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

2014-2015 Year End Report

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Acknowledgements

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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 2014 being the second 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, spring wheat and barley, and nutritional contents under high moisture (HM) grain systems. Due to inclement weather, only two farms were planted with winter wheat on the west coast in September 2013. In spring 2014, three farms were planted with spring wheat on the west coast and two farms planted with barley on the east coast. Additionally, small plot barley variety trials were planted at the Pynn's Brook Agricultural Research Station in June 2014 comparing the performance of different Canadian and northern European barley varieties under NL conditions.

Winter wheat planted in fall 2013 was harvested as HM grain in September 2014. Both fields had a forage cropping history. The highest grain yield was in Cormack (variety Emmit) with an average 1.34 metric tonnes (T) per acre when adjusted to 13.5% moisture content or dry grain equivalent. The Pasadena field (variety Brome) was not far behind with 1.19 T per acre as dry grain. Straw yield was higher on the Pasadena field with 2.71 bales per acre compared to 2.00 bales per acre in Cormack. Brome, the variety grown in Pasadena, has outperformed other varieties in straw production for the past 2 years. High moisture treatment and Ag Bag storage was successful and mycotoxin levels were within acceptable ranges up to 8 months post-harvest providing the bag is not punctured or left unsealed.

Spring wheat was planted on three farms on the west coast, one in Pasadena and two in Cormack – all with a forage cropping history. The Pasadena field planted only Fuzion, a dual purpose milling/feed wheat, and the Cormack fields also included feed wheat AC Walton. When adjusted to dry grain, AC Walton plots had the highest yields at 1.14 T and 1.08 T per acre. Fuzion did not perform as well, averaging 0.99 T per acre, with the highest yield in Pasadena at 1.06 T per acre. Straw production was highest on the same field in Cormack with 2.80 bales per acre on the AC Walton plot followed by 2.67 bales per acre on the Fuzion plot. These results underscore the influence field conditions have on productivity over variety selection alone.

Small plot barley trials were seeded especially late in 2014 due to wet soil conditions and priority to seeding on-farm trials. The shortened season led to early harvest of plots at higher MC than is advised. The highest grain yields were from European varieties with 1.34 and 1.11 T per acre. The highest grain yield from a Canadian variety was 1.01 T per acre from Legend. There was no statistical difference between the highest yields. The highest straw yield was from Legend (1.78 bales per acre), followed by a European variety (1.13 bales per acre) however results were not statistically significant.

On-farm barley trials were seeded late on the east coast due to wet field conditions and did not reach maturity by mid- October. Only a Synasolis plot could be harvested, and it was at 51% MC. Yields were low due to several factors, including forage bounce back and wet weather that delayed fungicide and herbicide applications. Harvest was 0.97 T per acre when adjusted to dry grain status, however high mycotoxin presence precluded its use as feed.

In fall 2014 wet weather prevented seeding of winter wheat on one farm on the west coast and they will instead plant spring wheat in spring 2015. In addition, one farm in Cormack and one in Lethbridge plated fall hybrid rye in September, the first offering of a hybrid cereal variety in North America. This species appears to be particularly suited to our climate and is a great improvement on traditional fall rye.

Wheat and barley production was considered low this year, however the season was substantially shortened by a long winter that extended into spring and delayed seeding, and early frosts in late August through September. Despite these challenges, the quality of grain harvested was much higher than last year, evidence of the progress we are making with best management practices. We must work on improving yields and maintaining quality to reduce the cost of production and increase the value for the NL livestock industry.

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 and cost-efficient 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). The local production of quality 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.

Some of the challenges of a shorter season can be overcome by adjusting cultivation practices. 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 incorporation of a high moisture (HM) grain treatment and storage system helps to reduce the risk of growing both winter and spring cereals. Grain can be harvested at much higher moisture contents (MC) than 'dry' status (20-32% vs 12-14%) and safely stored on-farm in an Ag Bag (that we use) or a suitable storage building/container. Analysis up to 8 months post-storage indicate quality is maintained as long as the bag remains uncompromised. HM grain allows a greater window for seeding and harvest.

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 2014 grain project were:

1. Develop cereal grain feed crop production systems suitable for the Newfoundland dairy industry;
2. Determine optimal seeding dates and relative economic suitability of selected cultivars of spring and winter cereals for high moisture grain and dry grain production in dairy feed rations;
3. Assess the cost benefits of straw production as a byproduct of grain production, and
4. To increase the economic viability of NL's livestock producers.

Funding and Partnerships

The 2014-2015 grain program was funded through the Provincial Agriculture Research and Development Program. Detailed information about approved funding for 2014-2015 can be found in Appendix A. Two European collaborations were also incorporated into this year's trials including projects with the Northern Periphery Program (NPP; European Union Sponsored) and the Nordic Atlantic Cooperation (NORA; sponsored by the Nordic Council of Ministers -Faroe Islands, Greenland, Iceland, and Coastal Norway).

Methods and Implementation

Winter Wheat Project

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

Participant 1 – Hammond Farms: Field site in Pasadena, NL – old forage field

Participant 2 – Rideout's Dairy: Field site in Cormack, NL – old forage field

Experiments were completed on one field in Pasadena, NL testing Brome winter wheat on 15 acres and one field in Cormack, NL testing Emmit winter wheat on 10 acres. The Cormack field was planted adjacent a 10 acre Warthog/Brome winter wheat field, however seeding irregularities prevented inclusion into the trial. Varieties were selected as recommended by the *2012 Cereal Guide to Cultivar Selection in Nova Scotia* (AgraPoint 2011). Grain was planted in ploughed fields at a seeding rate of 196 kg/ha (175 lbs/acre) using a Great Plains NT1206 no-till seeder. At planting fertilizer was applied according to individual soil reports so that no more than 35% of the total grain nitrogen (N) requirement was provided. 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 recorded 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) at a rate of 112 kg/ha (100 lbs/acre). In-crop herbicides were applied at recommended rates as required. At start of flowering, Prosaro® fungicide was applied to prevent/lessen Fusarium Head Blight (FHB).

Fields were harvested from late August through early September (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 threshed to record thousand kernel weights (TKW) and yields (for comparison to combine report). The remainder of each plot was combined. All fields were harvested as HM using a 5088 Case International Harvester and actual yield and MC results were recorded from on-board data recorders. 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 bagging was complete, bags were sealed with sand and left undisturbed for 3-4 weeks after which samples were taken for mycotoxin and nutritional analysis. Results were disseminated to participants and feeding decisions were made by the farmer.

Table 1. Cereal cultivation data including farm, region, crop planted (WW= winter wheat, SW = spring wheat, B = barley), varieties planted, total acreage planted per variety, seeding date, and harvest date.

Farm	Region	Crop	Varieties Planted	Total Acreage	Seeding Date	Harvest Date (2014)
Participant 1	Pasadena	WW	Brome	15	Sept 20 2013	Sept 3
Participant 2	Cormack	WW	Emmit	10	Sept 7 2013	Aug 26
Participant 3	Pasadena	SW	Fuzion	15	May 31 2014	Sept 4
Participant 4	Cormack	SW	Fuzion	9	May 29 2014	Sept 10
			AC Walton	9		Sept 18
Participant 5	Cormack	SW	Fuzion	7	June 2 2014	Sept 19
			AC Walton	8		
Participant 6	Burnt Hills	B	Synasolis	7.5	June 18 2014	Oct 14
			Leader	7.5		
Participant 7	The Goulds	B	Synasolis	9	June 18 2014	N/A
Participant 8	Cormack	B	Synasolis	12.5	May 30 2014	N/A
			Leader	12.5		

Spring Wheat Project

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

Participant 3 – Hammond Farms: Field site in Pasadena, NL – old forage field

Participant 4 – Larch Grove Farm: Field site in Cormack, NL – old forage field

Participant 5 – N&N Farms: Field site in Cormack, NL – renovated forage field

Experiments were completed on one field in Pasadena, NL testing Fuzion spring wheat, and two fields in Cormack, NL testing Fuzion and AC Walton (Table 1). Spring wheat variety Fuzion is a dual purpose milling and feed wheat. In Pasadena, Fuzion was planted in a ploughed field at a seeding rate of 160 kg/ha (143 lbs/acre) using a Great Plains NT1206 no-till seeder. In Cormack, Fuzion and AC Walton were planted in equal sized adjacent plots as a true no-till system. Participant 4 was a chemically destroyed forage field that was in production for 10+ years and Participant 5 was a chemically destroyed and disked old forage field. At planting fertilizer was applied according to individual soil reports to deliver 60% of crop N requirements. Four randomly selected 2 x 6 m subplots were cornered off with flexible plastic stakes to serve as replications within each variety/treatment. Germination data, plant growth stage, and general stand health (i.e. presence of disease, predation, etc.) was recorded within each sub-plot. Broadcast applications of ammonium nitrate were applied at the start of the elongation stage (GS30) to deliver 40% of the crop required N. At start of flowering, Prosaro® fungicide was applied to prevent/lessen FHB.

Fields were harvested in September. Subplots were hand harvested, weighed and dried in an oven at 49˚C for 72-84 hours. Samples were weighed again to obtain DW and threshed to record TKW and yields (for comparison to combine report). The remainder of each plot was combined. All fields were harvested as HM using a 5088 Case International Harvester and actual yield and MC results were recorded from on-board data recorders. 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 and sent to Activation Laboratories (Dairy One) for mycotoxin and nutritional analysis. Results were disseminated to participants and feeding decisions were made by the farmer.

Barley Project

Small Plot Trials

A spring barley varietal trial was conducted at Pynn's Brook Agricultural Research Station in 2014. Ten varieties of spring barley (Table 2), including four Canadian feed barleys, two Canadian malting barleys, three European malting barleys and one European dual purpose malting and feed barley were assessed for grain and straw yield. Experiments were conducted in a randomized complete block design with varieties as treatments, replicated three times. Plots were 1.4 x 5 m (trimmed to 4 m) and seeded at a rate of 200 kg/ha (178 lbs/acre). At seeding, fertilizer was applied according to soil reports to deliver 60% of crop N requirements. Seeding was late (June 17th) due to wet soil conditions and other on-farm seeding commitments. Topdress N fertilizer was applied at the end of tillering/start of elongation using ammonium nitrate to deliver 40% of the crop N requirements. Target® herbicide was applied according to label instructions. 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 8th and 13th. Entire plots were harvested, 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 to assess normality. A further Tukey HSD test assessed differences between plots.

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

Canadian Barley	European Barley
Selena – 2 row	Var 1 – 6 row
Leader – 2 row	Var 2 – 6 row
Legend – 6 row	Var 3 – 6 row
Synasolis – 6 row	Var 4 – 6 row
Newport (malting)– 2 row	
Newdale (malting) – 2 row	

On-Farm Trials

Participant 6 – Glenview Farms: Field site Burnt Hills, NL – oats and peas previous year

Participant 7 – H&E Williams Farm: Field site The Goulds, NL – renovated forage field

Participant 8 – Headline Holsteins: Field site in Cormack, NL – old forage field

Three large on-farm spring barley fields were seeded in NL in 2014, one in Cormack that was seeded on May 30th and two on the east coast of NL seeded on June 18th (Table 1). Participant 6 was a chemically destroyed oats and pea field and Synasolis and Leader barley was no-till seeded into two 7.5 acre plots. Participant 7 was a complete field renovation and barley was the first crop. Only 9 acres were available for the trial so one variety – Synasolis – was selected for analysis. Participant 8 was a chemically destroyed old (20+ years) forage field that was no-tilled. Fields were seeded at a rate of 180 kg/ha (160 lbs/acre) to account for the later seeding date. Fertilizer was applied according to soil reports to deliver 60% of crop N requirements. 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 to deliver remaining 40% of crop N requirements at the start of the elongation stage (GS30). The field belonging to Participant 8 experienced forage bounce-back by mid-July and the field was removed from the trial.

The Burnt Hills was harvested as HM grain on Oct 14. Lodging on the Leader plot prevented its harvesting; however the Synasolis plot was harvested at 51% MC. Subplots were hand harvested, weighed and dried in an oven at 49˚C for 72-84 hours. Samples were weighed again to obtain MC and then threshed to record grain and straw yield and TKW. The remainder of each plot was combined by a representative from the Agriculture and Agrifoods Canada Cool Climate Research Centre using an older model John Deere combine. 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, the bag was sealed with sand and undisturbed for 3-4 weeks after which samples were taken and sent to Activation Laboratories (Dairy One) for mycotoxin and nutritional analysis. Results were disseminated to Participant 6 and feeding decisions were made by the farmer. The field in The Goulds was not mature by mid-October and field conditions prohibited the AAFC combine from getting on the field. Had the combine from the west coast been available, the field would have been harvested.

Results

Winter Wheat Project

Both fields exhibited good establishment and reached the 3-5 leaf stage before the killing frost. In Pasadena and Cormack the winter was especially long, cold and with more snow than our 30 year averages (Figures 1 & 2) and winter-kill was observed on up to 10% of the Pasadena field and up to 25% of the Cormack field. Combined with combine restrictions, 14 and 7.5 acres were harvested on those fields respectively. Seeding irregularities in the Cormack winter wheat field (two varieties were mistakenly inter-seeded for the entirety of the Warthog plot) meant that only the Emmit plot could be included in the remainder of the test. The Warthog plot was still valuable to the farmer for feed and straw and was harvested with the Emmit plot. Both fields were harvested as HM with MCs ranging from 19-24%.

As last year, Brome produced higher straw yield (2.71 bales per acre) compared to Emmit (2.0 bales per acre; Table 3); however Emmit produced a higher grain yield at 1.34 T/acre vs. 1.19 T/acre for Brome. All grain yields in this report have been adjusted to the 13.5% dry grain equivalent. Yields were lower than last year; however that was to be expected with the winter-kill. The quality of the grain was much higher in 2013-2014 season than 2012-2013 as is reflected in the nutritional analysis (Table 4).

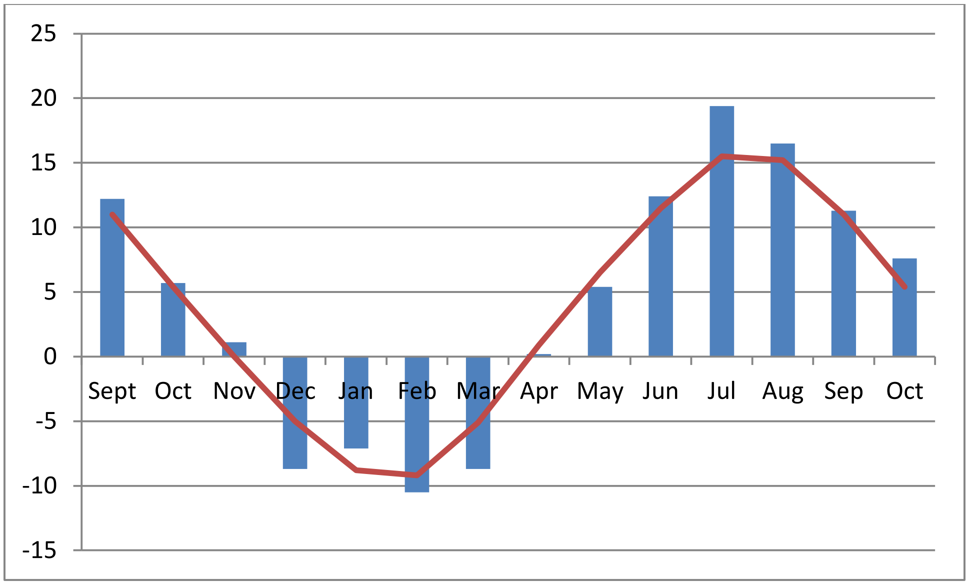
Nutritional contents were measured after three weeks to allow proper ensiling. Participant 1 in the winter wheat trial was also Participant 3 for the spring wheat trial and both were harvested days apart. Wheats were combined within the same bag due to space constrictions and bagging costs and are reported together. Crude protein ranged from 15.8-18.1%, ADF from 4.2-4.5%, NDF 8.1-10.7%, DE 3.72-3.80 mcal/kg, Ca 0.05-0.11%, P 0.45-0.47%, Mg 0.17-0.22% and K from 0.57-0.61% (Table 4). These values are all higher than the nutritional analysis from last year and indicate our management practices are improving as reflected in quality. The crude protein content is especially high and exceeded our top protein last year of 12.9%. Some of the higher values may be due to mixing of spring and winter wheat with Participant 1, however the contents of Participant 2 are also several percentage points higher than last year, even when compared to their field from last year (12.9% vs. 15.8%). Nutritional contents of feed corn grain (whole and ground) imported to NL were less than the cereals grown in NL and had equivalent or less digestible energy. Imported barley samples have been sent for analysis for further comparison.

High moisture treatment and Ag bag storage using the Murska 700HD was successful and farmers used grain at their convenience. A new system was employed to move grain from the truck to the Murska that was successful after some on-site adjustments, however it still remains a labour-intensive task. Additional experience should increase efficiency. Biotal remained effective as a preservative and mycotoxins never increased past detectable levels at storage.

In the fall of 2014 two participants on the west coast (Cormack, NL) planted winter wheat, and one on the east coast (St. John's). In addition, one farmer on the west coast (Cormack, NL) and one in central (Lethbridge, NL) planted fall hybrid rye, which are the first commercial fields in Canada (possibly North America) to plant this newly registered variety. Fall hybrid rye is supposed to be better suited to our climate and edaphic conditions.

Figure 1. Weather data for Cormack, Newfoundland and Labrador. Monthly data for 2013-2014 winter wheat season (blue) and the 30 year monthly average trend line (red line) is provided for both mean temperature (A) and precipitation (B).

A



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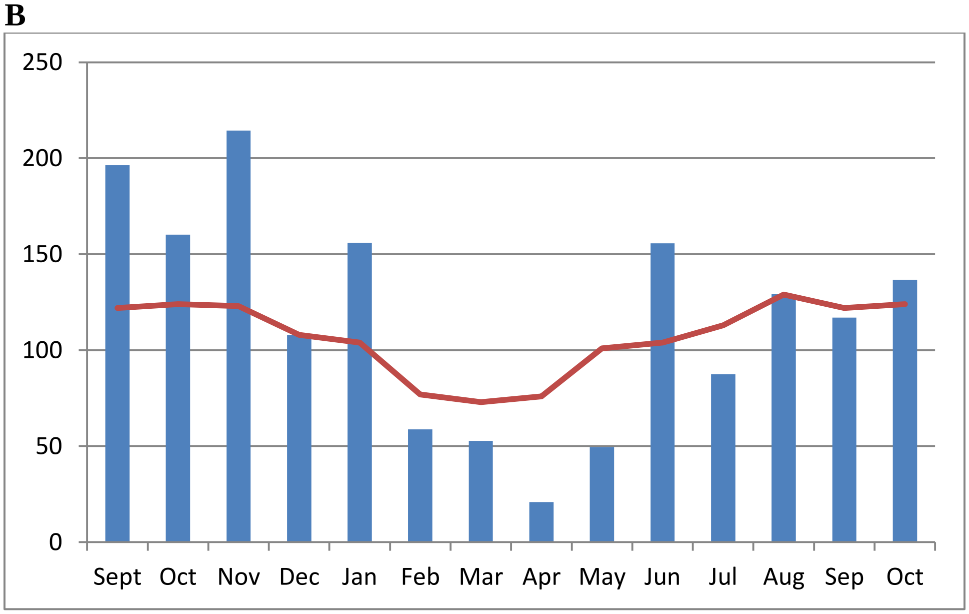
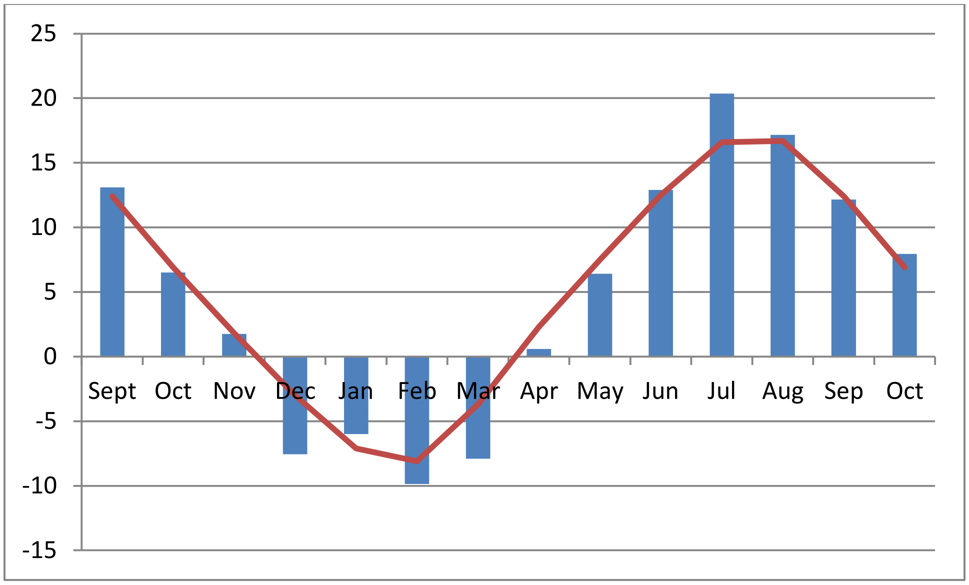


Figure 2. Weather data for Pasadena, Newfoundland and Labrador. Monthly data for 2013-2014 winter wheat season (blue) and the 30 year monthly average trend line (red line) is provided for both mean temperature (A) and precipitation (B).

A



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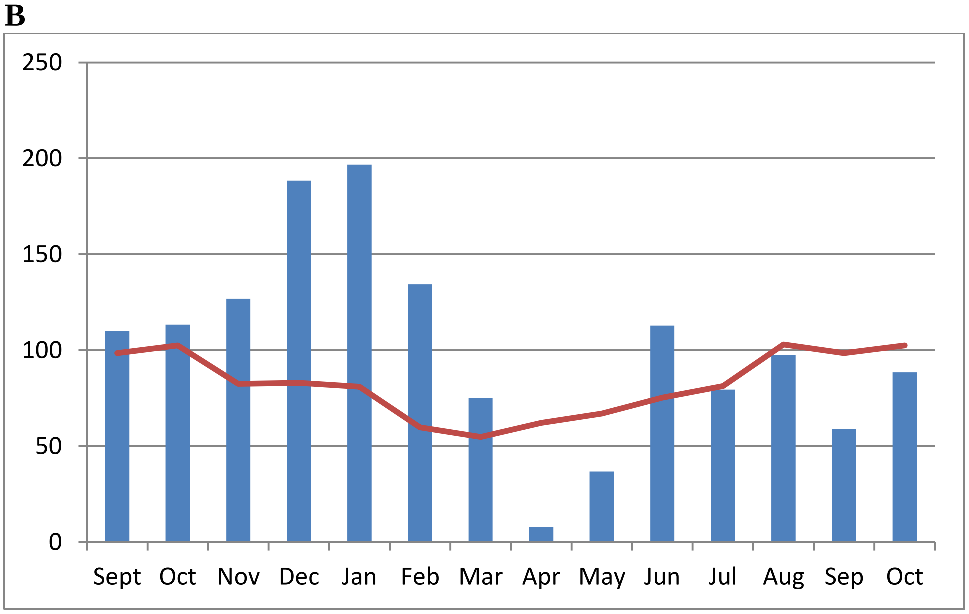


Table 3. Yield data for 2014 grain harvests. Participants, previous crops, crop planted, and varieties are provided along with moisture contents and yields for straw (bales) and grain (T) on a per acre basis. The grain yield has been adjusted to a dry equivalent of 13.5%.

Farm	Region	Previous Crop	Crop planted	Variety Planted	Moisture Content	Straw (Bales per acre)	Adjusted Grain Yield T per acre (13.5% MC)
Participant 1	Pasadena	Forage	Winter wheat	Brome	19%	2.71	1.19
Participant 2	Cormack	Forage	Winter wheat	Emmit	24%	2.00	1.34
Participant 3	Pasadena	Forage	Spring wheat	Fuzion	23%	2.64	1.06
Participant 4	Cormack	Forage	Spring wheat	Fuzion	30%	2.26	0.97
				AC Walton		2.47	1.08
Participant 5	Cormack	Forage	Spring wheat	Fuzion	28%	2.67	0.95
				AC Walton		2.80	1.14
Participant 7	Burnt Hills	Oats & Peas	Barley	Synasolis	51%	NA	0.87

Table 4. Cereal nutritional contents at three weeks post-harvest. Crop planted (WW= winter wheat, SW = spring wheat, B = barley), 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 dry basis. Participant 1 for the winter wheat trials was also Participant 3 for the spring wheat trials and both wheats were combined within the same bag and numbers are the same. Imported corn samples collected from two farms in the Cormack area are also included for comparison.

Farm	Crop	ADF (%)	NDF (%)	DE (mcal/kg)	CP (%)	Nutrient Content			
						Ca (%)	P (%)	Mg (%)	K (%)
P 1	WW	4.2	8.1	3.80	18.1	0.11	0.45	0.21	0.57
P 2	WW	4.5	10.7	3.72	15.8	0.05	0.47	0.17	0.61
P 3	SW	4.2	8.1	3.80	18.1	0.11	0.45	0.21	0.57
P 4	SW	5.6	9.7	3.81	17.4	0.11	0.49	0.19	0.59
P 5	SW	4.5	9.6	3.81	18.1	0.06	0.52	0.19	0.68
P 6	B	8.7	20.5	3.48	15.6	0.19	0.49	0.18	0.72
Corn – W		4.0	9.1	3.77	8.3	0.02	0.30	0.11	0.38
Corn - G		4.0	9.5	3.78	7.9	0.02	0.27	0.10	0.37

Spring Wheat Project

Fields exhibited good establishment in Pasadena and Cormack and reached high moisture maturity by September. In Pasadena, the field was harvested at a MC of 23% and the Cormack fields were harvested at 30% for Participant 4 and 28% for Participant 5.

The largest straw yield was AC Walton that exhibited an ~5-10% higher yield than Fuzion with 2.47-2.80 bales per acre for AC Walton vs. 2.26-2.67 bales per acre for Fuzion (Table 3). The grain yields of Fuzion were also relatively low, ranging from 0.95-1.06 T/acre which is less than the Canadian average for spring wheat (~1.2 T per acre). AC Walton had higher yields, ranging from 1.08-1.14 T per acre.

As with winter wheat, the nutritional contents were measured after three weeks to allow proper ensiling. Participant 1 in the winter wheat trial was also Participant 3 for the spring wheat trial and both were harvested days apart. Wheats were combined within the same bag due to space constrictions and bagging costs and are reported together. Crude protein ranged from 17.4-18.1, ADF from 4.2-5.6%, NDF 8.1-9.7%, DE 3.80-3.81 mcal/kg, Ca 0.06-0.11%, P 0.45-0.52%, Mg 0.19-0.21% and K from 0.57-0.68% (Table 4). Results are comparable to the 2014 winter wheat contents and higher than the 2013 winter wheat. Nutritional contents, including digestible energy, of feed corn grain (whole and ground) imported to NL were less than the spring wheat grown in NL. Imported barley samples have been sent for analysis for further comparison.

High moisture treatment and Ag Bag storage using the Murska 700HD was successful and farmers used grain at their convenience. Biotal was effective as a preservative and mycotoxins never increased past detectable levels at storage.

Barley Project

Small Plot Trials

Canadian and European varieties of barley were tested in 2014 as part of the Provincial varietal trials and European collaborations. European varieties tested were from short seasoned regions that may perform well in our climate.

Plots were hand harvested on October 8th and 13th with MCs ranging from 27-55% (Table 5). The ANOVA was significant, however a Tukey test indicated only the grain yields of varieties Newdale (0.50 T/acre) vs. European Var 2 (1.34 T per acre) and Leader (0.41T per acre) vs. European Var 2 were statistically different from the others and the European variety yielded higher. Of the Canadian varieties, Legend (1.01 T per acre) and Synasolis (0.94 T per acre) were the observed top producers which is similar to last year's findings, however yields were not statistically different from the others. Straw yields were similar with only Euro Var 2

(0.94 Bales per acre) exhibiting a significantly lower yield than legend (1.78 Bales per acre).

On-Farm Trials

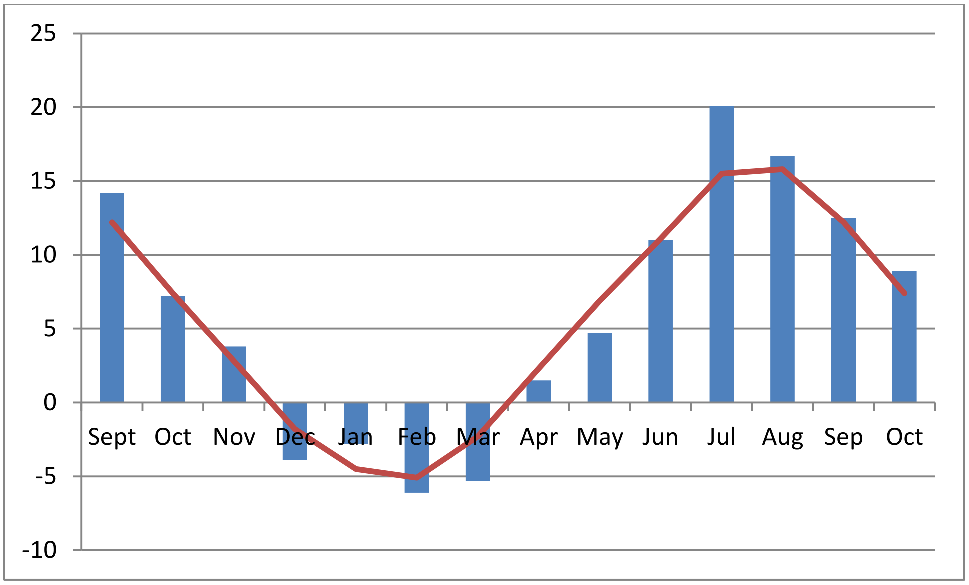
The on-farm barley trials on the east coast experienced difficulty with forage bounce-back during the season, particularly in the field belonging to Participant 6. Wet weather exceeding national averages (Figure 3), along with a previous cereal (oat) crop led to high disease pressure, however weather and other crop management commitments prevented application of fungicides and herbicides at optimal times. Winds caused lodging on the Leader side of the field and it could not be harvested to include in the trial. The Synasolis plot was harvested at 51% MC and yields were 0.87 tonnes per acre. The straw was not harvested. Nutritional contents (Table 4) indicate a high quality grain with a crude protein of 15.6%, however mycotoxin analysis showed a high presence of 10.77 ppm that precluded its use as feed.

Table 5. 2014 Barley varietal trial results indicating days to flowering initiation, 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 initiation of flowering	Harvest Moisture Content	TKW	Grain yield (Tonnes per Acre)	Straw yield (Bales per Acre)
Selena – 2 row	54	35%	41.9	0.89	1.10
Leader – 2 row	61	55%	40.61	0.41	1.06
Legend – 6 row	54	44%	39.21	1.01	1.78
Synasolis – 6 row	54	44%	35.41	0.94	1.05
Newport (m) – 2 row	54	47%	37.93	0.61	1.02
Newdale (m) – 2 row	61	54%	36.74	0.50	0.97
Var 1 – 6 row	48	33%	31.23	1.11	0.63
Var 2 – 6 row	48	38%	37.33	1.34	0.94
Var 3 – 6 row	54	27%	32.00	0.95	1.13
Var 4 – 6 row	54	32%	36.74	0.87	1.03

Figure 3. Weather data for St. John's, Newfoundland and Labrador. Monthly data for 2013-2014 winter wheat season (blue) and the 30 year monthly average trend line (red line) is provided for both mean temperature (A) and precipitation (B).

A



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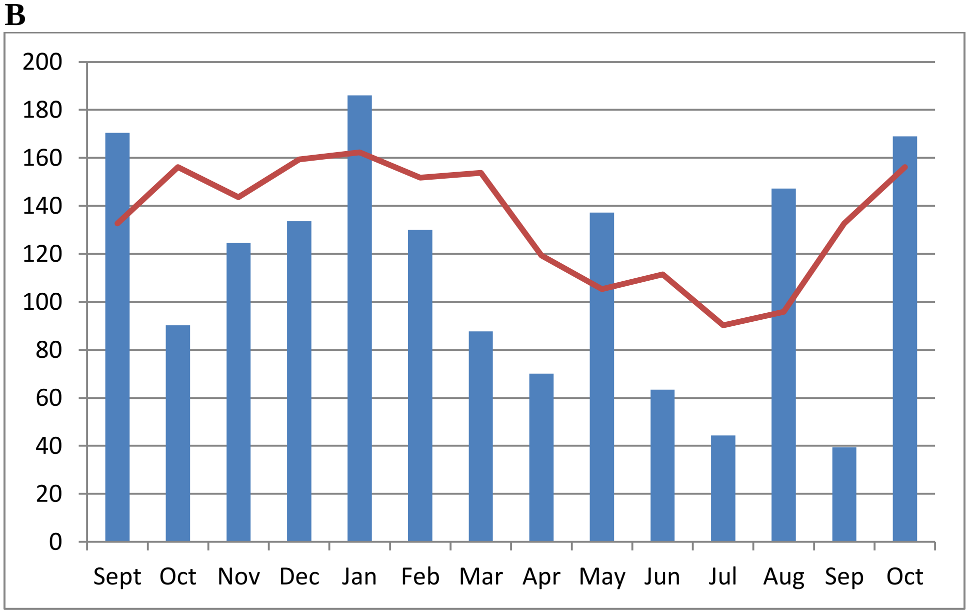

Pest Pressure

Various pests were detected over the growing season, most notably FHB and sooty head mould that were found in all fields. The FHB was treated with the fungicide Prosaro® according to label instructions to minimize mycotoxin presence. In addition to these infections, take-all, loose smut, covered smut, fusarium root rot, pythium root rot, and spot blotch were detected in some of the fields. Corn ear budworm was found in all fields in the west coast; however it is not considered a pest species. Monitoring stations will be set up in 2015 to assess the level of budworm pest pressure.

No fields tested completely free of mycotoxins during the 2014 harvest (Table 6). Deoxynivalenol (DON) was detected on the Pasadena fields and the spring wheat field belonging to Participant 4 at 0.13 ppm. The other spring wheat field in Cormack tested low as well at 0.70, however the barley field in the Burnt Hills tested above the safe feeding threshold at 10.77 ppm. This high level is attributed to the oat residue from the previous year's crop, and the presence of oat volunteers. DON was detected in the whole corn at a rate of 0.85 ppm and ground corn at 0.55 ppm. 3-Acetyl-DON was present in the whole corn at 14 ppm and 15-Acetyl-DON was present in both corn samples at 0.08 ppm in whole and 0.12 ppm in ground.T-2 and HT-2 was only detected on the field belonging to Participant 2 at 0.7 ppm for T-2 and 0.11 for HT-2, below ppb limits. Ochratoxin-A was not detected in any samples. Finally, zearalenone was detected in the winter wheat field belonging to Participant 2 at 2.99 ppm, the barley field in the Burnt Hills at 0.10 ppm and in the ground corn at 0.03 ppm. The upper limit to be considered safely fed to dairy cows is 3 000 ppm (Foragebeef.ca, 2014).

Table 6. Mycotoxin results from the 2013-2014 cereal program from each farm and indicating the crop planted (WW= winter wheat, SW = spring wheat, B = barley). Toxins measured include: deoxynivalenol (DON), 3-acetyl-deoxynivalenol (3ADON), 15-acetyl-deoxynivalenol (15ADON), trichothecene mycotoxin T-2, trichothecene mycotoxin HT-2, ochratoxin-A (Ochra-A, and zearalenone (Zear). Imported corn samples collected from two farms in the Cormack area are also included for comparison.

Farm	Crop Planted	DON (ppm)	3ADON (ppm)	15ADON (ppm)	T-2 (ppm)	HT-2 (ppm)	Ochra-A (ppm)	Zear (ppm)
P 1	WW	0.13	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
P 2	WW	*ND*	*ND*	*ND*	0.07	0.11	*ND*	2.99
P 3	SW	0.13	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
P 4	SW	0.13	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
P 5	SW	0.70	*ND*	*ND*	*ND*	*ND*	*ND*	*ND*
P 6	B	10.77	*ND*	*ND*	*ND*	*ND*	*ND*	0.10
Corn – W		0.85	1.4	0.08	-	-	*ND*	*ND*
Corn - G		0.55	*ND*	0.12	-	-	*ND*	0.03

ND = not detected "-" = not tested

Discussion

There is a high demand for cereals in NL for the dairy and livestock, baked goods and brewed beverages industries. The Newfoundland and Labrador Government is working to make quality cereal cultivation a reality in NL.

Yields were low in the small plot barley trials this year mainly due to the exceptionally late seeding date and earlier hard frost that meant trials did not have enough time to mature. Therefore, days to maturity is not reported. European varieties appeared to out-perform the Canadian varieties; however results were primarily not statistically significant and the thousand kernel weights of the Canadian varieties were higher. Additionally, European varieties appear to mature faster based on the days to initiation of flowering which the European varieties reached 1-2 weeks earlier.

Winter wheat grain yields exceeded that of spring wheat despite winter-kill; however there was higher straw production in the spring wheat fields. The quality of spring wheat was higher than winter wheat, particularly the crude protein. Crude protein is expected to be higher in Fuzion than other wheats tested because it is a dual purpose milling/feed wheat. Quality was much higher than last year which is most likely a result of proper timing of fertilizer and fungicide applications and harvesting as HM. The high protein levels led one farmer to lower his soybean protein ration, resulting in an unexpected cost savings.

Several factors led to lower yields this year in the on-farm trials. In the winter wheat fields abnormally colder temperatures coupled with a mid-winter thaw (including rain) led to winter-kill that was more pronounced in the Cormack field. Additionally, weed pressure along the periphery of the Cormack field could have inhibited spring recovery and crowded out those that re-emerged. In the Fuzion spring wheat field belonging to Participant 5 a combine problem caused 1-1.5 T of grain to be dumped within the field to facilitate repairs. Fuzion yields (and subsequent value) would have been higher and comparable to the AC Walton plot which was the second highest per acre harvest and highest per acre value. Low pH (below 5.8) was observed in most fields and more liming will be required to boost establishment. Continued experience and development of best management practices will increase yields and maintain quality. FHB is a source for many mycotoxins found within cereal fields (DON, 3ADON, 15ADON, T-2, HT-2, and Zearalenone) and due to its potential to lower yields and that it was found in almost all fields, fungicides must continue be applied. Weeds and forage volunteers continue to be a problem and we will continue to explore control and eradication measures. Diseases may be affected by fertilizer selection (i.e. Take-all) and therefore urea will be used to fulfill N requirements in the future. This will reduce the cost of production as urea is less costly and does not require a hazardous materials fee for shipping.

A ‘Materials Cost to Grow’ per acre is provided in Table 7. A traditional ‘cost of production' has not been compiled as labour costs vary between farms and the cost of our equipment (combine/seeders) does not reflect what most farmers would purchase (new vs. used) and associated costs (insurance etc.) would be lower. At the time of report submission, the value of 1 T of wheat delivered to the Cormack, NL area was approximately $360.00 and a bale of straw $100.00 (Anonymous Industry Source, Personal communications 2015) 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 $207.48 per acre for winter wheat and $159.48 per acre for spring wheat. The lower cost of spring wheat reflects one less fertilizer and in-crop herbicide application. For labour purposes, seeding fields takes approximately 4 hours, fertilizer/herbicide/fungicide application 2-3 hours and combining 4-8 hours.

Crop per acre values are substantially lower than last year's results mainly due to a decrease in the per tonne grain value ($360 in 2014 vs. $420 in 2013) and straw value ($100 in 2014 vs. $120 in 2013). Despite the lower import costs and low yields from the shortened season, fields were still valued at 2-4x their material cost inputs. The highest per acre harvest value was the Brome winter wheat field at $699.40 followed by the AC Walton spring wheat field belonging to Participant 5 at $690.40 (Table 8). The lowest per acre harvest value was on the Fuzion spring wheat field belonging to Participant 4 at $575.20 followed by the Fuzion spring wheat field belonging to Participant 5 at $609.00. The highest per acre profits were in the AC Walton spring wheat plot belonging to participant 5 at $530.92 and the Brome winter wheat field at $491.92. The lowest per acre profit values were the Fuzion spring wheat fields belonging to Participant 4 with $415.72 and Participant 5 at $449.52. Values will increase as we improve our techniques to reach our goal of 2 T per acre of winter wheat and 1.5 T per acre of spring wheat and 2.5 – 3 bales of straw per acre. Although the crop yield was low this year, the total value of the harvest included with this trial was $44,644.20. When including fields that were removed from the trial yet we still harvested and other fields farmers had planted on their own and had us harvest for them, the complete value of grain grown in NL over the 2013-2014 growing season increases to $70,000-$75,000.

Table 7. General material per acre costs for 2013-2014. Material costs per acre of winter wheat (WW) and spring wheat (SW) and the cost per tonne of winter wheat (WW) and spring wheat (SW) are reported. Cereal seed costs for planting have been averaged.

Item	Cost per Acre WW	Cost per Tonne of WW	Cost per Acre SW	Cost per Tonne SW
Seed (incl. shipping)	$47.30	$37.53	$47.30	$45.48
Fertilizer (incl. shipping)	$84.00	$66.67	$56.00	$53.84
Pre-Seed Herbicide	$5.16	$4.09	$5.16	$4.96
In-Crop Herbicide	$20.00	$15.87	-	-
Fungicide	$20.00	$15.87	$20.00	$19.23
Combine Fuel	$10.52	$8.35	$10.52	$10.12
Ag Bag	$12.50	$9.92	$12.50	$12.02
Acid Treatment	$8.00	$6.35	$8.00	$7.69
Total	$207.48	$164.65	$159.48	$153.48

Table 8. Estimated material cost to grow, total value of harvest, value per acre and profit for each participant during the 2013-2014 growing season. All estimates are based on the adjusted grain yield for 13.5% moisture content and a cost of $360 per T of wheat and $100 per bale of straw. Grain seed costs for planting have been averaged.

Farm	Variety Planted	Acres	Straw (Bales per acre)	Grain (T per acre at 13.5% MC)	Est. Material Cost to Grow	Est. Total Value of Harvest	Est. Value per Acre	Est. Profit	Est. per Acre Profit
P 1	Brome WW	14	2.71	1.19	$2904.72	$9791.60	$699.40	$6886.88	$491.92
P 2	Emmit WW	7.5	2.00	1.34	$1556.10	$5118.00	$682.40	$3561.90	$474.92
P 3	Fuzion SW	14	2.64	1.06	$2232.72	$9038.40	$645.60	$6805.68	$486.12
P 4	Fuzion SW	9	2.26	0.97	$1435.32	$5176.80	$575.20	$3741.48	$415.72
	AC Walton SW	9	2.47	1.08	$1435.32	$5722.20	$635.80	$4286.88	$476.32
P 5	Fuzion SW	7	2.67	0.95	$1116.36	$4263.00	$609.00	$3146.64	$449.52
	AC Walton SW	8	2.80	1.14	$1275.84	$5523.20	$690.40	$4247.36	$530.92

Conclusions

HM grain production holds the most promise for establishing cereals as a viable cropping option in NL. For example, harvest can occur earlier in the year when grain has ~32% MC, grain can easily be stored, higher yields are expected, decreased harvest losses, less disease pressure, 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). Additionally, HM barley has proved to be palatable feed for both NL swine and cattle (Tilley 1999) and our own HM wheat has successfully been used as feed for two years.

The second year of this project assessing winter wheat, spring wheat, and barley confirms findings from last year that cereals can be reliably grown in NL if a HM system is used. The program performed very well this season despite the abnormal weather conditions that led to winter-kill on winter wheat fields and further shortened our season. The integration of hybrid fall rye into the cereal program is another example of our innovative approach to cereal cultivation that is customized to our unique situation. To make this program even more successful we need to work to increase yields and decrease the costs of production.

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Appendix A

2013-2014 Approved cereal project budget.

Newfoundland Labrador

Provincial Agricultural Research & Development Program

Appendix A
Project Budget

Item Description	Line Object	Requested Budget
100 Salaries		
Salaries - Temporary Employees	120	$92,310.40
Overtime	140	$4,000.00
Subtotal Salaries		**$96,310.40**
300 Transportation & Communication		
Freight Express and Cartage	312	$15,000.00
Cellular Phones	342	$500.00
Fuel (Travel Status)	363	$4,000.00
Meals (Travel Status)	364	$2,500.00
Accommodations	365	$6,000.00
Vehicle Rental (Travel Status)	366	$300.00
Airfare	367	$2,100.00
Miscellaneous Travel	369	$200.00
Subtotal Transportation & Communication		$ 30,600.00
400 Supplies, Materials & Equipment Purchases		
Office Supplies	410	$200.00
Agricultural Supplies	413	$20,000.00
Personal & Household Supplies	414	$500.00
Construction & Maintenance Supplies	416	$1000.00
Machinery & Equipment Supplies (other small tools)	418	$6,000.00
Gasoline	419	$7,500.00
Miscellaneous Supplies	421	$1,000.00
Text Books	424	$350.00
Subtotal Supplies, Materials & Equipment		**$ 36,200.00**
500 Professional Services		
Professional Services	511	$3,000.00
Subtotal Professional Services		**$3,000.00**
600 Purchased Services		
General Purchased Services	611	$15,700.00
Training and Development	613	$1,500.00
Purchased Vehicle Repairs and Maintenance	617	$2,000.00

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Other Repairs and Maintenance	618	$2,500.00
Vehicles & Machinery Rentals	619	$10,000.00
Subtotal Purchased Services		$ 31,700.00
Total		**$197,810.40**