Malting Barley Grain Quality

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What is quality?

- A measure of excellence or a state of being free from defects, deficiencies and significant variations.
- Brought about by strict and consistent commitments to certain standards that achieve uniformity of a product in order to satisfy specific customer or user requirements.
  www.businessdictionary.com/definition/quality.htmlIn

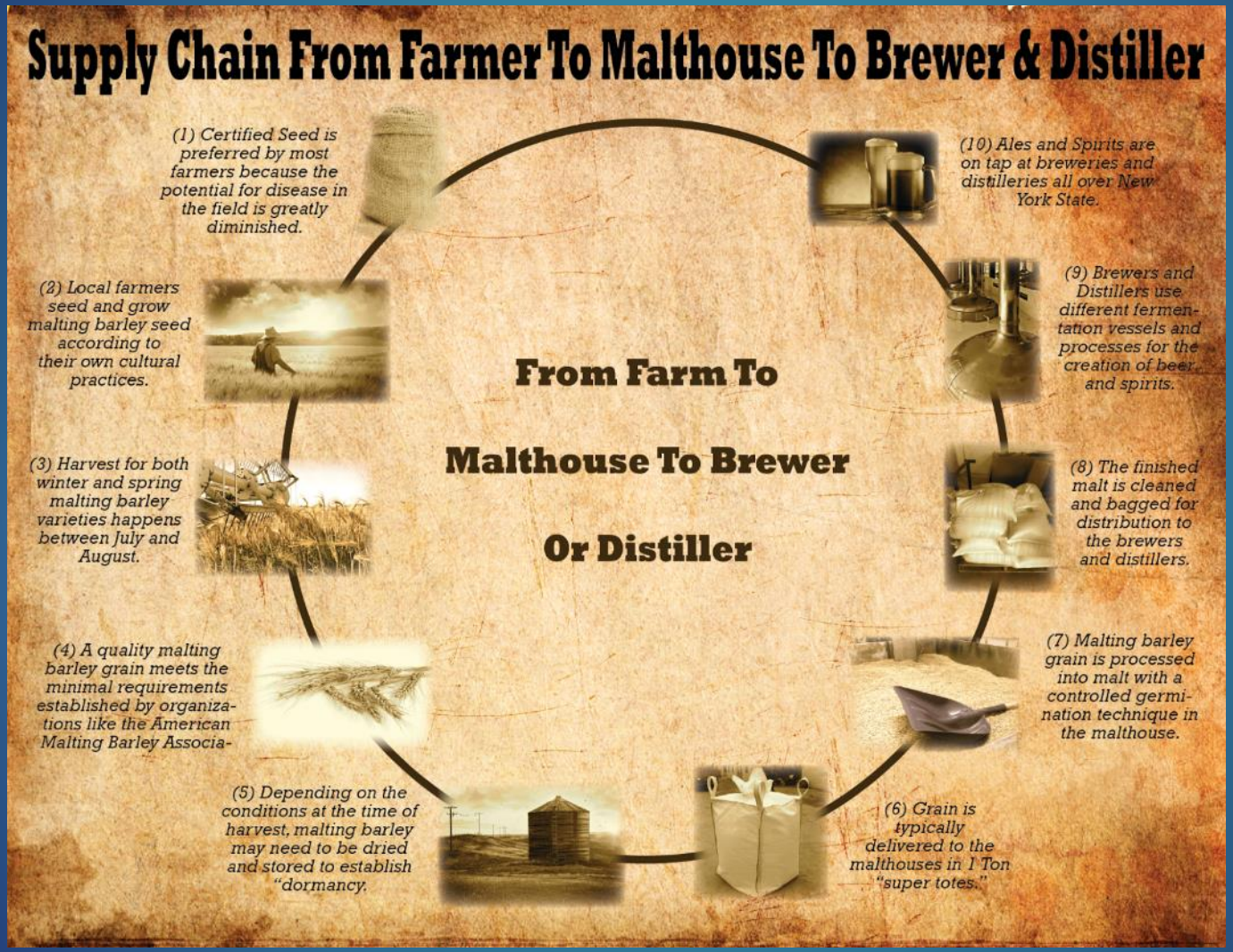
Grain quality standards

- Official standards set by Federal Grain Inspection Service
- Includes test weight, presence of foreign material, damaged or shrunken kernels
- Grain elevators must use this test
- Other quality tests may include moisture, protein, falling number and DON

Who sets malting barley grain quality?

- Somewhat arbitrary
- Maltsters
- American Malting Barley Association
- Brewers
- Consumer

Many pieces



- http://farmhousemalt.blogspot.com/2013/09/choreography-of-malt-supply-chain.html

What does end-user want?

- Maltster- quick and high germination (95%), acceptable CP (10-12%), low DON (<1 ppm), high plump (>90%)
- Brewer- high extract, beta-glucan, alpha amylase, S/T, DP, color, Maris Otter variety type, flavor (some brewers Holy Grail)
- YOU want excellent tasting beer.

AMBA Guidelines

American Malting Barley Association, Inc.

MALTING BARLEY BREEDING GUIDELINES
IDEAL COMMERCIAL MALT CRITERIA

	Six-Row	Adjunct Two-Row	All Malt Two-Row[1]	Grain Distillers'
AMBA Member Interest*	**4%**	**61%**	**31%**	**4%**
Barley Factors				
Plump Kernels (on 6/64)	> 80%	> 90%	> 90%	> 70%
Thin Kernels (thru 5/64)	< 3%	< 3%	< 3%	< 5%
Germination (4ml 72 hr. GE)	> 98%	> 98%	> 98%	> 98%
Protein	≤ 13.0%	≤ 13.0%	≤ 12.0%	11.5 -14.0%
Skinned & Broken Kernels	< 5%	< 5%	< 5%	< 5%
Malt Factors				
Total Protein	≤ 12.8%	≤ 12.8%	≤ 11.8%	11.0 - 13.5%
on 7/64 screen	> 60%	> 70%	> 75%	>50%
Glycosidic Nitrile (g/MT)			< 0.5	< 1.5
Measures of Malt Modification				
Beta-Glucan (ppm)	< 120	< 100	< 100	
F/C Difference	< 1.2	< 1.2	< 1.2	
Soluble/Total Protein	42-47%	40-47%	38-45%	>48%
Turbidity (NTU)	< 10	< 10	< 10	
Viscosity (absolute cp)	< 1.50	< 1.50	< 1.50	
Congress Wort				
Soluble Protein	5.2-5.7%	4.8-5.6%	< 5.3%	>6.0%
Extract (FG db)	> 79.0%	> 81.0%	> 81.0%	> 79.0%
Color (°ASBC)	1.8-2.5	1.6-2.5	1.6-2.8	<4.0
FAN	> 210	> 210	140-190	>250
Malt Enzymes				
Diastatic Power (°ASBC)	> 150	> 120	110-150	>200
Alpha Amylase (DU)	> 50	> 50	40-70	>75

* *Based on 2018 dues weighted survey of Regular members*

General Comments

Barley should mature rapidly, break dormancy quickly without pregermination and germinate uniformly.
The hull should be thin, bright and adhere tightly during harvesting, cleaning and malting.
Malted barley should exhibit a well-balanced, modification in a conventional malting schedule with four day germination.
Malted barley must provide desired beer flavor.
Distillers' Malt guidelines are designed to reflect how varieties perform when malted in the normal Brewers' cycles used for AMBA and CCRU variety trials.
[1]The All Malt Two-Row would be appropriate for malt distillers provided it has less than 0.5 g/MT Glycosidic Nitrile.

June, 2018

Standard Grading Factors

- Germination Energy
- Germination Capacity
- Grain Moisture
- Kernel Plumpness
- Grain Protein
- Pre-harvest Sprouting
- Deoxynivalenol (DON) level
- Skinned and Broken
- *Mold in the crease*

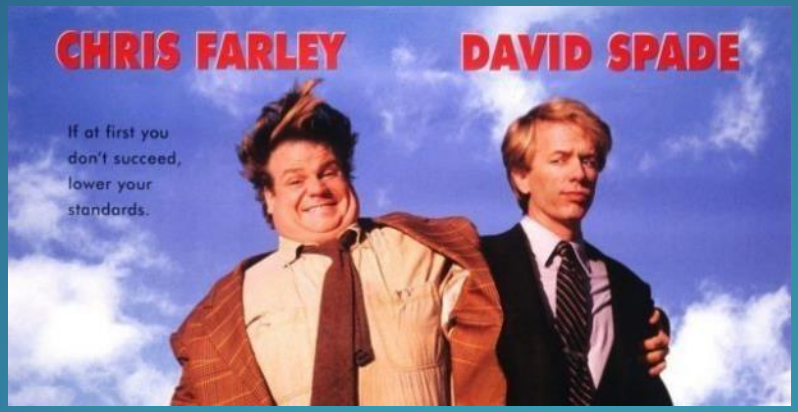
Example of North Dakota grain specs for Malt Barley

- Germination 95% Min
- Plump 75% Min
- Thin 5% Max
- Protein 13.5% Max
- Grain Moisture 13.5% Max
- Sprout 1% Max
- Dockage 0.5%
- Skinned and Broken 8% Max
- DON 1 PPM
- Extraneous materials 2% Max
- Free of heat or insects
- Blight 4% Max
- Mold 5% Max
- Wild Oats 1% Max
- Color uniform bright or gold

More notes about/explaining ND specs

- Free of musty and other nasty odors.
- Dockage is defined as material passing through an 8/64 triangle screen, and all other foreign material.
- 3. Extraneous materials are any combination of other barley varieties, other grains, foreign material, and immature / green kernels totaling 2% maximum.
- 4. All barley must be delivered in a cool, sweet condition and shall be free of heat or frost damage, ergot, smut, and other contamination, including, but not limited to animal filth, birds, and insects.

Holy Schnikes!



- One main takeaway- need a well written contract that covers everything.
- Act of God
- Delivery/storage
- Payment

What affects barley quality?

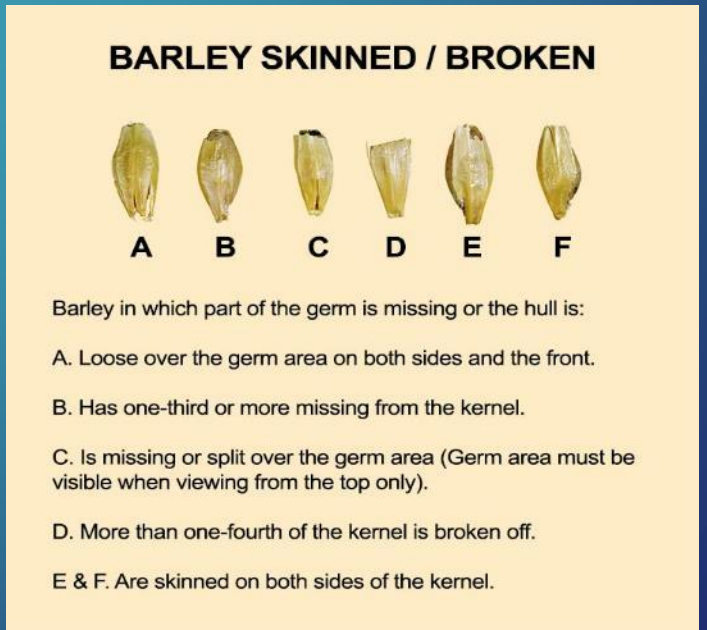
- Weather
- Planting date
- Variety
- Disease
- Temperature
- Excessive moisture
- Insufficient moisture
- Late harvesting
- Improper storage

Weather (Factor we can't control)

- Plays a significant role (2019)
- Impacts potential yield and quality
- High/low temps at wrong physiological time
- Grain weathering-affects visual appearance
- High temps (>90 F) may raise crude protein
- Pre-harvest sprout

Factors we can control

- Variety
- Certified seed
- Soil fertility
- Crop rotation
- Best agronomic practices
- Planting date
- Weed control
- Fungicide- seed treatment, foliar, *fusarium*
- Harvesting- avoid skinned and broken
- Storage- proper moisture, DE

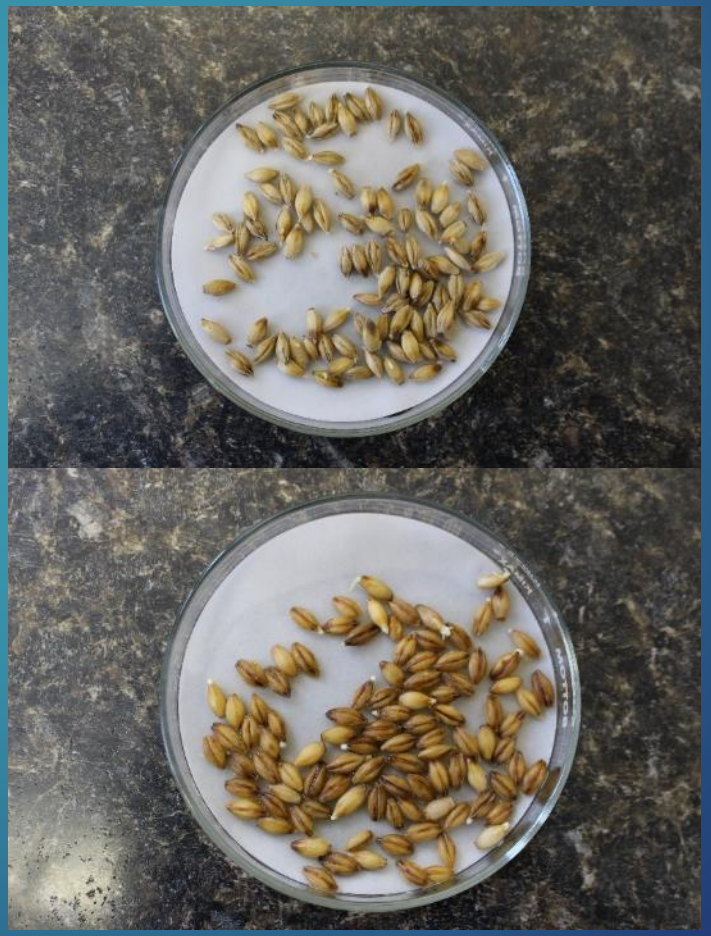


Germination

- Barley sold in live state
- Rapid, vigorous germination important for malting
- Loss of germinative energy or capacity usually due to environment or storage
- 100% to 95% germination gold standard at time of sale
- Influenced by variety and weather

Germination Energy

- 4 mL test, 8 mL test
- 100 seeds counted out and placed on 2 pieces of filter paper in a glass petri dish
- 4 or 8 mLs of water added- germinated seeds counted at 24, 48 and 72 hr intervals
- 2 plates for each test and sample
- Difference between 4 mL and 8 mL is water sensitivity



Germination Capacity

- Test is used to evaluate germination potential of barley by breaking the latent dormancy after harvest
- Some varieties exhibit high dormancy after harvest (winter barley, UK, EU genetics)
- 100 kernels of barley are placed in beaker
- Then 100 mL of 0.75% hydrogen peroxide solution is added
- Count chitted kernels after 48 hrs
- Winter barley may require 96 hr test if tested after harvest

Crude Protein

- CP is defined as the approximate amount of protein in foods that's calculated from the determined nitrogen (N) content by multiplying by a factor derived from the average percentage of nitrogen in the food proteins (Merriam-Webster, 2017).
- **Higher CP, lower available extract, lower amount of sugars-very important for brewers**
- Contributing factors to high protein
- Variety
- High N rate or not taking N credits into consi
- Stress during grain fill
- MSU Lab uses NIR (FOSS Infratec Nova)

Kernel Plumpness

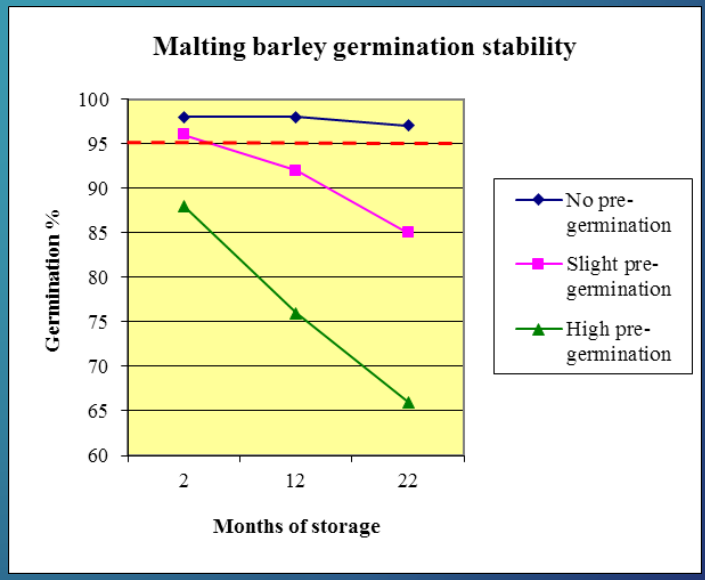
- Kernel size is indicative of the ratio between the endosperm and husk.
- Low plumpness usually due to high temps and low moisture during grain fill
- Other causes can be varietal, weed competition, plant disease or insufficient fertility
- High proportion of intermediates/thins leads to lower extract, more husk, higher soluble protein, higher enzymatic activity

Assortment test

- Lab uses Pfeuffer Sortimat
- Measures 4 fractions-7/64, 6/64, 5/64 and thins
- Cleaned sample of 100 g placed on top sieve
- Sortimat sieves for 3 minutes
- Sample fractions are then weighed
- Plumps reported as on 6/64 screen
- Thins reported as thru 5/64
- Require > than 90% for plumpness, < than 3% for thins
- Influenced by variety/temperature stress during grain fill

Pre-harvest sprout

- Occurs when grain germinates prematurely in field before harvest
- Due to environment and variety
- High levels of α-amylase within endosperm quicken germination
- Pre-germinated barley results in reduced germination in malthouse, which can result in high levels of beta-glucans in the wort
- Also affects storability of grain



Pre-harvest sprout test

- Lab uses a Rapid ViscoAnalyser-RVA StarchMaster2 manufactured by Perten
- Measures viscosity
- 4 g of a ground sample is added to a canister, then 25 mL of water is added
- Paddle placed into canister, sample mixed by jogging paddle, then canister and paddle are placed into machine
- Viscosity recorded after 3 min as cP, stirring number (RVA) then calculated
- Low RVU = High α-amylase levels

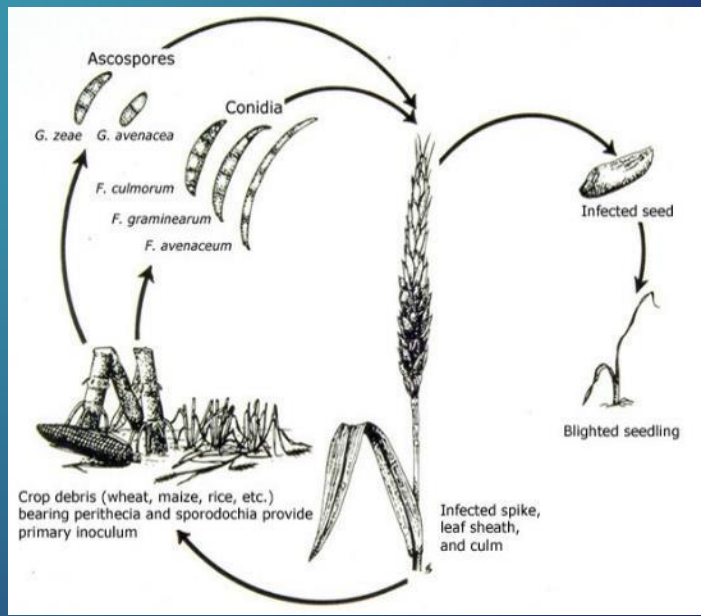
RVA interpretation

< 100 RVA	100-135 RVA	> 135 RVA
Malt immediately	Intermediate	Sound
Probability of GE loss in storage 95%	Probability of GE loss in storage 75% Store with low moisture, cool and dry conditions	Probability of retaining GE in storage 99%

- Canadian Grain Commission excellent source of information
- www.grainscanada.gc.ca

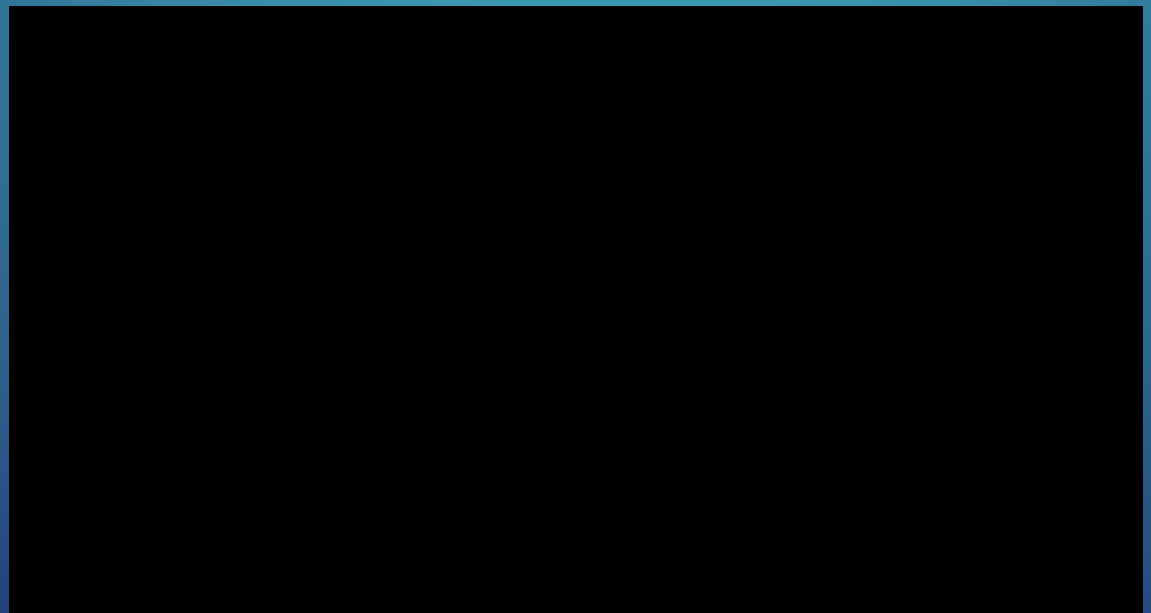
Last but certainly not least…….
Fusarium graminearum

- Fungal disease that infects kernels, commonly known as Fusarium head blight (FHB)
- Develops mycotoxins-deoxynivalenol (DON)
- Regulated by FDA, levels over 1ppm lead to rejection
- Favorable environment for infection-long periods (48 to 72 hrs) of high humidity and temperatures between 75 to 85 degrees F
- Spores carried by wind or splashed by rain
- Fungicides can used as preventative
- Causes gushing in beer, contaminated grain difficult to brew



Whats wrong with Beer Gushing?

- Waste of a good beverage
- Huge party faux pas
- Possible buzz kill
- Body extremities turn sticky and smelly
- Beer is not champagne

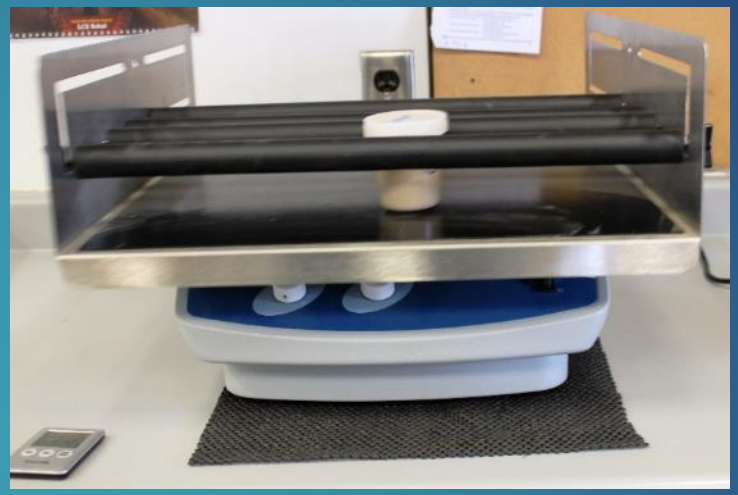


DON testing procedure

- Lab used the Reveal® Q+ for DON test along with an AccuScan® Gold reader in 2019
- Manufactured by Neogen corporation
- Test is a single step lateral flow immunochromatographic assay based on a competitive immunoassay format
- Lab participates in Neogens check sample profiency program
- Will be using Raptor going forward

Procedure

- Obtain a representative sample
- Grind and weigh out 10g sample
- Add 100 mL of distilled water
- Shake for 3 minutes
- Settle, then filter extract
- Transfer 100 µl sample extract to dilution cup, add 1,000 µl of diluent to cup, mix up and down 5x with pipette
- Transfer 100 µl of diluted sample extract to sample cup
- Place a test strip in sample cup, read promptly in 3 minutes



Other equipment

- Pfeuffer debearder/seed cleaner
- Perten lab mill
- Seedburo seed counter

MSU Lab Information

Analysis option	Includes	Price/sample
Complete analysis	moisture, kernel plump & thin, germination tests, protein, pre-harvest sprout, and DON	$50
Protein + DON only	NIR + Neogen Reveal Q+	$30
DON only	using Neogen Reveal Q+	$20
Germination only	germination energy, capacity and water sensitivity	$20

- https://www.canr.msu.edu/malting_barley/lab Malt Analysis
- Christian Kapp kappchri@msu.edu

  906-439-5114 ext 6
- Michelle Coleman 906-439-5114 ext 1

AgBioResearch
MICHIGAN STATE UNIVERSITY

MICHIGAN STATE UNIVERSITY | Extension

Other grain quality labs

University of Vermont-NWCS Quality Testing Laboratory

uvmgrain@uvm.edu

802-656-5392

Hartwick College Center for Craft Food & Beverage

Aaron MacLeod- macleoda@hartwick.edu

607-431-4232

NC State????

Take home

- High quality malting barley starts with the grower
- Proper management is key
- Doesn’t matter what sort of iron is run
- Equipment just needs proper maintenance
- Attention to details

Special Thanks

- You the audience
- Andrew Barhman
- Erin Kellar
- *Pink* Floyd Kientiz
- Michelle Coleman
- Scott Graham
- Dr. Dean Baas
- Dr. Brooke Wilke
- Dr. James Dedecker
- Christian Tollini
- Dr. Russell Freed

(the godfather emeritus)