Hops Harvest Moisture Determination

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In the Northeast, hop harvest generally begins in mid-August and continues through mid-September. Harvest date is primarily dependent on the hop variety. However weather can delay or hasten when a harvest will occur. Another factor that can influence harvest date is pest issues, including heavy spider mite and downy mildew infestations. In the major hop growing regions, harvest is generally targeted when cones reach approximately 23% dry matter. Table 1 outlines target harvest dry matters of 6 hop varieties.

Table 1. Target harvest dry matter of 6 hop varieties, and approximate time for a 1% increase in dry matter.

Variety	Target harvest dry matter	1% increase in dry matter every X days
Fuggle	21%	4
Mt. Hood	23%	6
Nugget	23%	4
Galena	22%	6
Tettnanger	21%	4
Willamette	20%	7

From the Oregon Hop Commission Hop Dry Matter Determination Method webpage: http://www.oregonhops.org/culture3.html

To determine your hops target dry matter, randomly sample 5 to 10 sidearms of the same variety from throughout the hopyard. Samples should be taken from near the top of the trellis, approximately two feet below the trellis wire. The sample should reflect the state of your yard, and should be taken when there isn't excess moisture in the hopyard, i.e. after the morning dew has dried, when it isn't raining, etc. Pick the cones off of the sidearm into a bucket, and mix thoroughly before selecting a subsample of 100 to 150 cones.

Once you have your subsample you can begin the determination of dry matter. Weigh an empty container in grams. Weigh the freshly picked hops in the container, and record both weights. Dry the hops down to 0% moisture. This can be done one of several ways:

1.) Overnight in a food dehydrator at 140 – 150°F
2.) In a Koster Moisture Tester (commonly used to test forage moisture)
3.) In a microwave or oven, being sure to remove the sample every minute or less to prevent scorching.

Using a food dehydrator will allow the cones to dry to 0% moisture overnight. However, the Koster tester and microwave methods require constant monitoring as they will dry the cones relatively quickly. Once the sample has reached a stable weight, the hops are at 0% moisture. Weigh the dry hops and record the weight in grams. To calculate the percent dry matter, use the following equation:

$$\textit{Hop percent dry matter} = 100 \times \frac{\textit{Dry cone weight} - \textit{Empty container}}{\textit{Green cone weight} - \textit{Empty container}}$$

Expected maturities for select varieties can be found in the Yakima Chief, Inc. Hop Variety Guide: http://www.yakimachief.com/hopvarieties/ycivarieties.pdf

Harvesting too early can reduce the yield of your hopyard and can also have an effect on next year's yield. This is especially true for new hopyards, early maturing varieties, or varieties with low vigor, as it disrupts the carbohydrate partitioning into the root system. Harvesting too early will also disrupt the flavor constituents of your hops as the alpha acids might not have reached peak levels. However, harvesting too late can also reduce brewing quality and aroma. Later harvested hops are at risk of accelerated oxidation in storage through the loss of volatile aroma compounds. Later harvested hops usually suffer from a shortened storageability, as do cones that have been damaged by diseases and/or pests. Be aware that cones that have been damaged by spider mites and other pests are prone to over-drying.

Hops should be dried down to 8-12% moisture (or 88 – 92% dry matter) for packaging and storage. Cones above this moisture will quickly loose quality due to microbial degradation, and cones below this moisture will fall apart and lose quality due to oxidation. Two methods to determine cone moisture during drying are described below.

The first method uses a small subsample to determine the moisture content of a large volume in an oast. You will need to purchase or make a small mesh bag, large enough to fit several handfuls of hop cones, and porous enough so that air can easily pass through the bag, and yet not so porous so that the hops will fall out. Weigh the mesh bag in grams and record the weight. Take a representative sample from your freshly harvested hops, equaling approximately 100 grams, and record the weight. Place the mesh bag full of fresh hops into the center of your oast along with the rest of your harvest. Since you know the weight of the sample in the mesh bag, you can calculate how much it will weigh when it is at 92% dry matter (or 8% moisture) by doing the following calculation:

$$\textit{Target weight} = \frac{\textit{Harvest \% dry matter}}{\textit{Target \% dry matter}} \times (\textit{Green sample weight}_{\text{without the weight of the mesh bag}})$$

So, for example, the mesh bag weighs 11 grams. You harvested at 23% dry matter. You put 100 grams of freshly harvested cones into the mesh bag. You are trying to dry your hops down to 92% dry matter (or 8% moisture).

$$\text{Target sample weight} = \frac{23\%}{92\%} \times 100 \text{ g} = 25 \text{ grams}$$

Target sample weight + bag = 25 g + 11 g = 36 grams

The total weight of the subsample will be 36 grams (cones plus mesh bag) when the cones in the oast reach 8% moisture.

Another method is to determine hop "shrink" when the cones are dried. A shrink factor is used to determine the amount of weight lost during drying.

The moisture shrink is calculated using the following equation:

$$\text{Moisture Shrink (\%)} = \frac{Mo - Mf}{100 - Mf} \times 100$$

Mo = original or initial moisture content (%)
Mf = final moisture content (%)

The moisture shrink for drying hop cones from 77 percent moisture (23 percent dry matter) to 8 percent moisture content is:

$$\text{Moisture Shrink (\%)} = \frac{77 - 8}{100 - 8} \times 100 = 75\ \%$$

Therefore if you place one hundred pounds of hop cones into the oast at 77 percent moisture (23 percent dry matter), it would weigh 25 pounds after drying down to 8% moisture [(100 lbs - (0.75 x 100 lbs)] = 25 lbs.

At this time, you can remove the cones from the oast, and allow them to sit or "condition" for several hours before packaging. In an oast, the moisture within the hop bed is rarely consistent, depending largely on where the fans and heat source are. Hop cones themselves can also vary in moisture, for example bracts are drier than strigs and smaller cones dry faster than larger ones. Conditioning allows the moisture to redistribute between and within the cones. There are many other methods to determine moisture during drying of hop cones aside from the two listed here. The most important factor is to make sure that the storage moisture is between 8 and 12% for optimum quality preservation during storage.

You can download an Excel tool and a drying lookup table for calculating hop harvest moisture here: www.uvm.edu/extension/cropsoil/wp-content/uploads/Hops_Drying_Calculator.xlsx

You can also access an online Hop Harvest Moisture Calculator by going here: http://www.uvm.edu/extension/agriculture/engineering/?Page=hopscalc.html

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