HARTWICK COLLEGE
est. 1797

Center for Craft
Food & Beverage

Crafting Quality from Field to Glass

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Mission

- Support growth and innovation in craft food and beverage production through quality testing, technical support, education and business development.

Definitions of Quality

- Fitness for use
  - functional characteristics
  - ie. Extract & Enzymes
- Free from defects
  - Preforms well in the brewery
  - Poor runoff, poor conversion, gushing, etc.
- Brand Values
  - the *art* of malting
  - Distinctive, innovative, local, sustainable

Quality Programs

- **ISO-9001**
  - A quality management certification based on a set of standard policies, procedures and documentation
- **Six-Sigma**
  - A continuous improvement program aimed at reducing process variation
- **HACCP**
  - A food safety and risk management assessment standard (Hazard Analysis & Critical Control Point)

Quality System Components

- Quality Policy
- Training
- Standard Procedures
- Corrective Action
- Documentation/Audit

Training

- **Quality skills for malthouse staff**
  - How to perform tests and measurements
  - How to calibrate instrumentation
  - How to maintain instrumentation
  - Understand the specifications
  - Understand process variation/control specs
  - How to react to an out-of-spec condition
  - How to escalate an issue

Areas of Quality Testing

- Raw Material
- In-process
- End Product

Quality Begins in the Field

- Build relationships with growers
- Lay out expectations in advance
- Take an active interest
- Choose suitable varieties

Importance of sampling

Grain Quality Specifications

Characteristic	***Specification***
Moisture maximum	13.5%
Test Weight minimum	42 lbs/bu
Protein minimum	9.0% (dry basis)
Protein maximum	12.5% (dry basis)
Plumpness	> 90% (over 6/64”)
Germination Energy	> 95%
DON	< 1.0 ppm

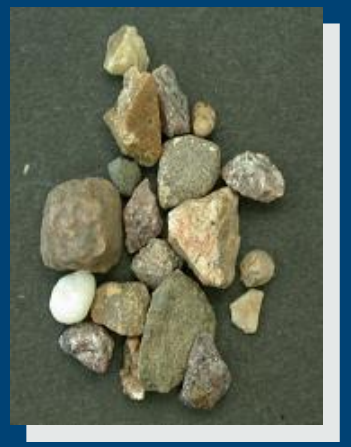
Foreign Material

objects

excrement

ergot

treated seed



stones

fertilizer pellets

Damaged Kernels

heated

peeled

smut

fusarium

frost

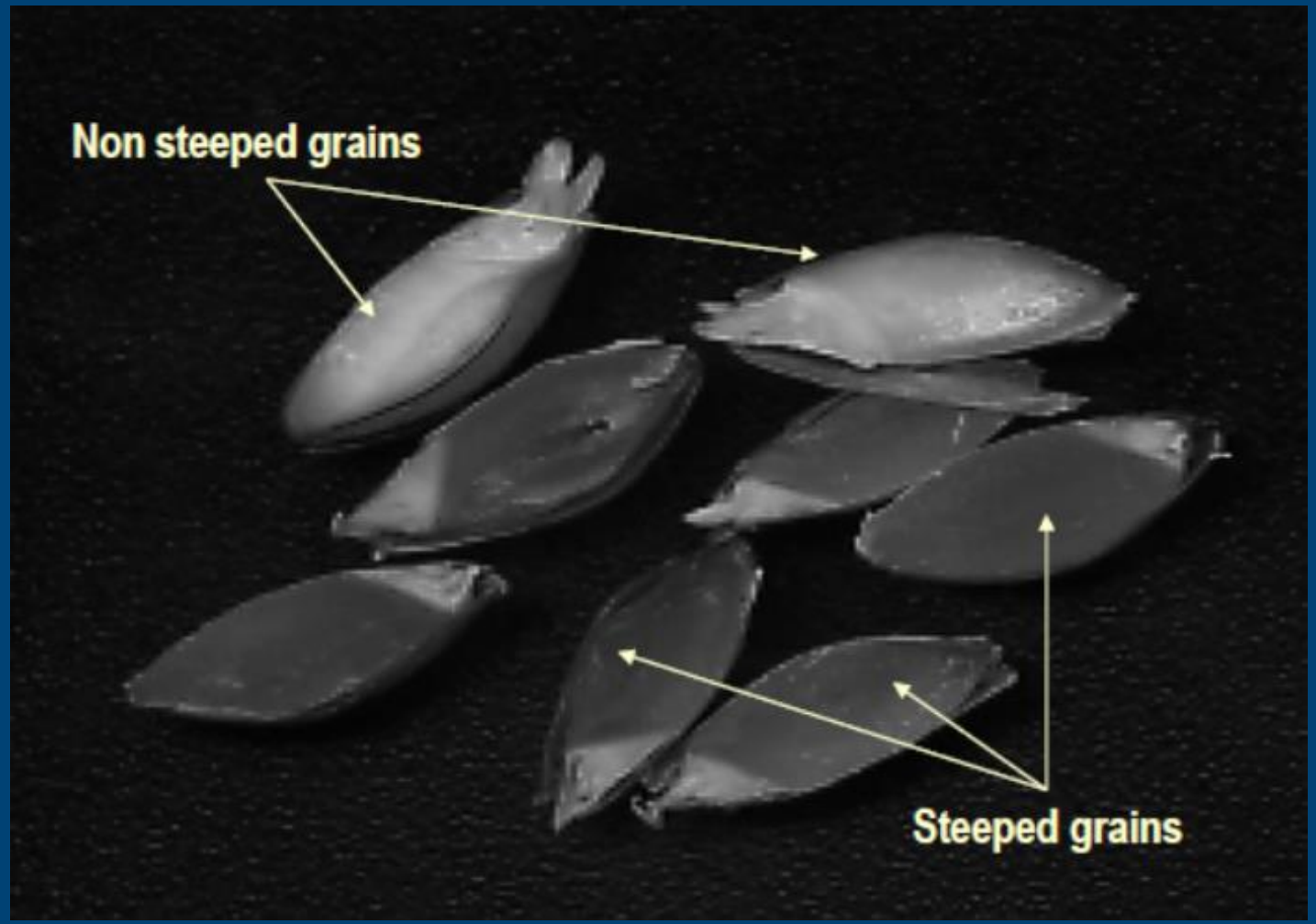
sprouted

In-Process Moisture

- Fast and accurate measurement of moisture content:
  - after steep immersions
  - During germination
  - Finished malt (lower temperature)

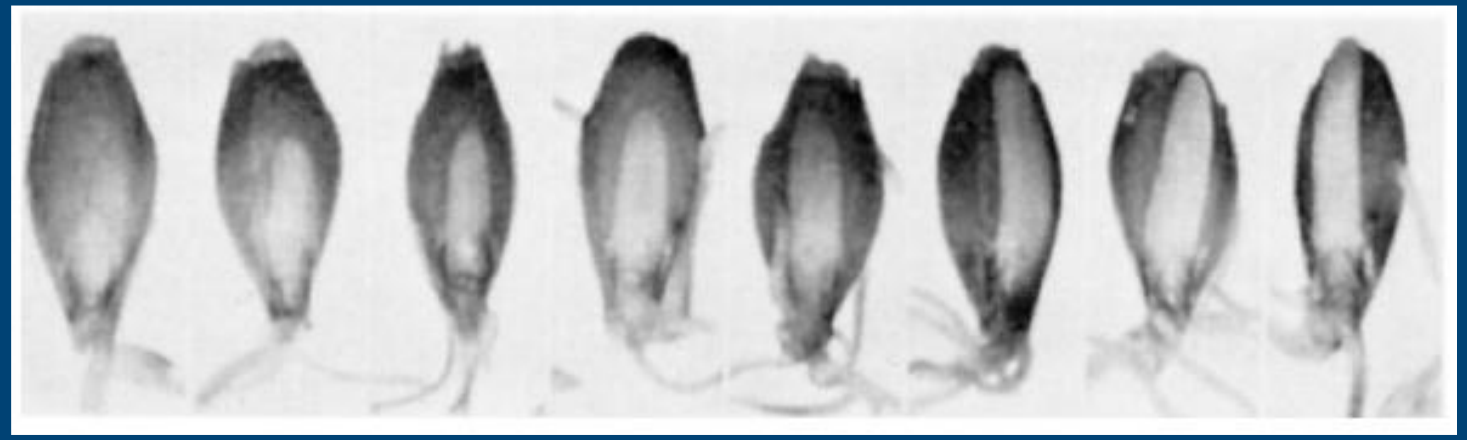
Hydration Index

- Immerse kernels of steeped malt (in a tea ball) in boiling water for 30 seconds
- Cut kernels and inspect
- Kernels should be fully translusent
- White areas are not hydrated



Acrospire Counting

- As the acrospire growth under the husk of germinating barley approaches the full length of the kernel, endosperm "modification" approaches the desired level.
- Excessive acrospire growth, extending substantially past the full length of the kernel, is considered undesirable from the standpoint of both quality and economics



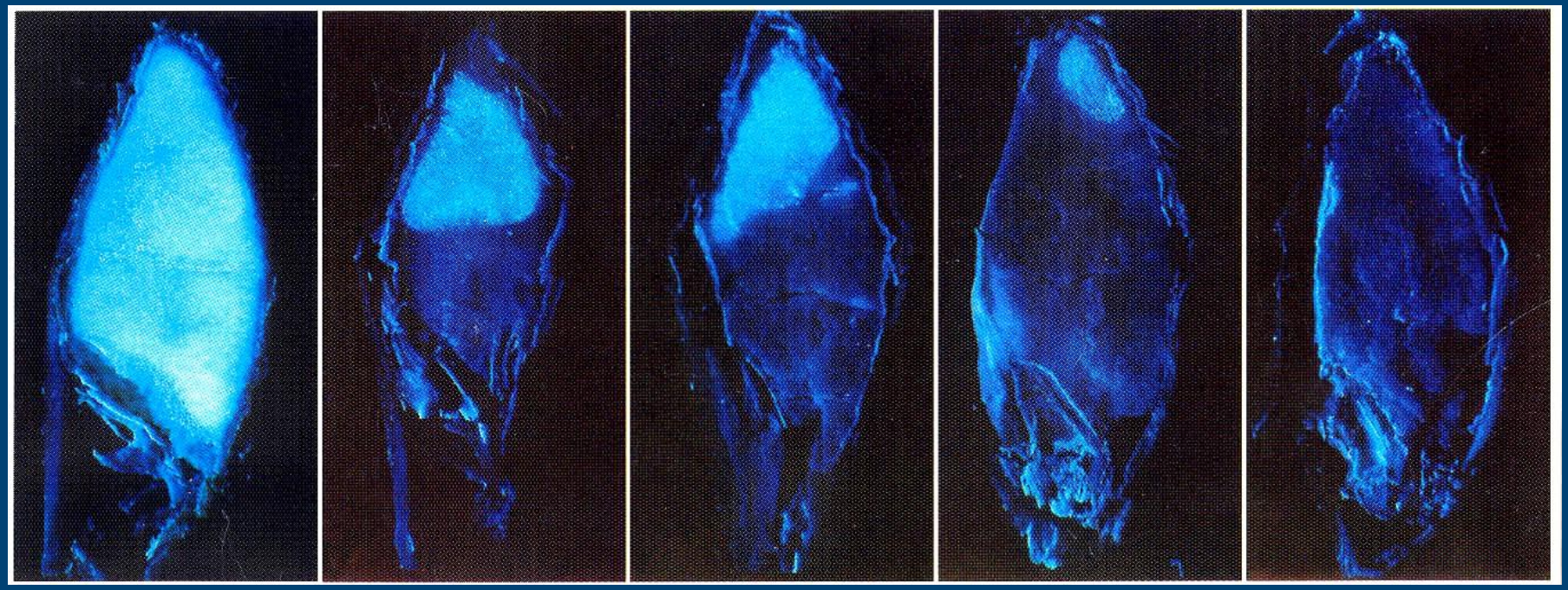
Rubbing-Out

- Modified endosperm becomes starchy/chalky
- Un-modified cell wall remains gummy/wa

Friability

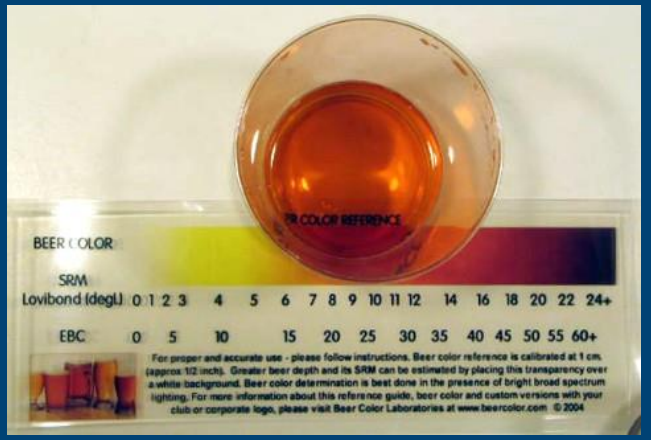
- General indication of overall modification
- Low friability results from:
  - high levels of β- glucan
  - High protein content
  - High moisture content
- High PUG = undermodified kernels
- High WUG = poor germination

Endosperm modification



Rapid Malt color method

- 25 g of fine grind malt into a 500 mL bottle
- 400 g of water
- Microwave on 50% power for 2 min .
- Mix and repeat
- Filter (extract must be clear)
- Measure absorbance @ 430 nm
- SRM = Absorbance X 25.4 (ºASBC)



Malt Sensory

- ASBC Hot Steep Method
- Validated through interlaboratory study (sensitive & repeatable)
- Characterize and compare products

Finished Malt Analysis

- Feedback for process optimization
- Monitor batch-to-batch consistency
- Develop product ranges
- Provide specs to customers

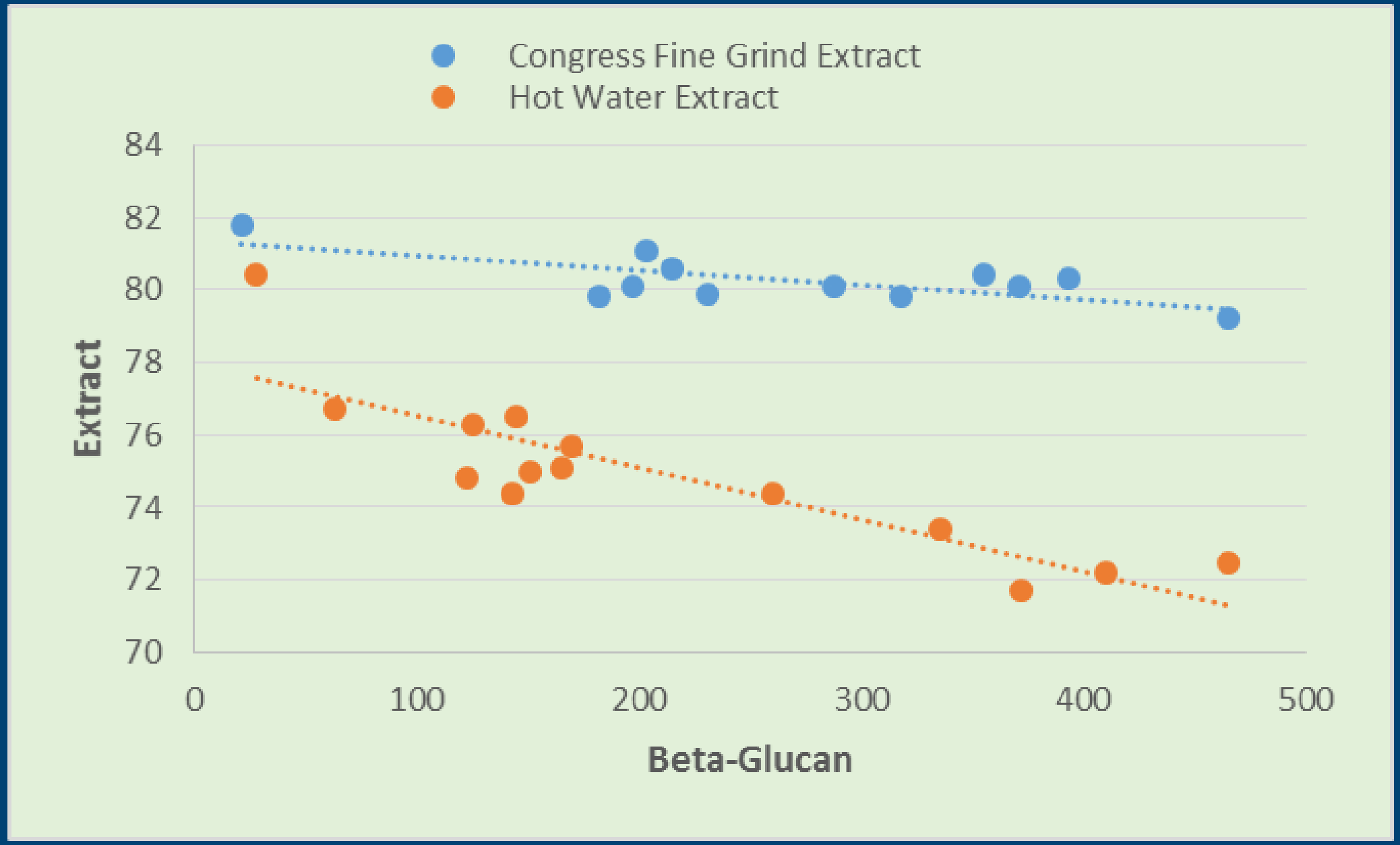
MALT	
Moisture, %	5.6
Protein, %	10.8
Friability, %	88.1
Diastatic Power, °L	105
Alpha-Amylase, D.U.	45.5
WORT	
Extract, Fine Grind, %	82.5
Extract, Coarse Grind, %	81.7
Fine/Coarse Difference, %	0.8
Soluble Protein, %	4.7
S/T, %	44.7
ß-Glucan, ppm	58
Viscosity, cps	1.37
FAN, mg/L	190
Color, °	2.59
pH	5.81
Clarity	clear
Filtration time	normal

Food Safety

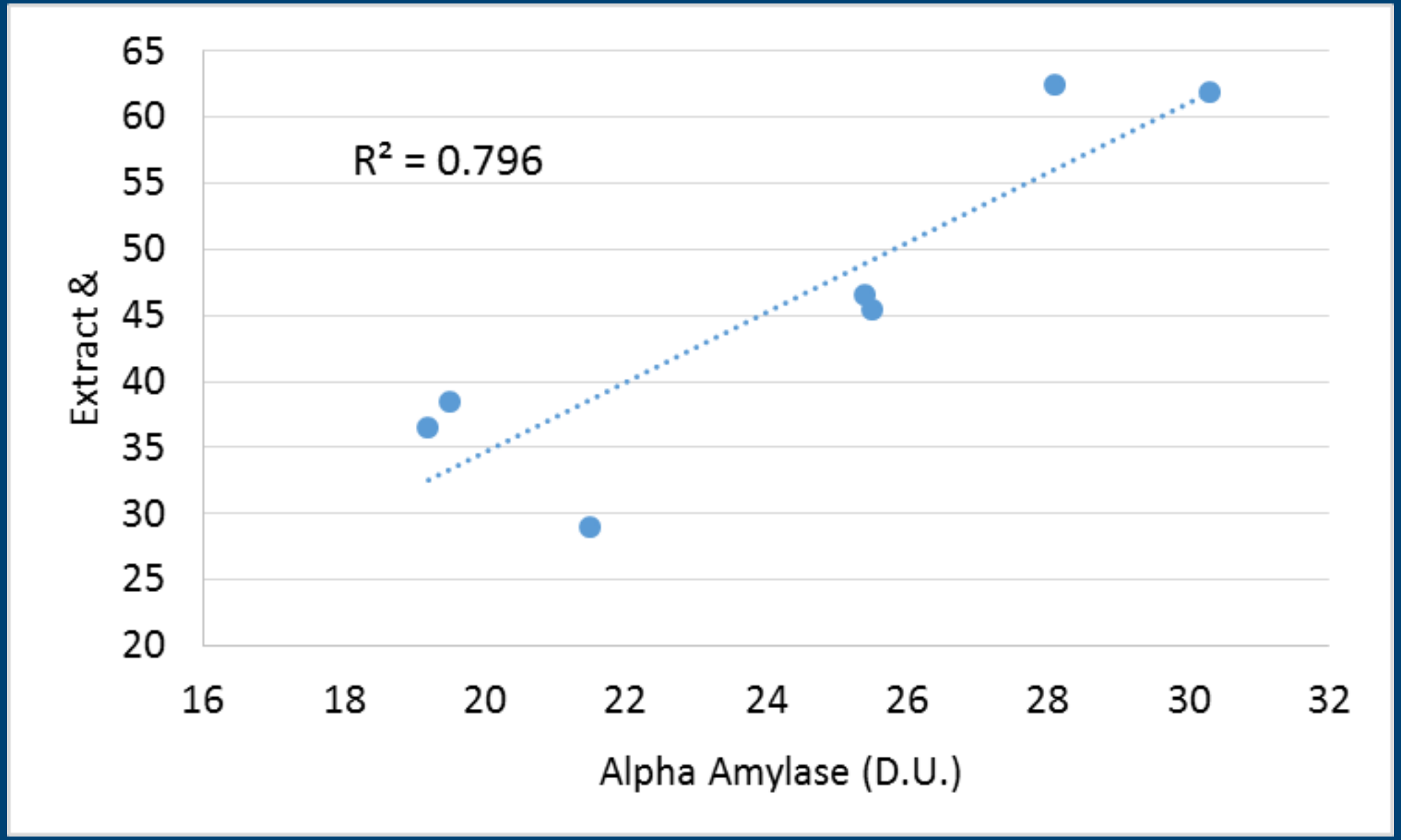
- Nitrosamine (NDMA)
  - Federally regulated carcinogen
  - Caused by direct exposure to NOx emission
- Glycosidic Nitrile
  - Precursor to ethyl carbamate
  - Formed in copper stills (all malt whisky production)
- Microbiological safety
  - Culinary malts, food ingredients, sprouted grain
  - E.Coli, mold, & mycotoxins

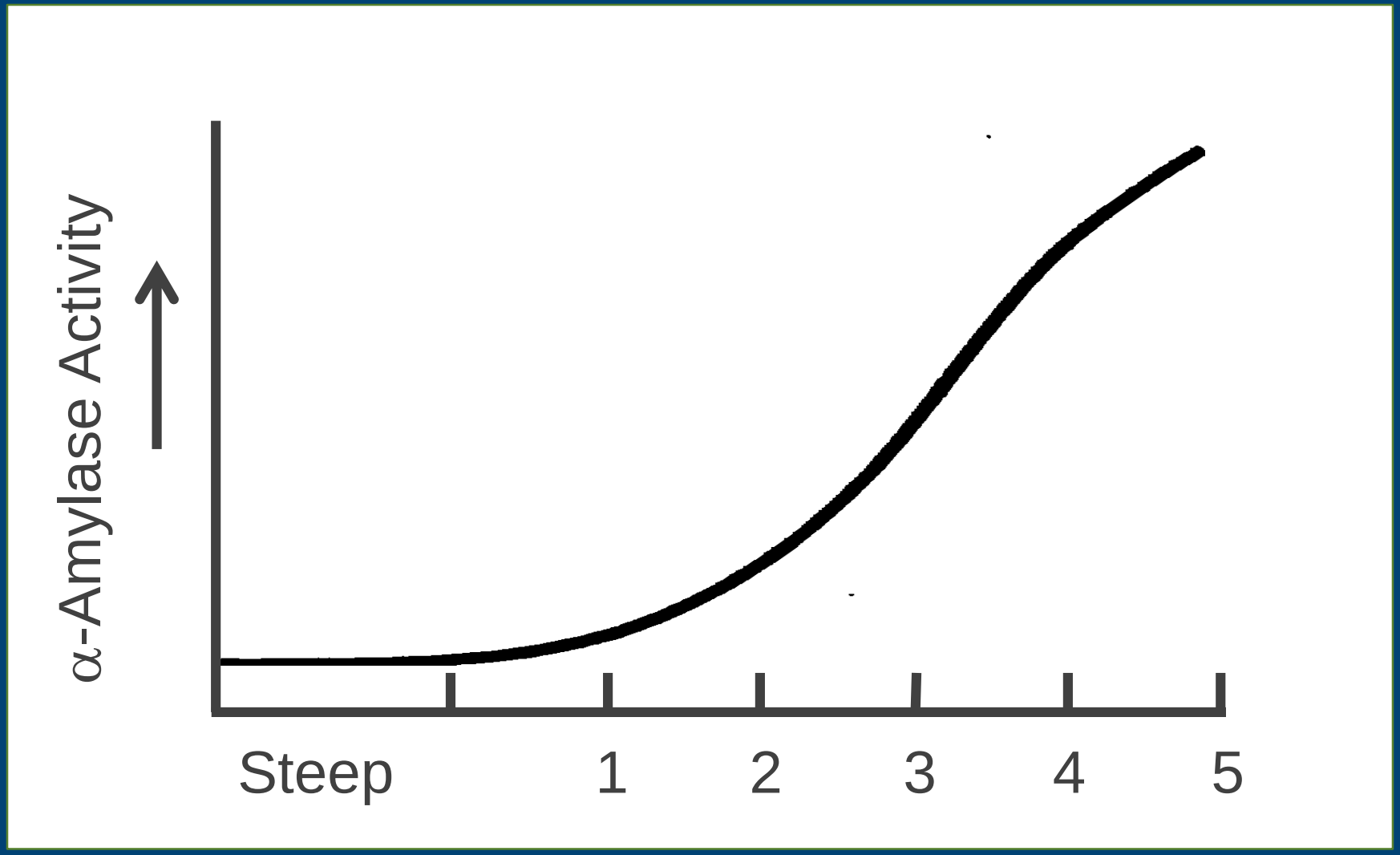
Considerations for brewing

- High Brewhouse Yield
  - high extract, low β-glucan
- Efficient conversion
  - Adequate alpha amylase
- Good wort separation
  - low β-glucan, low viscosity, good hull retention
- Good attenuation
  - high fermentability, adequate FAN, adequate DP


Congress Fine Grind Extract
Hot Water Extract
84
82
80
78
76
74
72
70
Extract
0
100
200
300
400
500
Beta-Glucan

Extract	Color	FAN	Alpha Amylase
%	°SRM	mg/L	D.U.
38.5	3.8	89	19.5
61.9	3.25	118	30.3
62.4	2.95	135	28.1
29.0	3.40	126	21.5
36.5	3.91	73	19.2
45.4	4.58	141	25.5
46.5	4.36	129	25.4


65
60
55
50
45
40
35
30
25
20
Extract &
R² = 0.796
16
18
20
22
24
26
28
30
32
Alpha Amylase (D.U.)


α-Amylase Activity
Steep
1
2
3
4
5

Extract %	Color °SRM	FAN mg/L	Alpha Amylase D.U.	Germination Time (hours)
38.5	3.8	89	19.5	45
61.9	3.25	118	30.3	62
62.4	2.95	135	28.1	66
29.0	3.40	126	21.5	47
36.5	3.91	73	19.2	48
45.4	4.58	141	25.5	53
46.5	4.36	129	25.4	54

Product	Protein %	Friability %	Extract %	Color	B-glucan mg/L	FAN mg/L	DP °L
SY Tepee Pale	9.0	87.0	81.2	2.80	104	116	100
Wintmalt Pilsner	9.0	88.3	81.7	1.80	72	172	138
Conlon Pale	13.0	66.0	77.9	3.80	141	242	150

Using Third Party Labs

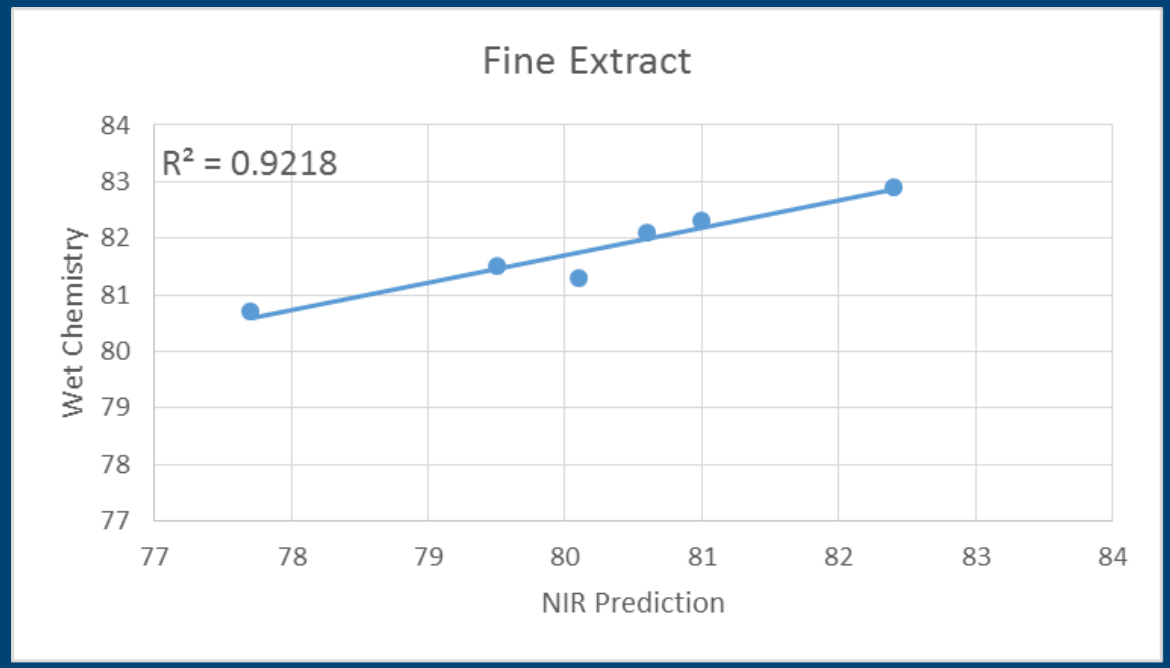
- Outsourcing some analysis can fill gaps in your quality assurance program by providing analysis that requires equipment you don't have or validation that your own analysis makes sense.
- Third party analysis can also be used for:
  - Validation of in house test methods
  - Calibration of equipment
  - Demonstrating Laboratory proficiency

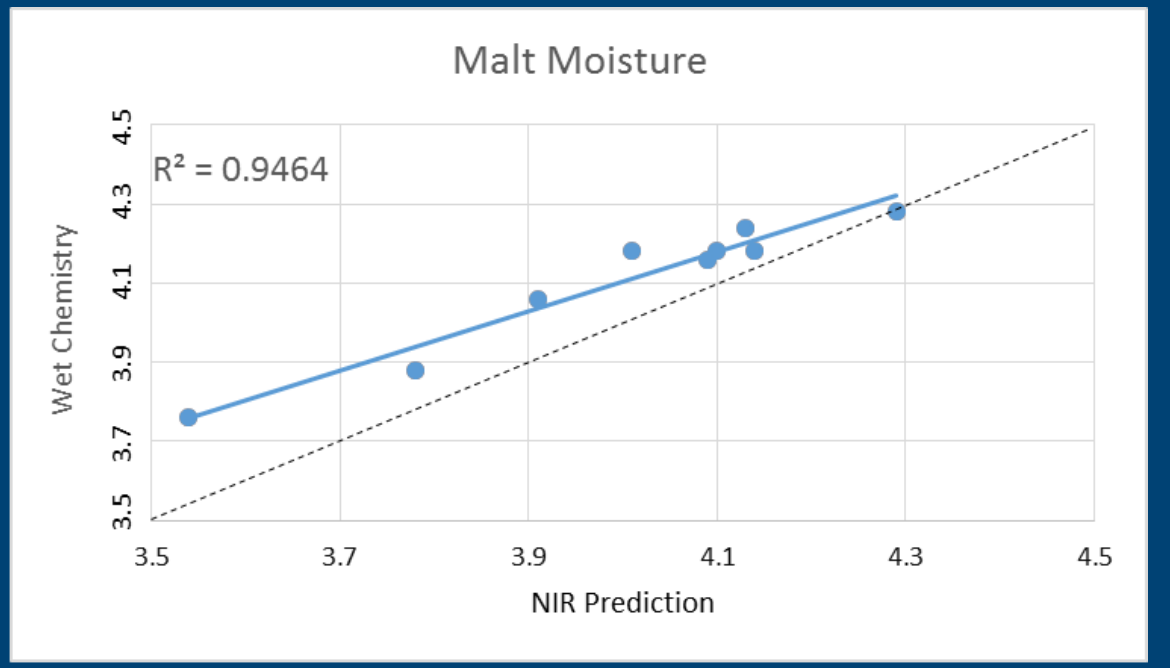
Third Party Testing labs

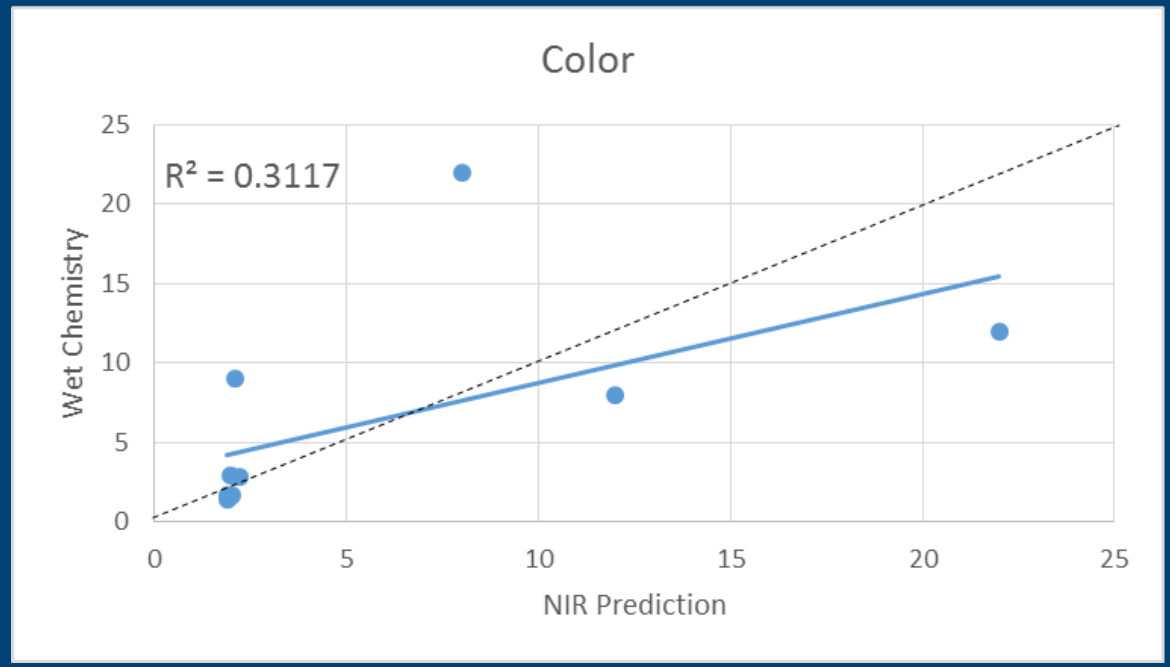
- When choosing a lab for 3rd party testing, be an informed consumer
- Ask questions about:
  - methods used
  - experience with malting barley
  - quality procedures in place

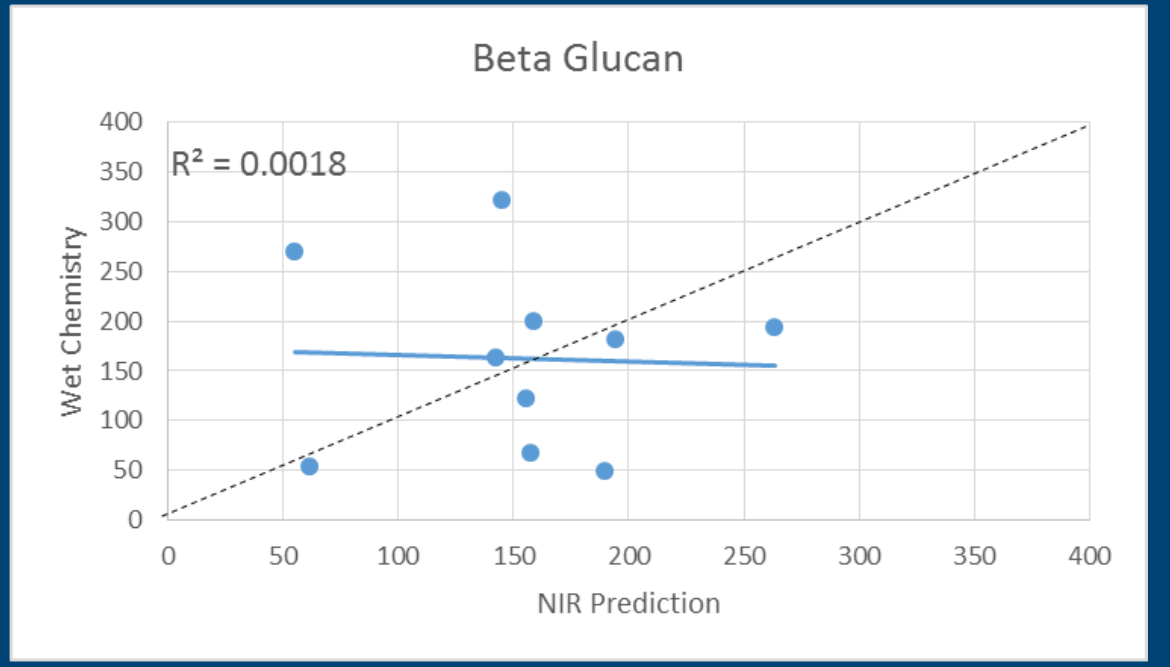
Near Infrared (NIR) Analysis

- Rapid, non-destructive method
- Predictions are based on calibrations developed from spectral libraries
- Accuracy depends **highly** on the calibration
- calibrations must contain genetic and geographic variability to be 'robust'
- Useful for screening and plant breeding applications
- Insufficient accuracy for Quality Control


Fine Extract
R² = 0.9218
Wet Chemistry
NIR Prediction
84
83
82
81
80
79
78
77
77
78
79
80
81
82
83
84


Malt Moisture
R² = 0.9464
Wet Chemistry
NIR Prediction
4.5
4.3
4.1
3.9
3.7
3.5
3.5
3.7
3.9
4.1
4.3
4.5


Color
R² = 0.3117
Wet Chemistry
NIR Prediction
25
20
15
10
5
0
0
5
10
15
20
25


Beta Glucan
R² = 0.0018
Wet Chemistry
NIR Prediction
400
350
300
250
200
150
100
50
0
0
50
100
150
200
250
300
350
400

Analytical Uncertainty

Test	Within a lab (r_{95})	Between labs (R_{95})
Moisture (%)	0.2	0.8
Extract (%)	0.4	1.4
Friability (%)	3.0	7.0
Color (°ASBC)	0.2	0.5
Diastatic Power (°L)	10	30
Alpha Amylase (DU)	5	15
FAN (mg/L)	7	40
B-glucan (mg/L)	20	50

Fee for service grain quality labs

- Michigan State University Extension
  - http://msue.anr.msu.edu/topic/malting_barley/lab
- Hartwick College
  - www.hartwick.edu/craftfoodandbeverage
- University of Vermont Extension
  - http://www.uvm.edu/extension/cropsoil/cereal-grain-testing-labMichigan State

Fee for service malt quality labs

- **In USA** – Hartwick College
  www.hartwick.edu/craftfoodandbeverage

- **In Canada** – Canadian Malting Barley Technical Center, MB
  www.cmbtc.ca

Contact us!

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www.hartwick.edu/craftfoodandbeverage