Canadian Grain Commission | Commission canadienne des grains

A review of malting barley development in Canada

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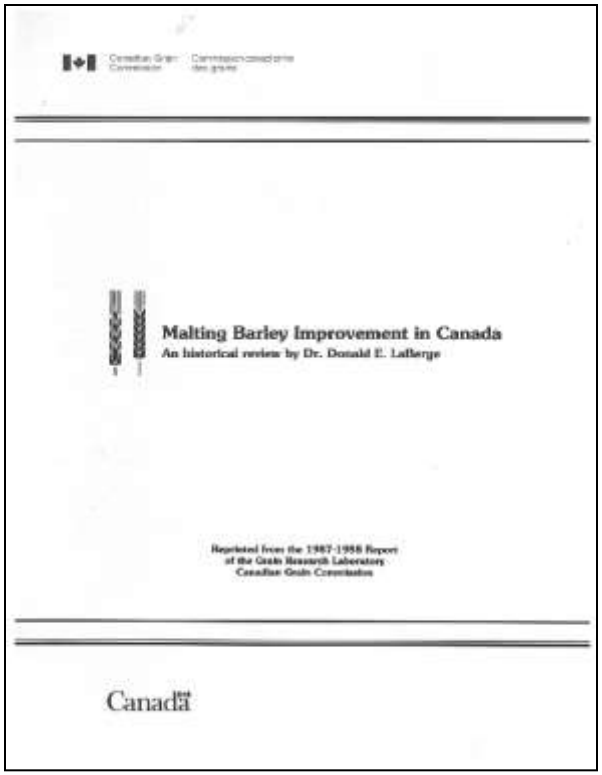
Canada



MJ Edney, AJ MacLeod and DE LaBerge
Evolution of a quality testing program for improving malting barley in Canada
Canadian Journal of Plant Science 2014

Outline for the presentation

- Early barley assessment - OAC 21
- Laboratory malting - Olli
- Comparative testing and check cultivars
  - Montcalm, Parkland
- Expansion of malt analysis - Bonanza
- Refining malt analysis
  - Harrington, AC Metcalfe, CDC Copeland
- Future directions for quality evaluation

Early history of malting barley in Canada

- English landraces:
  Thorpe and Chevrier
- Quality evaluated with simple sensory tests

OAC 21: The first true selection in Canada

- Selected as a single plant from Manchurina in 1890's (Guelph, Ontario)
- Selection based on lodging and yield
- OAC 21 most widely grown across the country
- Domestic malting industry identified OAC 21 as western Canada's cultivar with the greatest malting potential (1920)

History of CGC's standard malting cultivars

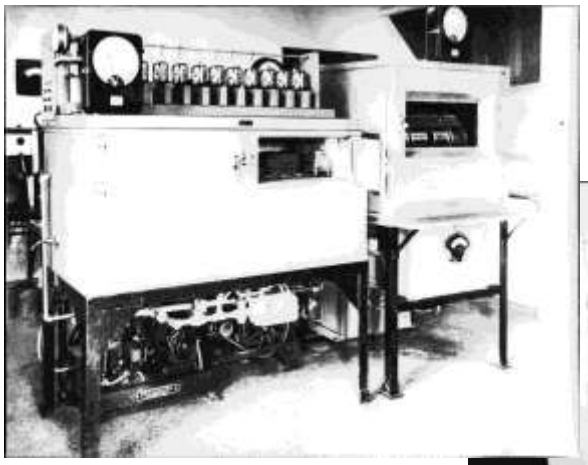
Two-rowed barley		Six-rowed barley	
Year	Variety	Year	Variety
1930	Thorpe	1930	OAC 21
1971	Betzes	1971	Conquest
1985	Klages	1985	Bonanza
1993	Harrington	2001	B1602

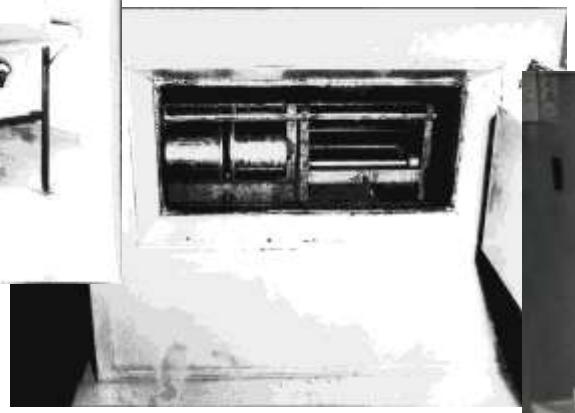
**Standard variety replaced by eligibility list in 2004*

Early comparative testing (compared to OAC 21)

- Malting began in 1929 at the University of Manitoba
- All the samples malted under the same schedule
- Malt extract and diastatic power (DP) only things measured reliably and understood
- Led to release of Olli, a Finnish import (1930's) with acceptable levels of extract and high levels of DP

Evolution of micro-malting (NRC 1940's)





- Better controlled airflow to prevent drying out of the barley

Montcalm 1945

- First malting barley cultivar from a hybrid cross made in Canada
- Compared to OAC 21
  - slightly higher malt extract
  - similar level diastatic power
  - similar steeping times and malt losses

	OAC 21	Montcalm
Grain protein (% DM)	14.4	13.6
Malt extract (% DM)	75.4	76.4
DP (° Lintner)	122	129

Data Source: Western Canadian Coop Trials 1940-1945

Parkland 1956

- First cultivar bred in Canada with quality evaluation throughout development
- Compared to OAC 21
  - similar level of diastatic power
  - lower grain protein and higher malt extract

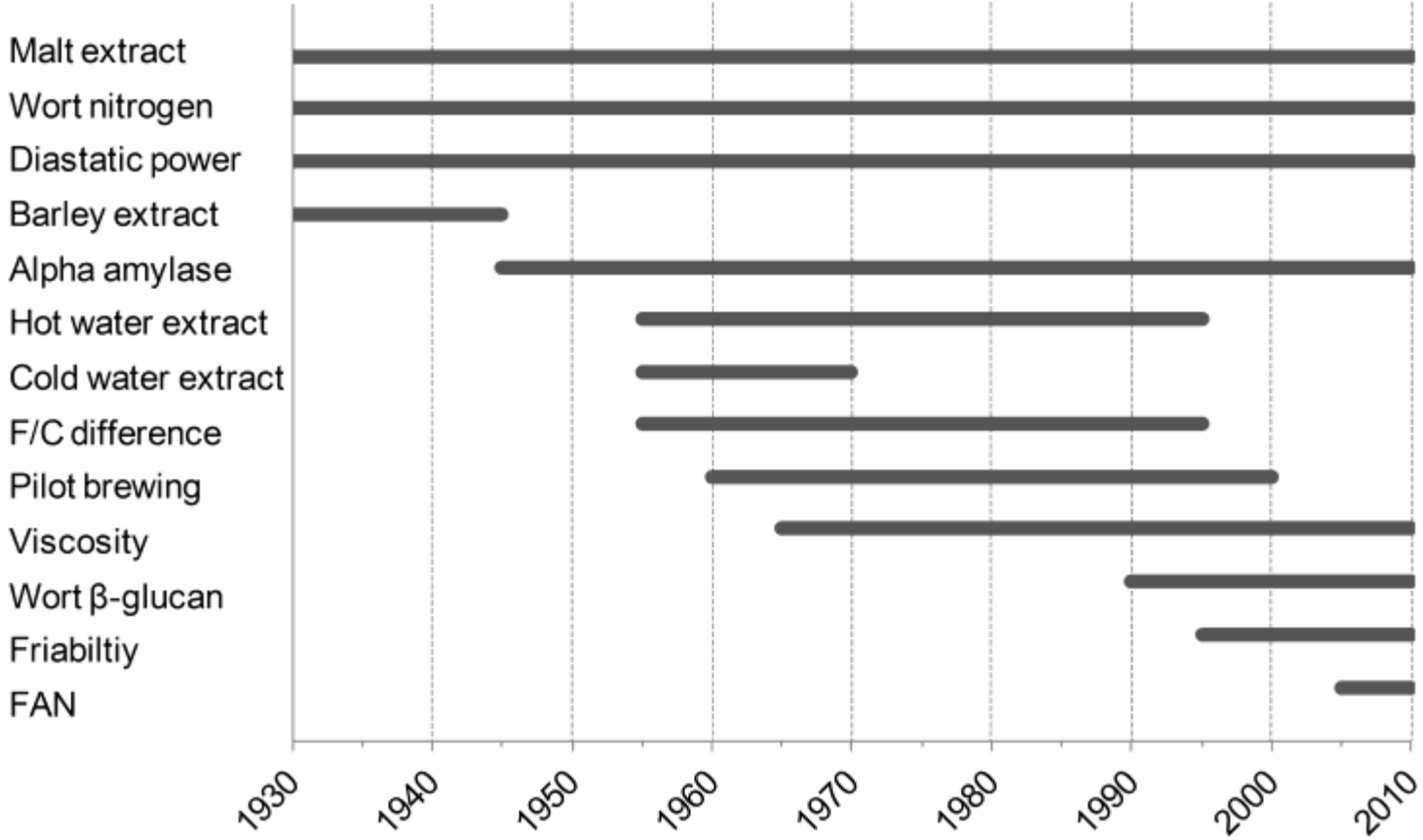
	OAC 21	Parkland
Grain protein (% DM)	15.1	14.4
Malt extract (% DM)	73.1	74.7
DP (° Lintner)	154	151

Data Source: Western Canadian Coop Trials 1951-1956

Refining malt analysis:
Dawning of the Age of Gums (1950's)

- Bass, Meredith & Anderson 1952
  Enzymes that degrade barley gums
  I Isolation from a bacterial source
  Cereal Chem. 29:262-272
- Fine-coarse malt extract difference
- Wort viscosity
- Kolbach index
  - now used specifically for protein modification

Timelines for methods used to evaluate malt quality of barley cultivars for western Canada



Pilot-scale malting and brewing (1950's)

- Malting done by industry as well as GRL
- Brewing done by BMBRI and industry

Bonanza 1970

- Last commercially successful blue-aleuroned, six-rowed malting barley
- - low grain protein and high extract combined with high levels of DP and alpha-amylase
  - faster processing

	Conquest	Bonanza
Grain protein (% DM)	15.2	14.3
Malt extract (% DM)	76.2	77.3
Fine/coarse difference	2.8	2.9
DP (° Lintner)	172	170
α-Amylase (DU)	25.2	22.5

Data Source: Western Canadian Coop Trials 1967-1968

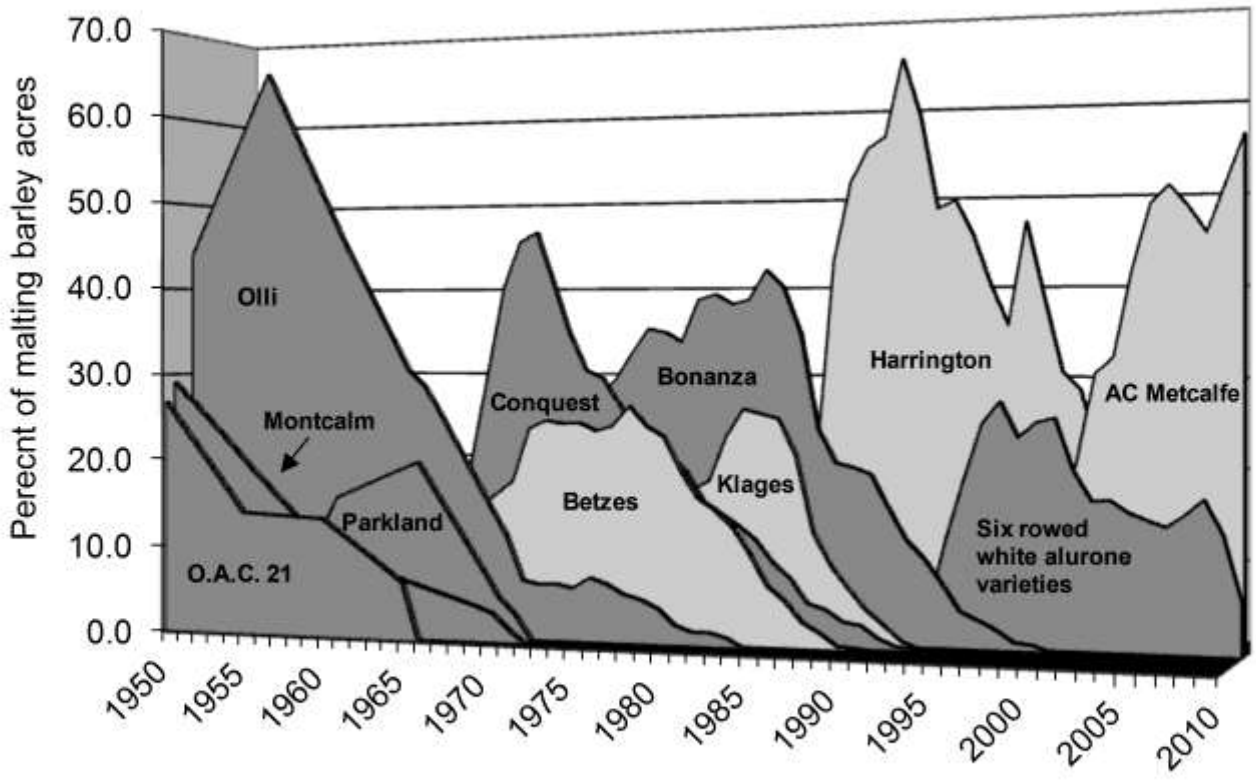
Six-rowed, white-aleuroned malting barley

- B1602, Robust, Excel, Legacy
- High levels of diastatic power and α-amylase
- Combined with high levels of soluble protein

	Bonanza	B1602
Malt extract (% DM)	76.1	77.7
Kolbach Index (%)	39.2	42.8
DP (° Lintner)	206	212

Data Source: Western Canadian Coop Trials 1986-1988

Sixty years of Canadian malting barley cultivars



Data Source: Line Elevator Association & Canadian Wheat Board variety surveys

Developing world class two-rowed malting barley for Canada

Canadian malting industry said (1960) :

"If Canada is to become a consistent supplier of malting barley and barley malt on world markets, we must develop two-rowed barley cultivars that can produce good quality malt……."

"……quality to include high levels of malt extract combined with high levels of starch-degrading enzymes and an ability to process quickly."

Three significant steps in developing two-rowed malting cultivars for the prairies

Betzes → **Klages** → **Harrington**

- Polish cultivar imported via US (1960)
- Quality approaching six-rows
- Early maturity
- Grown in dry land areas

- American-bred cultivar
- Two-rowed acres increased with better quality and agronomic traits (1970)

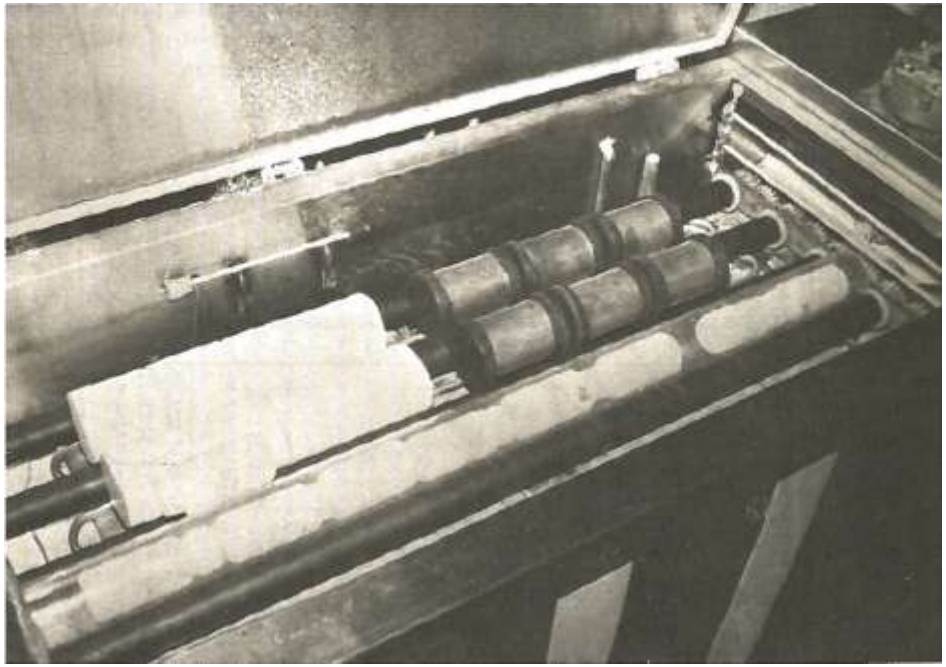
Harrington 1982

- Low protein cultivar with good extract and modification
- Also had high levels of starch-degrading enzymes

	Betzes	Klages	Harrington
Grain protein (% DM)	14.4	13.6	12.9
Malt extract (% DM)	75.8	79.0	79.8
Fine coarse difference	12.6	8.5	7.3
DP (° Lintner)	83	99	119
α-Amylase (DU)	24.7	42.6	47.5

Data Source: Western Canadian Coop Trials 1978

Beginnings of the automated systems



- First automated system designed and built at the Cereal Breeding Laboratory, Winnipeg (1960's and 70's)

Invasion of the Australians: Modern, automated (lab-scale) maltings

Phoenix Micromaltings

Joe White Maltings

- Endosperm modification more consistent and reproducible
- Improved ability to measure endosperm modification (wort ß-glucan and friability)

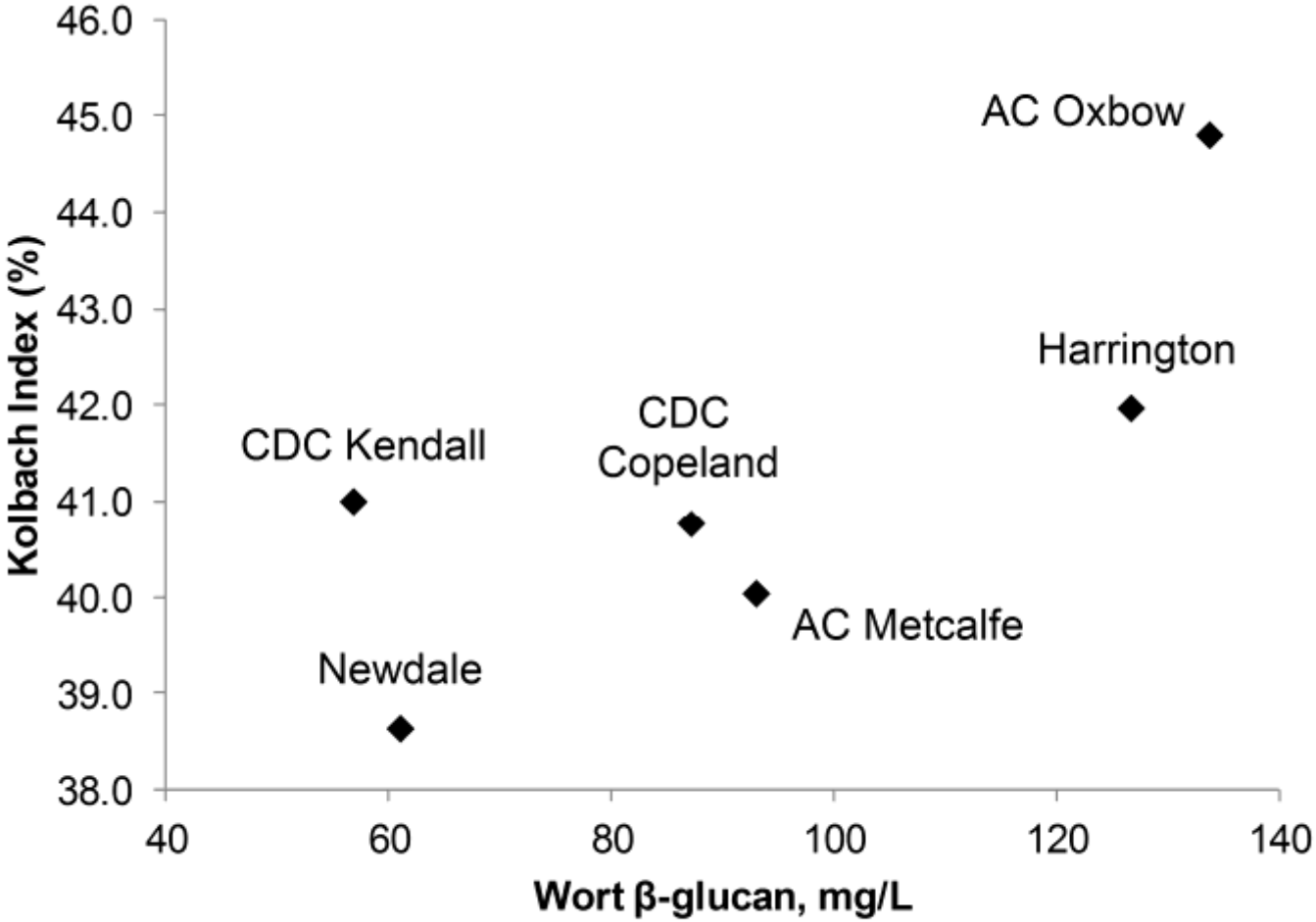
New technology and changing quality specifications

Mash filters

- **Processing more affected by ß-glucan**

Microfiltration of beer

Balance modification



Data source: CGC harvest survey quality bulletins

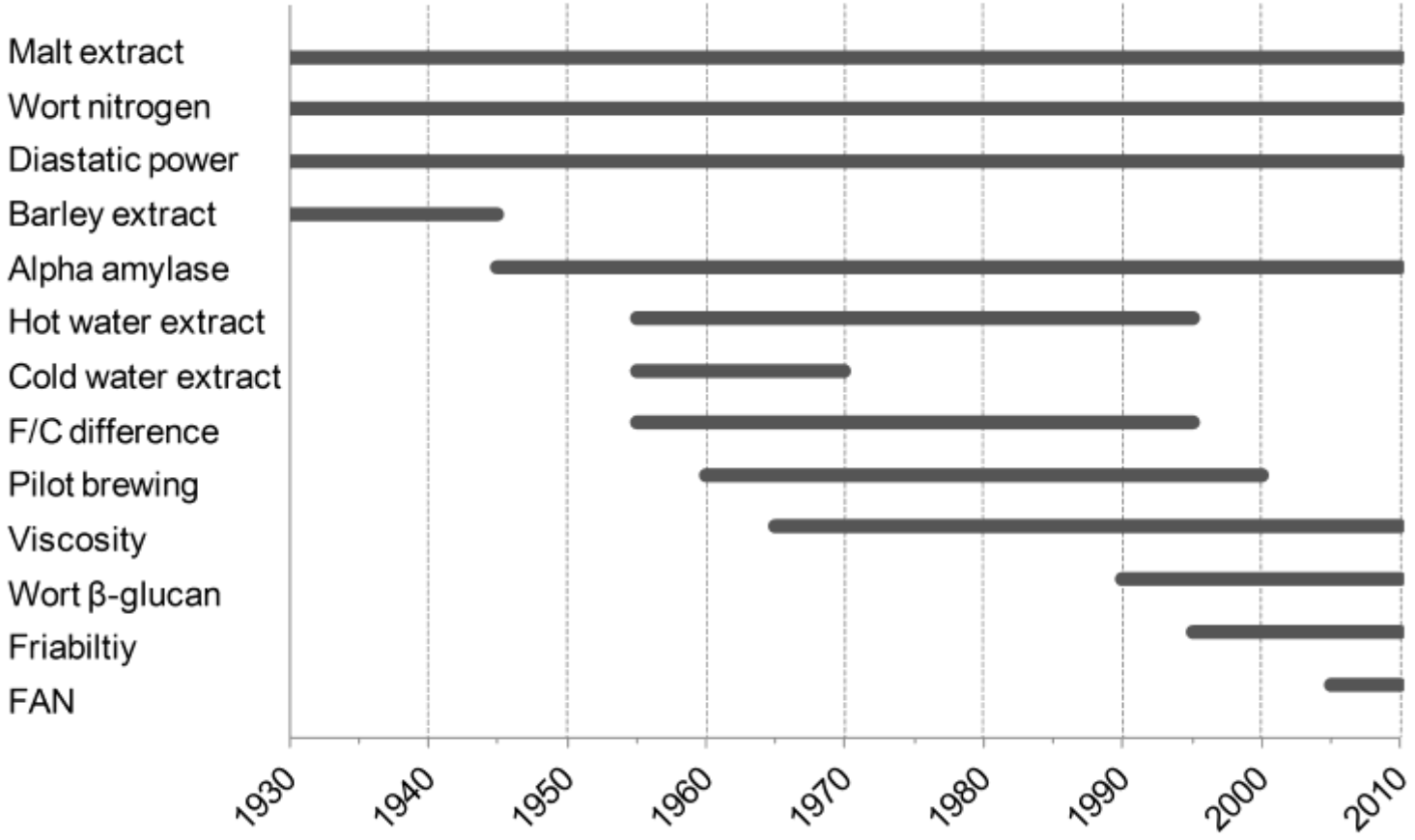
AC Metcalfe 1994 / CDC Copeland 1999

- **AC Metcalfe: Good enzyme potential combined with high extract and balanced modification**
- **CDC Copeland: Good level of friability**

	Harrington	AC Metcalfe	CDC Copeland
Malt extract (% DM)	79.5	79.9	79.5
Kolbach Index (%)	39.4	39.2	39.5
Wort ß-glucan (mg/L)	162	96	76
Friability (%)	82	77	84
DP (° Lintner)	125	145	125
α-Amylase (DU)	54.4	62.2	48.4

Data Source: CGC Malting Barley Harvest Survey 2004-2009

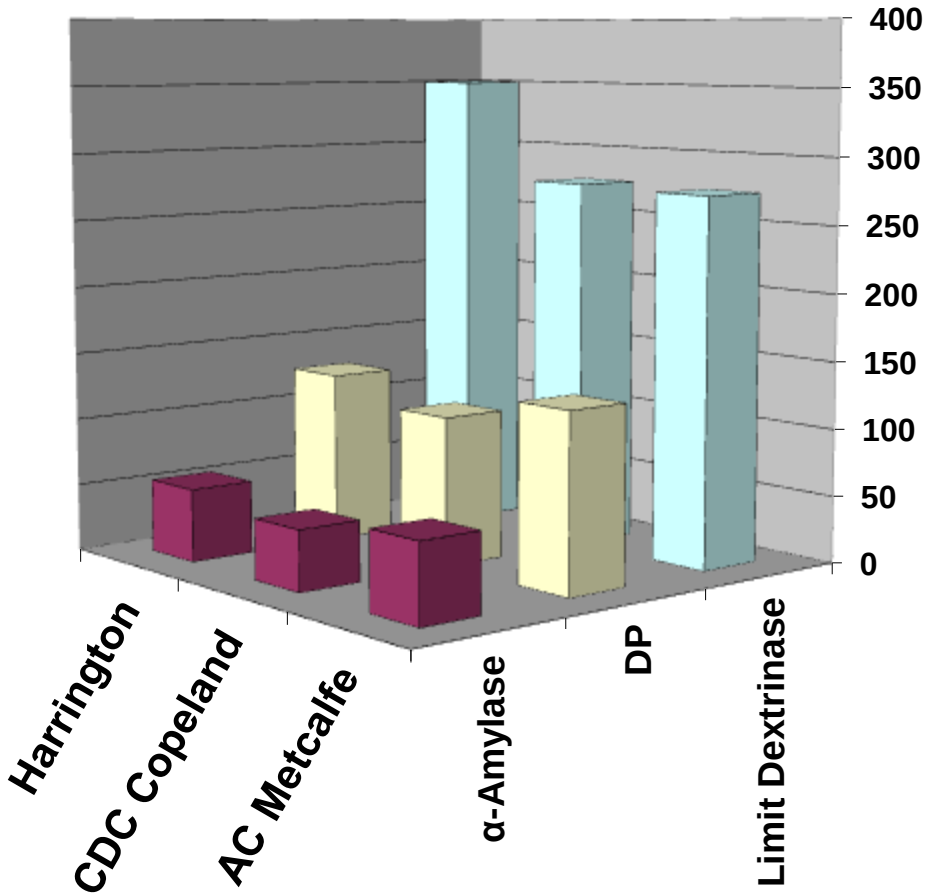
The changing of analyses used for registering malting barley cultivars



The Future

- Does knowledge of individual starch-degrading enzymes provide more information?

The Harrington advantage: Limit dextrinase



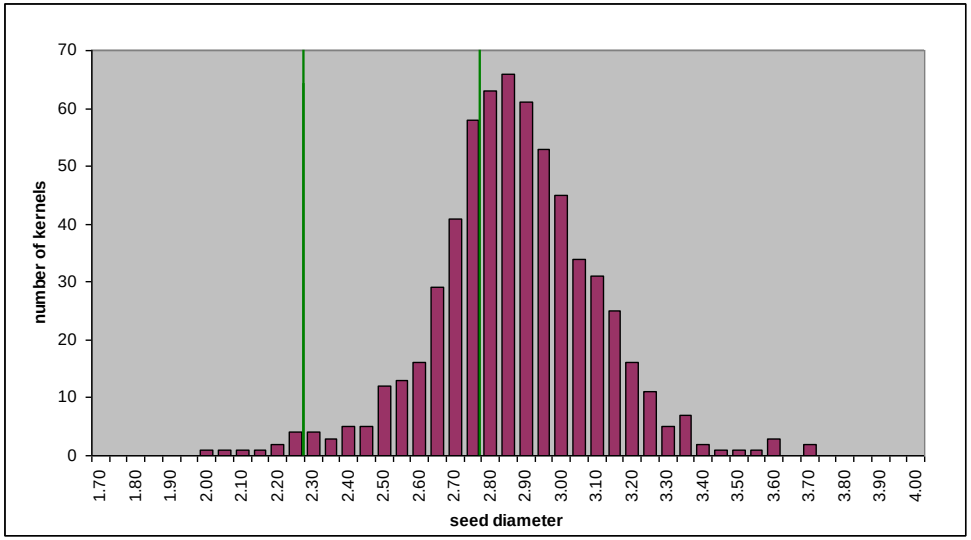
Data Source: CGC Malting Barley Harvest Survey 2004-2009

The Future

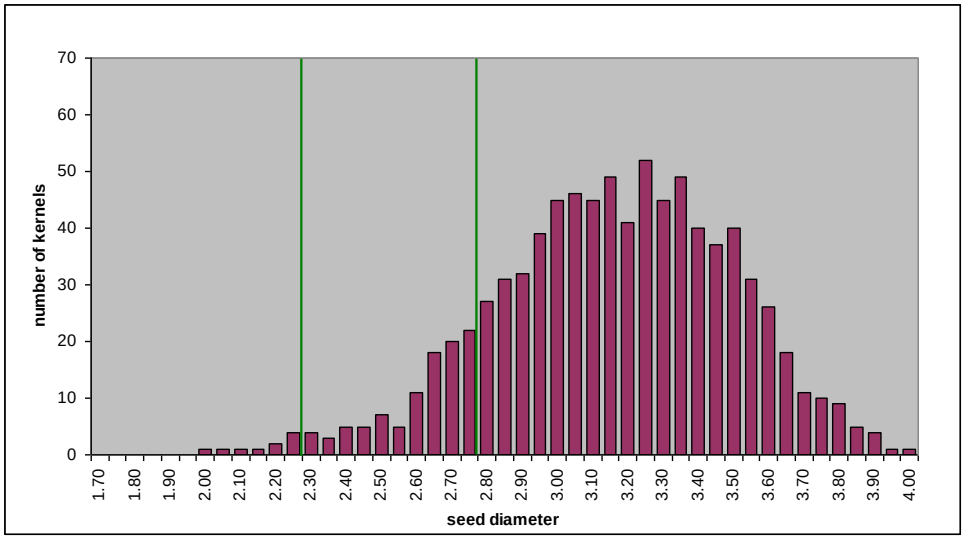
- Does knowledge of individual starch-degrading enzymes provide more information?
- Homogeneity of kernel size versus percent plump

Advantages of measuring homogeneity of barley size versus kernel plumpness

>7/64	>6/64
65%	95%



>7/64	>6/64
80%	95%

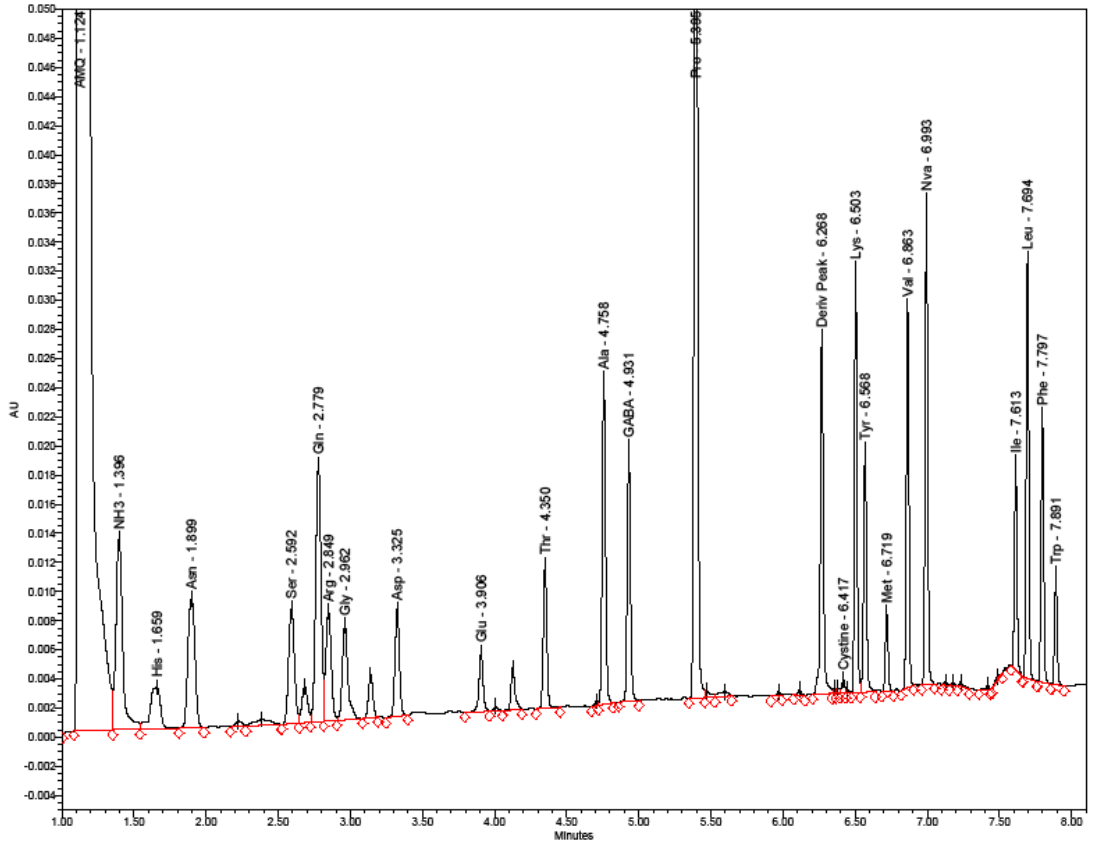


The Future

- Does knowledge of individual starch-degrading enzymes provide more information?
- Homogeneity of kernel size versus percent plump
- Beer flavour:
  Importance of individual amino acids versus FAN

UPLC and amino acid analysis

Waters UPLC system
– C18 reversed phase column



Chromatogram: derivitized wort

The Future

- Does knowledge of individual starch-degrading enzymes provide more information?
- Homogeneity of kernel size versus percent plump
- Beer flavour:
  Importance of individual amino acids vs FAN
- Markers for specific traits like:
  low lipoxygenase and low phytate barleys

Acknowledgements

- All the cooperators in the Western Canadian Barley Cooperative tests
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