

| Typical Beer Styles | Hops                    | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions   | Additional Information   |
|---------------------|-------------------------|--|------------------------|--|---|--|--|
| Barley wine         | <b>CASCADE (US)</b>     | Flowery and citrusy. Can have a grapefruit note.       | 5.75                   | 48 – 52  | Aroma variety with well-balanced bittering It is the most popular hop with the craftbrewing industry. Good for dry hopping.         | Centennial, Amarillo, to a lesser extent, Columbus                 | Released in 1972 and well-established in US industry. The first commercially accepted American-bred aroma hop. |
| Barley Wine         | <b>CHINOOK (US)</b>     | Medium intensity, spicy, piney, distinctive grapefruit | 13                     | 65 – 70  | A high alpha-acids hop with an acceptable aroma profile.  | Nugget, Columbus, Northern Brewer, Wye Target, possibly Centennial | Released in the US industry in 1985 and becoming increasingly popular with craft-brewers.                      |
| Barley Wine         | <b>PERLE (US)</b>       | Floral and slightly spicy                              | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers. | German Perle, German and US Northern Brewer                        | Excellent storagability.   |
| Belgian Tripel      | <b>SANTIAM (US)</b>     | Floral, slightly spicy                                 | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.   | German Tettnang, German Spalt, German Spalter Select               | Limited but stable acreage.  |
| Bock                | <b>SANTIAM (US)</b>     | Floral, slightly spicy                                 | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.   | German Tettnang, German Spalt, German Spalter Select               | Limited but stable acreage.  |
| English-style, All  | <b>GALENA (US)</b>      | Citrusy  | 13                     | 75 – 80  | An excellent high alpha acids hop with balanced bittering properties combines with a good aroma profile.                            | Nugget   | Released in 1978.  |
| ESB                 | <b>CRYSTAL (US)</b>     | Mild, spicy & flowery                                  | 4.5                    | 50   | Very popular in the craft-brewing industry. Viewed the most pungent of the new triploid Hallertau family of hops.                   | Mt. Hood, Hersbruck, French Strisselspalt, Liberty, Hallertau      | Primarily grown in Oregon. Acreage is increasing in the 1990's.  |
| Kölsch              | <b>HALLERTAU (GR)</b>   | Mild and pleasant                                      | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.  | Liberty, German Tradition, Ultra                                   | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.         |
| Kölsch              | <b>HERSBRUCKER (GR)</b> | Mild to semi-strong, pleasant and hoppy                | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt                                      | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.                                  |

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| Lager               | <b>PERLE (US)</b>         | Floral and slightly spicy                              | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers. | German Perle, German and US Northern Brewer                        | Excellent storagability.   |
| Lager (Bittering)   | <b>CHINOOK (US)</b>       | Medium intensity, spicy, piney, distinctive grapefruit | 13                     | 65 – 70  | A high alpha-acids hop with an acceptable aroma profile.  | Nugget, Columbus, Northern Brewer, Wye Target, possibly Centennial | Released in the US industry in 1985 and becoming increasingly popular with craft-brewers.                    |
| Lagers, German      | <b>BREWER'S GOLD (GR)</b> | Black currant, fruity, spicy                           | 6                      | Average  | Mainly used as a bittering hop  | UK Northdown, Northern Brewer, Galena, Bullion, US Brewer's Gold   | Originally bred in the UK by Professor E.S. Salmon   |
| Stout               | <b>CHINOOK (US)</b>       | Medium intensity, spicy, piney, distinctive grapefruit | 13                     | 65 – 70  | A high alpha-acids hop with an acceptable aroma profile.  | Nugget, Columbus, Northern Brewer, Wye Target, possibly Centennial | Released in the US industry in 1985 and becoming increasingly popular with craft-brewers.                    |
| Ale (Aroma)         | <b>CLUSTER (US)</b>       | Floral and spicy                                       | 7                      | 80 – 85  | An excellent general purpose hop with medium and balanced bittering potential and no undesirable aroma properties.                  | Galena, possibly US Northern Brewer                                | For years the standard US cultivar, improved mass selection in the mid-sixties. Limited acreage grown today. |

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| Ale, American       | <b>NORTHERN BREWER (US)</b> | Medium -strong                  | 9                      | 70 – 85  | A true dual-purpose hop, containing moderate of alpha acids combined with a good aroma profile.                          | German Northern Brewer, Chinook      | A major alpha hop in Germany, but declining in areas in England. Limited acreage in the US.   |
| Ale, English Style  | <b>STYRIAN GOLDING</b>      | Delicate, slightly spicy        | 5.75                   | 65 – 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.  | US Fuggle, Willamette, UK Fuggle     | The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggle.   |
| Ale, English Style  | <b>CHALLENGER (UK)</b>      | Mild to moderate, quite spicy   | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma       | US or German Perle, Northern Brewer  | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968. |
| Ales, All           | <b>BREWER'S GOLD (US)</b>   | Blackcurrant, fruity, spicy     | 9                      | Poor   | Mainly used as a bittering hop   | Bullion                              | Limited acreage in the US   |
| Ales, All           | <b>HORIZON (US)</b>         | Floral, spicy                   | 12                     | Average to good  | Good potential as a medium alpha, good aroma, purpose hop. Has a low co-humulone, which results in a clean tasting beer. | Magnum                               | Commercially grown in small quantities. Gaining in popularity with the craft-brewing industry.  |
| Ales, All           | <b>MILLENIUM (US)</b>       | Mild, Herbal, similar to Nugget | 15.5                   | 2400%  | Very new hop. Primarily used for alpha potential   | Nugget and Columbus                  | Released by John I Haas   |
| Ales, All           | <b>NUGGET (US)</b>          | Herbal                          | 13                     | 70 – 80  | A high alpha acids hop with a good aroma profile.  | Galena, Magnum, Columbus, Wye Target | Released in 1982 and now a major high alpha acids variety in the US. Also grown in Germany.   |

| Typical Beer Styles | Hops                      | Aroma   | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions   | Additional Information   |
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| Ales, All           | <b>STERLING (US)</b>      | Herbal, spicy with a hint of floral and citrus                      | 7.5                    | Good   | Perceived to be similar to a Saaz and Mt Hood combination. Finding favor as a Saaz replacement.                                | Czech Saaz   | Limited, but stable acreage.   |
| Ales, All           | <b>BREWER'S GOLD (GR)</b> | Black currant, fruity, spicy  | 6                      | Average  | Mainly used as a bittering hop   | UK Northdown, Northern Brewer, Galena, Bullion, US Brewer's Gold     | Originally bred in the UK by Professor E.S. Salmon   |
| Ales, All           | <b>PERLE (GR)</b>         | Moderately intense, good and hoppy                                  | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties             | US Perle, Northern Brewer  | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.   |
| Ales, All           | <b>TETTANG (GR)</b>       | Mild and pleasant, slightly spicy                                   | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop  | German Spalt, German Select, US Tettang, US Saaz, German Hersbrucker | Largely confined to the Tettang area near Lake Constance.  |
| Ales, All           | <b>FIRST GOLD (UK)</b>    | A little like Golding, spicy  | 7.5                    | Very good  | First commercial dwarf hop designed for aroma consideration in England, a very promising hop.                                  | UK Kent Golding, maybe Crystal                                       | Early brewing trials look very favorable, limited acreage  |
| Ales, All           | <b>NORTHDOWN (UK)</b>     | Mild, pleasant and delicate hop aroma                               | 8.5                    | 60 – 70  | A true dual-purpose hop with moderate bittering potential and excellent flavor/aroma characteristics.                          | UK Challenger, Northern Brewer                                       | Released in early 1970's with relatively high alpha acids for its time. Its excellent flavor properties ensured its continued survival after the release of the higher alpha acids variety Wye Target.       |
| Ales, All           | <b>PROGRESS (UK)</b>      | Moderately strong, good aroma                                       | 6                      | 60 – 80  | A robust hop aroma type with moderate bittering potential.   | UK Kent Golding, Fuggle  | One of the very few aroma hops actually purposebred in a modern breeding program. Released in the mid-sixties just before brewer demand switched to high alpha acids so it never become very widely planted. |
| Ales, All           | <b>TARGET (UK)</b>        | Pleasant English hop aroma, quite intense                           | 11                     | 45 – 55  | A good high alpha variety with an acceptable to desirable kettle hop aroma.  | Fuggle, Willamette   | The predominant UK variety at present and widely used for its high alpha acids content combined with an acceptable aroma. Normally used for bittering.   |
| Ales, All           | <b>ADMIRAL (UK)</b>       | Used for it's bittering potential; Displays a typical English aroma | 14.5                   |  | Looks to be good replacement for high alpha and dual purpose hops for brewing; Admiral is seen as a replacement to Wye Target. | U.K. Target, U.K. Northdown, U.K. Challenger                         | Bred at Wye College in England, granddaughter of Wye Challenger. Being grown for its high cropping and alpha yield.  |

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| Ales, all  | <b>PHOENIX (UK)</b>    | Similar to Wye Challenger   | 16.25                  | Very good  | Phoenix has all the characteristics of an English dual purpose variety similar to Wye Challenger  | U.K. Northdown, U.K. Kent Golding,<br>U.K. Challenger   | Phoenix is the most Wilt tolerant hop variety currently in production, this, coupled with its alpha and aroma properties makes it a useful hop for brewers and growers alike.  |
| Ales, all  | <b>PIONEER (UK)</b>    | A mild typical English aroma  | 9                      | Good   | A semi-dwarf hop as yet not widely grown. It is limited brewing trials suggest that this is a good dual purpose variety.  | U.K. Kent Golding   | Although this hop is classified as a dwarf variety it does not display all the characteristics associated with dwarfness and may grow better on low trellis, 10 foot wire work. Very limited acreage                         |
| Ales, All (bittering)                              | <b>MAGNUM (US)</b>     | No real distinct aroma character, so is viewed favorably as a clean bittering | 13                     | Very good  | Gaining increasing acceptance as a clean bittering hop.   | German Magnum, possibly Horizon   | Limited acreage in the US, but widely grown in Germany.  |
| Ales, All (Typically used as a first hop addition) | <b>MAGNUM (GR)</b>     | No real distinct aroma character, so is viewed favorably as a clean bittering | 13                     | Very good  | This high-alpha variety is a very promising new breed from the Hop Research Institution in Hüll with good resistance characteristics, high yield and good growth. | Columbus, Nugget  | Hallertau Magnum is the second largest hop variety and the main high alpha variety grown in Germany.   |
| Ales, American                                     | <b>AHTANUM (US)</b>    | Floral  | 6                      | Fair to good   | Used for its aromatic properties and moderate bittering   | Cascade, Amarillo   | Quite similar to Cascade   |
| Ales, American                                     | <b>AMARILLO (US)</b>   | Floral and citrusy  | 9.5                    | Average  | Gaining acceptance, viewed somewhat as a Cascade type   | Cascade, Centennial, possibly Chinook or Ahtanum  | Very limited acreage at this time.   |
| Ales, American                                     | <b>CASCADE (US)</b>    | Flowery and citrusy. Can have a grapefruit note.                              | 5.75                   | 48 – 52  | Aroma variety with well-balanced bittering It is the most popular hop with the craftbrewing industry. Good for dry hopping.                                       | Centennial, Amarillo, to a lesser extent,<br>Columbus   | Released in 1972 and well-established in US industry. The first commercially accepted American-bred aroma hop.   |
| Ales, American                                     | <b>CENTENNIAL (US)</b> | Medium intensity with floral and citrus tones                                 | 10.5                   | 60 – 65  | Very balanced hop, sometimes called a super cascade.  | Cascade, possibly Columbus or Chinook.<br>a blend of 70 Cascade and 30 Columbus<br>will give similar profile. | Named from the Washington State Centennial Celebration. At one time this variety was going to be destroyed for lack of interest by the world's major breweries. Today has found a very favorable following by craft-brewers. |

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| Ales, American      | <b>FUGGLE (US)</b>   | Mild, woody and fruity              | 4.75                   | 60 – 65  | Traditional English-type aroma hop  | UK Fuggle, Willamette, Styrian Golding,<br>US Tettnang           | Also known overseas as Styrian (Savinja) Golding in Slovenia and as UK Fuggle in England. In the US it has been replaced in part by Willamette (triploid Fuggle), which growers find more favorable.                |
| Ales, American      | <b>GALENA (US)</b>   | Citrusy                             | 13                     | 75 – 80  | An excellent high alpha acids hop with balanced bittering properties combines with a good aroma profile.          | Nugget   | Released in 1978.   |
| Ales, American      | <b>SANTIAM (US)</b>  | Floral, slightly spicy              | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.                                     | German Tettnang, German Spalt, German Spalter Select             | Limited but stable acreage.   |
| Ales, American      | <b>SIMCOE (US)</b>   | Very unique, pine-like aroma        | 13                     | Good   | Used for aromatic, and especially bittering properties  | Unknown  | Known as a bittering hop with good aroma characteristics  |
| Ales, American      | <b>TETTNANG (US)</b> | Slightly spicy                      | 4.5                    | 55 – 60  | A true noble aroma variety  | German Spalt Select, German Spalt,<br>Santiam                    | US Tettnang is similar to Fuggle. A very popular hop with the craft-brewery industry.   |
| Ales, Belgian-Style | <b>CRYSTAL (US)</b>  | Mild, spicy & flowery               | 4.5                    | 50   | Very popular in the craft-brewing industry. Viewed the most pungent of the new triploid Hallertau family of hops. | Mt. Hood, Hersbruck, French Strisselspalt,<br>Liberty, Hallertau | Primarily grown in Oregon. Acreage is increasing in the 1990's.   |
| Ales, Belgian-Style | <b>GOLDING (US)</b>  | Mild, delicate classic English-type | 4.5                    | 65 – 80  | US Goldings are very popular among ale breweries in the US  | UK East Kent Golding, UK Progress and possibly the Fuggle family | UK Golding clones have been introduced for growing here in Washington and Oregon. Before being grown in the US, there was a Golding grown in British Columbia (BC Golding), there are no longer any more BC Golding |

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| Ales, belgian-Style | <b>HALLERTAU (US)</b> | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop   | Liberty, German Hallertau, German Tradition          | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply |
| Ales, Belgian-Style | <b>SAAZ (US)</b>      | Very mild, spicy and earthy                    | 3.75                   | 45 – 55  | Available in small quantities.   | Czech Saaz, Polish Lublin, Sterling                  | High ambient temperatures can have an adverse effect on yields.   |
| Ales, Belgian-Style | <b>SANTIAM (US)</b>   | Floral, slightly spicy                         | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.                                | German Tettnang, German Spalt, German Spalter Select | Limited but stable acreage.   |
| Ales, Belgian-Style | <b>STERLING (US)</b>  | Herbal, spicy with a hint of floral and citrus | 7.5                    | Good   | Perceived to be similar to a Saaz and Mt Hood combination. Finding favor as a Saaz replacement.              | Czech Saaz   | Limited, but stable acreage.  |
| Ales, belgian-Style | <b>VANGUARD (US)</b>  | Similar to Hallertau.                          | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.   | Hallertau, German Hersbrucker, Mt Hood, Liberty      | Similar to Hallertau Mittlefruh   |
| Ales, Belgian-Style | <b>CZECH SAAZ</b>     | Very mild with pleasant hoppy notes            | 3.75                   | 45 – 55  | The classical "noble" aroma hop with long and strong traditions. Associated with the renowned Pilsner lager. | US Saaz, Polish Lublin, US Sterling                  | By far the predominant Czech variety and clones of it are grown in Poland and the Ukraine.  |
| Ales, Belgian-Style | <b>HALLERTAU (GR)</b> | Mild and pleasant                              | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.                                     | Liberty, German Tradition, Ultra                     | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.  |

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| Ales, Belgian-Style  | <b>HERSBRUCKER<br/>(GR)</b>  | Mild to semi-strong, pleasant<br>and hoppy | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt                 | Grown widely not only in the Hallertau but also in Spalt and Hersbruck<br>areas.   |
| Ales, Belgian-Style  | <b>STYRIAN<br/>GOLDING</b>   | Delicate, slightly spicy                   | 5.75                   | 65 – 80  | A world-renowned aroma hop with widespread usage in<br>both ale and lager brewing.                    | US Fuggle, Willamette, UK Fuggle              | The old traditional favorite of Slovenia. Also well-established in English<br>brewing as Fuggle.                             |
| Ales, Belgian-Style  | <b>KENT GOLDING<br/>(UK)</b> | Gentle, fragrant and pleasant              | 4.75                   | 65 – 80  | The classic English Ale hop which has been used<br>extensively in kettle hopping and for dry hopping. | US Golding, Whitbread Golding, UK<br>Progress | Traded as East-Kent Goldings, if grown in East Kent, Kent Goldings if<br>grown in mid-Kent, and Goldings if grown elsewhere. |
| Ales, English (dark) | <b>EROICA (UK)</b>           | Clean                                      | 13                     |  |   | Northern Brewer, Galena                       |  |
| Ales, English style  | <b>WILLAMETTE<br/>(US)</b>   | Mild and pleasant, slightly<br>spicy       | 5                      | 60 – 65  | A quality aroma hop   | US Fuggle, US Tettnang, Styrian Golding       | Released in 1976 and well-established in the US industry. Currently the<br>most widely grown aroma hops in the US.           |
| Ales, English style  | <b>FUGGLE (UK)</b>           | Mild, pleasant and hoppy                   | 4.75                   | 70 -80   | A hop long associated with typical English Ale brewing.<br>Imparts good hoppy late-hop flavor         | US Fuggle, Willamette, Styrian Golding        | Once a predominant hop in England but now reserved for aroma use in<br>conjunction with high alpha types.                    |



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| Ales, English style             | <b>KENT GOLDING (UK)</b>            | Gentle, fragrant and pleasant | 4.75                   | 65 – 80  | The classic English Ale hop which has been used extensively in kettle hopping and for dry hopping.                | US Golding, Whitbread Golding, UK Progress                    | Traded as East-Kent Goldings, if grown in East Kent, Kent Goldings if grown in mid-Kent, and Goldings if grown elsewhere.  |
| Ales, English style             | <b>STYRIAN GOLDINGS (SLOVENIAN)</b> | Delicate, slightly spicy      | 7.5                    | 65 - 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.                                   | U.S. Fuggles, U.K. Fuggles, Willamette                        | An ecotype of Fuggles grown in Slovenia. Also known as Savinja Golding. The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggles.   |
| Ales, english style (bittering) | <b>BULLION (UK)</b>                 |                               | 13.5                   |  |   | Brewer's Gold, Pacific Gem                                    | Bullion was raised in 1919 Engand from a wild Manitoban female crossed with and English male hop. It's considered a dual-purpose hop, but is generally used for bittering. It has an intense aroma, reminiscent of black currants. It is gradually losing ground to the new higher alpha hops with |
| Ales, Munich                    | <b>HALLERTAU (GR)</b>               | Mild and pleasant             | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.  | Liberty, German Tradition, Ultra                              | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.   |
| Ales, Stout, Barley Wine        | <b>NEWPORT (US)</b>                 | Mild                          | 15.25                  | 36 – 38  | Viewed as a high-bittering alpha hop.   | Galena, Nugget, Fuggles, Magnum, Brewer's Gold                | One of the newest varieties to be released in the US (Year 2002)   |
| Alt                             | <b>CRYSTAL (US)</b>                 | Mild, spicy & flowery         | 4.5                    | 50   | Very popular in the craft-brewing industry. Viewed the most pungent of the new triploid Hallertau family of hops. | Mt. Hood, Hersbruck, French Strisselspalt, Liberty, Hallertau | Primarily grown in Oregon. Acreage is increasing in the 1990's.  |

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| Alt                 | <b>MOUNT HOOD (US)</b> | Mild, somewhat pungent             | 6.5                    | 50 -60   | Aroma variety with marked similarities to the Hallertauer and Hersbrucker varieties. Most popular hop in the triploid Hallertau breeding program, partly due to the fact it was the first one released. | Crystal, French Strisselspalt, Hersbrucker                            | Released in the US in 1989.  |
| Alt                 | <b>PERLE (US)</b>      | Floral and slightly spicy          | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers.   | German Perle, German and US Northern Brewer                           | Excellent storagability.   |
| Alt                 | <b>HALLERTAU (GR)</b>  | Mild and pleasant                  | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.  | Liberty, German Tradition, Ultra                                      | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.                       |
| Alt                 | <b>PERLE (GR)</b>      | Moderately intense, good and hoppy | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties  | US Perle, Northern Brewer   | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety. |
| Alt                 | <b>SPALT (GR)</b>      | Mild and pleasant, slightly spicy  | 4.5                    | 50 – 60  | Traditional, very fine or noble aroma hop   | US Saaz, US Tettnang, German Spalt Select                             | Grown only in Spalt area and not a large acreage available.  |
| Alt                 | <b>TETTNANG (GR)</b>   | Mild and pleasant, slightly spicy  | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop   | German Spalt, German Select, US Tettnang, US Saaz, German Hersbrucker | Largely confined to the Tettnang area near Lake Constance.   |

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| Barley Wine         | <b>COLUMBUS (US)</b>   | Pungent                             | 15                     | Below average  | Originally bred for its alpha value, it has also become popular for its oil profile. Great for dry hopping.        | Nugget, Chinook, Wye Target, Northern Brewer, possibly Centennial | Also know as Tomahawk. Considered similar to Zeus.  |
| Barley Wine         | <b>GOLDING (US)</b>    | Mild, delicate classic English-type | 4.5                    | 65 – 80  | US Goldings are very popular among ale breweries in the US   | UK East Kent Golding, UK Progress and possibly the Fuggle family  | UK Golding clones have been introduced for growing here in Washington and Oregon. Before being grown in the US, there was a Golding grown in British Columbia (BC Golding), there are no longer any more BC Golding hops grown. |
| Barley Wine         | <b>MILLENIUM (US)</b>  | Mild, Herbal, similar to Nugget     | 15.5                   | 2400%  | Very new hop. Primarily used for alpha potential   | Nugget and Columbus   | Released by John I Haas   |
| Barley Wine         | <b>NUGGET (US)</b>     | Herbal                              | 13                     | 70 – 80  | A high alpha acids hop with a good aroma profile.  | Galena, Magnum, Columbus, Wye Target                              | Released in 1982 and now a major high alpha acids variety in the US. Also grown in Germany.   |
| Barley Wine         | <b>CHALLENGER (UK)</b> | Mild to moderate, quite spicy       | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma | US or German Perle, Northern Brewer                               | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968.   |
| Bitter              | <b>GLACIER (US)</b>    | Excellent, pleasant hoppiness       | 5.5                    | Good   | An excellent new variety with balanced bittering properties combined with a good aroma profile.                    | Willamette, US Fuggle, US Tettnang, Styrian Golding               | Released as a public variety in 2000 by Dr. Stephen Kenny, Washington State University. It was chosen for its low cohumulone and good yield potential.  |
| Bitter              | <b>GOLDING (US)</b>    | Mild, delicate classic English-type | 4.5                    | 65 – 80  | US Goldings are very popular among ale breweries in the US   | UK East Kent Golding, UK Progress and possibly the Fuggle family  | UK Golding clones have been introduced for growing here in Washington and Oregon. Before being grown in the US, there was a Golding grown in British Columbia (BC Golding), there are no longer any more BC Golding hops grown. |
| Bitter              | <b>SAAZ (US)</b>       | Very mild, spicy and earthy         | 3.75                   | 45 – 55  | Available in small quantities.   | Czech Saaz, Polish Lublin, Sterling                               | High ambient temperatures can have an adverse effect on yields.   |
| Bitter              | <b>TETTNANG (US)</b>   | Slightly spicy                      | 4.5                    | 55 – 60  | A true noble aroma variety   | German Spalt Select, German Spalt, Santiam                        | US Tettnang is similar to Fuggle. A very popular hop with the craft-brewery industry.   |

| Typical Beer Styles | Hops                                | Aroma                                       | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions                                      | Additional Information  |
|---------------------|-------------------------------------|---|------------------------|--|--|---|---|
| Bitter              | <b>CZECH SAAZ</b>                   | Very mild with pleasant hoppy notes         | 3.75                   | 45 – 55  | The classical "noble" aroma hop with long and strong traditions. Associated with the renowned Pilsner lager.       | US Saaz, Polish Lublin, US Sterling                         | By far the predominant Czech variety and clones of it are grown in Poland and the Ukraine.  |
| Bitter              | <b>NORTHERN BREWER (GR)</b>         | Medium-strong with some wild American tones | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile.      | Chinook, US Northern Brewer, German Brewer's Gold           | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.  |
| Bitter              | <b>CHALLENGER (UK)</b>              | Mild to moderate, quite spicy               | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma | US or German Perle, Northern Brewer                         | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968.   |
| Bitter              | <b>FUGGLE (UK)</b>                  | Mild, pleasant and hoppy                    | 4.75                   | 70 -80   | A hop long associated with typical English Ale brewing. Imparts good hoppy late-hop flavor                         | US Fuggle, Willamette, Styrian Golding                      | Once a predominant hop in England but now reserved for aroma use in conjunction with high alpha types.  |
| Bitter              | <b>PROGRESS (UK)</b>                | Moderately strong, good aroma               | 6                      | 60 – 80  | A robust hop aroma type with moderate bittering potential.   | UK Kent Golding, Fuggle                                     | One of the very few aroma hops actually purposebred in a modern breeding program. Released in the mid-sixties just before brewer demand switched to high alpha acids so it never became very widely planted.              |
| bitter              | <b>STYRIAN GOLDINGS (SLOVENIAN)</b> | Delicate, slightly spicy                    | 7.5                    | 65 - 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.                                    | U.S. Fuggle, U.K. Fuggle, Willamette                        | An ecotype of Fuggle grown in Slovenia. Also known as Savinja Golding. The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggle.  |
| bitter              | <b>BRAMLING CROSS (UK)</b>          | Quite mild and not unpleasant               | 8.9                    | 60 - 70  | Acceptable general purpose aroma hop but lacking the fineness of Golding aroma.                                    | U.K. Kent Golding, U.K. Progress, Whitbread Golding Variety | Raised in 1927 from the commercial Golding variety Bramling crossed with a Manitoban wild male hop. Its tolerance to Verticillium wilt allowed its expansion in the U.K. as the acreage of Fuggles and Goldings declined. |

| Typical Beer Styles | Hops                    | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|---------------------|-------------------------|--|------------------------|--|---|---|--|
| Bock                | <b>HALLERTAU (US)</b>   | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop  | Liberty, German Hallertau, German Tradition                       | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. If you want Hallertau, make sure you are getting the real thing. If |
| Bock                | <b>LIBERTY (US)</b>     | Mild with a slightly spicy character           | 4                      | 35 – 55  | Aroma variety with close similarities to imported German aroma varieties, especially Hallertau.   | US or German Hallertau, German Tradition, Mt Hood, possibly Spalt | Released in the US in 1991. Of the four triploid Hallertau varieties released, Liberty most closely resembles the Hallertau cultivar.  |
| Bock                | <b>MOUNT HOOD (US)</b>  | Mild, somewhat pungent                         | 6.5                    | 50 -60   | Aroma variety with marked similarities to the Hallertauer and Hersbrucker varieties. Most popular hop in the triploid Hallertau breeding program, partly due to the fact it was the first one released. | Crystal, French Strisselspalt, Hersbrucker                        | Released in the US in 1989.  |
| Bock                | <b>VANGUARD (US)</b>    | Similar to Hallertau.                          | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.  | Hallertau, German Hersbrucker, Mt Hood, Liberty                   | Similar to Hallertau Mittlefruh  |
| Bock                | <b>HALLERTAU (GR)</b>   | Mild and pleasant                              | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.  | Liberty, German Tradition, Ultra                                  | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.   |
| Bock                | <b>HERSBRUCKER (GR)</b> | Mild to semi-strong, pleasant and hoppy        | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt                                     | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.  |

| Typical Beer Styles | Hops                   | Aroma                                  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions   | Additional Information  |
|---------------------|------------------------|--|------------------------|--|--|--|---|
| Bock                | <b>SPALT (GR)</b>      | Mild and pleasant, slightly spicy      | 4.5                    | 50 – 60  | Traditional, very fine or noble aroma hop  | US Saaz, US Tettnang, German Spalt Select                        | Grown only in Spalt area and not a large acreage available.   |
| Bock                | <b>TRADITION (GR)</b>  | Very fine, similar to German Hallertau | 6                      | Good   | Only recently released so too early for general consensus. Brew to replace Hersbrucker in German grown areas.      | Liberty, German Hallertau  | Released in 1991 and undergoing expansion in German growing areas.  |
| Brown Ales          | <b>WILLAMETTE (US)</b> | Mild and pleasant, slightly spicy      | 5                      | 60 – 65  | A quality aroma hop  | US Fuggle, US Tettnang, Styrian Golding                          | Released in 1976 and well-established in the US industry. Currently the most widely grown aroma hops in the US.   |
| Brown Ales          | <b>CHALLENGER (UK)</b> | Mild to moderate, quite spicy          | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma | US or German Perle, Northern Brewer                              | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968.   |
| English-style, All  | <b>FUGGLE (US)</b>     | Mild, woody and fruity                 | 4.75                   | 60 – 65  | Traditional English-type aroma hop   | UK Fuggle, Willamette, Styrian Golding, US Tettnang              | Also known overseas as Styrian (Savinja) Golding in Slovenia and as UK Fuggle in England. In the US it has been replaced in part by Willamette (triploid Fuggle), which growers find more favorable.                            |
| English-style, All  | <b>GOLDING (US)</b>    | Mild, delicate classic English-type    | 4.5                    | 65 – 80  | US Goldings are very popular among ale breweries in the US   | UK East Kent Golding, UK Progress and possibly the Fuggle family | UK Golding clones have been introduced for growing here in Washington and Oregon. Before being grown in the US, there was a Golding grown in British Columbia (BC Golding), there are no longer any more BC Golding hops grown. |

| Typical Beer Styles | Hops                        | Aroma                                       | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions                              | Additional Information  |
|---------------------|-----------------------------|---|------------------------|--|--|---|---|
| English-style, All  | <b>NORTHERN BREWER (US)</b> | Medium -strong                              | 9                      | 70 – 85  | A true dual-purpose hop, containing moderate of alpha acids combined with a good aroma profile.                    | German Northern Brewer, Chinook                     | A major alpha hop in Germany, but declining in areas in England. Limited acreage in the US.   |
| ESB                 | <b>GLACIER (US)</b>         | Excellent, pleasant hoppiness               | 5.5                    | Good   | An excellent new variety with balanced bittering properties combined with a good aroma profile.                    | Willamette, US Fuggle, US Tettnang, Styrian Golding | Released as a public variety in 2000 by Dr. Stephen Kenny, Washington State University. It was chosen for its low cohumulone and good yield potential.              |
| ESB                 | <b>NORTHERN BREWER (GR)</b> | Medium-strong with some wild American tones | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile.      | Chinook, US Northern Brewer, German Brewer's Gold   | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.  |
| ESB                 | <b>STYRIAN GOLDING</b>      | Delicate, slightly spicy                    | 5.75                   | 65 – 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.                                    | US Fuggle, Willamette, UK Fuggle                    | The old traditional favorite of Slovenia. Also well established in English brewing as Fuggle.   |
| ESB                 | <b>CHALLENGER (UK)</b>      | Mild to moderate, quite spicy               | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma | US or German Perle, Northern Brewer                 | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968. |
| ESB                 | <b>FIRST GOLD (UK)</b>      | A little like Golding, spicy                | 7.5                    | Very good  | First commercial dwarf hop designed for aroma consideration in England, a very promising hop.                      | UK Kent Golding, maybe Crystal                      | Early brewing trials look very favorable, limited acreage   |

| Typical Beer Styles | Hops                                | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions                                      | Additional Information   |
|---------------------|-------------------------------------|--|------------------------|--|--|---|--|
| ESB                 | <b>FUGGLE (UK)</b>                  | Mild, pleasant and hoppy                       | 4.75                   | 70 -80   | A hop long associated with typical English Ale brewing. Imparts good hoppy late-hop flavor                               | US Fuggle, Willamette, Styrian Golding                      | Once a predominant hop in England but now reserved for aroma use in conjunction with high alpha types.   |
| ESB                 | <b>PROGRESS (UK)</b>                | Moderately strong, good aroma                  | 6                      | 60 – 80  | A robust hop aroma type with moderate bittering potential.   | UK Kent Golding, Fuggle                                     | One of the very few aroma hops actually purposebred in a modern breeding program. Released in the mid-sixties just before brewer demand switched to high alpha acids so it never become very widely planted.   |
| ESB                 | <b>STYRIAN GOLDINGS (SLOVENIAN)</b> | Delicate, slightly spicy                       | 7.5                    | 65 - 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.  | U.S. Fuggle, U.K. Fuggle, Willamette                        | An ecotype of Fuggle grown in Slovenia. Also known as Savinja Golding. The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggle.   |
| ESB                 | <b>BRAMLING CROSS (UK)</b>          | Quite mild and not unpleasant                  | 8.9                    | 60 - 70  | Acceptable general purpose aroma hop but lacking the fineness of Golding aroma.  | U.K. Kent Golding, U.K. Progress, Whitbread Golding Variety | Raised in 1927 from the commercial Golding variety Bramling crossed with a Manitoban wild male hop. Its tolerance to Verticillium wilt allowed its expansion in the U.K. as the acreage of Fuggles and Goldings declined.  |
| ESB                 | <b>PIONEER (UK)</b>                 | A mild typical English aroma                   | 9                      | Good   | A semi-dwarf hop as yet not widely grown. It is limited brewing trials suggest that this is a good dual purpose variety. | U.K. Kent Golding   | Although this hop is classified as a dwarf variety it does not display all the characteristics associated with dwarfness and may grow better on low trellis, 10 foot wire work. Very limited acreage   |
| Helles              | <b>HALLERTAU (US)</b>               | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop   | Liberty, German Hallertau, German Tradition                 | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. If you want Hallertau, make sure you are getting the real thing. If |



| Typical Beer Styles | Hops                        | Aroma                                       | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions                               | Additional Information   |
|---------------------|-----------------------------|---|------------------------|--|---|--|--|
| Helles              | <b>MOUNT HOOD (US)</b>      | Mild, somewhat pungent                      | 6.5                    | 50 -60   | Aroma variety with marked similarities to the Hallertauer and Hersbrucker varieties. Most popular hop in the triploid Hallertau breeding program, partly due to the fact it was the first one released. | Crystal, French Strisselspalt, Hersbrucker           | Released in the US in 1989.  |
| Helles              | <b>NORTHERN BREWER (US)</b> | Medium -strong                              | 9                      | 70 – 85  | A true dual-purpose hop, containing moderate of alpha acids combined with a good aroma profile.   | German Northern Brewer, Chinook                      | A major alpha hop in Germany, but declining in areas in England. Limited acreage in the US.                                  |
| Helles              | <b>SANTIAM (US)</b>         | Floral, slightly spicy                      | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.   | German Tettnang, German Spalt, German Spalter Select | Limited but stable acreage.  |
| Helles              | <b>VANGUARD (US)</b>        | Similar to Hallertau.                       | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.  | Hallertau, German Hersbrucker, Mt Hood, Liberty      | Similar to Hallertau Mittlefruh  |
| Helles              | <b>HERSBRUCKER (GR)</b>     | Mild to semi-strong, pleasant and hoppy     | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt                        | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.  |
| Helles              | <b>NORTHERN BREWER (GR)</b> | Medium-strong with some wild American tones | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile.   | Chinook, US Northern Brewer, German Brewer's Gold    | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.                           |
| Helles              | <b>PERLE (GR)</b>           | Moderately intense, good and hoppy          | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties  | US Perle, Northern Brewer                            | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety. |

| Typical Beer Styles | Hops                 | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information  |
|---------------------|----------------------|--|------------------------|--|---|---|---|
| Helles              | <b>SPALT (GR)</b>    | Mild and pleasant, slightly spicy                      | 4.5                    | 50 – 60  | Traditional, very fine or noble aroma hop   | US Saaz, US Tettnang, German Spalt Select                             | Grown only in Spalt area and not a large acreage available.                               |
| Helles              | <b>TETTNANG (GR)</b> | Mild and pleasant, slightly spicy                      | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop   | German Spalt, German Select, US Tettnang, US Saaz, German Hersbrucker | Largely confined to the Tettnang area near Lake Constance.                                |
| IPA                 | <b>AMARILLO (US)</b> | Floral and citrusy                                     | 9.5                    | Average  | Gaining acceptance, viewed somewhat as a Cascade type   | Cascade, Centennial, possibly Chinook or Ahtanum                      | Very limited acreage at this time.  |
| IPA                 | <b>CHINOOK (US)</b>  | Medium intensity, spicy, piney, distinctive grapefruit | 13                     | 65 – 70  | A high alpha-acids hop with an acceptable aroma profile.  | Nugget, Columbus, Northern Brewer, Wye Target, possibly Centennial    | Released in the US industry in 1985 and becoming increasingly popular with craft-brewers. |
| IPA                 | <b>WARRIOR (US)</b>  | Very mild  | 16                     | Good   | New hop with much potential. Very stable.   | Nugget, Columbus  | Very grower friendly  |
| IPA, American       | <b>COLUMBUS (US)</b> | Pungent  | 15                     | Below average  | Originally bred for its alpha value, it has also become popular for its oil profile. Great for dry hopping.       | Nugget, Chinook, Wye Target, Northern Brewer, possibly Centennial     | Also know as Tomahawk. Considered similar to Zeus.  |
| Kölsch              | <b>CRYSTAL (US)</b>  | Mild, spicy & flowery                                  | 4.5                    | 50   | Very popular in the craft-brewing industry. Viewed the most pungent of the new triploid Hallertau family of hops. | Mt. Hood, Hersbruck, French Strisselspalt, Liberty, Hallertau         | Primarily grown in Oregon. Acreage is increasing in the 1990's.                           |

| Typical Beer Styles | Hops                        | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information  |
|---------------------|-----------------------------|--|------------------------|--|---|---|---|
| Kölsch              | <b>HALLERTAU (US)</b>       | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop  | Liberty, German Hallertau, German Tradition                       | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. <i>If you want Hallertau, make sure you are getting the real thing. If</i> |
| Kölsch              | <b>LIBERTY (US)</b>         | Mild with a slightly spicy character           | 4                      | 35 – 55  | Aroma variety with close similarities to imported German aroma varieties, especially Hallertau.                                     | US or German Hallertau, German Tradition, Mt Hood, possibly Spalt | Released in the US in 1991. Of the four triploid Hallertau varieties released, Liberty most closely resembles the Hallertau cultivar.   |
| Kölsch              | <b>NORTHERN BREWER (US)</b> | Medium -strong                                 | 9                      | 70 – 85  | A true dual-purpose hop, containing moderate of alpha acids combined with a good aroma profile.                                     | German Northern Brewer, Chinook                                   | A major alpha hop in Germany, but declining in areas in England. Limited acreage in the US.   |
| Kölsch              | <b>PERLE (US)</b>           | Floral and slightly spicy                      | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers. | German Perle, German and US Northern Brewer                       | Excellent storagability.  |
| Kölsch              | <b>SANTIAM (US)</b>         | Floral, slightly spicy                         | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.   | German Tettnang, German Spalt, German Spalter Select              | Limited but stable acreage.   |
| Kölsch              | <b>VANGUARD (US)</b>        | Similar to Hallertau.                          | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.  | Hallertau, German Hersbrucker, Mt Hood, Liberty                   | Similar to Hallertau Mittlefruh   |
| Kölsch              | <b>PERLE (GR)</b>           | Moderately intense, good and hoppy             | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties                  | US Perle, Northern Brewer   | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.  |

| Typical Beer Styles | Hops                   | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|---------------------|------------------------|--|------------------------|--|---|---|--|
| Kölsch              | <b>SPALT (GR)</b>      | Mild and pleasant, slightly spicy              | 4.5                    | 50 – 60  | Traditional, very fine or noble aroma hop   | US Saaz, US Tettnang, German Spalt Select                             | Grown only in Spalt area and not a large acreage available.  |
| Kölsch              | <b>TETTNANG (GR)</b>   | Mild and pleasant, slightly spicy              | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop   | German Spalt, German Select, US Tettnang, US Saaz, German Hersbrucker | Largely confined to the Tettnang area near Lake Constance.   |
| Lager               | <b>AHTANUM (US)</b>    | Floral   | 6                      | Fair to good   | Used for its aromatic properties and moderate bittering   | Cascade, Amarillo   | Quite similar to Cascade   |
| Lager               | <b>CRYSTAL (US)</b>    | Mild, spicy & flowery                          | 4.5                    | 50   | Very popular in the craft-brewing industry. Viewed the most pungent of the new triploid Hallertau family of hops.   | Mt. Hood, Hersbruck, French Strisselspalt, Liberty, Hallertau         | Primarily grown in Oregon. Acreage is increasing in the 1990's.  |
| Lager               | <b>HALLERTAU (US)</b>  | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop  | Liberty, German Hallertau, German Tradition                           | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. If you want Hallertau, make sure you are getting the real thing. If you're not sure, ask! |
| Lager               | <b>LIBERTY (US)</b>    | Mild with a slightly spicy character           | 4                      | 35 – 55  | Aroma variety with close similarities to imported German aroma varieties, especially Hallertau.   | US or German Hallertau, German Tradition, Mt Hood, possibly Spalt     | Released in the US in 1991. Of the four triploid Hallertau varieties released, Liberty most closely resembles the Hallertau cultivar.  |
| Lager               | <b>MOUNT HOOD (US)</b> | Mild, somewhat pungent                         | 6.5                    | 50 -60   | Aroma variety with marked similarities to the Hallertauer and Hersbrucker varieties. Most popular hop in the triploid Hallertau breeding program, partly due to the fact it was the first one released. | Crystal, French Strisselspalt, Hersbrucker                            | Released in the US in 1989.  |

| Typical Beer Styles | Hops                        | Aroma                                       | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions                               | Additional Information   |
|---------------------|-----------------------------|---|------------------------|--|---|--|--|
| Lager               | <b>SAAZ (US)</b>            | Very mild, spicy and earthy                 | 3.75                   | 45 – 55  | Available in small quantities.  | Czech Saaz, Polish Lublin, Sterling                  | High ambient temperatures can have an adverse effect on yields.  |
| Lager               | <b>SANTIAM (US)</b>         | Floral, slightly spicy                      | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.                                 | German Tettnang, German Spalt, German Spalter Select | Limited but stable acreage.  |
| Lager               | <b>VANGUARD (US)</b>        | Similar to Hallertau.                       | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.  | Hallertau, German Hersbrucker, Mt Hood, Liberty      | Similar to Hallertau Mittlefruh  |
| Lager               | <b>HALLERTAU (GR)</b>       | Mild and pleasant                           | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.                                      | Liberty, German Tradition, Ultra                     | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho. |
| Lager               | <b>HERSBRUCKER (GR)</b>     | Mild to semi-strong, pleasant and hoppy     | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt                        | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.                          |
| Lager               | <b>NORTHERN BREWER (GR)</b> | Medium-strong with some wild American tones | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile. | Chinook, US Northern Brewer, German Brewer's Gold    | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.     |

| Typical Beer Styles | Hops                  | Aroma                                  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions  | Additional Information   |
|---------------------|-----------------------|--|------------------------|--|--|---|--|
| Lager               | <b>PERLE (GR)</b>     | Moderately intense, good and hoppy     | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties | US Perle, Northern Brewer   | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety. |
| Lager               | <b>SELECT (GR)</b>    | Very fine Spalter type aroma           | 5                      | Good   | Too early for general consensus but bred to be like the Spalt/Tettnang/Saaz group                                  | US Saaz, US Tettnang, German Spalt, German Tettnang, German Hersbrucker | Released in 1991 and seeing some limited expansion in German growing areas.  |
| Lager               | <b>SPALT (GR)</b>     | Mild and pleasant, slightly spicy      | 4.5                    | 50 – 60  | Traditional, very fine or noble aroma hop  | US Saaz, US Tettnang, German Spalt Select                               | Grown only in Spalt area and not a large acreage available.  |
| Lager               | <b>TETTNANG (GR)</b>  | Mild and pleasant, slightly spicy      | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop  | German Spalt, German Select, US Tettnang, US Saaz, German Hersbrucker   | Largely confined to the Tettnang area near Lake Constance.   |
| Lager               | <b>TRADITION (GR)</b> | Very fine, similar to German Hallertau | 6                      | Good   | Only recently released so too early for general consensus. Brew to replace Hersbrucker in German grown areas.      | Liberty, German Hallertau   | Released in 1991 and undergoing expansion in German growing areas.   |

| Typical Beer Styles                | Hops                                | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|------------------------------------|-------------------------------------|--|------------------------|--|---|---|--|
| Lager                              | <b>STYRIAN GOLDING</b>              | Delicate, slightly spicy   | 5.75                   | 65 – 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.   | US Fuggle, Willamette, UK Fuggle                                  | The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggle.  |
| Lager                              | <b>FUGGLE (UK)</b>                  | Mild, pleasant and hoppy   | 4.75                   | 70 -80   | A hop long associated with typical English Ale brewing. Imparts good hoppy late-hop flavor  | US Fuggle, Willamette, Styrian Golding                            | Once a predominant hop in England but now reserved for aroma use in conjunction with high alpha types.   |
| lager                              | <b>STYRIAN GOLDINGS (SLOVENIAN)</b> | Delicate, slightly spicy   | 7.5                    | 65 - 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.   | U.S. Fuggle, U.K. Fuggle, Willamette                              | An ecotype of Fuggle grown in Slovenia. Also known as Savinja Golding. The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggle. |
| Lager (Bittering)                  | <b>CLUSTER (US)</b>                 | Floral and spicy   | 7                      | 80 – 85  | An excellent general purpose hop with medium and balanced bittering potential and no undesirable aroma properties.  | Galena, possibly US Northern Brewer                               | For years the standard US cultivar, improved mass selection in the mid-sixties. Limited acreage grown today.   |
| Lager (Bittering)                  | <b>COLUMBUS (US)</b>                | Pungent  | 15                     | Below average  | Originally bred for its alpha value, it has also become popular for its oil profile. Great for dry hopping.   | Nugget, Chinook, Wye Target, Northern Brewer, possibly Centennial | Also known as Tomahawk. Considered similar to Zeus.  |
| Lagers (Typically base bitterness) | <b>MAGNUM (GR)</b>                  | No real distinct aroma character, so is viewed favorably as a clean bittering hop. | 13                     | Very good  | This high-alpha variety is a very promising new breed from the Hop Research Institution in Hüll with good resistance characteristics, high yield and good growth. | Columbus, Nugget  | Hallertau Magnum is the second largest hop variety and the main high alpha variety grown in Germany.   |
| Lagers, All                        | <b>HORIZON (US)</b>                 | Floral, spicy  | 12                     | Average to good  | Good potential as a medium alpha, good aroma, purpose hop. Has a low co-humulone, which results in a clean tasting beer.  | Magnum  | Commercially grown in small quantities. Gaining in popularity with the craft-brewing industry.   |

| Typical Beer Styles | Hops                        | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions                     | Additional Information   |
|---------------------|-----------------------------|--|------------------------|--|--|--|--|
| Lagers, All         | <b>STERLING (US)</b>        | Herbal, spicy with a hint of floral and citrus | 7.5                    | Good   | Perceived to be similar to a Saaz and Mt Hood combination. Finding favor as a Saaz replacement.              | Czech Saaz                                 | Limited, but stable acreage.   |
| Lagers, All         | <b>TETTANG (US)</b>         | Slightly spicy                                 | 4.5                    | 55 – 60  | A true noble aroma variety   | German Spalt Select, German Spalt, Santiam | US Tettnang is similar to Fuggie. A very popular hop with the craft-brewery industry.  |
| Lagers, All         | <b>CZECH SAAZ</b>           | Very mild with pleasant hoppy notes            | 3.75                   | 45 – 55  | The classical "noble" aroma hop with long and strong traditions. Associated with the renowned Pilsner lager. | US Saaz, Polish Lublin, US Sterling        | By far the predominant Czech variety and clones of it are grown in Poland and the Ukraine.   |
| Lagers, All         | <b>FRENCH STRISSELSPALT</b> | Medium intensity, pleasant and hoppy           | 4                      | 60 – 70  | Good to very good aroma hop  | Mt Hood, Crystal, Hersbruck                | Well accepted as good aroma hop around the world. Similar to Hersbruck in profile but preferred by some breweries.                                     |
| Lagers, All         | <b>TARGET (UK)</b>          | Pleasant English hop aroma, quite intense      | 11                     | 45 – 55  | A good high alpha variety with an acceptable to desirable kettle hop aroma.                                  | Fuggie, Willamette                         | The predominant UK variety at present and widely used for its high alpha acids content combined with an acceptable aroma. Normally used for bittering. |



| Typical Beer Styles     | Hops                          | Aroma   | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception   | Possible Substitutions   | Additional Information  |
|-------------------------|-------------------------------|---|------------------------|--|--|--|---|
| Lagers, All (bittering) | <b>MAGNUM (US)</b>            | No real distinct aroma character, so is viewed favorably as a clean bittering hop | 13                     | Very good  | Gaining increasing acceptance as a clean bittering hop.  | German Magnum, possibly Horizon                                  | Limited acreage in the US, but widely grown in Germany.   |
| Lagers, Australian      | <b>PRIDE OF RINGWOOD (AU)</b> | Quite pronounced but not unpleasant   | 8.5                    | 45 – 55  | Predominantly a bittering hop but with interesting aromatic qualities  | Galena, Cluster  | At time of release in 1965, it was the highest alpha acid hop in the world and went on to become more than 90 of the Australian crop- closely associated with such famous beers as Foster's Lager.  |
| Lambic                  | <b>BREWER'S GOLD (US)</b>     | Blackcurrant, fruity, spicy   | 9                      | Poor   | Mainly used as a bittering hop   | Bullion  | Limited acreage in the US   |
| Lambic                  | <b>FUGGLE (US)</b>            | Mild, woody and fruity  | 4.75                   | 60 – 65  | Traditional English-type aroma hop   | UK Fuggle, Willamette, Styrian Golding, US Tettnang              | Also know overseas as Styrian (Savinja) Golding in Slovenia and as UK Fuggle in England. In the US it has been replaced in part by Willamette (triploid Fuggle), which growers find more favorable. |
| Lambic                  | <b>CZECH SAAZ</b>             | Very mild with pleasant hoppy notes   | 3.75                   | 45 – 55  | The classical "noble" aroma hop with long and strong traditions. Associated with the renowned Pilsner lager. | US Saaz, Polish Lublin, US Sterling                              | By far the predominant Czech variety and clones of it are grown in Poland and the Ukraine.  |
| Lambic                  | <b>BREWER'S GOLD (GR)</b>     | Black currant, fruity, spicy  | 6                      | Average  | Mainly used as a bittering hop   | UK Northdown, Northern Brewer, Galena, Bullion, US Brewer's Gold | Originally bred in the UK by Professor E.S. Salmon  |

| Typical Beer Styles | Hops                            | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|---------------------|---------------------------------|--|------------------------|--|---|---|--|
| Lambic              | <b>HALLERTAU (GR)</b>           | Mild and pleasant                              | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.                                      | Liberty, German Tradition, Ultra                                      | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.   |
| Lambic              | <b>NORTHERN BREWER (GR)</b>     | Medium-strong with some wild American tones    | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile. | Chinook, US Northern Brewer, German Brewer's Gold                     | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.   |
| Lambic              | <b>TETTNANG (GR)</b>            | Mild and pleasant, slightly spicy              | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop   | German Spalt, German Select, US Tettnang, US Saaz, German Hersbrucker | Largely confined to the Tettnang area near Lake Constance.   |
| Lambic              | <b>FUGGLE (UK)</b>              | Mild, pleasant and hoppy                       | 4.75                   | 70 -80   | A hop long associated with typical English Ale brewing. Imparts good hoppy late-hop flavor                    | US Fuggle, Willamette, Styrian Golding                                | Once a predominant hop in England but now reserved for aroma use in conjunction with high alpha types.   |
| Munich              | <b>HALLERTAU (US)</b>           | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop  | Liberty, German Hallertau, German Tradition                           | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. If you want Hallertau, make sure you are getting the real thing. If you're not sure, ask! |
| Organic Beers       | <b>ORGANIC HALLERTAU (NZ)</b>   | Nice resinous, citrusy characteristic          | 8                      | Very good  | Commonly used for aroma variety.  | Unknown   | Available in limited quantities. New crop availability in March.   |
| Organic Beers       | <b>ORGANIC PACIFIC GEM (NZ)</b> | Pleasant, blackberry aroma                     | 15                     | Very good  | Widely used as a bittering hop. Woody flavor.   | Unknown   | Starting to see some limited use in the U.S. Considered to have some good future potential.  |

| Typical Beer Styles | Hops                       | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions   | Additional Information  |
|---------------------|----------------------------|--|------------------------|--|---|--|---|
| Pale Ale            | <b>PERLE (US)</b>          | Floral and slightly spicy                              | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers. | German Perle, German and US Northern Brewer                        | Excellent storagability.  |
| Pale Ale            | <b>WARRIOR (US)</b>        | Very mild  | 16                     | Good   | New hop with much potential. Very stable.   | Nugget, Columbus   | Very grower friendly  |
| Pale Ale            | <b>PERLE (GR)</b>          | Moderately intense, good and hoppy                     | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties                  | US Perle, Northern Brewer  | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.  |
| pale ale            | <b>BRAMLING CROSS (UK)</b> | Quite mild and not unpleasant                          | 8.9                    | 60 - 70  | Acceptable general purpose aroma hop but lacking the fineness of Golding aroma.   | U.K. Kent Golding, U.K. Progress, Whitbread Golding Variety        | Raised in 1927 from the commercial Golding variety Bramling crossed with a Manitoban wild male hop. Its tolerance to Verticillium wilt allowed its expansion in the U.K. as the acreage of Fuggles and Goldings declined. |
| Pale Ale, american  | <b>CASCADE (US)</b>        | Flowery and citrusy. Can have a grapefruit note.       | 5.75                   | 48 – 52  | Aroma variety with well-balanced bittering It is the most popular hop with the craftbrewing industry. Good for dry hopping.         | Centennial, Amarillo, to a lesser extent, Columbus                 | Released in 1972 and well-established in US industry. The first commercially accepted American-bred aroma hop.  |
| Pale Ale, american  | <b>CHINOOK (US)</b>        | Medium intensity, spicy, piney, distinctive grapefruit | 13                     | 65 – 70  | A high alpha-acids hop with an acceptable aroma profile.  | Nugget, Columbus, Northern Brewer, Wye Target, possibly Centennial | Released in the US industry in 1985 and becoming increasingly popular with craft-brewers.   |
| Pale Ale, american  | <b>COLUMBUS (US)</b>       | Pungent  | 15                     | Below average  | Originally bred for its alpha value, it has also become popular for its oil profile. Great for dry hopping.                         | Nugget, Chinook, Wye Target, Northern Brewer, possibly Centennial  | Also know as Tomahawk. Considered similar to Zeus.  |
| Pale Ale, American  | <b>GLACIER (US)</b>        | Excellent, pleasant hoppiness                          | 5.5                    | Good   | An excellent new variety with balanced bittering properties combined with a good aroma profile.                                     | Willamette, US Fuggle, US Tettnang, Styrian Golding                | Released as a public variety in 2000 by Dr. Stephen Kenny, Washington State University. It was chosen for its low cohumulone and good yield potential.  |
| Pale Ale, American  | <b>WILLAMETTE (US)</b>     | Mild and pleasant, slightly spicy                      | 5                      | 60 – 65  | A quality aroma hop   | US Fuggle, US Tettnang, Styrian Golding                            | Released in 1976 and well-established in the US industry. Currently the most widely grown aroma hops in the US.   |

| Typical Beer Styles                 | Hops                        | Aroma   | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|-------------------------------------|-----------------------------|---|------------------------|--|---|---|--|
| Pale Ales, English                  | <b>GLACIER (US)</b>         | Excellent, pleasant hoppiness   | 5.5                    | Good   | An excellent new variety with balanced bittering properties combined with a good aroma profile.   | Willamette, US Fuggle, US Tettnang, Styrian Golding               | Released as a public variety in 2000 by Dr. Stephen Kenny, Washington State University. It was chosen for its low cohumulone and good yield potential.   |
| Pale Ales, English                  | <b>GOLDING (US)</b>         | Mild, delicate classic English-type   | 4.5                    | 65 – 80  | US Goldings are very popular among ale breweries in the US  | UK East Kent Golding, UK Progress and possibly the Fuggle family  | UK Golding clones have been introduced for growing here in Washington and Oregon. Before being grown in the US, there was a Golding grown in British Columbia (BC Golding), there are no longer any more BC Golding hops grown.  |
| Pale Ales, English                  | <b>NORTHERN BREWER (GR)</b> | Medium-strong with some wild American tones                                       | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile.   | Chinook, US Northern Brewer, German Brewer's Gold                 | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.   |
| Pilsner (Typically base bitterness) | <b>MAGNUM (GR)</b>          | No real distinct aroma character, so is viewed favorably as a clean bittering hop | 13                     | Very good  | This high-alpha variety is a very promising new breed from the Hop Research Institution in Hüll with good resistance characteristics, high yield and good growth. | Columbus, Nugget  | Hallertau Magnum is the second largest hop variety and the main high alpha variety grown in Germany.   |
| Pilsners                            | <b>BREWER'S GOLD (US)</b>   | Blackcurrant, fruity, spicy   | 9                      | Poor   | Mainly used as a bittering hop  | Bullion   | Limited acreage in the US  |
| Pilsners                            | <b>CRYSTAL (US)</b>         | Mild, spicy & flowery   | 4.5                    | 50   | Very popular in the craft-brewing industry. Viewed the most pungent of the new triploid Hallertau family of hops.   | Mt. Hood, Hersbruck, French Strisselspalt, Liberty, Hallertau     | Primarily grown in Oregon. Acreage is increasing in the 1990's.  |
| Pilsners                            | <b>HALLERTAU (US)</b>       | Very mild, slightly flowery and somewhat spicy                                    | 4.5                    | 52 – 58  | Traditional German aroma hop  | Liberty, German Hallertau, German Tradition                       | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. If you want Hallertau, make sure you are getting the real thing. If you're not sure, ask! |
| Pilsners                            | <b>LIBERTY (US)</b>         | Mild with a slightly spicy character  | 4                      | 35 – 55  | Aroma variety with close similarities to imported German aroma varieties, especially Hallertau.   | US or German Hallertau, German Tradition, Mt Hood, possibly Spalt | Released in the US in 1991. Of the four triploid Hallertau varieties released, Liberty most closely resembles the Hallertau cultivar.  |

| Typical Beer Styles | Hops                        | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions                                | Additional Information   |
|---------------------|-----------------------------|--|------------------------|--|---|---|--|
| Pilsners            | <b>MOUNT HOOD (US)</b>      | Mild, somewhat pungent                         | 6.5                    | 50 -60   | Aroma variety with marked similarities to the Hallertauer and Hersbrucker varieties. Most popular hop in the triploid Hallertau breeding program, partly due to the fact it was the first one released. | Crystal, French Strisselspalt, Hersbrucker            | Released in the US in 1989.  |
| Pilsners            | <b>SAAZ (US)</b>            | Very mild, spicy and earthy                    | 3.75                   | 45 – 55  | Available in small quantities.  | Czech Saaz, Polish Lublin, Sterling                   | High ambient temperatures can have an adverse effect on yields.  |
| Pilsners            | <b>SANTIAM (US)</b>         | Floral, slightly spicy                         | 6                      | Average  | A newly developed American aroma hop that contains noble hop characteristics.   | German Tettngang, German Spalt, German Spalter Select | Limited but stable acreage.  |
| Pilsners            | <b>STERLING (US)</b>        | Herbal, spicy with a hint of floral and citrus | 7.5                    | Good   | Perceived to be similar to a Saaz and Mt Hood combination. Finding favor as a Saaz replacement.   | Czech Saaz  | Limited, but stable acreage.   |
| Pilsners            | <b>TETTNGANG (US)</b>       | Slightly spicy                                 | 4.5                    | 55 – 60  | A true noble aroma variety  | German Spalt Select, German Spalt, Santiam            | US Tettngang is similar to Fuggle. A very popular hop with the craft-brewery industry.                             |
| Pilsners            | <b>VANGUARD (US)</b>        | Similar to Hallertau.                          | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.  | Hallertau, German Hersbrucker, Mt Hood, Liberty       | Similar to Hallertau Mittlefruh  |
| Pilsners            | <b>CZECH SAAZ</b>           | Very mild with pleasant hoppy notes            | 3.75                   | 45 – 55  | The classical "noble" aroma hop with long and strong traditions. Associated with the renowned Pilsner lager.  | US Saaz, Polish Lublin, US Sterling                   | By far the predominant Czech variety and clones of it are grown in Poland and the Ukraine.                         |
| Pilsners            | <b>FRENCH STRISSELSPALT</b> | Medium intensity, pleasant and hoppy           | 4                      | 60 – 70  | Good to very good aroma hop   | Mt Hood, Crystal, Hersbruck                           | Well accepted as good aroma hop around the world. Similar to Hersbruck in profile but preferred by some breweries. |
| Pilsners            | <b>HALLERTAU (GR)</b>       | Mild and pleasant                              | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.  | Liberty, German Tradition, Ultra                      | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.             |
| Pilsners            | <b>HERSBRUCKER (GR)</b>     | Mild to semi-strong, pleasant and hoppy        | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt                         | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.                                      |

| Typical Beer Styles | Hops                        | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|---------------------|-----------------------------|--|------------------------|--|---|---|--|
| Pilsners            | <b>PERLE (GR)</b>           | Moderately intense, good and hoppy                     | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties          | US Perle, Northern Brewer   | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.                           |
| Pilsners            | <b>SELECT (GR)</b>          | Very fine Spalter type aroma                           | 5                      | Good   | Too early for general consensus but bred to be like the Spalt/Tettnang/Saaz group   | US Saaz, US Tettnang, German Spalt, German Tettnang, German Hersbrucker | Released in 1991 and seeing some limited expansion in German growing areas.  |
| Pilsners            | <b>SPALT (GR)</b>           | Mild and pleasant, slightly spicy                      | 4.5                    | 50 – 60  | Traditional, very fine or noble aroma hop   | US Saaz, US Tettnang, German Spalt Select                               | Grown only in Spalt area and not a large acreage available.  |
| Pilsners            | <b>TETTNANG (GR)</b>        | Mild and pleasant, slightly spicy                      | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop   | German Spalt, German Select, US Tettnang, US Saaz, German Hersbrucker   | Largely confined to the Tettnang area near Lake Constance.   |
| Pilsners            | <b>TRADITION (GR)</b>       | Very fine, similar to German Hallertau                 | 6                      | Good   | Only recently released so too early for general consensus. Brew to replace Hersbrucker in German grown areas.               | Liberty, German Hallertau   | Released in 1991 and undergoing expansion in German growing areas.   |
| Pilsners            | <b>STYRIAN GOLDING</b>      | Delicate, slightly spicy                               | 5.75                   | 65 – 80  | A world-renowned aroma hop with widespread usage in both ale and lager brewing.   | US Fuggle, Willamette, UK Fuggle  | The old traditional favorite of Slovenia. Also well-established in English brewing as Fuggle.  |
| Porter              | <b>CASCADE (US)</b>         | Flowery and citrusy. Can have a grapefruit note.       | 5.75                   | 48 – 52  | Aroma variety with well-balanced bittering It is the most popular hop with the craftbrewing industry. Good for dry hopping. | Centennial, Amarillo, to a lesser extent, Columbus                      | Released in 1972 and well-established in US industry. The first commercially accepted American-bred aroma hop.   |
| Porter              | <b>CHINOOK (US)</b>         | Medium intensity, spicy, piney, distinctive grapefruit | 13                     | 65 – 70  | A high alpha-acids hop with an acceptable aroma profile.  | Nugget, Columbus, Northern Brewer, Wye Target, possibly Centennial      | Released in the US industry in 1985 and becoming increasingly popular with craft-brewers.  |
| Porter              | <b>GLACIER (US)</b>         | Excellent, pleasant hoppiness                          | 5.5                    | Good   | An excellent new variety with balanced bittering properties combined with a good aroma profile.                             | Willamette, US Fuggle, US Tettnang, Styrian Golding                     | Released as a public variety in 2000 by Dr. Stephen Kenny, Washington State University. It was chosen for its low cohumulone and good yield potential. |
| Porter              | <b>NORTHERN BREWER (US)</b> | Medium -strong   | 9                      | 70 – 85  | A true dual-purpose hop, containing moderate of alpha acids combined with a good aroma profile.                             | German Northern Brewer, Chinook   | A major alpha hop in Germany, but declining in areas in England. Limited acreage in the US.  |

| Typical Beer Styles | Hops                        | Aroma                                       | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions                            | Additional Information  |
|---------------------|-----------------------------|---|------------------------|--|---|---|---|
| Porter              | <b>PERLE (US)</b>           | Floral and slightly spicy                   | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers. | German Perle, German and US Northern Brewer       | Excellent storagability.  |
| Porter              | <b>NORTHERN BREWER (GR)</b> | Medium-strong with some wild American tones | 8.5                    | 70 – 80  | A true dual-purpose hop containing moderate amounts of alpha acids combined with an acceptable aroma profile.                       | Chinook, US Northern Brewer, German Brewer's Gold | Although declining in area in England, this variety is one of the main high-alpha hops in Germany.  |
| Porter              | <b>PERLE (GR)</b>           | Moderately intense, good and hoppy          | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties                  | US Perle, Northern Brewer                         | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.  |
| Porter              | <b>CHALLENGER (UK)</b>      | Mild to moderate, quite spicy               | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma                  | US or German Perle, Northern Brewer               | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968.   |
| Porter              | <b>NORTHDOWN (UK)</b>       | Mild, pleasant and delicate hop aroma       | 8.5                    | 60 – 70  | A true dual-purpose hop with moderate bittering potential and excellent flavor/aroma characteristics.                               | UK Challenger, Northern Brewer                    | Released in early 1970's with relatively high alpha acids for its time. Its excellent flavor properties ensured its continued survival after the release of the higher alpha acids variety Wye Target.  |
| Porter              | <b>PROGRESS (UK)</b>        | Moderately strong, good aroma               | 6                      | 60 – 80  | A robust hop aroma type with moderate bittering potential.  | UK Kent Golding, Fuggle                           | One of the very few aroma hops actually purposebred in a modern breeding program. Released in the mid-sixties just before brewer demand switched to high alpha acids so it never become very widely planted.  |
| some finishing      | <b>BULLION (UK)</b>         |   | 13.5                   |  |   | Brewer's Gold, Pacific Gem                        | Bullion was raised in 1919 England from a wild Manitoban female crossed with an English male hop. It's considered a dual-purpose hop, but is generally used for bittering. It has an intense aroma, reminiscent of black currants. It is gradually losing ground to the new higher alpha hops with better storage properties. |
| Stout               | <b>CLUSTER (US)</b>         | Floral and spicy                            | 7                      | 80 – 85  | An excellent general purpose hop with medium and balanced bittering potential and no undesirable aroma properties.                  | Galena, possibly US Northern Brewer               | For years the standard US cultivar, improved mass selection in the mid-sixties. Limited acreage grown today.  |

| Typical Beer Styles                            | Hops                   | Aroma   | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information  |
|--|------------------------|---|------------------------|--|---|---|---|
| Stout  | <b>COLUMBUS (US)</b>   | Pungent   | 15                     | Below average  | Originally bred for its alpha value, it has also become popular for its oil profile. Great for dry hopping.   | Nugget, Chinook, Wye Target, Northern Brewer, possibly Centennial | Also know as Tomahawk. Considered similar to Zeus.  |
| Stout  | <b>GLACIER (US)</b>    | Excellent, pleasant hoppiness   | 5.5                    | Good   | An excellent new variety with balanced bittering properties combined with a good aroma profile.   | Willamette, US Fuggle, US Tettnang, Styrian Golding               | Released as a public variety in 2000 by Dr. Stephen Kenny, Washington State University. It was chosen for its low cohumulone and good yield potential.              |
| Stout  | <b>MILLENIUM (US)</b>  | Mild, Herbal, similar to Nugget   | 15.5                   | 2400%  | Very new hop. Primarily used for alpha potential  | Nugget and Columbus   | Released by John I Haas   |
| Stout  | <b>NUGGET (US)</b>     | Herbal  | 13                     | 70 – 80  | A high alpha acids hop with a good aroma profile.   | Galena, Magnum, Columbus, Wye Target                              | Released in 1982 and now a major high alpha acids variety in the US. Also grown in Germany.   |
| Stout  | <b>PERLE (US)</b>      | Floral and slightly spicy   | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers.                               | German Perle, German and US Northern Brewer                       | Excellent storagability.  |
| Stout  | <b>PERLE (GR)</b>      | Moderately intense, good and hoppy  | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable aroma properties  | US Perle, Northern Brewer   | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.  |
| Stout  | <b>CHALLENGER (UK)</b> | Mild to moderate, quite spicy   | 7.5                    | 70 – 85  | One of the few recognized dual-purpose hops combining moderate amounts of alpha acids with a good kettle hop aroma  | US or German Perle, Northern Brewer                               | A result of Wye's efforts to combine higher levels of alpha acids with technically good aroma, disease resistance, and good agronomic properties. Released in 1968. |
| Stout (Typically used as a first hop addition) | <b>MAGNUM (GR)</b>     | No real distinct aroma character, so is viewed favorably as a clean bittering hop | 13                     | Very good  | This high-alpha variety is a very promising new breed from the Hop Research Institution in Hüll with good resistance characteristics, high yield and good growth. | Columbus, Nugget  | Hallertau Magnum is the second largest hop variety and the main high alpha variety grown in Germany.  |
| Weizen   | <b>PERLE (US)</b>      | Floral and slightly spicy   | 8.25                   | 80 – 85  | A hop with German type aroma properties combines with moderate bittering potential. A dual purpose hop. Popular with craft-brewers.                               | German Perle, German and US Northern Brewer                       | Excellent storagability.  |



| Typical Beer Styles | Hops                        | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions   | Additional Information  |
|---------------------|-----------------------------|--|------------------------|--|---|--|---|
| Weizen              | <b>HALLERTAU (GR)</b>       | Mild and pleasant                              | 4.5                    | 50 – 60  | The classic German aroma hop associated with Bavarian style lager beers.  | Liberty, German Tradition, Ultra                                       | Limited areas grown in the US, tends to grow best in the milder climates of Oregon and northern Idaho.  |
| Weizen              | <b>PERLE (GR)</b>           | Moderately intense, good and hoppy             | 7                      | 70 -80   | A well accepted dual-purpose hop with a good combination balanced bittering and highly acceptable <u>aroma properties</u> | US Perle, Northern Brewer  | Introduced in the 1980's and grown in both Washington and Oregon states. Perle is the most popular German-grown hop variety.  |
| Weizen              | <b>TETTNANG (GR)</b>        | Mild and pleasant, slightly spicy              | 4.5                    | 55 – 60  | Traditional, very fine or noble aroma hop   | German Spalt, German Select, US Tettngang, US Saaz, German Hersbrucker | Largely confined to the Tettngang area near Lake Constance.   |
| Weizen              | <b>TRADITION (GR)</b>       | Very fine, similar to German Hallertau         | 6                      | Good   | Only recently released so too early for general consensus. Brew to replace Hersbrucker in German grown areas.             | Liberty, German Hallertau  | Released in 1991 and undergoing expansion in German growing areas.  |
| Weizen Bock         | <b>HERSBRUCKER (GR)</b>     | Mild to semi-strong, pleasant and hoppy        | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt  | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.   |
| Wheat               | <b>HALLERTAU (US)</b>       | Very mild, slightly flowery and somewhat spicy | 4.5                    | 52 – 58  | Traditional German aroma hop  | Liberty, German Hallertau, German Tradition                            | Limited acreage grown, though seeing increased popularity among craft-brewers. More expensive than the triploid Hallertau, Mt Hood & Liberty, which have better yield. Have seen, for example, Mt Hood sold as simply Hallertau. If you want Hallertau, you have to get it from the real thing. |
| Wheat               | <b>VANGUARD (US)</b>        | Similar to Hallertau.                          | 5.75                   | 75 – 80  | Still being tested and looked at by micro & craft breweries.  | Hallertau, German Hersbrucker, Mt Hood, Liberty                        | Similar to Hallertau Mittlefruh   |
| Wheat               | <b>FRENCH STRISSELSPALT</b> | Medium intensity, pleasant and hoppy           | 4                      | 60 – 70  | Good to very good aroma hop   | Mt Hood, Crystal, Hersbruck  | Well accepted as good aroma hop around the world. Similar to Hersbruck in profile but preferred by some breweries.  |

| Typical Beer Styles | Hops                    | Aroma  | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions  | Additional Information   |
|---------------------|-------------------------|--|------------------------|--|---|---|--|
| Wheat               | <b>HERSBRUCKER (GR)</b> | Mild to semi-strong, pleasant and hoppy          | 4.25                   | 55 – 65  | Good to very good aroma hop.  | Mt Hood, French Strisselspalt   | Grown widely not only in the Hallertau but also in Spalt and Hersbruck areas.  |
| Wheat               | <b>TRADITION (GR)</b>   | Very fine, similar to German Hallertau           | 6                      | Good   | Only recently released so too early for general consensus. Brew to replace Hersbrucker in German grown areas.   | Liberty, German Hallertau   | Released in 1991 and undergoing expansion in German growing areas.   |
| Wheat, American     | <b>CENTENNIAL (US)</b>  | Medium intensity with floral and citrus tones    | 10.5                   | 60 – 65  | Very balanced hop, sometimes called a super cascade.  | Cascade, possibly Columbus or Chinook. a blend of 70 Cascade and 30 Columbus will give similar profile. | Named from the Washington State Centennial Celebration. At one time this variety was going to be destroyed for lack of interest by the world's major breweries. Today has found a very favorable following by craft-brewers. |
| Wheat, American     | <b>LIBERTY (US)</b>     | Mild with a slightly spicy character             | 4                      | 35 – 55  | Aroma variety with close similarities to imported German aroma varieties, especially Hallertau.   | US or German Hallertau, German Tradition, Mt Hood, possibly Spalt                                       | Released in the US in 1991. Of the four triploid Hallertau varieties released, Liberty most closely resembles the Hallertau cultivar.  |
| Wheat, American     | <b>MOUNT HOOD (US)</b>  | Mild, somewhat pungent                           | 6.5                    | 50 -60   | Aroma variety with marked similarities to the Hallertauer and Hersbrucker varieties. Most popular hop in the triploid Hallertau breeding program, partly due to the fact it was the first one released. | Crystal, French Strisselspalt, Hersbrucker  | Released in the US in 1989.  |
| Wheat, American     | <b>SAAZ (US)</b>        | Very mild, spicy and earthy                      | 3.75                   | 45 – 55  | Available in small quantities.  | Czech Saaz, Polish Lublin, Sterling   | High ambient temperatures can have an adverse effect on yields.  |
| Wheat, American     | <b>TETTANG (US)</b>     | Slightly spicy                                   | 4.5                    | 55 – 60  | A true noble aroma variety  | German Spalt Select, German Spalt, Santiam  | US Tettnang is similar to Fuggle. A very popular hop with the craft-brewery industry.  |
| Witbier             | <b>CASCADE (US)</b>     | Flowery and citrusy. Can have a grapefruit note. | 5.75                   | 48 – 52  | Aroma variety with well-balanced bittering It is the most popular hop with the craftbrewing industry. Good for dry hopping.   | Centennial, Amarillo, to a lesser extent, Columbus  | Released in 1972 and well-established in US industry. The first commercially accepted American-bred aroma hop.   |
|                     |                         |  |                        |  |   |   |  |
|                     | <b>LUBLIN (PO)</b>      | Mild and typical of noble aroma types            | 3.75                   | 40 - 55  | Traditional aroma hop   |   | More freely available on the world market since opening of the former Eastern bloc. A landrace aroma variety grown in the area of the same name and widely believed to be a clonal selection of Saaz.                        |

| Typical Beer Styles | Hops                                  | Aroma                       | Alpha Acids<br>(w/w %) | Storageability (%<br>alpha acids remaining<br>after 6 months storage<br>at 20°C) | General Trade Perception  | Possible Substitutions | Additional Information  |
|---------------------|---------------------------------------|-----------------------------|------------------------|--|---|------------------------|---|
|                     | <b>MARYNKA (PO)</b>                   | Intensive                   | 10.5                   |  |   |                        |   |
|                     | <b>SUPER STYRIANS<br/>(SLOVENIAN)</b> | Quite mild, hoppy, pleasant | 8                      |  | A good dual-purpose variety contributing moderate levels of bittering coupled with pleasant European aroma. |                        | A trade name for dual-purpose varieties from Slovenia. The principal variety is Aurora - a seedling of Northern Brewer. Varieties established in Slovenia since the early 1970's and now with good acceptance in the world hop trade.   |
|                     | <b>PILGRIM (UK)</b>                   |                             | 11                     |  |   |                        | In brewing trials Pilgrim has performed well as a replacement for high alpha or dual purpose hops. Because of its alpha it has been compared to Target more than any other variety. It has however a much hoppier aroma than Target due to its higher levels of Humulene and Challenger-like Selinene levels. From early storage trials stability of the alpha acids in Pilgrim seem to be excellent. |