

AlphAroma vf 1151 – 2013

A 1980's triploid seedless smoothcone hybrid from New Zealand. It is considered a **super alpha aroma** variety with very high potential yields. The unusually high alpha/oil profile makes this a very potent **all-purpose hop**. Moderate resistance to mildews.

- **Alpha acids:** 5.8-11%, betas 2.6-4.8%, cohumulone 27%, total oils 1.2ml/100g, **myrcene 44-60%**, humulene 15%.
- **Aroma:** potent citrus and tropical fruit flavors
- **Yield:** very high potential yields, over 3000 lbs/acre reported
- **Maturity:** late, similar to other NZ varieties
- **Storage stability:** very good, over 70% remaining
- **Beer styles:** Pale Ales, Lagers, IPAs, potent for wet-hopping seasonal ales.
- **Grower Notes:** Large rangy grower that needs space. Plant habit is clavate- the sidearms increase in length towards the top of the bine; similar to many other NZ types. Sidearm length 24-48" or more. Recommend cluster-style planting or 48" in-row spacing.
- **Trellis type:** 14x 36-42"

Amallia

A native southwest hop variety from the genus **H. neomexicana**. A hop variety with deeply cut leaves and an early cone maturity. Heat tolerant. New variety currently being evaluated in our Michigan trials.

- **Alpha acids:** 5.5-9%, Beta 4.2-8.3%
- **Aroma:** earthy, strong orange citrus notes
- **Yield:** Reported as having medium to high yields
- **Storage stability:** Unknown
- **Maturity:** Early
- **Beer styles:** Browns, Dark Ales, being used by craft brewers in Colorado
- **Grower notes:** Heat tolerant and not suitable in cool wet climates and soils.

Brewers Gold

An heirloom American hop that is the parent of many popular high-alpha bittering varieties. A 1919 cross ManitobaBB1 X English male; an open pollination diploid. High yielding and vigor but keeping quality drops unless refrigerated. Supports 24-36" side arms with medium size cones. Substitute: Newport, Magnum, Galena. It is grown commercially in the Midwest & Northeast USA. A consistent performer in our Michigan trials and requested by craft brewers.

- **Alpha Acids:** 7-8.5%, beta 2.5-3.5%, cohumulone 36-48%, total oils 1.8-2.4%ml/100g, myrcene 37-40%, humulene 29-31%, caryophyllene 7-7.5%
- **Aroma:** black currant, fruity-spicy
- **Yield:** med-high 1500-2400 lbs/acre
- **Storage stability:** short if stored a room temp- (refrigerate)
- **Maturity:** Later – Late August/ Early Sept.
- **Beer styles:** English Ales, Lambic, Porter, Pilsner, Ales. Pairs well with German Noble type hops; craft brewers are increasingly asking for it.
- **Grower notes:** notably slower to break dormancy than most, a good climber, shows some resistance to mildews. 36" minimum in row spacing
- **Trellis types:** 12 or 14'x 42' even spacing or cluster style

Canadian Red Vine

A very vigorous diploid hop of French/ Canadian origin. It has a low alpha/ high cohumulone profile. CRV has heavy cone set/clustering and very long side arms (30 – 50 inches). Growth habit is similar to Cluster hops. In brewing, it should be mixed with other hops because its cohumulone ratio is high and can create a harsh bitter finish by itself. This hop is high yielding, very hardy and produces rhizomes profusely.

- **Alpha Acids:** 5% or less, high cohumulone @ 47%
- **Aroma:** Mild berry/cherry flavors, grapefruit peel aroma
- **Yield:** Very good- 2000 lbs/acre plus
- **Storage stability:** very good – over 80%
- **Maturity:** Late season
- **Beer styles:** Red Ales, Canadian/French porters, beers with “bite”.
- **Grower notes:** throws a lot of rhizomes compared to others, lower resistance to mildews. Long sidearms require 42-48" in-row spacing.
- **Trellis types:** 14x42 even or cluster spacing

Cascade

Released in 1972, the Cascade was the first commercially accepted American-bred aroma hop with a relatively low bittering value. It is one of the most popular hops for craft brewing and is great for dry hopping. The Cascade is a cross between the Fuggle X Russian hop Serebrianka. The compact medium sized cone has a square shoulder shape and has a moderate amount of light yellow lupulin that develops in unique tight balls in the cone. It has 24-30" sidearms and is good for picking, drying and baling. Substitute: Centennial, Amarillo, and possibly Columbus. Will grow in hot areas and tolerates alkaline soils. Craft brewers and growers “workhorse” hop.

- **Maturity:** Mid-season- First 3 weeks of August
- **Yield:** 1400-2000 lbs/acre

- **Alpha acids:** 4.5 – 7.0, betas 4.5- 7% cohumulone 33-40%, Total oils .7-1.5%/100g, myrcene 45-60%, humulene 8-16%
- **Storage stability:** Poor, less than 60-65% alpha acids remaining (refrigerate)
- **Aroma:** Medium with floral and citrusy tones
- **Beer Styles:** Pale Ales, IPA, Porters, Wheat beers. Adds citrus flavors.
- **Grower notes:** notably finer hop bines – more bines with a smaller diameter, creates a lot of late season growth near ground, which can harbor mites. Shows notable resistance to mildews. Raised rows recommended. 36” in-row spacing.
- **Trellis types:** 12’x 42’ even

Centennial

Sometimes called “super Cascade”; Centennial has nearly double the alpha profile of Cascade. Many craft brewer's today find this to be a very favorable variety because of its balance of aroma / bittering/high oils and lupulin content. Centennial is a diploid cross between Brewer's Gold X selected USDA male. It has a dense compact cone that is medium in size; with shorter 12-30” side arms. It has good pickability, drying and baling characteristics. It also has an abundant amount of lupulin that is dark yellow in color. Also used in landscapes because of its dark green foliage and habit. Substitute/ blend with Cascade, Columbus, Chinook, & Comet.

- **Maturity:** Early season- Late July/ Early August
- **Yield:** 1500-1750 lbs/acre
- **Alpha Acids:** 9.5-11.5% , betas 3.5-4.5%, cohumulone 28-30%, Total oils 1.5-2.5 ml/100g myrcene 45-55%, humulene 10-18%
- **Storage stability:** Fair 60-65% alpha acids remaining after 6 months
- **Aroma:** Medium with floral and citrus tones; not as citrusy as Cascade but has more bittering
- **Beer Styles:** All Ale styles and can be used with Wheat Beers. Adds a “grapefruit” note. Makes a “heady” brew because of the high lupulin levels.
- **Grower notes:** Breaks dormancy early, evenly & well. Bines emerge from crown more horizontally, a good climber after training, lots of similar sized bines from crown. Centennial is fussier about heavy soil types and drainage; does poorly if over-watered. It will tolerate more alkaline soils and water sources. Requires more labor than most to train and shows low resistance to downy mildew. Raised rows required except in very sandy soils. 36” in-row spacing.
- **Trellis types:** 12’x 42’ even.

Wye Challenger

Challenger is English diploid cross X German Zattler variety. Profile is similar to Northern Brewer but with better yields. It is a major commercial variety in England. Substitutes: Northern Brewer. Good **all-purpose** hop, higher alphas than most English hops, a versatile kettle hop with 12-20” short sidearms. Challenger is England’s response to U.S. Centennial.

- **Alpha Acids:** 6.2 – 9.8%, all-purpose hop w/ balanced bittering, betas 4-4.5%, cohumulone 20-25%, total oils 1.1.7ml/100g, myrcene 30-42%, humulene 25-32%, caryophyllene 8-10%
- **Aroma:** spicy, clean citrusy aroma with an added distinct herbal note
- **Yield:** 1000- 1600 lbs/acre (better than Northern Brewer)
- **Storage stability:** good – 70% plus
- **Maturity:** mid to late season
- **Beer styles:** Ales, Bitter, ESB, Porter, & many exploratory beers.
- **Grower notes:** Vigorous grower with a dense clustered cone set. Yields well in our Michigan trials and tolerates alkaline soils. Low resistance to mildews and wilt can be problematic under saturated soil conditions. Raised rows recommended. Dense large aromatic cones require careful drying / processing. This hop consistently surprises craft brewers in our trials. 36” in-row spacing.
- **Trellis types:** 12’x 42’, 16’x 42 “W’, 12’hedgerow

Chinook

Super alpha hybrid with high vigor & yield. A Peltham Golding X 63012M cross. (The German hop “Perle” shares the Peltham Golding parentage.) A dual purpose bittering/flavoring hop with heavy aroma; spicy, pine-resiny with grapefruit notes. Good pick-ability with 24-40” side arms. Substitute: Galena, Comet, Cluster hops. Popular with both craft and major brewers; thus grown by many Midwest growers as a “workhorse” hop.

- **Alpha Acids:** 10-14%, betas 3-4%, cohumulone 29-34%, total oils 1.5-2.7%, myrcene 35-40%, humulene 18-25%, caryophyllene 9-11%
- **Aroma:** moderately high , spicy, piney, grapefruit tones
- **Yield:** High – 1600 -2200 lbs/acre, large open cones
- **Maturity:** medium late, good cone set
- **Storage stability:** large heavy cones, dries well, good 60-75% remaining
- **Beer Styles:** pale ales, lagers, IPAs, steam beer, and heavy bodied dark ales.
- **Grower notes:** Slower to emerge from dormancy. It is the variety all other hops in the Midwest are compared to for vigor and yield. Chinook forms large primary vines and climbs well with consistent yields. Shows better resistance to mildews and pests than most varieties. Notably forgiving of soil types, drainage, and less-than-perfect growing conditions. 42” in-row spacing.
- **Trellis types:** 14’x 42 even or cluster

Cluster E-2 (Early) vf1120-2013

Early Cluster is probably the oldest **American clonal selection** to be used in commercial production. The heirloom variety is a cross of **Dutch** colonist’s diploid hops with wild native American hops found in the Eastern U.S.A. It is a classic **all-purpose hop**; the original “C” citrus hop. It is being “re-discovered” by craft brewers. 24-36” sidearms.

- **Alpha acids:** 5.5-8.5%, betas 4.5-5.5%, cohumulone 36-42%, total oils .4-1.2ml/100g, myrcene 45-55%, humulene 15-18%, high in soft resins
- **Aroma:** intense citrus & passion fruit
- **Yield:** moderate 1600-2000 lbs/acre
- **Maturity:** early, cones borne in clusters
- **Storage stability:** very good
- **Beer styles:** versatile kettle hop for a wide variety of beer styles; including Barley wines.
- **Grower notes:** vigorous grower, susceptible to mildews out west – needs good air circulation and proper planting density.
- **Trellis types:** 12 X 42', 36-42" in-row spacing

Cluster, Late L-8 (aka. Pacific Coast Cluster)

When Early Cluster was grown in the western states, the Late Cluster strain probably arose from an open pollination cross with wild native western hops. It also became an important commercial strain for growers along the west coast and seems better adapted to more southern climates of Oregon and California. Another classic heirloom hop that is being "re-discovered" by craft brewers. It is considered an **all-purpose variety**. 24-36" sidearms.

- **Alpha acids:** 5.5-8.5%, betas 4.5- 5.5%, cohumulone 40-42%, total oils .2-.46 ml/100g (lower average than Early Cluster), myrcene 45-58%, humulene 13-15%
- **Aroma:** same as early Cluster – intense citrus & passion fruit.
- **Yield:** reportedly better than Early Cluster 180-2000 lbs/acre
- **Maturity:** later than Early cluster 😊, clustered cone formation
- **Storage stability:** very good
- **Beer styles:** identical to Early Cluster
- **Grower notes:** reported better resistance to downy mildew than Early Cluster. Vigorous grower with higher cohumulone, lower oils than the Early strain.
- **Trellis type:** 12 X 42", 36-42" in-row spacing.

Columbia vf1152 -2013

An **all-purpose hop** with pungent aromatics and a clean, crisp flavor profile. This hop variety was developed for Budweiser in the 1960's as a triploid hybrid resulting from a cross of tetraploid Fuggle X Fuggle seedling and is Willamette's sister. Bud's brewer's preferred it in 6 out of 6 brew tests over Willamette, but were over-ruled by the head brewer in favor of the softer noble Willamette hop; which went on to be grown for Budweiser. A higher alpha version of Willamette and Columbia's oil profile is identical. A vigorous grower with 20-40" sidearms. Substitutes: Centennial, Chinook

- **Alpha acids:** 7.6-9.0%, betas 4%, cohumulone 40%, total oils 1.2ml/100g, myrcene 54%, humulene 17%
- **Aroma:** pineapple, bright lemony citrus notes – but not as strong as Chinook
- **Yield:** very good 1800- 2200 lbs/acre
- **Maturity:** early to mid-season
- **Storage stability:** good
- **Beer styles:** developed for lighter beer styles with a crisp finish, but is also finding use in Ambers, Porters, & Stouts.
- **Grower notes:** Medium-sized, pointy cones similar to Chinook cones. Vigorous grower with some resistance to mildews. Does not have the late-breaking dormancy issues like Willamette. Could be a great substitute for Willamette & Fuggle types; especially for Midwest growers.
- **Trellis type:** 12x42, 36-42”in-row spacing.

Columbus (aka CTZ)

A triploid hybrid variety with very high alpha acids & oils. Has **high bittering** qualities; used primarily for dry hopping. Grows well in hot, dry climates; but susceptible to mildews in humid conditions. There is some evidence that Columbus, Zeus, and Tomahawk are very closely related. Substitutes: Zeus, Tomahawk. Has brewing characteristics quite similar to Centennial; but stronger. It has 20-30” sidearms. Tight clustered, compact cones require careful oasting and conditioning.

- **Alpha Acids:** 14-17%, betas 4.5-5.5%, cohumulone 30-35%, total oils 1.5-2.0ml/100g, myrcene 25-45%, humulene 15-25%, caryophyllene 8-12%
- **Aroma:** strong, sharp and citrusy, herbal, resinous
- **Yield:** high 2400-2500lbs/acre
- **Maturity:** mid to late season
- **Storage stability:** no info
- **Beer styles:** American IPAs & Pale Ales, Stout, Lagers.
- **Grower notes:** Grows well, climbs well, can throw sterile male flowers when stressed; which can reduce total yields. Low resistance to mildews and mites. More clustered & dense cone set than Zeus. Tolerant of heat and alkaline soil types; grows well in sandy soils if properly fertilized. Dense tight cones must be dried carefully. 30”-36” in-row spacing.
- **Trellis types:** 12’/ 14’x 42’ even or clustered.

Comet

An early version of the “C” type hop – a vigorous American heirloom variety. It is an **all-purpose hop** used for bittering or as late additions to bring out the strong citrusy flavors. Result of a cross of English “Sunshine” X wild Utah male around 1962- (10 years prior to Cascade). A potent high-oils hop with “raspy” or “wild” bitterness; similar to Brewers Gold. 24-40”sidearms. Substitute: Galena, Summit

- **Alpha acids:** 11.3%, Betas 4.6%, cohumulone 41%, total oils 1.4-3.3ml/100g, myrcene 40-65%,

- **Aroma:** unique zesty grapefruit, with pineapple & orange notes.
- **Yield:** good 1700- 2000+ lbs/ acre reported
- **Maturity:** medium to late
- **Storage stability:** good / very good
- **Beer styles:** American Ales, IPAs, Lagers, Sour & Lambic styles
- **Grower notes:** Vigorous grower, medium-sized elongated cones, average resistance to mildews and pests. 36-40" in-row spacing.
- **Trellis type:** 12x42

Crystal

A 1983 triploid **super aroma** release. A cross of German Hallertauer X USDA21381M. Mt. Hood, Liberty, & Ultra are half sisters. Very mild bittering & highly aromatic. Craft brewers' specialty type hop for finishing aromas. Substitutes: Liberty, Mt. Hood, Hallertauer. 24"-36" sidearms. Often used with Magnum bittering hops. Oast at reduced temperatures to avoid losing volatile aromatic oils.

- **Alpha Acids:** 3-5%, betas 4.5-6.7% (reversed), cohumulone 20-22%, total oils .8-2.1ml/100g, myrcene 40-65%, humulene 18-24%, caryophyllene 4-8%
- **Aroma:** pleasant spice and floral tones, similar to Hallertauer, with very low bittering
- **Yield:** good 1500-2200 lbs/acre
- **Maturity:** mid to late
- **Storage stability:** fair 65% remaining
- **Beer styles:** German style pilsner, Lager, Kolsch, ESB, Belgian Ales. Used often in combination with Magnum, Saaz, & Cascade to boost finished aromas.
- **Grower notes:** grows well with good color, large vines are smoother than most American types. Responds well to more acidic soils with humic acids. Shows good resistance to mildews and pests. Good cone size & pick-ability /plant habit. Easier to grow than most other Hallertauer hybrids. Raised row recommended. 36"- 42" in-row spacing. Over drying cones at high temps can quickly destroy the aroma profile; leaving only hard resins with garlic/onion notes.
- **Trellis types:** 12/14'x 42' even or clustered

Fuggle H (US)

The classic Fuggle was selected by Mr. Richard Fuggle in 1875 in England. Fuggle H (the USA version) has higher oils and is more potent than the original English Fuggle version. Many classic beer recipes call for Fuggle **for flavoring**. It has short 12-20" sidearms and thus could be planted in high density plantings with tighter plant spacing. Substitute: Willamette, Columbia, Tettnanger. Will grow in hot areas w/ alkaline soils. Notable resistance to mildew diseases and pests.

- **Maturity:** Early – Late July / Early August
- **Yield:** Lower, 800-1400 lb/acre, unless grown with higher density populations

- **Alpha Acids:** 4.0-5.5%, betas 1.5-2.0%, cohumulone 25-33%, total oils .7-1.2 ml/100g, myrcene 40-50%, humulene 20-26%, caryophyllene 6-10%, farnesene 4-5%.
- **Storage stability:** very good 70-80% alpha acids remaining
- **Aroma:** Mild, pleasant, hoppy, robust hop with wood and fruit tones
- **Beer Styles:** All English style Ales, ESB, Bitter, Lager, European type Ales.
- **Grower notes:** US Fuggle H still holds its own against the new hybrids. Impressed in Midwest trials with overall vigor, habit, and yield. Shows good resistance to mildews and pests. Shorter sidearms than Willamette allows for tighter plant spacing. Responds to additional bone meal fertilization. Raised row recommended. 28" in-row spacing.
- **Trellis types:** 12'x 42', 16'x 42"W", 12' hedgerow

Galena

A vigorous American diploid **super-alpha bittering- type** hop. Result of a cross between Brewers Gold X undisclosed U.S. male. It is widely grown in the northwest USA. A large, robust hop with large bines and 20"-40" side arms. Good resistance to mildews and pests in our Midwest trials. Substitutes: Newport, Nugget, Chinook. A superior "workhorse" bittering type hop that few other hop varieties can keep up with.

- **Alpha Acids:** 10-14%, betas 7.2-9.0%, cohumulone 36-42%, total oils .9-1.3 ml/100g, unusually high myrcene content 55-60%, humulene 10-15%, caryophyllene 3-5.5%
- **Aroma:** sweet fruits like peaches and grapes with wood and grassy notes
- **Yield:** good 1600-2000 lbs/acre, vigorous grower
- **Maturity:** mid-season
- **Storage stability:** very good 75-85% remaining
- **Beer styles:** American Ale, Porter, Stout, ESB, Bitters. The standard hop for bittering when extra "kick" is desired.
- **Grower notes:** Great plant structure with large bines and excellent cone production. Can easily see why it is a popular choice for commercial growers out West. An all around "workhorse". Have not seen mildew problem spoken of in our Michigan trials. 42" in-row spacing.
- **Trellis type:** 14'x 42' even or clustered

Glacier

An **all-purpose aroma/ flavor** diploid variety. A **French Elasser** X Brewers Gold X N. Brewer cross. It is rapidly finding favor with microbrewers because of its excellent brewing profile. Glacier has a low cohumulone level that brews a very smooth beer with balanced bitterness and foam characteristics. Substitutes: Willamette, Fuggle, Crystal, Horizon. 18"-30" sidearms.

- **Alpha Acids:** 3.5-9.7% , betas 5.5-9.8%, low cohumulone 11-13%, total oils .7-1.6 ml/100g, myrcene 33-62%, humulene 24-36%, Caryophyllene 6.5-10%

- **Aroma:** Mild flavor, citrusy sweet fruit-type aroma (unique flavor) with wood and herbal notes
- **Yield:** very high potential, 2400 -2600 lbs/ acre
- **Storage stability:** good
- **Maturity:** Mid-season, dense cones are small but bines are heavily loaded
- **Beer styles:** English & American Pale Ales, Stouts, Porters. Low cohumulone brews a smooth well balanced beer in many styles.
- **Grower notes:** Good newer “French” variety that grows similar to Crystal. Smaller dense cones that are sticky with soft resins. Alphas are boosted compared to French Elasser. Plant responds well to additional humic acid and bone meal fertilization in our Michigan trials. Tolerates heavier type soils if pH range is correct and is not over-watered. Raised row required unless grown in sandy soil types. 36” in- row spacing.
- **Trellis types:** 12’x 42’ even or clustered. 12’ hedgerow.

Golding (US)

Classic diploid **English aroma** Hop. Goldings are noted for their unique candy-like sweet aroma profile. Similar to Kent Golding. They are utilized in many classic English beer recipes for aroma/ flavor and consistently win brewing awards. Many Golding types are prefaced by their growing location; as soil types influence their alphas and brewing profile. Goldings take two seasons to establish; similar to other European noble types. 20”-40” sidearms.

- **Alpha Acids:** 4-6%, Noble Type
- **Aroma:** Mild & pleasant, spicy/candy/ herbal notes, smooth & hoppy
- **Yield:** low to medium, unless grown in high- density populations
- **Storage stability:** Average, 65 -85%
- **Maturity:** mid-season
- **Beer styles:** English Ales, ESB, Pale Ales, Porters, Stouts
- **Grower notes:** Impressed with overall plant vigor, habit, and cone set in our Michigan trials. Yields of these noble hops are comparatively lower because cones are smaller, light and fluffy. Crowns exit dormancy quite quickly and reportedly do not overwinter well in Northern Michigan. Crowns benefit from winter protection with mulch in regions with rapid freeze thaw cycles and fall applications of potassium. Candidate for high-density and/or short Trellis hop yards. Responds to higher pH soil range than most varieties; with higher calcium & phosphorus levels. Additional bone meal is beneficial to plant vigor and boosting alpha levels. Raised row required. Shows good resistance to mildews and pests. 36” in-rowspacing.
- **Trellis types:** 12’x 42’, 16’x 42”W”, 12’ hedgerow

Hallertauer (US)

Traditional German **noble aroma type**. Very low bittering value. 12-30” side arms. Called for in many beer purist’s classic beer recipes and in premium beers. Requires well -drained acidic soils, high in humic acids. Commands a higher price than other Hallertau hybrids. Short sidearms 12-30”

- **Alpha Acids:** 3-5.5%, betas 3.5-5.5%, cohumulone 18-24%, total oils .6-1.0ml/100g, myrcene 35-44%, humulene 30-38%, caryophyllene 10-12%
- **Aroma:** subtle flower and spice, noble
- **Yield:** Fair 1000-1500 lbs/acre, unless planted high-density
- **Maturity:** Early
- **Storage stability:** low 55% remaining , refrigerate
- **Beer styles:** Pilsner, Bock, Lager, Wheat – Bavarian-style beers.
- **Grower notes:** Establishes, as well, or better than its newer hybrids when grow in the Midwest, although potential yields are lower. Good plant structure and growth. Susceptible to crown rots/ wilts in soggy soil conditions or if over-watered, but quite resistant to mildews and pests. Raised row required, with acidic soil conditions. Halletaur (US) takes two seasons to establish – similar to all the other noble European types. 28 -36”in-row spacing.
- **Trellis types:** 12’x 42’, 16’x42”W”, 12’ hedgerow.

Horizon

A unique **High Alpha/ Aroma variety**. A Brewers Gold X Zattler diploid hybrid released in 1997.(USDA65009 X USDA64035M). Resistant to Verticillium wilt. Good **dual purpose hop**, with high alpha acids and oils. Very low cohumulone level creates a smooth, balanced beer with good mouth-feel and foam stability. 15-30”side arms. Substitutes: Nugget may be a genetically related sister, but Horizon’s plant habit is totally different.

- **Alpha Acids:** 11-14%, betas 6.5-8.5%, cohumulone 16-22%, total oils 1.2-2.2 ml/100g, high myrcene 55-70%, humulene 8-13%, caryophyllene 5-9%, farnesene 2.5-3.5%
- **Aroma:** Floral bouquet, Spicy with citrus notes ; **unique High alpha/ Aroma variety**
- **Yield:** good 1800-2000 lbs/acre
- **Maturity:** mid to late
- **Storage stability:** good 68-89 very % remaining
- **Beer styles:** Pale Ales , Lagers, American IPA/IIPA, American Brown Ales. Craft brewers like this hop because the very low comulone level is unusual in such a high alpha hop. This trait makes excellent foam characteristics with very little harshness or bitter aftertaste that is common in most high alpha varieties. Compares well with noble varieties.
- **Grower notes:** one of the best new high alpha /aroma varieties in trials so far; grows and climbs well, with a better crown structure than Nugget. Plant habit is notably different than most hops – with smaller, fuzzier leaves and shorter internodes. These traits create a dense foliage that can harbor mites and powdery mildew. A candidate for short trellis if spaced properly. Raised row recommend. Prefers more acidic soils. 30”- 36”in-row spacing.
- **Trellis types:** 12’x 42’ even or clustered, 12’ hedgerow, possible short trellis type.

Kent Golding

The Kent Golding is a traditional diploid English **aroma hop** that was developed by clonal selection around 1790 from a start of Canterbury Whitebine. It has a light, fluffy cone structure that is small in size with small amounts of pale yellow lupulin. Cones will shatter if picked too late. Side arms are 20-40" long. Goldings varieties are desired by microbrewer's because of their aroma in kettle hopping, late hopping and dry hopping. Considered the premium English aroma type. Substitutes: other Golding varieties.

- **Maturity:** Mid-season – First 3 weeks of August
- **Yield:** Medium 1400 + lbs/acre, can be boosted by higher density plantings
- **Alpha acids:** 4 – 5.5%
- **Storage stability:** Good 65-85% alpha acids remain
- **Aroma:** Gentle, fragrant, and pleasant floral and spice notes
- **Beer Styles:** All English style Ales, ESB, Bitter, Firestone Walker DBA
- **Grower notes:** Takes two seasons to establish, requires raised row and higher pH soils than most varieties. Plants respond well to additional bone meal in fertilization. Some resistance to mildews. Candidate for hedgerow and/or high-density hop yards to boost yields. 36" in-row spacing.
- **Trellis types:** 12'x 42' even or clustered.

Lawton

An unknown feral-type hop collected in Michigan, 2012. Probably a survivor immigrant hop. Very vigorous and disease resistant. 24"- 40" sidearms with good cone size & yield. Currently being evaluated in our Michigan trials.

- **Alpha acids:** cones tested 3.5 -4.0% from uncultivated specimen
- **Aroma:** pungent, woody & earthy – not citrusy
- **Yield:** high – based on cone size and set on specimen plant
- **Storage stability:** Unknown
- **Maturity:** mid to late season
- **Beer styles:** Bittering type – non- citrus
- **Grower notes:** Growth and vigor out- paced even the triploid hybrid varieties in our trials. Does not fit the profile of a true wild native wild American hop. 42" spacing.
- **Trellis types:** 14'x 42' even/clustered

Liberty

One of the four hybrid triploid Hallertauer **noble aroma varieties**. Liberty was released in the USA in 1991. (tetraploid Hallertaur mf. X USDA64035M). The cones are smaller but dense, on 12-30" side arms. They have good picking, drying and baling characteristics. The dark yellow lupulin is found in

moderate amounts. Liberty is a noble aroma variety that is more disease resistant than the parent Hallertauer variety for resistance to Verticillium wilt and crown rots. Substitute: Hallertauer, Mt. Hood. Prefers well-drained, acidic soils.

- **Maturity:** Early to mid-season
- **Yield:** 1000-1700 lbs/acre
- **Alpha Acids:** 4.0-6.0 % acids remaining
- **Aroma:** Mild, slightly spicy, similar to Hallertauer
- **Beer Pilsner, Bock, US Wheat, Kolsch, all Belgian styles**
- **Grower notes:** Takes two seasons to start/establish, has to have great drainage, will not tolerate heavy, wet, soggy soils. This is the most challenging hop trialed, to date. However, craft brewers are increasingly asking for it because of its brewing profile. Requires raised rows and acidic, well-drained soils. Plants respond to addition of humic acids to the fertilization program. Only recommended for experienced growers with site specific conditions. Candidate for higher density plantings. Shows resistance to mildews. 36" in-row spacing.
- **Trellis types:** 12'x 42', 16'x 42"W", even or clustered.

Magnum

A German **extract/ bittering hybrid** with good yield potential. Released 1980; a Galena X German male 75/5/3. No distinct aroma addition when brewing – considered a very clean, non-harsh, bittering hop with very high alpha acids. Used in a wide array of beers and pairs well with low bittering noble aroma hops, and Horizon, Crystal. Substitutes: nothing close; possibly Galena. 24"-36" sidearms.

- **Alpha Acids:** 13-15% w/ relatively low cohumulone offer superior foam and mouth feel.
- **Aroma:** faint spice and citrus, bittering type w/ little harshness
- **Beer Styles:** Great for American IPAs, pale ales, German-style lagers, smooth and easy drinking beers like Lawnmower. This bittering type is really gaining ground for use in bittering with Saaz & Crystal hops.
- **Maturity:** mid-season – Mid to late August
- **Yield:** High, 1800 lbs/ acre plus, good cone size and pick-ability.
- **Storage stability:** 80%-85% alpha acids remaining after 6 months storage < 70° F
- **Grower notes:** Comes out of the ground well with large primary vines and is easy to train. Some resistance to mildews and pests. A large variety that is only slightly less vigorous than Galena. Takes two seasons to establish. Prefers acidic, well-drained soils that are high in humic acids. Raised row recommended. Shows some resistance to mildews and pests. 38-42" in-row spacing.
- **Trellis types:** 12'x42' clustered or 14'x 42' even/clustered.

Mount Hood

Mount Hood was released in the US in 1989, and is a triploid **noble aroma hybrid** selection of the German Hallertauer variety. (USDA 21397 X USDA 19058M). Mount Hood is the most popular seedless hop in the triploid Hallertau breeding program. This variety was bred to resemble true German Hallertauer mf. The cone structure is a fairly compact medium structure, on 20-40" sidearms. The lupulin is yellow in color with a moderate amount. Substitutes: Crystal, Hersbucker.

- **Maturity:** Early to mid-season- first 3 weeks of August
- **Yield:** medium 1520-1960 lbs/acre (which is outstanding for a noble type)
- **Alpha Acids:** 3.0-8.0 % , betas 5-8%, cohumulone 21-23%, total oils 1-1.7ml/100g, myrcene 30-40%, humulene 15-38%, caryophyllene 7-16%
- **Storage stability:** Fair to poor 55-60% alpha acids remaining – should refrigerate.
- **Aroma:** “clean” mild spice/floral with woody pine tone, like German Hallertauer
- **Beer Styles:** Lager, Pilsner, Bock, US Wheat, Alt, Munich Helles, Bavarian styles.
- **Grower notes:** great variety with good vigor and habit, not as aggressive as other American triploids, grows more Eurostyle. Takes two years to establish; similar to other European types. Good resistance to pests and disease. Requires acidic well-drained soils. Raised row recommended. Shows some resistance to mildews and pests. Plants respond to additional humic acid levels. 36" in-row spacing.
- **Trellis types:** 12'x 42' even/clustered. Possible 16'x 42" W clustered.

Mount Rainier

A newer **hybrid aroma hop** from the USDA-ARS program in Corvallis, Washington. Profile is very similar to Hallertauer mittlefruh but with higher Alpha acids. Result of a Magnum X 19058M cross. A promising new **all-purpose variety**. 18-24" sidearms. Substitutes: Hallertauer

- **Alpha acids:** 5-8.1, betas 5-7%, cohumulone 21-24%, total oils .2-.5 ml/100g,
- **Aroma:** Excellent noble floral boquet, citrus and licorice notes
- **Yield:** Above average for noble types- 1200-1800 lbs/acre
- **Maturity:** Early to mid-season
- **Storage stability:** fair – should be refrigerated like other aroma types
- **Beer styles:** Many styles of Ales, Lagers, Porters – a great finishing hop
- **Grower notes:** good resistance to mildews.
- **Trellis types:** 10-12 X 36-42", 36" in-row spacing.

Neo 1

A new hop based off breeding/selection from native **H. neomexicana hops**. Currently in our Michigan trials for evaluation.

- **Alpha acids:** 7-9%, Beta 3-3.3%
- **Aroma:** reported as super lemon, citrus
- **Yield:** Unknown
- **Maturity:** Very early
- **Beer styles:** Unknown
- **Grower notes:** Early maturing with deeply cut leaves. Lower resistance to mildews and mites. Sets burrs more quickly than Amallia. This species is finer in plant structure and habit than most American types and is intolerant of wet, soggy soils. 28"-36" spacing.
- **Trellis types:** 12'x 42', 12' hedgerow, possible short trellis.

Newport

The Newport is a newer high alpha **bittering variety** that was developed at the Agricultural Research Service (ARS) in Corvallis, OR in 1996. Released in 2002, it has a complex pedigree based Hallertauer Magnum hops. Specifically bred to have better resistance to mildews. It has a much more balanced bittering/ aroma/ flavor profile than Magnum or Galena. It is more similar to Nugget; in that Newport also does not impart a strong citrus note. Used/ blended in a wide variety of beers. Substitute: Galena, Nugget. 18"-36" sidearms.

- **Maturity:** Moderately Late
- **Yield:** High 2300-2840 lbs/acre
- **Alpha Acids:** 13.5-17.0%, betas 7.2-9.1%, cohumulone 36-38%, **high total oils** 1.6-3.6ml/100g, myrcene 47-54%, humulene 9-11%, Caryophyllene 4.5-7%
- **Storage stability:** Good 60% of alpha acids remaining after 6 months
- **Aroma:** earthy citrus with wine /balsamic notes. Fairly pungent, resinous flavor.
- **Beer Styles:** Many Ales, Stout, Barley Wine.
- **Grower notes:** Beefy crowns with good primary vines and plant habit, climbs well, has higher aroma/ flavor ratio than Nugget. Good resistance to mildews and tolerates a wider range of soil conditions than most varieties. 36"-42" in-row spacing.
- **Trellis types:** 12/14'x 42' even or clustered

Northern Brewer(US)

An older 1934 aromatic English Canterbury Golding X OB21m X American native variety with a crisp, neutral aroma, but with high bittering qualities. Good versatile **all-purpose** hop with high oils. Has 12-20" short side arms. Popular with eastern USA craft brewers for full-bodied ales. Substitutes: nothing close -Nugget, Chinook, Vojvodina.

- **Alpha Acids:** 7-9%, beta 3-5%, cohumulone 20-30%, **high total oils** 1.5-2.0ml/100g, myrcene 50-60%, humulene 20-30%, caryophyllene 5-10%
- **Aroma:** woody, herbaceous and peppery character, clean aroma
- **Yield:** lower 800-1200 lbs/acre, unless high density planting is used.
- **Maturity:** early
- **Storage stability:** very good 75-80% remaining
- **Beer styles:** American style ales, ESB, Bitter, California Steam, Porter, Stouts.
- **Grower notes:** An oft overlooked variety that reportedly grows well in sandy sites. Also grown in Europe, shorter side arms pick well. Shows resistance to mildews. Short side arms make this a candidate for short trellis and/or higher density plantings. Brewers are rediscovering its uniqueness. Raised row recommended. Tight 28"-36" in-row spacing.
- **Trellis types:** 12'x 42', 12' hedgerow

Nugget

Released in 1982, the Nugget is a diploid cross between Brewer's Gold and a high alpha-acid male with good storage properties (USDA65009 X USDA63015M). It is an important **high alpha bittering/ flavoring variety** in the US as well as Germany. Nugget is a great variety for picking, drying and baling. It has a cluster cone structure that is heavy, tight and moderately long. The lupulin from the Nugget is abundant with a yellow-orange color. Superior plant habit; 20-40" side arms. Substitutes: Newport, Galena.

- **Yield:** good 1700-2200 lbs/acre
- **Maturity:** Late – Late August / Early Sept.
- **Alpha Acids:** Potent 12.0-14.0%, beta 4.2-5.8%, cohumulone 22-30%, high total oils 1.5-3.2 ml/100g, myrcene 48-59%, humulene 12-22%, caryophyllene 7-10%
- **Storage Stability:** very stable, 70-80% remaining alpha acids
- **Aroma:** Strong green herbal notes- not citrusy - used mainly for bittering
- **Beer Styles:** Pale ales, Stouts, IPAs. **Dual purpose hop.**
- **Grower notes:** In the top ten varieties for vigor and yield with large primary bines. Crown buds tend to form high on this variety and buds are more exposed to winter desiccation if not covered in areas with inadequate snow cover. If plants are cut too close to the ground in the spring "blind" plants with no crown buds are common and are slow to recover. Mulch or soil cover is recommended to protect high buds over the winter. Shows some resistance to mildews. Prefers more acidic soil types & humic acid. 36" - 42" in-row spacing.

Pacific Gem

A late maturing New Zealand triploid **super alpha hop**. Developed from a tetraploid smooth cone X open pollination cross. Has a high yield potential if diseases can be managed. 30"-40" sidearms. Currently being evaluated in our Michigan trials. Substitutes: Columbus, Zeus, Pacific Jade, Pacific Sunrise.

- **Alpha acids:** 11.5- 13.5% or higher, beta acids: 5-7%, cohumulone 30-40%
- **Aroma:** fruity, blackberries
- **Yield:** high, 2000 lb/acre if mildew is controlled
- **Storage Stability:** very good, even at room temperature
- **Maturity:** very late – too late for northern latitudes
- **Beer styles:** IPA, Ales, Porters, Imperial Stouts
- **Grower notes:** Very late maturity and susceptible to downy mildew. Vigorous grower with no excess bottom growth. 42" spacing minimum. This cultivar needs space and good air circulation or mildew is a problem.
- **Trellis types:** 14'x 42' even/ cluster

Perle (US)

Perle was bred in Germany at the Hop Research Center and made available here in the states in the 1980's. Northern Brewer X German male hop. This is a well rounded **dual purpose** hop with 20-40" side arms. Popular with craft & microbrewers. Moderate clean bittering qualities and clean spicy aroma used in a wide range of beers. Good resistance to diseases and pests. Substitute: Northern Brewer, Cluster, Galena, Chinook.

- **Yield:** Good 1160 - 1600 lbs/acre w/ abundant dark yellow lupulin
- **Maturity:** Mid-season- first 3 weeks of August
- **Alpha Acids:** 7 - 9.5%, betas 3-5%, cohumulone 27-32%, total oils .7-1.2ml/100g, myrcene 45-55%, humulene 28-33%, caryophyllene 10-12%
- **Storage Stability:** Excellent 80-85% remaining alpha acids
- **Aroma:** Pleasant floral bouquet and slightly spicy. Similar to noble types.
- **Beer Styles:** Pale Ale, Pilsners, Stout, Lager, Weizen, Alt, Barley Wine, Kolsch, to name a few.
- **Grower notes:** rounded light green cones look like a string of pearls. Distinctly different aroma compared to the 4 C's, good vigor, habit, and yields in our trials. Prefers a more acidic soil like most German bred hops. Responds to additional bonemeal fertilization. Kind of an odd duck – an English type genome converted to German growing conditions. Shows resistance to mildews but is intolerant of over-watering or soggy soils. Raised row required. Takes two years to establish. 36" in-row spacing.
- **Trellis types:** 12'x 42' even or clustered

Saaz (US)

A seedling derived from the **classic Czechoslovakian hop with noble aroma**. Has a low bittering value like most noble hops. Saaz is often listed in classic European beer recipes and adds a **distinct peppery flavor**, due to the high level of farnesene. It is used in Bohemian and fine Pilsner beers by many brewers. It is considered to be one of the finer noble hops in the world. Substitute: Sterling. 6"-24" sidearms. Can be grown high density, possible short trellis.

- **Alpha Acids:** 3-5% beta 3-5%, cohumulone 24-28%, total oils .5-1.0 ml/100g, myrcene 25-37%, Humulene 23-40%, caryophyllene 7-11%, farnesene 9-13%
- **Aroma:** unique mild blend of earth and spice, **unique peppery flavor** addition
- **Yield:** low , typically less than 1000 lbs/acre; unless grown high density population
- **Storage stability:** low, should refrigerate. Over -mature cones will shatter.
- **Maturity:** Early
- **Beer styles:** Classic Pilsner, Lager, Wheat, Belgian-style Ales, Bohemian.
- **Grower notes:** The quickest hop to break winter dormancy; thus susceptible to freeze back and loss of crown buds- needs protective mulching. Smaller crowns with lower vigor; similar to other noble types.. Seems to grow better in areas with more moderate winters. Responds to additional bone-meal and a balanced calcium/phosphate ratio. A candidate for short trellis and/or high density hop yards. Shows resistance to mildews. Does not tolerate wet, soggy soil conditions. Raised row required. Saaz combines very well with Crystal and Magnum. Takes two years to establish. 28"- 36" in-row spacing.
- **Trellis types:** 12'x 42', 16'x 42"W", 12' hedgerow.

Santiam

Released by the Agriculture Research Service in Corvallis, OR in the year 1997. Santiam is a great **all-purpose** triploid **seedless aroma hop** bred from a diploid Tettnanger clone X tetraploid Hallertauer cross. 20-40" side arms. Santiam has noble aroma hop characteristics more similar to German Tettnanger. Adds a spicy character to beers because of its high farnesene content. Substitute: Spalter Select, German Tettnanger.

- **Maturity:** Mid-season
- **Yield:** High potential 1400-2100 lbs/acre
- **Alpha Acids:** 5-7.9%, betas 5.3-8.5, cohumulone 18-24%, high total oils 1.2-2.3ml/100g, myrcene 25-48%, humulene 13-30%, caryophyllene 4.8-8.8%, **farnesene 9.3-15%**
- **Storage stability:** Fair 40-50% alpha acids remaining (refrigerate)
- **Aroma:** excellent floral bouquet with spicy, sweet fruity noble hop notes (smells like Zebra Stripe gum) adds a peppery flavor similar to Saaz.
- **Beer Styles:** Lager, US Ales, Pilsner, Belgian Tripel and other Belgianstyles, Kolsch, Bock, Munich Helles. Great for wet hopping and adding fragrance to pale ales.
- **Grower notes:** this hop has superior vigor, growth, and habit when compared to many other noble German hop crosses. Good strong crown development. Prefers acidic well-drained soil

types like most German types, but likes additional bone meal. Shows some resistance to downy mildews. Intolerant of soggy soils; raised row recommended. 36" in-row spacing.

- **Trellis types:** 12'x 42' even or clustered.

Serebrianka vf2013 – “Silver Hop”

A classic **Russian noble aroma hop** with high ratios of oils. Possibly related to other Saazer type hops and one of the hops used to breed Cascade hops. The name translates to “smooth tongue” and in southern Russia it is considered an all-purpose hop. It has short 12-18" sidearms. A trials candidate for short trellis/ high density hop yards.

- **Alpha acids:** 3.5-5.7%, betas 3%, cohumulone 23%, total oils .4-.8 ml/100g, myrcene 30%, humulene 45%, farnesene 12%
- **Aroma:** light & mellow, fruity orange peel & melon, unique smoke/tobacco finishing notes.
- **Yield:** reported as low from out west – similar to most other classic noble hop yields.
- **Maturity:** early
- **Storage:** poor unless refrigerated – similar to other aroma-type hops
- **Beer styles:** Imperial Stouts, Baltic Porters, Browns & pale ales where the malt is the focus. Excellent head formation and foam retention characters.
- **Grower notes:** This variety is newly virus treated and is being re-evaluated in Michigan growing trials. 24-30" in-row spacing / high density.

Sorachi Ace vf – 2013

A **Japanese high alpha aroma variety** released in 1984. A cross of Brewers Gold X Saazer X Japanese male. It is considered an all-purpose hop that is used where a strong lemony character is desired. 12-36" sidearms with some resistance to disease and pests.

- **Alpha acids:** 10.7-14%, betas ??, cohumulone 23%, total oils 2-2.8ml/100g
- **Aroma:** bold lemony with slight oak & dill tones
- **Yield:** 1200-1600 lbs/acre reported
- **Maturity:** mid-season
- **Storage stability:** fair- should be refrigerated
- **Beer styles:** Farmhouse Ales , Saisons, IPAs, Tripels, Witbiers. A good single hop brew type.
- **Grower notes:** Has to be oasted and stored carefully or off-buttery flavor can develop. New in Michigan growing trials for 2014.
- **Trellis type:** 12 X 42; 36-40" in-row spacing

Southern Brewer

A **South African** variety. Resulted from several open pollinated crosses of Fuggle in the early 1970's. It is considered to be a **high alpha aroma variety**, but it is used mainly as a bittering hop in Africa. Interesting potential as a U.S. grown hop. 20-40" sidearms with good vigor. Substitutes: Fuggle H

- **Alpha acids:** 9-10.5%, betas 2.8-5%, cohumulone 38-41%, total oils .95 ml/100g. myrcene 50-61%, humulene 10-25%, caryophyllene 4.3%, farnesene 3-11%
- **Aroma:** hoppy bouquet with earthy, woody tones
- **Yield:** good 1700 lbs +/- acre reported in Africa
- **Maturity:** mid-season, with medium large ovate cones
- **Storage stability:** good
- **Beer styles:** Belgian style Witbiers, IPAs, mainly used as a hoppy bittering component
- **Grower notes:** reported resistance to mildews and pests. This hop seems to be a high-strength version of Fuggle. Will be in Michigan grower trials in 2014.

Southern Cross

A triploid seedless New Zealand **high alpha aroma variety** released in 1994. A cross of a tetraploid smoothcone X diploid NZ male. Generally a bittering-type hop, but can be a versatile dual purpose due to its high levels of oils. 20-40" sidearms with a bit less of the rangy plant habit of most NZ varieties. No close substitutes.

- **Alpha acids:** 11-14%, betas 6-7%, cohumulone 28%, total oils 1.2 ml/100g, myrcene 31%, humulene 20%
- **Aroma:** citrusy lemon peel, pine needles and spice
- **Yield:** high potential 1800 lbs/acre+, elongated cones
- **Maturity:** mid-season (earlier than other NZ types)
- **Storage stability:** very good
- **Beer styles:** popular in IPAs, excellent oils profile.
- **Grower notes:** A promising NZ type in Michigan grower trials 2014. Plant has a wedge-shaped (clavate) form with the longest sidearms at the top of the bine.
- **Trellis type:** 12 X 42', 42-48" in-row spacing. Good candidate for cluster-style planting.

Spalter Select

A German **seedless triploid aroma variety** brought to the U.S. by a major brewer as an upgrade replacement for Tettnanger. It is a cross of Spalt X Hallertauer mittlefruh. It is considered a superior growing **noble type hop** to others in its class. Used in ultra-premium beers. 12"-20" short sidearms. Can be planted high density. Spalter Select pairs well with Magnum bittering hops and is comparable to Saaz and Santiam.

- **Alpha Acids:** 4-6%, betas 3-4%, cohumulone 20-28%, total oils .5-1.2ml/100g, myrcene 40-50%, humulene 15-20%, caryophyllene 6-8%, farnesene 10-15%
- **Aroma:** Fine fragrant floral/spice/ peppery notes unique to Spalter/ Saaz types
- **Yield:** average- 1200 to 1600 lbs./ acre, possible high density type
- **Storage stability:** fair to good
- **Maturity:** mid to late-season, later than Hallertauer
- **Beer styles:** Fine German-style Ales, Lager, Pilsner
- **Growers notes:** grew very well in our Michigan trials, more even annual cone production than Tettanager. Should be considered for Midwest production. Prefers well-drained acidic soils; raised row recommended. Responds to additional humic acid levels. Requires two years to establish. Spalter types have a unique flavor compared to other German-bred noble varieties. Tight 24"-36" in-row spacing.
- **Trellis types:** 12'x 42', 16'x 42'"W", 12' hedgerow

Star 21217

A **Yugoslavian aroma hop** released in the 1970's. A Belgian variety with a high humulene content that is associated with Flavors like Basil, Cloves, And Corriander. This hop is best used as a late-addition finishing hop; similar to Hallertauer mittlelfruh.

- **Alpha acids:** 3.2%, betas 1.7-2.5%, cohumulone 24%, total oils .47ml/100g, myrcene 34%, humulene 34%
- **Aroma:** pleasant noble type aroma – woody, herbal with spicy tones
- **Yield:** low unless planted high density; typical yield for traditional noble types
- **Maturity:** early
- **Storage Stability:** good
- **Beer styles:** Belgian & Bohemian styles. Finishing aroma hop.
- **Grower notes:** Possible short trellis type; good for high density plantings. Some resistance to mildews.
- **Trellis types:** 10 X 36-42", 24" in-row spacing

Sterling

A Saazer-type improved diploid hybrid (USDA 21522 X USDA21361M), 1/4 Cascade parentage with reported better winter hardiness than Saazer. A **noble/ American aroma type** with higher alpha oils, bitterness, and floral aroma than Saazer. Considered a dual purpose hop. 24-36" side arms. Sstitutes: nothing really close because of the added citrus notes - Tettanager, , Saazer.

- **Alpha Acids:** 6-9%, betas 4-6%, cohumulone 21-28%, total oils .6-1.9ml/100g, myrcene 44-48%, humulene 19-23%, caryophyllene 5-8%, **farnesene 11-15%**
- **Aroma:** Herbal with faint floral & citrus tones. Peppery note similar to Saazer types.
- **Maturity:** Mid-season- mid to late August
- **Storage:** fair 50-65% (refrigerate)
- **Yield:** moderate 1200-1800 lbs/acre
- **Grower notes:** the first to enter dormancy, intolerant about wet soils. Reportedly tough to grow in Northern Michigan, but grows well in the Southwest. Seem to do well in more southern climates with mild winters and drier soils. Susceptible to mildews and viruses. Takes two years to establish. Did not perform as well as Saaz (US) in our Michigan trials. 36" in-row spacing.
- **Trellis types:** 12'x 42' even or clustered

Super Alpha

A New Zealand **high alpha hop variety** obtained from seed from a tetraploid smoothcone variety. A vigorous, high-yielding hop with better resistance to downy mildew than Pacific Gem. 24"-48" long sidearms. Currently being evaluated in our Michigan trials.

- **Alpha acids:** 9.5- 12.7%, beta acids: 3.6- 7.0%, cohumulone 36%, high myrcene levels
- **Aroma:** resinous, herbal piney, lemongrass
- **Yield:** Fair, 1000- 1800 lbs/acre. (Yields per acre are lower because plants require more spacing because of longer sidearms.)
- **Storage stability:** very good, even at room temperature
- **Maturity:** very late season – not recommended for Northern latitudes with short seasons
- **Beer styles:** Lager, Pilsner, Doppelbock, Bitter, Winter Ale
- **Grower Notes:** a vigorous, good climber with long side arms. Requires space to prevent side arm tangling. Better resistance to mildews than other NZ types. 42"- 48" spacing or cluster planting recommended.
- **Trellis types:** 14'x 42' even/ cluster

Tahoma – vf# 1021

Released by Washington State University in 2013. Tahoma is a daughter of Glacier that retains the very low cohumulone characteristic of Glacier with somewhat higher alpha acid content. Tahoma has a pleasant aroma with subtle lemon citrus notes. New variety currently being evaluated in our Michigan trials.

- **Alpha acids:** 7.6%, Beta: 8.8%
- **Aroma:** subtle lemon, and citrus notes
- **Yield:** good plant vigor
- **Storage stability:**
- **Maturity:**
- **Beer styles:** all -purpose
- **Grower notes:**
- **Trellis types:** 12 X 42, 36" in-row spacing

Teamaker

A very unique hybrid **high aroma** hop also used in making antimicrobial organic herbal teas and compounds. Teamaker's alpha and beta levels are reversed. Has antibiotic properties and has potential use as a replacement for antibiotics in animal husbandry. Teamaker adds flavor without additional bitterness (similar to Crystal). The high beta acids inhibit bacterial growth and can replace formalin in sugar processing. Teamaker is used as a "late hopping" aroma hop to add flavor where additional bittering is not desired. Also makes a good flavored ice tea. Utilized in brewing similar to Crystal hops. 24"-36" sidearms.

- **Alpha Acids:** very low - .6 – 1.8%
- **Beta Acids:** significantly higher than most varieties- 5.4- 13.2%
- **Aroma:** Strong spicy floral bouquet, iced tea flavors with no harsh bitterness
- **Yield:** good
- **Storage stability:** good
- **Maturity:** mid-season
- **Beer styles:** smooth Pale Ales
- **Grower notes:** vigorous plant with good yields and habit. Some resistance to mildews and crown rots. Rare high aroma type – probably the strongest aroma picked wet. Grows very well in our Michigan trials. 36"-42" spacing.
- **Trellis types:** 12'x42' clustered or 14'x 42' even/clustered.

Tettnanger (US)

A **noble -type aroma variety**, derived from a **Swiss** Tettnanger clone. It is used as a **dual purpose hop** and is comparable somewhat to Saaz. 12-36" side arms. Substitutes: Spalter Select, Santiam. Craft brewers are rediscovering its hidden potentials. 12"-36" sidearms.

- **Alpha Acids:** 3.5 – 5.5%, betas 3-4.5%, cohumulone 20-25%, total oils .4-.8ml/100g, myrcene 30-45%, 18-23%, caryophyllene 6-7%, farnesene 5-8%

- **Aroma:** a pleasant floral bouquet, mild and slightly spicy.
- **Maturity:** Early with smaller cones
- **Yield:** medium 1000-1400 lbs/acre, unless high density is used
- **Storage:** good 70% remaining
- **Beer styles:** German Ales and Lagers, American Ales, Wheat beers.
- **Grower notes:** an older commercial variety that grows well in our Michigan trials, reportedly varies year-to-year in yields. Shows resistance to mildews, but does poorly in overly wet soils. Establishes more quickly than most noble types. 30-36" in-row spacing.
- **Trellis types:** 12'x 42' even or clustered. 12' hedgerow.

Ultra

A Hallertauer/Saazer triploid **seedless aroma hybrid** developed in the USA. Bred 1983, from a tetraploid Hallertau mf (USDA21397) X Saazer type male (USDA21237). Reports of good yields in northern growing areas. Aroma/oil profile is very similar to Hallertauer mittelfruh and is in demand with craft brewers. 24"-36" sidearms. Substitutes: Saaz, Tettnanger(US), Spalter Select, Santiam.

- **Alpha Acids:** 3-5.5% , betas 3-4%, cohumulone 17-24%, total oils .7-1.3%, myrcene 10-20%, humulene 30-35%, **caryophyllene 7-10%**, farnesene < 1%
- **Aroma:** Hallertauer mittelfruh aroma profile w/ pleasant bitterness. Floral with spice.
- **Yield:** very good in cooler areas- 1800 to 2000 lbs/acre (great for a noble type)
- **Storage stability:** good – 70% remaining
- **Maturity:** mid to late season, smaller cones- like all Hallertauer mf. types
- **Beer styles:** Pilsner, Lagers, Bock, Wheat beers – a great finishing hop.
- **Growers notes:** Ultra has been one of the slowest hops to establish. It demands excellent drainage and soil conditions. Responds to an acidic soil with bone meal added. Low resistance to mildews if improperly sited and over-fertilized/watered. A challenging hop to grow well, but if successful can sell it all day long at premium prices. 36" in-row spacing.
- **Trellis types:** 12'x 42' even or clustered. 16'x 42' clustered only; because of longer sidearms.

Vanguard vf771

A diploid **noble aroma hop** developed in the late 1970's in Washington State. Essential oils profile is quite similar to Hallertauer mittelfruh. Developed & tested for Anheuser Busch but not released until recently. Result of a cross of USDA21285 X USDA64037M. Very high humulene oil content with low cohumulone – considered a noble profile. 15-30" sidearms with good vigor. Substitutes: other Hallertauer varieties and hybrids.

- **Alpha acids:** 5-6%, betas 5-7%, cohumulone 14-15%, total oils .8-1.20ml/100g, myrcene 20%, **humulene 43%**
- **Aroma:** very fragrant refined noble aroma of woody spice.
- **Yield:** very good for a noble type hop- 1200-1600 lbs/acre

- **Maturity:** medium to late
- **Storage stability:** similar to other noble aroma types – should be refrigerated.
- **Beer styles:** Best used as a late-addition finishing hop in many beer styles where extra aroma is desired. Excellent for wet-hopping seasonal beers.
- **Grower notes:** Shows notably better vigor than most Hallertauer cultivars. Has some resistance to mildews but doesn't tolerate wet heavy soil types. 36" in-row spacing.
- **Trellis type:** 12X42

Wye Viking

An **English Svaloef** cross related to Saxon bred at Wye college. (Svaloef is an old Swiss variety that is no longer grown) It has an unusually higher alpha acids profile than most aroma types and is an **all-purpose type hop**. Good possibilities for American brewers crafting new aromatic beers. 12"-20" short sidearms. A candidate for short trellis and hedgerow trellis. A case of a Swiss variety being used to produce an English cultivar; resembles German Tettnanger with higher alpha acids.

- **Alpha Acids:** 8-10% balanced bittering, "**super-aroma hop**", betas 4-5%, cohumulone 21-24%. Total oils .85-1.3ml/100g, myrcene 47%, humulene 10.5%, caryophyllene 5.3%, farnesene 9.1%
- **Aroma:** pleasant, unique Svalof type aroma. Complex floral, herbal, spicy and peppery.
- **Yield:** medium 1000 / 1200 lbs/acre, unless planted high density
- **Storage stability:** good- 70%
- **Maturity:** mid-season
- **Beer styles:** English-style & Red Ales, Lagers, Stout.
- **Grower notes:** notably smaller plant structure than American types; candidate for hedgerow type yards with proper spacing. Shows resistance to mildews but is susceptible to mites due to dense plant habit. Two years to establish. Prefers a more neutral or alkaline soil with additional bonemeal. Raised row required and intolerant of over-watering. (Plants irrigated at the same level as Chinook almost drowned out in a single season.) 24"-36" in-row spacing.
- **Trellis types:** 12'x 42' even, 12' hedgerow, short trellis.

Vojvodina

A Northern Brewer X Golding cross from **Yugoslavia**. It is a late-maturing, **high-alpha aroma variety** with a superior noble hop aroma profile. Has great potential as an **all-purpose** hop in American craft brewing. This hop is slow to catch on simply because it is difficult to pronounce. A "Super-Golding" with double the alphas of Golding. 20"-36" sidearms.

- **Alpha Acids:** 6- 10.5 % (alphas double that of Goldings), betas 3.6%, cohumulone 30%, total oils .6-1.4ml/100g, myrcene 30%, humlone 13%
- **Aroma:** Noble Golding hop tones more pronounced than Northern Brewer; mellow

- **Yield:** medium – 1600 lbs/acre plus
- **Storage:** very good- 76% plus
- **Maturity:** late season
- **Beers:** Potential for a wide range of beers and styles
- **Growers note:** Growers being asked to produce a Golding should consider trials of this top cultivar from Europe. It grows well in our Michigan trials and is higher alpha than English Goldings. Tolerant of more neutral pH and heavier soils if crowns are raised. Two years to establish. Responds to additional bone meal and balanced calcium/ phosphorus levels. Some resistance to mildews. 36" in-row spacing.
- **Trellis types:** 12'x 42' even or clustered, 16'x 42' clustered. Possible 12' hedgerow.

Willamette

Released in 1967, the Willamette is a triploid seedless variant of the English Fuggle variety. It was one of the most widely grown **aroma hops** in the US. It has a vigorous growth habit with longer 24-40" sidearms. The round cone structure is small to medium in size. It also has a moderate amount of lupulin that is golden yellow in color. **A quality aroma/ flavoring "workhorse" hop** is the general perception of the Willamette. Some resistance to diseases and pests. Substitutes: Fuggle H, Tettmanger, Columbia.

- **Maturity:** Early-/ Mid-August through Early September
- **Yield:** moderate 1400-1700 lbs/acre
- **Alpha Acids:** 4.0-6.0% , betas 3-4% , cohumulone 30-35%, total oils 1-1.5ml/100g, myrcene 30-55%, humulene 20-30%, caryophyllene 6.5-8.5%, farnesene 5-6%
- **Storage stability:** 60-65% of alpha acids remaining
- **Aroma:** Mild and pleasant fruit, slightly spicy, woody, a little earthy
- **Beer Styles:** English-style Pale Ale, ESB, Bitter, Amber Ales, Porter, Stouts
- **Grower notes:** a standard commercial variety. Crown buds form relatively high, so they need winter protection by hilling the rows in fall or mulching. Of the Fuggle types, Willamette is the slowest to break winter dormancy. Needs warm temperatures to really get going – does less than optimum in areas with lake effect cooling or if spaced too tightly or planted too closely. Tolerant of a wider range of pH and soil types than most hops. 42" in-row or cluster spacing.
- **Trellis types:** 14'x 42' even/clustered. Possible 12'x 42' clustered if thinned properly.

Yeoman

A **high-alpha aroma variety** bred at Wye College, England in the 1970's. It is a robust **bittering variety** used mainly as a hoppy kettle addition with other noble hops. Short 12-24" sidearms with high oils. Substitutes: Zenith, Northern Brewer.

- **Alpha acids:** 12-16%, betas 4-5%, cohumulone 25%, total oils 1.7-2.4ml/100g, myrcene 48%, humulene 20%

- **Aroma:** Pleasant English aroma, very hoppy with some citrus flavors. More mellow than Target hops.
- **Yield:** Fair 1000 -1600 lbs/acre
- **Maturity:** Early to mid-season
- **Storage stability:** very good
- **Beer styles:** Ales. Lager, IPAs; mixes well with noble-type hops like Willamette and Mt. Hood
- **Grower notes:** good resistance to mildews, tolerant of more alkaline soils, likes bone meal.
- **Trellis types:** 10 or 12 X 42", 24-36" in-row spacing

Zenith

A **high alpha aroma variety** bred at Wye College, England in the 1970's. Good resistance to mildews. It is a hoppy **all-purpose** hop (not as bitter as Yeoman) that works well with many other finishing type hops. Has a notably strong aroma for a high alpha type with high oils. Short 12-20" sidearms. Substitutes: Yeoman, Northern Brewer.

- **Alpha acids:** 9-11%, betas 3%, cohumulone 25%, total oils 1.76 ml/100g, myrcene 52%, humulene 18% (slightly less AA than Yeoman, but better yield potential)
- **Aroma:** pleasing bouquet with hoppy citrus flavors
- **Yield:** good – approaching 2000 lbs/acre (higher than Yeoman)
- **Maturity:** early to mid-season
- **Storage stability:** very good
- **Beer styles:** Ales, Lagers, IPAs
- **Grower notes:** good resistance to mildews, tolerant of more alkaline soils, likes bone meal.
- **Trellis type:** 10 or 12 X 42", 24-36" in-row spacing.

Zeus (aka CTZ)

A super high alpha American hybrid very similar to Columbus. (like lawsuit similar!) Alpha acids reported as high as 20%. Cones have high lupulin content and makes a "heady" IPA. A high powered hop with good aroma and bittering. Brews similar to Columbus but has larger, looser cone sets. 12"-36" sidearms.

- **Alpha Acids:** very high- 13 – 17%, relatively low beta acids- 4.5-6.5%
- **Aroma:** pungent but still pleasant – lots of lupulin
- **Yield:** very high – 2400- 3000 lbs/acre
- **Storage:** no info
- **Maturity:** mid to late season
- **Beer Styles:** **American IPA**, Pale Ales, Stouts, Lagers- makes a "heady" beer because of the high lupulin levels

- **Grower notes:** Brewing profile very similar to Columbus. Seems to have slightly better plant characteristics, good primary vines on vigorous crowns. Cones more dispersed and open. Does better in Northern areas than Columbus; possibly because of a later breaking winter dormancy level. Low resistance to mildews. 20"-36" sidearms.
- **Trellis types:** 12'/14'x 42' even or clustered.