



**Provincial Agrifoods
Research & Development Fund
Report
2013-2014**

Alternative Feeds Program:

*Forage Mixtures for Yield & Quality
and
Non-Traditional Forage Identification Trial*

Produced for: Department of Natural Resources

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Executive Summary

The 2012 growing season left many Newfoundland and Labrador (NL) farmers producing insufficient quantities of forage to meet farm needs. On a dry matter basis, dairy producers in central and eastern NL reported producing approximately 39,600 bales of forage in 2011, however this decreased to approximately 26,500 bales in 2012 (Peter MacIntyre, personal communication 2012). The reason for reduced forage yields in 2012 can partly be attributed to drought conditions in early summer which slowed forage growth and resulted in a plague of Armyworms (*Mamestra configurata*).

At the best of times, NL producers can experience a shortage of forage which may be explained by, (1) limited available land base for forage production, (2) low plant species diversity and (3) a lack of field renovation practices. Low species diversity in the perennial forage stands of NL can be attributed to two main factors. A shortage of new forage species and knowledge of their growth in NL, as well as management practices which favor the growth of grasses and impede the establishment of legumes.

The objective of this research project is to help identify new species/ cultivars and forage mixtures that could increase the diversity of NL perennial forage stands. Results may also reinforce the idea that mixes of several forage species tend to be more productive than monocultures.

The original project lead, Dan MacEachern unfortunately left at the end of May 2013. The remaining Alternative Feeds Program staff picked-up the Forage Project where he left off. To date, there had been no interest expressed by NL farmers for the “No-Till Seeding of Crops for Soil Improvement”, therefore it was pursued further. It was the intention of the staff to plant the small plot trial “Evaluation of Tillage Radish”, unfortunately due to time constraints this trial was also not executed. Therefore only 2 of the 4 originally proposed trials took place in 2013.

The final goals of the project were to:

- (i) assess alternative forage mixtures for yield and quality.
- (ii) evaluate non-traditional forage varieties identification trial.

It was impossible to infer from the “Forage Mixtures for Yield and Quality” trial which forage grass-legume mixture should be recommended to producers without having analyzed the nutritional data, and based on yield observations alone. Therefore, at this time the main outcome from this trial is realizing the errors that were made, particularly at seeding and how they can be avoided future projects.

Based on observations made at harvest from the “Non-Traditional Forage Variety Assessment” trial, it appears that the Festulolium, Crimson Clover, and Sudan Grass Hybrid outperformed the 3 brassica species. However, without having analyzed the yield and nutrition data it is impossible to make recommendations as to what crop should be grown by NL forage producers. It is the impression of the research team that the brassica species are of the least interest to forage producers.

1 Introduction

The 2012 growing season left many Newfoundland and Labrador (NL) farmers producing insufficient quantities of forage to meet farm needs. On a dry matter basis, dairy producers in central and eastern NL reported producing approximately 13,000 bales less in 2012 compared to 2011 (Peter MacIntyre, personal communication 2012). Although the difference of approximately 13,000 bales may seem insignificant, the increased demand for forage caused a spike in prices, resulting in producers spending over three times that spent in the previous year. This equated to an extra \$1.4 million in forage costs, with an average price per bale of roughly \$111.00.

The reason for reduced forage yields in 2012 can partly be attributed to drought conditions in early summer which slowed forage growth and resulted in a plague of Armyworms (*Mamestra configurata*). These pests devastated forage stands by consuming plants which were already stressed by adverse environmental conditions.

At the best of times, NL producers can experience a shortage of forage which may be explained by, (1) limited available land base for forage production, (2) low plant species diversity and (3) a lack of field renovation practices.

Through the *Growing Forward* land clearing initiative, the government of NL is hoping to expand the presently limited land base for agricultural production. Clearing new land will give producers the opportunity to achieve self-sufficiency in forage production and reduce reliance on existing forage stands, allowing for experimentation with alternate crops, forage mixtures, as well as novel management practices.

Low species diversity in the perennial forage stands of NL can be attributed to two main factors. A shortage of new forage species and knowledge of their growth in NL, as well as management practices which favor the growth of grasses and impede the establishment of legumes. This research proposal will offer potential projects that will help identify new species and cultivars that could increase the botanical diversity in NL perennial forage stands. Results may also reinforce the idea that mixes of several forage species tend to be more productive than monocultures.

This project originally consisted of four components:

- (i) Forage mixtures for Yield and Quality
- (ii) Evaluation of Tillage Radish
- (iii) No-Till Seeding for Soil Improvement
- (iv) Non-traditional Forage Variety Identification Trial

The original project lead, Dan MacEachern unfortunately left at the end of May 2013. The remaining Alternative Feeds Program staff picked-up the Forage Project where he left off. At that time there had been no interest expressed by NL farmers for the “No-Till Seeding of Crops for Soil Improvement”, therefore it wasn’t pursued any further. It was the intention of the staff to plant the small plot trial “Evaluation of Tillage Radish”; unfortunately due to time constraints this trial was also not executed. Therefore only 2 of the 4 originally proposed trials were initiated in 2013.

Discussion in this report will be surrounding the remaining project objectives:

- (i) To assess alternative forage mixtures for yield and quality.
- (ii) To evaluate non-traditional forage varieties.

Following the departure of Mr. MacEachern the Alternative Feeds Coordinator-Forage position was temporarily filled until the end of the calendar year. As of December 31st, 2013 the lab results from the plant samples were not complete, therefore the project quantitative data has not been processed and will not be presented in this report. The discussion presented in this report is based on qualitative data and observations only. The Department of Natural Resources is in the process of filling this position, at which time analysis and interpretation of this data will be completed.

2 Forage Mixtures for Yield and Quality: An Assessment of Kura Clover

2.1 Project Background and Rationale

Timothy (*Phleum pratense* L.) has long been the industry standard species for grass silage production in NL (Kunelius et al. 2003). It can produce dry matter yields up to 10 T ha⁻¹ (Dürr et al. 2005), but re-growth tends to be slow, particularly under dry and hot climatic conditions (Nova Scotia Crop Development Institute 1993), which results in low second-cut yields. Finding a drought tolerant, high yielding and highly nutritious grass to seed with legumes would benefit the industry by providing a buffer under increasingly frequent drought conditions.

A previous project focused on growing forage stands consisting of one grass species with a legume, such as red clover (*Trifolium pratense*) to compare yields to that of timothy (Kennedy 2010). This study indicated that fields of meadow fescue (*Festuca pratensis*) in their second year of production yielded numerically greater yields than that of timothy and the other forage grasses tested (Kennedy 2010). This indicated that not only does meadow fescue have potential as a replacement for timothy in forage mixtures, but that mixtures, rather than single grass species in a stand result in higher yields for the second-cut, contrary to findings by Madore (2009). This is supported by the findings of other researchers (Sturludóttir 2011) who observed forage mixtures producing greater yields and having higher feed quality than the most productive grass monocultures.

Findings from Kennedy's (2010) project on grass performance in NL were used as a base for continued research into species performance in NL. Selected for use in the current project are the two grass species found to perform well in NL - meadow fescue and meadow brome (*Bromus biebersteinii*). The common legumes red clover, birdsfoot trefoil (*Lotus corniculatus*), and alfalfa (*Medicago sativa*) were used in mixes with these grasses, along with a "new to NL" legume, kura clover (*Trifolium ambiguum*). The performance of this particular species was of particular interest.

Kura clover is a forage species which is not on record as have ever been grown in NL before. It is known to have high feed quality, handle low soil pH, be winter hardy, and

can persist in soils for as long as 13 years (Taylor 2009). What separates kura clover from other legumes and allows for kura's hardiness is that it spreads by rhizomes and has a deep fibrous root system (Hannaway and Myers 2004). Its ability to establish and thrive in NL must be determined.

The original objective of this trial was to develop innovative forage mixtures to maximize forage production in existing fields. However, due to challenges presented at seeding, the trial became a seeding method comparison (no-tillage and conventional) and forage mixture evaluation.

Ultimately, this trial will provide benefits to forage producers by decreasing forage importation, increasing on-farm forage production, and potentially increasing the quality of livestock feed, which may lead to increased milk production. The province will also gain knowledge on forage grass and legume selection, as well as best management practices for establishing forage fields in NL.

2.2 Methods and Materials

2.2.1 Site Description

The experimental site for this trial was planted on a 50 acre field located in Pasadena, NL (Figure 1) that was in tame production. The site was rented from Hammond Farms and was chosen due to its close proximity to the Pynn's Brook Research Facility. Its location allowed for reduced travel for regular staff monitoring, farm machinery, and supplies required for this trial. The trial field was divided into 15 plots in 3 blocks, avoiding low and wet areas of the field.

According to Kirby (1988), the soils are predominated by Earle (Orthic Humo-Ferric Podzols) soil series, typified by very gravelly fluvial deposit derived mainly from red sandstone, gray siltstone, and granitic rocks. Earle soils are gravelly loamy sand, with moderately well to rapid drainage, and it is over 100 cm to bedrock. There was minimal slope to the field, with some low spots that appeared have pooled water and a soil with a higher clay content.

All preparatory agronomic activities were performed by Hammond Farm. This involved the thorough process of burning down the existing stand, tilling, liming, rock picking, and rolling the field. Previous to this project, the field was not maintained on a regular basis and had developed a large seed bank in many areas of the field.

Government staff began seeding on June 10th, 2013, with the original intention of using the Department of Natural Resources 6' Great Plains no-till seeder to seed the entire field. The seeder had been calibrated for all of the desired species and seeding began in Treatment 2 in Block A, working east across the field. At the fourth plot (identified as "Cut" in Figure 1) in Block A, the drop tubes continually jammed, resulting in sporadic seeding of the plot. The tubes were unjammed and the fifth plot (Block A Treatment 3) was seeded without incident. Unfortunately, the problem started in the next plot, again resulting in sporadic seeding. At this time it was decided that a new seeder should be



Figure 1 Field used for Forage Mixtures for Yield and Quality Trial in Pasadena. Plots and treatments are identified.

used to complete seeding the trial. Hammond Farm permitted the use of their 12' Brillion Sure Stand Seeder, which drops the seed onto the soil surface and then rolls it, as opposed to drilling it like a no-till seeder. The remainder of the field was seeded using the Brillion seeder. Due to excessive weed problems from a weed bank that was present in much of Block C, it was excluded further from the trial.

Fertilizer applications were made using a Gearmore Inc. Spinner Spreader S273L, on 3 separate occasions. An application of 111 lb/ac of 8-0-46 was made on July 8th, followed by top-dress (34-0-0 at 100 lb/ac) on July 23rd and a potash (0-0-52+0.6%B+7%S at 223 lb/ac) (AFACT ND) application on August 22nd.

A recommended method of controlling weeds in the establishment year is to clip them just before they go to head, eliminating their ability to drop new seeds (Green et al. 2006). This clipping was performed by Hammond Farms just prior to the potash application in mid-August. Hammond Farm completed final harvest and bailing of the entire field by the end of September.

Harvest samples from the plots were taken by provincial government staff twice throughout the growing season, once immediately before clipping on August 13th and once again just prior to the final fall harvest on September 20th.

2.2.2 Methodology

The trial was monitored on a weekly basis, with all treatments evaluated separately. Stand establishment was evaluated by counting the number of plants along a 12" (~30cm) length within the 1 m² plot (Figure 1). A good stand was considered to be 4 plants or greater, while a fair stand was 2-4 plants, and a poor stand was anything less than 2 plants (Saskatchewan Forge Council ND). Plant stage, height, and percent cover (see Appendix, Figure 7) were monitored on a weekly basis by placing a 0.25m² quadrat in each plot.



Figure 2. To determine establishment, plants were counted along a 30cm line.

Harvest of the plots was completed by randomly placing a 0.25m² quadrat into each plot, and harvesting what was within the quadrat. The forage was bagged and dried at 60°C for 48 hours to determine dry matter yield per hectare. Samples were then ground and submitted to the PEI Analytical Laboratories for nutritional analysis, including: ADF, NDF, CP, digestible energy, and nutrient content (Ca, P, Mg and K). After each cut, forage height was measured.

In addition to plant sampling, soil samples were taken 3 times throughout the growing season (spring, summer, fall) to monitor fertility levels. Soil penetrometer readings were taken simultaneously to monitor the crops impact on soil compaction. Pest and nutrient deficiency were monitored throughout the field season.

Temperature and precipitation were monitored from the Pynn's Brook site because of its close proximity using a Hoskin Scientific temperature probe and rain gauge.

2.2.3 Experimental design

The experimental design was modified from the original plan due to mechanical problems with the seeding equipment. Further discussion will reflect this change.

The experiment was carried out as a block design; blocked by two seeding methods, with four forage mixture treatments containing three replications. The two seeding methods were: 6' Mounted No-Till Compact Drill and 12' Brillion Sure Stand Seeder. Within each block were 4 forage mixture treatments consisting of the control – red clover and timothy; kura clover, meadow brome, and meadow fescue; birdsfoot trefoil, meadow brome, and meadow fescue; and alfalfa, meadow brome, and meadow fescue. Replications consisted of 3 randomly placed 1 m² plots in each treatment. All treatments were approximately 0.8 hectare (2 acre) area. Treatments and their respective seeding rates can be found in the Table 1 of the Appendix.

2.3 Results and Discussion

As mentioned in the report introduction, all results discussed will be in reference to qualitative and observations only. Quantitative data will be analyzed at a later date by the incoming Alternative Feeds Coordinator dealing with forages.

Researchers observed poor and slow establishment of all treatments, but it was noticeably worse in the block that was seeded using the Brillion Seeder. It was not surprising to see that the no-till drilled plots were establishing better than the conventionally seeded plots because it has been shown that clover establishment is more successful when drilled (Smith et al. 2009). As recommended by AFACT (ND) it would have been good practice to roll the entire field following seeding to ensure good soil to seed contact, particularly because of the dry soil conditions.

The slow establishment of all treatments in both blocks was attributed to a variety of factors, this first and most significant one being the soil and weather conditions. Moisture deficiencies at the time of seeding have been attributed to causing forage seeding failures, according to the Saskatchewan Forage Council (ND). The literature

suggests that planting should be done when there is a high probability of rainfall and when temperatures are moderate, between 5 and 8 °C. The conditions during seeding were very dry and in the range of 15-20°C. The original plan had been to plant nearly a month earlier when temperatures were lower and soils were at a higher moisture level but due to unforeseen circumstances this did not occur.

The second factor, which was compounded by the dry weather, was the lack of fertilizer at seeding. A lack of foresight and knowledge of the original project lead resulted in no fertilizer being ordered for application at seeding. Original soil tests indicated that the forage crops would require additional potassium (K) but no phosphorus (P) (see Appendix, Figure 8). In recent years it has been encouraged not to add nitrogen to legume crops, however, it is still strongly recommended to add nitrogen fertilizer when seeding legume and grasses together (AFACT ND; Mahler 2005). Incorporating fertilizer into the seedbed prior to seeding is often recommended, especially when applying fertilizers containing P and K, since they are relatively immobile in the soil (Mahler 2005). A fertilizer blend that is commonly applied at forage seeding was ordered and applied in late July but at that time seeds/ seedlings were already without water and proper nutrients for establishment.

A focus stated in the original proposal was to take significant note of the performance of the kura clover plots, given that they hadn't previously been grown in NL. Based on initial counts, it appears that the kura clover plots took longer to establish than the other legumes and did not have good establishment. According to a fact sheet released by the University of Kentucky Cooperative Extension Service (2010), establishment can be challenging for this crop and requires ideal conditions with little weed competition. It is recommended by the research team that this crop and its potential for growth in NL be explored further. Kura clover stands are known to thicken with age, so some time and patience may be required

Weeds can also pose a significant threat to the establishment of forage crops (AFACT ND) and unfortunately because of unideal conditions at planting weeds were able to overtake many of the trial crops, including the kura clover (UK Cooperative Extension Service 2010). This resulted in lower than expected yields in all plots and in both seeding method blocks (Figure 3). Unfortunately, because of the variety of species in the field, the only course of action available to combat the weeds was mowing them. The mowing did appear to have an impact on the weed population but the true result of this activity will not be realized until the next growing season.

It is impossible to infer which forage grass-legume mixture should be recommended to producers without having analyzed the nutritional data, and based on yield observations alone. Therefore, at this time the main outcome from this trial is realizing the errors that were made, particularly at seeding and how they can be avoided future projects. Things to keep in mind for future large scale field trials are the capacity of the equipment available, weather and soil conditions at planting time, soil fertility and crop nutrient requirements, and weed control.



Figure 3. The photo on the left is of a red clover plot seeded with the Brillion seeder to document the significant weed population. While the photo on the right depicts a plot seeded with the no-till seeder.

3 Non-Traditional Forage Variety Assessment

3.1 Project Background and Rationale

One of the keys to having a productive perennial forage stand that provides quality forage is having strong plant genetic material. This means growing forage species that may have adapted to handle an environment similar to the regional environment. One of the easiest ways to achieve this is by selecting the latest cultivars available through local seed suppliers. The problem with this is that the climatic conditions where these cultivars were tested may not be similar to ones own local conditions. This is the situation faced by many Newfoundland producers. Forage species that have been developed and tested in other parts of Canada, such as Saskatchewan or Ontario, may not perform as admirably on Newfoundland and Labrador.

In Atlantic Canada timothy (*Phleum pratense*), smooth brome (*Bromus inermis*), meadow brome (*B. riparius*), orchardgrass (*Dactylis glomerata*), meadow fescue (*Festuca pratensis*), tall fescue (*F. arundinacea*), reed canarygrass (*Phalaris arundinacea*), and reedtop (*Agrostis* spp.) are the grass species best adapted to the Atlantic Provinces' soils and climate for silage production (Forage and Corn Variety Evaluation Task Group 2000). Deciding which species to plant can depend on soil properties such as pH, drainage, and texture, however species characteristics such as hardiness, yield, and forage quality also comes into play.

The concept behind the “Non-traditional forage variety assessment” trial was to grow alternate annual crops that could be planted in renovation years, which would yield well and have good feed value. Oats are commonly grown in NL in renovation years but are known to mature later than other small grains, frequently resulting in them either being left in the field or being harvested at the wrong stage for ideal nutrition.

This project will assess the value of six non-traditional forage varieties. All of the tested varieties grow in other temperate regions of the world but little research has been done on

their performance in NL. The identification and resulting addition of alternative crops to the NL producer's arsenal of varieties could greatly decrease producer dependence on forage imports.

The species chosen for this study were:

Canadian Forage Sudan Hybrid 30 (CFSH 30) (*Sorghum X drummondii*): has been adapted for growth in Canada, and is thought to be a superior feed compared to corn and exhibits good regrowth (AERC Inc. 2007).

Festulolium (*Festulolium braunii*, K.A.): is a hybrid of Festuca (meadow fescue) and Lolium (Italian ryegrass), which is well adapted to cool climates but requires fertile, well-drained soils. It is a high quality perennial bunchgrass known for good winter hardiness, persistence, and stress tolerance (DLF Group 2013).

Crimson Clover (*Trifolium incarnatum* L.): is a winter annual herbaceous legume that will grow on soils of poorer quality than most other clovers. It does not do well in extreme cold or heat but its growth at lower temperatures is superior to other clovers (USDA 2009).

Tillage Radish® (*Raphanus sativus*, var. longipinnatus): also known as Forage Radish, is a winter annual that is often sown in pastures with grasses for grazing, and helps to alleviate soil compaction (Santangelo 2011).

Forage Turnip (*Brassica campestris* var. rapa): is known to have a high feed value for grazing with large leaves and root bulb. It is a fast growing crop, but it does not grow well in wet, poorly drained soils (Undersander et al. 2004).

Forage Rape (*Brassica napus* L.): exhibits rapid growth to provide a leafy crop for late fall consumption. When harvested for silage, forage rape has a high feed value but should be supplemented with fiber (Hannaway and Larson 2004).

The primary project objective was to increase the economic viability of Newfoundland and Labrador livestock producers by decreasing the necessity of forage importation, increasing on-farm forage production, and potentially increasing the quality of livestock feeds. This will result in recommendations for forage species selection, and determining comparative dry matter yields and forage quality of selected species. The information gained on these crops will be used to diversify forage species grown in the industry. Ultimately, the results will be used to select species for evaluation for field renovation potential.

3.2 Methods and Materials

3.2.1 Site Description

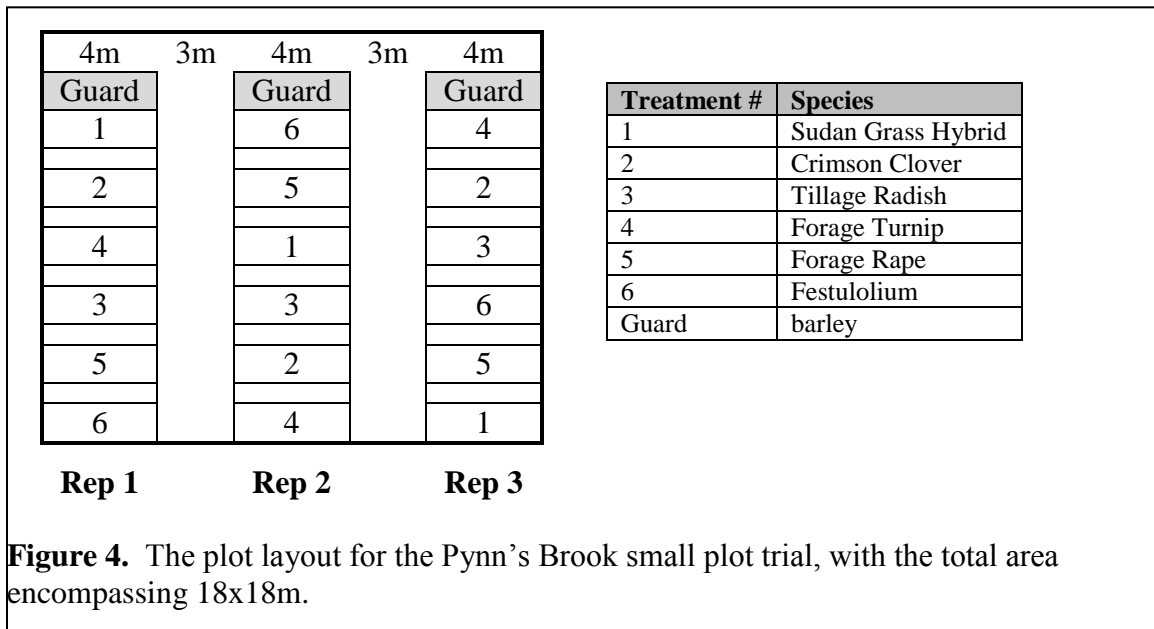
To evaluate non-traditional forage species, a small plot trial was initiated at Pynn's Brook Research Facility (49° 05 N; 57° 33 W) on an 18x18m field (See Appendix for **Procedure for Small Plot Trial Site Preparation**).

According to Kirby (1988), the soils are predominated by Lakeland (Orthic Gleysol) and Microwave (Gleyed Eluviated Dystric Brunisol) soil series, typified by red to reddish brown sandy loam till derived from red micaceous sandstone, red siltstone, and minor granite. These soils have developed on level to slightly inclined terrain, 2-5% slope. The soils are a fine sandy loam to loam with imperfect to poor drainage, with the water table near the surface in the spring and fall. Tile drains help to keep the field drained during the spring and fall when the water table is high and field activities are necessary.

All agronomic activities were performed by Department of Natural Resources Alternative Feeds Program staff. This involved the thorough process of burning down the existing stand, liming, tilling, disking, and rolling the field.

The trial area was sprayed with Round-up Weathermax (1.67 L/ha) on June 20th, approximately 1 week before intended seeding. Planting occurred June 28th, 2013 using a Wintersteiger Plotseed TC research seeder (See Appendix, Table 2 for seeding rates). Immediately before planting, the trial area was fertilized with 17-15-20 at 100 lb/ac, according to soil fertility and crop requirements. Following soil sampling and analysis (See Appendix, Figure 9) it was decided that the crops should receive a second fertilizer application. On August 1st 100 lb/ac of 0-0-60 was applied to the entire trial area to raise the soil potash level. At the same time 300 lb/ac of 17-5-15 was applied to the entire trial area with the exception of the crimson clover plots. Being a legume, it was recommended in the literature that additional nitrogen not be applied to the clover (USDA 2009). All fertilizer applications were spread by hand.

Following sample harvest and previous to the plants going to seed, the entire trial area was mowed and sprayed to prevent volunteers the next year.



3.2.2 Methodology

All of the crops will only be grown for one year. There will be a harvest taken off of the plots at the end of the season.

Plots were monitored on a weekly basis beginning at seeding and throughout the 2013 growing season. Immediately after seeding three 1m lengths were staked out in each plot to monitor: establishment; plant density; stage and height; and overall performance. Stand establishment was evaluated by counting the number of plants along the 1 m length. Germination date was also recorded for each plot.

Harvest samples from the plots were taken by provincial government staff twice throughout the growing season. Harvest was dependent on plant growth stage. Two (Tillage radish and Festulolium) of the six crops were harvested on August 14th, while the remaining were harvested on September 3rd. The three 1m lines in each plot were harvested, bagged, and then dried at 60°C for 48 hours to determine dry matter yield per hectare. Samples were then ground and submitted to the PEI Analytical Laboratories for nutritional analysis, including: ADF, NDF, CP, digestible energy, and nutrient content (Ca, P, Mg and K).

Pest and nutrient deficiency were monitored throughout the field season.

Temperature and precipitation were monitored using a Hoskin Scientific temperature probe and rain gauge.



Figure 5. A Festulolium plot set-up in early August, with the blue stakes indicating the 1m length to monitor stand performance.

3.2.3 Experimental design

The experimental design was a completely randomized design, consisting of a pure stand

of each species (six treatments) with three replications. The treatments were Sudan Grass hybrid, Crimson Clover, Tillage Radish, Festulolium, Forage Rape and Forage Turnip. Treatments were randomly assigned to 1.5 x 6.0m plots, with barley guards in between.

3.3 Results and Discussion

At this time no conclusive results are available to report, therefore the following discussion is based on the authors' observations.

Within one week of planting all treatments had begun to germinate. Approximately 3 weeks following seeding signs of a pest were observed in the forage rape treatment. The pest was identified as the cabbage flea beetle by Leah Madore, Pest Management Specialist. Damage from this pest resulted in reduced forage rape populations, as observed in the 1m monitoring rows. No other treatments appeared to be effected.

Plant height and stage were used to determine optimum harvest time to achieve the best feed quality. The tillage radish, forage rape, and forage turnip were all harvested at budding, while the crimson clover was harvested in early bloom stage, and the Festulolium and CFSH 30 were harvested just before heading. The first harvest occurred on August 14th and only included the tillage radish and Festulolium. The remaining treatments were harvested on September 4th.

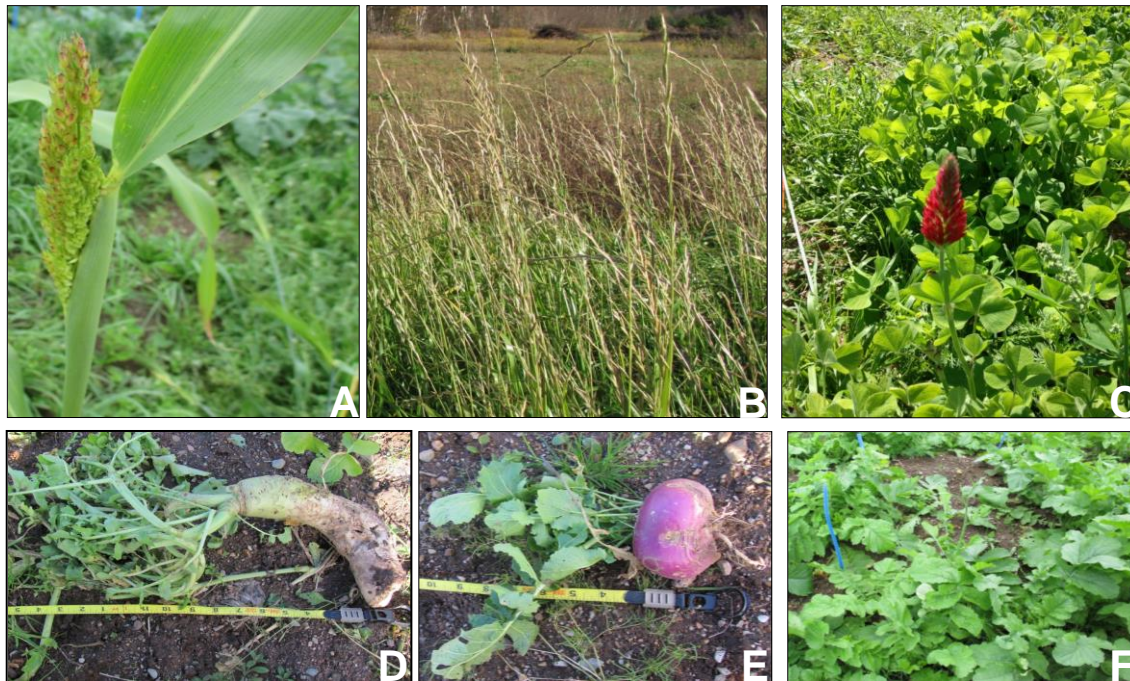


Figure 6. The Canadian Forage Sudan Grass 30 (A), Festulolium (B), Tillage Radish® (D), and Forage Turnip (E) shown are from late October, while the Crimson Clover (C) and Forage Rape (F) are shown at harvest in early September.

Based on the literature (Hannaway and Larson 2004, Undersander et al. 2004, AERC Inc. 2007, USDA 2009, Santangelo 2011, DLF Group 2013), all treatments reached maturity

within the suggested period with the exception of the CFSH 30, which appeared delayed.

Based on observations, it appears that the Festulolium, crimson clover, and Sudan grass hybrid outperformed the forage rape, forage turnip, and tillage radish. However, without having analyzed and interpreted both the harvest yield data and nutritional analysis results, it is impossible to make recommendations as to what crop should be used in the future by NL forage producers. It is also prudent to take into consideration that all of these crops were planted at the end of their recommended seeding dates. Therefore, it is recommended that future trials be done with the three crops that appeared to perform the best. It is also the impression of the project team that these would be of the most interest to forage producers, as opposed to the brassica species.

4 Conclusions and Future Recommendations

It is impossible to infer which forage grass-legume mixture should be recommended to producers without having analyzed the nutritional data, and based on yield observations alone. Therefore, at this time the main outcome from this trial is realizing the errors that were made, particularly at seeding and how they can be avoided future projects. Things to keep in mind for future large scale field trials are the capacity of the equipment available, weather and soil conditions at planting time, soil fertility and crop nutrient requirements, and weed control.

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Appendices

Table 1. Treatments and seeding rates for forage yield and quality experiment to be conducted at the Pasadena research site.

Treatment	Forage Mixture	Cultivar	Seeding rate (kg ha ⁻¹)
1 (control)	Red Clover	AC Endure	7
	Timothy	Richmond	5
2	Kura Clover	Cossack	12
	Brome Grass	Paddock	9
	Meadow Fescue	Pardel	9
3	Birdsfoot Trefoil	Bull	7
	Brome Grass	Paddock	9
	Meadow Fescue	Pardel	9
4	Alfalfa	Magnum 3801	11
	Brome Grass	Paddock	9
	Meadow Fescue	Pardel	9

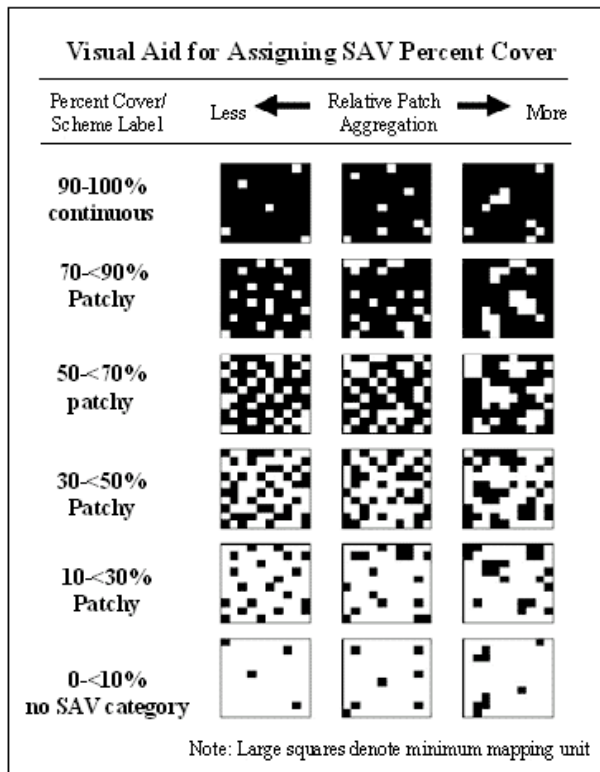
Figure 7. A visual aid for assessing percent cover for the 0.25m² mixed forage plots.

Table 2. Seeding rates and weight of seeds for each 1.5x4m plot.

Species	Seeding Rate (kg/ha)	Plot weight (g)
Tillage Radish	5	3.8625
Festulolium	28	23.1
Crimson Clover	14	11.55
Forage Sudan Hybrid	15	12.375
Forage Turnip	7	2.475
Forage Rape	10	1.65

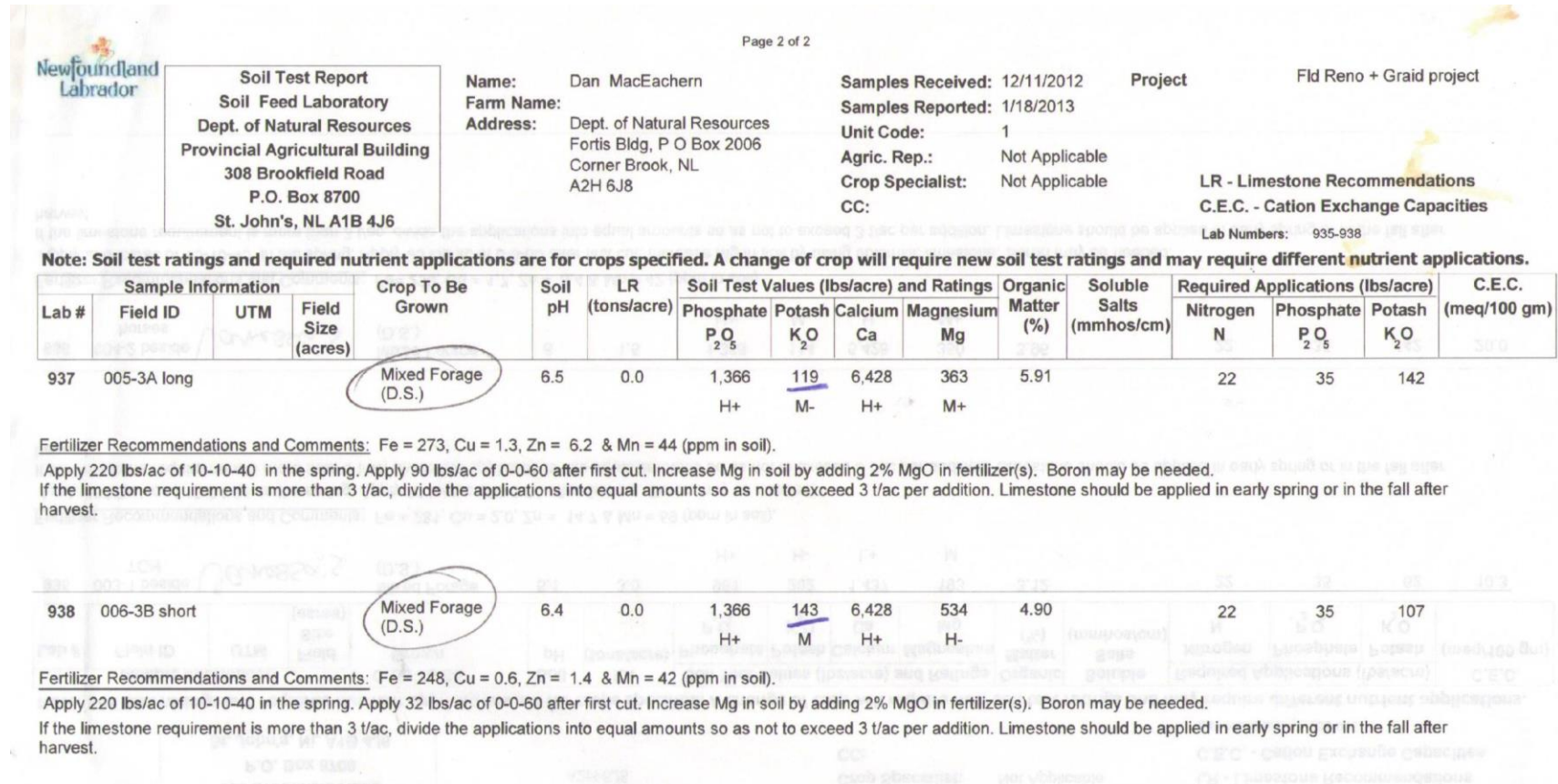


Figure 8. Soil test results from the field in Pasadena used in the Forage Mixtures for Yield and Quality Trial.



Soil Test Report
 Soil & Plant Laboratory
 Dept. of Natural Resources
 Provincial Agricultural Building
 308 Brookfield Road
 P.O. Box 8700
 St. John's, NL A1B 4J6
 Tel: 709-729-6738

Page 1 of 2

Name: Jennifer Roper
 Farm Name:
 Address: Prov. Ag. Bldg.
 Brookfield Rd.
 St. John's, NL
 A1B 4J6

Samples Received: 2013/07/16
 Samples Reported: 2013/07/26
 Unit Code: 1
 Agric. Rep.: Not Applicable
 Crop Specialist: Not Applicable
 CC:

Project Pynn's Brook

LR - Limestone Recommendations
 C.E.C. - Cation Exchange Capacities

Lab Numbers: 380-380

Note: Soil test ratings and required nutrient applications are for crops specified. A change of crop will require new soil test ratings and may require different nutrient applications.

Sample Information				Crop To Be Grown	Soil pH	LR (t/ha)	Soil Test Values (mg/L) and Ratings				Organic Matter (%)	Soluble Salts (mS/cm)	Required Applications (kg/ha)			C.E.C. (cmol/kg)	
Lab #	Field ID	UTM	Field Size (ha)				Phosphorus P	Potassium K	Calcium Ca	Magnesium Mg			Nitrogen N	Phosphate P ₂ O ₅	Potash K ₂ O		
380	Pynn's Brook			Mixed Forage	5.6	6.9	64	59	1,722	419	4.79			100	40	140	19.5
							H	M-	M+	H							

Nutrient Recommendations and Comments:

For mixed forage, 60 kg/ha of nitrogen should be applied in early spring. An additional 40 kg/ha, in nitrate form, should be applied after the first cut. Apply phosphate in early spring. For established legume and mixed forage, apply 60% of the potash in early spring and 40% after the first cut. Boron may be needed.

Other Tests					
Nitrogen:	%	Carbon:	%	Total Sulphur:	%
Sulphur:	mg/L	Iron:	214 mg/L	Manganese:	15 mg/L
Zinc:	2.0 mg/L	Boron:	0.6 mg/L	Aluminum:	1,436 mg/L
Copper:	2.5 mg/L	Nitrate-N:	mg/L	Ammonium-N:	mg/L
Sodium:	mg/L				

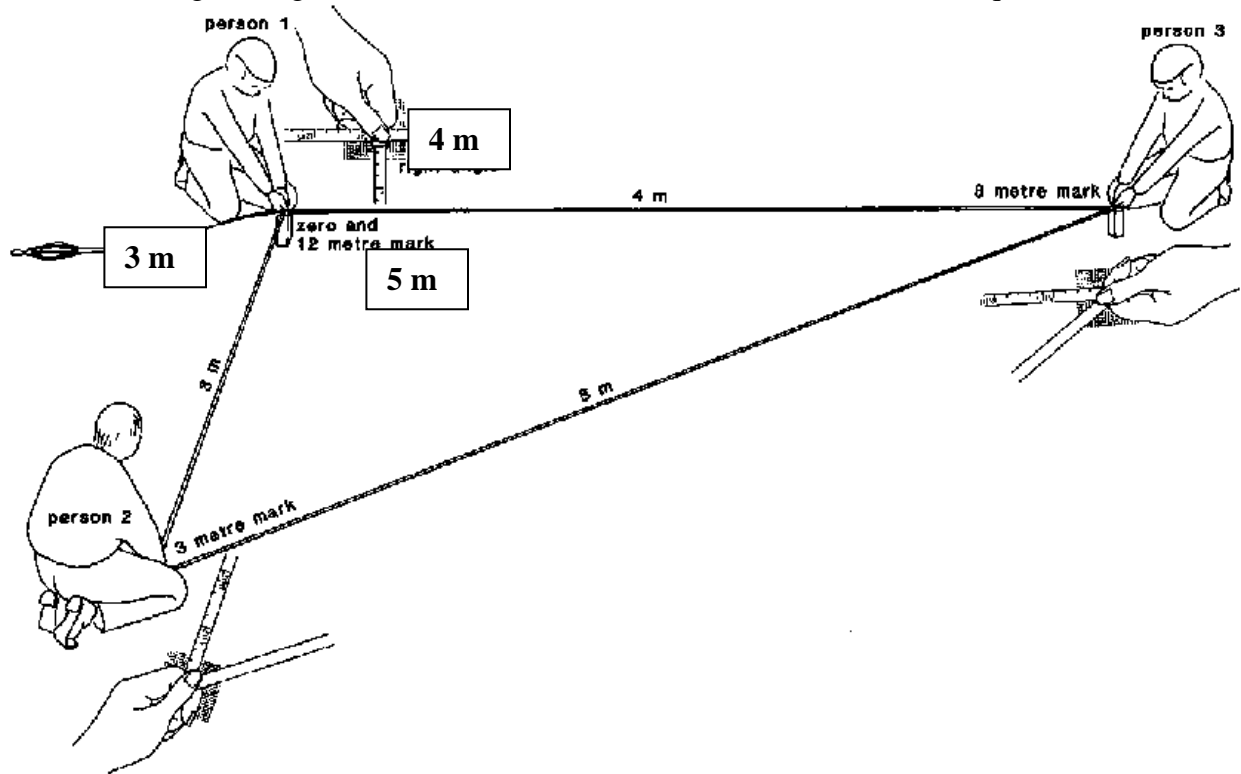
If the limestone requirement is more than 6.7 t/ha, divide the applications into equal amounts so as not to exceed 6.7 t/ha per addition. Limestone should be applied in early spring or in the fall after harvest.

Figure 9. Soil test results from Pynn's Brook small plot trial to determine additional fertilizer requirements.

Procedure for Small Plot Trial Site Preparation:

1. Mark off area $(18\text{m} \times 18\text{m}) = 324\text{m}^2$.

Create a 90° angle using the 3, 4, 5 method (see below) to ensure the area is square.



Use tall stakes you inserted at 3 and 4 meters to ensure that you corner posts at 18 meters are in a straight line with the original (first) stake you put in the ground. Use long stakes to mark the four corners.

2. Along one side of the square, put a small wooden or plastic stake at each of the following measures:

Meters: 4m ---- 7m ---- 11m ---- 14m ---- 18m ---- 24m

“The point of this is to mark out where your replications and rows between replications are situated”

3. Use some baler twine to temporarily mark a straight line between each of the corresponding stakes, connecting the two longest sides. When the line is straight and taut, make a line on the ground using chalk, lime, or spray paint. These lines will be used as a guide as starting and stopping points when seeding the plots (you can improvise and use what is available).