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Improvement of malting barley quality and yield with agronomic practices

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Canada

Collaborating Scientists

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- Alberta Agriculture & Rural Development (AARD): P.E. Juskiw, Y. Kabeta, B. Chapman
- Canadian Grain Commission (CGC): M.J. Edney, T, Graefenham, M. Izydorczyk

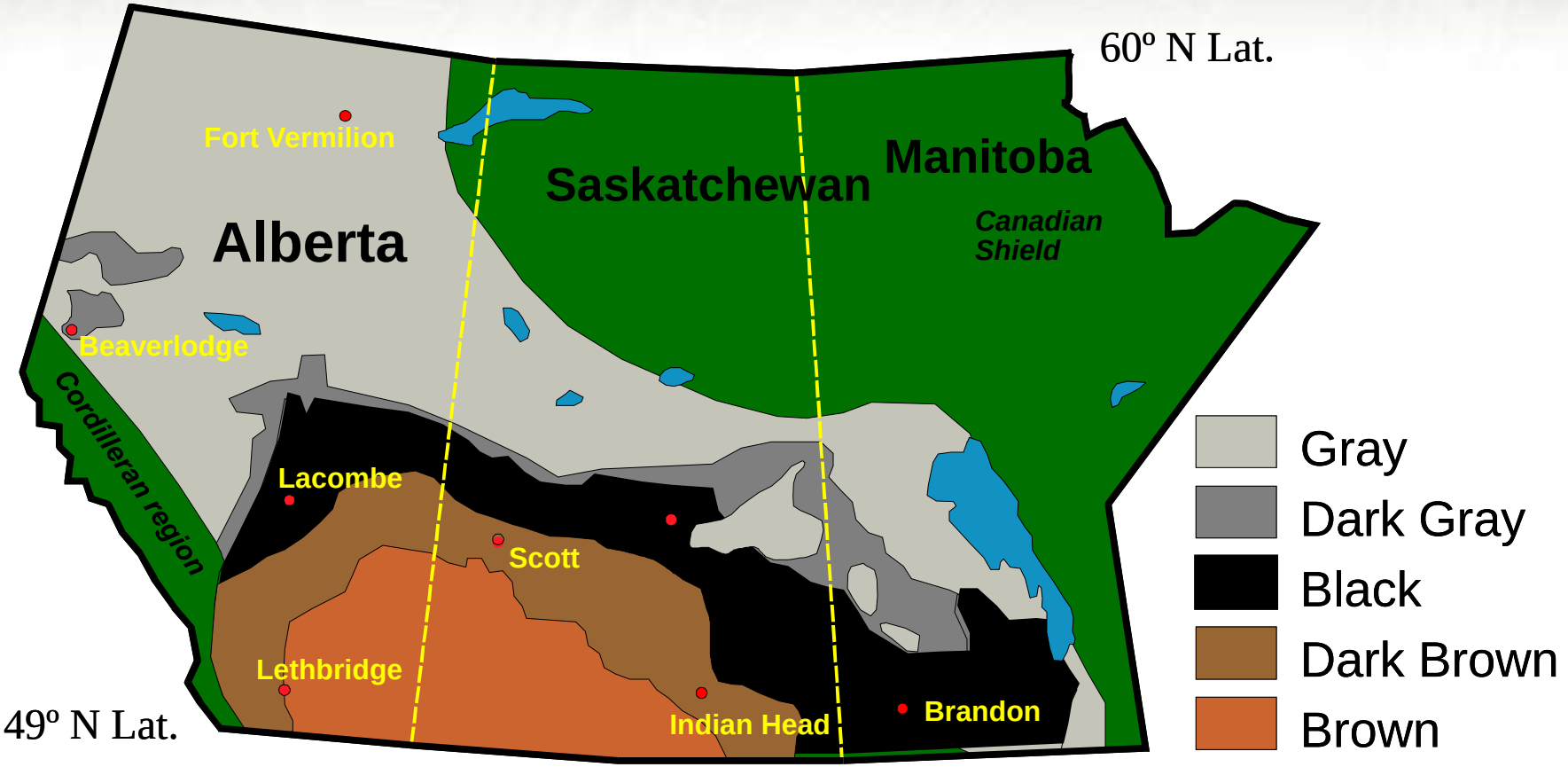
Acknowledgements –Industry Partners

- Western Grains Research Foundation
- Alberta Barley Commission
- The Canadian Wheat Board
- Rahr Malting Canada Ltd.
- Barley Malting and Brewing Research Institute
- AAFC – Barley DIAP

Acknowledgements – Technical Support

- AAFC, AARD and CGC technical staff at the various locations

Western Canadian Study Locations



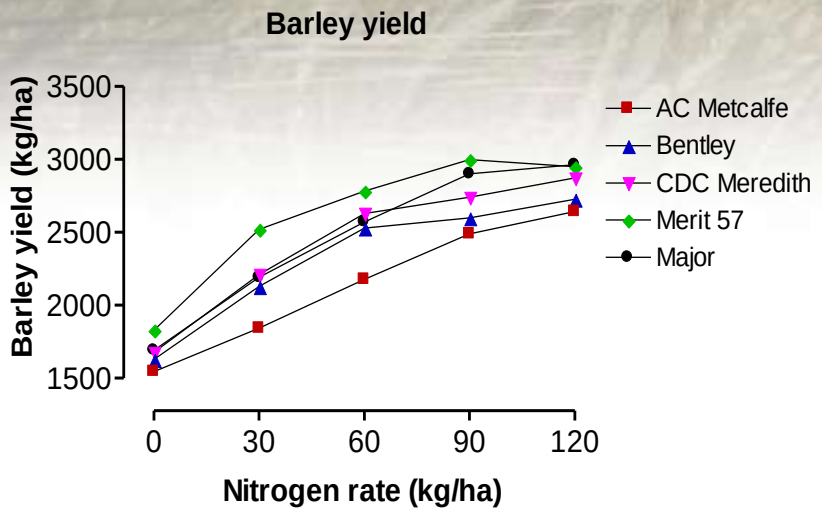
2005 to 2010

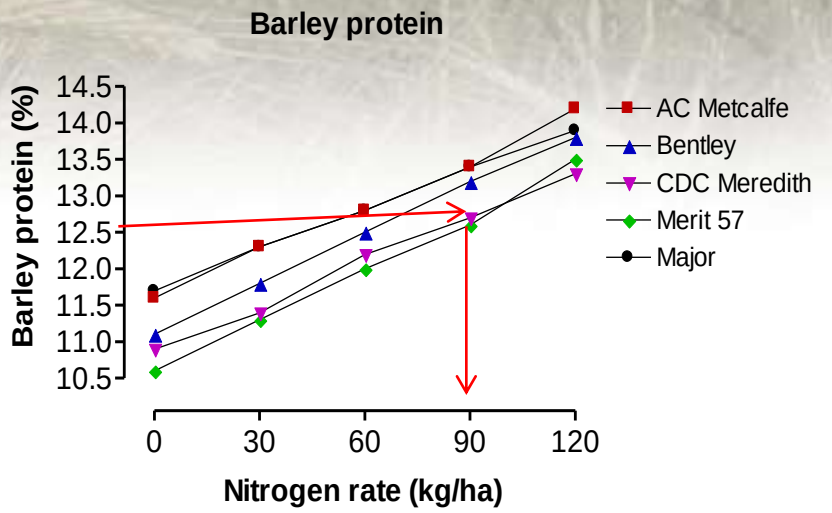
- Seeding barley relatively early reduced the risk of poor quality, especially in terms of excessive protein
- Seeding at 300 seeds/m^2 optimized yield and quality including improved kernel uniformity and improved modification
- Planting barley on barley residue resulted in reduced yield and quality and increased disease incidence compared to planting on canola or field pea
- Yields were highest when barley was planted on field pea residue, and this did not result in a significant increase in grain protein levels – inorganic N!
- CDC Copeland yielded higher than AC Metcalfe, had less protein and tended to modify better
- Recommending nitrogen rates to optimize yield and quality remained a significant challenge

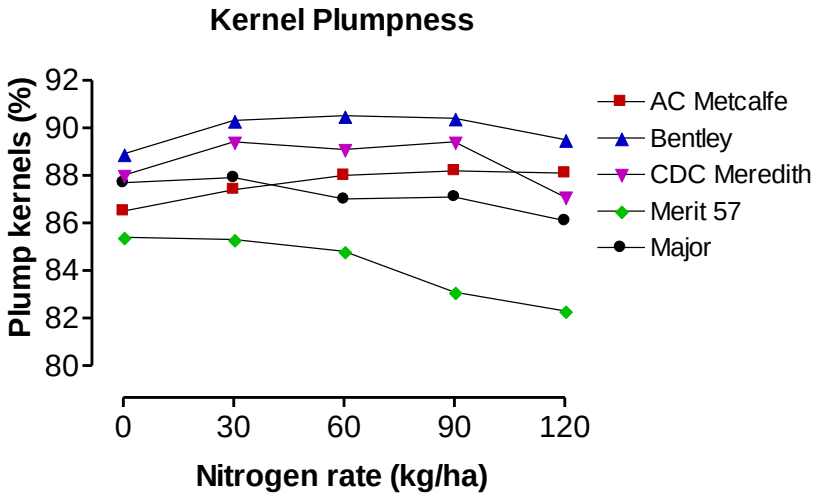
GF 1 (2010-2013). Exp. I Varietal responses to nitrogen – PI J.T. O'Donovan

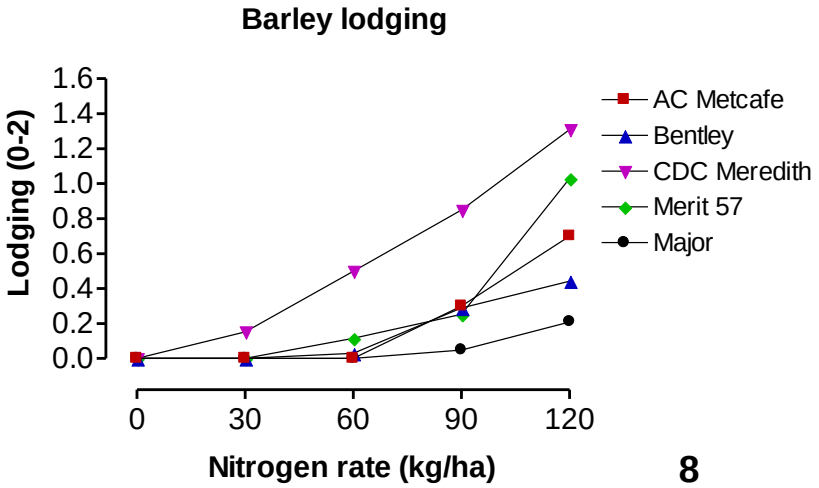
- AC Metcalfe – standard, AAFC, Brandon, MB
- Major - AAFC, Brandon, MB
- Bentley – AARD, Lacombe, AB
- CDC Meredith – Crop Development Centre, University of Saskatchewan
- Merit 57 - Busch Agricultural Resources LLC, Fort Collins, USA
- N rates, 0, 30, 60, 90, 120 kg/ha actual N

Response of malting barley varieties to nitrogen rates



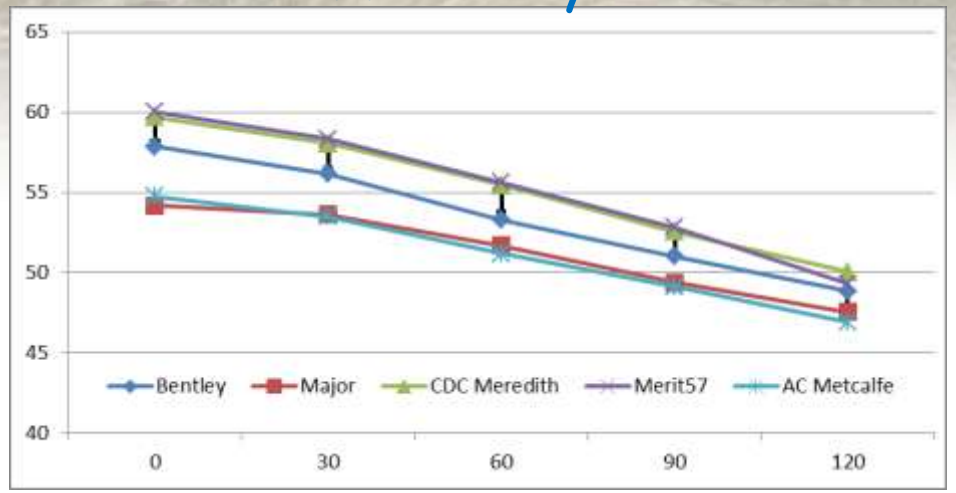




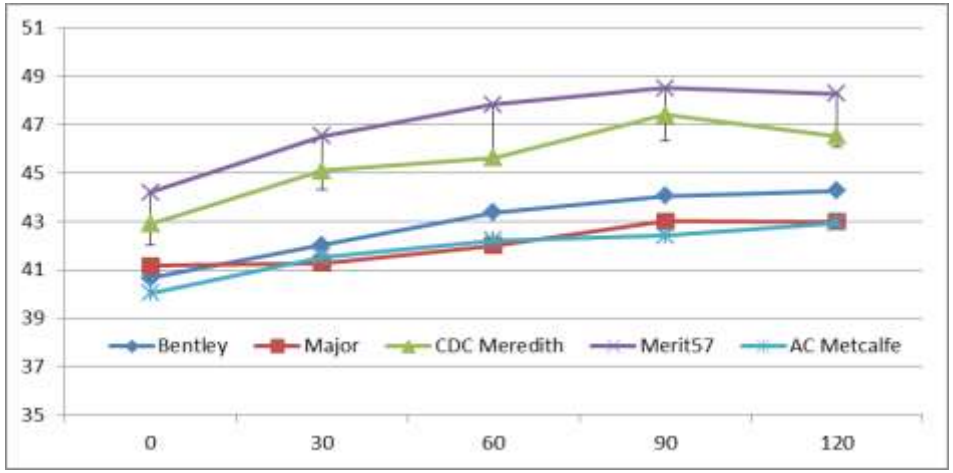


Nutrient use efficiency and chlorophyll content – Yadeta Kabeta AARD

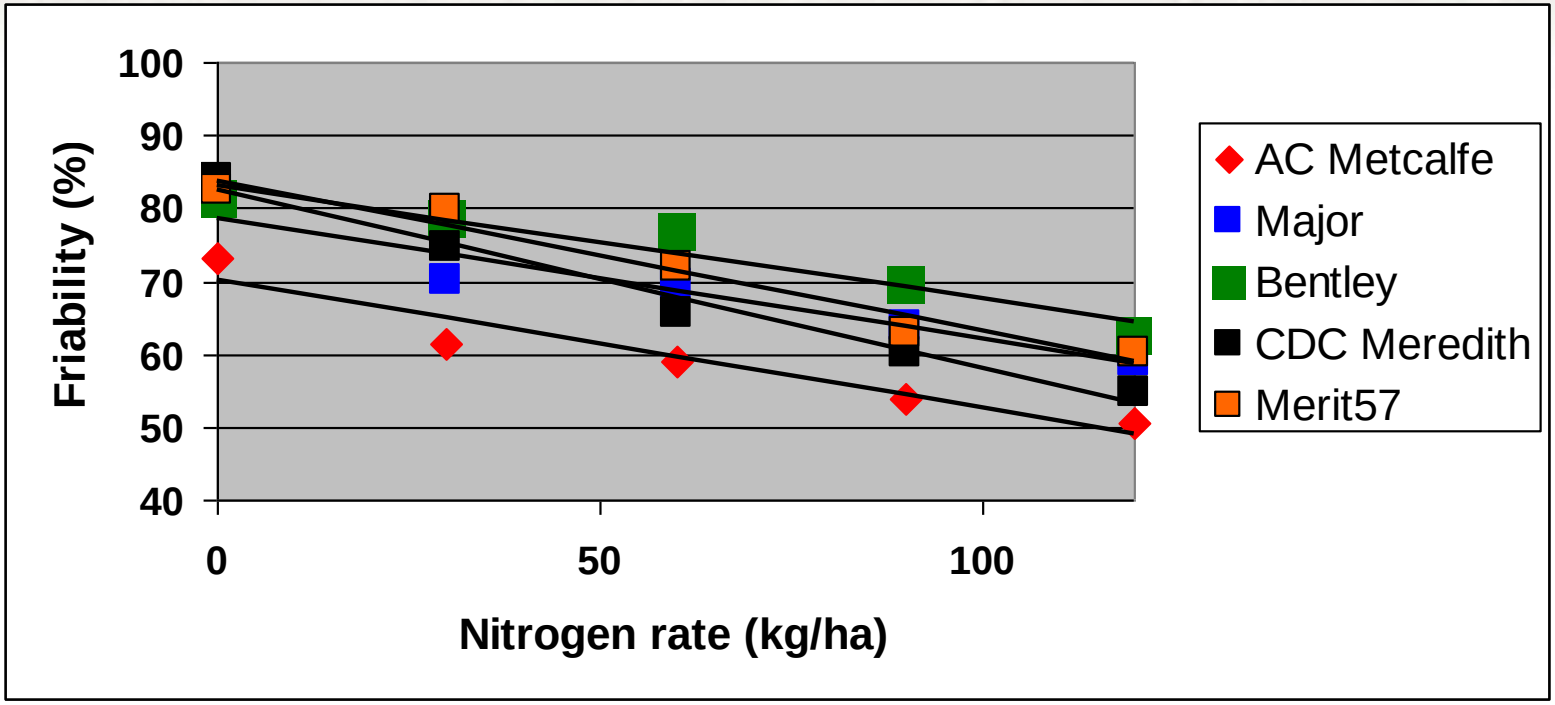
Varietal nutrient use efficiency at increasing nitrogen rates



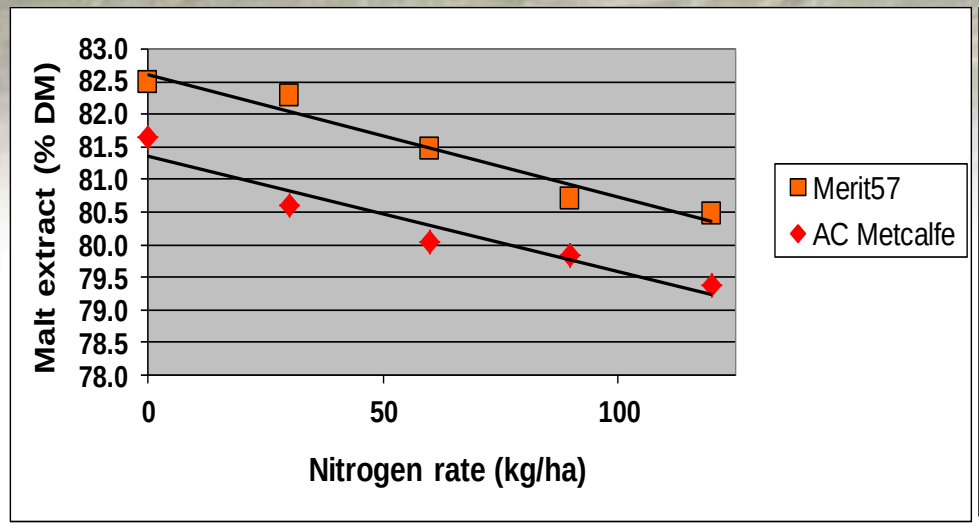
Varietal leaf chlorophyll content at increasing nitrogen rates

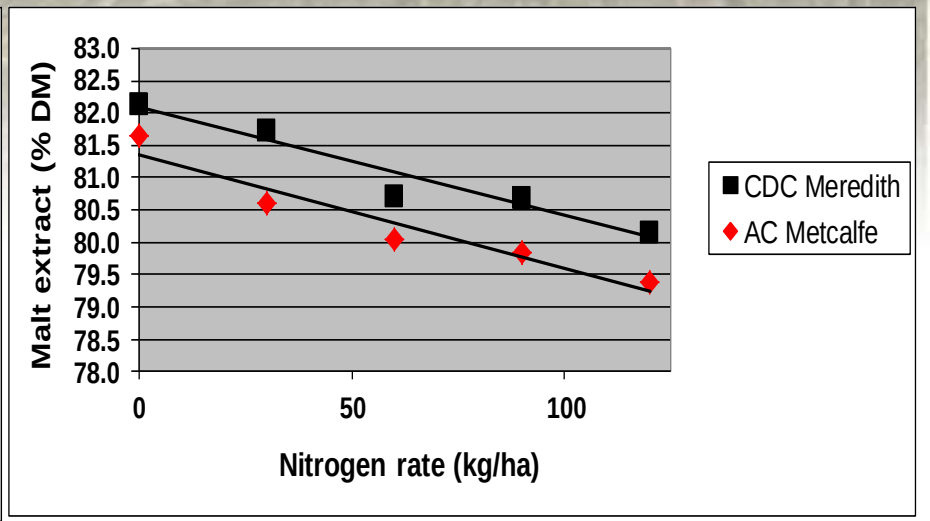


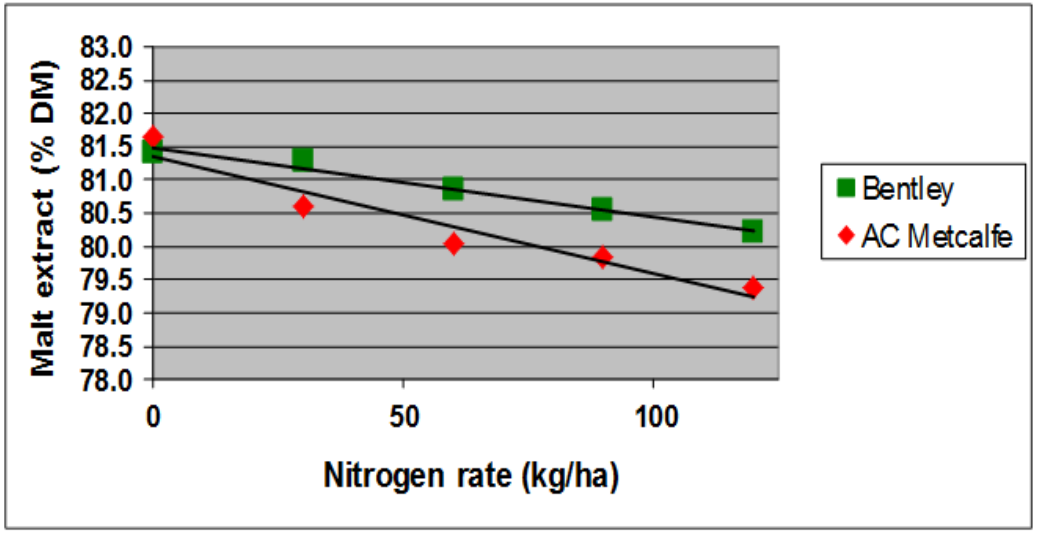
Friability of AC Metcalfe, CDC Meredith and Merit 57 at different N rates – M. Edney CGC



Extract levels of AC Metcalfe, CDC Meredith and Merit 57 at different N rates – M. Edney CGC







GF I. Exp. 2. Legume crops in rotation on malting barley yield and quality - PI J.T. O'Donovan

2009	2010	2011
Field pea (grain)	RR canola	Malt barley
Faba bean (grain)	RR canola	Malt barley
Faba bean (green manure)	RR canola	Malt barley
Lentils (Clearfield) grain	RR canola	Malt barley
Wheat (Clearfield)	RR canola	Malt barley
Canola (Clearfield)	RR canola	Malt barley

N applied at 0, 30, 60, 90, 120 kg/ha in 2010 and 2011

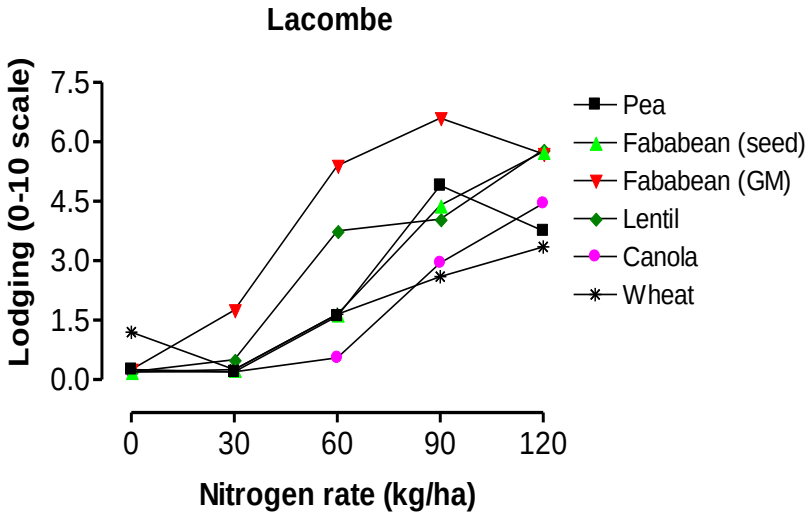
Effect of legumes in rotation on malt barley yield in 2011

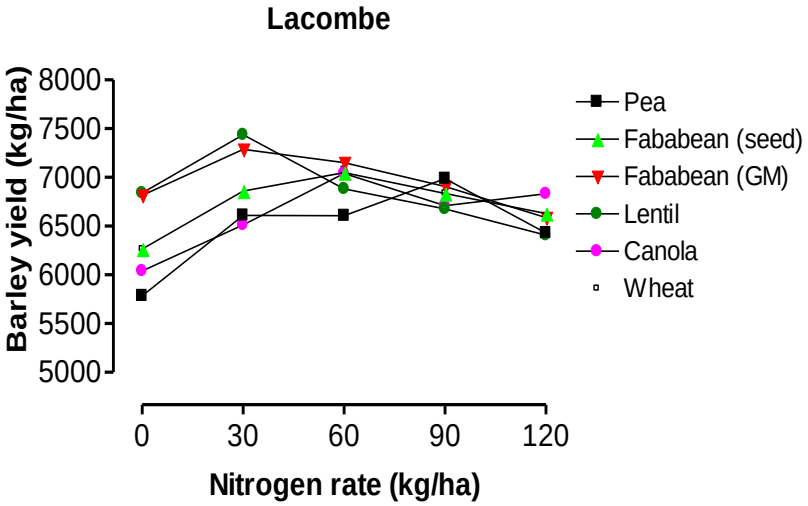
	Crop residue in 2009		
	Wheat	Pea	Lentil
Location		—T/ha—	
Beaverlodge	4.18	5.19	5.28
Lacombe	6.19	6.19	6.85
Lethbridge	4.81	5.28	4.94
Indian Head	3.22	3.39	3.65
Scott	4.74	4.86	4.83
Swift Current	4.13	4.15	4.09
Brandon	1.93	2.35	2.34
Average	4.17	4.49	4.57

Effect of legumes in rotation on malt barley protein in 2011

	Crop residue in 2009		
	Wheat	Pea	Lentil
Location		—%—	
Beaverlodge	10.5	10.5	11.1
Lacombe	11.8	11.8	12.6
Lethbridge	10.9	11.1	11.2
Indian Head	10.7	11.2	10.4
Scott	12.2	12.5	11.7
Swift Current	10.6	10.6	10.8
Brandon	12.4	12.2	12.6
Average	11.3	11.4	11.5

Effect of nitrogen and crop residue on lodging





GF 1. Exp. 3 Nitrogen management in malting barley using optical sensors and split applications of nitrogen – PI G.P. Lafond

- To develop an algorithm to estimate yield potential in malting barley using optical sensor-based measurements (GreenSeeker).
- The main objective is to determine if the GreenSeeker optical sensor is better at determining the optimum N rate than the current method of fall or spring soil sampling for residual NO_3-N.
- Potential to better refine the N requirement of malting barley in terms of optimizing yield and quality
- Some variability among sites and years, but results suggest potential to reduce amount of N required to optimize yield and quality with split-applications using GreenSeeker
- A final report is in preparation

GF I. Exp. 4 Effect of harvesting method and date on yield and quality of malting barley – PI T.K. Turkington

Harvest Method	Harvest Date	Barley yield (T/ha)	Barley protein (%)
Straight cut	Normal	4.67a	12.0c
Swath then combine	Normal	4.30b	12.1bc
Straight cut	2 weeks after normal	4.15b	12.3a
Swath then combine	2 weeks after normal	3.82c	12.3ab

Effects of date and method of harvesting on quality - M. Edney & T. Graefenham

- Harvesting date affected quality more than harvesting method and negative effects were more pronounced at locations with more precipitation between dates
- Late harvested barley was less bright, tended to pre-germinate more, had lower vigour and greater microbial load, and had increased levels of soluble protein and FAN due to exogenous enzymes
- Swathed barley tended to be less bright and had slightly higher microbial levels

GF 1. Exp. 5 Effect of seed source on yield and quality of malting barley – PI T.K. Turkington

- Malt barley seed (one year from certified, bin-run) was sourced by RAHR Malting from three locations each of the 3 years and compared to certified seed
- Over the three years of the experiment, no consistent differences were found between certified and bin run seed in terms of yield or malting quality
- It is possible that bin-run seed from other locations or seed more than one year from certified would result in inferior yield or quality

Overall Summary

- All the new varieties yielded higher than AC Metcalfe
- Merit 57, CDC Meredith and Bentley had lower protein, better NUE and higher extract than AC Metcalfe
- Bentley tended to have the highest kernel plumpness while Merit 57 had the lowest (but high extract!!)
- CDC Meredith tended to tiller and lodge more than the other varieties
- Merit 57 took longest to mature followed by CDC Meredith, but both yielded very well in the northern regions
- Growing pea or lentil two years before malting barley sometimes improved yield, but did not lead to increases in protein to unacceptable levels
- Optical sensor (GreenSeeker) technology may hold promise for better estimating the N requirements of malt barley
- Timely harvesting was crucial to optimizing yield and quality of malt barley, and direct combining provided slight advantages over swathing
- Little or no differences were found between certified seed and seed that was one year from certified
- Three final reports were prepared and one is pending

GF II. Proposed Malting Barley Studies

- Nitrogen management in malting barley using optical sensors and split-applications of nitrogen fertilizers – PI G.P. Lafond??
- Quality and yield response of new malting barley varieties to increasing nitrogen rates, AAC Synergy, CDC Kindersley, Cervesa, Voyager – PI J.T. O'Donovan
- Effect of timing of pre-harvest glyphosate application on seed germination, yield and quality – PI J.T. O'Donovan
- Effect of plant growth regulator (PGR) application on lodging, yield and quality of malting barley - PI J.T. O'Donovan
- Effect of seed treatments and foliar fungicides and their interaction with plant growth regulators on yield and quality – PI T.K. Turkington
- Effect of seed treatments and foliar fungicides and their interaction with variety resistance on fungicide response and yield and quality – PI T.K. Turkington