Hop Quality Control Points

- In the field
  - Pest management
  - Fertility
- Harvest
- Drying
- Conditioning
- Packaging
- Storage

- Heat
- Time
- Moisture
- Oxygen
Hop percent dry matter = 100 x 
  Dry cone weight – Empty container
  Green cone weight – Empty container

What's Happening: Musings from the Hopyard!

Hop Harvest Readiness

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.

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 hop yard, 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.
Hop Harvest Moisture Calculator

STEP 1: Weigh a Sample

Sample (A) Weight: 120 grams

Weigh a sample (A) of your harvested hops, making sure to 'tare' the scale before adding the hops, or subtract the weight of the container from the total weight.

STEP 2: Dry the Sample to 0% Moisture & Re-weigh

Sample (A) Weight at 0% moisture:

Dry out the sample with a microwave, dehydrator, or oven. If using a microwave or oven, stir the sample every minute to prevent scorching! Weigh frequently: the sample is at 0% moisture when it no longer loses weight.

- Google: “UVM hops moisture calculator”, 1st link
- Also available as an Excel spreadsheet for offline use
Drying

- At harvest, hops are roughly 75-80% moisture.
- For proper storage, you need them at 8-12% moisture.

<table>
<thead>
<tr>
<th>Too wet</th>
<th>Too dry</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mold &amp; mildew</td>
<td>Brittle</td>
</tr>
<tr>
<td>Discolouration</td>
<td>Oxidation</td>
</tr>
<tr>
<td>Spoilage</td>
<td>Loss of alphas, oils</td>
</tr>
<tr>
<td>Loss of alphas, oils</td>
<td></td>
</tr>
</tbody>
</table>
Drying

• At harvest, hops are roughly 75-80% moisture
• For proper storage, you need them at 8-12% moisture

Say you have 10 lbs of fresh hops at 80% moisture

\[
10 \text{ lbs fresh hops} \times 80\% \text{ moisture} \div 100 = 8 \text{ lbs water}
\]

\[
10 \text{ lbs fresh hops} \times 20\% \text{ dry matter} \div 100 = 2 \text{ lbs of dry matter}
\]
Think about it: you need fans (and a bit of heat) to move 8 lbs water for 10 lbs of fresh hops
Hop Oast = 80% to 8-12%
- Moisture from strig moves to bracts
- Moisture evaporates off bracts
- Colour should not change with drying
- As hop starts to dry, will open up
Oast issues

• Non-uniform airflow
  – Blow holes
  – Too much air will damage cones

• Non-uniform drying (within cone, within batch)

• Bracts fall off
Oast issues

• If too hot, essential oils will oxidize/breakdown
  – Alpha acids will start to break down (isomerize) at 60°C (140°F)
  – Start to lose essential oils at ~40°C (104°F)

Remember – air is lazy!
Modular Hops Oast

• Goal: Provide rapid, heated (“but not hot!”) hop drying in modular design
• Cabinet & tray design – based on an ostrich egg incubator
• Public domain design -
  http://www.uvm.edu/extension/cropsoil/wikis
  alternatively: uvm.edu search “hops wiki”, 1st link
Wikis

You will need to Register or Log In to see the wikis below:

Hops Cask wiki

Small-Scale Hops Harvester wiki
Dry 800 lbs wet cones per day
4' x 8' x 7'
Oast cost

Materials
Lumber-screws-hardware  $493
Angle Iron for Tray Racks  $208
1/3 H.P. Fan Motors (2)  @ $110.00  $220
Fan Blades (2) @$78.00 (Multi-Wing)  $156
Heating Elements 3000 Watt (2)  @ $332.00  $664
Heating and Fan Controls  $200

Total  $1941

Labor 30 Hours
Drying

10 lbs fresh hops at 80% moisture =
8 lbs of water
2 lbs of dry matter biomass

What would the hops be at 8% moisture????

2 lbs of dry matter ÷ 0.92 = 2.17 lbs of hops

2.17 lbs of hops at 8% moisture
0.17 lbs of water
2 lbs of dry matter biomass

Roughly 5:1 shrink
How do I know when my hops are at 8 – 12% moisture in my oast?
1.) Figure out what moisture your hops are:

1. Take a subsample (roughly 100 g), weigh
   - Ideally 1 decimal place!
2. Dry using a food dehydrator, oven or microwave
1.) Figure out what moisture your hops are:

1. Take a subsample (roughly 100 g), weigh
   – Ideally 1 decimal place!
2. Dry using a food dehydrator, oven or microwave
3. Once the hops stop losing weight, they’re dry

\[
\text{Hop \% dry matter} = \frac{\text{Dry cone weight} - \text{Empty container}}{\text{Green cone weight} - \text{Empty container}} \times 100
\]

Then throw this sample away
2a.) Figure out when they’re dry:

1. Take a NEW subsample (roughly 100 g), weigh
   – Ideally 1 decimal place!
2. Weigh a mesh bag
3. Put NEW subsample in mesh bag
Determining Hop Harvest Moisture and Ideal Storage Duration
2b.) Figure out when they’re dry:

Determine how much that mesh bag should weigh when the hops are at 8% moisture

\[ \text{Target weight} = \]
\[ \left( \frac{\text{Harvest \% dry matter}}{\text{Target \% dry matter}} \right) \times \left( \text{Green sample weight without the weight of the mesh bag} \right) \]

Then add the weight of the bag back in.
For example

- Harvested at 23% dry matter
- Mesh bag = 11 grams
- 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)

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.
Google: “UVM hops moisture calculator”, 1st link
Also available as an Excel spreadsheet for offline use
Conditioning

• Hops at “8-12%” moisture coming out of the oast:
  – Variable throughout the drying tray
  – Bracts ~5-7% moisture
  – Strigs ~25-35%
Good Storage

• Largely dependent on RELATIVE HUMIDITY in storage
  – Produce cooler

• Colder is better
### Table 2. Average temperature by treatment, Burlington, VT 2014.

<table>
<thead>
<tr>
<th>Location</th>
<th>Average Temperature °F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Room temperature</td>
<td>72.4</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>37.1</td>
</tr>
<tr>
<td>Chest freezer</td>
<td>0.2</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Location</th>
<th>Alpha acids (%)</th>
<th>Beta acids (%)</th>
<th>HSI</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chest freezer</td>
<td>12.16a</td>
<td>9.64a</td>
<td>0.211a</td>
</tr>
<tr>
<td>Refrigerator</td>
<td>11.73b</td>
<td>9.21b</td>
<td>0.215a</td>
</tr>
<tr>
<td>Room temp</td>
<td>9.8c</td>
<td>7.63c</td>
<td>0.358b</td>
</tr>
</tbody>
</table>
Figure 1: Degradation of alpha acids in hops stored at 3 temperatures across a 12 week period, Burlington, VT 2014.
Hops Quality

“Quality is the indicator for the condition in which hop constituents are when being added to the beer/wort, i.e. the definition of quality indicates whether degradation took place from picking to dosage.”