

## Hops.

Hops are a vining, perennial plant. Hops are grown from cuttings, called roots or rhizomes. When you buy a hop plant to grow it is a female. Male hops are only used to create new varieties. Most hops are clones, and so they are genetic duplicates of other hop plants of the same variety.

Before hops were used in beer, they were used by herbalists to create hop teas to calm people, help them sleep and ease their digestions. People used to make pillows stuffed with hops because it supposedly helped them sleep.

Before hops were used in beer, beer was flavored and bittered with Gruit, a blend of herbs and spices. The introduction of hops into beer was controversial. Because the hops protected the beer from bacteria with its preservative qualities, hopped beers didn't need to be brewed as alcoholic as unhopped beers. Some people felt they were being cheated by the lower alcohol beer.

### Growing Hops.

When you buy hops in the store you are going to get a plastic bag with a live root thing in it. It may look like a piece of root, or it may have tendrils hanging off of it. Keep it in a cool dark place until you are ready to plant it. Choosing your location.

Your hop plant needs sunlight, water, a place to climb and room to grow. Hops will grow in part shade, but do not flower well there. Climbing support must be sturdy. A heavy fence works well. A trellis, if large enough works well. It is not unusual for the hops to grow thirty feet in a season. They will need room. They do make a pleasant green screen between neighbors' yards.

Planting.

Plant your hops 4" deep. Loosen the soil below the root to be planted, or dig a deeper hole and back fill it with compost. Water the planting and go away. Your first indication that something is happening will be when red shoots start to emerge from the ground. They will spread leaves and turn green in a couple of days. When they are 18" high they must be trained to your support. Be careful as the vines do break if handled roughly. You can use a very heavy twine or rope to train your hops on until they get to your support.

Growing season.

Your hop vines will grow fastest during the first half of the season. There will be more than one vine. Keep an eye on them and continue training them back to the support. They will need adequate water. Water at the roots, as hops are often susceptible to leaf diseases. If the leaves are wilting you have waited too long between waterings.

The hops will put out tiny spiky flowers. As these grow, they will start to look like the hops flowers you have seen pictures of. When this happens the vines are reaching their maximum extent. If no flowers are forming, your plant was building energy for next year, when it will undoubtedly produce enough hops for all of us.

Harvesting.

Knowing when to harvest your hops can be tricky. The flowers need to be ripe, but not turning brown. If they are unripe they will smell like hay or grass. Ripe hop flowers should smell piney and hoppy. They should feel sticky. The flowers will be lighter and drying out. If you break open a flower, the lupulin glands will be bright gold-yellow.

You must be careful if it starts to rain at the end of the growing season and the weather cools off. If you are in a waiting game with your hops several days of cool rainy weather at the end of the season can turn your hops brown and spoil their flavor.

Hop flowers are extremely prone to oxidation, which will spoil their flavor. They should be dried in a food dehydrator within two days. They should then be frozen and used within a month, the sooner the better. You do not have the advantages of the commercial hop processors, with their nitrogen storage facilities and oxygen barrier packaging.

You will have to guess the alpha acid content yourself. If it was a good growing season, and your hops did well you might estimate about 6% alpha acid.

## Using Hops.

### Whole leaf hops vs. Pellets vs. Plugs.

Whole leaf hops supposedly impart more 'fresh' hop flavor. They haven't been processed as much as pellets or plugs. They do have a slightly lower bitterness utilization rate than pellets. They will help form a filter bed in a boiler, or plug your racking cane, or plug your boiler valve. These are good candidates for use with hop bags.

Pellet hops are convenient because of their size, and the fact that they are all ground up. They don't clog things like whole leaf hops or plugs. They have a higher utilization rate than leaf hops. They settle out in the fermenter, and get covered with yeast and trub, so they may not impart all the aroma and flavor expected.

Plug hops are whole leaf hops pressed into plugs 1-1/2" in diameter. They are for dry hopping as they will fit through the neck of a fermenter. They will cause a big mess in your fermenter and plug your racking tube, if you do not put them in a hop bag.

### Bittering with Hops.

The most important statistic regarding the use of hops for bittering is the alpha acid %. This number will vary by variety, batch and growing season. There are two ways of calculating the amount of bitterness you can expect from a given amount of hops at a given alpha acid %. The first involves the Alpha Acid Unit and the second the International Bitterness Unit.

Alpha Acid Units (AAU's) a.k.a. Hombrew Bitterness Units (HBU's).

Many homebrew recipes indicate how many ounces of hops of a given alpha acid % are to be used. But if hops with that alpha acid % are not available, one must translate to the new hop. This can be done with an AAU calculation. AAU's will equal the ounces of hops times the alpha acid % divided by the number of five gallon batches you are making. For example, two ounces of cascades at 4.5% would equal 9 AAU's in a five gallon batch, and 4.5 AAU's in a ten gallon batch. If you only had 6.0% alpha acid hops available, you can readily see that substituting 1 1/2 ounces of 6.0% hops will yield the same bitterness as 2 ounces of the 4.5 % hops.

International Bitterness Units (IBU's).

The calculations above do not take into account the amount of time the hops are boiled. The IBU calculation takes into account the amount of time each hop addition is boiled. For each addition the IBU's are calculated and then added together. This result in an estimate only, as it takes a laboratory to measure actually IBU's, which are equivalent to parts per million iso-alpha acids.

To calculate the IBU's for one addition the formula is used:

$(\text{Weight in ounces} \times \text{Alpha Acid \%} \times \text{Utilization factor} \times 7489) / (\text{Gallons of Wort} \times (1 + \text{Correction Factor}))$

Where: Correction factor =  $(\text{Boil Gravity} - 1.050) / .02$  if the gravity is greater than 1.049, otherwise Correction factor equals zero.

Utilization factor =  $18.11 + 13.86 * \text{hyptan}[(\text{MINUTES} - 31.32) / 18.27]$  or use this table:

Boiling Time (minutes)	%Utilization
0 - 5	5.0
6 - 10	6.0
11 - 15	8.0
16 - 20	10.1
21 - 25	12.1
26 - 30	15.3
31 - 35	18.8
36 - 40	22.8
41 - 45	26.9

For a five gallon batch of wort at 1.048 with a three one ounce hop additions of 6.0% AA at 60 minutes, 20 minutes and 5 minutes the calculation would be:

1<sup>st</sup> Addition:  $(1.0 \text{ oz.} \times .06 \times .269 \times 7489) / (5 \times (1+0)) = 24.17$

2<sup>nd</sup> Addition:  $(1.0 \text{ oz.} \times .06 \times .101 \times 7489) / (5 \times (1+0)) = 9.08$

3<sup>rd</sup> Addition:  $(1.0 \text{ oz.} \times .06 \times .05 \times 7489) / (5 \times (1+0)) = 4.5$ ; for a total of 37.74 IBU's.

## Hops for Flavor and Aroma.

Hop flavors and aroma run a full spectrum from woody, herbaceous and grassy to spicy, lemony, and passion fruit. There are now more than one hundred varieties of hops and some taste like others and some are completely unique. Some varieties are grown strictly for bittering purposes, either in extract or raw, and so their flavor is unimportant. Hop producers are continually turning out new varieties. Many times these new varieties have very similar flavor and aroma to existing varieties, but they have improved growing qualities, like disease resistance.

Here is a table of some varieties you are likely to find:

Ahtanum	American	Floral and citrusy.
Amarillo	American	Floral and citrusy.
Cascade	American	Floral, Spicy, Citrusy
Centennial	American	Citrusy, Floral, Orange
Challenger	English	Fruity, spicy
Chinook	American	Resiny, Grapefruity, some smokiness
Columbus	American	Citrusy, woody.
Crystal	American	Similar aroma to Hallertauer
East Kent Goldings	English	Citrus-sweet, lemon, floral, violets, apricot. At greater concentrations, orange, orange marmelade
First Gold	English	Citrus, orange peel, apricot
Fuggle	English	Earthy, grassy, minty
Hallertauer Mittelfruher	<b>Noble hop</b>	Delicate and subtle aroma
Hersbrucker	German	Floral and spicy.
Liberty	American	Hallertauer hybrid. Subtle lemon, citrus.
Magnum	American	Citrusy, Spicy
Mt. Hood	American	Hallertauer hybrid. Floral and herbal.
Northdown	English	Fruity, strawlike
Northern Brewer	German	Subtle floral, woody and earthy.
Perle	German	Subtle fruitiness
Pioneer	English	Lemon/grapefruit
Progress	English	Lime-fruit
Saaz	<b>Noble hop</b>	Delicate spiciness and floral.
Simcoe	American	Piney.
Spalter	<b>Noble hop</b>	Subtle fruit and spice.
Strissel Spalt	France	Fruity and spicy.
Styrian Goldings	Slovenia	Pine, Lemon, Citrus
Target	English	Orange, Marmelade, peppery-geranium
Tettnang	<b>Noble hop</b>	Mild spicy aroma
Willamette	American	Fuggle hybrid. Black currant and herbal.

It is important to remember that hops will vary from one year to the next in terms of bittering capability, flavors and aroma.

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## The Hop Schedule.

The amount of time the hops are boiled in the wort determines how much bitterness, flavor and aroma they are going to impart to your beer. The longer the hops are boiled the more bitterness they will impart, and the less flavor and aroma they will impart. Most bittering additions are done at around sixty minutes from the end of the boil. Flavoring additions are done between thirty minutes from the end of the boil right up until the end of the boil. There will be a balance between boiling enough to extract the flavor, and boiling so much you drive the volatile flavoring oils out of the beer.

Aroma additions are traditionally done at the end of the boil.

## First Wort hopping, Hopbacks, and Dry Hopping.

There are other ways to impart hop flavor and aroma to your beers than the traditional hop schedule. First wort hopping is the method of added some hops to the bottom of the empty boiler and then running the hot liquor from sparging on to the hops. This is an old German method, and supposedly the hop flavor and aroma are bound up in the solution in such a way they cannot be driven off by the boiling process.

The Hopback is a small container loaded with hops with an inlet and outlet. At the end of the boil the hot wort is run through the hopback and then through the chiller. A strainer or colander could be used instead, but I do not recommend it. The chances for significant oxidation are high.

Dry hopping is the process of adding hops to your fermenter after the primary fermentation has subsided. If there is too much CO<sub>2</sub> in solution, the escaping gas from the fermenter will scrub the aromatics out of the beer. The best practice is to dry hop in the secondary fermenter.

Aroma is lost and degraded if the beer is exposed to too much air. Protect the beer from air in order to maintain the hop aroma.

## Flavor examples:

60 Minute IPA	Simcoe and Amarilla
Founders Centennial	Centennial
Harpoon Ale	Cascade
Stone Pale Ale	Magnum and Ahtanum
Summit IPA	dry hopped with East Kent Goldings

## Other examples:

Anchor Liberty	Cascade and Liberty
Anchor Steam	Northern Brewer
Anderson Valley IPA	Columbus
Arcadia IPA	dry hopped with Columbus
Fullers London Porter	100% Fuggles
Hacker-Pschorr Oktoberfest	Hallertauer Mittlefruh
Rogue Uberfest	100% Sterling
Sam Smith Pale Ale	East Kent Goldings
Sierra Nevada Pale Ale	Cascade