Viability of Winter Wheat and Spring Barley Cultivation for Animal Feed Production in Insular Newfoundland

2013-2014 Year End Report

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Executive Summary

Imported feed is one of the largest farm operating expenses in Newfoundland and Labrador (NL). Despite adequate forage supply in some areas of NL, farmers here do not produce their own cereals, a major component of animal feed. This cereal research project is a long-term program, with 2013 being the first year for harvest. Cultivation of winter and spring cereals were examined at field scale and small plot to determine the viability of a cereal program in NL. Trials assessed straw and grain yield of winter wheat and spring barley, and nutritional contents of winter wheat under high moisture (HM) and dry grain systems. Two farms were planted with winter wheat on the east coast and three farms on the west coast in the fall of 2012. Small plot spring barley variety trials were planted at the Pynn's Brook Research Station in spring of 2013 comparing the performance of different Canadian and northern European barley varieties under NL conditions.

Winter wheat planted in fall 2012 was harvested as HM grain in September 2013. Yields varied according to previous land use. A root vegetable field exhibited highest grain yield with an average 2.04 metric tonnes (T) per acre at 25% moisture content (MC) or 1.78 T equivalent dry grain, a renovated forage field was second with 1.67 T at 28% MC or 1.39 T dry, a field with a long grass crop history (3 years corn, 1 yr barley followed by winter wheat) produced on average 1.06 T at 17% MC or 1.02 T dry and finally a newly cleared field yielded 1.05 T at 25% MC or 0.91 T equivalent as dry grain. Disease pressures (i.e. fusarium head blight) and low pH may have contributed to lowering yields and fungicide treatments and additional liming will be incorporated into future cropping systems. High moisture treatment and Ag bag storage was successful and mycotoxin levels were within acceptable ranges at 3 and 5 months post-harvest.

Barley was seeded late due to wet field conditions and did not reach maturity by mid-October. Variety Selena exhibited the top grain yield for 2-row at 1.26 T per acre and Synasolis was the top 6-row barley at 1.25 T per acre. Leader had the highest overall straw yield (1.48 T per acre) for 2-row and Rhea was highest for 6-row (1.15 T per acre). Finnish varieties were substantially shorter than Canadian barleys and straw yields from those varieties were low.

With minimal inputs, wheat and barley production was considered high for a baseline year, and are only expected to improve with the incorporation of better management practices such as in-crop herbicide and fungicide applications. Despite added costs, the increase in yield should assist in reducing the current cost of production. All farmers responded well to our project and are continuing their participation.

In Fall 2013 wet weather prevented seeding of winter wheat on one farm on the west coast and two farms on the east coast. These farms will instead plant spring cereals in spring 2014.

Introduction

The objective of the Alternative Feeds Program (AFP) is to research and provide a cost-effective, high-energy feed for the livestock industry in NL. Farmers are faced with the challenges of growing crops on a limited land base with short seasons, and providing a high-energy, cost-efficient feed.. The local production of food and livestock feed is essential, as it increases the province's self-sufficiency, and reduces the cost of transportation and reliance on the mainland for importing feed. The quality of grain brought into the Island has often been poor due to lengthy storage and shipping periods (Anonymous Industry Source, Personal communications 2014). Dairy farmers that have fed locally grown grain to dairy cattle have reported either no change (MacPherson 1998; P. McLean, Personal Communications 2014) or an increase in milk production (A. Gill Personal Communications 2011; I. Richardson Personal Communications 2014; M. Rideout Personal Communications 2014).

Winter varieties are planted in the fall and overwinter to start growing again in the spring of the following year and harvested in late summer-early fall. Planting winter wheat may compensate for the shorter NL growing season because plants get a jumpstart from establishing the year before, ready to grow as soon as the snow is gone and temperatures rise above 5˚C. This is often weeks earlier than spring cereal seeding can take place.

The Newfoundland and Labrador Government, in collaboration with the Government of Canada has committed to assisting in the establishment of a viable grain program in NL. Grain has the potential to benefit both the livestock and cropping industry by providing rotational options for vegetable farmers and is particularly suited as a crop to plant following a forage field renovation. Volunteer cereals growing in a newly planted forage field have the potential to act as a nurse crop and assist in forage establishment.

The objectives for the 2013 grain project were:

1. to determine if winter wheat can survive Newfoundland winters and maintain yield,
2. to establish baseline (minimal input) data i.e. nutritional content, straw and grain yields, and problematic disease presence (i.e. fusarium head blight),
3. to assess the effectiveness of an HM grain system, specifically Biotal 500 bacterial inoculant and an Ag Bagging system to store HM wheat,
4. to seed additional winter wheat fields for 2014-2015 assessment, and
5. to compare the performance of different barley varieties under minimal management.

Funding and Partnerships

The 2012-2014 grain program was funded through the Agricultural Research Initiative program which was a partnership between the Newfoundland and Labrador Government and the Government of Canada. Detailed information about approved funding for 2012-2013 and 2013-2014 can be found in Appendices A & B.

Methods and Implementation

Winter Wheat Project

Participants in the winter wheat project from 2012-2014 are listed below with their field location.

Participant 1 – Headling Holsteins: Field site in Cormack, NL – long history of grass cropping (i.e. corn 3+ yrs, spring barley 1 year followed by winter wheat)

Participant 2 – Larch Grove Farm: Field site in Cormack, NL – newly cleared field

Participant 3 – Rideout's Dairy: Field site in Cormack, NL – potato rotation

Participant 4 – Glenview Farms: Field site Burnt Hills, NL – old forage field

Participant 5 – H&E Williams Farm: Field site The Goulds, NL – old forage field

Experiments were completed in a random complete block design with varieties (Brome, Emmit and Warthog) as treatments. Two side by side plots between 7.5 and 9.6 acres were planted with two randomly selected varieties of winter wheat (Table 1) as recommended by the *2012 Cereal Guide to Cultivar Selection in Nova Scotia* (AgraPoint 2011). Varieties were planted in ploughed fields at a seeding rate of 196 kg/ha (175 lbs/acre) using a Great Plains NT1206 no-till seeder. One field, Participant 5, had not ploughed their field, rather had chemically killed the forages using Roundup® Weathermax at recommended label rates and disked the soil to disturb intact roots. At planting 200 kg/ha (178 lbs/acre) of 5-20-20 fertilizer was applied. Four randomly selected 2 x 6 m subplots were cornered off with flexible plastic stakes to serve as replications within each variety/treatment. In the fall, germination data, plant growth stage, and general stand health (i.e. presence of disease, predation, etc.) was recorded within each sub-plot. In the spring, winter survival was assessed by visually estimating % wheat cover of sub-plot in spring and comparing to fall photos and observations. Plant height, plant growth stage and general stand health continued to be monitored. Broadcast applications of ammonium nitrate were applied in spring and at the start of the elongation stage (GS30) in all trials at a rate of 112 kg/ha (100 lbs/acre).

Fields were harvested from late August through early October (Table 1). Subplots were hand harvested, weighed and dried in an oven at 49˚C for 72-84 hours. Samples were weighed again to obtain dry weights (DW) and harvest MC (east coast only) and then threshed to record thousand kernel weights (TKW) and yields (east coast only). The remainder of each 10 acre plot was combined. All fields were harvested as HM except for Participant 1, where following combining, grain was loaded into an upright grain silo and a dryer was used for 2-3 days. Fields on the west coast were combined with a 5088 Case International Harvester and actual yield and MC results were recorded from on-board data recorders. Seed samples were immediately collected and couriered to Activation Laboratories in Ontario for mycotoxin analysis and to assess acid detergent fiber (ADF), neutral detergent fiber (NDF), digestible energy (DE), crude protein (CP), and nutrient content (Ca, P, Mg and K). Grain was loaded into a Murska 700HD bioprocessor (Appendix C) for rolling and treatment with a HM preservative (Biotal Buchneri 500, Lallemand Animal Nutrition) and Ag Bagging. When bagging was complete, bags were sealed with sand and left undisturbed for 3-4 weeks after which samples were taken again for mycotoxin and nutritional analysis. Results were disseminated to participants and feeding decisions were made by the farmer.

Table 1. Winter wheat cultivation data including farm, region, varieties planted, total acreage planted per variety, seeding date, and harvest date.

Farm	Region	Varieties Planted	Total Acreage	Seeding Date (2012)	Harvest Date (2013)
Participant 1	Cormack	Brome	9.6	Sept. 6	Sept. 22
		Emmit	9.6		
Participant 2	Cormack	Emmit	8.6	Sept. 19	Oct. 3
		Warthog	8.6		
Participant 3	Cormack	Brome	7.8	Sept. 4	Sept. 11
		Warthog	7.8		
Participant 4	Burnt Hills	Emmit	9.1	Sept. 5	Aug. 29
		Warthog	9.5		
Participant 5	The Goulds	Brome	7.5	Sept. 8	NA
		Emmit	7.5		

Spring Barley Project

A spring barley varietal trial was conducted at Pynn's Brook Research Station in 2013. Ten varieties of spring barley (six Canadian, four Finnish; Table 2) were assessed for straw and grain yield. Experiments were conducted in a randomized complete block design with varieties as treatments, replicated four times. Plots were 1.8 x 5 m and seeded at a rate of 170 kg/ha (152 lbs/acre). At seeding, 20-20-20 fertilizer was applied at a rate of 300 kg/ha (267 lbs/acre) per soil reports. Seeding was late (June 8th) due to wet soil conditions. Topdress nitrogen (N) fertilizer was applied on July 6th at the end of tillering/start of elongation using a concentration of 34-0-0 and rate of 112 kg/ha (100 lbs/acre). Hand weeding occurred once throughout the season and was performed late when both crop and weeds were mature and setting seed. Weekly measurements were recorded including height, growth stage (zadoks; Zadok et al. 1974), start and finish flowering dates, tiller number and grain stage when grain fill was in progress.

Barley plots were harvested on October 14th, after the overnight temperature had dropped below zero for three consecutive nights. Three 1 m^2 quadrats were harvested from all plots and were then weighed and placed in a drying oven at 49˚C for 72-84 hours. When dry, samples were weighed again to obtain total biomass DW and determine MC when harvested. Samples were then threshed and TKW, grain and straw yields were recorded. An ANOVA was performed on data to assess normality.

A small spring barley side project was also initiated in 2013 in Cormack Newfoundland. Two farms (Participant 2 and another unnamed participant) provided two side by side 10 acre plots that were seeded with Island and Leader barley. The experiment was a randomized complete block design with varieties as treatments. On June 7th, Participant 1 drill-seeded barley into a newly cleared and ploughed field at a rate of 190 kg/ha (170 lbs/acre). Fertilizer (27-7-14) was applied during seeding at a rate of 300 kg/ha (267 lbs/acre) according to soil reports. Four randomly selected 2 x 6 m subplots were cornered off with flexible plastic stakes to serve as the replications within each variety/treatment. Weekly data was taken from within replications including plants per 1 m, growth stage, and general stand health (i.e. presence of disease, predation, etc.). Topdress fertilizer of 34-0-0 was applied at a rate of 112 kg/ha (100 lbs/acre) at the start of the elongation stage (GS30).

Fields were harvested as HM grain on October 13th. Subplots were hand harvested, weighed and dried in an oven at 49˚C for 72-84 hours. Samples were weighed again to obtain harvest MC and then threshed to record TKW. The remainder of each 10 acre plot was combined with a 5088 Case International Harvester. Actual yield and MC results were recorded from on-board data recorders. Seed samples were immediately collected and couriered to Activation Laboratories in Ontario for mycotoxin analysis and to assess ADF, NDF, DE, CP, and nutrient content. Grain was loaded into a Murska 700HD bioprocessor for rolling and treatment with a HM preservative (Biotal Buchneri 500, Lallemand Animal Nutrition) and Ag Bagging. When complete, bags were sealed with sand and undisturbed for 3-4 weeks after which samples were taken again for mycotoxin and nutritional analysis. Results were disseminated to Participant 2 and feeding decisions were made by the farmer.

Another participant planted barley on June 2nd according to the above protocol except this field was a true no-till. Both Island and Leader were no-till drilled into an older (10+ yrs) forage field that had been treated with a tank mix of Round-up® Weathermax and 2, 4-D at regular recommended label rates two weeks prior to seeding. Mid-season, the forages rebounded and overtook the barley which then had to be abandoned as a cereal trial. Cereals and forages were harvested together at season end as a forage blend. This experiment will not be described further.

Table 2. Varieties of spring barley tested in small plot trials.

Canadian Barley	Finnish Barley
Island – 2 row	Var 1 – 6 row
Leader – 2 row	Var 2 – 6 row
Selena – 2 row	Var 3 – 6 row
Legend – 6 row	Var 4 – 6 row
Rhea – 6 row	
Synasolis – 6 row	

Results and Discussion

Farmer reception of the cereal project has been very positive. All farmers that participated in the first year of trials have returned for the second year, including the two participants whose fields were abandoned as cereal trials mid-season.

Winter Wheat Project

All fields exhibited good establishment and reached the 3-5 leaf stage before the killing frost as recommended to survive overwintering (Alberta Agriculture and Rural Development 2014). When spring arrived, several fields looked completely winter-killed however all rebounded completely within 2-3 weeks.

Forages rebounded in the field belonging to Participant 5 in the middle of the growing season which then overtook the winter wheat. The trial was abandoned and cereals and forages were harvested together as a forage blend. This experiment will not be described further.

It is inappropriate to average across all field types as the systems were very different and there was too much time between each harvest, therefore only individual results are reported. Brome produced highest straw yield across all types of fields (Table 3) as was expected because it was the tallest variety. Warthog provided the highest grain yield followed by Emmit and Brome. The overall highest grain yield (avg. 2.04 T per acre) was harvested from the field that had previously grown potatoes in the year prior to seeding and the lowest yields (1.05T per acre and 1.06 T per acre) were from the newly cleared field and the field with a continuous grass cropping history. On the grass cropped field winter wheat was planted 3-5 days after spring barley was harvested which we suspect was too close of an interval for the soil to rebound sufficiently after intensive usage. On the west coast, the highest yielding field was harvested at least 22 days before the new clear and grass fields.

Nutritional contents were measured at harvest and again after three weeks to monitor for changes that could occur during storage (Table 4). With the exception of Participant 1, all other participants harvested as HM and stored grain in Ag bags. Additionally, due to cost, both varieties were stored within the same bag and therefore a composite sample was collected and they will be reported together. Results for Participant 1 were combined for suitable comparison. Crude protein ranged from 8.2-10.6%, ADF from 3.3-4.6%, NDF 8.0-9.2%, DE 2.77-3.12 mcal/kg, Ca 0.01-0.02%, P 0.31-0.36%, Mg 0.11-0.13% and K from 0.35-0.53% (Table 4). These values are lower than current wheat nutritional standards, however are higher than nutritional contents of corn grain (whole and ground) that has been imported to NL for feed. Corn samples were obtained from farms in the Cormack area as no small grain imports (i.e. barley or wheat) were available for testing. Considering this was a baseline year, grain quality and yields are expected to increase as we expand our knowledge of best management practices.

High moisture treatment and Ag bag storage was successful and farmers used grain at their convenience. It was difficult getting grain from the dump truck to the Murska hopper and there were substantial losses during that process. Afterwards one farmer did have difficulty getting grain out of the bag for feeding and in the future would prefer a free flowing system or possibly a bunker silo. The Murska could accommodate this through use of its installable auger. Biotal was a cost-efficient and safer alternative to organic acid treatment and mycotoxin levels were within acceptable ranges for 3 and 5 months post-harvest. Further studies are required to assess effectiveness when used for long-term storage (6+ months).

Fungal diseases were detected over the growing season, most notably fusarium head blight and sooty head mould that were found in all fields. The Burnt Hills appeared particularly affected where the field looked completely shadowed and the harvest date was moved up (Aug 29) to prevent potential losses. After treatment and storage, tests came back negative for mycotoxin presence suggesting what was observed in the field was sooty head mould and not a more toxic infection. Two fields on the west coast (Participants 2 and 3) were tested for mycotoxins and results were below the standard testing thresholds or undetected. The field belonging to Participant 1 did test positive at harvest for Deoxynivalenol (DON) at 0.54 ppm in the Brome plot and 0.96 ppm, Ochratoxin A at 0.003 ppm and Zearalenone at 0.10 ppm in the Emmit plot (Table 5). These infection rates were attributed to the previous barley crop that was harvested one week prior to winter wheat seeding. It is proposed pathogens overwintering in the barley residue readily infected the wheat during the next growing season. Interestingly, both of the imported corn samples (whole and ground) tested positive for mycotoxins. Deoxynivalenol was detected in the whole corn at a rate of 0.85 ppm and ground corn at 0.55 ppm. In addition, 3-acetyl-deoxynivalenol was recorded on the whole corn at 14 ppm. In both corn samples, 15-acetyl-deoxynivalenol was present at 0.08 ppm in whole and 0.12 ppm in ground corn. Finally, zearalenone was detected in the ground corn at 0.03 ppm. Fusarium head blight is a source for many of these toxins and due to its potential to affect animal health, lower yields, and because it was found in all fields, fungicides will be applied in future trials.

Several factors led to lower yields in our first year. Wet weather in May (Figures 1 & 2) and transport delays prohibited fertilizing equipment from getting on the field until June, therefore topdress N application was not applied at the optimum time (early- to mid-May). Seedlings resuming growth in the spring need N to restart growing and what was provided at seeding has either been used up or washed away and yields may have been lowered. Low pH (below 5.8) was observed in most fields and more liming will be required to boost establishment. Additionally, in-crop pesticide use was not employed, leading to disease and weed pressures that would likely have affected yield. On the east coast recreational vehicles had damaged up to 20% of the field. With the exception of weather and vandalism, better management practices of getting fertilizer on early in the spring and in-crop herbicide and fungicide applications are expected to substantially increase yields.

High moisture grain production in NL is possible and can be beneficial to our agricultural community. For example, harvest can occur earlier in the year when grain has ~35% MC, grain can easily be stored, higher yields are expected, decreased harvest losses, less predation (less time on the field), potential for increased feed to gain ratios (Mader and Rust No Date), and increased feed palatability (McLelland 2008). Farmers in our trials did see an increase in milk production when feeding their HM grain versus their traditional dry grain blends (corn and small grains); however that was beyond the scope of this trial. High moisture barley has proved to be palatable feed for both NL swine and cattle (Tilley 1999). One of our participants liked how the damp grain remained suspended within the hay ration rather than falling to the bottom of the trough like dry grain. Cows usually ate the pooled dry grain first however with the HM wheat they were eating a more complete ration for more of the day. Disadvantages of HM grain includes it is sometimes more difficult to combine with more green matter, a preservative treatment is necessary (however the preservative is often a nutrient), hammering or rolling of the grain must be done during/before treatment, treated grain cannot be stored with untreated grain, and loading from an Ag Bag for mixing may be problematic. There is also an increased cost in the form of Ag Bags and preservative, however some of those costs are countered by the cost of drying if that system was employed instead, or by the cost of transportation if importing from mainland Canada.

A Cost of Production analysis could not be completed for this report. Instead, a general cost of materials per acre is provided in Table 6. At the time of report submission, the value of 1 T of wheat delivered to the Cormack, NL area was approximately $410.00 and a bale of straw $120.00 (Anonymous Industry Source, Personal communications 2014) and this will be used as the standard for the analysis. The cost of materials per acre including seed, fertilizer, herbicide, combine fuel, Ag bag and preservative was $167.57. Material costs for each varietal plot ranged from $1307.05 for Participant 3 to $1608.67 for Participant 1 (Table 7). Interestingly, when all yields are adjusted for harvest moisture, Participant 3 had the second highest overall harvest values ($9261.72 and $9807.72) and Participant 1 the second lowest ($6025.92 and $6526.08). The highest harvest values were in the forage field (Participant 4) with $10,216.57 and $9197.90. However when adjusted for acreage, the vegetable field (Participant 3) had the highest values per acre with $1187.40 and $1257.40 versus $1122.70 and $968.20 for the forage field (Participant 4). The lowest harvest values were from the newly cleared field and the field that had previously grown grass crops for 3+ years, indicating it may not be economical to grow grain under these conditions. Numbers will increase as we improve our techniques to reach our goal of 2 T of grain and 2.5 – 3 bales of straw per acre minimum.

Poor weather in the fall of 2013 led to only two participants in the 2013-2014 season being able to plant winter wheat in time to assure adequate stand establishment. The others will plant spring barley in the spring of 2014. There is a strong desire by farmers to plant cereals into a true no-till system by chemically burning forage fields and direct no-till seeding the grain. The interest is very high because of our rocky soils and may lead to the purchase of new equipment under the current Growing Forward program, therefore we find it necessary to test this system with them to determine if it is a suitable replacement to ploughing. One of the winter wheat test fields on the west coast was planted into a ploughed forage field, while the other was planted as a no-till.

Table 3. Yield data for 2013 winter wheat harvest. Yields are provided for straw (bales) and grain (T) on a per acre basis based on provided moisture content at harvest and adjusted dry grain equivalent

Farm	Region	Previous Crop	Variety Planted	Moisture Content	Straw (Bales per acre)	Grain Yield (T per acre)	Adjusted Grain Yield T per acre (13.5% MC)
Participant 1	Cormack	Barley	Brome	17%	2.19	0.93	0.89
			Emmit	17%	1.77	1.19	1.14
Participant 2	Cormack	New clear	Emmit	24%	1.63	1.02	0.90
			Warthog	25%	1.74	1.07	0.93
Participant 3	Cormack	Potato	Brome	24%	4.36	1.84	1.62
			Warthog	25%	3.85	2.24	1.94
Participant 4	Burnt Hills	Forage	Emmit	28%	4.06	1.86	1.55
			Warthog	28%	3.90	1.47	1.22

Table 4. Nutritional contents from Participant 1 winter wheat fields at harvest and Participants 2-4 at three weeks post-harvest. Acid detergent fiber (ADF), neutral detergent fiber (NDF), digestible energy (DE), crude protein (CP), and nutrient content (Ca, P, Mg and K) are reported as fed with dry basis in parenthesis. Samples from Participants 2-4 were stored within the same Ag Bag and combined results are provided. Results for Participants1 were combined for suitable comparison. Imported corn samples collected from two farms in the Cormack area are also included for comparison.

Farm	ADF (%)	NDF (%)	DE (mcal/kg)	CP (%)	Nutritent Content			
					Ca (%)	P (%)	Mg (%)	K (%)
Participant 1	3.3*(3.9)*	9.2*(11.1)*	3.12*(3.75)*	10.6*(12.5)*	0.02 *(0.02)*	0.36 *(0.44)*	0.12 *(0.14)*	0.35 *(0.42)*
Participant 2	4.6*(6.1)*	8.3*(11.0)*	2.77*(3.67)*	9.7*(12.9)*	0.02 *(0.03)*	0.32 *(0.43)*	0.13 *(0.17)*	0.51 *(0.67)*
Participant 3	3.6*(4.8)*	8.0*(10.6)*	2.77*(3.67)*	8.2*(10.9)*	0.01 *(0.01)*	0.31 *(0.41)*	0.11 *(0.15)*	0.49 *(0.65)*
Participant 4	3.8*(5.0)*	8.3*(10.9)*	2.88*(3.74)*	9.9*(12.9)*	0.02 *(0.03)*	0.35 *(0.45)*	0.13 *(0.16)*	0.53 *(0.68)*
Corn – Whole	3.3*(4.0)*	7.6*(9.1)*	3.13*(3.77)*	6.9*(8.3)*	0.02 *(0.02)*	0.25 *(0.30)*	0.09 *(0.11)*	0.32 *(0.38)*
Corn - Ground	3.4*(4.0)*	8.0*(9.5)*	3.17*(3.78)*	6.6*(7.9)*	0.02 *(0.02)*	0.23 *(0.27)*	0.08 *(0.10)*	0.31 *(0.37)*

Table 5. Mycotoxin results from Participant 1 (Brome and Emmit plots) and from whole and ground imported corn samples obtained from dairy farms in the Cormack area. Results are provided for detected toxins including deoxynivalenol (DON), 3-acetyl-deoxynivalenol (3ADON), 15-acetyl-deoxynivalenol (15ADON), ochratoxin-A, and zearalenone.

Farm	DON (ppm)	3ADON (ppm)	15-ADON (ppm)	Ochratoxin-A (ppm)	Zearalenone (ppm)
P1 – Brome	0.54	*ND*	*ND*	*ND*	*ND*
P1 - Emmit	0.96	*ND*	*ND*	0.003	0.10
Corn – Whole	0.85	14	0.08	*ND*	*ND*
Corn - Ground	0.55	*ND*	0.12	*ND*	0.03

ND = not detected

Table 6. General material per acre costs for 2012-2013. Grain seed costs for planting have been averaged across all three varieties.

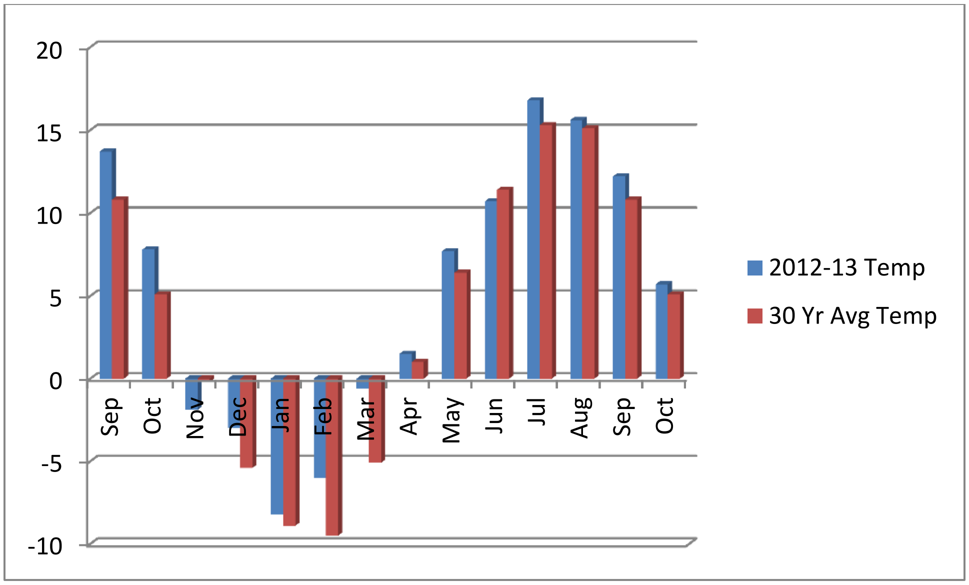
Item	Cost per Acre
Seed (incl. shipping)	$47.30
Fertilizer (incl. shipping)	$84.00
Pre-Seed Herbicide	$5.16
Combine Fuel	$10.61
Ag Bag	$12.50
Acid Treatment	$8.00
Total	$167.57

Table 7. Estimated material cost to grow, total value of harvest and value per acre for each participant during the 2012-2013 growing season. All estimates are based on the adjusted grain yield for 13.5% moisture content and a cost of $410 per T of wheat and $120 per bale of straw. Grain seed costs for planting have been averaged across all three varieties.

Farm	Variety Planted	Straw (Bales per acre)	Acreage	Adjusted Grain Yield T per acre (13.5% MC)	Est. Material Cost to Grow	Est. Total Value of Harvest	Est. Value per Acre
Participant 1	Brome	2.19	9.6	0.89	$1608.67	$6025.92	$627.70
	Emmit	1.77	9.6	1.14	$1608.67	$6526.08	$679.80
Participant 2	Emmit	1.63	8.6	0.90	$1441.10	$4855.56	$546.60
	Warthog	1.74	8.6	0.93	$1441.10	$5074.86	$590.10
Participant 3	Brome	4.36	7.8	1.62	$1307.05	$9261.72	$1187.40
	Warthog	3.85	7.8	1.94	$1307.05	$9807.72	$1257.40
Participant 4	Emmit	4.06	9.1	1.55	$1524.89	$10216.57	$1122.70
	Warthog	3.90	9.5	1.22	$1591.92	$9197.90	$968.20

Figure 1. Weather data for Cormack, Newfoundland and Labrador. Monthly data for 2012-2013 winter wheat season (blue) and the 30 year monthly average (red) is provided for both mean temperature (A) and millimeters of precipitation (B).

A



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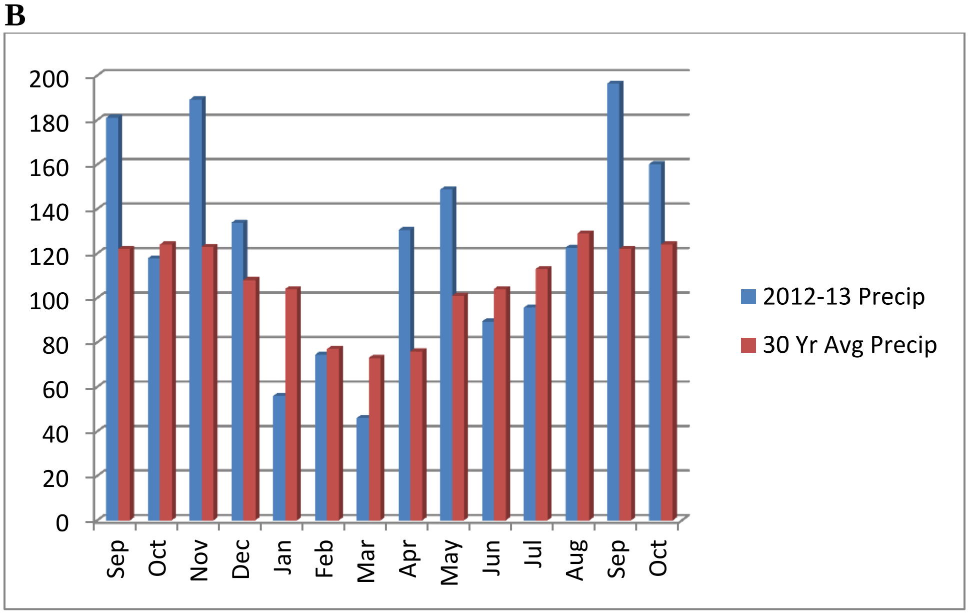
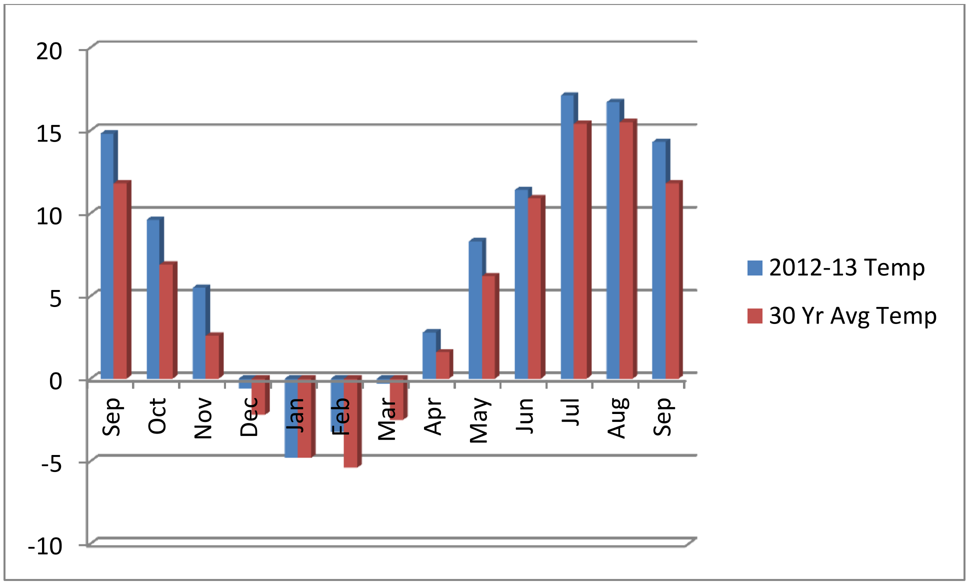


Figure 2. Weather data for The Goulds, Newfoundland and Labrador. Monthly data for 2012-2013 winter wheat season (blue) and the 30 year monthly average (red) is provided for both mean temperature (A) and millimeters of precipitation (B).

A



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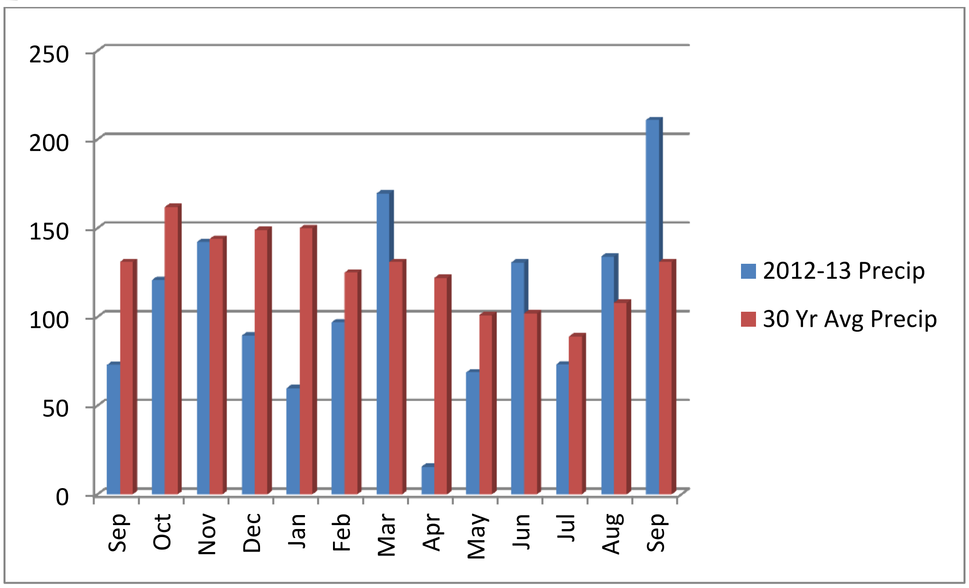


Spring Barley Project

This was considered a baseline year for barley assessments in the cereal program and minimal inputs were applied to determine what additions are cost effective to increase yields and quality. Canadian and Finland varieties were tested as northern Europe (+Iceland) is a short seasoned region and they have already selected for many early maturing traits in their breeding programs. Evidence can be found in the days to completion to flowering (Table 5) where two of the four Finnish varieties were the first to complete flowering whereas the Canadian varieties finished up to 13 days later. We were unable to determine days to maturity as wet weather in late August and throughout September meant although mature, the grain was unable to ripen on the stalk and had to be harvested as HM (Figure 3).

Plots were hand harvested in October with an average MC of 26%. Variety Synasolis and Legend of 6-row (24% MC) and Island of 2-row (23% MC) had the lowest MC and Finland Variety 1 6-row (29% MC) and Leader 2-row (27% MC) the highest (Table 9). Variety Selena exhibited the top grain yield for 2-row with 1.26 T per acre and Synasolis was the top 6-row barley with 1.25 T per acre. Leader, a 2-row, had the highest overall straw yield (1.48 T per acre) and Rhea was highest for 6-row (1.15 T per acre). Finnish varieties were substantially shorter than the Canadian barleys and straw yields from those varieties were low. Finland typically breeds for shorter varieties because they experience gusting winds in their growing region. Also, the NL agricultural community as a whole values straw much more than other areas in Canada or internationally and therefore it is not something always considered in breeding.

Many factors were present to lower yield expectations. An important consideration is that yields were recorded after drying in an oven for several days. Actual farmer yields are expected to be higher as our samples were dried to a lower water content than normal dry grain status. Wet conditions during May (Figure 3) delayed barley seeding until June which is considered late and decreased the growing season by two weeks. In addition, other project priorities delayed weeding past recommended control times leading to a performance trial under sub-optimum conditions. As a baseline year, pesticide controls were withheld to see what problems were present that would require control in future years. A yield lowering infection was detected (fusarium head blight) and will need to be controlled for in future trials. Sooty head mould was also present; however it is not typically considered a serious problem (Government of Saskatchewan 2013). If we are able to minimize these issues and increase our knowledge and use of best management practices in future trials, yields should substantially increase.

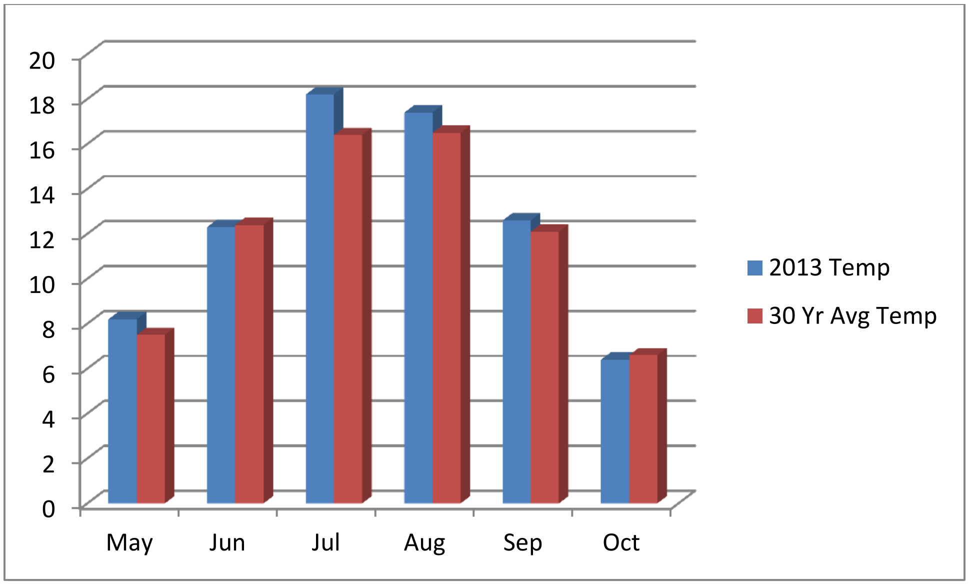
The side barley experiment on the large newly cleared field resulted in low barley yields of 1.05 T per acre for variety Island and 0.89T per acre for Leader, both at 26% MC. A newly cleared field has a very low pH and is lacking many soil nutrients necessary for good grain establishment (Neenan 1960; Bona et al. 1993). Based on the winter wheat trial and this barley trial we believe it is not possible to efficiently grow cereals in NL under these conditions.

Table 9. 2013 Spring barley varietal trial results indicating days to flowering completion, harvest moisture content, thousand kernel weight (TKW) and yields (grain and straw). Yield results have been scaled to 'yield per acre' to assist with selection.

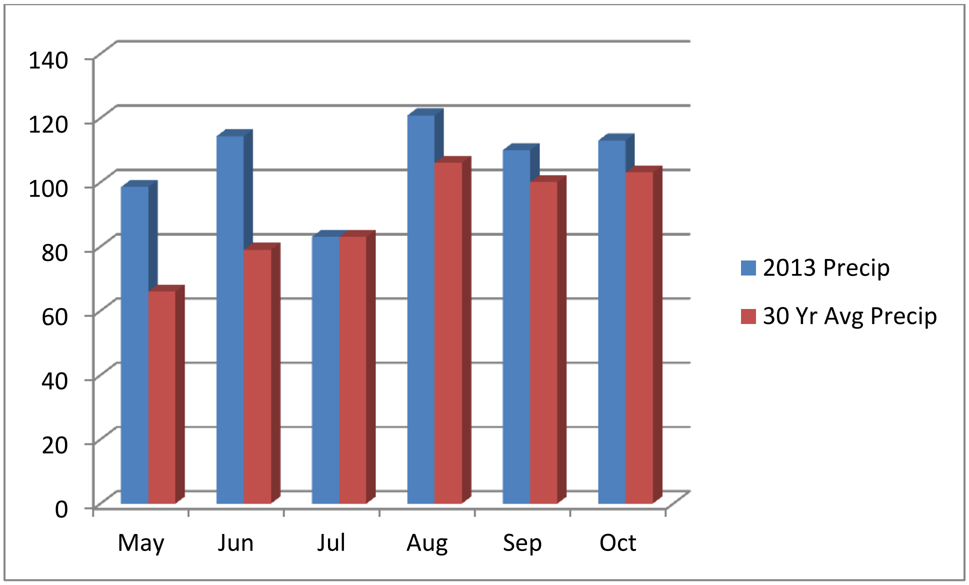
Barley Variety	Days to completion of flowering	Harvest Moisture Content	TKW	Grain yield (Tonnes per Acre)	Straw yield (Bales per Acre)
Island – 2 row	47	23%	43.93	1.12	1.23
Leader – 2 row	54	27%	45.97	1.05	1.48
Selena – 2 row	47	25%	42.97	1.26	1.25
Legend – 6 row	47	24%	43.30	1.16	1.12
Rhea – 6 row	54	26%	42.55	1.13	1.15
Synasolis – 6 row	54	24%	40.65	1.25	1.10
Var 1 – 6 row	47	29%	36.15	0.73	0.63
Var 2 – 6 row	41	28%	35.85	1.11	0.91
Var 3 – 6 row	41	28%	38.43	0.98	0.87
Var 4 – 6 row	54	27%	38.28	0.69	0.75

Figure 3. Weather data for Pasadena, Newfoundland and Labrador. Monthly data for 2013 (blue) and the 30 year monthly average (red) is provided for both mean temperature (A) and millimeters of precipitation (B).

A



B



Conclusions

There is a high demand for cereals in NL not just for the dairy and livestock industries, but also for human consumption i.e. baked goods and brewed beverages. The Newfoundland and Labrador Government with the Government of Canada are working to make quality cereal cultivation a reality in NL.

The first year of this project assessing winter wheat and barley with minimal inputs indicate cereals can reliably be grown in NL if a HM system is used. Spring barley is the most likely cereal to reach dry grain status, but this cannot be guaranteed when considering a heavy snow pack can delay spring seeding and wet conditions usually experienced in the late summer and early fall can prevent drying on the stalk. Winter wheat can avoid spring seeding delays and provide a jumpstart on establishment and growth for the next season. Wet fall conditions can still lead to problems for reaching dry status, however that issue is eliminated when prepared to harvest as HM grain. Yields and nutritional contents are expected to be higher with the addition of fungicides and continued development of best management practices. In the future, we will need to incorporate nutritional experiments to explore the performance of NL HM grain in a typical feeding system. Ultimately, we will be able to provide concrete growing guidelines for those wishing to grow cereals on the Island, including cost-effective HM storage options and expected yields.

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Appendix A

2012-2013 Approved cereal project budget.

Item Description	Line Object	AFP Winter Grain
100 Salaries		
Salaries - Temporary Employees	120	$ 142,014.60
Salaries - Other Employees	130	$ 48,448.40
Overtime	140	$ 8,000.00
Other Wage Payments	165	
Clothing Allowance	160	
Subtotal Salaries		**$ 198,463.00**
200 Employee Benefits		
Membership Fees - Employees	231	
Subtotal Employee Benefits		**$ -**
300 Transportation & Communication		
Freight Express and Cartage	312	$ 1,000.00
Travelling Third Party	326	$ -
Telecommunication Services - Other	340	
Cellular Phones	342	$ 1,500.00
Vehicle Mileage	362	
Fuel (Travel Status)	363	$ 10,000.00
Meals (Travel Status)	364	$ 6,264.00
Accommodations	365	$ 4,000.00
Vehicle Rental (Travel Status)	366	
Airfare	367	$ 2,600.00
Other Modes of Travel	368	
Miscellaneous Travel	369	$ 2,000.00
Subtotal Transportation & Communication		**$ 27,364.00**
400 Supplies, Materials & Equipment Purchases		
Office Supplies	410	$ 200.00
Medical Supllies	412	
Agricultural Supplies	413	$ 14,500.00
Personal & Household Supplies	414	
Food Items	415	
Construction & Maintenace Supplies	416	
Machinery & Equipment Supplies (other small tools)	418	$ 2,000.00
Gasoline	419	$ 3,000.00
Small Tools and Appliances	420	
Miscellaneous Supplies	421	$ 1,000.00
Text Books	424	
Heating Fuel	425	

Subtotal Supplies, Materials & Equipment		**$**	**20,700.00**
500 Professional Services			
Consulting Services	510		
Professional Services - Com.Debenture Debt	511	$	1,000.00
Consulting Services -Legal	513		
Management Consulting Services	515		
Consulting Services - Medical	518		
Subtotal Professional Services		**$**	**1,000.00**
600 Purchased Services			
Advertising and Promotion	610		
General Purchased Services	611	$	4,000.00
Training and Development	613	$	-
Printing	615		
Purchased Vehicle Repairs and Maintenace	617	$	2,000.00
Other Repairs and Maintenace	618	$	5,000.00
Vehicles & Machinery Rentals	619	$	15,000.00
Office Space Rentals	622		
Insurance	630		
Electricity	631		
General Maintenance	648		
Subtotal Purchased Services		**$**	**26,000.00**
700 Property, Furnishings & Equipment			
Office Furniture and Equipment	710		
Machinery and Vehicles	711		
Subtotal Property, Furnishings & Equipment		**$**	**-**
ACAT 130 Grants			
Total		**$ 273,527.00**	

Appendix B

2013-2014 Approved cereal project budget.

AGRICULTURE RESEARCH INITIATIVE

Item Description	Line Object	Approved Amount Tracking code: 232093
100 Salaries		
Salaries – Temporary Employees	120	$ 42,060.00
Overtime	140	$ 5,000.00
Subtotal Salaries		**$ 47,060.00**
300 Transportation & Communication		
Freight Express and Cartage	312	$ 6,500.00
Travelling 3rd party	326	$ 1,635.00
Cellular phones	342	$ 500.00
Fuel (Travel Status)	363	$ 5,000.00
Meals (Travel status)	364	$ 3,000.00
Accommodations	365	$ 6,000.00
Airfare	367	$ 3,600.00
Subtotal Transportation & Communication		**$ 26,235.00**
400 Supplies, Materials & Equipment Purchases		
Office supplies	410	$ 200.00
Medical supplies	412	$ 80.00
Agricultural supplies	413	$ 25,000.00
Personal and household supplies	414	$ 2,000.00
Construction & maintenance supplies	416	$ 1,500.00
Machinery & equipment supplies (other small tools)	418	$ 10,000.00
Gasoline	419	$ 6,00.00
Small tools and appliances	420	$ 2,000.00
Miscellaneous Supplies	421	$ 12,500.00
Subtotal Supplies, Materials & Equipment Purchases		**$ 59,280.00**
500 Professional Services		
Professional services	511	$ 12,500.00
Subtotal Professional Services		**$ 12,500.00**
600 Purchased Services		
General purchased services	611	$ 10,000.00
Training and development	613	$ 2,000.00
Purchased vehicle repairs and maintenance	617	$ 2,000.00
Other repairs and maintenance	618	$ 10,000.00
Subtotal Purchased Services		**$ 24,000.00**
TOTAL		**$ 169,075.00**

Canada

Newfoundland Labrador

Appendix C

Equipment used to treat HM grain (A) and the end product (B),(C) and (D).

A) Murska Bioprocessor unit showing the white preservative storage tank and the Ag Bagging attachment on the back. It also comes with an easy-to-mount auger if bagging is not desired.

B) Ag Bag filled for Participant 3

C) Ag Bag belonging to Participant 2 during winter. The post to the left is placed so workers won`t drive over it by mistake.

D) High moisture grain after 4 months in the bag. Shadowing on the bottom is from the sun.