Alternative Feeds Program
ON-FARM FORAGE TRIALS

2009-2010 RESEARCH PROJECTS

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F. Greening
P. McLean

&

Silage Grasses
F. Greening
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M. Rideout
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EXECUTIVE SUMMARY

When referring to animal agriculture throughout Canada, the province of Newfoundland and Labrador is identified as having unique challenges. Livestock producers have a very limited amount of land suitable for forage production. Additionally, transportation costs into the province are expensive for importing both forage and concentrates. This has led to Newfoundland and Labrador's livestock producers taking advantage of newly emerging opportunities to maximize both quantity and quality of feeds grown on limited land bases.

One method of minimizing feed costs is through forage selection. For example, producers began growing corn silage approximately 17 years ago with a single farm growing 20 hectares (50 acres). Since that time, it has been grown throughout the island; currently there is approximately 750 hectares (1,800 acres) seeded annually, with nearly 70% of this grown under Samco X-tend plastic mulch.

Originally developed in Ireland, the Samco X-tend technology has enabled producers to increase Corn Heat Units (CHU) by 300 CHU. This enables the utilization of varieties which were formerly unable to reach maturity. Morris (2004) found that the Samco X-tend system both increased heat unit availability and led to a 33% increase in dry matter over conventionally sown corn. Current research focuses on variety selection and herbicide choice for optimal performance with this system.

Continual cropping of silage corn has led to a variety of problems. Growing this crop in the same fields has been shown to increase soil compaction and nutrient depletion. In recent years of this study, there has been a noted increase in both the quantity and species of weeds found in corn fields. To compound this problem, some herbicide resistance has begun to emerge in various weed species.

New cropping technologies such as the X-Tend plastic system, which has only been available to Newfoundland and Labrador's forage producers for five years, not only enables farmers to decrease their dependency upon imported grains and increases the level of feed self sufficiency, but have strengthened departmental-producer relationships.

In some areas of the province, farmers feel that the use of corn silage, even with the Samco system, is not optimal for forage production based on climatic limitations. In such circumstances, producers rely on grass-legume mixtures. Traditionally, farmers have chosen a Timothy-Clover mix as a result of previous research findings throughout Atlantic Canada. However, timothy has been shown to have limitations in regrowth after cutting, particularly in dry, hot summer conditions. This was the planting year to examine five alternative grass species to the traditionally grown timothy.

CORN SILAGE PROJECT

INTRODUCTION

In the modern world of agriculture new crops and cropping technologies are promising increased yields and improved nutritional values. Self sufficiency is the ultimate goal on both the farm level and as a nation. The Newfoundland and Labrador Alternative Feeds Program aims for continued growth at the primary and secondary levels of a diversified and sustainable Agrifoods Sector. Its mission is to carry out and ensure the successful completion of research and development initiatives as stated in the project mandate for the On-Farm Silage Corn Project, under the Alternative Feeds Program.

One crop which has emerged as an important feed-stuff in our province is silage corn. It is known as a high energy feed, with additional benefits such as the potential to improve leg and hoof soundness and increase heat detection. Approximately 17 years ago, the first 20 hectares (50 acres) were planted in our province.

On average, Newfoundland and Labrador accumulates approximately 1,800 to 2,200 corn heat units per year; to produce silage corn, a minimum of 2,000 CHU is required. It is for this reason that the Samco Integrated Crop System (technology from Ireland introduced six years ago) is of such value, due to the ability to plant the crop earlier than with conventional seeding. Newfoundland and Labrador's climate, particularly the Eastern region, is marginal for successful corn production. Central and Eastern producers - where the climatic conditions are traditionally harsher than the rest of the province - have had outstanding success with the Samco system.

This year, the on-farm silage corn plots were seeded using the Samco X-tend Plastic System. Research focused on herbicide choice to maximize yield and nutritional value of the crop.

Table 1: Producers Participating in the 2009-2010 Silage Corn Project

Farm	Location
C. Lester	St. John's
F. Greening	Musgravetown
P. McLean	Nicholsville

BACKGROUND INFORMATION

Recent trials by producers and government have shown silage corn to be an important part of the forage mixture produced across the province. By growing silage corn in their fields instead of conventional hay varieties, both forage and livestock producers have seen an increase in forage quality and dry matter yields. Silage corn has the ability to yield 11.92 tonnes/hectare

(5.25 tons/acre), nearly 1.5 times greater than traditional forage crops at 8.35 tonnes/hectare (3.68 tons/acre) of dry matter (MacPherson, 2002).

The introduction of industrial milk quota to Newfoundland and Labrador's dairy industry is one reason for the increased interest in high energy crops, such as silage corn. The introduction of this quota system has seen an increase in dairy herd size across the province. With only 2% of Newfoundland and Labrador's land mass suitable for agricultural production, there is concern in meeting these additional feeding requirements. Many producers do not have sufficient land to meet their cropping requirements when using traditional forages. Corn, known for its high yields, may be of aid in overcoming this challenge.

In 2005 and 2006, the On Farm Corn Silage research team experienced weed control problems. Herbicide and weed identification trials were initiated in 2007 to determine which herbicide, or combination of herbicides, was the most effective control in varying areas.

IMPORTANCE OF Corn Heat Units

CHU is an indicator of accumulated temperature - the most important environmental factor influencing plant development. CHU observations allow for accurate prediction of plant maturity stages and hybrid selection for specific agricultural areas (Tollenaar).

Corn development is driven primarily by temperature, and this is especially true during the planting to silking period. CHU was developed to calculate the impact of temperature on corn development (OMAFRA Field Crop Team, 2002). CHU is a measure of how heat affects the growth and development of crops, in particular corn. When dealing with CHU, the rate of growth is expected to increase as temperature increases, but day and night temperatures are considered separately since it is believed that no growth occurs at night when temperatures are below 4.4°C and 10°C during the day. Additionally, maximum growth occurs at 30°C and decreases with temperatures higher than this (www.aceweather.ca/generalinfo.htm). CHU is calculated in the following method:

$$CHU = \frac{1.8\,(Tmin - 4.4) + 3.3\,(Tmax - 10) - 0.082\,(Tmax - 10)2}{2}$$

Where:

- Tmin = daily minimum temperature; and,
- Tmax = daily maximum temperature
  (Manitoba Agriculture, Food and Rural Initiatives, 2004).

The development of corn plants is controlled by their genetic makeup and how those genes react to the environment where the plant is growing. This makes it critical to match CHU rating of the hybrid with the CHU rating of the area to be planted. If the hybrid's rating is too high, then the plant will not reach maturity. This indicates that maturity and development are more important when selecting a hybrid, than actual yield results (Manitoba Agriculture, Food and Rural Initiatives, 2004).

Newfoundland and Labrador has a harsh climate generally unsuitable for growing warm-weather crops, including silage corn. Average annual CHUs were 1,967 (farmzone.com, 2008) for the province's island during the growing season of May 15 to October 15; this was an increase of 106 CHU from 2007. CHUs ranged from 1,475 CHU on the South East Avalon, to 2363 CHU in the Stephenville-Bay St. George area.

Introduction of new technology, such as the Samco Integrated Crop System, has helped farmers overcome this climatic setback. By capturing up to 430 additional CHU under the plastic mulch, high-energy, high yielding crops such as corn can be grown with greater success rates. The majority of appropriate varieties are situated at 2,000 – 2,100 CHU, making these additional heat units valuable. Additionally, because germination of corn requires a minimum temperature of 10°C, the use of plastic to warm the soil is extremely beneficial during the critical spring germination period.

PROJECT PROCEDURE

SEEDING SILAGE CORN

Soil amendment recommendations were made to participating producers based on previous soil reports. The use of manure on the participating fields was a factor in these recommendations. The previous year's forage fields were sprayed with Round-Up at 3.5 L/hectare to eliminate forage re-growth. All fields were appropriately fertilized and prepared for seeding.

Planting occurred from May 13 to June 10, 2009. Trials were planted, using the variety 39W54, with a seeding rate of 93,000 plants/ha (37,300 plants/ac). All test plots were planted using 'Chinese' plastic mulch.

At the time of seeding, all locations (with the exception of the 'Control' group in the Herbicide Trials) were sprayed with a chemical herbicide for pre-emergence weed control. The variety grown, 39W54, is produced by Pioneer and has a CHU index of 2,150. This is a very early hybrid with outstanding yield and is characterized by excellent dry down.

The research protocol followed for the on-farm silage corn plots was supplied by Dr. Alan Kwabiah of the Atlantic Cool Climate Research Center and can be found in Appendix B.

Two CR 510 data loggers were set up at planting time on Lester's Farm in St. John's, and at Headline Holsteins (McLean's) in Nicholsville. These devices were used to measure CHUs accumulated under plastic, compared to exposed areas. This would give a measure of additional CHUs available when using the Samco system.

Observations were made on each on-farm plot throughout the planting, growing and harvesting of the trials. Results were also obtained from samples collected from each farm. From October 1 to 21st, random samples of three to four 1-meter row samples were collected at harvest and weighed for fresh whole sample weight. A single sample from each treatment was then dried in an oven at 60°C until 100% dry matter was reached. It was again weighed to determine final mass. The calculation used to calculate dry matter follows:

$$\frac{\text{Whole Sample Dry Weight}}{\text{Whole Sample Fresh Weight}} \times 100\%$$

To determine individual plant weight, the number of plants per sample was also recorded at the time of sample collection. The formula used to calculate dry matter yield per hectare/acre is shown below:

(Average Fresh Whole Sample Weight) ÷ (1,000.00 g/kg) = kg/sample
(kg/sample) x (5,310.84 samples/acre) = kg/acre
(kg/acre) ÷ (1,000.00 kg/ton) = tons/acre
(tons/acre) x (2.47) = tones/hectare
(tons/acre) x (% Dry Matter) = Dry Weight/acre
(tonnes/hectare) x (% Dry Matter) = Dry Weight/hectare

RESULTS & DISCUSSION

OVERVIEW OF RESULTS

As herd size in Newfoundland and Labrador continually increases above the national average, the dairy industry struggles with land availability to produce enough feed stuffs to become self-sufficient. Silage corn is seen by producers as a way to use the same amount of land base to at least double, and in some instances triple, their conventional forage yields, while at the same time producing an energy crop which cuts down on their imported energy feeds. This promotes favorable conditions for Total Mixed Ration (TMR) feeding, adding minimal protein supplements and in some cases, allowing for the sale of extra baled silage or hay. By incorporating corn silage into cropping rotations, more self-sufficient farmers can locally sell excess forage at a premium and save buyers from the additional transportation costs of mainland products. The On Farm Silage Corn Project is meeting its mission: to advance the industry's success through ongoing technical assistance.

The 2009 season has seen the silage corn project entering its twilight phase. The two-row Samco seeder, purchased in 2006 by the Department of Natural Resources, has proved to be an ideal tool to construct small scale research plots, while it has the ability to easily be transported to different farms with minimal effort. Up to five acres of structured plots or 10 acres of 'commercial' planting can be completed per day (i.e. constant population rates) if there is a nearby source of water available for tank fill-ups.

There was a complete crop loss this year at F. Greening's farm in Musgravetown. Moose were rampant in the area and ate nearly every corn cob in the herbicide trial plot. As such, conclusions will not be statistically correct, but trends may be observed.

Herbicide Trial

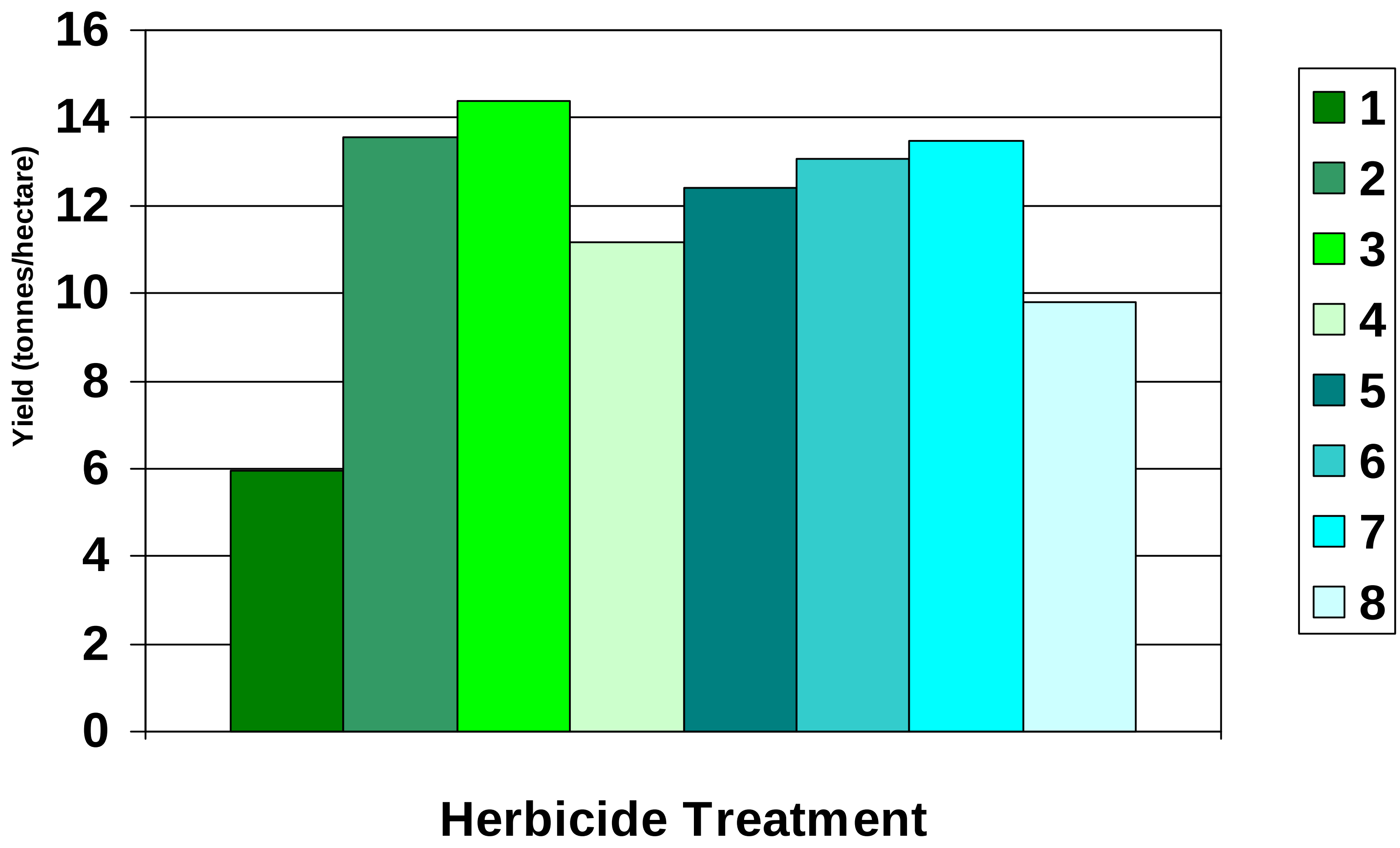
Table 2: Provincial Corn Yields – Herbicide Trial, 2009

Location	Treatment Number	Herbicide Treatment	Yield (kg/m)		DM Yield (T/ha)	% Dry Matter
			Fresh	Dry		
P. McLean (West)	1	Control	1.603	0.320	4.20	19.82
	2	Converge 480 (3.1 L/ha) + Converge Pro (220 mL/ha)	4.158	1.011	13.26	26.61
	3	Prowl (4.2 L/ha) + Callisto (300 mL/ha)	4.295	1.131	14.84	26.87
	4	Prowl (4.2 L/ha) + Aatrax (3.1L/ha) + Callisto (300 mL/ha)	3.466	0.878	11.52	25.34
	5	Primextra II Magnum (3 L/ha)	3.866	0.993	13.03	25.68
	6	Primextra II Magnum (4 L/ha)	3.230	0.847	11.11	26.32
	7	Primextra II Magnum (4L/ha) + Callisto (300 mL/ha)	3.786	0.988	12.81	26.09
	8	ElimEP (60g/ha) + Dual II Magnum (750 mL/ha) + Banvell II (0.75)	2.668	0.641	8.41	23.94
F. Greening* (Central)	1	Control	N/A	N/A	N/A	N/A
	2	Converge 480 (3.1 L/ha) + Converge Pro (220 mL/ha)	N/A	N/A	N/A	N/A
	3	Prowl (4.2 L/ha) + Callisto (300 mL/ha)	N/A	N/A	N/A	N/A
	4	Prowl (4.2 L/ha) + Aatrax (3.1L/ha) + Callisto (300 mL/ha)	N/A	N/A	N/A	N/A
	5	Primextra II Magnum (3 L/ha)	N/A	N/A	N/A	N/A
	6	Primextra II Magnum (4 L/ha)	N/A	N/A	N/A	N/A
	7	Primextra II Magnum (4L/ha) + Callisto (300 mL/ha)	N/A	N/A	N/A	N/A
	8	ElimEP (60g/ha) + Dual II Magnum (750 mL/ha) + Banvell II (0.75)	N/A	N/A	N/A	N/A

* Yields not measured due to extensive moose damage throughout plot.

Table 2 (cont'd)

Location	Treatment Number	Herbicide Treatment	Yield (kg/m)		DM Yield (T/ha)	% Dry Matter
			Fresh	Dry		
C. Lester (East)	1	Control	1.843	0.68	7.68	31.78
	2	Converge 480 (3.1 L/ha) + Converge Pro (220 mL/ha)	3.343	1.15	13.85	31.59
	3	Prowl (4.2 L/ha) + Callisto (300 mL/ha)	3.510	1.01	13.92	30.24
	4	Prowl (4.2 L/ha) + Aatrax (3.1L/ha) + Callisto (300 mL/ha)	3.433	1.13	10.83	24.04
	5	Primextra II Magnum (3 L/ha)	3.060	1.03	11.78	29.34
	6	Primextra II Magnum (4 L/ha)	3.648	1.29	15.02	31.39
	7	Primextra II Magnum (4L/ha) + Callisto (300 mL/ha)	3.533	1.13	14.15	30.54
	8	ElimEP (60g/ha) + Dual II Magnum (750 mL/ha) + Banvell II (0.75)	2.695	0.99	11.22	31.73



Graph 1: Average yield (tonnes/ha) by herbicide treatment, 2009

HERBICIDE SELECTION

The single most detrimental, controllable factor in corn yield loss is weeds. In use of the Samco system, where later season herbicide control options are limited, producers must focus on choices at planting time. It was the goal of this trial to determine relative effectiveness of available products or combination thereof, to best suit producers needs.

Lamb's-quarters and Lady's Thumbs were again identified as being the most important weed populations (by average dry matter). As strong competitors for resources, even small numbers can create detrimental yield losses. This can be noted in Graph 1; use of no chemicals (Treatment 1) resulted in yields reduced by up to 60 %. All test treatments (treatments 2-8) preformed better than the Control (treatment 1), where no chemical was sprayed. While some minor differences in yield between treatments 2 to 8 may be observed, this was not significant during the 2009 year. The greatest conclusion that may be drawn is that herbicide is necessary to maximize yields.

Due to variability of the effectiveness of chemical weed control, few concrete conclusions may be drawn. The greatest variable on herbicide effectiveness seems to be temperature at time of planting. Air temperatures of 5-10°C, preferably on overcast days, seems to lead to the greatest effectiveness of the chemicals. Temperatures too high at planting will often result in volatization under the plastic. Temperatures below this range are generally below the ideal level for the active ingredients.

In choosing farm appropriate options, producers should consider the following points:

1. What are the neighboring crops? *Despite registration on silage corn, adjacent crops may prevent the use of certain options. For example, Banvel II can cause extreme damage to potato crops.*

2. What is the weather forecasted? *Certain herbicides require specific temperatures or rainfall to be activated. The use of plastic mulch may create volatization losses of chemicals, or be more effective than in uncovered area because of the artificial rise in temperature of 5-10°C.*

3. What active ingredient was contained in the herbicide I used last year? *Herbicide rotation is important in order to avoid chemical resistance in weed populations*, and;

4. With new plastic technology, temperatures accumulated shortly after being planted are closer to those required by herbicides for chemical activation. Even with this new technology timing of herbicide application is still the most important factor.

CLIMATIC CONDITIONS

Table 3: On-Farm accumulated CHU and precipitation (mm)

Region	Accumulation Date	CHU		Precipitation* (mm)
		Bare Ground	Under Plastic	
Deer Lake	06/15 – 10/07	2281	2498	347.9
St. John's	05/21 – 10/13	2093	2579	309.2

(*www.farmzone.com, 2008).

Table 3 illustrates the advantage of using the Samco system. Up to an additional 484 CHU were captured by planting under plastic. This would normally be vital for the success of corn in both Deer Lake and St. John's during a typical year. This year, however, high CHU levels were experienced throughout the province.

Climatically, the 2009 growing season was relatively hot and dry. However, in many areas, planting was delayed, if not prevented wholly, by wet field conditions. This was a result of a cool, wet spring. Insufficient heat was accumulated to dry fields for planting. As the summer progressed, conditions became hotter than average. Additionally, a severe draught was experienced throughout the province, with most areas receiving minimal precipitation for nearly six weeks. From late August to the end of September, precipitation was then higher than average.

Data collected from the CR-510 illustrates the importance of an early planting date. Producers should be advised that if planting is delayed after early to mid-May, of the following options:

1. Is planting without plastic possible? After this deadline, there would be little additional CHU accumulation under plastic; use of mulch could be considered an avoidable expense and;

2. If maturity will not be reached, and nutritional value will be compromised, is it a necessary crop?

CONCLUSION

Technology in agriculture has become the basis of economical sustainability. From hybrid availability to crop seeding, it plays an important role in today's agricultural world. Silage corn has proved its ability to increase forage dry matter yields over traditional forages.

The Alternative Feeds Program has aided production of silage corn in Newfoundland and Labrador by introducing new technologies to the agricultural community. The Samco X-tend System is allowing producers to grow silage corn crops that exceed previously grown conventional yields by approximately 25%. This herbicide trial indicates that the greatest effect on yield may not be the chemical chosen, but instead the conditions at planting.

The production of corn silage crops has been shown to have two important benefits on some of Newfoundland and Labrador's farms. It allows producers to both decrease dependency on expensive importation of grains and feeds, and increase farm yields on a set land-base. The Alternative Feeds Programs, On-Farm Silage Corn Project has been a long-term project where the Department of Natural Resources, Agriculture and Agrifoods Canada and local producers have cooperated to test the efficiency of silage corn as a feed-stuff for local producers.

In recent years however many producers have begun to turn their backs on this crop in favor of more 'traditional' forages. Variability over the years in regards to both quality and yield has caused producers in marginal areas to re-evaluate their cropping choices. Grass-legume mixtures are being favored in such regions, particularly Timothy-Clover blends.

DRY MATTER YIELD OF SILAGE GRASSES

INTRODUCTION

Newfoundland and Labrador is known to have unique agricultural challenges. For example, only 2% of total land area has been identified as suitable for agronomic production. With increasing operational costs, livestock producers must maximize this limited land-base through selection of crops that are both highly nutritious and high yielding.

Timothy is the primary grass chosen for mixtures in Newfoundland and Labrador. It is a winter-hardy species with many advantages, such as tolerance to wet, acidic soils and ease of establishment (Forage and Corn Variety Evaluation Task Group, 2000). However, several farms currently growing timothy as the primary forage grass have expressed concern regarding the lack of yield in the second cut. In forage research trials throughout Atlantic Canada, timothy regrowth has proven slow. Average yields of second cut silage was 2.6 t/ha, as opposed to 6.5 t/ha in the first cut (P.E.I. Department of Agriculture, 2009).

In a Prince Edward Island study of biomass and composition, several species were identified as having greater yields than timothy, while maintaining quality (Kunelius et. al, 2001). In pure grass swards, Creeping Red Fescue, and two cultivars of Tall Fescue produced upwards of 10% higher yields than timothy.

To create recommendations for the Province of Newfoundland and Labrador, five alternative forage grasses were grown, as well as timothy (as the control). To fully identify the best species (based on dry matter yield) four sites were selected throughout the Island of Newfoundland to create recommendations based upon climate and soil types.

The species chosen for this study (based on research throughout the Atlantic Provinces) included:

Timothy (*Phleum pratense*) – Richmond variety: A very winter-hardy species known for good persistence and tolerance to wet, acidic soils. Slow regrowth, particularly in hot, dry conditions.

Reed Canarygrass (*Phalaris arundinacea*) – Venture variety: Good to excellent regrowth. Known to be high yielding in well drained soil. Very important to harvest at or before heading to maximize palatability and quality. Stored seed may not retain its germination rate in storage.

Orchardgrass (*Dactylis glomerata*) – Kay variety: Very early maturation with rapid regrowth after cutting. Danger of stand injury with ice and flood conditions.

Meadow Bromegrass (*Bromus riparius*) – Paddock variety: Rapid regrowth after cutting. Relatively uniform seasonal growth. Limited on-farm information is available in Atlantic Canada.

Meadow Fescue (*Festuca pratensis*) – Pardel variety: Perennial bunchgrass adapted to the same soil and climatic conditions as timothy. Better regrowth than timothy during mid-summer.

Tall Fescue (*Festuca arundinacea*) – Courtney variety: Adapted to most soil types. Highly productive in terms of seasonal yield. Maintains quality later into summer.

Grasses are generally not grown in pure stands; a legume is added to increase both yield and protein content. To create results closer to those found in practice, each grass was grown with red clover in a 1:1 ratio (by seed count).

Table 4: Producers Participating in the 2009-2010 Silage Grass Project

Farm	Location
F. Greening	Musgravetown
J. Wells	Robinson's
M. Rideout	Cormack
T. Williams	St. John's

PROJECT PROCEDURE

In the early spring of 2009-2010, livestock producers, as identified in Table 4 were sent a brief project description and an application to participate. Four farms throughout the province were selected, based on pre-determined eligibility criteria, such as a minimum prepared field size of 5 acres.

Soil samples were taken at each location to determine soil pH and fertility.Where applicable, manure samples were taken to ensure accurate recommendations. Fields involved in this experiment were appropriately treated for weeds, limed, fertilized, and a proper seed bed prepared for planting.

From June 6 to July 15, 2009, planting occurred. Plots were divided into six sections and planted with the grass-legume mixtures (legume was inoculated prior to planting). Planting order was randomly predetermined for each site. Seeding rate was 12 kg/ha, with a 1:1 ratio of grass to legume seeds.

Each site was monitored on a weekly basis and varieties evaluated separately. Please refer to Appendix B for Research Protocols.

RESULTS & DISCUSSION

OVERVIEW OF RESULTS

Due to the late planting date, growth was not as great as expected. Please see Table 6 for the comparative growth of each grass species, by farm.

Table 5. Comparative height of grass species (cm), by farm Mid-October.

Grass Species	F. Greening	J. Wells	M. Rideout	T. Williams
Timothy	N/A	17	19	24
Orchardgrass	N/A	30	28	36
Meadow Fescue	N/A	15	23	17
Tall Fescue	N/A	24	18	14
Meadow Brome	N/A	26	29	20
Reed Canarygrass	N/A	21	24	23

Due to the late planting date, grasses did not reach maturity before the onset of fall. Nutritional samples were not taken due to immaturity of the crop. Table 7 illustrates the dry matter yield and dry matter percentage of each grass type, by farm.

Table 6. Comparative Dry matter yield (t/ha) and dry matter percentage of assorted grasses.

Grass Species	F. Greening		J. Wells		M. Rideout		T. Williams	
	DMY	DM %	DMY	DM %	DMY	DM %	DMY	DM %
Timothy	N/A	N/A	0.54	19.78	0.59	18.94	0.62	19.68
Orchardgrass	N/A	N/A	0.50	20.86	0.47	20.77	0.46	19.92
Meadow Fescue	N/A	N/A	0.41	24.10	0.50	21.43	0.47	18.54
Tall Fescue	N/A	N/A	0.94	23.79	0.82	22.89	0.78	19.81
Meadow Brome	N/A	N/A	0.63	18.61	0.69	19.25	0.59	17.18
Reed Canarygrass	N/A	N/A	0.78	22.44	0.85	21.98	0.82	21.13

Overall, while Orchardgrass and Meadow Brome appeared taller, greater dry matter yields were gained in the first year by Tall Fescue and Reed Canarygrass.

It should be noted that the plots at F. Greenings had to be abandoned. Heavy weed burdens were experienced, with little to no growth of forage. It is believed that this may be due to the extreme lateness of planting (July 15). Extreme hot dry weather was experienced following planting; the forage crop did not germinate. Similarly, heavy infestation of Lady's Thumb was experienced at J. Well's farm. Again a late planting date (July 2, 2009) is believed to be the primary cause.

CONCLUSION

As a result of late funding approval, several changes were made to the original Project Proposal.

1. Varieties were not those originally chosen. Most seed suppliers had sold out of certain varieties months previous to the order being made.
2. Many farmers had already completed seed orders and crop choices for the year. As a result, interest in this project was very low; only four farms were interested in participating.
3. Planting dates were delayed into the hotter, drier months of summer (as late as mid-July). This created several problems, including loss of F. Greening's fields to weeds.
4. Grass crops did not reach cutting maturity, also as a result of delayed planting.

Due to the high weed populations on two farms, the proposal for the 2010-2011 planting season has been modified to include planting with a companion crop of oats and peas to suppress weeds and ensure a nutritious crop in the establishment year. This may also lead to yield comparisons between crops planted with and without companion crops.

APPENDIX A

RESEARCH PROTOCOL

CORN SILAGE HERBICIDE TRIALS

Research Protocol
Optimal Plant Population and Hybrid Trial for Cool Climate Corn

(By – Dr. Allan Kwabiah, Corn Project Lead Scientist, AAFC, and St. John's)

1. **Rational:**

Temperature is the most limiting climatic factor for cool climate corn growth and development. Farmers have quickly adopted the use of plastic mulch to overcome the temperature limitations. The use of plastic mulch has greatly enhanced the ability to capture and retain heat in the soil during early growth periods of corn. Corn growers in Newfoundland have limited experience with agronomic practices such as plant population recommendations that are needed to achieve maximum yield potential.

2. **Hypothesis:**

Corn hybrids seeded under plastic mulch will have a greater tolerance of high plant population.

3. **Objective:**

To determine proper plant population for corn hybrids seeded under plastic mulch.

4. **Trial Set-up:**

- Plot sizes will be 10 x 6.08m
- Plots will consist of eight rows spaced 72cm apart
- Dates for seeding window will be between April 23 – May 24
- Main treatments = 2 (Plastic and No Plastic)
- Sub-plots = 2 (Hybrids)
- Sub-subplot = 3 (seeding rates: 79,000, 92,000 and 105,000 plants/ha)
- Each treatment will be replicated three times at each location

5. **Seed Requirements:**

Seed calculations are based on **8 rows at 76cm** spacing and plots measuring **10m x 6.08m = 60.8m sq**.

A planting population of **79,000 seeds per ha** corresponds to **6 seeds per meter**

A planting population of **92,000 seeds per ha** corresponds to **7 seeds per meter**

A planting population of **105,000 seeds per ha** corresponds to **8 seeds per meter**

6. Suggested hybrids:

Hybrid	CHU	Company
39N03	2100	Pioneer
39D81	2600	Pioneer
39J26	2300	Pioneer
39M27	2150	Pioneer
39P78	2050	Pioneer

7. Experimental Details:

- The experiments will be located on sites where the soil climate and management will provide the potential for high economic yields of corn.
- Soil sampling at the sites will be carried out first to determine pH and existing nutrient (total N, P, K, Ca, Mg) and soil organic matter content, which will be used as a measure of the soil fertility.
- The seeds will be sown by a corn seeder at the specified spacing to achieve the desired plant population.
- The experimental design will be a split-split-split (with three replications) with the plastic mulch (with and without) as the main treatment, the hybrids as sub-plots, and the plant populations as the sub-sub-plots.
- The seeded areas will be fertilized at seeding with the fertilizer inputs determined from soil test recommendations.
- A pre-emergence herbicide will be sprayed on the field at seeding. Type of herbicide will be determined by the history of weed infestation at the site.
- The plastic will not be removed unless symptoms of plant growth impairment are demonstrated.
- Any visually observed pests, diseases and nutrient deficiency symptoms that appears persistent and threatening to corn growth and performance should be noted and reported (without delay) to **Dr. A. Kwabiah (AAFC, St. John's)**. (See address below).
- Soil and air temperatures will be measured for selected sites with 107 and 107B probes that use thermistors to measure temperature. The 107 probe is designed to measure air temperature and will be placed on the soil surface. The 107B is designed to measure soil/water temperature and will be buried 5 cm deep in the soil.
- Temperature should be monitored with a CR-510 data logger (Campbell Scientific, Logan, Utah) with a scan rate of 60 seconds and averaged hourly.
- Using the maximum day-time and minimum night-time air temperatures, daily corn heat units (DCHU) will be calculated to determine cumulative CHU.

8. Key hybrid performance measurement indicators:

- The sites will be monitored following seeding to determine ***time to emergence***. At the start of emergence randomly selected areas within plots will be counted in order to determine ***% emergence*** of seeds for each treatment. Plant counts will be repeated one more time at the end of the establishment period. When emergence has finished a final seedling count will be conducted to determine final ***plant population***.

- Seedling vigor and relationship to plastic mulch
- Stalk strength (lodging susceptibility)
- Time to reach the 6^{th} leaf stage of growth (V6), V10, V12 etc,
- 50% silking
- 50% tasseling
- Maturity

Note: Silk date on each plot should be recorded when 50% of the plants had formed silk 2.5cm long.

- At harvest, the following should be measured:
  - Dry matter of whole plant silage (yield),
  - Grain yield (if any),
  - Grain harvest index (HI),
  - Soil analysis.
- Dried corn silage samples will be analyzed for quality by determining:
  - Digestable energy (MJ/kg),
  - Acid detergent fibre (ADF),
  - Neutral detergent fibre (NDF),
  - Crude protein,
  - Nutrient content (Ca, P, Mg and K).
- Data from all sites and all questions and concerns pertaining to the Corn Research Project should be directed to:

- Dr. Allan Kwabiah, Atlantic Cool Climate Crop Research Centre, 308 Brookfield Road, P.O. Box 39088, St. John's, NL A1E 5Y7. Tel: 709-772-5278; Fax 709-772-6064;
- Email: kwabiaha@agr.gc.ca (Preferred)

APPENDIX B

RESEARCH PROTOCOL

DRY MATTER YIELD OF SILAGE GRASSES

Research Protocol - 2009
Forage grass selection to increase dry matter yield in Newfoundland and Labrador.

Afton Madore, Alternative Feeds Coordinator, Department of Natural Resources

1. Rational

Timothy, the forage grass of choice throughout Atlantic Canada, has been identified as having several productive limits. With a shallow root system making the plant prone to drought stress, and slow regrowth after cutting, Newfoundland and Labrador livestock producers have experienced problems with low second-cut yields. In studies conducted throughout the Atlantic Canadian provinces, several alternative varieties have been identified as having greater dry matter yields than timothy. However, this selection variable has not been fully explored in the unique soil and climatic conditions of Newfoundland and Labrador.

2. Hypothesis

Alternative grass species (e.g. tall fescue) will have higher dry matter yields than timothy under a 2-3 cut silage system in Newfoundland and Labrador.

3. Objective

To determine comparative dry matter yields of six grass species in a 2/3 cut silage system.

4. Trial Set Up

- A minimum of six farms will be selected to grow timothy and five additional grass species.
- Fields on-farm will be a minimum of five acres, to be divided approximately equally between varieties.
- Seeding dates will be from May 21-June 21.
- Seeding rate will be 20 kg/ha, with equal seed ratio of grass to legume (red clover).
- Varieties chosen are those as recommended by the Atlantic Provinces Agricultural Services Coordinating Committee.
- At the Pynn's Brook Research Station, and the Atlantic Cool Climate Crop Research Center, two smaller plots will be created (1.5 x 6.0 m per variety).

1. Species and Hybrids Selected

- Timothy - Novis or Richmond
- Reed Canarygrass – Venture
- Orchard Grass – Kay
- Meadow Bromegrass – Paddock
- Meadow Fescue – Pardell

- Tall Fescue – Courtney
- Red Clover – AC Endure

2. Experiment Details

- Soil samples will be taken to determine pH and fertility (N, P, K, Ca & Mg).
- Fields chosen will be limed, fertilized and a proper seed-bed prepared in a weed free field.
- Red clover will be inoculated prior to planting.
- Each variety will be sown at a rate of 20 kg/ha with a 1:1 seed ratio of grass to legume.
- Weekly samples will be taken from the boot stage to the heading out stage.

3. Key Performance Measurement Indicators

- Each site will be monitored after seeding for:
    - time to:- emergence
      - boot stage
      - heading-out
    - Weed population
    - Diseases
    - Pests
    - Nutrient Deficiencies
- Weekly measurement of both grass and red clover height will be recorded.
- At each location, yields will be calculated by taking three samples from each variety to determine DM yield using a forage square.
- Samples will be analyzed for quality by determining:
    - Digestible Energy (DE)
    - Acid Detergent Fiber (ADF)
    - Neutral Detergent Fiber (NDF)
    - Crude Protein (CP)
    - Nutrient Content (Ca, P, Mg, K)
    - Economic Benefits
- Following the variety trial, an economic benefit analysis will be completed.

APPENDIX C

HERBICIDE WEED SEPARATIONS

Table 7. Herbicide Trial Weed Separations, F. Greening, 2009

		Lady Quarters		Grass		Pineapple	
Rep	**Treatment**	Wet	Dry	Wet	Dry	Wet	Dry
1	Control	118.4 g	21.8 g				
2	Control	124. 3 g	22.9 g				
3	Control	156.7 g	28.7 g	1.9 g	0.8 g	6.8 g	1.7 g
1	Primextra II Magnum (4 L/ha)						
2	Primextra II Magnum (4 L/ha)						
3	Primextra II Magnum (4 L/ha)						
1	Primexta II Magnum (3 L/ha)						
2	Primexta II Magnum (3 L/ha)						
3	Primexta II Magnum (3 L/ha)						
1	Primextra II Magnum (4.0L/ha and Callisto 300ml/ha)						
2	Primextra II Magnum (4.0L/ha and Callisto 300ml/ha)						
3	Primextra II Magnum (4.0L/ha and Callisto 300ml/ha)						
1	Prowl 3.2L/ha+ Aatrax 3.1L/ha + Callisto 300ml/ha						
2	Prowl 3.2L/ha+ Aatrax 3.1L/ha + Callisto 300ml/ha						
3	Prowl 3.2L/ha+ Aatrax 3.1L/ha + Callisto 300ml/ha						
1	Prowl 3.2L/ha + Callisto 300ml/ha						
2	Prowl 3.2L/ha + Callisto 300ml/ha						
3	Prowl 3.2L/ha + Callisto 300ml/ha						
1	Converge 480 and Converge Pro 220 ml/ha						
2	Converge 480 and Converge Pro 220 ml/ha						
3	Converge 480 and Converge Pro 220 ml/ha						
1	Banvel 2 0.75L/ha + ElimEP 60g/ha and Dual 2 0.75L/ha						
2	Banvel 2 0.75L/ha + ElimEP 60g/ha and Dual 2 0.75L/ha						
3	Banvel 2 0.75L/ha + ElimEP 60g/ha and Dual 2 0.75L/ha						

Table 7. Herbicide Trial Weed Separations, C. Lester (West), 2009

		Lady Thumb		Grass		Hemp		Lamb Quarter		Sheppard Purse	
Rep	Treatment	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
1	Control	122.5 g	15.8 g			7.5 g	0.2 g	707. 5 g	71.3 g	0.6 g	0.3 g
2	Control	283.1 g	26.2 g			1.9 g	0.3 g	468.4 g	45.4 g	6.8 g	0.3 g
3	Control	113.7 g	10.4 g	14.4 g	0.9 g			687. 5 g	72.3 g	1.1 g	0.1 g
1	Primextra II Magnum (4 L/ha)							318.6 g	92.7 g		
2	Primextra II Magnum (4 L/ha)							381.2 g	90.3 g		
3	Primextra II Magnum (4 L/ha)							279 g	44.6 g		
1	Primexta II Magnum (3 L/ha)	263.3 g	40.9 g	15.2 g	0.6 g			779.3 g	171.1 g		
2	Primexta II Magnum (3 L/ha)	495.5 g	66.3 g	11.7g	0.7 g			487.7 g	75.8 g		
3	Primexta II Magnum (3 L/ha)	455.7 g	40.3 g					312.9 g	36.2 g		
1	Primextra II Magnum (4.0L/ha and Callisto 300ml/ha)			65.4 g	9.5 g			123.9 g	12.6 g		
2	Primextra II Magnum (4.0L/ha and Callisto 300ml/ha)							93.3 g	9.5 g		
3	Primextra II Magnum (4.0L/ha and Callisto 300ml/ha)			11.6 g	1.5 g			146 g	14.1 g		
1	Prowl 3.2L/ha+ Aatrax 3.1L/ha + Callisto 300ml/ha										
2	Prowl 3.2L/ha+ Aatrax 3.1L/ha + Callisto 300ml/ha			33.6 g	3.3 g						
3	Prowl 3.2L/ha+ Aatrax 3.1L/ha + Callisto 300ml/ha	20.2 g	1.8 g	3.8 g	0.3 g						
1	Prowl 3.2L/ha + Callisto 300ml/ha	35.3 g	3.7 g					18 g	1.5 g		
2	Prowl 3.2L/ha + Callisto 300ml/ha	23.6 g	2.1 g	6.4 g	0.8 g						
3	Prowl 3.2L/ha + Callisto 300ml/ha	50.4 g	4.8 g								
1	Converge 480 and Converge Pro 220 ml/ha			3.0 g	0.3 g	26.1 g	8.6 g	75.5 g	6.4 g		
2	Converge 480 and Converge Pro 220 ml/ha	30.5 g	1.0 g	2.8 g	0.1 g	3.0 g	1.5 g	8.2 g	0.9 g		
3	Converge 480 and Converge Pro 220 ml/ha					15.5 g	1.0 g				
1	Banvel 2 0.75L/ha + ElimEP 60g/ha and Dual 2 0.75L/ha	402.5 g	45.3 g					51.7 g	4.1 g		
2	Banvel 2 0.75L/ha + ElimEP 60g/ha and Dual 2 0.75L/ha	314.5 g	31.8 g					76.3 g	6.8 g		
3	Banvel 2 0.75L/ha + ElimEP 60g/ha and Dual 2 0.75L/ha	207 g	18.4 g	91.9 g	14.2 g			76.2 g	7.2 g		

Table 7. Herbicide Trial Weed Separations, P. McLean, 2009

Plant Weights in Grams

Treatment	Replicate	Lambs Quarters		Plantain		Lady's Thumb		Barnyard grass		Corn Spurry		Hemp Nettle	
		Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry	Wet	Dry
Control	1	73	18.1	0	0	46.5	10.9	33.8	27.4	24.2	19.7	16.4	4.8
Control	2	132.9	33.2	27.3	6.8	92.3	22.1	12.9	8.5	18.5	15.8	19.3	5.8
Control	3	79.4	18.4	22.9	5.1	14.1	3.4	43.6	36	12.2	6.1	21.6	6.1
Converge 480 + Converge Pro	1	0	0	0	0	0	0	0	0	0	0	0	0
Converge 480 + Converge Pro	2	0	0	0	0	0	0	0	0	0	0	0	0
Converge 480 + Converge Pro	3	26.1	6.2	0	0	0	0	0	0	0	0	0	0
Prowl + Callisto	1	0	0	0	0	0	0	0	0	0	0	0	0
Prowl + Callisto	2	23.4	6.8	0	0	0	0	0	0	12.9	10.86	0	0
Prowl + Callisto	3	0	0	0	0	0	0	0	0	0	0	0	0
Prowl + Aatrax + Callisto	1	0	0	0	0	84.6	23.6	0	0	0	0	0	0
Prowl + Aatrax + Callisto	2	0	0	0	0	0	0	0	0	0	0	13.4	2.7
Prowl + Aatrax + Callisto	3	46.3	13.1	0	0	0	0	0	0	0	0	0	0
Primexta II Magnum (3 L/ha)	1	0	0	0	0	0	0	0	0	0	0	0	0
Primexta II Magnum (3 L/ha)	2	0	0	0	0	0	0	0	0	0	0	0	0
Primexta II Magnum (3 L/ha)	3	0	0	0	0	23.7	7.2	11.1	7.4	0	0	0	0
Primextra II Magnum (4 L/ha)	1	0	0	0	0	0	0	0	0	0	0	0	0
Primextra II Magnum (4 L/ha)	2	0	0	0	0	0	0	0	0	0	0	0	0
Primextra II Magnum (4 L/ha)	3	39.4	8.3	0	0	0	0	0	0	0	0	0	0
Primextra + Callisto	1	0	0	0	0	0	0	0	0	0	0	28.6	5.9
Primextra + Callisto	2	0	0	0	0	0	0	0	0	0	0	0	0
Primextra + Callisto	3	0	0	0	0	0	0	0	0	0	0	0	0
ElimEP + Dual II Magnum + Banvell II	1	0	0	10.6	2.4	15.2	3.7	12.3	9.6	0	0	13.5	3.9
ElimEP + Dual II Magnum + Banvell II	2	38.9	9.2	0	0	18.9	3.1	15.1	9.1	0	0	0	0
ElimEP + Dual II Magnum + Banvell II	3	61.2	17.6	0	0	26.4	8.8	19.6	12.4	0	0	0	0

APPENDIX D

SELECTED 2009 PHOTOS

Picture 1. Planting at C. Lesters, May 13, 2009

Picture 2. Snow fall, C.Lester's May 26, 2009

Picture 3. Heavy weed population in Control, P. McLean August 26, 2009

Picture 4. Moose damaged crop at F. Greening's, August 19, 2009

Picture 5. Planting at T. William's, June 19, 2009

Picture 6. Heavy populations of Lady's Thumb at J. Wells, August 24, 2009

Picture 7. Weed population at F. Greening; primarily Lamb's Quarters, August 19, 2009

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