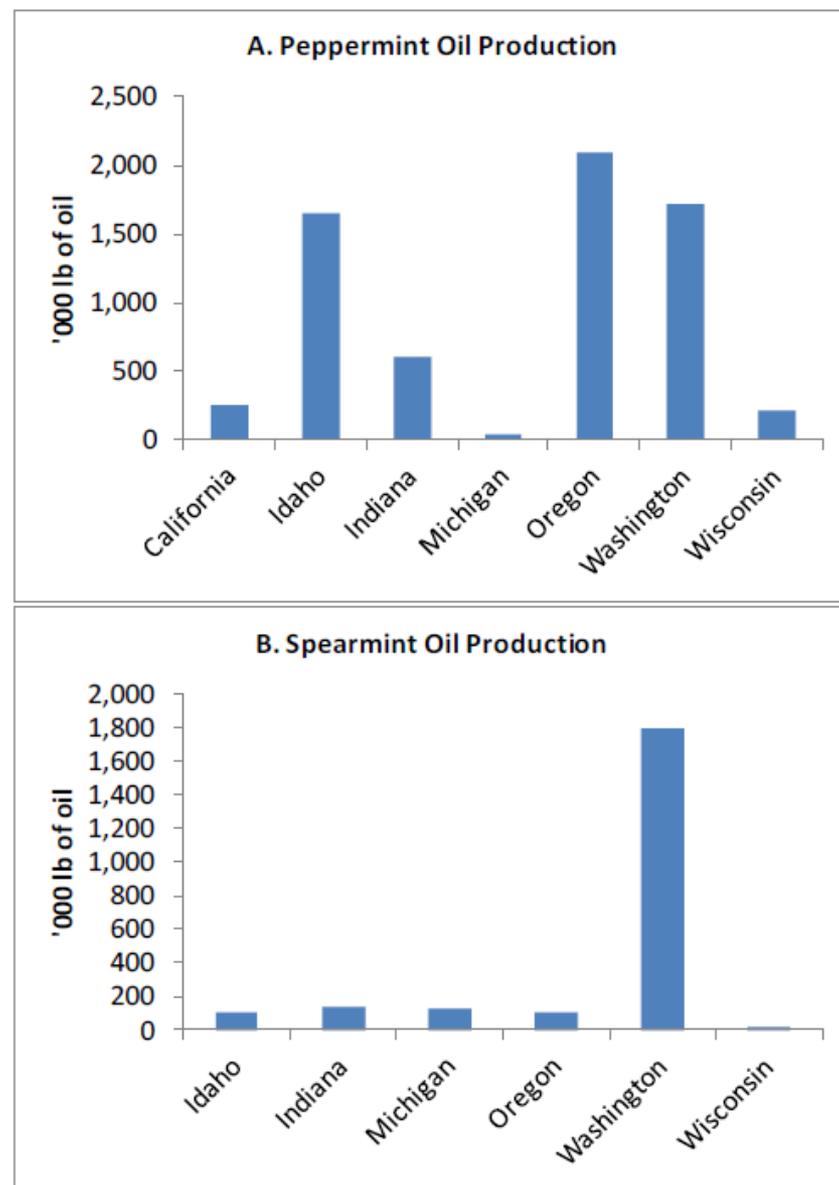


Figure 2. Production of peppermint oil (A) and spearmint oil (B) by state, 2011.

Source: USDA NASS (2013b).

Mint

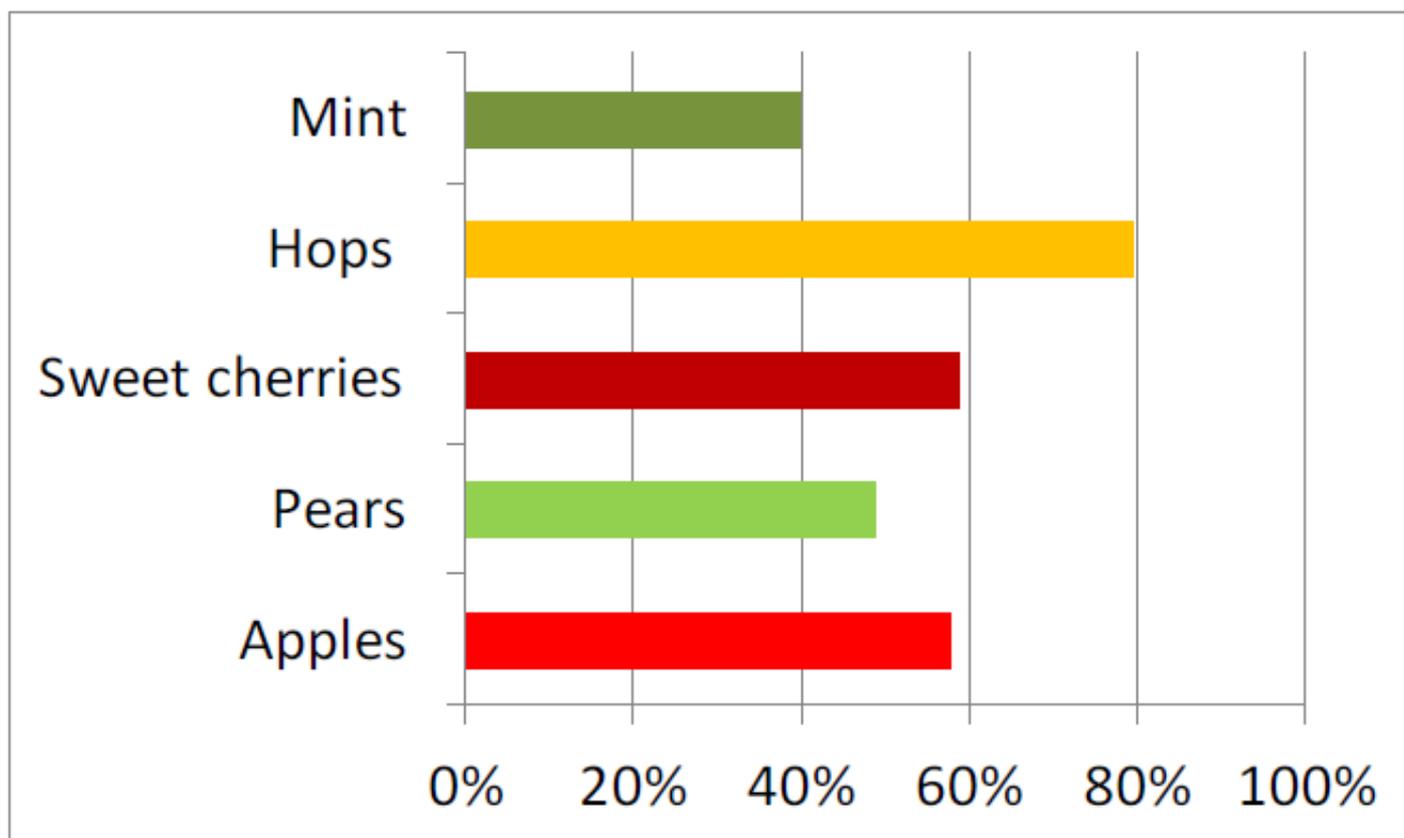


Figure 1. Washington production of selected specialty crops as a percentage of U.S. total.

Source: USDA NASS (2013b).