Craft beer trends and the state of Michigan hops

UVM Hop Conference
Burlington, VT
February 2018

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Senior Extension Educator
Michigan State University
CRAFT BREWER DEFINITION

AN AMERICAN CRAFT BREWER IS SMALL, INDEPENDENT, AND TRADITIONAL.

SMALL
Annual production of 6 million barrels of beer or less (approximately 3 percent of U.S. annual sales). Beer production is attributed to the rules of alternating proprietorships.

INDEPENDENT
Less than 25 percent of the craft brewery is owned or controlled (or equivalent economic interest) by a beverage alcohol industry member that is not itself a craft brewer.

TRADITIONAL
A brewer that has a majority of its total beverage alcohol volume in beers whose flavor derives from traditional or innovative brewing ingredients and their fermentation. Flavored malt beverages (FMBs) are not considered beers.
U.S. BEER SALES 2013

OVERALL BEER
-1.9%
196,241,321 bbls

17.2% CRAFT
15,302,838 bbls

IMPORT BEER
-0.6%
27,539,358 bbls

49% EXPORT CRAFT BEER
282,526 bbls

OVERALL BEER MARKET
$100 BILLION

CRAFT BEER MARKET
$14.3 BILLION
20% DOLLAR SALES GROWTH

IMPORT
(27,539,358 bbl)

7.8% Share in 2013
(15,302,838 bbl)

DOMESTIC
(153,399,125 bbl)

Source: Brewers Association, Boulder, CO
U.S. Beer Sales Volume Growth 2014

Overall Beer: 0.5% growth
- 197,124,407 bbls

Craft Beer: 17.6% growth
- 21,775,905 bbls

Import Beer: 6.9% growth
- 29,430,185 bbls

Export Craft Beer: 36% growth
- 383,422 bbls

Overall Beer Market: $101.5 billion

Craft Beer Market: $19.6 billion
- 22% dollar sales growth

Craft Beer Market Share in 2014:
- 11% share
- (21,775,905 bbls)

Import Beer:
- (29,430,185 bbls)

Domestic Beer:
- (145,918,317 bbls)

Source: Brewers Association, Boulder, CO
U.S. Beer Sales Volume Growth 2015

Overall Beer: 0.2% growth
- 196,701,792 BBLs

Craft Beer: 12.8% growth
- 24,076,864 BBLs

Import Beer: 6.2% growth
- 31,245,124 BBLs

Export Craft Beer: 16.3% growth
- 446,151 BBLs

Overall Beer Market: $105.9 billion
Craft Beer Market: $22.3 billion (16% dollar sales growth)

Craft 12.2% Share in 2015
- 24,076,864 BBLs

Source: Brewers Association, Boulder, CO
U.S. Beer Sales Volume Growth 2016

Overall Beer 0.0%  
196,749,624 BBLs

6.2% Craft  
24,104,852 BBLs

Import Beer 6.8%  
33,366,352 BBLs

4.4% Export Craft Beer  
465,617 BBLs

Overall Beer Market $107.6 Billion

Craft Beer Market $23.5 Billion  
10% Dollar Sales Growth

12.3% Share in 2016  
(24,104,852 BBLs)

Import (33,366,352 BBLs)

Domestic (139,278,420 BBLs)

Source: Brewers Association, Boulder, CO
Per Capita Consumption of Ethanol
U.S. from 2000 to 2016

ABV for Beer 4.6%, Wine 11.5% Spirits 38%
Number of Breweries, 1873 - 2017

ECONOMIC IMPACT

456,373 JOBS
Craft beer full-time equivalent jobs - a 7.5% increase from 2014.

$67.8 BILLION
Craft brewers’ contribution to the U.S. economy in 2016, a 21.7% increase from 2014.

Sources:
Brewers Association
and Beer Institute
2,700+ SEAL ADOPTERS!

Representing over 75% of domestic, independent craft beer production.

BEER IS BIPARTISAN

The Craft Beverage Modernization and Tax Reform Act (CBMTRA) was reintroduced in the 115th Congress and has reached a majority of support in both houses.

TAKE A BEERCATION

Beer tourism is growing, with the average craft drinker visiting 3.5 breweries near their homes and 2.5 breweries within two hours’ driving distance.
TAKE CRAFT BACK

A tongue-in-cheek consumer awareness campaign garnered over $3.7 million in mock pledges from nearly 12,000 beer lovers in an attempt to raise $213 billion to purchase Anheuser-Busch InBev.

$213 000 000 000

$73.4 MILLION
Donations from craft brewers to charitable causes in 2016, up from $71 million in 2014.

1.1 MILLION HOMEBREWERS
Over 1 million homebrewers produced more than 1.4 million barrels of beer – equaling 1% of total U.S. beer production.

Want more statistics on the U.S. beer scene?
Visit BrewersAssociation.org

INFOGRAPHIC © BREWERS ASSOCIATION
Craft Answers Consumer Demand for Extreme Flavor & High-Alcohol Content

<table>
<thead>
<tr>
<th>“Originals”</th>
<th>“Exaggerated”</th>
<th>“Revisionists”</th>
<th>“Extremists”</th>
</tr>
</thead>
<tbody>
<tr>
<td>Traditional mild pale / American lagers at Premium - Sub Premium price points</td>
<td>Premium - Super Premium line extensions leveraging legacy brand name while varying type, flavoring, and calorie count</td>
<td>Super Premium independent Craft brands / Incognito Craft brands (Blue Moon, Shock Top, Leinenkugel) identifying strongly with a sense of place, personality, or specific product</td>
<td>Super Premium independent Craft brands producing extreme / adventurous / Intense Craft Beer</td>
</tr>
<tr>
<td>Marquee beer giants’ legacy brands and traditional sub-brands (Bud Light, Miller Light, Coors Light)</td>
<td></td>
<td>Unique, hoppy, seasonal, flavored</td>
<td>Innovative brewing, double portions of hops, barrel fermenting / aging, bottle fermenting, fruit infusing, large format bottles</td>
</tr>
<tr>
<td></td>
<td></td>
<td>IPAs, porter, stout, pilsner, black &amp; tan, rye, wheat beer, etc.</td>
<td>Additional Beer types: imperial stout, double IPA, sour ale, smoked porter etc.</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>Experimentation with Beer-Wine hybrids</td>
</tr>
</tbody>
</table>
2016 US Breweries by Size

- % of Taxable Removals
- % of Breweries

6M+:
- 69.3%
0.3%

1M to 6M:
- 17.4%
0.2%

100,001 to 1M:
- 7.3%

1,001 to 100,000:
- 24.5%
5.5%

0 to 1,000:
- 74.0%
0.6%
<table>
<thead>
<tr>
<th>Brewer Size (CEs)</th>
<th>Growth % YTD</th>
<th>% Volume</th>
</tr>
</thead>
<tbody>
<tr>
<td>1,000,000+</td>
<td>-1.7%</td>
<td>61.2%</td>
</tr>
<tr>
<td>100k to 1M</td>
<td>6.0%</td>
<td>24.5%</td>
</tr>
<tr>
<td>10K to 100K</td>
<td>17.1%</td>
<td>12.1%</td>
</tr>
<tr>
<td>Less than 10K + New</td>
<td>58.5%</td>
<td>2.2%</td>
</tr>
</tbody>
</table>
GOLD MEDAL WINNER
GREAT AMERICAN BEER FESTIVAL, 2011

Who would of thought that what started as an inside joke amongst the Right Brain brew team would evolve into our most acclaimed beer ever?

Brewed with REAL Mangalitsa pig heads and bones, this rich and chocolaty porter is infused with a symphony of salty, smoky, and savory flavors.

Some have hailed it as the ‘quintessential bacon beer’ while others call it a true breakfast brew. Regardless of what you call it this imaginative and complex beer simply has to be tried to be understood.

MANGALITSA PIG PORTER
PORTER BREWED WITH REAL PIG PARTS

CONTENT
1 PINT & 6 FL. OZ.

RIGHT BRAIN BREWERY
225 E. 16th Street
Traverse City, MI 49684
www.rightbrainbrewery.com

Alc. 6.4% by Vol

REMINDERS:
BEER NO EVIL

WARNING:
(1) According to the Surgeon General, women should not drink alcoholic beverages during pregnancy because of the risk of birth defects.
(2) Consuming alcoholic beverages impairs your ability to drive a car or operate machinery. May cause health problems.
Craft is Reshaping the Way Beer is Marketed from “Brand” to “Style” like Wine

**Commentary**

- Style (instead of brand) is becoming the more important aspect of consumer choice, especially among Millennials
  - The consumer chooses style first (Pale Ale, IPA, Wheat, etc.) and then chooses brand within style (Sierra Nevada, Lagunitas, Blue Moon, etc.)
- Craft is enabling producers to dialogue with retailers about maintaining and expanding shelf space to prevent further erosion from Wine and Spirits
- Retailers are beginning to merchandise beer by style, just as they merchandise wine by varietal
- Cider and Flavored Malt Beverages (FMBs) are further expanding Beer’s retailer shelf space

**New Merchandising of Beer by Style**

*Pale Ale*

*IPA*

*Wheat Beer*
Craft – Volume Share Change by Style, 2015

Source: IRI (2016)
IPA’s Rise

IPAs as % of Craft and Overall Beer

<table>
<thead>
<tr>
<th>Year</th>
<th>Craft</th>
<th>All Beer</th>
</tr>
</thead>
<tbody>
<tr>
<td>2012</td>
<td>11.7%</td>
<td>0.6%</td>
</tr>
<tr>
<td>2013</td>
<td>13.9%</td>
<td>0.8%</td>
</tr>
<tr>
<td>2014</td>
<td>17.6%</td>
<td>1.1%</td>
</tr>
<tr>
<td>2015</td>
<td>22.5%</td>
<td>1.5%</td>
</tr>
<tr>
<td>2016</td>
<td>26.5%</td>
<td>1.9%</td>
</tr>
<tr>
<td>2017</td>
<td>29.3%</td>
<td>2.2%</td>
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</tbody>
</table>
## Beer Styles

### 2016 Dollar Share & Growth

<table>
<thead>
<tr>
<th>Style</th>
<th>$ Sales Share</th>
<th>Growth Rate</th>
</tr>
</thead>
<tbody>
<tr>
<td>IPA</td>
<td>25.4%</td>
<td>22.6%</td>
</tr>
<tr>
<td>Seasonal</td>
<td>13.3%</td>
<td>-2.3%</td>
</tr>
<tr>
<td>Other Pale Lagers</td>
<td>11.2%</td>
<td>9.2%</td>
</tr>
<tr>
<td>Pale Ale</td>
<td>8.8%</td>
<td>4.4%</td>
</tr>
<tr>
<td>Variety</td>
<td>7.6%</td>
<td>5.2%</td>
</tr>
<tr>
<td>Amber Ale</td>
<td>4.3%</td>
<td>1.2%</td>
</tr>
<tr>
<td>Amber Lager</td>
<td>4.1%</td>
<td>-6.3%</td>
</tr>
</tbody>
</table>

Source: IRI Group
2017 U.S. Brewing Industry Update

- Total U.S. beer sales down $\sim 0.5\text{-}1.0\%$
- Imports grew, but U.S. domestic volume was off $\sim 1.5\text{-}2\%$
- Total number of U.S. breweries tops 6,000 for first time ever
- Craft volume growth rate likely decreased from 6.2\% to $\sim 5\%$, to $\sim 25.3$ MM barrels ttl volume

2018 American Hop Convention
Craft Beer Production
1999 – 2017

US Craft Beer Production Volume (MM US BBL)

2018 American Hop Convention
Craft Beer Production % Growth 2000 – 2017

US Craft Beer Volume Change YOY

Production Year


1% 1% 2% 1% 5% 8% 6% 7% 12% 13% 15% 18% 18% 13% 18% 6.2% 5% est

2018 American Hop Convention
2017 U.S. Hop Industry Update

- TTL U.S. acres increased from 52,963 to 55,786 (+5.3%), an all-time high. Non-PACNW acres grew 19% to 2,500

- TTL U.S. production increased from 88.6 MM to 106.2 MM pounds (19.8% vs CY2016: +10.7%). Non-PACNW production grew 25%.

- Total U.S. yield increased from 1713 to 1959 pounds per acre (14.4%)

- Idaho: ID production surpassed OR as the number 2 U.S. producing state; Mill 95 opened, the first processor and dealer in Idaho
BA Member Hop Usage Survey

• Annual Survey in July & August
• Ten Years of Data collected 2008 - 2017
• Look back to production years 2007 – 2016
• Only includes craft volume as defined

A SURVEY, so the results shown are NOT totals: “Actual Mileage May Vary”

BA Annual Hop Survey + USDA National Hop Reports + BA BIPS Survey + USDA NASS Hop Stocks Reports => This presentation
US Brewing & Hop Usage Summary

- Hop usage rates measured in ‘17 survey increased +2.7% over ‘16 surveyed rates from 1.50 to 1.54 PPB (2016 beer production year)
- Contracting rates remain high, although they decreased from 96% to 89% overall, and from 89% to 71% among brewers under 2,500 bbls
- Shifts in top ten varieties and ttl varieties
- Shortfalls measured in 2017 in different varieties from 2016
- Measured variety “Impact” for the first time

2018 American Hop Convention
U.S. Craft Beer Hopping Rates

TTL Pounds / TTL BBL

Production Year


0.93 0.95 1.12 1.185 1.28 1.296 1.362 1.39 1.50 1.54

2018 American Hop Convention
YOY Change in Hop Usage Rates (pounds per bbl)

2009: 17.9%
2010: 12.1%
2011: 5.8%
2012: 8.0%
2013: 5.1%
2014: 2.1%
2015: 7.9%
2016: 2.7%

Beer Production Year

2018 American Hop Convention
Contracting Rates By Brewer Volume

2009: 84.1%
2010: 83.0%
2011: 89.0%
2012: 92.8%
2013: 92.0%
2014: 96.6%
2015: 95.8%
2016: 96.0%
2017: 89.0%

71.1% 73.3% 82.4% 86.1% 91.2% 93.0% 91.4% 89.0% 71.0%

- all brewers
- <2,500 bbls

2018 American Hop Convention
Varieties Drive Volume Growth

Total Number of Varieties Used By U.S. Craft Brewers (Survey Year)

- 2008: 90
- 2009: 88
- 2010: 92
- 2011: 97
- 2012: 105
- 2013: 114
- 2014: 132
- 2015: 135
- 2016: 125
- 2017: 146

2018 American Hop Convention
Craft Brewer Hop Usage
Top Ten Varieties

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<tbody>
<tr>
<td>Cascade</td>
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<tr>
<td>Centennial</td>
<td>Centennial</td>
<td>Centennial</td>
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<td>Centennial</td>
<td>Centennial</td>
<td>Centennial</td>
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<tr>
<td>Chinook</td>
<td>Chinook</td>
<td>Simcoe</td>
<td>Chinook</td>
<td>Chinook</td>
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<td>Chinook</td>
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<tr>
<td>Willamette</td>
<td>CTZ</td>
<td>Chinook</td>
<td>Simcoe</td>
<td>Simcoe</td>
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<td>Simcoe</td>
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<tr>
<td>Simcoe</td>
<td>Simcoe</td>
<td>CTZ</td>
<td>Citra</td>
<td>Citra</td>
<td>Citra</td>
<td>Crystal</td>
<td>Crystal</td>
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<tr>
<td>CTZ</td>
<td>Amarillo</td>
<td>Amarillo</td>
<td>Hall Mitt (Ger)</td>
<td>Amarillo</td>
<td>Citra</td>
<td>Citra</td>
<td>Citra</td>
</tr>
<tr>
<td>US Golding</td>
<td>Crystal</td>
<td>Crystal</td>
<td>Amarillo</td>
<td>Mosaic</td>
<td>Nugget</td>
<td>Mosaic</td>
<td>Mosaic</td>
</tr>
<tr>
<td>Crystal</td>
<td>Willamette</td>
<td>Willamette</td>
<td>Crystal</td>
<td>Crystal</td>
<td>Crystal</td>
<td>Amarillo</td>
<td>Amarillo</td>
</tr>
<tr>
<td>Amarillo</td>
<td>Saaz (CZ)</td>
<td>Citra</td>
<td>Magnum (Ger)</td>
<td>Hall Mitt (Ger)</td>
<td>Mosaic</td>
<td>Mosaic</td>
<td>Mosaic</td>
</tr>
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<td>Ahtanum</td>
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<td>CTZ</td>
<td>Magnum (Ger)</td>
<td>Magnum (Ger)</td>
<td>Magnum (Ger)</td>
</tr>
</tbody>
</table>
Shortfall By Brewers
2016 Beer Production Year

% of Respondents Reporting Shortfall in Variety 2016

Galaxy (au) - 16.1%
Citra - 6.9%
Centennial - 4.6%
Nelson Sauvin (nz) - 3.4%
Mosaic - 2.3%
Chinook - 1.1%
Simcoe - 1.1%
Amarillo - 1.1%
Saaz (cz) - 1.1%
Motueka (nz) - 1.1%

2018 American Hop Convention
Shortfall By Gap Size
2016 Beer Production Year

Shortfall Pounds as % of Total Pounds Consumed

- Enigma (au): 121%
- Nelson Sauvin (nz): 28%
- Galaxy (au): 7.9%
- N Brewer: 1.6%
- E Kent Goldings (uk): 0.7%
- Perle: 0.6%
- Citra: 0.6%
- Goldings: 0.3%
- Centennial: 0.1%
- Aurora (sl): 0.1%

2018 American Hop Convention
Impact By Variety
2016 Beer Production Year

Impact = pounds rank + use frequency rank

2018 American Hop Convention
Definitions and Assumptions

• Each Crop lasts one year, starting in September and ending at the end of the following August

• September stocks represent “Carryout” of previous year crop

• Treat inventories on an accrual or running basis

• Controlling stocks for crop size is crucial
U.S. Hop Stocks Analysis

USDA-NASS September 2017 Hop Stocks Report
U.S. Hop Stocks Analysis

September Total Stocks as Proportion of Prior Year Crop Pounds

Data from USDA-NASS September 2017 Hop Stocks Report

2018 American Hop Convention
U.S. Hop Stocks Analysis

September Dealer & Grower Stocks Less Brewer Stocks As A Proportion of Prior Year Crop

Data from USDA-NASS September 2017 Hop Stocks Report

2018 American Hop Convention
Conclusions and Looking Ahead

- 2017 Craft volume rose ~5-6% to ~25 MM bbls
- Craft hopping rates grew 2.7% to 1.54 ppb in 2016
- U.S. craft brewers use 83% U.S. grown hops
- Innovation in varieties continues to drive beer sales
- Galaxy (AU) is very important to U.S. craft brewers
- USDA public breeding will get a boost in 2018 and beyond, will need additional funders
- Hop Industry investing effort to achieve favorable federal outcomes

Source: USDA NASS & HGA Hop Acreage Reports
Top Global Producing Hop Countries/States by Hectares 2016

- Slovakia: 137 hectares
- Belgium: 156 hectares
- Russia: 158 hectares
- Austria: 250 hectares
- Romania: 270 hectares
- Ukraine: 369 hectares
- USA-MICHIGAN: 405 hectares
- New Zealand: 412 hectares
- S. Africa: 420 hectares
- France: 459 hectares
- Spain: 542 hectares
- Australia: 602 hectares
- UK-England: 900 hectares
- Slovenia: 1484 hectares
- Poland: 1534 hectares
- China: 2000 hectares
- USA-Idaho: 2286 hectares
- USA-Oregon: 3142 hectares
- Czech Republic: 4775 hectares
- USA-Washington: 15153 hectares
- Germany: 18535 hectares

Challenges: Lack generations of production knowledge
1. Horticultural (pests, disease, and mgmt) and control options
2. Infrastructure development
3. Capital-upfront costs
4. Post harvest (right sizing dryer, proximity to picking, marketing and sales, etc)
A restaurant-brewery that sells 25% or more of its beer on site.

**2016**

**1.35M**

**BARRELS**

**14.8%**

**GROWTH RATE**

STATE OF THE INDUSTRY | BREWERS ASSOCIATION
> 15,000 barrels (17,600 hectoliters) of beer per year with 75% or more of its beer sold off-site
Annual beer production of between 15,000 & 6,000,000 barrels
Average case price in 2016: $36.18

Price increase: +2.9%
WHAT'S HOT

ALL CONCEPT TRENDS

CULINARY CONCEPTS

1. Hyper-local sourcing
2. Natural ingredients/clean menus
3. Environmental sustainability
4. Locally sourced produce
5. Locally sourced meat and seafood

Restaurant.org
WHAT'S HOT

ALL BEVERAGE TRENDS

ALCOHOLIC BEVERAGES

1. Craft/artisan spirits
2. Onsite barrel-aged drinks
3. Locally produced wine/spirits/beer
4. Regional signature cocktails
5. Culinary cocktails

NATIONAL RESTAURANT ASSOCIATION
Local Craft vs Other craft Vendors
Chicago Supermarkets

- Local Craft Brewers Dollar Sales passed up Non-Local Craft Brewers earlier this year

Dollar Sales

Source: IRI InfoScan IRI Chicago, IL FODO Market Quad Weeks Jan 27, 2013 through July 12, 2015
OUR CLASSIC PALE ALE, WITH MICHIGAN GROWN, CASCADE HOPS. BRIGHT HOPPINESS AND PLEASANT AROMATICS FRAMED WITH BALANCING SWEETNESS OF PALE MALTS.

PAIRINGS: SPICY DISHES, HARD CHEESES, GREENS.

ENJOY AS YOU PLEASE AND FOR YOURSELF.

NEW HOLLAND BREWING
Available in Michigan only. A tribute to our beautiful state, this refreshing ale is made with Michigan-grown Crystal and Zuper-SaaIZER hops. Derived from Saaz, a traditional noble hop hailing from the Czech Republic, these Zuper-Saaizer hops, grown locally at Hophead Farms, impart intense and fruity aromas. Combined with the citrus notes of the Crystal hops and the simple malt bill, this beer is crisp, bright and delicious.

**ABV:** 5.4%
**IBUs:** 45
**RateBeer Rating:** 89
**Availability:** May
2017 MI Chinook Cup

1. MI Local
2. Empire Hops
3. Top Hops
The Hop Quality Group proudly presents the 6th annual CASCADE CUP 2017

1st place- Morrier Ranch, Washington
2nd place- CLS Farms, Washington
3rd place- B & D Hop Farm, Oregon
4th place- Hop Head Farms, Michigan
Luponic Distortion's Newest Features Michigan Hops

June 2, 2017

In contrast to the piney, grapefruit notes Brynildson has imprinted in his head for the Pacific Northwest grown hop, he found more Mandarin orange in the Michigan grown cones. It is a showcase of terroir and how a difference of 2,000 miles can distinctly influence a hop. “I was really blown away, not just in quality but how distinct they were to those grown in the Northwest,” he said. “These hops were bordering on tropical, I wasn’t familiar with that from Chinooks. It was a pleasant surprise.”

He said the Michigan hop emergence is surprising, especially for an “old time” brewer like him, who has long felt the new emerging hop regions might never hold their weight. As hop regions pop up, Brynildson said the first few years might be the most luscious, as hops are nutrient rich, so fresh soil might be best. “It’s a legit growing region,” Brynildson said of Michigan. “A lot of us, especially old timers, we thought these new hop growing regions weren’t going to have a huge impact mostly because of scaling and pricing. But this little experiment changed my mind all together.”

https://oct.co/essays/luponic-distortions-newest-features-michigan-hops
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https://oct.co/essays/luponic-distortions-newest-features-michigan-hops

LUPONIC DISTORTION 006
MAY 2017 - SEPT 2017

Revolution No. 006 is driven by a mix of seven different hop varieties, and is the first-ever West Coast beer to focus on Michigan-grown hops. “This beer showcases what happens when you take two familiar Northwest hop varieties and grow them 2,000 miles to the east,” says Brewmaster Matt Brynildson. “The typical piney, dank attributes of these hops are transformed into something much brighter, with a racy citrus quality that adds yet another new layer to the lore of Luponic Distortion.”
The Cascade cultivar takes its name from the Cascades, a mountain range of volcanic origin in the USA. The Cascade variety was bred in Oregon as part of the USDA breeding programme and released in 1972. The typical features of Cascade are its long, dark-green cones and its relatively low alpha acid content. Cascade has a very pleasant fruity, citrus-like aroma and is the most popular variety among US craft brewers.
Cascade

**Cascade**
**Germany / Hallertau**

In the raw hops, fresh grapefruit comes to the forefront, accompanied by green fruits, such as grapes and quince, but also with sweet pineapple combined with red berries – with a distinct raspberry sauce character. In the cold infusion, the overall profile is augmented by fine tea aromas.

**Cascade**
**Germany / Hersbruck**

The cold infusion features refreshing citrus aromas, green fruits and spicy-herbal elements, as well as notes of passion fruit. In the raw hops, sweet and green fruits such as quince predominate in combination with lilac and vegetal top notes. The aroma of coffee is particularly pronounced.
For the cold infusion, 3 g of pellets was dissolved in 200 ml water (20 °C) for 30 min and subsequently evaluated in order to simulate, to some extent, the change in aroma through dry hopping.

Cascade USA

The distinguishing features of this variety are its long, dark-green cones and its low alpha content. In the cold infusion, citrus aromas come strongly to the fore, whereas cream caramel and fruity notes of blackberries and mango predominate in the raw hops. Due to its optimal cultivation characteristics and good resistance to downy mildew, Cascade produces high yields. The Cascade variety is very popular for use in US-American craft beers, particularly for India Pale Ales.

Cascade Australia

In both the raw hops and the cold infusion, this cultivar features sweet fruity aromas of peach and plum, as well as red berries, such as cassis and raspberries. These give it a particularly juicy flavour. The overall impression is rounded off by notes ranging from spicy-herbal to cream caramel. Strong citrus aromas of grapefruit and bergamot create a delightful contrast and impart a special flavour to the beer.
Chinook
Washington/Oregon

This cultivar takes its name from a Native American tribe indigenous to the region around Washington.

It was developed in Washington State within the framework of the USDA breeding programme and was released as a high-alpha variety in 1985. The female parent of this variety is the English Golding. Chinook is characterised by strong growth in all growing regions and produces its highest yields in the Yakima region. In its raw state, this hop has a herbal, almost smoky, character, reminiscent of tarragon, junipers, basil and lavender. Held together by a well-balanced citrus note, in the cold infusion, red berries, sweet fruits and floral elements predominate - with resinous pine essences completing the sophisticated aroma spectrum.

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**Descriptor**  | **This includes the following aromas:**
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Menthol | Mint, melissa, sage, metallic, camphor
Tea | Green tea, camomile tea, black tea
Green fruits | Pear, quince, apple, gooseberry, wine pear, rhubarb
Citrus | Grapefruit, orange, lime, lemon, bergamot, lemon grass, ginger
Germ | Green grass, tomato leaves, green peppers
Vegetal | Celery, leek, onion, arugula, garlic, wild garlic
Cream caramel | Butter, chocolate, yoghurt, gingerbread, honey, cream, caramel, toffee, coffee
Woody aromatic | Tobacco,ognon, tar, hay, leather, bark, wood oil, incense, myrrh, resin
Spicy/herbal | Sage, pepper, chilli, curry, juniper, mayonnaise, tarragon, oil, lavender, aniseed, licorice, fennel
Red berries | Currant, blueberries, raspberries, blackberries, strawberries
Sweet fruits | Blueberry, elderberry, honey, red berry, peach, apricot, passion fruit, lychee, dried fruit, plum, pineapple, white jelly beans
Floral | Elderflowers, camomile blossoms, lily of the valley, jasmine, apple blossom, rose, geranium

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*For the cold infusion 2 g of pellets was dissolved in 200 ml water (90 °C) for 20 min and subsequently evaluated in order to simulate the change in aroma through dry hopping.
USDA Public Breeding

**Washington**: Powdery mildew resistance, Aroma, Yield, Alpha/beta acid content, hop storage index, oil content, test brews in years 6 and 7

**Oregon**: Disease resistance Females

**“Liking” Sensory**: Dozens of plants, 8-16 ounces

- **Yr2**: Germ seeds and GH screening in OR, 20 – 25K seedlings
- **Yrs 3, 4, & 5**: Establish and evaluate female plants as single hills, ~ 600 females
- **Yr2**: Low trellis for sex selection in OR, ~5000 plants
- **Yrs 3**: Low trellis downy mildew evaluation in OR, ~600 females

**Descriptive Sensory**: Hundreds of plants, 2-4 ounces

**PACNW and Others**: Yield, Chemistry, Test brews, Stability

- **Yr1**: Make crosses and obtain seed
  - **Public Release**: Release statements written & published
- **Yrs 9, 10, & 11**: Establish and evaluate grower trials in PACNW and other regions, 1 or 2 clones
- **Yrs 6, 7, & 8**: Establish and evaluate 30 Hill plots in WA and OR, ~20 clones

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Conclusions

Growers in the Pacific Northwest and Germany grow over 75% of the world's hops, and this will not change anytime soon.

Provided new growers can produce high quality hops at a reasonable price, as more consumers are introduced to craft beer, their desire for flavor, variety, and "local" will continue to drive demand for hops in re-emerging and new growing regions.

As craft beer expands overseas, there is opportunity for increasing exports.

Variety is the key, which makes it difficult for producers growing a perennial plant.

UVM, MSU, other universities have been working the last several years to develop a "pre-breeding program" and test the terroir of existing varieties in different locations to support producers outside the PNW.