

W I L L A M E T T E V A L L E Y H O P S , L L C

PRODUCT CATALOGUE





WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

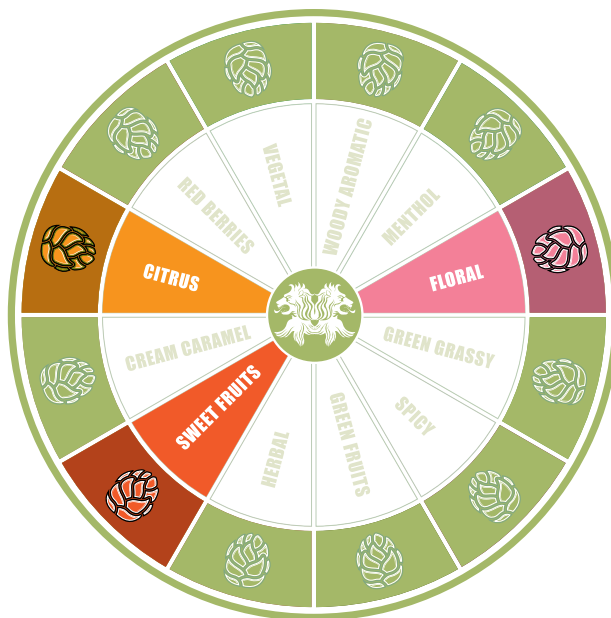


Aloha®

GERMAN AROMA HOP

This unique BARTH-HAAS GROUP Hop Creation gives your beer an exotic boost with a flavour coming directly from Hawaii.

Pedigree	No data
Aroma/Flavor	Floral, Citrus, Sweet fruits
Alpha Acids*	8.0% - 10.0%
Beta Acids	No data
Cohumulone	No data
Total Oil	1.5 - 2 ml/100g
Myrcene	No data
Humulene	No data
Caryophyllene	No data
Farnesene	No data
Storage Stability	No data



Varieties subject to availability. Contact your Territory Manager to place your order.

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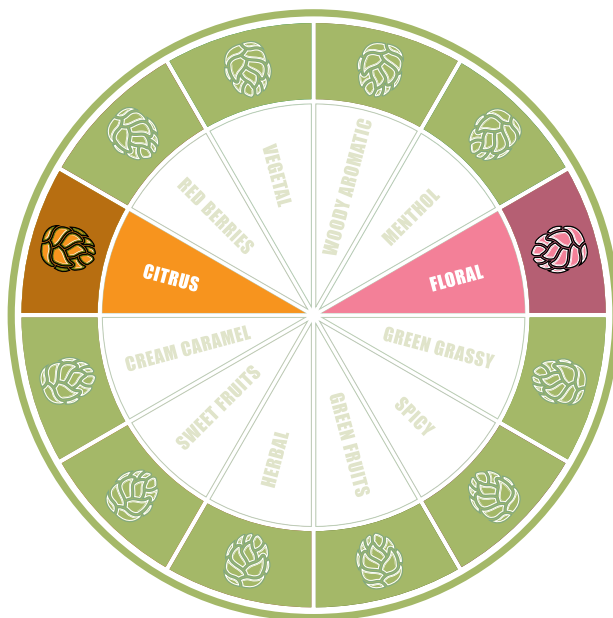


Amarillo®

U.S. AROMA HOP

Amarillo is a branded hop of recent origin, introduced by Virgil Gamache Farms Inc. in Washington state. This brand is characterized by mid to high alpha and low cohumulone content. It's aroma is reported to be similar to Cascade and the variety has good resistance to powdery mildew.

Pedigree	Open Pollination
Aroma/Flavor	Floral, Citrus
Alpha Acids*	8.0% - 11.0%
Beta Acids	6.0 - 7.0%
Cohumulone	22 - 24% of alpha acids
Total Oil	1.5 - 1.9 ml/100g
Myrcene	68 - 70% of total oil
Humulene	9 - 11% of total oil
Caryophyllene	2 - 4% of total oil
Farnesene	2 - 4% of total oil
Storage Stability	Fair



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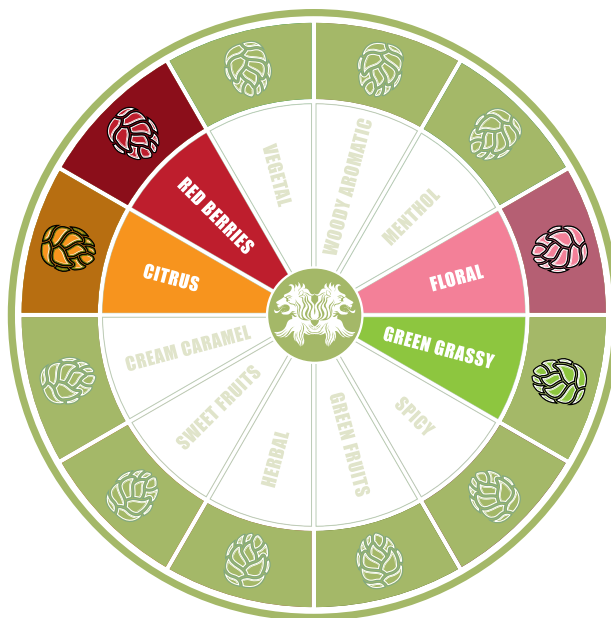


Aramis

FRENCH AROMA HOP

The most important aroma hop variety in the Alsace region is the traditional Strisselspalter. Aramis was developed as part of a breeding programme in order to launch a new variety with a similar aroma profile and polyphenol properties to Strisselspalter onto the market. It has an enhanced bitter potential.

Pedigree	Daughter of Strisselspalt
Aroma/Flavor	Floral, Citrus, Grassy
Alpha Acids*	7.9% - 8.3 %
Beta Acids	3.8% - 4.5 %
Cohumulone	No Data
Total Oil	1.2 - 1.6 ml/100g
Myrcene	app. 0.4% of total oil
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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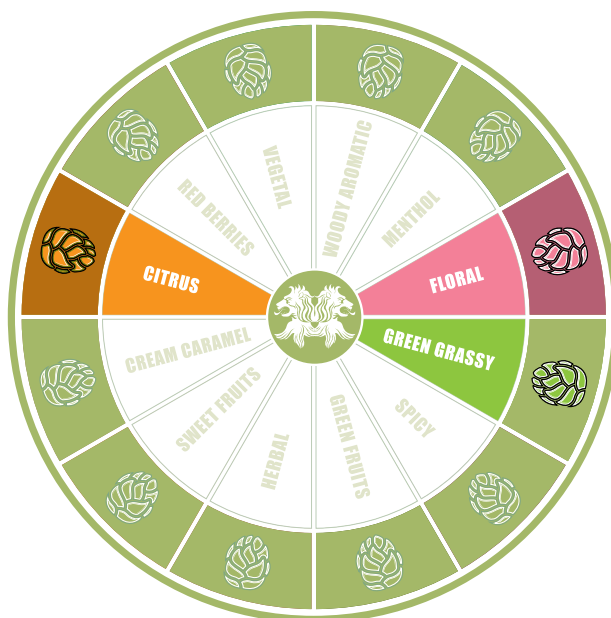


Aurora

SLOVENIAN AROMA HOP

Aurora is the Latin word for dawn. This cultivar used to be called Super Styrian and is derived from Northern Brewer. It has a rich green colour, an intense, pleasantly hoppy aroma and has outstandingly good storage stability.

Pedigree	Daughter of Northern Brewer
Aroma/Flavor	Floral, Citrus, Grassy
Alpha Acids*	7.0 - 9.0 %
Beta Acids	3.0 - 5.0 %
Cohumulone	No Data
Total Oil	0.9 - 1.4 ml/100g
Myrcene	35.0 - 53.0 % of total
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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Azacca™

U.S. AROMA HOP

Azacca is named for the Haitian god of agriculture. It was developed through the American Dwarf Hop Association in Yakima and formerly known as experimental ADHA 483. Azacca is high alpha, high oil hop brand which exhibits a complex range of aromas including mango, papaya, orange, grapefruit, lemon, pine, spice, pineapple and grassy.

Pedigree	Daughter of Toyomidori & ADHA 94/95
Aroma/Flavor	High Citrus, Tropical Fruit
Alpha Acids*	14 - 16%
Beta Acids	4.0 - 5.5%
Cohumulone	38 - 45% of alpha acids
Total Oil	1.6 - 2.5 ml/100g
Myrcene	46 - 55% of total oil
Humulene	14 - 18% of total oil
Caryophyllene	8 - 12% of total oil
Farnesene	<1% of total oil
Storage Stability	



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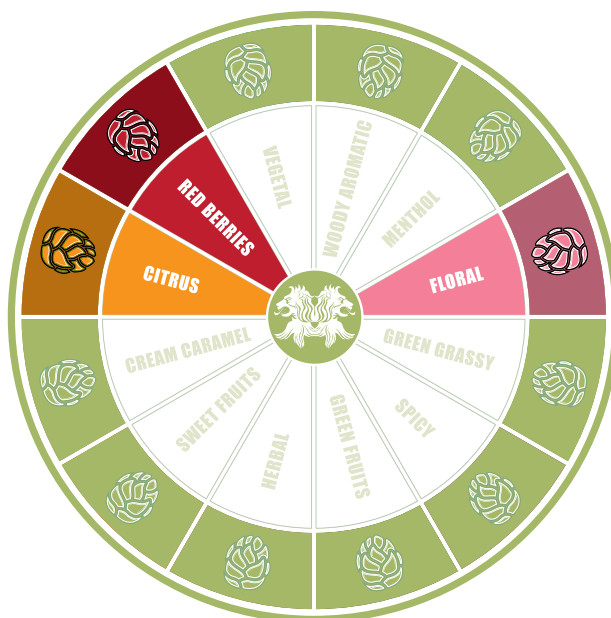
Barbe Rouge

FRENCH AROMA HOP



Barbe Rouge is a French aroma hop developed in the Alsace region with red fruit and floral notes along with a hint of citrus.

Pedigree	
Aroma/Flavor	Red Fruits, Strawberry, Bubble Gum
Alpha Acids*	7.5 - 9.5%
Beta Acids	3.5 - 4.6%
Cohumulone	25 - 28% of alpha acids
Total Oil	1.8 - 2.2 ml/100g
Myrcene	52 - 58% of total oil
Humulene	17 - 21% of total oil
Caryophyllene	3 - 3.3% of total oil
Farnesene	0 - 3% of total oil
Storage Stability	



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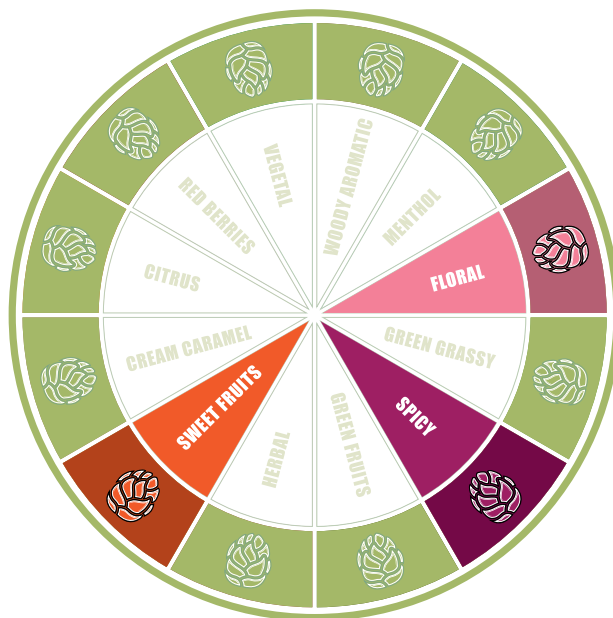
Bru-1™

U.S. EXPERIMENTAL FLAVOR HOP



The experimental variety Bru-1™, developed through Brulotte Farms in the Yakima Valley, exemplifies the bold flavor of new American aroma varieties. The hops have a pleasant fruity character that dominates the aroma, but in beer, Bru-1™ really shines. The Haas Experimental Brewery made a beer dry hopped with 2.0 lbs per barrel of hop, and the beer aroma was described as pineapple, tropical fruit, and spicy. Bru-1™ has shown to pair well with Citra, Chinook, HBC 438, and other U.S. aroma varieties.

Pedigree	
Aroma/Flavor	Fruity, Floral, Spicy
Alpha Acids*	13 - 15%
Beta Acids	8.0 - 10%
Cohumulone	35 - 37% of alpha acids
Total Oil	1.5 - 2.0 ml/100g
Myrcene	50 - 55% of total oil
Humulene	9 - 11% of total oil
Caryophyllene	7 - 8% of total oil
Farnesene	<1% of total oil
Storage Stability	



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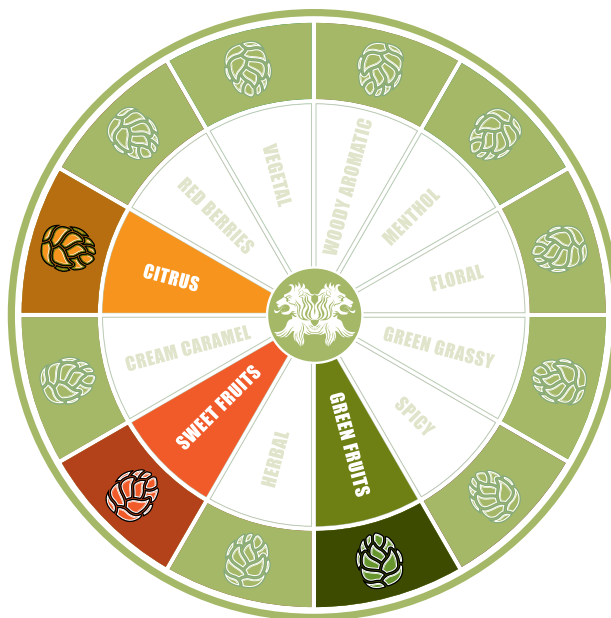


Callista

GERMAN FLAVOR HOP

Callista is a daughter of the well-known variety Hallertau Tradition and carries very beautiful big hop cones. She is named after one of Jupiter's moons and can be used in many beer styles with her impressive fruity and harmonious notes.

Pedigree	Hallertau Tradition and male descendent from Huell
Aroma/Flavor	Citrus, Sweet & GreenFruits
Alpha Acids*	2.0% - 2.5%
Beta Acids	5.0 - 10.0%
Cohumulone	
Total Oil	1.3 - 2.1 ml/100g
Myrcene	63.5% of total oil
Humulene	
Caryophyllene	
Farnesene	
Storage Stability	



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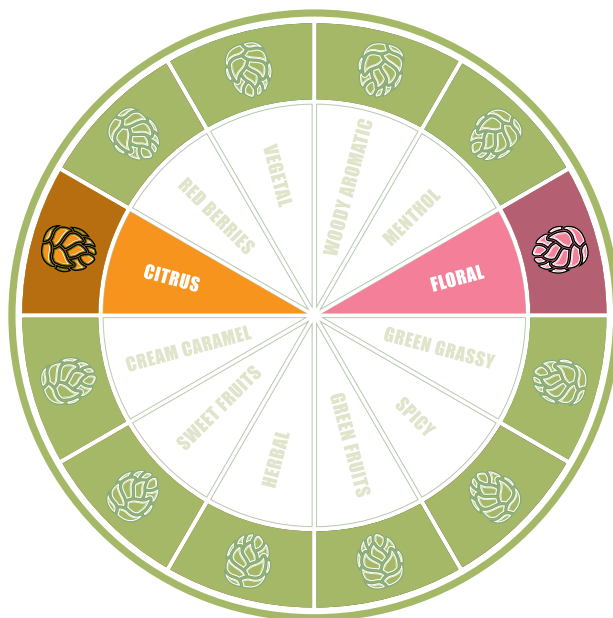


Cascade

U.S. AROMA HOP

Cascade was developed in the USDA breeding program at Oregon State University and released as a U.S. aroma variety in 1972. It is characterized by its dark green elongated cone with an aroma that is of medium strength often described as a distinctive floral, grapefruit-like character. Cascade is the definitive hop for American craft brews.

Pedigree	Cross of English Fuggle with male originating from Russian variety Serebrianka
Aroma/Flavor	Unique floral, Citrus
Alpha Acids*	4.5 - 7.0%
Beta Acids	4.8 - 7.0%
Cohumulone	33 - 40% of alpha acids
Total Oil	0.7 - 1.4 ml/100g
Myrcene	45 - 60% of total oil
Humulene	8 - 13% of total oil
Caryophyllene	3 - 6% of total oil
Farnesene	3 - 7% of total oil
Storage Stability	Very poor



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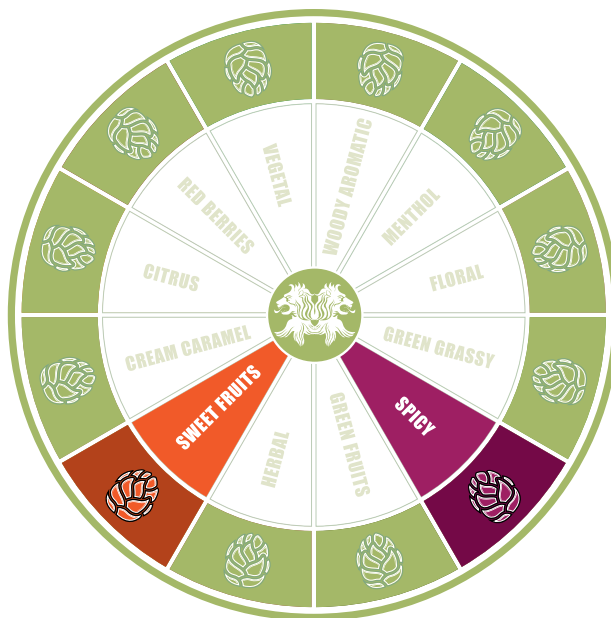
Cashmere

U.S. AROMA HOP



A cross between Cascade and Northern Brewer released by Washington State University in 2013, Cashmere is a dual-purpose stunner evoking coconut, melon, tangerine, and other tropical and spicy notes alongside smooth bitterness.

Pedigree	Cross between Cascade and Northern Brewer
Aroma/Flavor	Stone Fruit, Tropical/Fruit, Spicy
Alpha Acids*	6.9 - 10.1%
Beta Acids	3.5 - 7.1%
Cohumulone	22 - 24% of alpha acids
Total Oil	0.5 - 1.8 ml/100g
Myrcene	39 - 42% of total oil
Humulene	26 - 29% of total oil
Caryophyllene	12 - 13% of total oil
Farnesene	<1% of total oil
Storage Stability	



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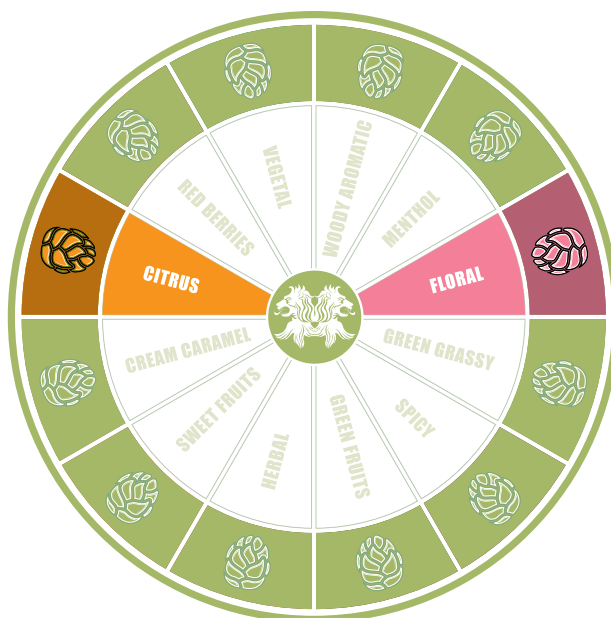


Centennial

U.S. AROMA HOP

Named after the Washington state centennial anniversary in 1989, Centennial is an aroma-type cultivar developed from the USDA hop breeding program at Washington State University in 1974 and released in 1990. Centennial is a well blended aroma hop and is sometimes referred to as Super Cascade.

Pedigree	Combina on of Brewer's Gold, Fuggle, East Kent Golding, and others.
Aroma/Flavor	Floral and Citrus
Alpha Acids*	9.5 - 11.5%
Beta Acids	3.4 - 4.5%
Cohumulone	29 - 30% of alpha acids
Total Oil	1.5 - 2.5 ml/100g
Myrcene	45 - 55% of total oil
Humulene	10 - 18% of total oil
Caryophyllene	5 - 8% of total oil
Farnesene	<1% of total oil
Storage Stability	Fair



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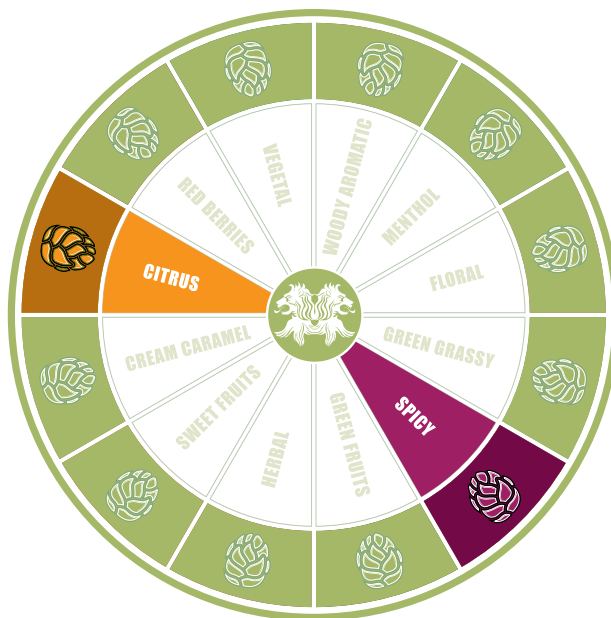


Chinook

U.S. DUAL-PURPOSE HOP

Chinook was developed by the USDA breeding program in Washington state and released in 1985 as a high alpha acids variety. This cultivar takes its name from the Native American tribe indigenous to the region around Washington state. The female parent is one of the English Goldings. The variety has a robust spicy, citrus aroma and grows vigorously in all areas.

Pedigree	Cross of Petham Golding and USDA select male
Aroma/Flavor	Medium intense, spicy, piney, grapefruit
Alpha Acids*	12 - 14%
Beta Acids	3.0 - 4.0%
Cohumulone	29 - 35% of alpha acids
Total Oil	1.7 - 2.7ml/100g
Myrcene	35 - 40% of total oil
Humulene	18 - 23% of total oil
Caryophyllene	9 - 11% of total oil
Farnesene	<1% of total oil
Storage Stability	Good



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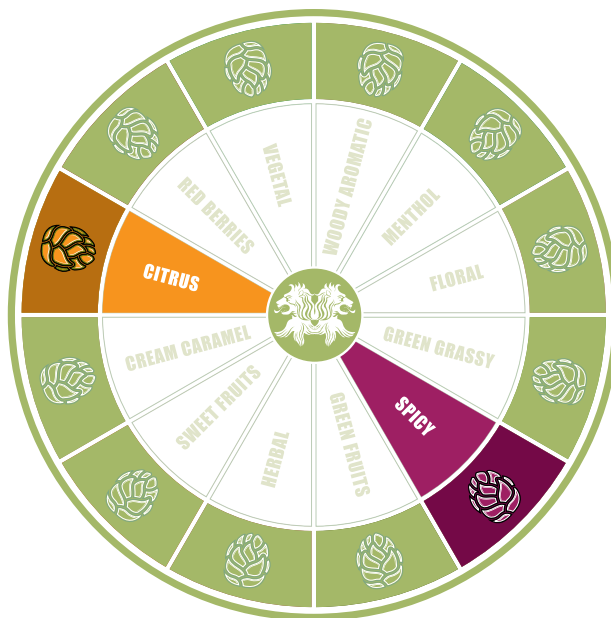


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Pedigree	Cross of Petham Golding and USDA select male
Aroma/Flavor	Medium intense, spicy, piney, grapefruit
Alpha Acids*	12 - 14%
Beta Acids	3.0 - 4.0%
Cohumulone	29 - 35% of alpha acids
Total Oil	1.7 - 2.7ml/100g
Myrcene	35 - 40% of total oil
Humulene	18 - 23% of total oil
Caryophyllene	9 - 11% of total oil
Farnesene	<1% of total oil
Storage Stability	Good



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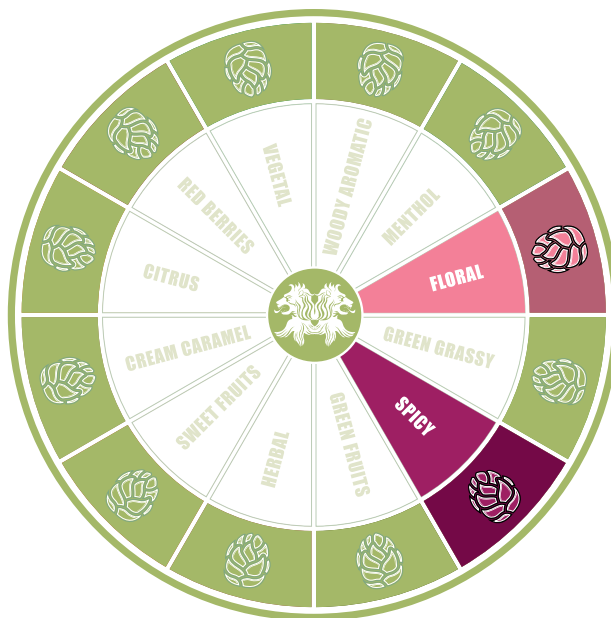


Cluster

U.S. BITTER HOP

Cluster is one of the oldest varieties grown in the U.S. The rootstock origin is uncertain. Until the late 1970's, Cluster was one of only a few varieties grown in the U.S. and dominated the growing acreage. Alpha acids content is medium, aroma is strong and storage stability of the alpha acids is among the best in the world. The variety grows with good vigor and cone production.

Pedigree	Unknown but possibly a cross between English variety and U.S. male hop
Aroma/Flavor	Floral and Spicy
Alpha Acids*	5. - 8.5%
Beta Acids	4.5 - 5.5%
Cohumulone	37 - 43% of alpha acids
Total Oil	0.4 - 0.8 ml/100g
Myrcene	45 - 55% of total oil
Humulene	15 - 18% of total oil
Caryophyllene	6 - 7% of total oil
Farnesene	<1% of total oil
Storage Stability	Excellent



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Columbus

U.S. HIGH ALPHA HOP



The current Super High Alpha varieties, which include the names Columbus, Tomahawk and Zeus (CTZ) have the same female parent as Nugget, making them at least half sisters to Nugget. The CTZ varieties are currently used extensively for beer bittering. However, CTZ's are losing favor due to their very poor storage characteristics and susceptibility to mildews.

Pedigree	Nugget daughter
Aroma/Flavor	Aroma c, Pungent
Alpha Acids*	15 - 17%
Beta Acids	4.5 - 5.0%
Cohumulone	28 - 32% of alpha acids
Total Oil	2.5 - 3.5 ml/100g
Myrcene	50 - 60% of total oil
Humulene	12 - 18% of total oil
Caryophyllene	9 - 11% of total oil
Farnesene	<1% of total oil
Storage Stability	Very poor



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

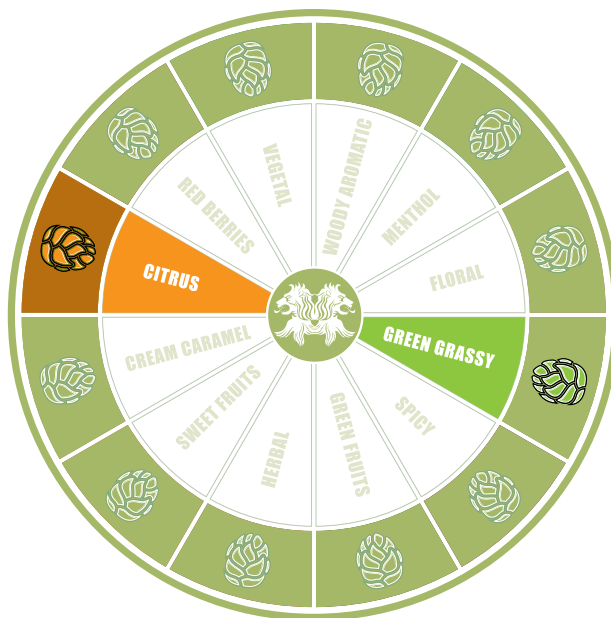


Comet

U.S. AROMA HOP

Comet is a hop variety with relatively high alpha acids content and provides a "wild American" aroma. It was released as high alpha hop from the USDA hop breeding program in 1975 primarily for production in Washington and Idaho. The variety is susceptible to downy mildew but resistant to verticillium wilt.

Pedigree	Open Pollination
Aroma/Flavor	Grassy, Citrus
Alpha Acids*	9.4 - 12.4%
Beta Acids	3.0 - 6.1%
Cohumulone	40 - 45% of alpha acids
Total Oil	1.4 - 3.3 ml/100g
Myrcene	40 - 65% of total oil
Humulene	1 - 2% of total oil
Caryophyllene	5 - 7% of total oil
Farnesene	<1% of total oil
Storage Stability	



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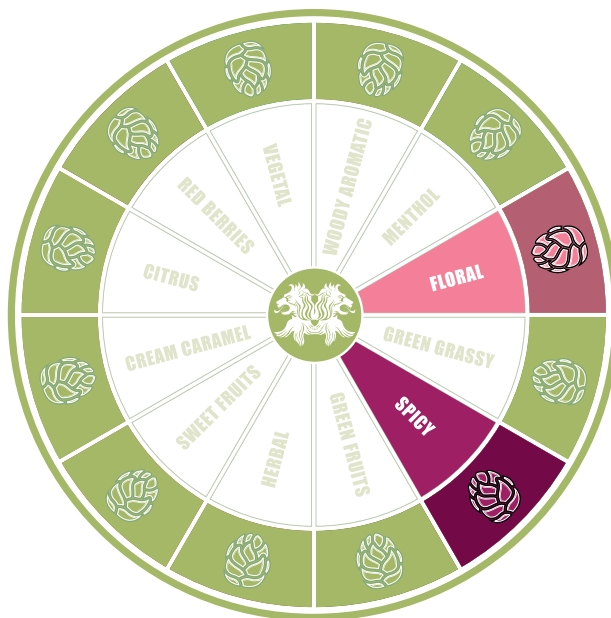


Crystal

U.S. AROMA HOP

Crystal is a triploid variety developed from the German aroma hop variety Hallertauer Mittelfrüh with primary contributions from Cascade, Brewer's Gold and Early Green. Released in 1993 from the USDA breeding program, Crystal has become popular in U.S. craft brewing as a triploid Hallertauer.

Pedigree	Half-sister of Mt. Hood and Liberty derived from Hallertau Mi lefrüh and other crosses
Aroma/Flavor	Mild, Spicy and Floral
Alpha Acids*	4.0 - 6.0%
Beta Acids	5.0 - 6.7%
Cohumulone	20 - 26% of alpha acids
Total Oil	0.8 - 2.1 ml/100g
Myrcene	40 - 65% of total oil
Humulene	18 - 24% of total oil
Caryophyllene	4 - 8% of total oil
Farnesene	<1% of total oil
Storage Stability	Very poor



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HOP VARIETY DATA SHEET

Czech Saaz

CZECH AROMA HOP



Saaz is the famous aroma landrace variety originating in the Czech area of the same name. It has very mild, pleasant noble hoppy notes perfectly suited for and defines the Czech-style pilsner beers.

Pedigree	Czech landrace variety
Aroma/Flavor	Classic noble aroma
Alpha Acids*	3.0 - 6.0%
Beta Acids	4.5 - 8.0%
Cohumulone	23 - 26% of alpha acids
Total Oil	0.4 - 1.0 ml/100g
Myrcene	25 - 40% of total oil
Humulene	15 - 25% of total oil
Caryophyllene	10 - 12% of total oil
Farnesene	14 - 20% of total oil
Storage Stability	Very poor to poor



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HOP VARIETY DATA SHEET



Ekuannot™

U.S. AROMA HOP

Ekuannot (formerly HBC 366) was commercially released in 2014 as “Equinox” by the Hops Breeding Company in Yakima, and subsequently renamed due to trademark issues. It has intense and unique fruity and citrus notes including melon, berry, citrus-lime, apple and papaya. Ekuannot also contains some spicy green pepper note. This hop brand has a high alpha acids content and high essential oil and is known for its vibrant yellow color during its early growth in the spring.

Pedigree	Formerly HBC 366 and Equinox
Aroma/Flavor	Tropical fruit, Fruit, Citrus and Spicy
Alpha Acids*	14.5 - 15.5%
Beta Acids	4.5 - 5.5%
Cohumulone	32 - 38% of alpha acids
Total Oil	2.5 - 4.5 ml/100g
Myrcene	30 - 45% of total oil
Humulene	12 - 20% of total oil
Caryophyllene	8 - 12% of total oil
Farnesene	<1% of total oil
Storage Stability	



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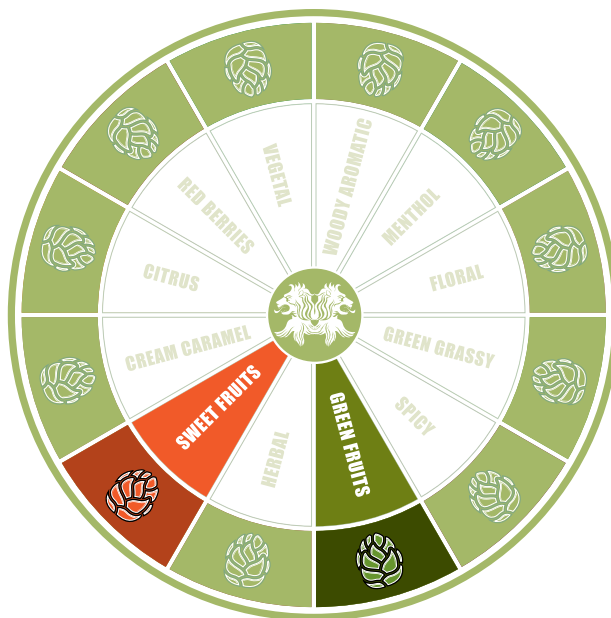


El Dorado®

U.S. AROMA HOP

The El Dorado hop brand was released by CLS Farms, LLC in Moxee Washington in 2010. Little information is available about its pedigree, but it is believed to be derived from a neomexicanus subspecies of *Humulus lupulus*. Its primary flavor character is fruity showing a blend of tropical fruit, watermelon and stone fruit.

Pedigree	
Aroma/Flavor	Tropical fruit, Watermelon, Stone fruit
Alpha Acids*	14 - 16%
Beta Acids	7.0 - 8.0%
Cohumulone	28 - 33% of alpha acids
Total Oil	2.5 - 2.8 ml/100g
Myrcene	55 - 60% of total oil
Humulene	10 - 15% of total oil
Caryophyllene	6 - 8% of total oil
Farnesene	<1% of total oil
Storage Stability	Good



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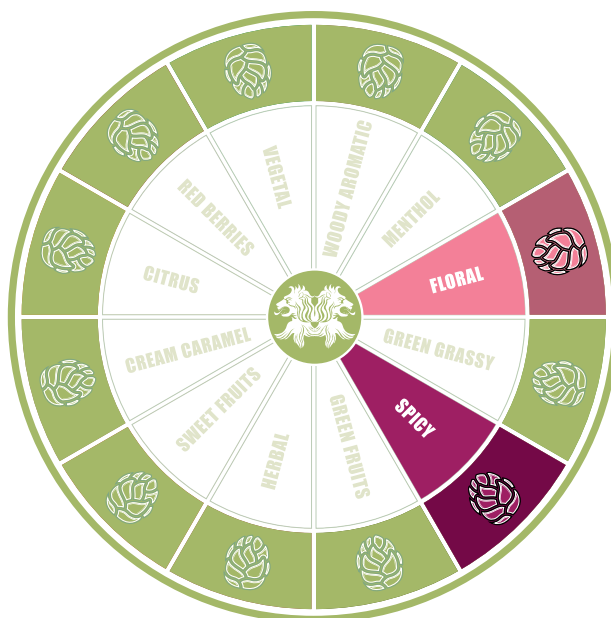
Ella™

AUSTRALIA AROMA HOP



Ella is a versatile flavor hop brand developed through the Hop Products Australia breeding program (part of Barth-Haas Group). The hop contributes a combination of floral aromas with hints of anise. Ella is reminiscent of, yet distinctly different in character to noble European hop brands, and provides a contrast to the citrus and tropical fruit characters of many modern flavor hops. It grows vigorously, producing moderately large, dense cones.

Pedigree	Open Pollination
Aroma/Flavor	Spice, Floral
Alpha Acids*	12.3 - 16.3%
Beta Acids	4.0 - 6.8%
Cohumulone	32 - 38% of alpha acids
Total Oil	1.8 - 2.6 ml/100g
Myrcene	38 - 43% of total oil
Humulene	16 - 22% of total oil
Caryophyllene	13 - 16% of total oil
Farnesene	>2% of total oil
Storage Stability	



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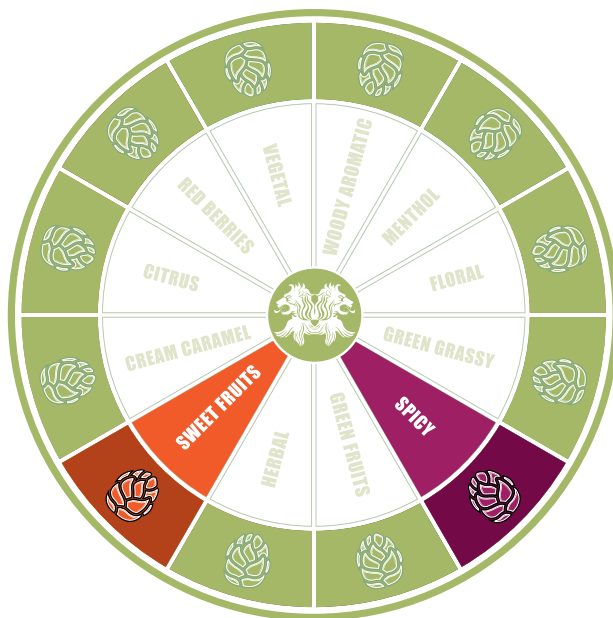
Endeavour

U.K. AROMA HOP



Endeavour is a newly bred dwarf variety from a cross made in 2002 at Wye Hops in the UK. This variety imparts unique English flavor notes to beer - like citrus, spicy and red fruits. Early tests show it to be resistant to powdery and downy mildews.

Pedigree	Seeding of Cascade and granddaughter of Target
Aroma/Flavor	Unique English aroma - Spicy, Fruity
Alpha Acids*	7.5 - 10.6%
Beta Acids	3.8 - 5.3%
Cohumulone	30 - 36% of alpha acids
Total Oil	1.2 - 1.8 ml/100g
Myrcene	27 - 37% of total oil
Humulene	3 - 10% of total oil
Caryophyllene	
Farnesene	5 - 8% of total oil
Storage Stability	Good



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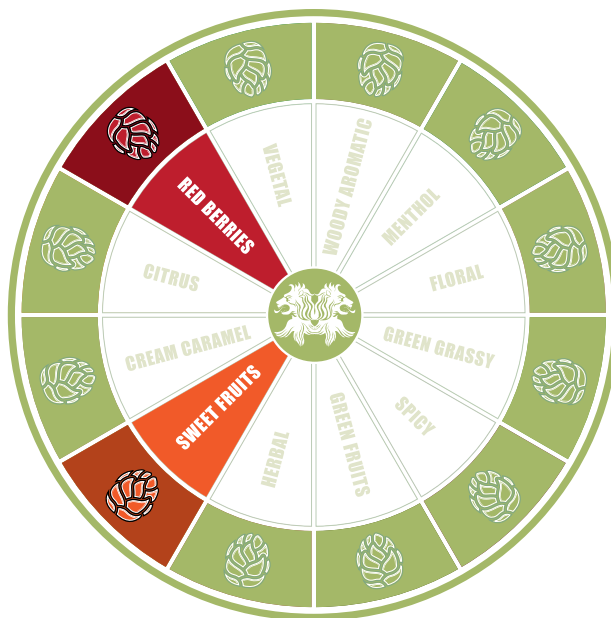


Enigma™

AUSTRALIA AROMA HOP

This hop brand was released by the Hop Products Australia breeding program (Barth-Haas Group). Technically, Enigma is a descendent of Tettnanger, but has a range of flavors more characteristic to that found in a North American Hop. It has a high alpha content, but is known more for its complex fruity character which includes raspberry, red current, light tropical and "Pinot Gris" notes.

Pedigree	Tettnanger, North American hop
Aroma/Flavor	White wine, Red fruits, Light Tropical
Alpha Acids*	14.5 - 16.5%
Beta Acids	4.5 - 6.0%
Cohumulone	37 - 43% of alpha acids
Total Oil	1.8 - 3.0 ml/100g
Myrcene	30 - 35% of total oil
Humulene	12 - 19% of total oil
Caryophyllene	6 - 8% of total oil
Farnesene	7 - 12% of total oil
Storage Stability	



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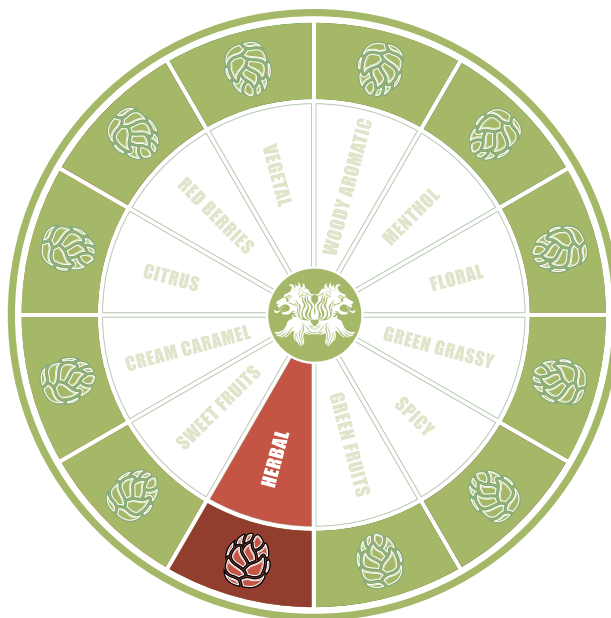


Eureka!™

U.S. HIGH ALPHA HOP

This hop brand produces a very high alpha content approaching 20% but is also noted for its dark fruits aroma including black current. Eureka! also has some herbal and pine notes. Released by Hopsteiner, it was formerly known as Experimental Hop 05256.

Pedigree	Apollo and Merkur
Aroma/Flavor	Black current, dark fruits, herbal, pine
Alpha Acids*	17.0 - 19.9%
Beta Acids	4.6 - 6.0%
Cohumulone	28 - 30% of alpha acids
Total Oil	2.5 - 4.4 ml/100g
Myrcene	
Humulene	
Caryophyllene	
Farnesene	0.1 - 0.3 % of total oil
Storage Stability	



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WILLAMETTE VALLEY HOPS, LLC

ADVANCED PRODUCT DATA SHEET



INTRODUCING FLEX®

Flowable for Efficiency and Flexibility



John I. Haas, Inc. and the Barth-Haas Group introduce FLEX, a beer bittering hop product that provides improved brewhouse efficiency and flexibility. FLEX is designed to reduce wort losses and provide the clean bittering you need for your beer in a convenient, easy to use form. FLEX is formulated purely from hops and is an excellent alternative to standard and concentrated hop pellets and powders. Contact your Barth-Haas Group sales representative to request a trial sample.

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WILLAMETTE VALLEY HOPS, LLC

ADVANCED PRODUCT DATA SHEET

For more than 100 years, Haas and the Barth-Haas Group have been providing innovative hops and hop products that help brewers brew great beer. It all begins with the finest hops that we source directly from our own Haas farms as well as our trusted network of growers. From there we use our proprietary technology, and decades of processing expertise, to produce quality hop products

that brewers demand. Our attention to detail during every step of the process, from the bale – to the industry's best pellets – to our reliable CO₂ technology, is what defines Barth-Haas as a leader in hop innovation. FLEX is the result of listening to brewers and your ever increasing need to effectively and efficiently brew great beers.



FLEX is another example of the quality and innovation that goes into every hop product we make.

HIGH ALPHA ACID CONCENTRATION

FLEX contains approximately 65% alpha acids and provides greater efficiency in shipping and storage as compared to standard pellets and powders.

HIGH BITTERNESS UTILIZATION

Because the alpha acids from FLEX are dosed in a liquid form, bitterness utilization is typically improved over T90 hop pellets by 10-20% (relative).

CONVENIENTLY POURABLE

Our proprietary processing technology results in a CO₂ hop resin with low viscosity at room temperature that makes it easy to measure and dose.

NOTHING BUT PURE HOPS

FLEX is formulated using only hop lupulin components in their native form.

NO HOP SOLIDS!

With FLEX you needn't worry about costly losses and waste disposal associated with wort retention in hop solids. In addition, you'll avoid poor whirlpool performance due to excess trub.

NO SPECIAL DOSING REQUIREMENTS OR CALCULATIONS

It is recommended that FLEX be dosed directly to the brew kettle at the beginning of boil. Use a typical formula for alpha dosing assuming 35% utilization to the final beer; adjust as needed.

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HOP VARIETY DATA SHEET

Fuggle

U.K. AROMA HOP



Named after the Kent grower that introduced it in 1875 and revered ever since as the classic aroma hop for British Bitters and Pale Ales. The variety is often used in combination with Goldings. Fuggle has typical English aroma whose robust character contributes nicely to beer flavor. Sometimes it is used as a distinctive dry hop.

Pedigree	Land variety
Aroma/Flavor	Typical English aroma
Alpha Acids*	3.0 - 5.6%
Beta Acids	2.0 - 3.0%
Cohumulone	25 - 30% of alpha acids
Total Oil	0.7 - 1.4 ml/100g
Myrcene	24 - 28% of total oil
Humulene	33 - 38% of total oil
Caryophyllene	9 - 13% of total oil
Farnesene	5 - 7% of total oil
Storage Stability	Fair



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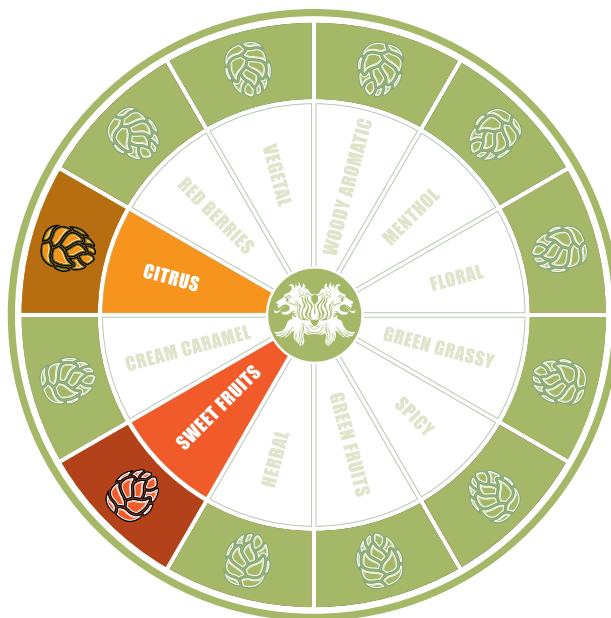


Galaxy™

AUSTRALIA AROMA HOP

The Australian hop brand Galaxy was developed from the breeding program at Hop Products Australia (Barth-Haas Group) and is attracting much attention as a high-impact flavor hop. When used as a late addition, it contributes a striking and distinctive citrus and passion fruit character. Developed and grown exclusively in Australia, Galaxy is a late maturing seedless brand..

Pedigree	Australian high-alpha female and Australian male from Perle
Aroma/Flavor	Intense passion fruit, Citrus
Alpha Acids*	12.5 - 15.5%
Beta Acids	6.0 - 9.0%
Cohumulone	32 - 42% of alpha acids
Total Oil	1.8 - 3.0 ml/100g
Myrcene	39 - 57% of total oil
Humulene	1 - 2% of total oil
Caryophyllene	7 - 13% of total oil
Farnesene	3 - 5% of total oil
Storage Stability	



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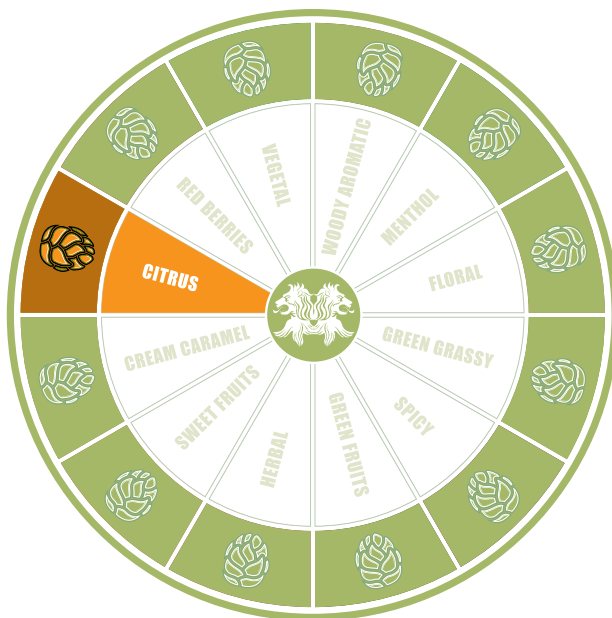


Galena

U.S. HIGH ALPHA HOP

Galena is the ancient Roman term for the mineral galenite which occurs in the soils of Oregon and gives its name to the hop variety grown there. Galena is a high alpha acids variety developed in the USDA breeding program in Idaho and released as a variety in 1978. It is characterized by high alpha acids and a relatively high content of beta acids.

Pedigree	Open Pollination of Brewers Gold
Aroma/Flavor	Mild citrus notes
Alpha Acids*	11.5 - 13.5%
Beta Acids	7.2 - 8.7%
Cohumulone	36 - 40% of alpha acids
Total Oil	0.9 - 1.3 ml/100g
Myrcene	55 - 60% of total oil
Humulene	10 - 13% of total oil
Caryophyllene	3 - 5% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good to excellent



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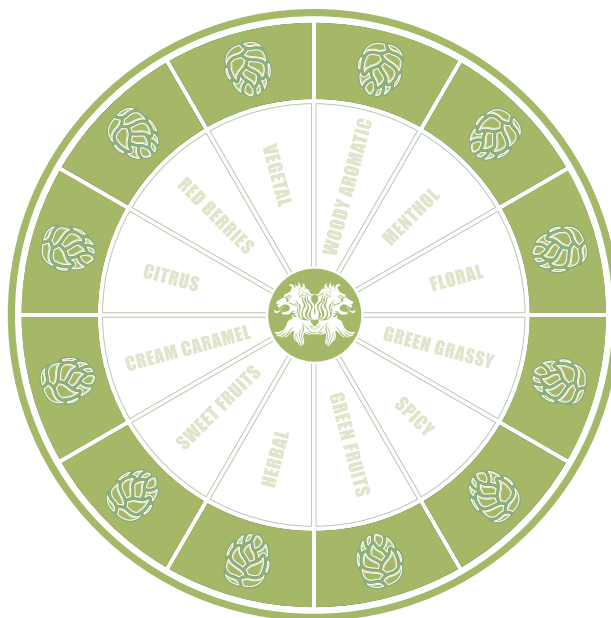


Glacier

U.S. DUAL PURPOSE HOP

Glacier is a dual-purpose hop with well balanced bittering properties and a pleasant aroma profile. It was released from the Washington State University USDA breeding program in 2000, and selected for its low cohumulone content and good yield potential. Glacier exhibits a pleasant hoppy aroma.

Pedigree	Cross between French Elsasser female and USDA experimental male
Aroma/Flavor	Mild and pleasant
Alpha Acids*	3.3 - 9.7%
Beta Acids	5.4 - 9.5%
Cohumulone	11 - 13% of alpha acids
Total Oil	0.7 - 1.6 ml/100g
Myrcene	33 - 62% of total oil
Humulene	24 - 36% of total oil
Caryophyllene	6 - 10% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good



Varieties subject to availability. Contact your Territory Manager to place your order.

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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

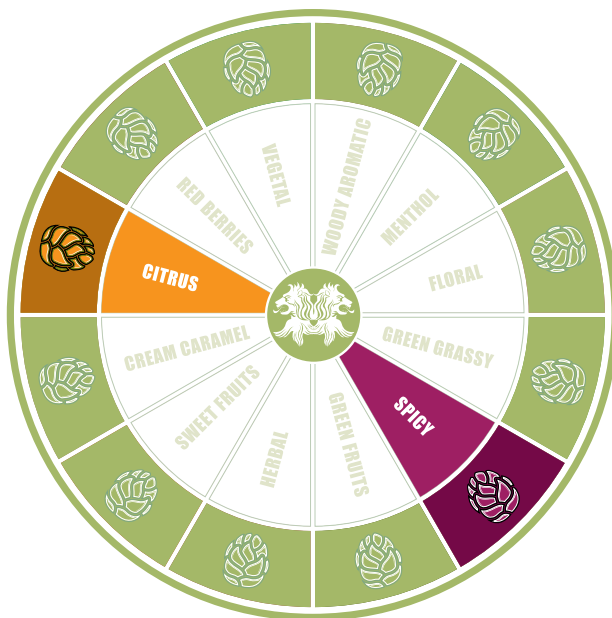
Golding

UK AROMA HOP



Developed from the wild Canterbury Whitebine variety in the late 1700's and brought to the market in 1790. The aroma has been described as gentle, fragrant, and pleasant and is recognized as having a typical English character. Goldings are also found to be useful for late hopping lagers, when a delicate aroma is required.

Pedigree	Clonal selection in 1790
Aroma/Flavor	Spicy with some Citrus
Alpha Acids*	4.5 - 6.5%
Beta Acids	1.9 - 2.8%
Cohumulone	30 - 34% of alpha acids
Total Oil	0.4 - 0.8 ml/100g
Myrcene	18 - 28% of total oil
Humulene	34 - 45% of total oil
Caryophyllene	12 - 17% of total oil
Farnesene	<1% of total oil
Storage Stability	Fair to good



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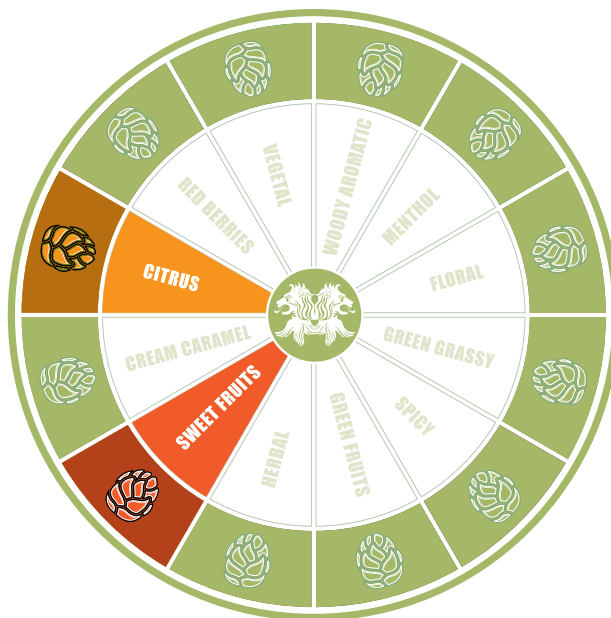
Hallertau Blanc

GERMANY AROMA HOP



Hallertau Blanc is a new German variety with a bouquet of tropical fruits, stone fruits and grapefruit. The variety was bred at Hüll, released in 2012 and is one of the varieties which have been bred and commercialized in response to demand from the craft beer industry's desire for bold tastes and differentiating flavors.

Pedigree	Daughter of Cascade
Aroma/Flavor	Tropical fruit and Grapefruit
Alpha Acids*	9.0 - 12%
Beta Acids	4.5 - 5.5%
Cohumulone	22 - 26% of alpha acids
Total Oil	1.5 ml /100g
Myrcene	70% of total oil
Humulene	0 - 3% of total oil
Caryophyllene	0 - 2% of total oil
Farnesene	<1% of total oil
Storage Stability	



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HOP VARIETY DATA SHEET



Hallertau Mittelfrüh

GERMAN AROMA HOP

Hallertauer Mittelfrueh is the original regional variety of Hallertau and, with its delicate aroma and average bitter content, is still very popular today. This hop variety almost disappeared due to its high susceptibility to wilt. Thanks to a resurgence in demand and newly available virus-free plants, however, the cultivar is currently making a comeback.

Pedigree	Land variety
Aroma/Flavor	Sweet fruits, Citrus, Licorice
Alpha Acids*	3.0 - 5.5%
Beta Acids	3.0 - 5.0%
Cohumulone	No data
Total Oil	0.7 - 1.3 ml/100g
Myrcene	20 - 28% of total oil
Humulene	No data
Caryophyllene	No data
Farnesene	No data
Storage Stability	No data



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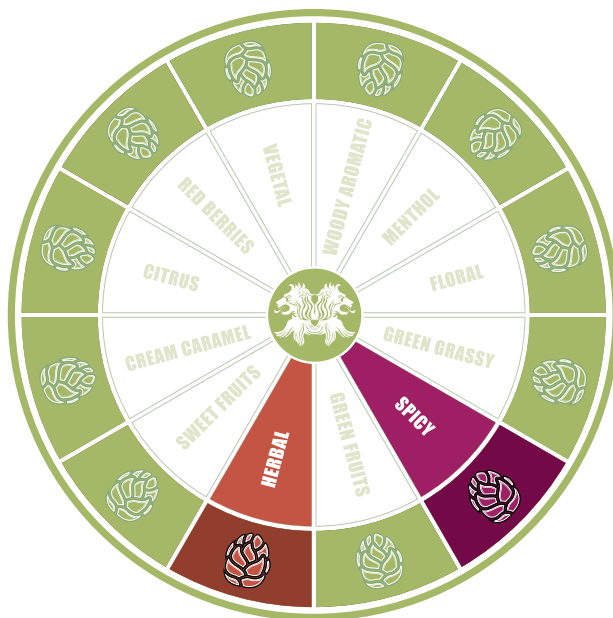


Hallertau Perle

GERMANY AROMA HOP

The combination of good alpha acids content with good aroma gave rise to Perle's popularity. High yields and good tolerance to most diseases make this variety attractive also for growers. Released in 1978, it is well established in Germany and also grown in the U.S. in both Washington and Oregon.

Pedigree	Bred from Northern Brewer
Aroma/Flavor	Herbal, Spicy
Alpha Acids*	4.0 - 9.0%
Beta Acids	2.5 - 4.5%
Cohumulone	29 - 35% of alpha acids
Total Oil	0.5 - 1.5 ml/100g
Myrcene	20 - 35% of total oil
Humulene	35 - 55% of total oil
Caryophyllene	10 - 20% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good to excellent



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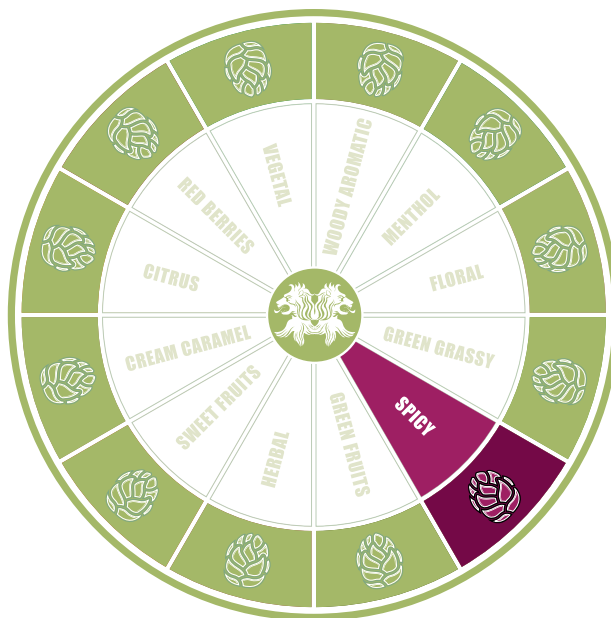
Hallertau Tettnang

GERMANY AROMA HOP



The Tettnanger variety is a traditional and indigenous hop from the Saaz group which is mainly cultivated around Tettnanger on Lake Constance Germany. The unique combination of the favorable climate at Lake Constance and sandy clay soils from the Ice-age produces a very fine aroma. This variety has a good tolerance to plant diseases. Tettnanger is widely used in lager beer styles.

Pedigree	Traditional German landrace variety
Aroma/Flavor	Mild and pleasant, slightly Spicy
Alpha Acids*	2.5 - 5.5%
Beta Acids	3.0 - 5.0%
Cohumulone	22 - 28% of alpha acids
Total Oil	0.5 - 0.9 ml/100g
Myrcene	20 - 35% of total oil
Humulene	22 - 32% of total oil
Caryophyllene	6 - 11% of total oil
Farnesene	16 - 24% of total oil
Storage Stability	Poor



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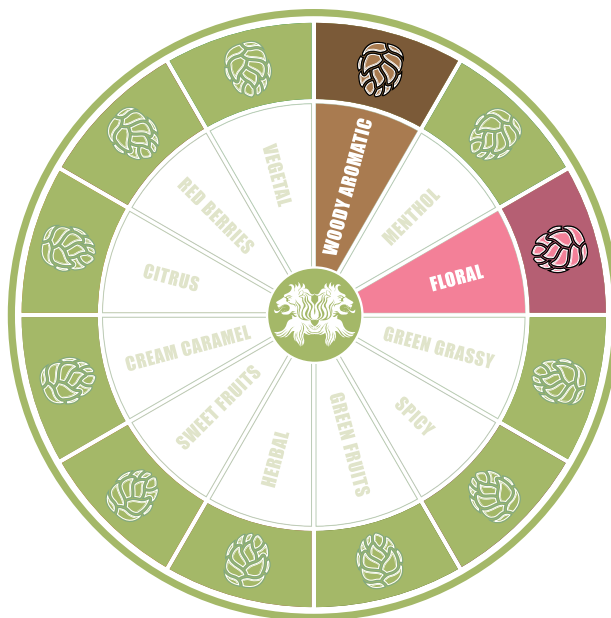
HBC 472

U.S. EXPERIMENTAL FLAVOR HOP



HBC 472 was bred and developed through the Hop Breeding Company (HBC) in the Yakima Valley, Washington and is the result of the open pollination of a wild American hop known as the subspecies *neomexicanus*. The uniqueness of the flavor characteristics HBC 472 gives to beer has generated a great deal of interest in this cultivar among brewers. The aroma of the HBC 472 hop consists of floral, woody, earthy and coconut. In beer this hop delivers a surprising fruity note along with its distinctive “472 coconut-woody character”.

Pedigree	Open Pollination
Aroma/Flavor	Floral, Woody, Coconut
Alpha Acids*	9.0% - 11.0%
Beta Acids	7.0 - 9.0%
Cohumulone	42 - 46% of alpha acids
Total Oil	1.5 - 2.5 ml/100g
Myrcene	30 - 32% of total oil
Humulene	1 - 2% of total oil
Caryophyllene	30 - 32% of total oil
Farnesene	<.02% of total oil
Storage Stability	



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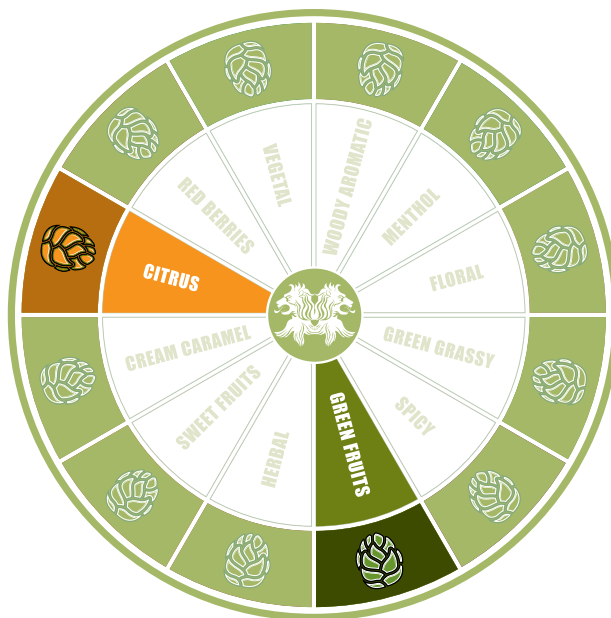
Herkules

GERMANY HIGH AROMA HOP



True to its name, Herkules is a robust, high-yielding high bittering hop cultivar tolerant to various diseases. It was released in 2006 by the Hop Research Center Hüll having an excellent brewing quality combined with a very good storage stability.

Pedigree	Daughter of Taurus
Aroma/Flavor	Robust hoppy, Citrus, Melon
Alpha Acids*	12.0 - 17.0%
Beta Acids	4.0 - 5.5%
Cohumulone	32 - 38% of alpha acids
Total Oil	1.6 - 2.4 ml/100g
Myrcene	30 - 50% of total oil
Humulene	30 - 45% of total oil
Caryophyllene	7 - 12% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

Hersbrucker

GERMANY AROMA HOP



A traditional German variety from the Hersbrucker growing area which exhibits a fine noble aroma but sometimes shows a very low alpha acids content. It is considered as a successor of Hallertauer Mittelfrüh with a good tolerance to diseases.

Pedigree	German land variety
Aroma/Flavor	Noble aroma type
Alpha Acids*	1.5 - 4.0%
Beta Acids	2.5 - 6.0%
Cohumulone	17 - 25% of alpha acids
Total Oil	0.5 - 1.0 ml/100g
Myrcene	15 - 30% of total oil
Humulene	20 - 30% of total oil
Caryophyllene	8 - 13% of total oil
Farnesene	<1% of total oil
Storage Stability	Fair to poor



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Hexahop Gold®

Hexahop Gold® is an aqueous solution, standardised to 10% w/w, comprising a mixture of hexahydro-iso- α -acids and tetrahydro-iso- α -acids produced from CO₂ hop extract using a patented, all-aqueous process. Hexahop Gold® improves foam stand and cling and can be used for light-stable hopping in beers that will be packaged in green or clear glass. Hexahop Gold® imparts clean, smooth bitterness and is especially effective when used to develop low BU beers. Hexahop Gold® will also act as an antimicrobial agent when added to beer. Hexahop Gold® is classified as a modified hop extract which may be safely used in beer in accordance with US FDA regulation 21 CFR 172.560(b) (6) (7).

Product specifications:

Description:	A yellow to amber colored, aqueous solution of the potassium salts of tetrahydro-iso- α -acids and hexahydro-iso- α -acids.
Concentration:	Standard concentration is 10.0% $\pm$ 0.5 of a 50:50 mixture of tetrahydro-iso- α -acids and hexahydro-iso- α -acids by HPLC.
pH:	8.5 – 11.0
Density:	1.020 g/mL (approximately) at 20 °C (68 °F)
Viscosity:	2 - 10 mPas at 20 °C (68 °F)
Solubility:	Soluble in pH-adjusted de-mineralised water, and in alcohol
Iso- α -acids:	< 0.1%

Quality and Food Safety:

The Barth-Haas Group maintains quality management systems registered to the ISO 9001 standard, as well as food safety management programs based on internationally recognised (HACCP) principles. Please refer to our web site (www.barthhaasgroup.com) for more information on our systems and programs.

Product Use:

Hexahop Gold® is normally used after fermentation and before final filtration. Utilisation of Hexahop Gold® in final beer can be expected between 55 - 80% depending on the time and efficiency of dosing (kettle dosing is not advisable, as utilisation can decrease considerably). The point of addition should be close to a region of turbulent flow, e.g. on the suction side of a centrifugal pump. The dosing pump should be adjusted to deliver the Hexahop Gold® over approx. 70% of the total transfer time. It is advisable to make the addition prior to the final filtration step. Local high concentrations of hexa/tetrahydro-iso- α -acids should be avoided and the addition point should be well separated from that of other beer additions. Hexahop Gold® may be added at ambient temperature without prior dilution directly to beer. If dilution is necessary, the use of de-mineralised water with a pH adjustment to 10 – 11 (with KOH) is necessary. Do not use sodium bases to adjust the pH of de-mineralised water – caustic soda or sodium hydroxide form poorly soluble salts with most hop acids.

The amount of Hexahop Gold® is calculated based on the hop product concentration and the assumed utilisation. Conducting trials at the brewery will determine the correct dosage of Hexahop Gold® with regard to sensory bitterness and foam enhancement. Depending on the type of beer, Hexahop Gold® may give 1.0 - 1.3 times the perceived bitterness of normal iso-α-acids. Hexahop Gold® should not be left in dosing lines at low temperatures and we recommend cleaning dosing lines with warm, slightly alkaline de-mineralised water or ethanol after use.

Usage Calculations:

The following calculations are based on the assumption that the mixture of hexahydro-iso-α-acids and of tetrahydro-iso-α-acids is 1.3 times as bitter as iso-α-acids (IAA). Utilisation of hexahydro-iso-α-acids (HHIAA) can be expected to be about 70% or higher when Hexahop Gold® is used as recommended.

Desired Sensory Bitterness Units = BU

$$\text{hexa/tetra pure required in beer (mg/L)} = \frac{\text{BU}}{1.3} \quad (1.3 \text{ assumes sensory bitterness relative to IAA})$$

$$\text{Dosage hexa/tetra pure in mg/L (70\% utilisation assumed)} = \frac{\text{BU}}{1.3} \times \frac{100}{70}$$

$$\text{Dosage in grams hexa/tetra per hL of beer} = \frac{\text{BU}}{1.3} \times \frac{100}{70} \times \frac{100}{1000}$$

Amount of Hexahop Gold® (10% soln) in g/hL :

$$\frac{\text{BU}}{1.3} \times \frac{100}{70} \times \frac{100}{1000} \times \frac{100}{10} \text{ g/hL} = \text{BU} \times 1.10 \text{ g/hL}$$

Amount of Hexahop Gold® (10% soln) in mL/hL :

$$\frac{\text{BU}}{1.3} \times \frac{100}{70} \times \frac{100}{1000} \times \frac{100}{10} \times \frac{1}{1.020} \text{ mL/hL} = \text{BU} \times 1.08 \text{ mL/hL}$$

(e. g. for **5** desired sensory bitterness units $5/1.3 \times 100/70 \times 100/1000 \times 100/10 = \mathbf{5.5}$ g/hL (**5.4** mL/hL) are necessary)

Foam Enhancement:

Calculate required Hexahop Gold® as shown above for final hexa/tetra pure hop acids concentration to typically be between 2 and 5 mg/L for foam enhancement. We recommend that the final concentration of hexa/tetra hop acids not be more than 5 mg/L to prevent excessive foaming effects.

Reduce alternative bittering contribution (kettle or other products) by equivalent BU to compensate for the bitterness of Hexahop Gold®.

Light Stability:

Hexahop Gold® will only provide protection from light-struck flavour if a complete absence of normal iso- α -acids is achieved, therefore no other sources of non-reduced iso- α -acids should exist in the wort or beer streams. Thus for light-stable beers packaged in clear or green glass bottles, all the hop bitterness must be derived from reduced hop acids such as Tetrahop Gold®, Redihop® or Hexahop® products. Iso- α -acids (from equipment or yeast) must not be present in the beer. If beta extracts are used as kettle additives, ensure that the concentration of α -acids and iso- α -acids are below 0.2%

Packaging:

Hexahop Gold® is normally supplied in high-density polythene containers of 20 kg.

Storage and Best-by Recommendation:

Store Hexahop Gold® in full, closed containers at 15 – 25 °C (59 – 77 °F). Prolonged storage at high temperature can cause deterioration. Hexahop Gold® performs best if used within 24 months from the time of production if stored as recommended.

Safety:

Safety Data Sheet (SDS) is available on our website at www.barthhaasgroup.com.

Analytical Methods:

The concentration of hexa- and tetrahydro-iso- α -acids is measured by UV Spectrophotometry (with modified formula factors) or by the EBC Method 7.9 (HPLC). Details of recommended methods are available on request.

Technical Support:

We will be pleased to offer help and advice on the use of Hexahop Gold® in brewing.

HopAid® Antifoam

Purpose

HopAid® Antifoam is used during fermentation to prevent excessive foam formation. It can be used for top and bottom fermented beers in all kinds of fermenters. Produced with deionised water and hop extract is considered food safe in both USA (GRAS) and EU.

Product Specifications

Appearance:	Creamy pale yellow emulsion
Odour:	Slight odour of hops
Solids:	< 12%
Yeast and Moulds*:	< = 10 cfu/g
TVC*:	< = 100 cfu/g
Centrifuge Test:	Pass / Fail

* Values monitored on a regular basis but not on every batch.

Composition

Ingredient	Range
Hop Extract fraction	5 – 10 %
Food grade emulsifier	0.1 – 2 %
Water	Balance

Application

HopAid® Antifoam should be dosed into cold wort. Either inline or, alternatively, dosed into the fermenter before the cold wort is transferred. This will ensure good mixing with the wort which is essential for optimum performance. Dosing into hot wort will lead to unpredictable losses in the hot trub.

Depending on the brewing recipe and fermentation regime the dose rate for most applications will lie between 5 and 50 g/hL. For a normal strength lager type a starting dose rate of 20 g/hL is recommended. However, fermentations with high levels of foam stabilizing substances such as hop acids and proteins, dark malts and higher fermentation temperatures may require higher dosing

rates. Products with high levels of adjuncts may require lower levels of HopAid® Antifoam addition. If the brewer is using a synthetic, silicone based product the dose rate can be used as an indication. In most cases HopAid® Antifoam should be dosed at 2x the concentration as the Silicone based product.

Effect of HopAid® Antifoam on the final beer

Technical studies and feedback from customers have not shown a negative impact on final beer foam, in fact some data suggest a positive one.

HopAid® Antifoam: Yeast and pH

Yeast removes the vast majority of the active components by adsorption on to the cell wall. Any remainder may be removed by filtration.

HopAid® Antifoam is incompatible with strong acids and bases.

Strong acids and strong bases will damage the antifoam, so HopAid® Antifoam should not be added to yeast directly after acid washing of the yeast. Beer pH is fine.

Trial Design:

The trial should consist of 2 initial trial fermentations, both with the same volume of wort and in tanks with the same dimensions. To the first fermentation no HopAid® Antifoam should be added (control sample) and the foam height should be monitored. Ensure that the tank is big enough to include the foam built in the control sample. The second fermentation with HopAid® Antifoam, added in the recommended starting dose rate, should use the same wort volume. To understand the required dose rate and the effects of HopAid® Antifoam, it is important to measure the following attributes if possible:

- Foam height in fermentation tank
- IBUs of the beer
- % of attenuation
- Beer foam stability

Safety

There are no known health hazards for this product. Please consult safety data sheet for full information.

Packaging

HopAid® Antifoam Antifoam is packaged in 1 kg Tetrapacks and 10 kg aluminium foils.

Transport

Transport temperatures should be maintained above 0°C to ensure the product does not freeze

Storage

Ideally store away from direct sunlight and between 5°C and 20°C if unopened. HopAid® Antifoam can be stored in the original unopened containers for up to 15 months. Do not freeze as this will cause the emulsion to collapse. If this occurs the product can be redispersed by shaking to restore its antifoam capacity. Open containers should be stored cool (+5°C) and used within 2 days.



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HOP VARIETY DATA SHEET

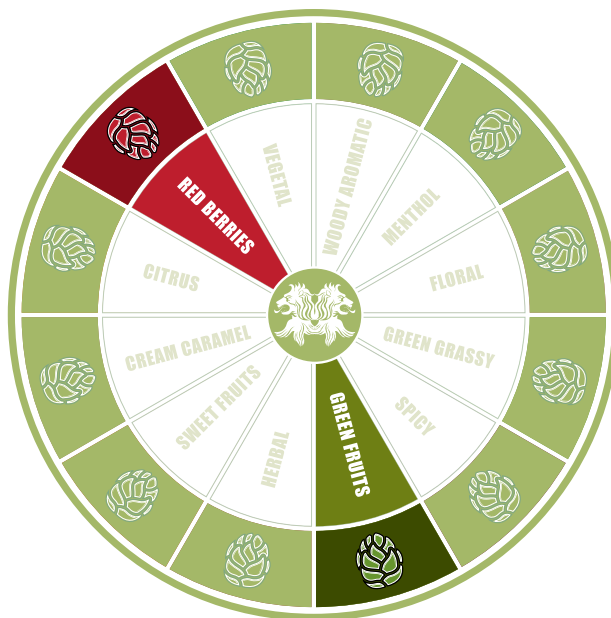


Hüll Melon

GERMANY AROMA HOP

Hüll Melon is a new variety from Germany with distinctive honeydew melon and strawberry aroma. The variety was bred at Hüll, and released in 2012 as one of the varieties bred and commercialized in response to demand from the craft beer industry's desire for bold tastes and differentiating flavors.

Pedigree	Daughter of Cascade
Aroma/Flavor	Distinctive melon
Alpha Acids*	6.9 - 7.5%
Beta Acids	7.3 - 7.9%
Cohumulone	25 - 30% of alpha acids
Total Oil	0.8 ml/100g
Myrcene	36% of total oil
Humulene	10 - 20% of total oil
Caryophyllene	5 - 10% of total oil
Farnesene	<1% of total oil
Storage Stability	



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET



Idaho 7™

U.S. EXPERIMENTAL HOP

Idaho 7 is a U.S. experimental hop variety first released in 2015 from Jackson Hop Farm in Wilder, ID. This variety is used mostly as an aroma hop and for dry hopping due to its strong flavor and aroma. Idaho 7 also has fairly high alpha acids content for bitterness.

Pedigree	U.S. experimental
Aroma/Flavor	Tropical, Citrus, Pine
Alpha Acids*	13.0 - 15.0%
Beta Acids	4.0 - 5.0%
Cohumulone	30 - 40% of alpha acids
Total Oil	1.0 - 1.6 ml/100g
Myrcene	45 - 55% of total oil
Humulene	10 - 20% of total oil
Caryophyllene	5 - 10% of total oil
Farnesene	No data
Storage Stability	No data



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Isohop[®]

Iso- α -acids are the native bittering acids found in traditionally hopped beer. Isohop[®] is a standardised solution of iso- α -acids (30% w/w) produced from CO₂ hop extract using an all-aqueous process. Isohop[®] is used to replace kettle bittering hops to improve hop utilisation or to adjust bitterness in beers that may have been under-hopped in the kettle. For precise control of beer bitterness, Isohop[®] should be added post-fermentation to adjust the bitterness of the beer to the target bitterness units (BU). It may also provide an economic alternative to kettle hopping when performing high-gravity brewing. When hopping does not go according to plan, Isohop[®] will help to get back on target. Isohop[®] will contribute to foam stand and cling similar to that of traditional bitter hopping (whole hops, pellets, or CO₂ extract). Isohop[®] will also act as a natural antimicrobial agent when added to beer. Isohop[®] provides a very good utilisation along with comparatively low costs. Isohop[®] is classified by the U.S. FDA as a modified hop extract that may be safely used in beer in accordance with US FDA regulation 21 CFR 172.560 (b) (2-5).

Product Specifications:

Description:	A pale yellow to amber aqueous solution of the potassium salts of iso- α -acids
Concentration:	Standard concentration is 30.0% $\pm$ 0.5 of iso- α -acids by HPLC
pH:	8.0 – 10.0
Density:	1.075 g/mL (approximately) at 20 °C (68 ° F)
Viscosity:	10 - 20 mPas at 20°C (68°F)
Solubility:	Soluble in pH-adjusted de-mineralised water, and in alcohol
α -acids:	< 0.7%
β -acids:	< 0.3%

Quality and Food Safety:

The Barth-Haas Group maintains quality management systems registered to the ISO 9001 standard, as well as food safety management programs based on internationally recognised (HACCP) principles. Please refer to our web site (www.barthhaasgroup.com) for more information on our systems and programs.

Product Use:

Isohop[®] is normally used after fermentation and before final filtration. Utilisation of Isohop[®] in final beer is typically between 60 - 90% depending on the time and efficiency of dosing. If Isohop[®] is used in the brewhouse, utilisation may be expected at 50 - 60%. The preferred point of post-fermentation addition is close to a region of turbulent beer flow, e.g. on the suction side of a centrifugal pump. The dosing pump should be adjusted to deliver the Isohop[®] over approx. 70% of the total transfer time. It is advisable to make the addition prior to the final filtration step. Local high concentrations of iso- α -acids should be avoided in the beer stream and the addition point should be well separated from that of any other additions. Isohop[®] may be added at ambient temperature without prior dilution directly to beer. Dilution is not advised, but if necessary, the use of de-mineralised water and a pH adjustment to 9 - 10 with KOH is recommended. Do not use sodium

bases to adjust the pH of dilution water; caustic soda or sodium hydroxide form poorly soluble salts with most hop acids.

The amount of Isohop[®] needed for dosing is calculated based on the product concentration and the assumed utilisation. Conducting trials at the brewery will determine the correct dosage of Isohop[®] in regard to sensory bitterness. Isohop[®] will give similar bitterness as that of traditional iso- α -acids. Following dosing, we recommend cleaning lines and dosing pumps with warm slightly alkaline demineralised water or ethanol immediately after each use.

Usage Calculations for Bitterness Adjustment:

The following calculations are based on an assumed utilisation of 80%.
(IAA = iso- α -acids).

Desired Sensory Bitterness Units = BU

$$\text{Dosage IAA in mg/L (80\% utilisation)} = \text{BU} \times \frac{100}{80}$$

$$\text{Dosage in grams IAA per hL of beer} = \text{BU} \times \frac{100}{80} \times \frac{100}{1000}$$

Dosage amount of Isohop[®] (30% IAA) in g/hL :

$$\text{BU} \times \frac{100}{80} \times \frac{100}{1000} \times \frac{100}{30} \text{ g/hL} = \text{BU} \times 0.42 \text{ g/hL}$$

Amount of Isohop[®] (30% IAA) in mL/hL :

$$\text{BU} \times \frac{100}{80} \times \frac{100}{1000} \times \frac{100}{30} \times \frac{1}{1.075} \text{ mL/hL} = \text{BU} \times 0.39 \text{ mL/hL}$$

(e. g. for 5 desired sensory bitterness units $5 \times 100/80 \times 100/1000 \times 100/30 = 2.1$ g/hL 30% Isohop[®] is necessary if utilisation is 80%)

Packaging:

Isohop[®] is normally supplied in high-density polyethylene containers of 20 kg or 10 kg. Larger package units are available on request.

Storage and Best-by Recommendations:

Store Isohop[®] in full, closed containers at 2 – 8 °C (36 – 46 °F). Prolonged storage at high temperature can cause deterioration. Isohop[®] performs best if used within 24 months from the time of production if stored as recommended.

Safety:

Any material coming into contact with the skin should be washed off with soap and water. For more information, refer to the relevant Safety Data Sheet (SDS).

Analytical Methods:

The determination of iso- α -acids comprises three types of methods, the specific measurement of iso- α -acids by means of HPLC, spectrophotometric or conductometric methods. In regard to the spectrophotometric method, please note that the optical density multiplication factor in the formula needs to be adjusted from 50 to 70.

- o EBC 7.8 for Iso- α -acids, α -acids, β -acids by HPLC
- o EBC 7.9 for Iso- α -acids
- o ASBC Hops-16 (Iso- α -, α -, and β -acids in Hop Extracts and Isomerised Hop Extracts by HPLC

Technical Support:

We will be pleased to offer help and advice on the use of Isohop[®] in brewing.



WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

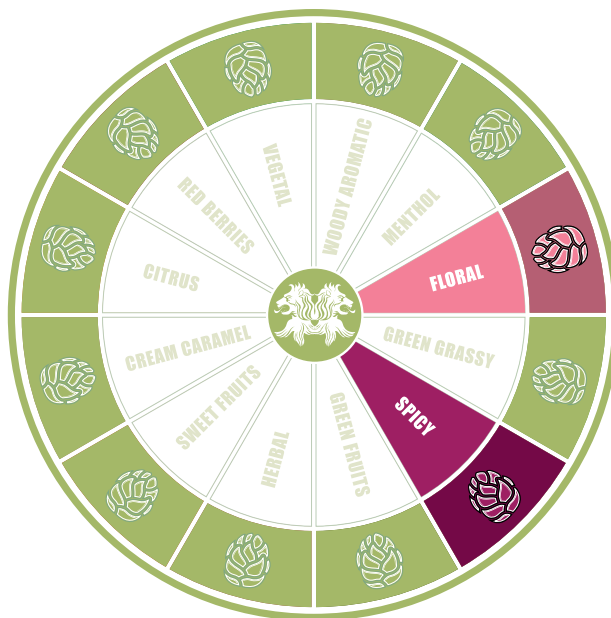


Liberty

U.S. AROMA HOP

Liberty is a triploid variety bred as a cross between a female Hallertau Mittlefrüh and a downy mildew resistant German male hop. The variety was developed in 1983 from the USDA program at Oregon State University and released in the U.S. in 1991. Of the four triploid Hallertau Mittlefrüh varieties released, Liberty most closely resembles the Hallertau Mittlefrüh.

Pedigree	Triploid from Hallertau Mittlefrüh and German aroma male hop
Aroma/Flavor	Mild, slightly Spicy, Floral
Alpha Acids*	3.0 - 5.0%
Beta Acids	3.0 - 4.0%
Cohumulone	24 - 30% of alpha acids
Total Oil	0.6 - 1.2 ml/100g
Myrcene	20 - 40% of total oil
Humulene	35 - 40% of total oil
Caryophyllene	9 - 12% of total oil
Farnesene	<1% of total oil
Storage Stability	Poor to fair



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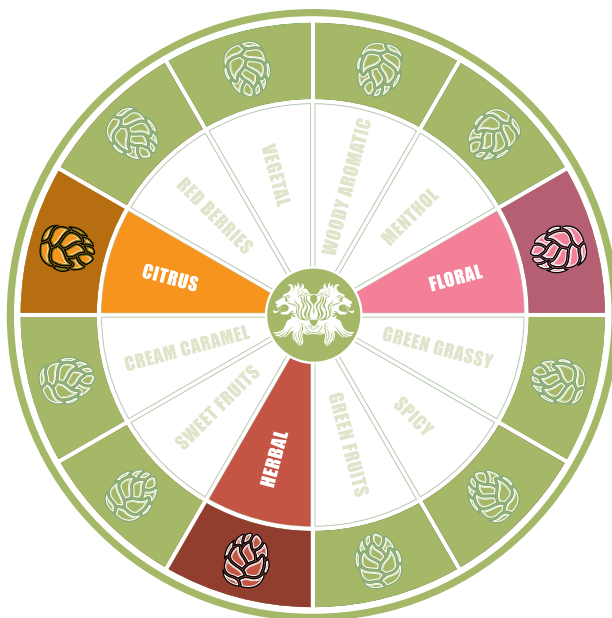


Loral™

U.S. AROMA HOP

Loral™ is a hop brand developed by the Hop Breeding Company and released in 2016; previously known as HBC 291. It provides pleasant floral and herbal notes reminiscent of a noble aroma hop. Loral's mother is U.S. Glacier and her grandmother the long established French noble aroma variety Tardif de Bourgogne. The father is a son of the Nugget variety. Loral is characterized by having numerous small, dense cones with moderate alpha acids.

Pedigree	U.S. Glacier and U.S. Nugget
Aroma/Flavor	Floral, Herbal, Citrus
Alpha Acids*	10.0 - 12.0%
Beta Acids	4.5 - 5.5%
Cohumulone	21 - 23% of alpha acids
Total Oil	1.5 - 2.5 ml/100g
Myrcene	37 - 39% of total oil
Humulene	23 - 25% of total oil
Caryophyllene	6 - 8% of total oil
Farnesene	>1% of total oil
Storage Stability	Good



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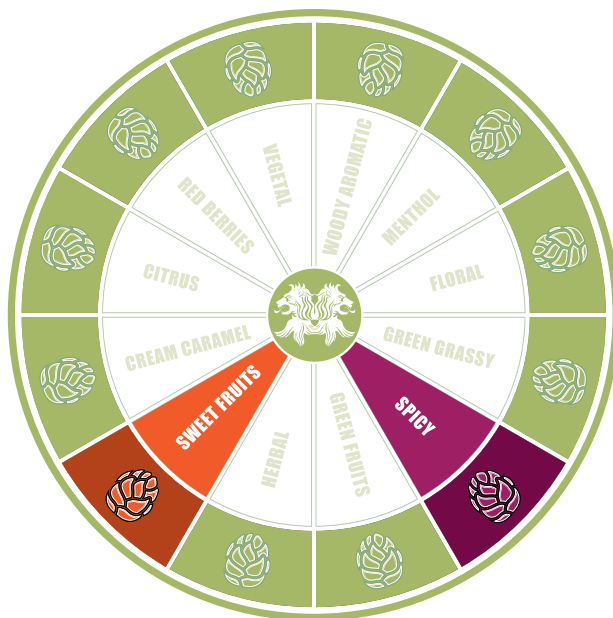
Magnum

GERMANY HIGH ALPHA HOP



This high alpha variety was bred in 1980 at Hüll Hop Research Center in Germany and is known for its extremely large and heavy cones. It produces good yields, and like many of the Hüll varieties, Hallertauer Magnum has a high tolerance to disease.

Pedigree	Daughter of U.S. Galena
Aroma/Flavor	Spicy, some Fruity
Alpha Acids*	11.0 - 16.0%
Beta Acids	5.0 - 7.0%
Cohumulone	21 - 29% of alpha acids
Total Oil	1.6 - 2.6 ml/100g
Myrcene	30 -45% of total oil
Humulene	30 - 45% of total oil
Caryophyllene	8 - 12% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good



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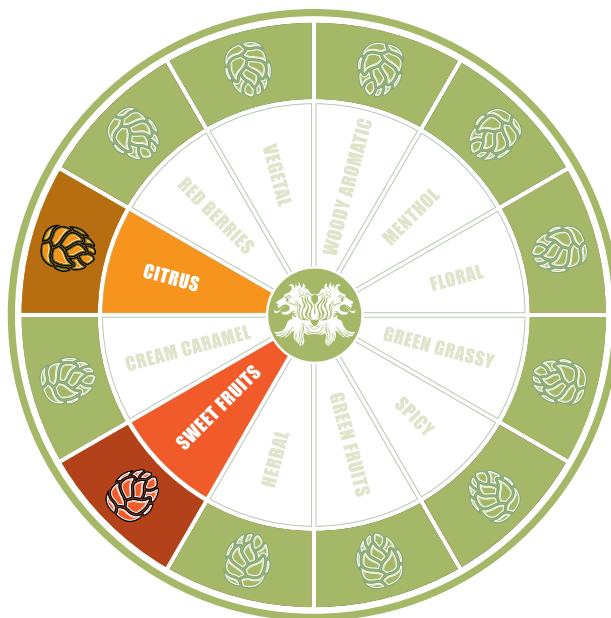
Mandarina Bavaria

GERMANY AROMA HOP



Mandarina Bavaria is a new German hop with a pleasant fruitiness and very distinctive tangerine and citrus notes. The variety was bred at Hüll and was released in 2012 in response to demand from the craft beer industry and its desire for bold tastes and differentiating flavors.

Pedigree	Daughter of Cascade
Aroma/Flavor	Fruity, Citrus
Alpha Acids*	7.0 - 10.0%
Beta Acids	5.0 - 6.5%
Cohumulone	31 - 35% of alpha acids
Total Oil	2.2 ml/100g
Myrcene	71% of total oil
Humulene	5 - 15% of total oil
Caryophyllene	1 - 5% of total oil
Farnesene	<1% of total oil
Storage Stability	



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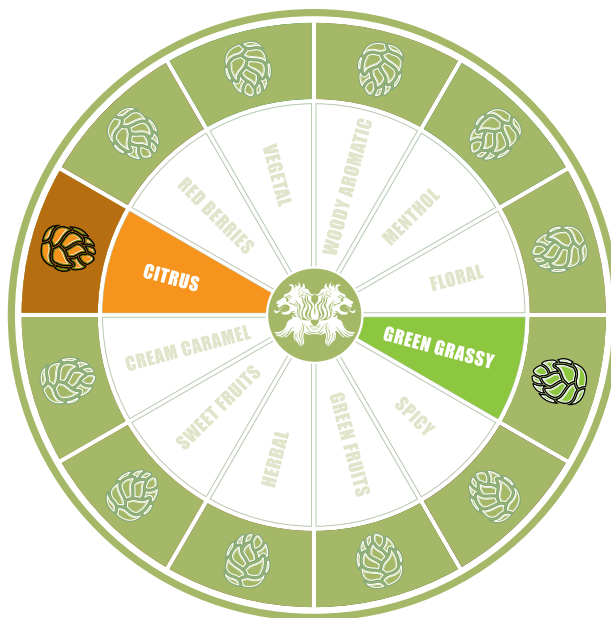
Marynka

POLISH BITTERING HOP



This variety is popular due to its aroma characteristics but also on account of its bitter characteristics.

Pedigree	Brewers Gold Daughter
Aroma/Flavor	Citrus, Grassy
Alpha Acids*	9.0% - 12.0 %
Beta Acids	10.2 %- 13.0 %
Cohumulone	No Data
Total Oil	1.8 - 2.2 ml/100g
Myrcene	28.0 - 31.0 % of total
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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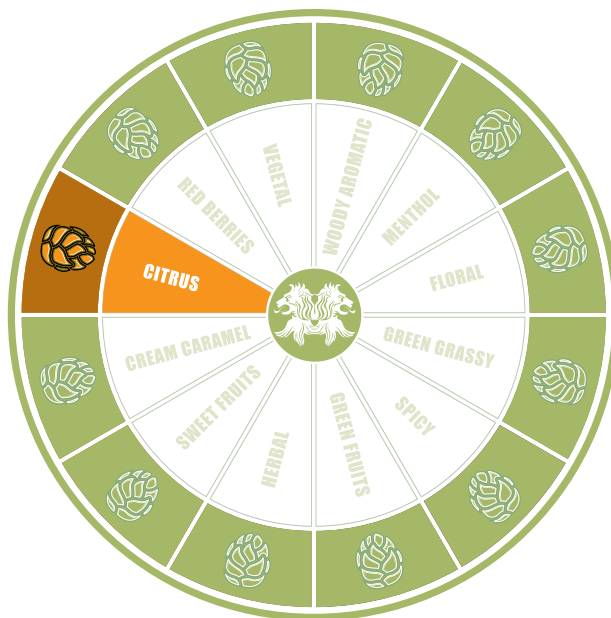


Merkur

GERMANY HIGH ALPHA HOP

Merkur is a high-alpha variety bred at the Hop Research Center in Hüll Germany and was registered in 2001. It shows good resistance to powdery mildew and moderate agronomic yield.

Pedigree	Cross between Hallertau Magnum and German experimental variety
Aroma/Flavor	Earthy and Citrus
Alpha Acids*	12.0 - 14.0%
Beta Acids	4.5 - 5.5%
Cohumulone	18 - 20% of alpha acids
Total Oil	2.0 - 3.0 ml/100g
Myrcene	45 - 50% of total oil
Humulene	28 - 32% of total oil
Caryophyllene	8 - 10% of total oil
Farnesene	<1% of total oil
Storage Stability	Fair



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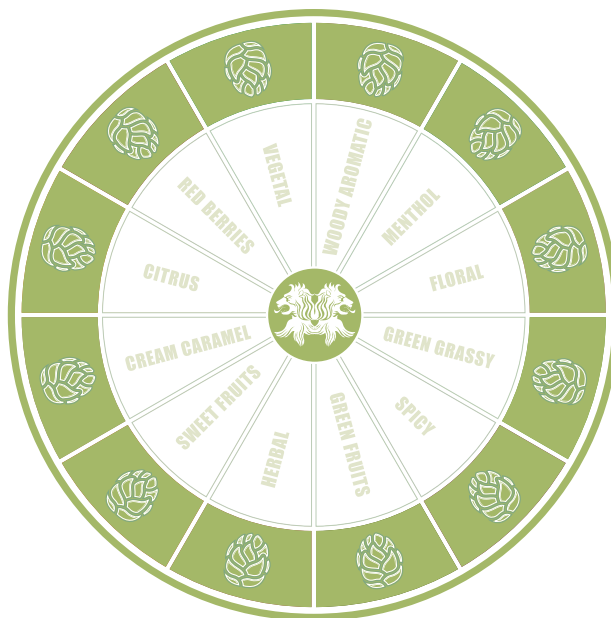


Millenium®

U.S. HIGH ALPHA HOP

Millenium is a high alpha hop brand developed through the John I. Haas, Inc. breeding program and released in 2000, the turn of the millenium. With Nugget as the mother, this triploid brand exhibits the same powdery mildew resistance as Nugget and its brewing profile is comparable to that of Nugget and Columbus-type varieties.

Pedigree	Triploid high alpha; Nugget mother
Aroma/Flavor	Mild, somewhat pungent
Alpha Acids*	14.5 - 16.5%
Beta Acids	4.3 - 5.3%
Cohumulone	28 - 32% of alpha acids
Total Oil	1.8 - 2.2 ml/100g
Myrcene	30 - 40% of total oil
Humulene	23 - 27% of total oil
Caryophyllene	9 - 12% of total oil
Farnesene	>1% of total oil
Storage Stability	Excellent



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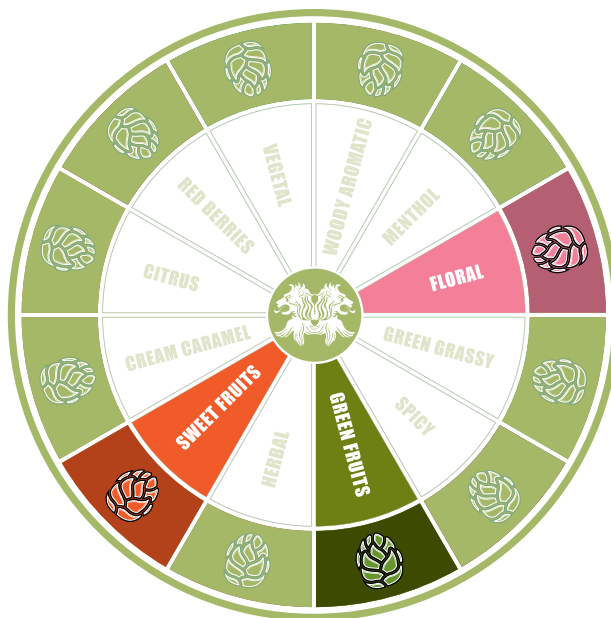
Mistral

FRENCH DUAL-PURPOSE HOP



Mistral is a French dual-purpose hop developed and released by the Institute of Hop Research and Brewing in the Alsace region of France. It's subtle character presents fruity, rose and melon notes.

Pedigree	No data
Aroma/Flavor	Sweet fruits, Melon, Rose
Alpha Acids*	5.1%
Beta Acids	3.1 - 3.8%
Cohumulone	No data
Total Oil	0.8 - 1.5 ml/100g
Myrcene	No data
Humulene	No data
Caryophyllene	No data
Farnesene	No data
Storage Stability	No data



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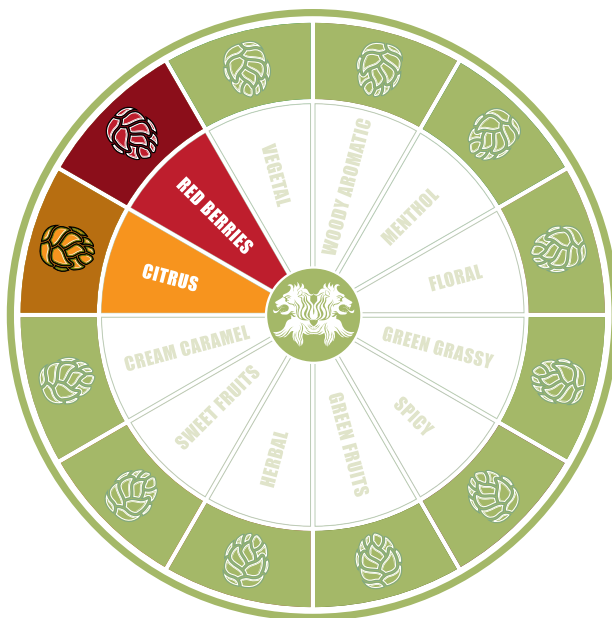
Monroe™

GERMAN AROMA HOP



The new hop variety Monroe established itself similarly extravagant as who it was named after. With an alpha content of only 2.5 % and an oil content of 0.95 ml/100 g, Monroe showcases itself at the beginning as mild and smooth. When you add the hop to a beer, then she shows her true colors: exactly like everyone remembers Marilyn Monroe in a red dress. A guise full of red aromas. In the nose, there are wonderful raspberry notes supplemented with orange syrup and added to this in the taste is the sweet taste that reminds one of summer and cherries.

Pedigree	From wild U.S. variety
Aroma/Flavor	Red berries, Citrus
Alpha Acids*	2.5%
Beta Acids	No data
Cohumulone	No data
Total Oil	0.95 ml/100g
Myrcene	No data
Humulene	No data
Caryophyllene	No data
Farnesene	No data
Storage Stability	No data



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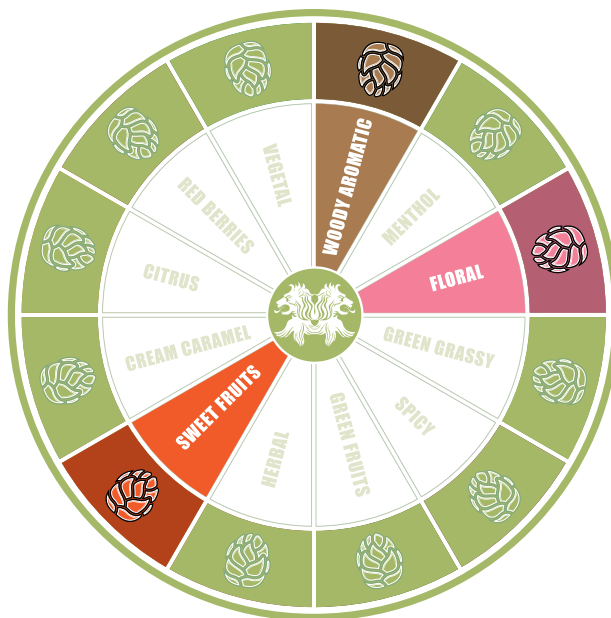


Mosaic®

U.S. AROMA HOP

Mosaic is an aroma hop brand developed by Hop Breeding Company LLC (John I. Haas, Inc. and Select Botanicals Group) and released in 2012. Mosaic offers a unique and complex blend of floral, tropical, fruity, and earthy characteristics that translate very favorably into several styles of beer. Mosaic is the daughter of YCR 14 Simcoe® and a Nugget derived male.

Pedigree	Daughter of Simcoe® and Nugget male
Aroma/Flavor	Floral, Fruity
Alpha Acids*	11.5 - 13.5%
Beta Acids	3.2 - 3.9%
Cohumulone	24 - 26% of alpha acids
Total Oil	1.0 - 1.5 ml/100g
Myrcene	47 - 53% of total oil
Humulene	13 - 16% of total oil
Caryophyllene	5 - 8% of total oil
Farnesene	0% of total oil
Storage Stability	Very good



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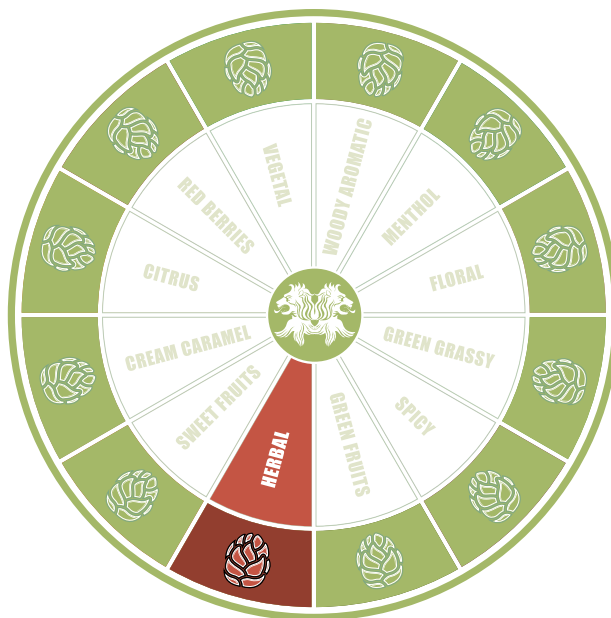


Mount Hood

U.S. AROMA HOP

Mt. Hood is an aroma variety released in 1989 from the USDA breeding program in Oregon. The variety is a triploid daughter of Hallertauer Mittlefrüh and a sister to Liberty with analytical data similar to both. It has low alpha acids and beta acids content, low cohumulone, and high humulene in the essential oil. Mount Hood exhibits a pleasant, mild aroma.

Pedigree	Triploid daughter of Hallertau Mittlefrüh and Liberty
Aroma/Flavor	Mild, Herbal, somewhat pungent
Alpha Acids*	4.0 - 7.0%
Beta Acids	5.0 - 8.0%
Cohumulone	21 - 23% of alpha acids
Total Oil	1.2 - 1.7 ml/100g
Myrcene	30 - 40% of total oil
Humulene	30 - 38% of total oil
Caryophyllene	13 - 16% of total oil
Farnesene	>1% of total oil
Storage Stability	Poor



Varieties subject to availability. Contact your Territory Manager to place your order.

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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET



Northern Brewer

U.K. DUAL PURPOSE HOP

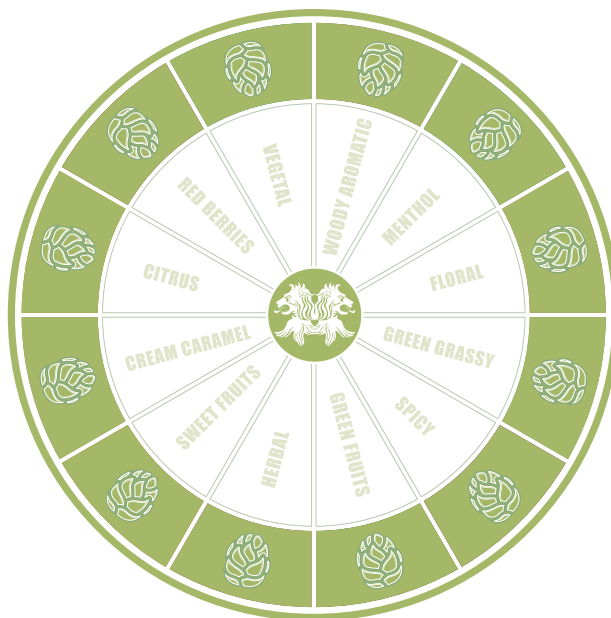
Bred in England in 1934, this variety was developed specifically for Scottish & Newcastle Breweries and originally grown in the North of England - hence its name. It has a high alpha content and is currently one of the main varieties in the German Hallertau region, where it has developed good aroma qualities by adapting to climate and soil. Northern Brewer is wilt-resistant.



A

b

Pedigree	Canterbury Golding crossed with male seedling of Brewers Gold
Aroma/Flavor	Medium intensity, Pine, Minty notes
Alpha Acids*	6.0 - 10.0%
Beta Acids	3.0 - 5.0%
Cohumulone	27 - 32% of alpha acids
Total Oil	1.0 - 1.6 ml/100g
Myrcene	25 - 45% of total oil
Humulene	35 - 50% of total oil
Caryophyllene	10 - 20% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good



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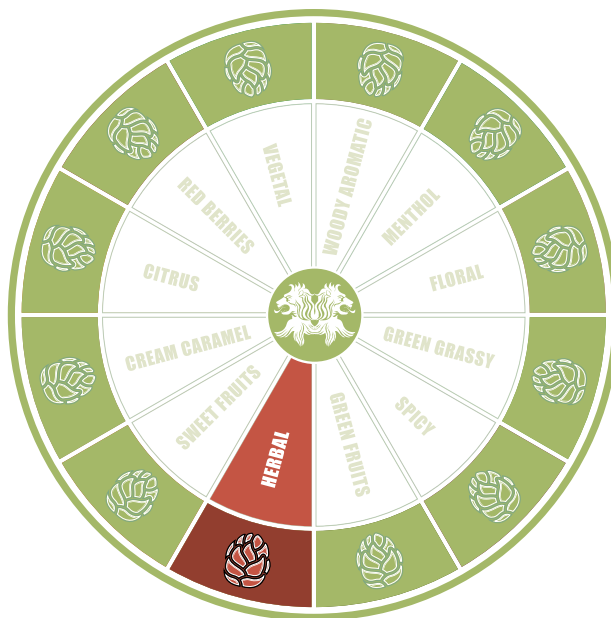


Nugget

U.S. HIGH ALPHA HOP

Nugget is a high alpha variety with high yield originally developed through the USDA program at Oregon State University from a cross made in 1970 and registered much later in 1984. The variety is tolerant to a wide range of soil conditions and thus grows vigorously in all areas. Nugget is also grown in the German Hallertau but shows a bit lower alpha content there.

Pedigree	Daughter of Brewers Gold
Aroma/Flavor	Mild, pleasant Herbal
Alpha Acids*	11.5 - 14.0%
Beta Acids	3.0 - 5.0%
Cohumulone	22 - 30% of alpha acids
Total Oil	0.9 - 1.3 ml/100g
Myrcene	27 - 42% of total oil
Humulene	16 - 19% of total oil
Caryophyllene	7 - 10% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good to excellent



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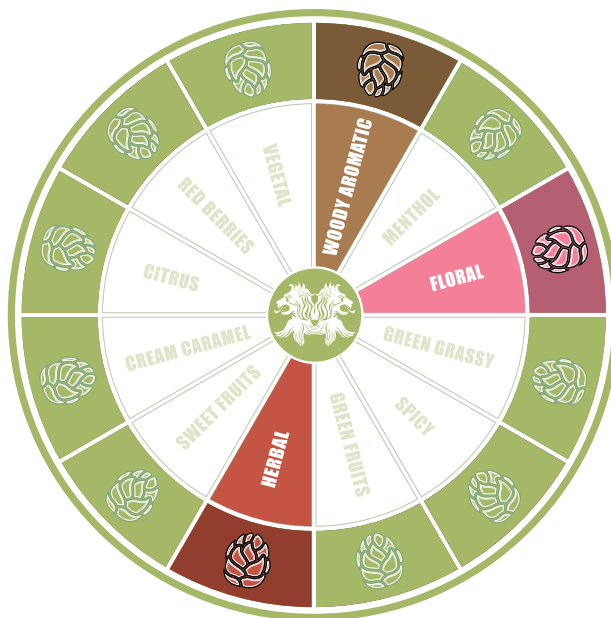


Pahto™

U.S. HIGH ALPHA HOP

Pahto is a U.S. High Alpha Hop - formerly known as HBC 682. This variety is named after the native word for Mount Adams in Washington state. It is useful as a bittering hop, produces high yield rates and is resistant to disease.

Pedigree	No data
Aroma/Flavor	Floral, Herbal, Earthy
Alpha Acids*	17 - 20%
Beta Acids	4.5 - 6.0%
Cohumulone	300 - 32% of alpha acids
Total Oil	1.0 - 2.5 ml/100g
Myrcene	60 - 70% of total oil
Humulene	8 - 12% of total oil
Caryophyllene	4 - 6% of total oil
Farnesene	No data
Storage Stability	No data



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General:

PHA[®] Classic products are prepared from cone hops by specific extraction and distillation methods. They consist of original hop oil compounds in a propylene glycol (PG) solution. PG is a permitted carrier for flavours as per regulation 2006/52/EC. PHA[®] products are exclusively supplied worldwide by the Barth-Haas Group.

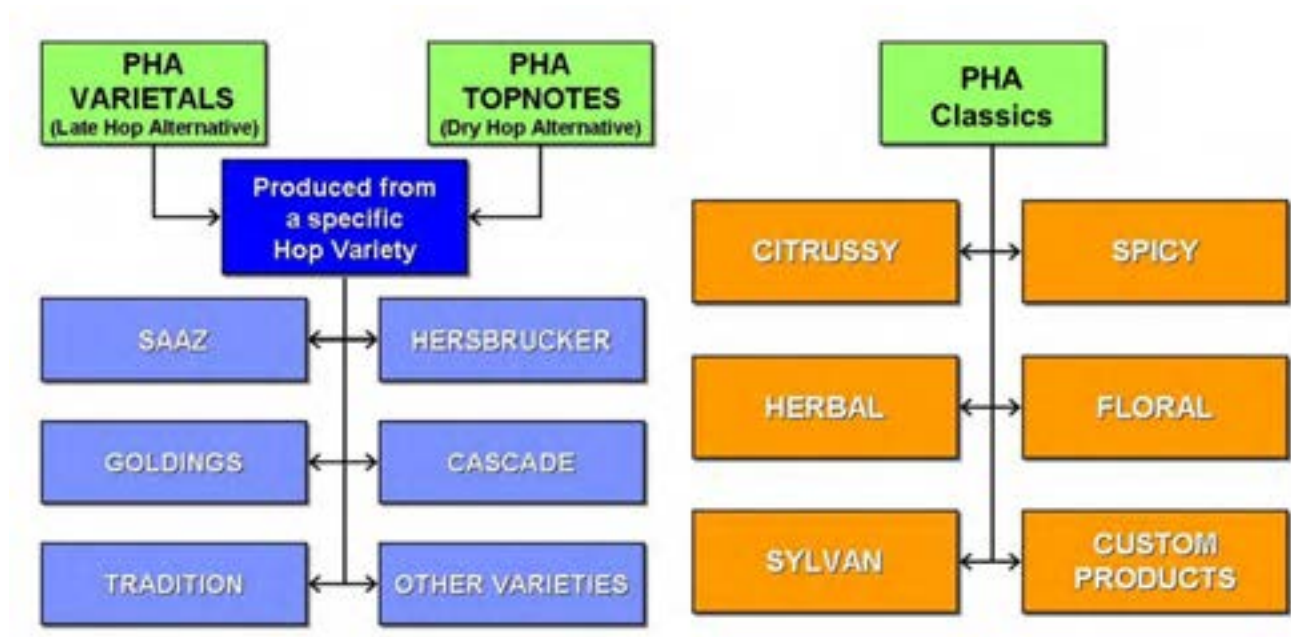


Fig. 1: Range of PHA[®] products

Characteristics:

PHA[®] Classic products are 100% soluble in beer (or other beverages). In general, PHA[®] products offer an alternative means of adding hop aroma independent of any other product or process and of annual crop variations. They can complement traditional means of adding hop aroma by kettle addition. Specifically, PHA[®] Classic products can impart beer flavour attributes such as citrusy, floral, herbal or spicy characteristics. They enhance pleasant existing flavours in the beer/soft drink and can mask some off-flavours. The following Classic PHA[®] products are available:

Classic PHA[®] :

 Citrusy:	 Floral:
<i>Contains the components of hop oil that contribute a citrus / grapefruit type character</i>	<i>Contains components of hop oil that add a fragrant, fresh note to beer</i>
 Sylvan:	 Herbal:
<i>Contains components from hop oil that contribute a fresh woody character. Very useful in low alcohol beers.</i>	<i>Contains components of hop oil that contribute a 'green', fresh-hop character</i>
 Spicy:	
<i>Contains components from hop oil that contribute to body and mouth-feel</i>	

Product specifications: Available on request.

Product Use:

The PHA[®] Classic products are completely soluble in beer and are intended for addition to fined or filtered beers. The required amount of PHA[®] may be metered directly into the beer stream during transfer to bright beer tank or other appropriate vessel. A usage rate of PHA[®] per hectoliter normally is about 10 ml but might vary between 5 – 40 ml according to the desired intensity of aroma. We recommend laboratory scale trials to determine which concentration gives the desired effect. This evaluation can be carried out on bottles of 250 to 500 ml capacity. The beer chosen for the test should not contain a significant proportion of aroma hops. The rate of initial tasting should be approximately 100 ppm of the PHA[®] as supplied. PHA[®] can be dosed directly using a micro syringe or Zipette at a rate of 0.1ul/ml bottle volume, i.e for a 330ml bottle 33ul gives a dose rate equivalent to 10ml/hl. Chill the beer to normal drinking temperature. Open and introduce the required volume of PHA[®] in the headspace of the beer bottle onto the glass or beneath the surface of the beer and reclose the bottle. Invert the bottle several times to ensure mixing and chill again for at least two hours before opening and tasting.

On a large scale, PHA[®] Classic products are used as a post fermentation addition to finished beer, where 100% utilization is feasible. PHA[®] Classic products are lightstable and therefore can be used to introduce hop aroma into a beer brewed using exclusively downstream products such as Tetrahop Gold[®] and Redihop[®]. These products may be added without prior dilution to beer either before or after the final filtration preferably by metered injection into a turbulent beer stream during transfer. They can also be added to bright beer without any increase in haze or deterioration in foam stability. If possible the pump should be adjusted to deliver the PHA[®] over approx. 95% of the total transfer time.

Special properties of PHA[®]:

- **Light stable**
 - All PHA[®] are free of hop α -acids and can be used with any packaging type.
- **Fully soluble**
 - PHA[®] utilization is 100% because it is fully soluble in brewed beverages.
- **Easy handling**
 - Provided as a standardized solution for direct dosing into bright beer.
- **Natural**
 - PHA[®] products are 100% derived from hops by physical processes.
- **Product development**
 - PHA[®] give the opportunity to differentiate existing products or to create new ones.

Packaging:

The standard package size of PHA[®] is 1 and 5 l aluminium flask. Larger package units are available on request.

Storage and shelf life:

PHA[®] products are stable in unopened containers for at least 24 months. Store at 0-20 °C (32-68 °F) in high-grade stainless steel, glass, aluminum or lacquered steel drums.

Safety:

Please refer to our SDS which can be downloaded on our website.

Technical Support:

We will be pleased to offer help and advice on the use of PHA[®] in brewing/soft drink production.



General:

PHA® Topnotes are prepared from cone hops by specific extraction and distillation methods. They consist of original hop oil compounds in a propylene glycol (PG) solution. PG is a permitted carrier for flavours as per regulation 2006/52/EC. PHA® products are exclusively supplied worldwide by the Barth-Haas Group.

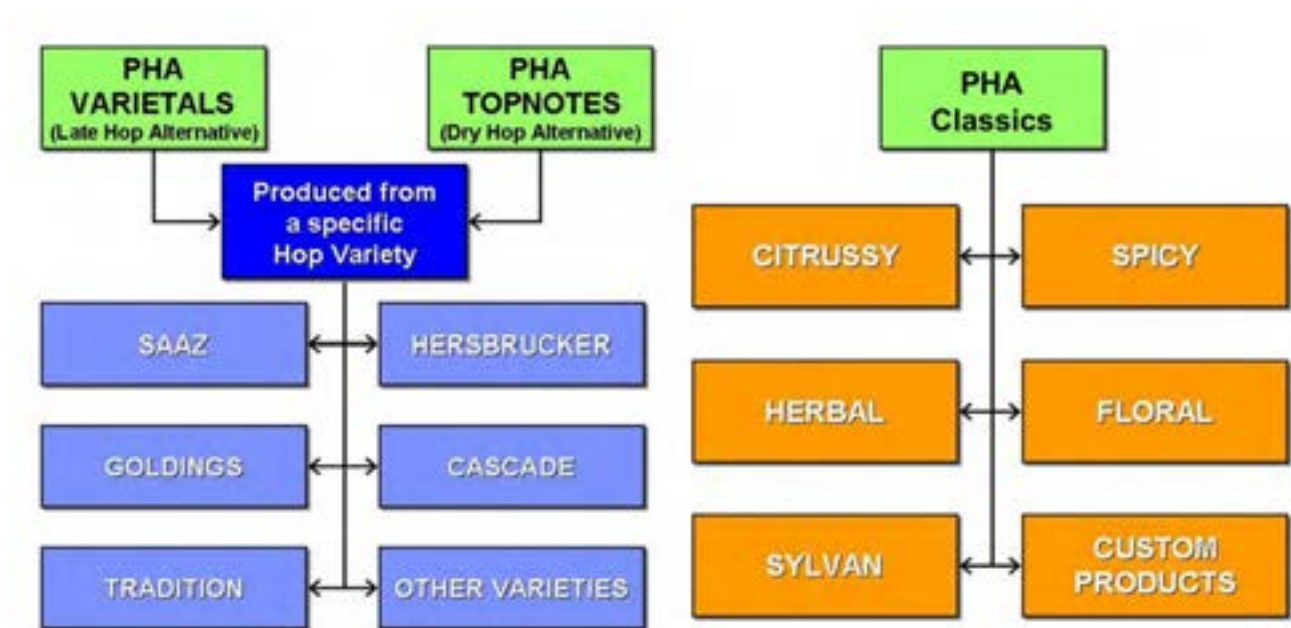


Figure 1: PHA® Products

Characteristics:

Topnotes January 2014

e-mail: info@BarthHaasGroup.com

www.BarthHaasGroup.com

PHA[®] Topnotes are soluble in beer (or other beverages). In general, PHA[®] products offer an alternative means of adding hop aroma independent of any other product or process. Specifically, PHA[®] Topnotes give a very intense '**dry hop**' aroma to beer that is characteristic of the specific variety from which it is prepared. They enhance pleasant existing flavors in the beer/soft drink and can mask some off-flavors. The following PHA[®] Topnotes are immediately available:

PHA[®] Topnotes:



Saaz:

Czech aroma variety selected in the area of the same name. Mild with pleasant hoppy notes.



Hersbrucker:

A traditional variety with good aroma and considered as a successor of Hallertauer Mittelfrueh.



East Kent Golding:

Gentle, fragrant, and pleasant. Recognised as having the most typical English aroma.



Cascade:

US variety characterised by medium strength and distinct aroma.



Styrian Golding: This variety is cultivated mainly in Slovenia, but also in Styria (Austria). Characteristic aroma.

Custom Products: Custom-made PHA[®] Topnotes from other varieties are available on request.

Product specifications:

Description: water white solution, can be hazy

Specific Gravity (20°C): 1.034 - 1.037

Flash point: >90 °C (194 °F)

Product Use:

PHA[®] products are completely soluble in beer and are intended for addition to fined or filtered beers. The required amount of PHA[®] may be metered directly into the beer stream during transfer to bright beer tank or other appropriate vessel. A usage rate of PHA[®] per hectoliter normally is about 10 ml but might vary between 5 – 40 ml according to the desired intensity of aroma. We recommend laboratory scale trials to determine which concentration gives the desired effect. This evaluation can be carried out on bottles of 250 to 500 ml capacity. The beer chosen for the test should not contain a significant proportion of aroma hops. The rate of initial tasting should be approximately 100 ppm of the PHA[®] as supplied. PHA[®] can be dosed directly using a micro syringe or Zipette at a rate of 0.1ul/ml bottle volume. i.e. for a 330ml bottle 33ul gives a dose rate equivalent to 10ml/hl. Chill the beer to normal drinking temperature. Open and introduce the required volume of PHA[®] in the headspace of the beer bottle onto the glass or beneath the surface of the beer and reclose the bottle. Invert the bottle several times to ensure mixing and chill again for at least two hours before opening and tasting.

On a large scale, PHA[®] Topnote products are used as a post fermentation addition to finished beer, where 100% utilization is feasible. PHA[®] Topnote products are lightstable and therefore can be used to introduce hop aroma into a beer brewed using exclusively downstream products such as Tetrahop Gold[®] and Redihop[®]. These products may be added without prior dilution to beer either before or after the final filtration preferably by metered injection into a turbulent beer stream during transfer. They can also be added to bright beer without any increase in haze or deterioration in foam stability. If possible the pump should be adjusted to deliver the PHA[®] over approx. 95% of the total transfer time.

Special properties of PHA®:

- **Light stable**
 - All PHA® products are free of hop α -acids and can be used with any beer packaging type.
- **Fully soluble**
 - PHA® utilization is up to 100% because it is fully soluble in brewed beverages.
- **Easy handling**
 - Provided as a standardised solution for direct dosing into bright beer.
- **Natural**
 - PHA® products contain hop oil fractions obtained by physical methods.
- **Product development**
 - PHA® products give the opportunity to differentiate existing products or to create new ones.

Packaging:

The standard package size of PHA® is 1 and 5 l aluminium flask. Bigger package units are available on request.

Storage and shelf life:

PHA® products are stable in unopened containers for at least 24 months. Store at 0-20°C (32-68°F) in high-grade stainless steel, glass, aluminium or lacquered steel drums.

Safety:

Please refer to our SDS which can be downloaded on our website.

Technical Support:

We will be pleased to offer help and advice on the use of PHA® in brewing/soft drink production.

PHA® Varietals

PHA® Varietals in propylene glycol (PG)

General:

PHA® Varietals are prepared from cone hops by specific extraction and distillation methods. They consist of original hop oil compounds in an aqueous propylene glycol (PG) solution. PG is a permitted carrier for flavours as per regulation 2006/52/EC. PHA® products are exclusively supplied worldwide by the Barth-Haas Group.



Figure 1: PHA® Varietal

Characteristics:

PHA® Varietals are 100% soluble in beer (or other beverages). In general, PHA® products offer an alternative means of adding hop aroma independent of any other product or process. Specifically, PHA® Varietals give a subtle 'late hop' aroma to beer that is characteristic of the specific variety from which it is prepared. They enhance pleasant existing flavors in the beer/soft drink and can mask some off-flavors. The following PHA® Varietals are available:

PHA® Varietals:

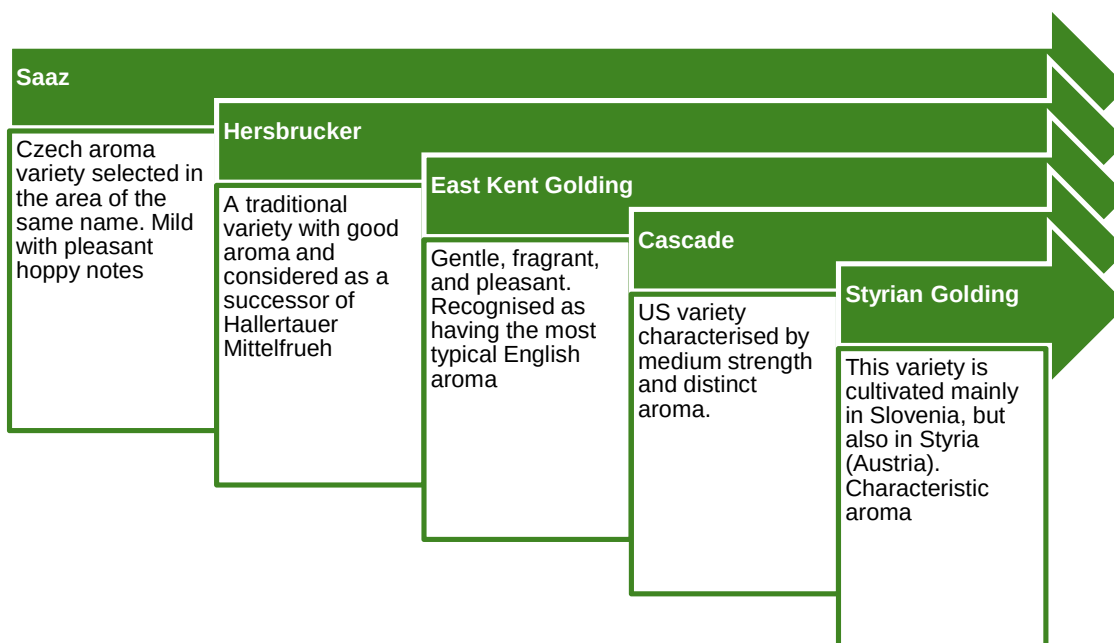


Figure 2: Examples from the PHA® varietal range

Custom made Products:

Custom-made PHA® Varietals from other varieties are available on request.

Product specifications:

Description:	water white solution, can be hazy
Specific Gravity (20oC):	1.034 - 1.037
Flash point:	> 90 °C (194 °F)

Product Use:

PHA® products are completely soluble in beer and are intended for addition to fined or filtered beers. The required amount of PHA® may be metered directly into the beer stream during transfer to bright beer tank or other appropriate vessel. A usage rate of PHA® per hectoliter normally is about 10 ml but might vary between 5 – 40 ml according to the desired intensity of aroma. We recommend laboratory scale trials to determine which concentration gives the desired effect. This evaluation can be carried out on bottles of 250 to 500 ml capacity.

On a large scale, PHA® Varietal products are used as a post fermentation addition to finished beer, where 100% utilization is feasible. PHA® Varietal products are lightstable and therefore can be used to introduce hop aroma into a beer brewed using exclusively downstream products such as Tetrahop Gold® and Redihop®. These products may be added without prior dilution to beer either before or after the final filtration preferably by metered injection into a turbulent beer stream during transfer. They can also be added to bright beer without any increase in haze or deterioration in foam stability. If possible the pump should be adjusted to deliver the PHA® over approx. 95% of the total transfer time.

Trial Guide:

We recommend benchtop trials to determine which concentration gives the desired effect. To get a better initial understanding for the effect of individual PHA® products and the required dose rate, we recommend dosing directly into a glass of beer. For more accurate results, we suggest following this up with dosing into bottles as explained below. The rate for initial tasting trials should be approximately 10 mL/hL of the PHA® as supplied. PHA® products can be dosed directly using a micropipette or syringe. For example, a 330 mL bottle, a 33µL amount of PHA® gives a dose rate equivalent to 10mL/hL. Chill the beer to normal drinking temperature. Open and introduce the required volume of PHA® in the headspace of the beer bottle and reclose the bottle. Invert the bottle several times to ensure mixing and chill again for at least two hours before opening and tasting.

Special properties of PHA®:

The PHA® products have the following properties:

- Natural: 100% derived from hops by physical processes.
- Fully soluble: utilisation is 100% because of full solubility in beverages.
- No negative impact on beer quality: Do not increase beer haze or reduce beer foam stability.
- Easy handling: Provided as standardised solution for direct dosing.
- Light stability: free of hop α -acids; can be used with any packaging type.
- Ideal for brand diversification: differentiate existing products or create new ones.

Packaging:

The standard package size of PHA® is 1 and 5 l aluminium flask. Larger package units are available on request.

Storage and shelf life:

PHA® products are stable in unopened containers for at least 24 months. Store at 0-20 °C (32-68 °F) in high-grade stainless steel, glass, aluminum or lacquered steel drums.

Safety:

Please refer to our SDS which can be downloaded on our website.

Technical Support:

We will be pleased to offer help and advice on the use of PHA® in brewing/soft drink production.



WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

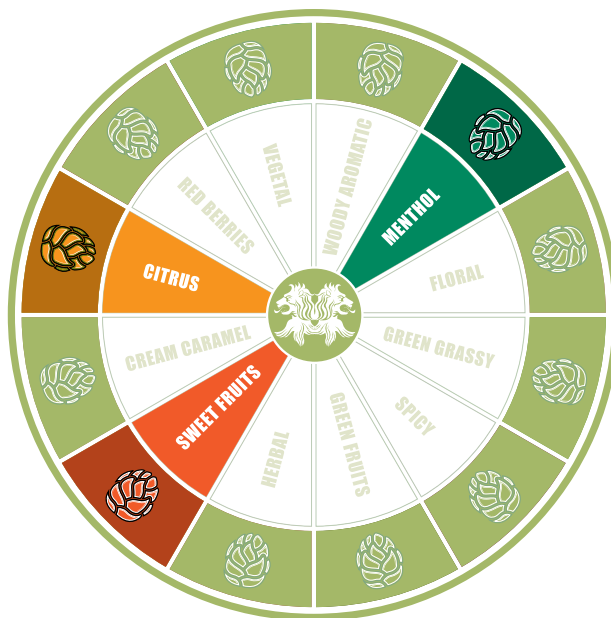
Polaris

GERMAN AROMA HOP



Polaris is a new variety with an intense but pleasant fruit aroma and a very refreshing note similar to a peppermint where fruity and resin notes come to the forefront. The aroma variety was bred in Huell at the request of the beer industry in light of its demand for bold tastes and new aromas. It came onto the market in 2012.

Pedigree	Huell breeding line
Aroma/Flavor	Fruity, Citrus, Minty
Alpha Acids*	18.0% - 23.0 %
Beta Acids	4.5 - 6.0 %
Cohumulone	No Data
Total Oil	app. 4.4 ml/100g
Myrcene	app. 50.3 % of total
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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WILLAMETTE VALLEY HOPS, LLC

ADVANCED PRODUCT DATA SHEET



OAK AGEING & HOP AROMA

DRY HOPPING PELLET • EU STYLE

Complex and noble flavours with both hops and oak for innovative beers.

fruity and light hop aroma - paired with typical woody notes of untoasted oak casks:
tangerines, oranges, grapes, wine-like, tannic, oaky, pineapples

APPLICATION:

similar handling compared to dry-hopping with hop pellets without the disadvantages of barrel ageing (oxidation, labor-intensive, costs)

DOSAGE:

provoak is dosed according to the hop oil concentration comparable to dry-hopping (3-6 mL Oil/hL)

CONTACT TIME:

approx. 1 week if dosed during lagering

DUAL PURPOSE PRODUCT:

one product - one pellet - one dose with two aroma components: hops and oak

100% NATURAL AND FOOD GRADE PRODUCT

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WILLAMETTE VALLEY HOPS, LLC

ADVANCED PRODUCT DATA SHEET



OAK AGEING & HOP AROMA

DRY HOPPING PELLET • US STYLE

Complex and noble flavours with both hops and oak for innovative beers.

Intense, sweet hop aroma - paired with the typical heavy notes of toasted oak casks:
red berries, dried fruit, bourbon, oranges, full-bodied, barrique, wild berries, vanilla

APPLICATION:

similar handling compared to dry-hopping with hop pellets without the disadvantages of barrel ageing (oxidation, labor-intensive, costs)

DOSAGE:

provoak is dosed according to the hop oil concentration comparable to dry-hopping (3-6 mL Oil/hL)

CONTACT TIME:

approx. 1 week if dosed during lagering

DUAL PURPOSE PRODUCT:

one product - one pellet - one dose with two aroma components: hops and oak

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Redihop[®]

Redihop[®] is an aqueous alkaline solution of the potassium salts of rho-iso- α -acids, and is produced from CO₂ hop extract. Redihop[®] gives protection from light-struck flavour when used as a sole source of hop-derived bittering or in conjunction with other reduced hop products. Furthermore, when added to wort or beer, Redihop[®] will act as an antimicrobial agent. Redihop[®] is often described as having a pleasant smooth bitterness. Redihop[®] is classified as a modified hop extract that may be safely used in beer in accordance with US FDA regulation 21 CFR 172.560 (b) (1).

Product Specifications:

Description:	A reddish to amber-brown, aqueous solution of reduced (<i>rho</i>) iso- α -acids in potassium salts form. A re-dissolvable precipitate may form during normal storage.
Concentration:	30.0% $\pm$ 0.5 of rho-iso- α -acids by HPLC
pH:	10 – 11
Density:	1.090 g/mL (approximately) at 20 °C (68 °F)
Viscosity:	20 – 40 mPas at 20 °C (68 °F)
Iso- α -acids:	< 0.2%

Quality and Food Safety:

The Barth-Haas Group maintains quality management systems registered to the ISO 9001 standard, as well as food safety management programs based on internationally recognised (HACCP) principles. Please refer to our web site (www.barthhaasgroup.com) for more information on our systems and programs.

Product Use:

Redihop[®] is normally used as a post fermentation addition to unhopped beer, but good utilisation can be achieved by addition to the kettle and therefore, some brewers prefer to make a partial or even complete addition to the wort. Dosing Redihop[®] into the kettle reduces the chances of encountering bacterial growth during fermentation. For light-stable beers packaged in clear or green glass bottles, all hop bitterness must be derived from light-stable hop products such as Redihop[®], usually in combination with Tetrahop Gold[®] or Hexahop Gold[®]. Redihop[®] should be added, without prior dilution, to the kettle or directly to beer either before or after conditioning but before the final filtration. Preferably, post-fermentation dosage should be by metered injection into a turbulent beer stream during transfer. The addition point should be well separated from that of any other additions.

The dosing rate depends on the expected utilisation for the chosen point of addition, and also allowing for the fact that rho-iso- α -acids are less bitter than normal iso- α -acids by a factor of 0.7. Actual utilisation varies depending on plant and process conditions in the brewery. To ensure optimum performance for post fermentation addition, we recommend that Redihop[®] be warmed to 50 °C (120 °F) and then agitated to ensure dissolution of any precipitate before use. We

recommend that the clear solution be injected directly into the turbulent beer stream preferably after primary filtration and gravity adjustment, but prior to final filtration (polish/trap filter). The dosing pump should be adjusted to deliver Redihop® over approximately 70% of the total transfer time. Following dosing, we recommend cleaning lines and dosing pumps with warm slightly alkaline demineralised water or ethanol immediately after each use

Usage Calculations:

The following calculations are based on the fact that, for the same concentration in beer, rho-iso-α-acids (rho-IAA) are reported to have only 0.7 sensory bitter units compared with normal iso-α-acids (IAA). Utilisation of rho-IAA is likely to be about 70 - 75% when Redihop® is used post-fermentation and about 45% when used in the kettle.

1. Post-fermentation use

Desired Sensory Bitterness Units = BU

$$\text{rho IAA required in beer (mg/L)} = \frac{\text{BU}}{0.7} \quad (0.7 = \text{bitterness of Redihop relative to IAA})$$

$$\text{Dosage rho IAA in mg/L (70\% utilisation assumed)} = \frac{\text{BU}}{0.7} \times \frac{100}{70}$$

$$\text{Dosage in grams rho IAA per hL of beer} = \frac{\text{BU}}{0.7} \times \frac{100}{70} \times \frac{100}{1000}$$

Dosage amount of Redihop® (30% rho IAA) in g/hL :

$$\frac{\text{BU}}{0.7} \times \frac{100}{70} \times \frac{100}{1000} \times \frac{100}{30} \text{ g/hL} = \text{BU} \times 0.68 \text{ g/hL}$$

Dosage amount of Redihop® (30% rho IAA) in mL/hL :

$$\frac{\text{BU}}{0.7} \times \frac{100}{70} \times \frac{100}{1000} \times \frac{100}{30} \times \frac{1}{1.090} \text{ mL/hL} = \text{BU} \times 0.62 \text{ mL/hL}$$

(e.g. in order to achieve a bitterness of **12** desired sensory bitter units ($12/0.7 \times 100/70 \times 100/1000 \times 100/30$) **8.2** g/hL of Redihop® or **7.5** mL/hL are necessary).

2. Kettle use

Substituting 45% for 70% utilisation in the calculation shown above, the amount of Redihop® to use in the kettle = BU X 1.06 mL/hL

(e. g. for **12** Sensory Bitter Units; **12.7** g/hL)

Light Stability:

Redihop[®] will only provide protection from light-struck flavour if a complete absence of normal iso- α -acids is achieved, therefore no other sources of non-reduced iso- α -acids should exist in the wort or beer streams. Thus for light-stable beers packaged in clear or green glass bottles, all the hop bitterness must be derived from reduced hop acids such as Tetrahop Gold[®], Redihop[®] or Hexahop[®] products. Iso- α -acids (from equipment or yeast) must not be present in the beer. If beta extracts are used as kettle additives, ensure that the concentration of α -acids and iso- α -acids are below 0.2%

Packaging:

Redihop[®] is normally supplied in high-density polyethylene containers of 20 kg.

Storage and Best-by Recommendation:

Store Redihop[®] in full, closed containers at 15 – 25 °C (59 - 77 °F). It is normal for a precipitate of rho-iso- α -acids to separate during storage, however, warming the product to 50 °C and gentle agitation will re-dissolve this precipitate. Redihop[®] is best if used within 24 months from production date if stored as recommended. Opened containers should be used within a few days.

Safety:

The Safety Data Sheet (SDS) is available on our website www.barthhaasgroup.com.

Analytical Methods:

The concentration of reduced (*rho*) iso- α -acids is measured by UV Spectrophotometry (with modified factors) or by the EBC Method 7.9 (HPLC). Details of recommended methods are available on request.

Technical Support:

We will be pleased to offer help and advice on the use of Redihop[®] in brewing.



WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

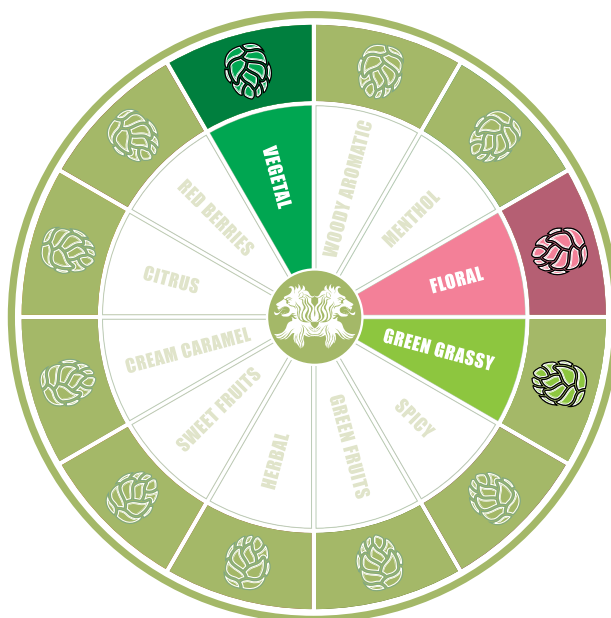
Relax™

GERMAN AROMA HOP



Relax is a hop variety that originally wasn't bred for beer but instead for tea. Despite having a very low α -acid content, Relax has a remarkably high β -acid and oil content, which still makes it a very attractive variety for the brewer. Because of its high oil content, a broad range of different flavours can be expected. This could be verified by a simple rub and sniff: from cornflower and the aroma of alpine meadows to lemongrass and hibiscus, this variety shows a refreshing profile. When a cold extraction with this variety is completed, notes of honeydew melon are present.

Pedigree	Huell Breeding Line
Aroma/Flavor	Green grassy, Floral, Melon
Alpha Acids*	.25%
Beta Acids	13.2%
Cohumulone	No data
Total Oil	1.15 ml/100g
Myrcene	No data
Humulene	No data
Caryophyllene	No data
Farnesene	No data
Storage Stability	No data



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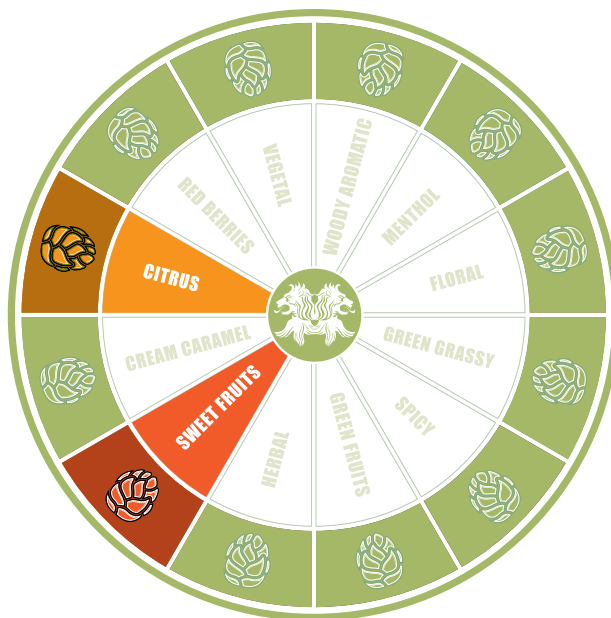
Sabro™

U.S. AROMA HOP



Sabro brand HBC 438 was developed by the Hop Breeding Company and released in 2018. Sabro is an aroma hop that is notable for its complexity of fruity and citrus flavors. It imparts distinct tangerine, coconut, tropical fruit, and stone fruit aromas with hints of cedar, mint, and cream. Sabro's pedigree is the result of a unique cross pollination of a female neomexicanus hop. With a robust brewing performance, Sabro proves to be a strongly expressive hop that translates its flavor incredibly well into beer.

Pedigree	Neomexicanus female
Aroma/Flavor	Fruity, Citrus, Coconut
Alpha Acids*	12.0 - 16.0%
Beta Acids	4.0 - 7.0%
Cohumulone	20 - 24% of alpha acids
Total Oil	2.5 - 3.5 ml/100g
Myrcene	51 - 68% of total oil
Humulene	7 - 14% of total oil
Caryophyllene	7 - 11% of total oil
Farnesene	<1% of total oil
Storage Stability	



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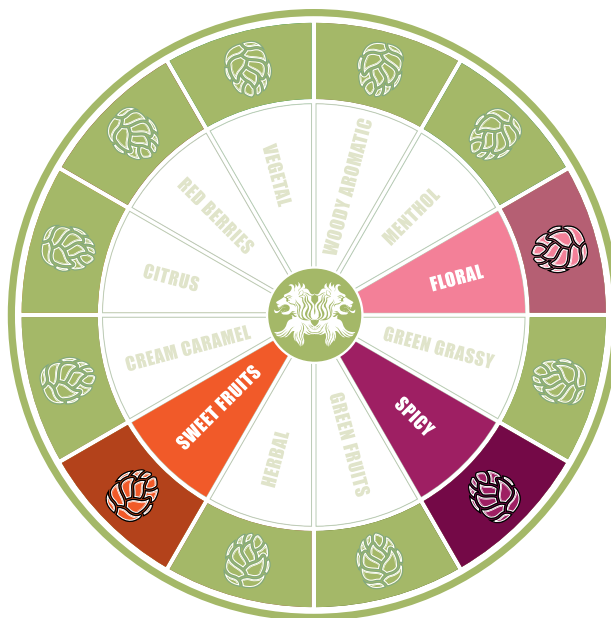
Saphir

GERMANY AROMA HOP



Saphir is a very fine aroma variety, with average bitter value and storage characteristics. It was developed at the Hop Research Center in Hüll, Germany and released in 2002.

Pedigree	Bred at Hop Research Center in Hüll Germany
Aroma/Flavor	Spicy, Fruity, Floral
Alpha Acids*	2.0 - 4.5%
Beta Acids	4.0 - 7.0%
Cohumulone	12 - 17% of alpha acids
Total Oil	0.8 - 1.4 ml/100g
Myrcene	25 - 40% of total oil
Humulene	20 - 30% of total oil
Caryophyllene	9 - 14% of total oil
Farnesene	<1% of total oil
Storage Stability	Good



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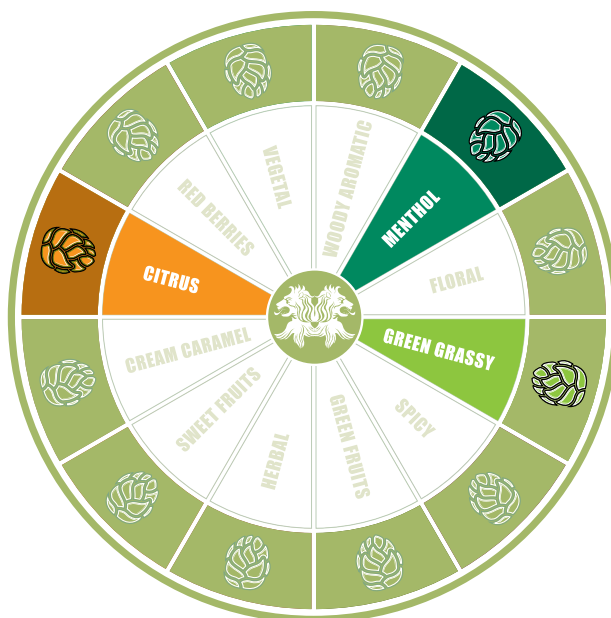
Savinjski

SLOVENIAN AROMA HOP



Styrian Savinjski Golding is a traditional Slovenian variety originating from the English variety Fuggle, which was brought to Slovenia in the early 19th century. This variety is known for its noble hop aroma and pleasant bitterness.

Pedigree	Daughter of Fuggle
Aroma/Flavor	Citrus, Grassy, Menthol
Alpha Acids*	4.5 - 6.0 %
Beta Acids	2.5 - 3.5 %
Cohumulone	No Data
Total Oil	0.5 - 1.0 ml/100g
Myrcene	27.0 - 33.0 % of total
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

Spalter

GERMANY AROMA HOP



Spalt variety has a very good aroma and is comparable to German Tettnanger. The locally grown Spalt variety belongs to the Saaz range and is cultivated exclusively in the region around Spalt. Despite its sometimes less than satisfactory yields, this variety has become more popular again. Spalt Spalter has good resistance to wilt and other diseases.

Pedigree	German landrace variety
Aroma/Flavor	Traditional fine noble aroma
Alpha Acids*	2.5 - 5.5%
Beta Acids	3.0 - 5.0%
Cohumulone	22 - 29% of alpha acids
Total Oil	0.5 - 0.9 ml/100g
Myrcene	20 - 35% of total oil
Humulene	20 - 30% of total oil
Caryophyllene	8 - 13% of total oil
Farnesene	12 - 18% of total oil
Storage Stability	Poor



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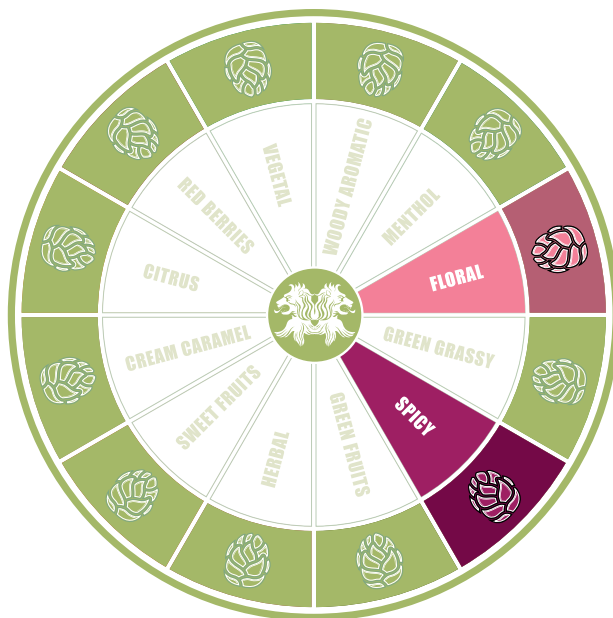
Spalter Select

GERMANY AROMA HOP



Spalter Select was bred at Hüll Hop Research Center and its fine aroma and high farnesene content are typical of Spalt-type hops. This variety grows quickly and develops a very strong “head”. Spalter Select is characterized by a good tolerance to diseases like wilt and downy mildew.

Pedigree	Hüll breeding material
Aroma/Flavor	Spalt-like, Spicy, Floral
Alpha Acids*	3.0 - 6.5%
Beta Acids	2.5 - 5.0%
Cohumulone	21 - 27% of alpha acids
Total Oil	0.6 - 0.9 ml/100g
Myrcene	20 - 40% of total oil
Humulene	10 - 22% of total oil
Caryophyllene	4 - 10% of total oil
Farnesene	15 - 22% of total oil
Storage Stability	Good



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET



Sterling

U.S. AROMA HOP

Sterling is an aroma cultivar derived from diploid seedling from cross of Saaz and a number of other varieties including Cascade, Brewers Gold, Early Green and German open-pollination. Released in 1998, Sterling is moderately resistant to downy and powdery mildews.

Pedigree	Mostly Saaz and Cascade
Aroma/Flavor	Herbal, Spicy, Hint of Floral, Citrus
Alpha Acids*	6.0 - 9.0%
Beta Acids	4.0 - 6.0%
Cohumulone	22 - 28% of alpha acids
Total Oil	1.3 - 1.9 ml/100g
Myrcene	44 - 48% of total oil
Humulene	19 - 23% of total oil
Caryophyllene	5 - 7% of total oil
Farnesene	11 - 17% of total oil
Storage Stability	Fair to good



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

Styrian Golding Celeia

SLOVENIA AROMA HOP



Celeia is a triploid hybrid between autotetraploid Savinjski Golding and the 105/58 hybrid between Aurora (Super Styrian) and a Slovenian wild hop. It is known for a noble hoppy aroma and pleasant bitterness. Celeia has widespread usage in both lager and ale beers.

Pedigree	Hybrid of Styrian Golding, Aurora, experimental line and Slovenian wild hop
Aroma/Flavor	Pleasant hoppy aroma
Alpha Acids*	3.0 - 6.5%
Beta Acids	2.0 - 3.3%
Cohumulone	27 - 31% of alpha acids
Total Oil	1.5 - 3.6 ml/100g
Myrcene	26 - 40% of total oil
Humulene	18 - 23% of total oil
Caryophyllene	8 - 9% of total oil
Farnesene	3 - 7% of total oil
Storage Stability	Good



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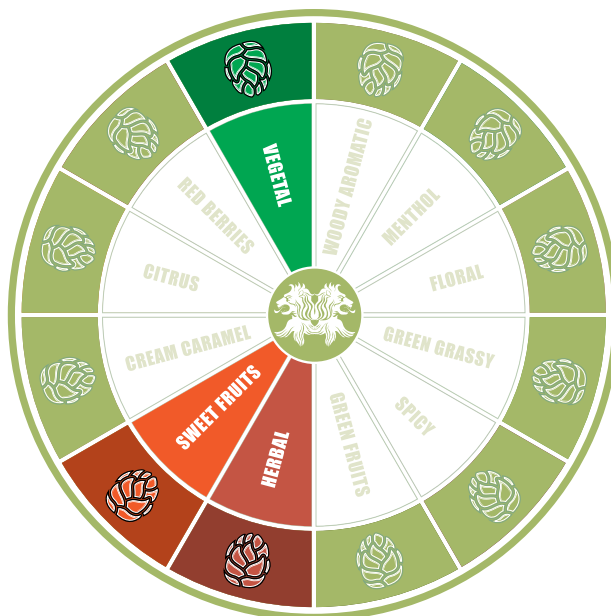
Summer

AUSTRALIAN AROMA HOP



Summer™ is an original Australian aroma variety with characteristic aromas of sweet fruits. This cultivar displays unmistakable light fruit notes of apricot and melon, pleasantly balanced by an underlying hop character. Being low in alpha acid, brewers can be very flexible with their dosing when using this hop for flavour and aroma.

Pedigree	Open pollination
Aroma/Flavor	Sweet Fruit, Herbal, Vegetal
Alpha Acids*	4.0 - 7.0 %
Beta Acids	4.8 - 6.1 %
Cohumulone	No Data
Total Oil	0.9 - 1.3 ml/100g
Myrcene	5.0 - 13.0 % of total
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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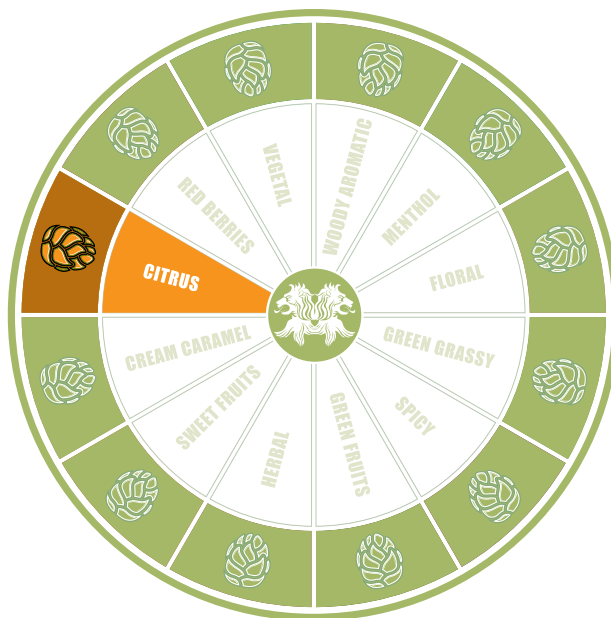


Summit™

U.S. HIGH ALPHA HOP

Summit is a dwarf high alpha hop brand bred by the American Dwarf Hops Association in the U.S. Released in 2003, it has unusually high alpha acids content, excellent storage stability and powdery mildew resistance. Summit has a strong aroma profile which includes citrus and grapefruit notes.

Pedigree	From Nugget crossed with progeny of female Zeus and USDA males
Aroma/Flavor	Strong Citrus and Grapefruit
Alpha Acids*	16.0 - 18.0%
Beta Acids	4.0 - 6.0%
Cohumulone	26 - 33% of alpha acids
Total Oil	1.5 - 2.5 ml/100g
Myrcene	35 - 50% of total oil
Humulene	15 - 25% of total oil
Caryophyllene	10 - 15% of total oil
Farnesene	<1% of total oil
Storage Stability	Excellent



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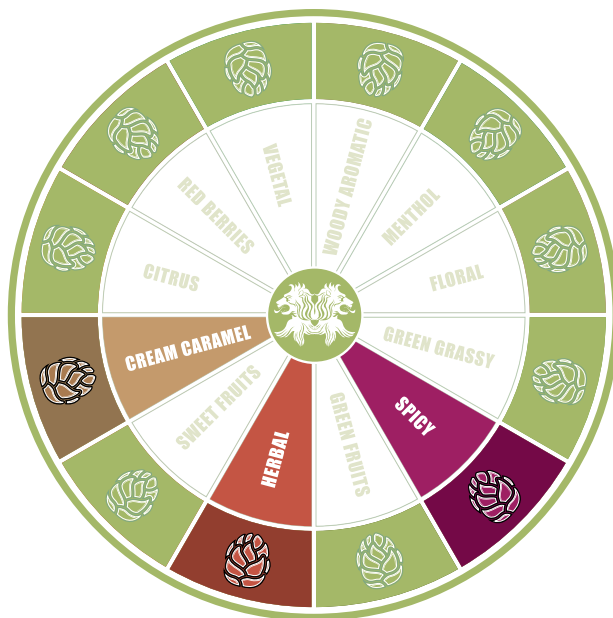


Super Pride

AUSTRALIAN HIGH ALPHA HOP

The Australian hop variety Super Pride is a seedless high alpha acid variety, bred by the Hop Products Australia Rostrevor breeding programme. Bred from the famous Pride of Ringwood – Australia's dominant hop variety since the 1960's – Super Pride features similar mild aromas and low cohumulone levels. Super Pride has higher alpha acid than its mother Pride of Ringwood. Bred in 1987, commercial production began in 1998 and since 2002 Super Pride has been the major hop variety grown by Hop Products Australia. With its excellent bittering qualities Super Pride is now accepted by many major breweries.

Pedigree	Daughter of Pride of Ringwood
Aroma/Flavor	Spicy, Gingerbread, Herbal
Alpha Acids*	app. 14.3 %
Beta Acids	app. 6.8 %
Cohumulone	No Data
Total Oil	1.2 ml/100g
Myrcene	25.0 - 50.0 % of total
Humulene	No Data
Caryophyllene	No Data
Farnesene	No Data
Storage Stability	No Data



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Tetrahop Gold[®]

Tetrahop Gold[®] is an aqueous alkaline solution of the potassium salts of tetrahydro-iso- α -acids. It is produced from CO₂ hops extract using a patented all aqueous process. Tetrahop Gold[®] enhances beer foam when used as a post-fermentation replacement for a part of the normal bittering. In the absence of normal α -acids and iso- α -acids, Tetrahop Gold[®] will give complete protection from the formation of light-struck flavour. Furthermore, it will act as an antimicrobial agent when added to beer. Tetrahop Gold[®] is classified as a modified hop extract that may be safely used in beer in accordance with the US FDA regulation 21 CFR 172.560 (b) (6).

Product Specifications:

Description:	A yellow to amber colored, aqueous solution of the potassium salts of tetrahydro-iso- α -acids.
Concentration:	Standard concentration is 9.0% $\pm$ 0.5 of tetrahydro-iso- α -acids by HPLC
pH:	8.5 – 11.0
Density:	1.017 g/mL (approximately) at 20 °C (68 °F)
Viscosity:	2 - 10 mPas at 20°C
Solubility:	Soluble in pH-adjusted de-mineralised water, and in alcohol
Iso- α -acids:	< 0.1%

Quality and Food Safety:

The Barth-Haas Group maintains quality management systems registered to the ISO 9001 standard, as well as food safety management programs based on internationally recognised (HACCP) principles. Please refer to our web site (www.barthhaasgroup.com) for more information on our systems and programs.

Product Use:

Tetrahop Gold[®] is normally used after fermentation and before final filtration. Utilisation of Tetrahop Gold[®] in final beer can be expected between 55 - 80% depending on the time and efficiency of dosing (kettle dosing is not advisable). The point of addition should be close to a region of turbulent flow, e.g. on the suction side of a centrifugal pump. The dosing pump should be adjusted to deliver Tetrahop Gold[®] over approximately 70% of the total transfer time. It is advisable to make the addition prior to the final filtration step. Local high concentrations of tetrahydro-iso- α -acids should be avoided and the addition point should be well separated from that of any other additives. Tetrahop Gold[®] may be added at ambient temperature without prior dilution directly to beer. If dilution is necessary, the use of demineralised water and a pH adjustment to 10 – 11 with KOH is necessary. Do not use sodium bases to adjust the pH of the dilution water – caustic soda or sodium hydroxide form poorly soluble salts with most hop acids.

The amount of Tetrahop Gold[®] is calculated based on the product concentration and the assumed utilisation. Conducting trials at the brewery will determine the correct dosage of Tetrahop Gold[®] with regard to sensory bitterness and foam enhancement. Depending on the

type of beer, Tetrahop Gold® may give 1.0-1.7 times the perceived bitterness of normal iso-α-acids. Tetrahop Gold® should not be left in dosing lines at low temperatures. We recommend cleaning lines and dosing pumps with warm slightly alkaline demineralised water or ethanol after use.

Usage Calculations:

The following calculations are based on the assumption of tetrahydro-iso-α-acids (THIAA) being 1.7 times as bitter as iso-α-acids (IAA). Utilisation of THIAA is expected to be up to 70 - 75% when Tetrahop Gold® is used as recommended.

Desired Sensory Bitterness Units = BU

$$\text{THIAA required in beer (mg/L)} = \frac{\text{BU}}{1.7}$$

$$\text{Dosage THIAA in mg/L (70\% utilisation assumed)} = \frac{\text{BU}}{1.7} \times \frac{100}{70}$$

$$\text{Dosage in grams THIAA per hL of beer} = \frac{\text{BU}}{1.7} \times \frac{100}{70} \times \frac{100}{1000}$$

Dosage amount of Tetrahop Gold® (9% THIAA) in g/hL:

$$\frac{\text{BU}}{1.7} \times \frac{100}{70} \times \frac{100}{1000} \times \frac{100}{9} \text{ g/hL} = \text{BU} \times 0.93 \text{ g/hL}$$

Dosage amount of Tetrahop Gold® (9% THIAA) in mL/hL:

$$\frac{\text{BU}}{1.7} \times \frac{100}{70} \times \frac{100}{1000} \times \frac{100}{9} \times \frac{1}{1.015} \text{ mL/hL} = \frac{\text{BU} \times 0.93 \text{ g/hL}}{1.015 \text{ g/mL}} = \text{BU} \times 0.92 \text{ mL/hL}$$

(e. g. for 5 desired sensory bitterness units $5/1.7 \times 100/70 \times 100/1000 \times 100/9 = 4.7$ g/hL (4.6 mL/hL) of Tetrahop Gold® are necessary)

Foam Enhancement:

Calculate required Tetrahop Gold® as shown above (for foam and cling enhancement we generally recommend Tetrahop Gold® not be added to the final beer at a concentration greater than 5 ppm THIAA). Reduce kettle bittering by an equivalent BU to compensate for the bitterness contribution of Tetrahop Gold®.

Light Stability:

Tetrahop Gold® will only provide protection from light-struck flavour if a complete absence of normal iso-α-acids is achieved, therefore no other sources of non-reduced iso-α-acids should exist in the wort or beer streams. Thus for light-stable beers packaged in clear or green glass bottles, all the hop bitterness must be derived from reduced hop acids such as Tetrahop Gold®, Redihop® or Hexahop® products. Iso-α-acids (from equipment or yeast) must not be present in

the beer. If beta extracts are used as kettle additives, ensure that the concentration of α -acids and iso- α -acids are below 0.2%

Packaging:

Normally supplied in high-density polythene containers of 20 kg.

Storage and Best-by Recommendation:

Store Tetrahop Gold[®] in full, closed containers at 15 – 25 °C (59 – 77 °F). Prolonged storage at high temperature will cause deterioration. Tetrahop Gold[®] performs best if used within 24 months from the time of production if stored as recommended.

Safety:

Safety Data Sheet (SDS) is available on our website www.barthhaasgroup.com.

Analytical Methods:

The concentration of tetrahydro-iso- α -acids is measured by UV Spectrophotometry (with modified factors) or by the EBC Method 7.9 (HPLC). Details of recommended methods are available on request.

Technical Support:

We will be pleased to offer help and advice on the use of Tetrahop Gold[®] in brewing.



WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET

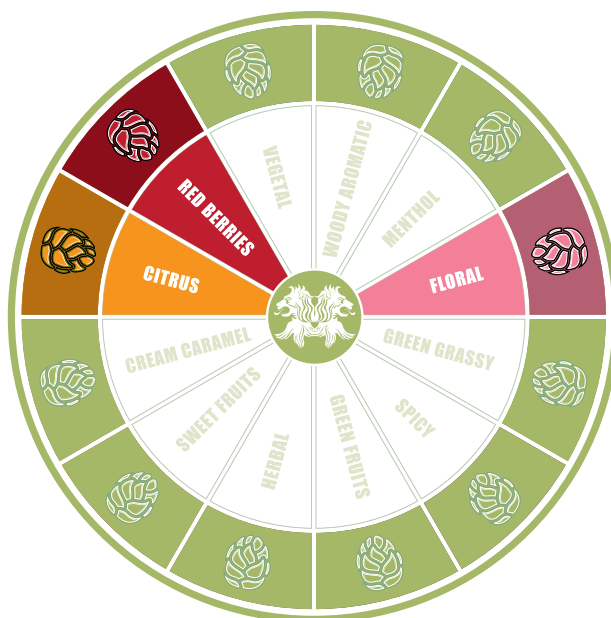


T'N'T

U.S. AROMA HOP

This exclusive BARTH-HAAS GROUP Hop Creation provides an explosive aroma and taste character to your beer.

Pedigree	No data
Aroma/Flavor	Floral, Citrus, Red berries
Alpha Acids*	12.0 - 13.0%
Beta Acids	No data
Cohumulone	No data
Total Oil	1.3 - 1.5 ml/100g
Myrcene	No data
Humulene	No data
Caryophyllene	No data
Farnesene	No data
Storage Stability	No data



Varieties subject to availability. Contact your Territory Manager to place your order.

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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET



Topaz™

AUSTRALIA DUAL PURPOSE HOP

The Topaz hop brand was originally selected as a seedless high alpha hop, but recent work has shown it to have excellent flavor potential. Topaz can provide earthy notes similar in character to English brands, and fruit flavors including lychee can be detected from late-hop additions and higher gravity brews.

Pedigree	Australian high-alpha female and UK male
Aroma/Flavor	Fruity and pleasant
Alpha Acids*	13.8 - 18.0%
Beta Acids	5.0 - 8.3%
Cohumulone	45 - 53% of alpha acids
Total Oil	0.7 - 2.2 ml/100g
Myrcene	33 - 56% of total oil
Humulene	10 - 16% of total oil
Caryophyllene	6 - 13% of total oil
Farnesene	<1% of total oil
Storage Stability	



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HOP VARIETY DATA SHEET

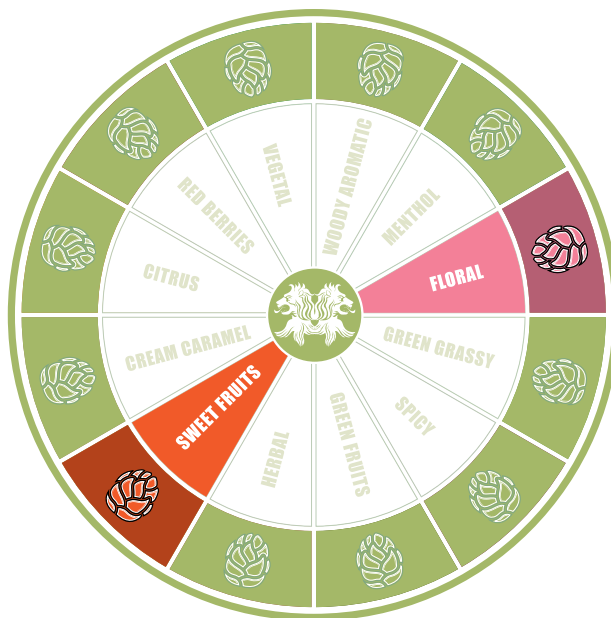
Triskel

FRANCE AROMA HOP



Triskel is a new hop cultivar with an aroma similar to Strisselspalt, from which Triskel inherited its floral notes, but slightly fruitier. High content of essential oils make Triskel very suitable for late and dry hopping, contributing a pleasant and well-balanced bitter character. The name “Triskel” was inspired by triskelion, the symbol of the Gauls, ancestors of the modern French people.

Pedigree	Cross between Strisselspalt and male English Yeomar
Aroma/Flavor	Floral, Fruity
Alpha Acids*	8.0% -9.0%
Beta Acids	4.0 - 4.7%
Cohumulone	20 - 23% of alpha acids
Total Oil	1.5 - 2.0 ml/100g
Myrcene	60% of total oil
Humulene	10 - 15% of total oil
Caryophyllene	
Farnesene	
Storage Stability	



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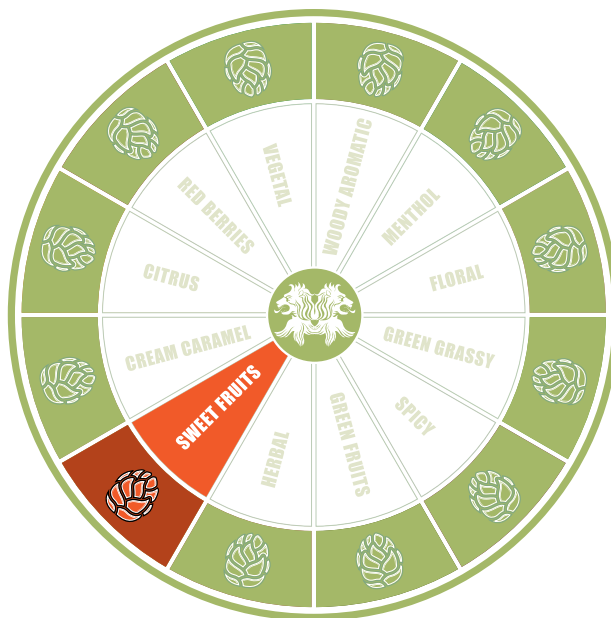


Vic Secret™

AUSTRALIA AROMA HOP

Developed in the Hop Products Australia breeding program (part of Barth-Haas Group), Vic Secret was released in 2013. Vic Secret shows distinctive and pleasant pine and fruity flavor characteristics. It is a sister of Topaz, derived from a cross of an Australian female and a UK male.

Pedigree	Australian high-alpha female and UK male
Aroma/Flavor	Pleasant pine, Tropical and Pineapple
Alpha Acids*	14.0 - 17.0%
Beta Acids	5.7 - 8.7%
Cohumulone	51 - 57% of alpha acids
Total Oil	1.9 - 2.8 ml/100g
Myrcene	38 - 45% of total oil
Humulene	9 - 13% of total oil
Caryophyllene	8 - 12% of total oil
Farnesene	<1% of total oil
Storage Stability	



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WILLAMETTE VALLEY HOPS, LLC

HOP VARIETY DATA SHEET



Warrior®

U.S. HIGH ALPHA HOP

Warrior is a high alpha hop brand developed by Yakima Chief Ranches. It has high agronomic yields and exhibits a moderate tolerance to powdery mildew. Warrior is characterized by a low cohumulone content and very good storage stability.

Pedigree	No information
Aroma/Flavor	Very mild
Alpha Acids*	14.5 - 16.5%
Beta Acids	4.3 - 5.3%
Cohumulone	22 - 26% of alpha acids
Total Oil	1.3 - 1.7ml/100g
Myrcene	40 - 50% of total oil
Humulene	15 - 19% of total oil
Caryophyllene	9 - 11% of total oil
Farnesene	<1% of total oil
Storage Stability	Very good



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HOP VARIETY DATA SHEET

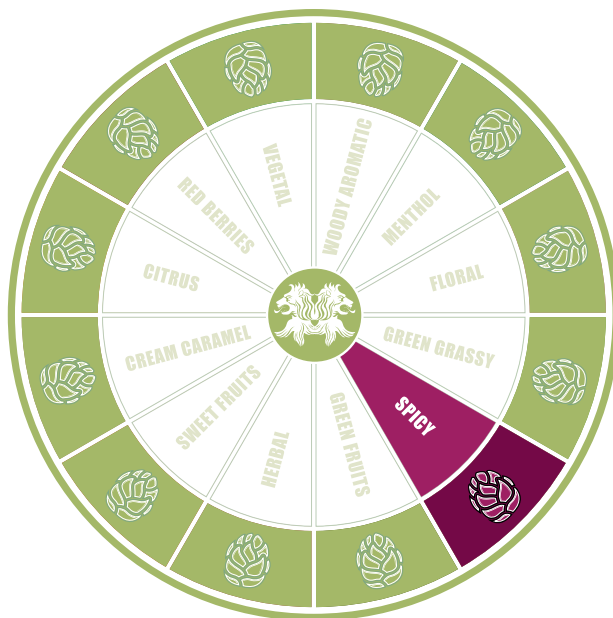


Willamette

U.S. AROMA HOP

Willamette, the triploid daughter of Fuggle, was released as a U.S. aroma variety in 1976 from the USDA breeding program in Oregon. The variety is characterized by a low alpha acids content, mild aroma similar to Fuggle, and average argonomic yields

Pedigree	Triploid seedling of English Fuggle
Aroma/Flavor	Mild and pleasant, slightly Spicy
Alpha Acids*	4.0 - 6.0%
Beta Acids	3.5 - 4.5%
Cohumulone	30 - 35% of alpha acids
Total Oil	1.0 - 1.5 ml/100g
Myrcene	30 - 40% of total oil
Humulene	20 - 27% of total oil
Caryophyllene	7 - 8% of total oil
Farnesene	5 - 6% of total oil
Storage Stability	Fair



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