

Pocket Guide Information

The range of available hop varieties undergoes constant change as breeding programs bring forth new varieties and older ones are displaced. The purpose of this guide is to categorize new varieties and to enable systematic comparisons and descriptions among varieties. It depicts a total of 22 hop varieties cultivated in Germany.

The 15 aroma varieties are composed of five classic land varieties including Saazer, nine Huell cultivars (Hop Research Center Huell/Bavaria) and Cascade from the US. Of the six bitter varieties, one originates from England, one from the US, and the remaining four are Huell cultivars. Polaris from Huell represents a dual purpose hop.

A variety description usually encompasses three fundamental aspects:

- Agronomic properties, in the guide restricted to the two most important characteristics: yield and disease tolerance
- Chemical components including bittering compounds, aromatic compounds and polyphenols
- Sensory evaluation

As sensory description based on standardized terminology is currently not possible, a subjective description of aroma impressions is not included. The perception, specific desires, and personal philosophy of the individual brewer are decisive. All numbers are averages over many years excluding the normal deviations resulting from influences of crop year, weather, geographic location, etc. The data for 19 varieties are derived exclusively from the Hallertau, whereas data for the local land varieties Spalter and Tettnanger originate from their particular production areas of Spalt and Tettngang. Saazer is mainly grown in the region of Elbe-Saale.

Agronomic characteristics:

- Yield in kg/ha. The data reflect official harvest numbers and are based on a 10-year average where applicable.
- Tolerance to wilt, powdery mildew, downy mildew, hop aphids and spider mites is described as low, medium and good, the assessment performed by the Bavarian State Research Center for Agriculture (LfL).

Chemical components:

All results have been compiled by the AHA (Arbeitsgruppe Hopfenanalyse = Hop Analysis Working Group). The AHA is an association of laboratories of the hop industry and state institutions and is the most authoritative body for hops analysis worldwide. The AHA performs the most important preparatory work for the European Brewery Convention (EBC). The results are based on varying amounts of data. While harvests are analyzed in their entirety for α -acids, for example, only smaller amounts of data are available for other components.

In addition to absolute values given as % weight/weight as is (% w/w), for example, significant components are also indicated as a proportion to the α -acids.

While previous varietal summaries have contained ratios such as that of α - to β -acids, it is more sensible to indicate the reverse ratio of β - to α -acids. This gives a clearer impression of the ratio between important valuable components and the α -acids. As far as possible, official analysis methods were used and are specified.

The following data in particular are included:

- **α -acids** – Method according to EBC 7.4 (lead conductance value); annual publication of the AHA; average over many years; for new varieties with fewer harvests, the average is calculated based on the number of harvests. Values in % w/w.
- **β : α** – Ratio of β - to α -acids determined according to EBC 7.7 (HPLC); β -acids are an important positive indicator of associated bittering components.
- **cohumulone** – Relative % of α -acids; method EBC 7.7.
- **polyphenols** – Non specific method EBC 7.14; values in % w/w. The AHA is currently developing an HPLC method, for which some findings have already been published.
- **polyphenols: α** – Ratio polyphenols to α -acids (EBC 7.4): values in % : %, thus dimensionless.
- **xanthohumol** – Most important hop polyphenol; analysis according to EBC 7.7 (HPLC of bitter acids); values in % w/w; the 2 digits after the decimal point result from the calculated mean.
- **xanthohumol: α** – Ratio xanthohumol to α -acids (EBC 7.4: values in % : %, thus dimensionless).
- **total oil** – Distillation method (EBC 7.10): values in ml/100g, in steps of 0.05ml/100g for values < 1.0ml/100g and in steps of 0.1ml/100g for values > 1.0ml/100g. The data refer to freshly harvested samples, as hop oil is subject to extensive postharvest losses due to its volatility.
- **particulars in oil** – The following compounds are measured according to method EBC 7.12 (gas chromatography):
 - β -caryophyllene : humulene, dimensionless ratio
 - farnesene in 4 groups: > 10% fraction of total oil < 10% fraction of total oil < 3% fraction of total oil < 0.5% fraction of total oil
- **myrcene**: deliberately omitted due to high volatility and unreliable data.
- **linalool**: analysis according to method EBC 7.12 (gas chromatography); important indicator of hop aroma in beer; values in mg/100g as is.
- **linalool: α** – Ratio linalool to α -acids (EBC 7.4): values in mg linalool per g α -acids (mg/g).



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Hops from Germany

unique worldwide

Huell Melon Hallertauer Merkur
Hallertauer Taurus Polaris Nugget
Saphir Cascade Perle
Hallertauer Mittelfrüher
Spalter Hersbrucker Spät
Tettnanger Smaragd Saazer
Opal Spalter Select
Hallertauer Tradition Northern Brewer
Hallertauer Magnum Herkules
Mandarina Bavaria Hallertau Blanc



Preface to the Second Edition

In 2010, the Pocket Guide was published for the first time for 16 hop varieties grown in Germany. In the meantime, there are four newcomers to the range of breeds from Hüll that are grown on a large scale: Hallertauer Blanc, Mandarina Bavaria, Huell Melon and Polaris. In addition, the Saaz variety from the Czech Republic and the Cascade variety from the USA are now grown on significant areas in German growing regions. Therefore this 2nd edition of the Pocket Guide now covers 22 hop varieties. In parallel, the growing of varieties like Merkur, for example, has lost in significance. Nevertheless, they have been purposely left on the list, because there is still a limited demand for them. The varieties Callista and Ariana, which were only authorized in May 2016, are not included in the list because of the lack of data required to be gathered over several years.

The changes below have been made compared with the 2010 edition.

1. Assignment of Hop Varieties to Groups

In addition to the aroma hop and bitter hop groups, according to the IHGC (International Hop Growers Convention) there are also "dual purpose hops". A variety from this group can count as a bitter hop but also have special aroma characteristics, like Polaris, for example. In the large group of aroma hops there are additional specifications as to whether a variety can be assigned to the "noble aroma hops" (classic aroma landraces) or the "special flavor hops" (often used for dry hopping).

2. Storage Stability

All attempts by the AHA (Arbeitsgruppe Hopfenanalyse = Hop Analysis Working Group) to reliably differentiate the storage stability of hop varieties have so far been unsuccessful. In particular, there is no reliable information about storage over several years. Therefore no specifications are given.

3. Tolerance to Diseases and Pests

Since it is generally considered today that there can be no permanent resistance to diseases and/or pests, we prefer to use the term tolerance instead of resistance. The assessment is restricted to 3 levels, "low, medium and good", because greater differentiation cannot be put to the test. In addition to the fungal diseases wilt, downy mildew and powdery mildew we have now included the two pests: hop aphids and spider mites.

4. Data

Since the data of the established varieties have hardly changed in the past 6 years no changes have been made compared with the data status of 2010. The only exception is the data of the Herkules variety which now have a broader basis and the figures have been changed accordingly.

The table is explained in detail on the back of the Pocket Guide.

Variety	Spalter	Tettnanger	Hallertauer Mfr.	Hersbrucker Spät	Saazer	Perle	Hallertauer Tradition	Spalter Select	Saphir	Opal	Smaragd
Abbreviation assignment	SP Aroma ¹⁾	TE Aroma ¹⁾	HA Aroma ¹⁾	HE Aroma ¹⁾	SA Aroma ¹⁾	PE Aroma	HT Aroma	SE Aroma	SR Aroma	OL Aroma	SD Aroma
Bitter Substances											
α-acids (EBC 7.4)	4.1	4.0	4.1	3.1	3.2	7.4	6.2	5.1	4.1	7.9	5.9
β:α (EBC 7.7)	1.3	1.4	1.3	2.4	1.1	0.7	0.8	1.0	1.9	0.8	0.9
cohumulone (EBC 7.7)	24	25	21	20	25	30	26	23	15	15	15
Polyphenols											
polyphenols (EBC 7.14)	5.3	5.2	4.6	4.4	5.3	4.1	4.3	4.9	4.5	3.7	4.5
polyphenols:α	1.3	1.3	1.1	1.4	1.7	0.6	0.7	1.0	1.1	0.5	0.8
xanthohumol (EBC 7.7)	0.34	0.29	0.27	0.21	0.30	0.55	0.41	0.42	0.37	0.41	0.32
xanthohumol:α	0.083	0.073	0.066	0.069	0.094	0.074	0.066	0.082	0.090	0.051	0.054
Aroma Substances											
total oil (EBC 7.10)	0.60	0.60	0.85	0.75	0.55	1.30	0.70	0.70	1.10	0.95	0.90
β-caryophyllene: humulene	0.28	0.29	0.29	0.48	0.28	0.31	0.28	0.4	0.43	0.34	0.30
farnesene (EBC 7.12)	> 10	> 10	< 3	< 0.5	> 10	< 0.5	< 0.5	> 10	< 0.5	< 3	< 3
linalool (EBC 7.12; mg/100g)	4	4	6	5	3	4	7	8	10	11	10
linalool:α	1.0	1.0	1.5	1.6	0.9	0.5	1.1	1.6	2.4	1.4	1.7
Yield (kg/ha)	1200	1300	1250	1750	1200	1850	1950	2000	2000	1900	1900
Tolerance to Diseases and Pests											
wilt (mild strains)	good	good	low	medium	good	good	medium	good	medium	medium	medium
downy mildew	low	low	low	low	low	good	good	good	low	good	medium
powdery mildew	medium	medium	medium	low	medium	low	medium	low	medium	medium	low
hop aphids	low	low	low	medium	low	low	medium	good	medium	medium	medium
spider mites	low	low	low	medium	low	medium	medium	good	medium	medium	medium
Variety	Cascade	Mandarina Bavaria	Hallertau Blanc	Huell Melon	Northern Brewer	Nugget	Hallertauer Magnum	Hallertauer Taurus	Hallertauer Merkur	Herkules	Polaris
Abbreviation assignment	CA Aroma ²⁾	MB Aroma ²⁾	HC Aroma ²⁾	HN Aroma ²⁾	NB Bitter	NU Bitter	HM Bitter	TU Bitter	MR Bitter	HS Bitter	PA Dual
Bitter Substances											
α-acids (EBC 7.4)	6.0	7.9	8.5	5.8	9.2	11.3	13.9	15.9	13.3	16.7	18.6
β:α (EBC 7.7)	1.0	0.8	0.6	1.4	0.6	0.4	0.5	0.3	0.5	0.3	0.3
cohumulone (EBC 7.7)	31	30	24	29	27	29	27	23	20	36	26
Polyphenols											
polyphenols (EBC 7.14)	4.3	4.0	5.4	3.9	3.9	3.4	2.6	3.1	4.2	3.8	4.0
polyphenols:α	0.7	0.5	0.6	0.7	0.4	0.3	0.2	0.2	0.3	0.2	0.2
xanthohumol (EBC 7.7)	0.39	0.59	0.38	0.56	0.61	0.68	0.47	0.89	0.37	0.80	0.79
xanthohumol:α	0.065	0.075	0.045	0.097	0.066	0.060	0.034	0.056	0.028	0.048	0.042
Aroma Substances											
total oil (EBC 7.10)	1.00	1.20	1.10	1.10	1.50	1.70	2.40	2.00	2.20	1.70	3.20
β-caryophyllene: humulene	0.50	0.30	1.00	1.20	0.34	0.47	0.28	0.29	0.29	0.28	0.40
farnesene (EBC 7.12)	< 10	< 3	< 0.5	> 10	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5	< 0.5
linalool (EBC 7.12; mg/100g)	4	5	5	3	4	10	8	19	13	8	8
linalool:α	0.7	0.6	0.6	0.5	0.4	0.9	0.6	1.2	1.0	0.5	0.4
Yield (kg/ha)	2100	2100	2300	1900	1600	2200	2000	2000	2000	2700	2200
Tolerance to Diseases and Pests											
wilt (mild strains)	low	medium	medium	medium	good	low	good	medium	medium	good	good
downy mildew	medium	medium	medium	medium	low	low	good	low	medium	low	low
powdery mildew	medium	good	good	good	low	low	low	low	good	low	low
hop aphids	medium	medium	medium	medium	low	low	low	low	low	low	low
spider mites	medium	medium	medium	medium	low	low	low	low	low	low	low

¹⁾ often characterized as "noble aroma hops"
²⁾ often characterized as "special flavor hops"