**Guidelines and Suggestions for Starting Maltsters**

*Advice compiled from MSU barley lab experience and from a presentation given by Ryan Hamilton, previously of Pilot Malt House in Michigan*

**Advice in securing your grain:**

- Encourage contracts – they protect all parties involved
- Specifically outline your quality assurance programs and ensure producer understands them
- Address storage and transportation concerns as early as possible

**Developing Malt Recipes:**

Many sources of variation effecting your end product exist, it is important to consider these and make appropriate adjustments to your recipes. An in house lab is critical for building awareness and making timely recipe modifications.

**Sources of potential variation:**

- Barley variety
- Plumps, skinned/broken seed, weed seeds and other contaminations
- Grain moisture and storage
- Growing environment, ie – dryland/irrigated, year to year stresses, fertility, farmer to farmer management
- Protein level – potential role in grain moisture uptake
- Germinative capacity, energy, and grain water sensitivity
- Malt house water quality, ie pH, hardness, temperatures etc.
- Malt house style & equipment, ie floor malting, small/large scale, automation etc.
- Chosen recipe, ie duration and quantity of air rests, temperature, aeration, humidity, agitation, length of germ, kilning

It is important to become familiar with your facility, its advantages and limitations and learn how to adapt these qualities to best suit the grain you source and your desired end product. The art of the maltster is taking variable grains and creating a consistent and reliable product.

**Quality Assurance – Building an In-House Lab**

Analysis which should be performed in house:

- Moisture: both grain and uptake through process
- Kernel Assortment
- Germinative Capacity, Germinative Energy, and Water Sensitivity
- Protein

*Also potentially useful: Chapon test*

*Some protocols described below, others accessible through the ASBC website – a membership is recommended.*
**Suggested Equipment:**

**Bunn G1 Commercial Coffee Mill**
- easy to use
- uses two rotating discs to grind sample to uniform particle size
- reliable and durable
- can be used to mill raw grain or malt samples for:
  - moisture analysis (in combination with an oven)
  - rapid color assessment

~$800

**AgraTronix MT-16 Grain Moisture Tester**
- easy to use, portable/durable
- reasonably reliable for raw grain testing
- unreliable for malting processes (testing moisture at steep, germ, kiln)

~$170

**A&D MX-50 Moisture Analyzer**
- easy to use
- Accurate & precise
- Can be used with all processes (raw grain intake, steeping, germ, kiln, finished malt)
- Costly, but “absolutely critical to success”

~$2800

**Kernel Assortment – ASBC Malt & barley screens**
- easy to use
- can be used for raw and malted barley
- Three screen sizes commonly used: 7/64”, 6/64”, and 5/64”.
- $190/screen, $450/set of 3, $750/set of 6
Germinative Capacity (Hydrogen peroxide method), Energy & Water sensitivity

Materials:
- Petri dishes (2) – 90mm
- Qualitative filter papers (4) – 80mm (Whatman No. 1 or equivalent)
- Graduated pipette – 10mL
- Volumetric flask – 200mL
- Hydrogen peroxide, mixed to 0.75% with distilled or deionized water

- Tests are easy to perform, and essential to success
- Inexpensive, lab ware/filter paper can be purchased through online retailers, bulk discounts often available

Scale – Ohaus ranger 3000
- easy to use
- portable and durable
~$400

Protein – FOSS Infratec Sofia
- Portable, durable, reliable
- Easy to use
- Required calibrations for reliable measurements
- Pre-calibrated with measurements for barley, wheat, canola, rapeseed
- Significantly costly ~$13,500

Additional Testing:
Friability – Pfeuffer friabilimeter
- easy to use
- used to indirectly assess degree of modification of finished malt
- provides extremely valuable insight
~$7,000
Color Analysis – Thermo Fisher Scientific Genesys 10S Vis Spectrophotometer
- easy to use
- Used to assess wort color by means of ASBC “Quick Color Method”
- results can be validated agains outside lab to increase accuracy and monitor precision
~$3,500

Other general tips for success:
- Take copious notes on your malting process and track measurements (example tracking Excel available for download on MSU website in maltser resources)
- Identify the problematic factors in your finished malt analysis
- Adjust your process as needed to attempt to rectify the outcome
- Environmental factors and/or inherent characteristics of the barley varieties you are using may impede target goals
- Join associations such as the Craft Maltsters Guild for more information
- Attend short courses such as those put on by NDSU, CMBTC, and Hartweck College

Protocols:

**Moisture Uptake:**

Obtain starting moisture of grain

Use a teaball/teabag or something similar to contain a measured weight of grain.

Subject sample to your malting process – pull at a desired interval, ie 24hrs into steep or at steep out etc

Re-weigh grain to determine grain moisture:

Calculation: (Total weight at 24/48 hrs – original grain weight)/(Total grain weight at 24/48hrs)

Example:

You started with 10g of grain that was 9.8% moisture and at 24 hrs the grain weight had increased to 15g

Original moisture = 10*0.098 = 0.98g

Original grain weight = 10 – 0.98g = 9.02g

(15g – 9.02g))/15 = 0.398

The grain is at 39.8% moisture at 24hrs. Use this knowledge along with your goal moisture to adjust your program.

*This process could also be done using a moisture meter such as the A&D MX 50 above, removing the need to have pre moisture and weight.
**Chapon Test:**

Remove a portion of grain (ideally 100 seeds) from select points during your steeping process – for example at steep out and 24hrs into germination.

Boil the grains for 60 seconds – can be done quickly by placing the grains in a small volume of water and microwaving

Remove the grains from the water and cut them lengthwise

Areas of the endosperm which are white and starchy have not been hydrated, areas which are translucent and darker in color have been hydrated. The compounds responsible for modification are hydrolytic and therefore your goal for best modification is to get good/even endosperm hydration.

Seeds can be scored from 0, ¼, ½, ¾, 1 according to hydration. Each grain gets a score of 0-4 based on level of hydration and a Steep Index score can be calculated for easy record keeping.

**Example Chapon test performed with 25 seeds for 16 different lines:**

Parameters which can effect hydration: barley variety, grain protein, water temp, and steeping regime

**Other protocols available through ASBC:**

Germination: Suggested to use Germination C: Germ Energy, Germ Capacity, and Water Sensitivity simultaneous

Malt Moisture: ASBC method w/ milled grain and oven

Physical tests (grain and malt): assortment, skinned and broken etc

Rapid Malt Color

++many other protocols having to do with analysis of malt, beer, hops and more
Example Grain Production Contract:

<table>
<thead>
<tr>
<th>Producer:</th>
<th>Buyer:</th>
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<tbody>
<tr>
<td>Name:</td>
<td>Name:</td>
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<tr>
<td>Address:</td>
<td>Address:</td>
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<td>Phone:</td>
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<td>Email:</td>
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<table>
<thead>
<tr>
<th>Delivery:</th>
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<tbody>
<tr>
<td>Address:</td>
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</table>
| Pilot Malt House, LLC  
1000 100th St SW Suite E/F  
Byron Center, Mi 49315 |
| Delivery Period: |
| August 1st, 2016 |
| To: |
| March 31st, 2017 |
| Packaging & Delivery Specifications: |
| Extra Delivery Rate: $ / |
| Extra Storage Rate: $ / |

<table>
<thead>
<tr>
<th>Specifications:</th>
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<tbody>
<tr>
<td>Grain Species: Malting Barley</td>
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<tr>
<td>Variety:</td>
</tr>
<tr>
<td>Seed Provided: <em>Yes</em> <em>No</em></td>
</tr>
<tr>
<td>Germination minimum: 95%</td>
</tr>
<tr>
<td>Plump minimum: (2-row)95%; (6-row)90%</td>
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<tr>
<td>Thin maximum: 0.4%</td>
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<tr>
<td>Skinned &amp; Broken: &lt;5%</td>
</tr>
<tr>
<td>Foreign Materials: &lt;.25%</td>
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<tr>
<td>Protein maximum: (2-row)12%;(6-row)13%</td>
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<tr>
<td>Thousand Kernel Weight (TKW): &gt;42g as is</td>
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<tr>
<td>Moisture maximum: 13.5%</td>
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<tr>
<td>RVA target value: 100</td>
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<tr>
<td>Vomitoxin (DON) Maximum: 1 ppm</td>
</tr>
<tr>
<td>Aflatoxin: N/A</td>
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<tr>
<td>Fumonisin: N/A</td>
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<tr>
<td>Mold Maximum: N/A</td>
</tr>
<tr>
<td>Blight Maximum: N/A</td>
</tr>
<tr>
<td>Ergot: N/A</td>
</tr>
<tr>
<td>(Indicate N/A if not applicable.)</td>
</tr>
<tr>
<td>Other Specifications:</td>
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<table>
<thead>
<tr>
<th>Quantity</th>
<th>Price and Terms</th>
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</thead>
<tbody>
<tr>
<td>Quantity:</td>
<td>Price $ /Bushel</td>
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<tr>
<td>Payment:</td>
<td>Invoiced per truckload, Net 30</td>
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This Malt Grain Production Contract ("Contract") is entered into between the Producer and Buyer indicated above on the later date indicated below ("Effective Date").

PRODUCER: Buyer:

<table>
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<tr>
<th>Name:</th>
<th>Name:</th>
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<tr>
<td>Title:</td>
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<td>Date:</td>
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