



Enabling Agricultural Research and Innovation

Element 1, Innovative Research and Development Interim Report

1. *Project title and project number:* C1819-0246-Y3 NB Forage Variety Evaluation and Management Trials
2. *Project leader and collaborators:* The project team will include Ray Carmichael, NBSCIA General Manager, Zoshia Fraser, NBSCIA Assistant General Manager, NBSCIA Research Technician; Summer Research Assistant, Agro-Environmental club Agrologists; Pat Toner, Jason Wells and David Dykstra (NBDAAF).

ABSTRACT/RÉSUMÉ

This report is for the third year in this project and summarizes findings from April 1, 2020 to Feb 12, 2021. This report aims to identify nutrient uptake and removal requirements of legume and grass forage stands at the higher forage yields being obtained and at medium fertility and pH levels, evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward, evaluate the role of annual forage species and cereals (oats, barley, peas, etc.) as a companion or nurse crop, and evaluate numerous plant species for suitability as emergency forage crops on New Brunswick livestock farms. An alfalfa stand was planted in Knightville, NB in the spring of 2020 to test new fertilizer recommendations for higher potassium. Due to COVID-19 the Grasses/Legume mixture evaluation was abandoned. For the nurse/companion forage crop evaluation, alfalfa was seeded alone and in combination with various nurse crop options. Results show that more alfalfa plants grew when there was no nurse crop. The emergency/annual forage crop evaluation looked at options for producers to utilize in the face of global warming and changing weather patterns. Sorghum-sudangrass had the highest T/ha in 1st Cut and Seasonal Dry Matter Yields. All crops were negatively affected by the dry climactic conditions.

Ce rapport couvre la troisième année de ce projet et résume les résultats obtenus entre le 1er avril 2020 et le 12 février 2021. Il vise à déterminer les besoins d'absorption et d'élimination des éléments nutritifs des peuplements de légumineuses et de graminées fourragères aux rendements fourragers supérieurs obtenus et à des niveaux de fertilité et de pH moyens, à évaluer l'effet de l'interaction des espèces de trèfle rouge et de luzerne (les légumineuses) avec les espèces de graminées susceptibles d'offrir une qualité et un rendement supérieur dans des mélanges fourragers simples et complexes pendant la durée de vie d'un peuplement de graminées, à évaluer le rôle des espèces fourragères annuelles et des céréales (avoine, orge, pois, etc.) en tant que cultures compagnes ou de soutien et à évaluer l'aptitude de nombreuses espèces végétales à servir de fourrage de secours dans les exploitations d'élevage du Nouveau-Brunswick. Un peuplement de luzerne a été semé à Knightville (N.-B.) au printemps 2020 afin d'y tester les nouvelles recommandations d'engrais à plus forte teneur en potassium. En raison de la COVID-19, le projet d'évaluation du mélange de graminées/légumineuses a été abandonné. Pour l'évaluation de la culture fourragère compagne, la luzerne a été semée seule et en combinaison avec diverses cultures de soutien. Les résultats révèlent que la croissance de la luzerne est plus forte en l'absence de culture compagne. L'évaluation des fourrages de secours et annuels visait à examiner les options dont disposent les producteurs pour faire face au réchauffement de la planète et à l'évolution des conditions météorologiques. Le sorgho fourrager de type Sudan Grass a enregistré la plus grande quantité de tonne/ha pour la première coupe et les rendements saisonniers de matière sèche. Toutes les cultures ont été négativement perturbées par les conditions climatiques sèches.

3. *Specify period of time for which the interim report is being submitted:* April 1, 2020-Feb 12, 2021

4. *Project Objective(s):*

- To identify nutrient uptake and removal requirements of legume and grass forage stands at the higher forage yields being obtained and at medium fertility and pH levels.
- To evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward.
- To evaluate the role of annual forage species and cereals (oats, barley, peas, etc.) as a companion or nurse crop.
- To evaluate numerous plant species for suitability as emergency forage crops on New Brunswick livestock farms.

5. *Project Deliverable(s):*

- Evaluation of New Brunswick's present fertility requirements of legume and grass forage crops at the higher forage yields being obtained and at medium fertility and pH levels. This will indicate if New Brunswick fertility recommendations need revisions to support the yields that producers are expected to achieve.
- Identification of the species interaction in both complex and simple forage mixtures over a production cycle. Red clover and alfalfa (legumes) and standard grass species as well as some of the newer grass species with the potential for higher quality and yield will be looked at.
- Evaluation of the comparative advantage of various annual forage species used as a companion or nurse crop in the establishment year and subsequent production years of alfalfa.
- Evaluation of the comparative advantage of various "emergency" annual forage species.

6. *Summary of Progress:*

Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations

To identify nutrient uptake and removal requirements of legume and grass forage stands at the higher forage yields being obtained and at medium fertility and pH levels

Project leader and collaborators: Ray Carmichael (NBSCIA) and Pat Toner, Jason Wells and David Dykstra (NBDAAF).

Specify period: April 1, 2020-Feb 12, 2021

Project Objective(s): To determine how well alfalfa yield would respond to a new fertilizer recommendation for increased levels of potassium.

Project Deliverable(s): A yield-based trial for various fertilizer scenarios comparing K₂O additions to removal.

Summary of Progress: The forage research site was relocated to Knightville, NB in the spring of 2020 (Figure 1). Due to Covid-19, work at the site was delayed, but an area did get planted to a straight alfalfa stand so that fertilizer treatments could be imposed in the spring of 2021.

Figure 1. New Forage Site in Knightville, NB



GRASSES LEGUME MIXTURE EVALUATION

To evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward.

Complex forage mixtures sometimes containing a couple of legume species and more species of grasses are being promoted by sales persons in New Brunswick. Meanwhile forage researchers, such as Dr. Dan

Undersander at UW and Dr. Gerry Cherney at Cornell University are recommending simpler mixtures containing a legume and one or two grass species.

Summary of Progress

The exceptionally dry climactic conditions at the Richmond Corner site during the 2019 growing season had a negative impact on establishment for all mixtures and species. Since most of the forage work was being moved to a new site in Knightville, NB in 2020, these plots were abandoned. Due to the Covid-19 pandemic and a late start in the field this trial did not get seeded.

NURSE OR COMPANION FORAGE CROP EVALUATION

To evaluate the role of annual forage species and cereals (oats, barley, peas, etc.) as a companion or nurse crop

The use of a cereal crop as a companion/nurse crop (referred to as nurse crop from this point forward) has been a long-standing practice on many livestock farms in New Brunswick. The idea behind this practice is that the cereal crop competes with weeds early in the growing season and ensures that a decent crop is realized in the establishment year. Some farms would harvest the cereal crop as mature grain and take the straw for use as bedding. Other farms opt to take the cereal crop as silage and depending on the year take a subsequent cut of forage in mid-August. This system can penalize forage production the following year when the cereal crop lodges, grain harvest and/or silage harvest is later than desired for the forage crop to get satisfactory growth going into winter or the cereal crop is seeded at too high a rate. Farms have moved away from the traditional oat or barley nurse crop, to using cereal/pea mixtures, annual ryegrass and even Sudangrass being suggested lately.

Alfalfa was seeded alone and in combination with various nurse crop options (Table 1). The dry climactic conditions during the 2020 growing season impacted the establishment and performance of all combinations.

Yield of the various nurse crops in the establishment year was quantified. Samples were taken from the Hauldrop harvester for analysis at A&L Labs for forage quality and dry matter. This lab was chosen because it offers a forage package that looks at digestibility of the forage, a parameter that is being requested by the industry. Dry matter yield in T/ha was averaged across the three replicates for each of the species and mixture treatments and an ANOVA were conducted between treatments.

The establishment of the alfalfa was evaluated in the fall of 2020. It is evident from Figure 1 that more alfalfa plants were present when alfalfa was planted alone (no nurse). The establishment of the alfalfa will be reevaluated in the spring of 2021 and 1st production year yields will be determined. Data will be analysed to determine the advantages or detriments caused by the various companion/nurse crops.

Table 1: Nurse Crop Plot Layout and Seeding Rates.

Rep 1		Rep 2		Rep 3
Guard		Guard		Guard
Medium Oats/Peas (80kg/ha)		Low Sudangrass (15kg/ha)		Medium Oats/Peas (80kg/ha)
No Nurse Crop		High Sudangrass (20kg/ha)		High Sudangrass (20kg/ha)
Low Ryegrass + Low Oats/Peas (5kg/ha + 55kg/ha)		Medium Oats (80kg/ha)		High Oats (135kg/ha)
Low Oats/Peas (55kg/ha)		Low Ryegrass (5kg/ha)		Low Ryegrass + Low Oats/Peas (5kg/ha + 55kg/ha)
High Oats/Peas (160kg/ha)	Pathway	Medium Oats/Peas (80kg/ha)	Pathway	Low Oats (55kg/ha)
Low Ryegrass (5kg/ha)		High Ryegrass (10kg/ha)		Low Sudangrass (15kg/ha)
Low Oats (55kg/ha)		Low Oats (55kg/ha)		Low Ryegrass (5kg/ha)
Low Sudangrass (15kg/ha)		No Nurse Crop		Medium Oats (80kg/ha)
High Sudangrass (20kg/ha)		Low Oats/Peas (55kg/ha)		High Ryegrass (10kg/ha)
High Oats (135kg/ha)		High Oats/Peas (160kg/ha)		High Oats/Peas (160kg/ha)
Medium Oats (80kg/ha)		High Oats (135kg/ha)		Low Oats/Peas (55kg/ha)
High Ryegrass (10kg/ha)		Low Ryegrass + Low Oats/Peas (5kg/ha + 55kg/ha)		No Nurse Crop
Guard		Guard		Guard

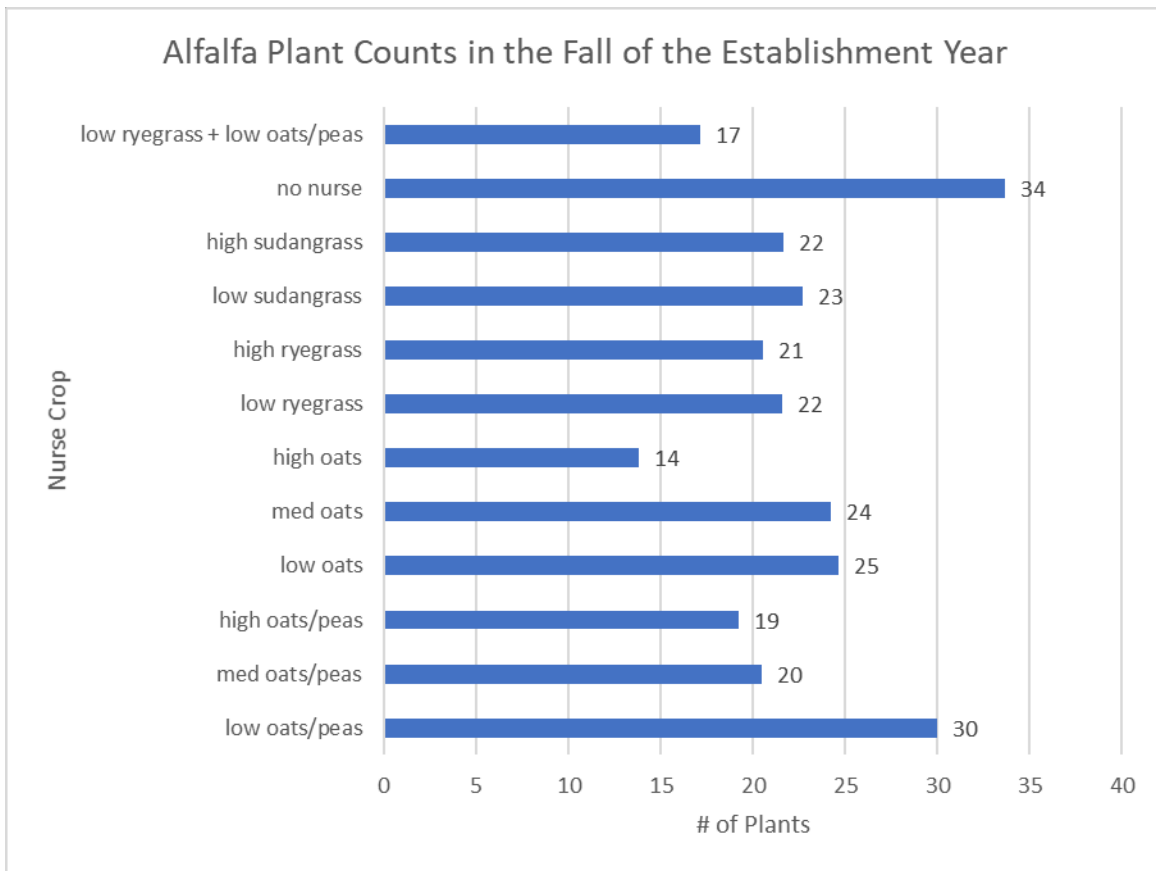


Figure 2. Alfalfa Plant Counts in the Fall of 2020

EMERGENCY or ANNUAL FORAGE CROP EVALUATION

Management of annual crops or mixtures to re-establish winter failure or compensate for drought and weather extremes caused by global warming will become critical to NB livestock producers.

An extremely dry growing season in 2018 and widespread winter kill in 2019 left NB livestock producers scrambling to find crop options that would provide them enough feed for their animals. Annual species including corn silage, hybrid pearl millet, sorghum-sudangrass, hybrid sudangrass, Italian ryegrass, teff, forage oats and peas, silobuster, fall rye and forage soybeans were all established in replicated plots at the Knightville site to assess their ability to provide a high-yielding and high-quality source of feed in a single season following challenging growing conditions. The parameters of evaluation were wet yield, dry matter yield and numerous quality parameters which included a calculation for milk yield per hectare.

Samples were taken from the Hauldrop harvester for analysis at A&L Labs for forage quality and dry matter. This lab was chosen, because it offers a forage package that looks at digestibility of the forage; a parameter that is being requested by the industry. Dry matter yield in T/ha was averaged across the three replicates for each of the species and mixture treatments and an ANOVA were conducted between treatments.

Summary of Progress

Potential annual forage species were established in a RCBD as illustrated in Table 2.

Table 2: Emergency Forage Plot Layout and Seeding Rates for Summer Seeding.

Rep 1		Rep 2		Rep 3
Guard		Guard		Guard
Oats and Peas (160kg/ha)		Fall Cereal Rye (110kg/ha)		Fall Cereal Rye + Red Clover (110kg/ha + 5kg/ha)
Oats (135kg/ha)		Hybrid Sudangrass (34kg/ha)		Hybrid Sudangrass (34kg/ha)
Italian Ryegrass (35kg/ha)		Italian Ryegrass (35kg/ha)		Italian Ryegrass (35kg/ha)
Teff (12kg/ha)		Soybeans (100kg/ha)		Oats and Peas (160kg/ha)
Berseem Clover (17kg/ha)		Oats and Peas (160kg/ha)		Oats (135kg/ha)
Soybeans (100kg/ha)	Pathway	Fall Cereal Rye + Red Clover (110kg/ha + 5kg/ha)	Pathway	Berseem Clover (17kg/ha)
Sorghum-Sudangrass (34kg/ha)		Hybrid Pearl Millet (17kg/ha)		Fall Cereal Rye (110kg/ha)
Hybrid Pearl Millet (17kg/ha)		Teff (12kg/ha)		Sorghum-Sudangrass (34kg/ha)
Fall Cereal Rye + Red Clover (110kg/ha + 5kg/ha)		Oats (135kg/ha)		Teff (12kg/ha)
Silobuster (160kg/ha)		Silobuster (160kg/ha)		Soybeans (100kg/ha)
Hybrid Sudangrass (34kg/ha)		Sorghum-Sudangrass (34kg/ha)		Silobuster (160kg/ha)
Fall Cereal Rye (110kg/ha)		Berseem Clover (17kg/ha)		Hybrid Pearl Millet (17kg/ha)
Guard		Guard		Guard

Due to the Covid-19 pandemic and the uncertainty that field work could even be carried out in 2020, all species were planted on June 21, 2020. This timing did not favor the cool season crops and it is believed that their performance suffered as a result. The exceptionally dry climactic conditions during the 2020 growing season had a visible negative impact on establishment and growth of all species under test.

Figure 2 and 3 illustrates the difference in dry matter yield per hectare between species. Statistical significance is indicated on the figure by letters. The suitability of any crop is ultimately determined by the forage production system available on the farm.

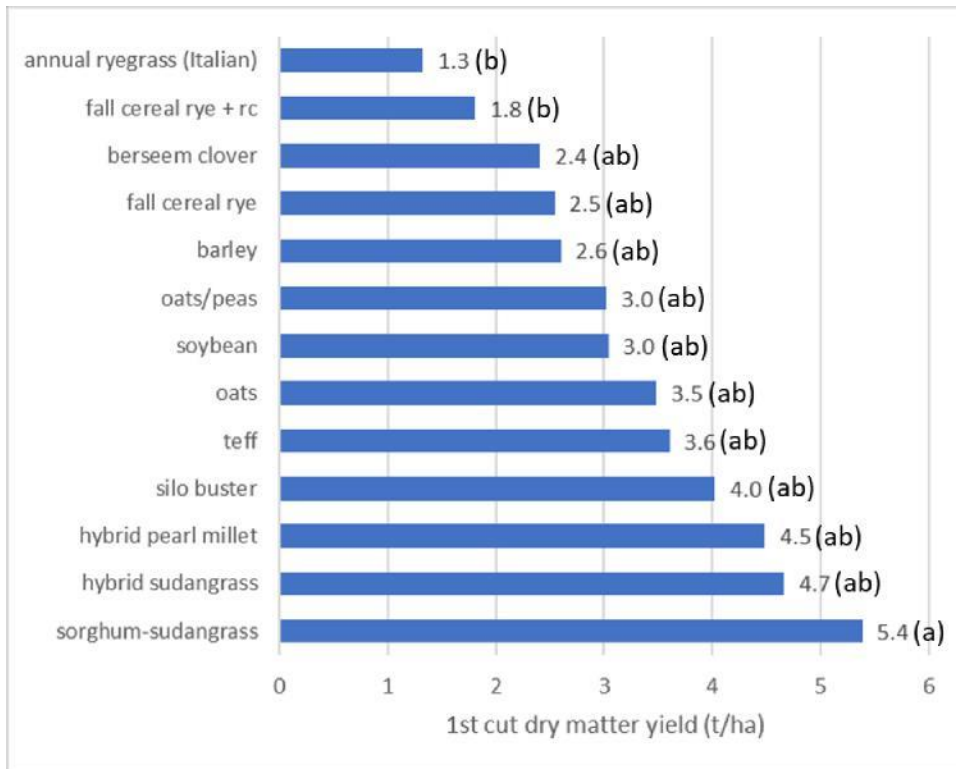


Figure 2. 1st Cut Dry Matter Yield

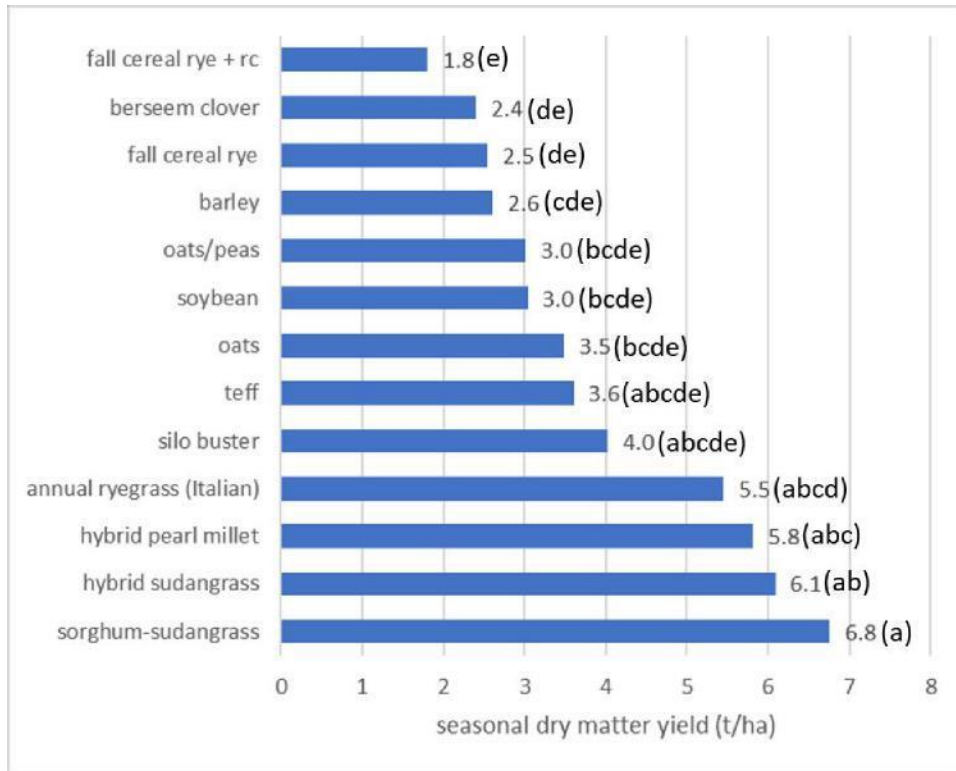


Figure 3. Seasonal Dry Matter Yield

In the fall of 2020, plots that would not have a second harvest taken were replaced with winter annuals (Table 3) to evaluate their ability to provide forage next spring.

Table 3: Emergency Forage Plot Layout and Seeding Rates for Fall Seeding.

Rep 1		Rep 2		Rep 3
Guard		Guard		Guard
Fall Cereal Rye Drilled (110kg/ha)	Pathway	Fall Cereal Rye (110kg/ha)	Pathway	Fall Cereal Rye + Red Clover (110kg/ha + 5kg/ha)
Winter Triticale + Clover (110kg/ha + 4kg/ha)		Hybrid Sudangrass (34kg/ha)		Hybrid Sudangrass (34kg/ha)
Italian Ryegrass (35kg/ha)		Italian Ryegrass (35kg/ha)		Italian Ryegrass (35kg/ha)
Teff (12kg/ha)		Soybeans (100kg/ha)		Winter Triticale (110kg/ha)
Fall Cereal Rye Broadcast (190kg/ha)		Winter Triticale + Clover (110kg/ha + 4kg/ha)		Fall Cereal Rye Broadcast (190kg/ha)
Soybeans (100kg/ha)		Fall Cereal Rye + Red Clover (110kg/ha + 5kg/ha)		Winter Triticale + Clover (110kg/ha + 4kg/ha)
Sorghum-Sudangrass (34kg/ha)		Hybrid Pearl Millet (17kg/ha)		Fall Cereal Rye (110kg/ha)
Hybrid Pearl Millet (17kg/ha)		Teff (12kg/ha)		Sorghum-Sudangrass (34kg/ha)
Fall Cereal Rye + Red Clover (110kg/ha + 5kg/ha)		Fall Cereal Rye Broadcast (190kg/ha)		Teff (12kg/ha)
Winter Triticale (110kg/ha)		Fall Cereal Rye Drilled (110kg/ha)		Soybeans (100kg/ha)
Hybrid Sudangrass (34kg/ha)		Sorghum-Sudangrass (34kg/ha)		Fall Cereal Rye Drilled (110kg/ha)
Fall Cereal Rye (110kg/ha)		Winter Triticale (110kg/ha)		Hybrid Pearl Millet (17kg/ha)
Guard		Guard		Guard

Adjustments: no adjustments are needed.