HARTWICK COLLEGE
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Center for Craft
Food & Beverage

Lessons From the Malt Lab

Aaron MacLeod

Craft Malt Conference
February 3, 2017

Our Mission

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

Investment

- The Center has been awarded a total of $1,125,000 in start-up funding from federal, state, and private sources
  - Empire State Development
  - USDA Rural Business Development
  - Appalachian Regional Commission
  - George Alden Trust


BAKER SterilGARD
Entris

Megan Douglass

Rachel Truland

Grain Quality Testing

Barley Selection Package (Moisture, Protein, Plump, Kernel Weight, Germination Energy, RVA, & DON)	$75
Moisture & Protein	$15
Starch	$25
Germination (4mL, 8mL & Capacity)	$20
DON (ELISA)	$35
RVA (for pre-harvest germination)	$25

Other Grain Quality Testing Labs

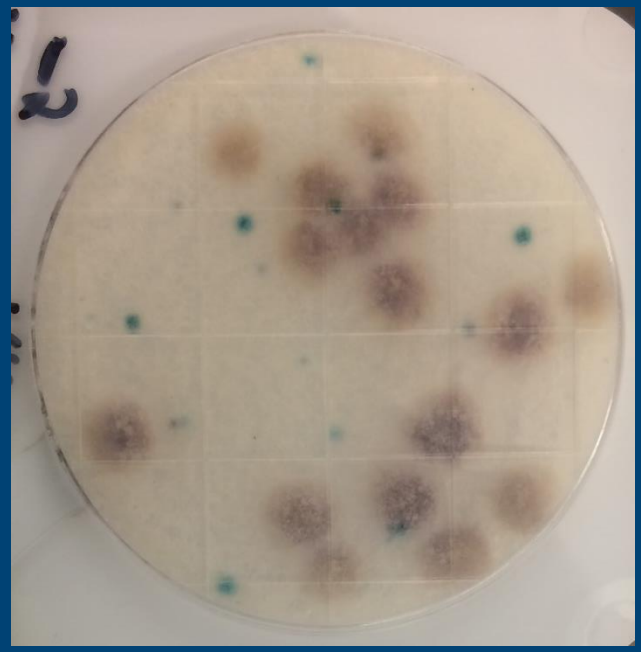
- Michigan State University Extension
  - http://msue.anr.msu.edu/topic/malting_barley/lab
- University of Vermont Extension
  - http://www.uvm.edu/extension/cropsoil/cereal-grain-testing-labMichigan State

Malt Quality Testing

Full Malt Analysis – (Moisture, Assortment, Friability, Fine Extract, Coarse Extract, F/C Difference, β-glucan, FAN, soluble protein, S/T, DP, α-amylase, color, filtration time, clarity)	$150
Basic Malt Analysis – (Moisture, Fine Extract, β-glucan, FAN, DP, α-amylase, color, filtration time, clarity)	$75
Enzymes Only (Diastatic Power & α-amylase)	$50
Specialty Malt Analysis – (Moisture, Extract, Color)	$25

Safety Testing

DON	$35
Aflatoxin	$35
Ochratoxin	$30
Total Aerobic Count	$30
Yeast & Mold Count	$30
EColi	$30
Nitrosamines (NDMA)	$175
Glycosidic Nitrile	$225



Pilot Scale Processing

- Micromalting assessment
- Variety & Agronomy Trials
  - Cornell
  - Penn State
  - Virginia Tech
  - UD Davis
  - Oregon State University
  - Washington State University

Member Benefits

- Malt QC Program for Regular Members :
  - Basic Malt Analysis for $50/sample
  - No minimum sample frequency
  - Convenient quarterly invoicing
  - Reports in excel format for ease of data tracking and analysis

➢ 42 Member Malthouses use the lab

➢ 2893 malt samples tested to date

How to use 3rd Party Labs

- Feedback for process optimization
- Characterize malted products (specifications & ranges)
- Monitoring process variation
- Validation of in house test methods
- Calibration of laboratory equipment

MECCA GRADE Estate Malt

Product Information & Analysis

9619 NW Columbia Drive, Madras, Oregon 97741 ★ 541.526.8152 ★ www.meccagrade.com

PELTON

Pilsner-Style
Foundation Malt

Analysis

Plump	98.7%	Protein	11.4%
Thru	0.3%	S/T	42.1%
Moisture	4.8%	Alpha Amylase	69.5
Extract FG, Dry Basis	80.0%	Diastatic Power (Lintner)	157
Extract CG, Dry Basis	79.0%	Color (SRM)	1.95
Beta Glucan (mg/L)	97	Variety	Full Pint
Freshly-Malted	9/27/2017	Vintage	2016 Harvest

Characteristics & Applications

Pelton is the perfect choice for crafting premium lagers, light ales, farmhouse, and wild beers. It produces a complex,

Base Malts

2-ROW PALE

- SRM: 3.5
- Protein: 9.5%
- CG Extract: 81%
- Flavor: Clean, malty, bread crumb.

2-ROW PILSNER

- SRM: 1.8
- Protein: 10.5%
- CG Extract: 81.5%
- Flavor: Crisp, sweet, light straw clean finish

6-ROW

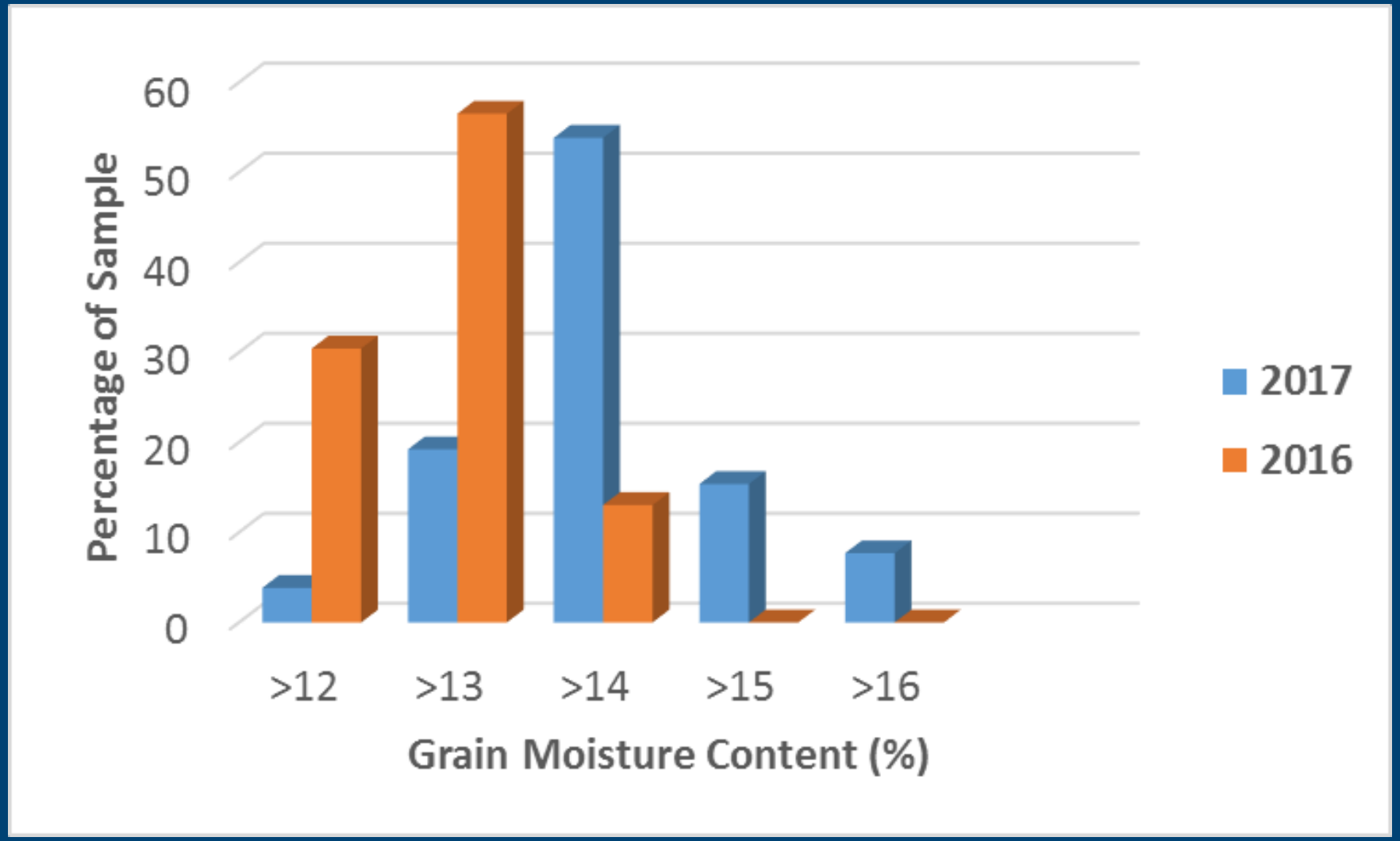
- SRM: 1.7
- Protein: 9%
- Extract: 79%
- Flavor: light husk, earthy

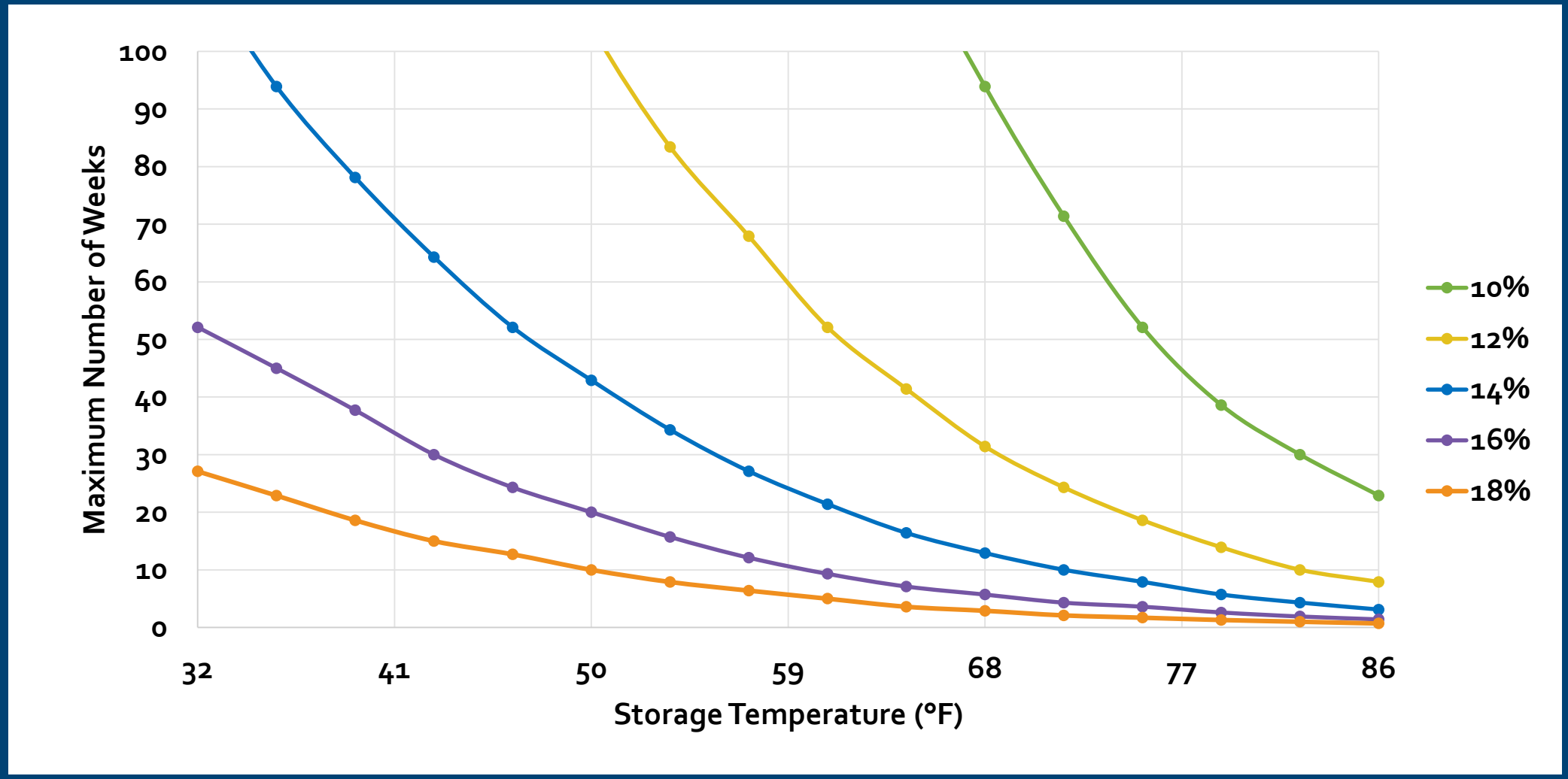
VIENNA

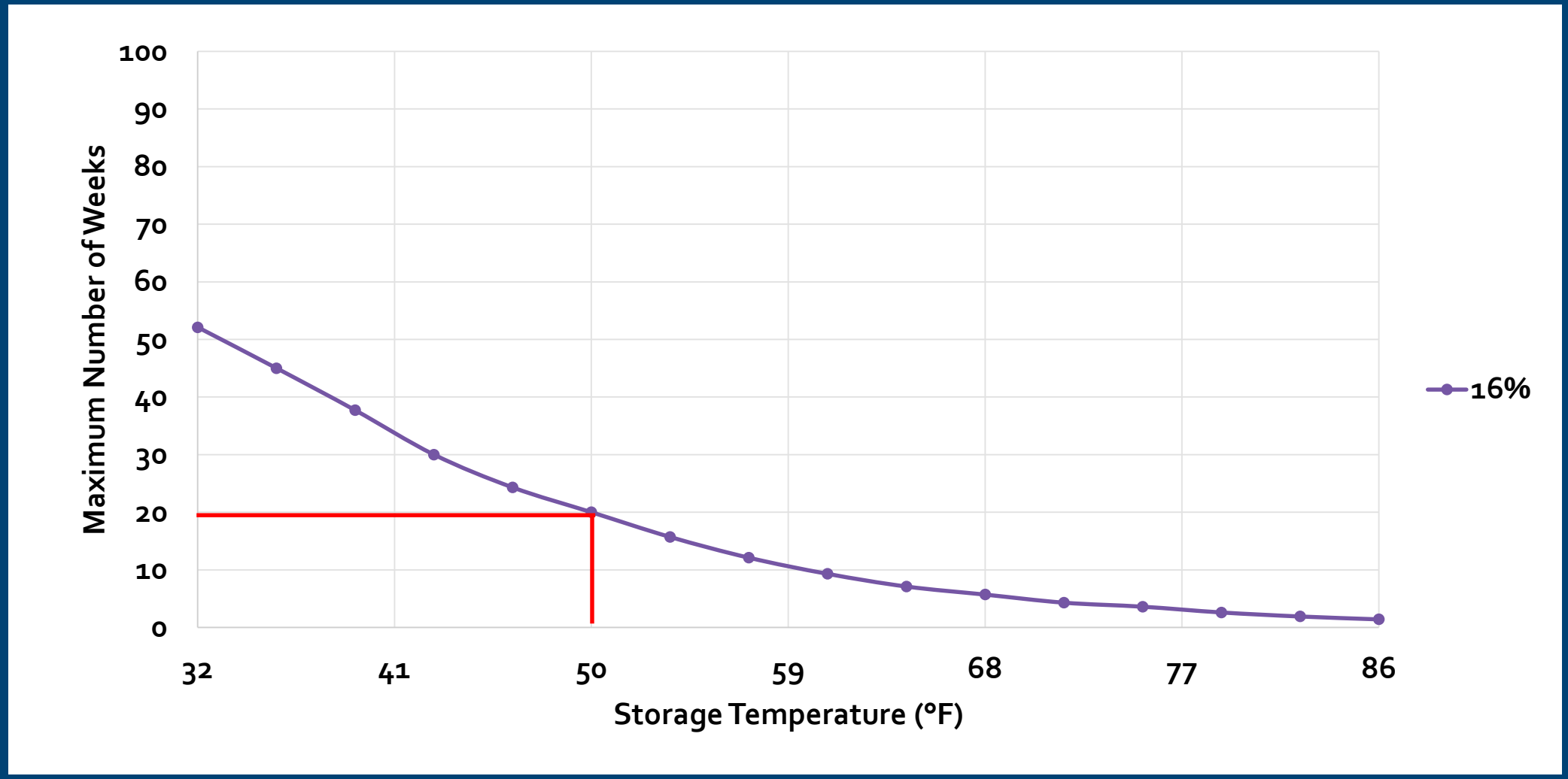
- SRM: 4
- Protein: 9%
- Extract: 81%
- Aroma: Sweet Aromatic, Breakfast Cereal, Grape Nut, Bready, Cracker
- Flavor: Medium Sweet, Medium Body

The view from the hill……

Grain Moisture




Maximum Number of Weeks
100
90
80
70
60
50
40
30
20
10
0
32
41
50
59
68
77
86
Storage Temperature (°F)
10%
12%
14%
16%
18%


Maximum Number of Weeks
100
90
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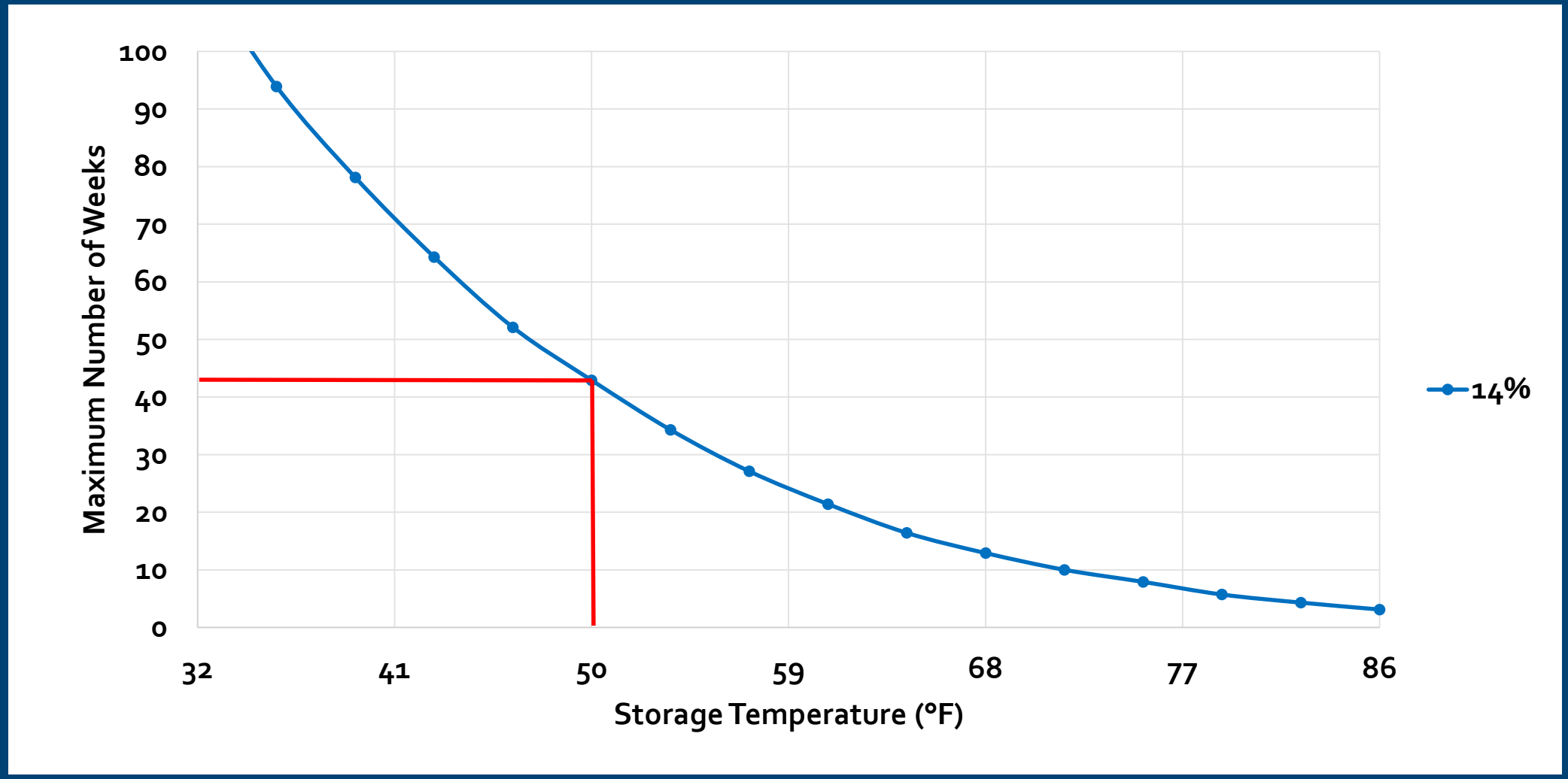
77
86
Storage Temperature (°F)
16%


Maximum Number of Weeks
100
90
80
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60
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40
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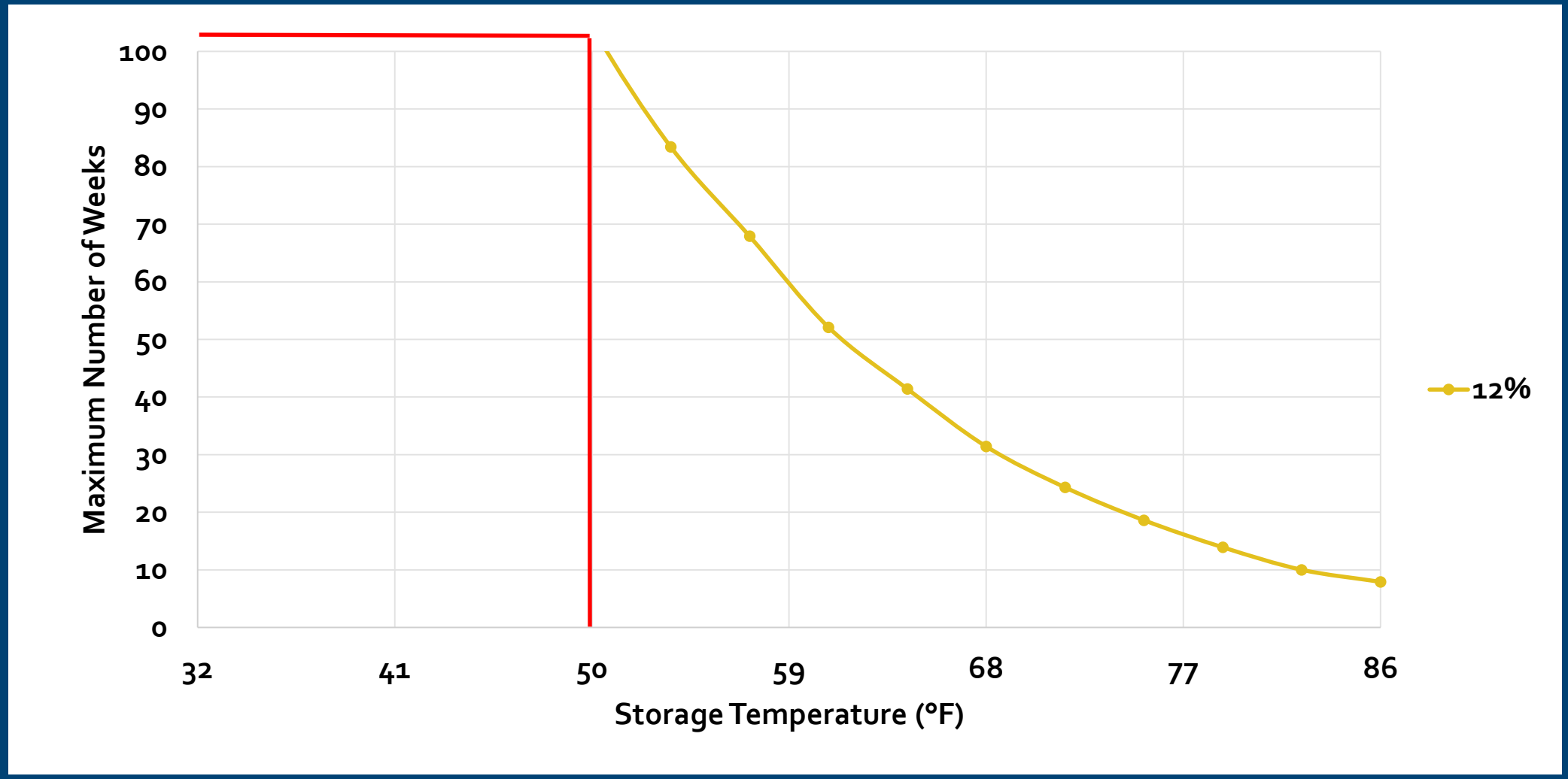
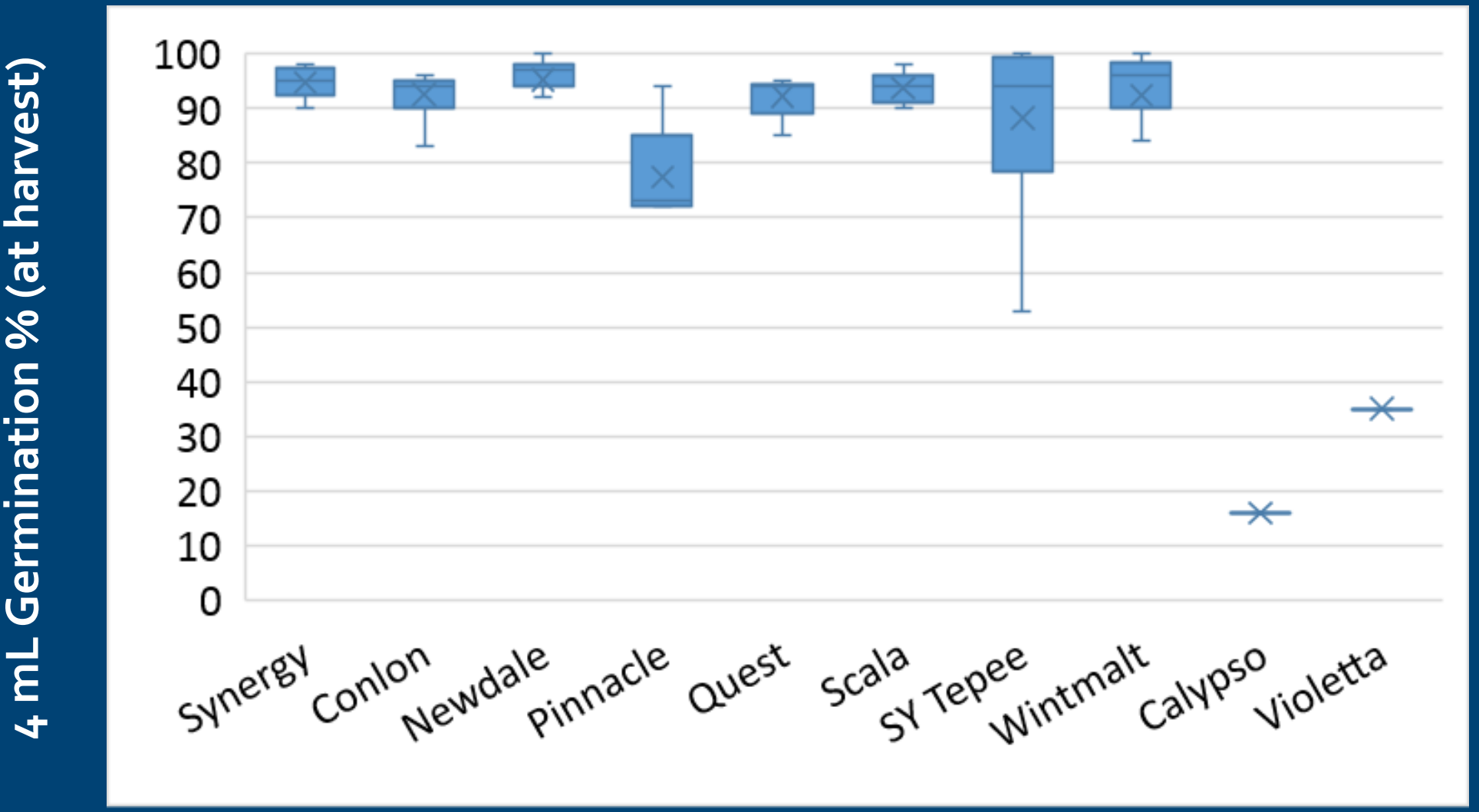
20
10
0
32
41
50
59
68
77
86
Storage Temperature (°F)
14%


Maximum Number of Weeks
100
90
80
70
60
50
40
30
20
10
0
32
41
50
59
68
77
86
Storage Temperature (°F)
12%

Germination loss during storage

	At Harvest July/Aug			December
	Moisture %	Germination Energy %	RVA	Germination Energy %
Scala	13.2	99	65	93
Synergy	13.3	98	75	98
Synergy	14.1	97	45	91
Scala	15.3	97	20	73
Conlon	15.3	94	30	73
Newdale	16.1	98	20	48

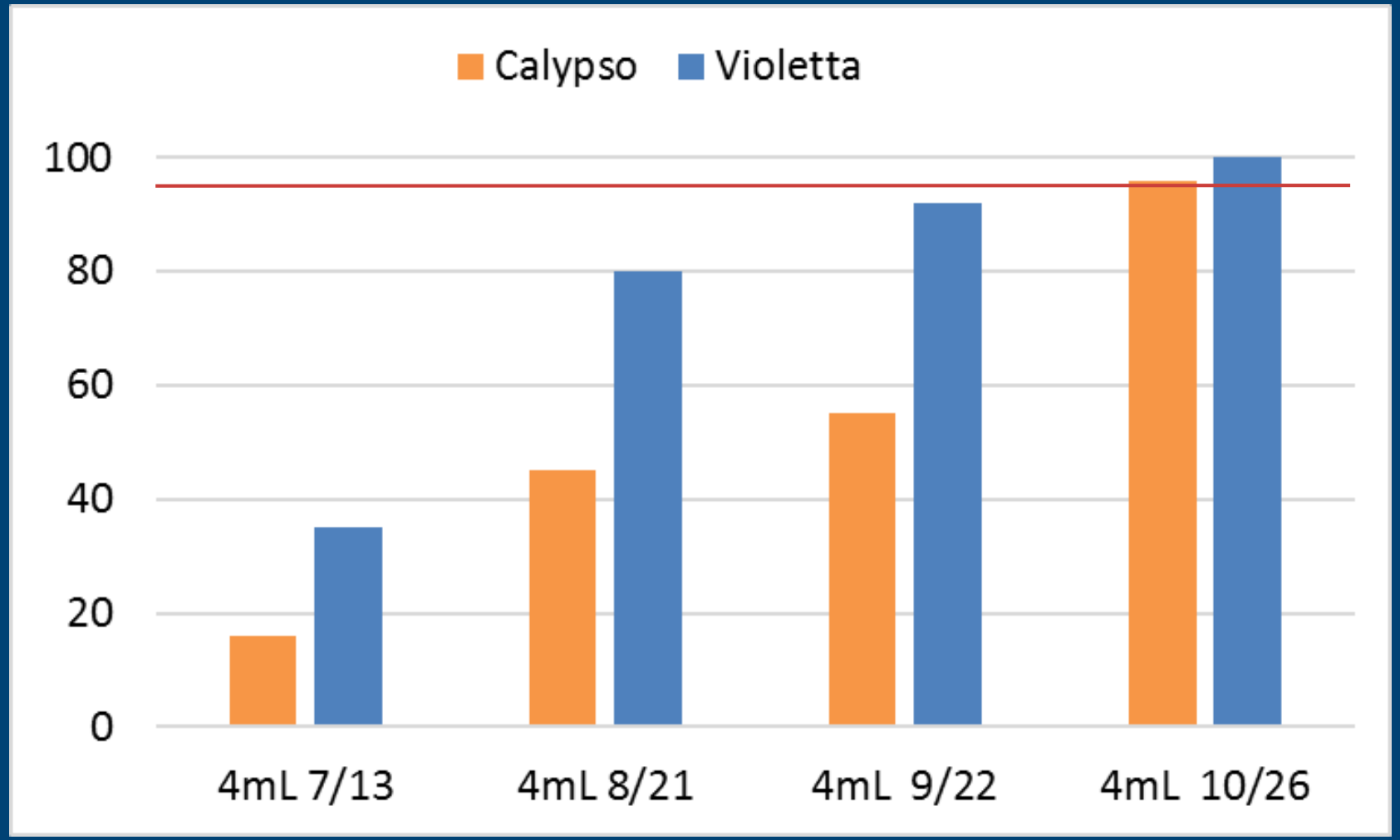
Germination & Dormancy - 2017



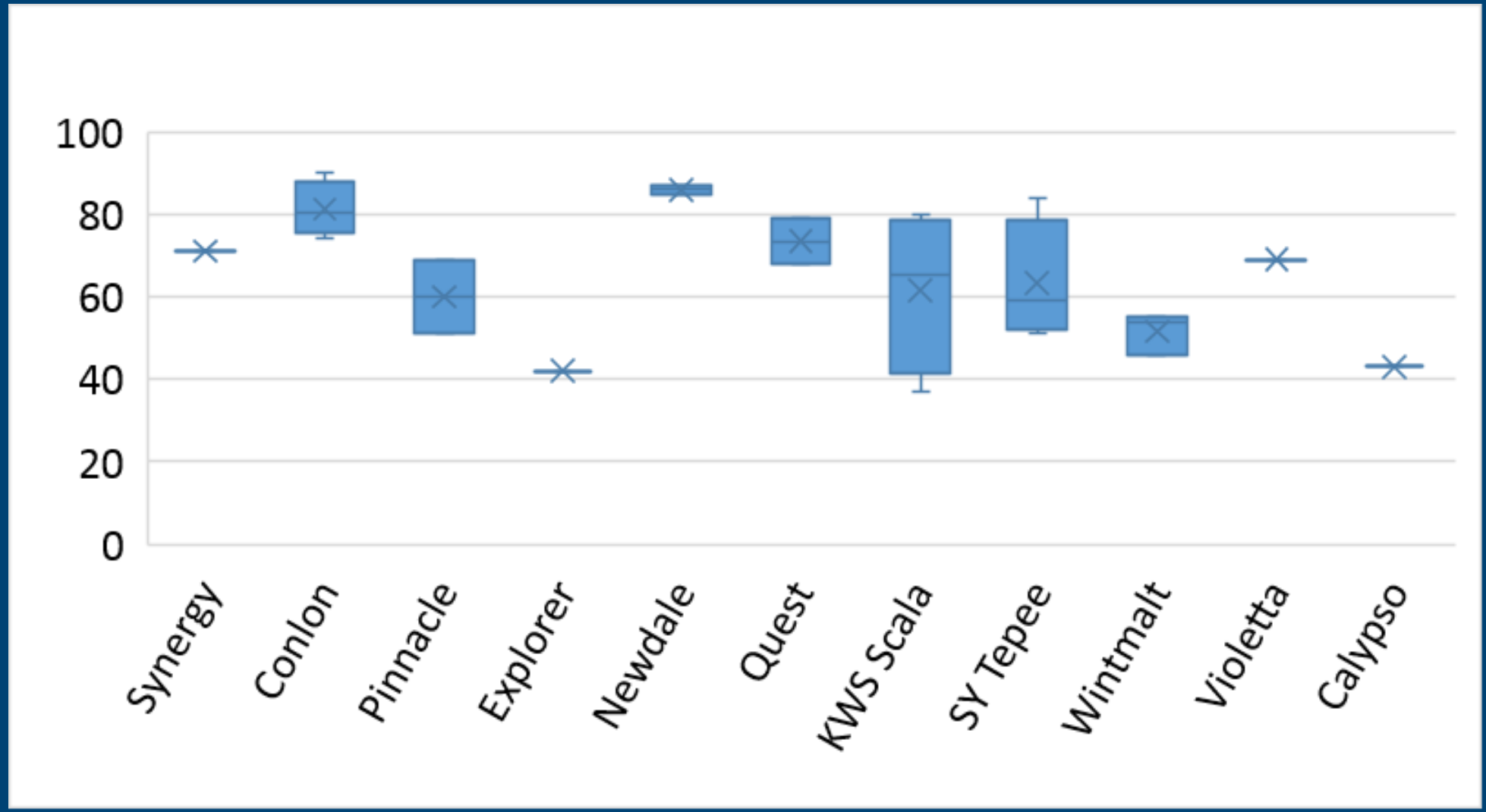
Is cleaning a solution?

	Germination Energy %
> 7/64"	76
>6/64"	81
>5/64"	78
<5/64"	61

Dormancy Break



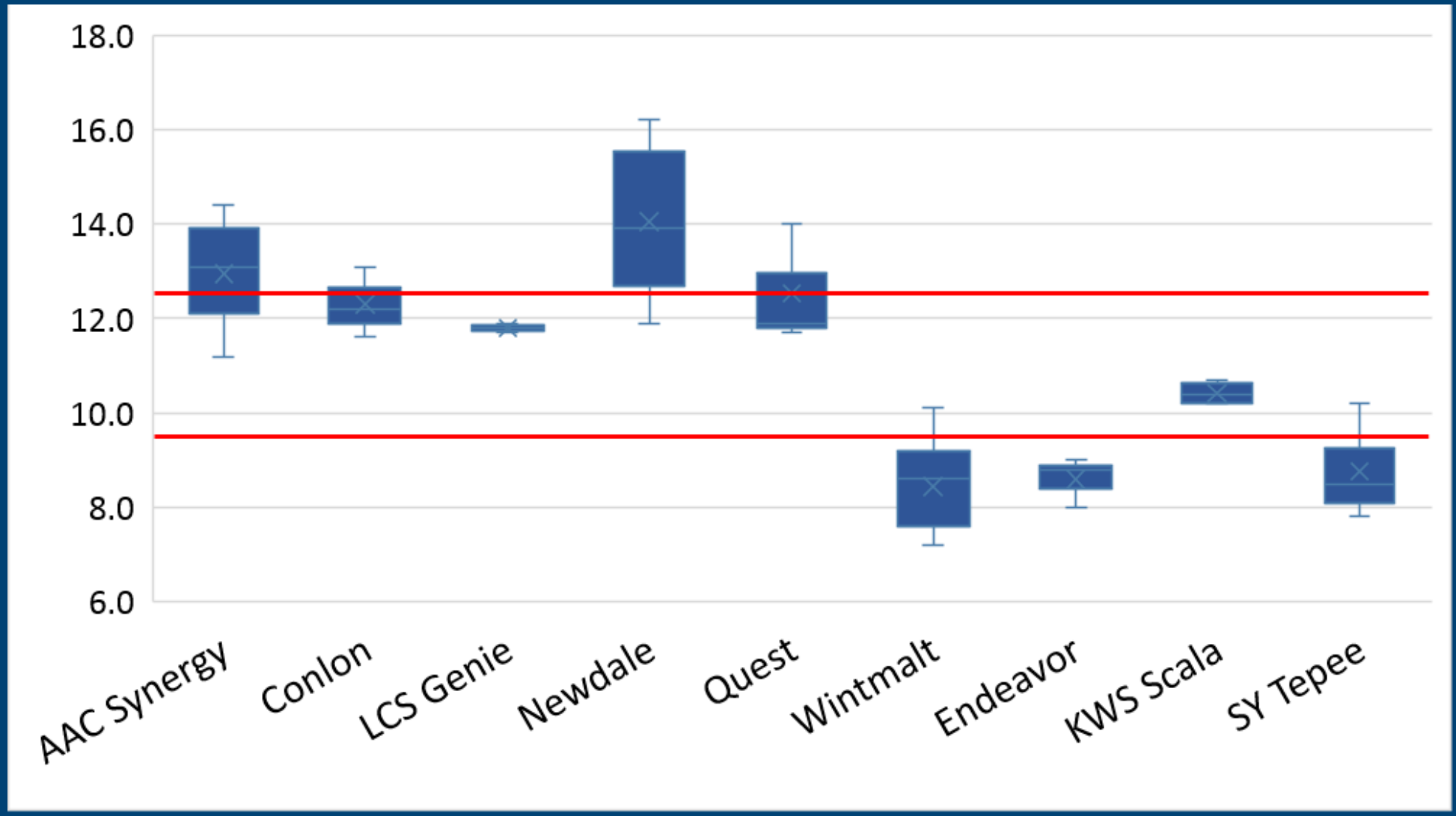
Water Sensitivity - 2017



Vigor vs Vitality

		Day 1	Day 2	Day 3	Total
Barley A	4 mL	47	51	2	**100**
	8 mL	95	3	0	**98**
Barley B	4 mL	33	91	3	**97**
	8 mL	31	22	8	**61**

Protein


18.0
16.0
14.0
12.0
10.0
8.0
6.0
AAC Synergy
Conlon
LCS Genie
Newdale
Quest
Wintmalt
Endeavor
KWS Scala
SY Tepee

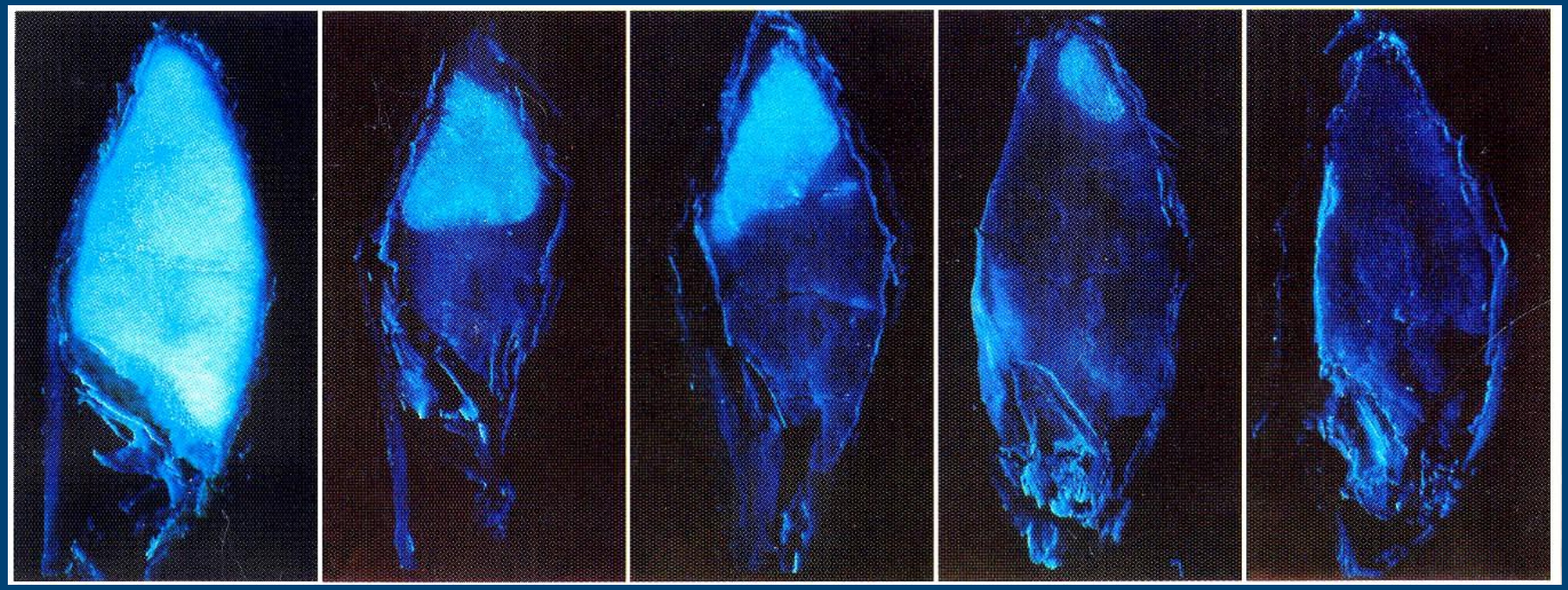
What Is Quality?

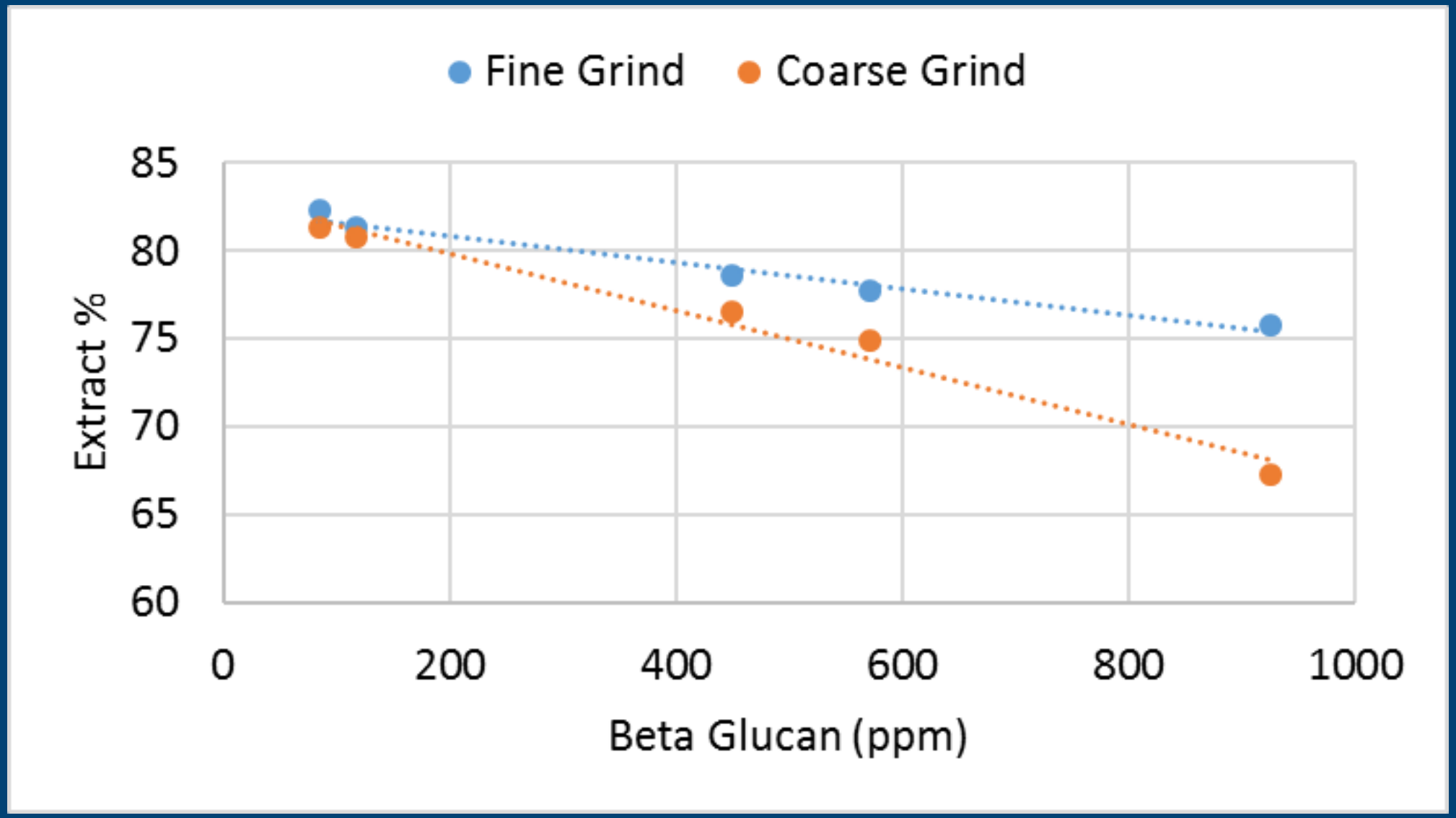
- Fitness for use
  - functional characteristics
  - Meets customer expectations
- Free from defects
  - Preforms well in the brewery
  - Safe
- Brand Values
  - the *art* of malting
  - Distinctive, innovative, local, sustainable, flavorful

What do brewers need?

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

Endosperm modification




Fine Grind
Coarse Grind
85
80
75
70
65
60
Extract %
0
200
400
600
800
1000
Beta Glucan (ppm)

Endosperm Modification

- Barley genetics
- Kernel hydration
- Germination moisture/temperature/time

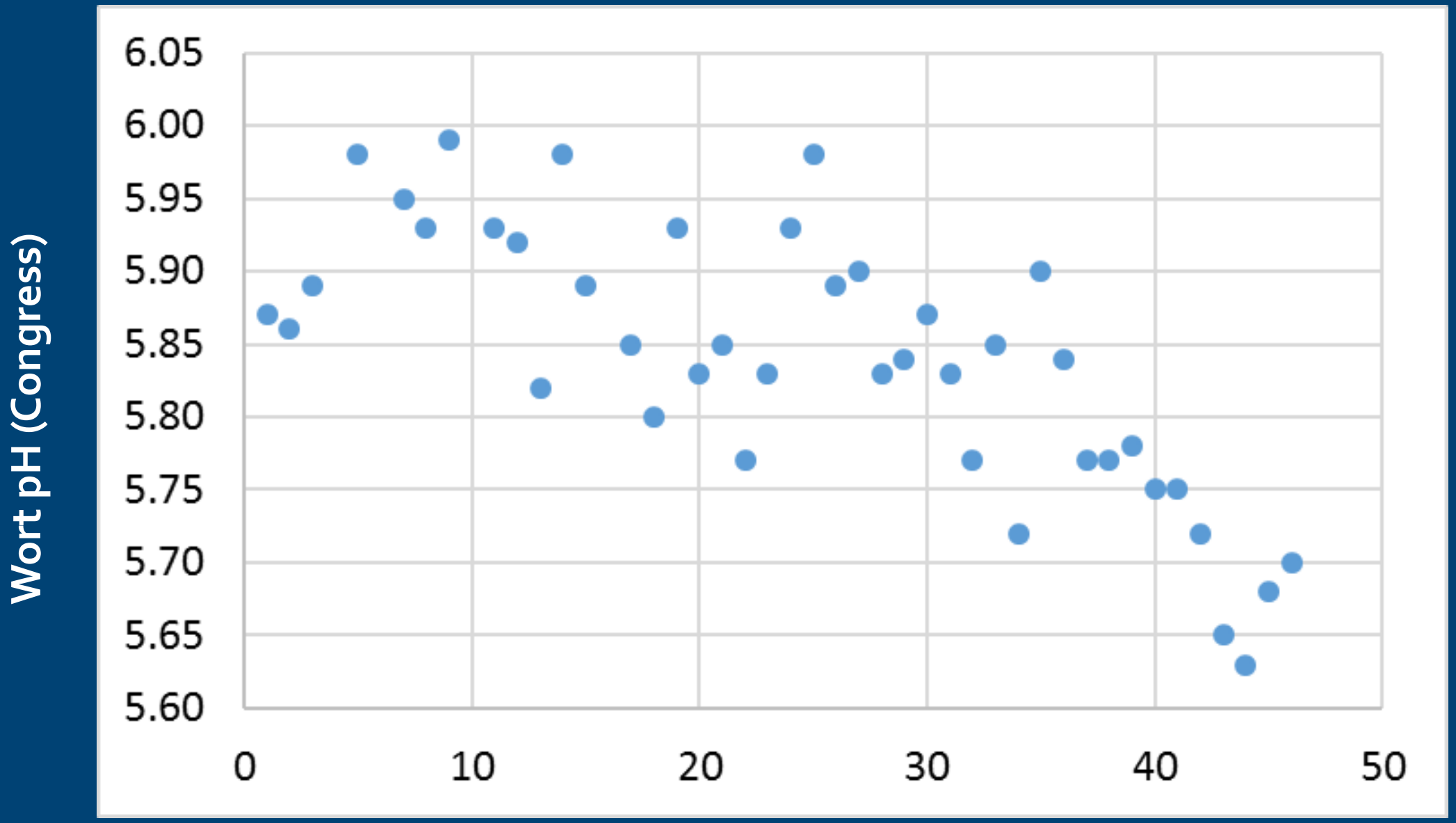

500 ml
PYREX
USA
1
500 ml
PYREX
USA
18

Haze

- Undermodified (high beta-glucan)
- Low alpha amylase (dextrin haze)
- Too low S/T
- Too high S/T
- Microbial activity
  - High CO_2, high temperature germination

Wort pH

- Normal range for base malt 5.80 – 6.10
- Lower for higher color malts (this is normal)
- Sign of anaerobic respiration in germination
  - Poor airflow
  - Dead kernels


Wort pH (Congress)
6.05
6.00
5.95
5.90
5.85
5.80
5.75
5.70
5.65
5.60
0
10
20
30
40
50

Nitrosamines

- NDMA in barley malt at levels greater than 10 ppb is considered avoidable contamination under section 406 of the Federal Food, Drug, and Cosmetic Act.
- The action level of 10 ppb NDMA in barley malt applies to all barley malt produced after October 1, 1980
- Actionable if a composite of 10 subsamples of finished product barley malt contains greater than 10 ppb NDMA
- Action levels represent limits at or above which FDA can take legal action to remove products from the market.

Nitrosamines

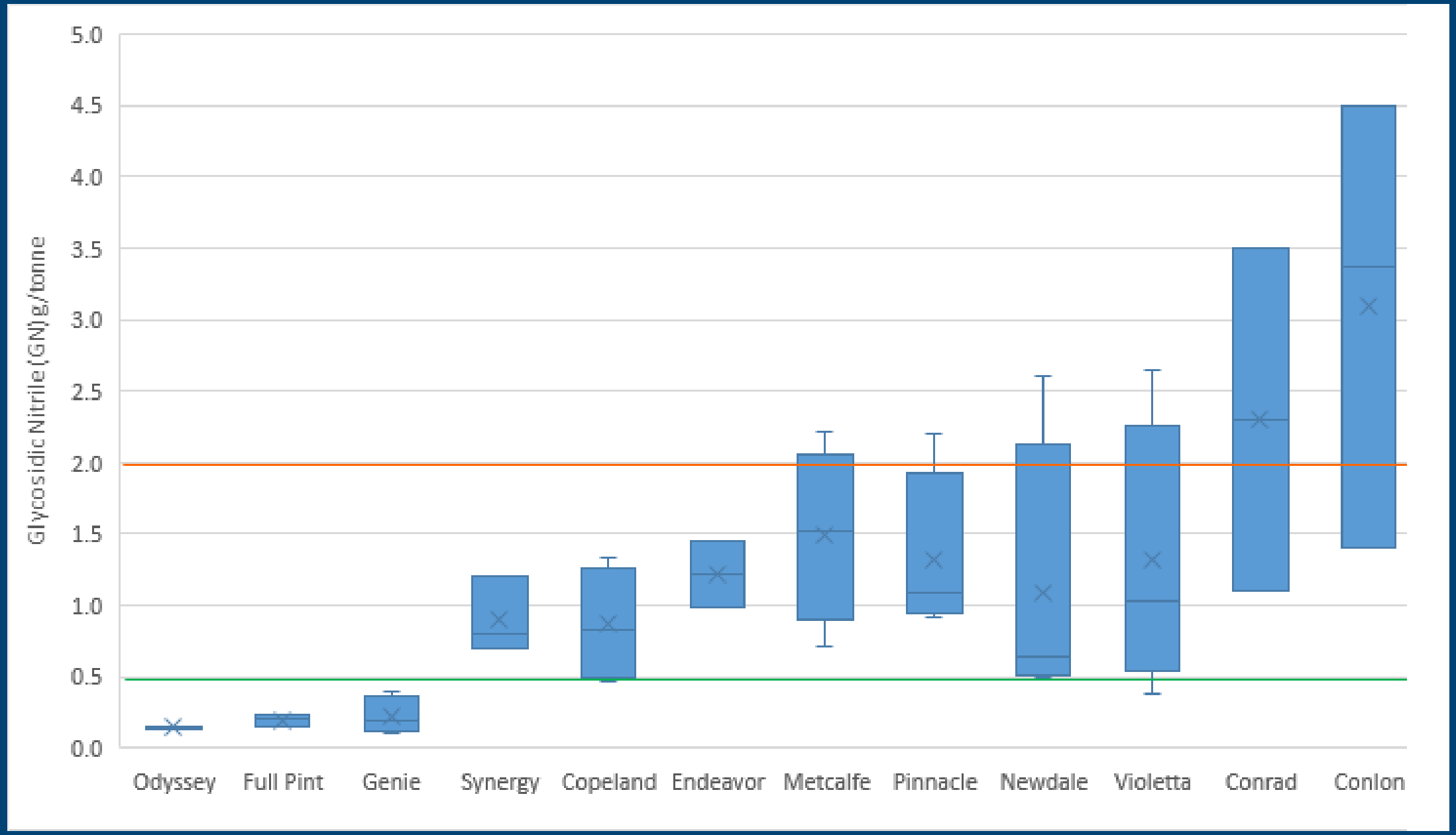
- Risk Factors
  - Direct fire kilning
  - Industrial emissions

- Mitigation
  - Indirect fire kilns
  - Low NOx burners
  - Burn sulfer in the kiln

Glycosidic Nitrile

- Risk Factors
  - Barley genetics
  - All malt spirit production
  - Copper stills

- Mitigation
  - Non-GN producing or Low GN varieties
  - Malting conditions (low temp, low moisture, short germination)


5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
Glycosidic Nitrile (GN) g/tonne
Odyssey
Full Pint
Genie
Synergy
Copeland
Endeavor
Metcalfe
Pinnacle
Newdale
Violetta
Conrad
Conlon

	Crisp Marris Otter	Simpsons Golden Promise	Weyerman Pale Ale	Rahr 2-Row
Moisture, %	3.1	4.4	4.8	4.8
Extract, %	81.8	81.2	81.0	81.8
Protein, %	9.4	9.6	11.0	11.6
Friability, %	94.3	94.5	87.2	85.6
Color, °L	4.3	3.2	3.95	2.2
Kolbach, S/T %	47.1	46.7	39.5	43.0
FAN	154	192	148	187
β-glucan. %	212	64	114	118
Diastatic Power, °L	75	100	105	140
α-amylase, DU	40.0	53.2	59.5	63.0

Beyond the numbers…

- *"If you want something different, then it isn't going to be the same"*

-J.Sahler, Strong Rope Brewery

Contact us!

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www.hartwick.edu/craftfoodandbeverage