Project Identification

1. **Project Title:** Response of Forages to Fall Vs Spring Seeding Date in a Wet Hummocky Landscape
2. **Project Number:** 20170331
3. **Producer Group Sponsoring the Project:** Conservation Learning Centre
4. **Project Location(s):** SW 20-46-26 W2 RM #461 (Prince Albert)
5. **Project Start and End Dates (Month & Year):** March 2017 to December 2019
6. **Project Contact Person & Contact Details:**

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Objectives and Rationale

7. Project objectives:

The objective of this demonstration is to illustrate the response of different forages to a fall versus spring seeding date in a hummocky landscape within north central Saskatchewan.

8. Project Rationale:

The typically wet and cold spring conditions in north central Saskatchewan often make it difficult to seed spring forages. These wet and cold conditions delay spring forage seeding and may reduce emergence and stand establishment. This project explores the viability of fall seeding forages. Forages that are seeded in the fall can take advantage of snow melt and efficiently utilize early spring moisture. Additionally, drier conditions in the fall may allow acres that were previously unreachable in the spring to be seeded.

Recently, the conditions for spring seeding forages have been very poor in north central Saskatchewan. The area experienced a prolonged wet period from 2010-2017. These wet springs often forced producers to seed into late spring, which resulted in poor emergence. The 2018 and 2019 spring conditions were extremely dry, and many producers in the area struggled with poor emergence and stand establishment. Determining which forage species could be successfully seeded in the fall could help alleviate issues producers face during spring seeding.

Methodology and Results

9. Methodology:

Six different forage species including 3 legumes and 3 grasses were seeded at 2 different dates (fall vs spring) using recommended seeding rates (Table 1). This was replicated twice across two different slopes, allowing for comparison of upper, mid, and lower slope positions. Plot size at rep 1 was 2 m by 20 m and rep 2 was 2 m by 30 m. Prior to seeding, the sites were tilled. Rep 1 had been tilled and left fallow for the year prior to seeding and rep 2 had spring wheat seeded in the upper and mid slopes and wetland vegetation located along the edges and within the depression. The wetland vegetation in rep 2 was mowed, soil tilled, and lower slope and depression harrowed to remove remaining heavy trash.

Table 1. Forage species and seeding rates used in trial.

Species	Seeding rate (kg/ha)
Cicer milkvetch	13.5
Alfalfa	9.6
Sainfoin	33.9
Hybrid bromegrass	14.5
Meadow bromegrass	16.5
Timothy	4.5

The window for fall seeding was narrow and needed to occur after October 15th when mean daily and soil temperature is ≤5°C and before freeze-up. Conditions were warm up to October 24th, which experienced a maximum temperature of 16.5°C, and snow occurred October 25th. Fall seeded forages were seeded October 28th, 2017 and freeze-up occurred immediately afterwards.

Spring seeding occurred as soon as conditions were favourable to do so on May 17, 2018. Although spring conditions were relatively dry, it was necessary to wait for the lower slope positions to dry. Although it was possible to seed all the way into the lower slope positions and depressions in the fall, it was not possible to seed as far in the spring. Seeding rates were the same for both seeding times and the same seed lot was used for both dates. Forages were seeded using a small plot cone seeder with disc openers on 12 in row spacing. Seeding depth was approximately 0.25-0.5 in deep. Both seeding dates were seeded side by side to facilitate visual comparisons, and forage species were randomized. No fertilizer was applied. Plots were mowed throughout the growing season to control weeds, until forages became established.

In 2018, the spring plant density and % coverage of final seedling stands was recorded. Spring plant density was determined June 18, 2018 by counting the number of seedlings in two 1m rows per plot at the lower, mid, and upper slope positions. In 2019, data collection consisted of

a record of emergence (yes/no) and % coverage of spring seedling stands, and final seedling stands. Emergence was recorded on May 10, 2019 by surveying the upper, mid, and lower slope positions and determining if the forage had emerged (yes/no). Notes about the emergence; whether it was uniform or patchy were also recorded. Visual ratings of % coverage for the upper, mid, and lower slope positions were recorded on July 16, 2018, June 18, 2019, and August 6, 2019 using a simple line transect method. Using a fiberglass pole, 10 cm increments were marked over a 1 m length. The pole was then laid beside selected seeded rows and the number of 10 cm sections that had at least 1 plant or portion of a plant located between each 10 cm segment were counted. If more than 1 plant was located within a section, the section was only counted once, but if a plant were straddling two sections, the plant would be counted twice. No plants present would result in a score of 0% and a maximum score of 100% was given if at least 1 plant was present in all 10 sections. The onsite Saskatchewan Research Council Climate Station monitored weather related conditions.

Since the trial was only replicated twice, no statistical analysis was completed; however, the large plot sizes and different landscape positions provided a good demonstration and indication of the results that would be expected in a larger field setting within the north central growing region.

10. Results

Soil Tests

Soil testing was completed in the fall of 2017 prior to seeding. Macronutrients were high in rep 1 that had been fallow prior to seeding and were lower in rep 2 (Tables 2 and 3). Salts were higher in rep 2 and were likely greatest at the edge of the depression in the lower slope position. The edges of seasonal wetlands are typically located at the lower slope position in both reps during the early spring. In the fall, it was possible to seed through the lower slope position and into the depression, but it was not possible for all plots in the spring.

Table 2. Soil test results for site/replicate 1.

Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mm ho/cm)
0 – 15	62	37	489	28	5.7	6.6	0.26
15 – 30	147			84		7	0.31
0 – 30	209						

Table 3. Soil test results for site/replicate 2.

Depth (cm)	N (lb/ac)	P (ppm)	K (ppm)	S (lb/ac)	OM (%)	pH	Salts (mm ho/cm)
0 – 15	5	9	227	120	7.1	7	1.45
15 – 30	15			360		6.6	0.78
0 – 30	20						

Weather

There was no substantial warm up period throughout the winter of 2018 and a snow pack of up to 50 cm was present up until April 18, 2018. The snow pack melted quickly and was gone by April 24, 2018. Soil conditions were still very dry from the previous fall. Conditions remained dry up until May 30, 2018 when the CLC received 7 mm of precipitation. Substantial precipitation did not occur until the end of June 2018. Overall the spring was very hot and dry, and the fall was very cool and damp (Table 4).

The winter months of 2019 were very cold. In February of 2019, there was a period of five days below -40˚C. At the end of February there was a snowpack of 53cm, and in March the snow began to melt under warming temperatures. In April the snow was almost completely melted, until it snowed again in the beginning of May. Overall the spring and summer was dry (Table 4), and the CLC and producers in the area struggled with poor crop emergence due to dry soil conditions. The first frost did not occur until September 27th (-0.5˚C), and the first hard frost occurred on October 9th (-7.2˚C). September had a higher than average precipitation and October was colder than average (Table 4), which made it a wet and cold harvest.

Table 4. Weather conditions over the 2018 and 2019 growing season at the Conservation Learning Centre.

	May	June	July	August	September	October	Average/Total
				--- Temperature (°C) ---			
2019	9.5	15.8	17.4	15.1	11.6	1.0	11.7
2018	13.3	16.3	17.4	15.7	6.5	1.4	11.8
2012-2017	11.5	16.0	18.7	17.6	12.5	3.8	13.4
				--- Precipitation (mm) ---			
2019	30.0	54.4	57.4	16.8	59.6	11.6	229.8
2018	12.5	49.8	112.4	38.4	29.3	8.6	251.0
2012-2017	69.4	85.4	93.3	49.6	25.2	26.0	348.7

Year of Establishment

In the upper slope position, spring seeding of alfalfa and hybrid brome grass had higher spring plant emergence compared to fall seeding in 2018 (Table 5). In the midslope position, spring

seeding resulted in better spring plant emergence for cicer milkvetch, meadow bromegrass, and timothy. In the lower slope position, spring seeding resulted in higher plant emergence of alfalfa, sainfoin, hybrid bromegrass, and meadow bromegrass. There did not appear to be a large difference in spring plant emergence between the two seeding dates for the remaining forage species in the various landscape positions in 2018.

Table 5. Spring plant density of forages seeding in the fall or spring across different landscape positions for 2018.

Forage Species	Spring Plant Emergence (plants/m^2)					
	Upper		Mid		Lower	
	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding
Cicer milkvetch	34	20	30	51	87	98
Alfalfa	44	100	58	55	80	143
Sainfoin	52	40	35	52	62	88
Hybrid bromegrass	27	80	68	73	30	72
Meadow bromegrass	109	98	50	90	99	183
Timothy	44	30	26	48	94	93

Year 2 Spring Emergence Following Establishment

Initial spring 2019 emergence was patchy for nearly all forages. This emergence issue was likely the result of dry spring conditions in 2019. As of May 10, 2019, spring-seeded timothy and fall-seeded alfalfa in the lower slope position of rep 1 were the only forage species to have not emerged. In rep 2, all the forage species except for cicer milkvetch had emerged in all the landscape positions. Cicer milkvetch had not yet emerged for fall and spring seeded dates in the upper slope and for spring seeded in the mid slope. Cicer milkvetch had poor emergence all throughout rep 2, but fall-seeded cicer milkvetch appeared to have slightly better emergence than spring seeded. Fall-seeded meadow bromegrass visually had higher plant emergence than spring-seeded.

Spring 2019 Stand Coverage

Any late emerging forages appeared to have no effect on their % coverage in June of 2019. Spring-seeded cicer milkvetch had consistently lower % coverage than fall-seeded over all landscape positions (Table 6). Spring-seeded timothy had lower % coverage than fall-seeded in the mid-slope position (Table 6). There appears to be no clear difference between spring and fall seeded dates for any of the other forages in the spring of 2019.

Table 6. Average spring seedling stands of forages seeded in the fall or spring across different landscape positions in June 18, 2019.

Forage Species	Spring Seedling Stands (% coverage)					
	Upper		Mid		Lower	
	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding
Cicer milkvetch	75	52.5	70	47.5	97.5	65
Alfalfa	92.5	82.5	95	92.5	82.5	77.5
Sainfoin	60	70	90	72.5	50	42.5
Hybrid bromegrass	62.5	77.5	92.5	95	72.5	62.5
Meadow bromegrass	80	97.5	97.5	92.5	62.5	87.5
Timothy	85	87.5	85	45	82.5	92.5

Final 2019 Stand Coverage

In spring of 2018, some spring seeded forages, like the bromegrasses (Table 5), had higher plant populations than the fall seeded forages, but the same spring seeded forages had lower final stand counts vs the fall seeding date (Table 7). This was likely due to late-seeded spring forages having adequate soil moisture when seeded, but the hot and dry summer that followed killed many of the newly emerging seedlings. In the 2nd year, the forages were more established, and thus better able to withstand the hot and dry conditions in 2019. Overall, the percent cover of all forages in the spring of 2019 (Table 6) increased in the summer (Table 7) as the plants branched out.

Cicer milkvetch had greater percent cover when seeded in the fall for both 2018 and 2019 for all landscape positions (Table 7). However, there was not as great of a difference in percent cover for cicer milkvetch between fall and spring seeded in 2019 compared to 2018. Fall-seeded timothy had greater percent cover than spring-seeded in 2018 for all landscape positions, and in 2019 for the upper and mid-slope positions. In 2018, alfalfa, hybrid bromegrass, and meadow bromegrass had higher percent cover when seeded in the spring in certain landscape positions, but in 2019 there was no difference between fall or spring seeded. Both meadow bromegrass and alfalfa did well across all landscape positions, and almost all forages, except sainfoin, increased in percent cover from 2018 to 2019. Both sainfoin and timothy appear to have the best percent coverage in the lower slope position compared to their own coverage in other slope positions, suggesting the higher soil moisture present in the lower slope likely contributed to higher plant populations for these forage species. Timothy is a spring flooding tolerant species, but does not do well under drought or saline stresses. Sainfoin is intolerant of salinity

and rep 2 in particular had a higher presence of salts. Dry and hot conditions likely exacerbated the problem and led to relatively weedy sainfoin plots.

Table 7. Final average forage stands for spring or fall seeded forages across different landscape positions in August 2018 and 2019.

Forage Species	Final Forage Stands (% coverage)					
	Upper		Mid		Lower	
	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding
Cicer milkvetch 2018	70	43	90	30	30	0
Cicer milkvetch 2019	100	90	95	70	100	90
Alfalfa 2018	68	90	65	68	25	78
Alfalfa 2019	100	100	100	100	100	100
Sainfoin 2018	78	78	60	60	60	93
Sainfoin 2019	75	25	55	40	65	90
Hybrid bromegrass 2018	90	5	85	28	55	53
Hybrid bromegrass 2019	55	100	95	85	75	80
Meadow bromegrass 2018	38	55	40	0	78	0
Meadow bromegrass 2019	100	100	100	100	90	100
Timothy 2018	80	23	48	30	83	50
Timothy 2019	90	35	100	60	80	100

This demonstration was featured at the CLC Annual Field Day held July 26, 2018 with 70 people in attendance and the annual Crop Talk event held March 21, 2019 in Prince Albert with approximately 50 people in attendance. A factsheet will be created to share on the CLC website and at the 2020 Crop Talk event.

11. Conclusions and Recommendations

Previous studies suggest that grass forages tend to be more successful after a fall seeding versus legumes like alfalfa. This seems to be true with year 1 of this forage study. However, in the second year, there appears to be no difference between fall and spring seeded grass forages, except for timothy. Timothy had higher percent cover when seeded in the fall for all landscape positions in year 1, and in the upper and mid-slope positions for year 2. Spring seeded alfalfa and sainfoin were more successful in certain landscape positions for year 1, but no differences in year 2. Cicer milkvetch appears to be more successful when seeded in the fall for both year 1 and 2.

The 2018 season was a tricky growing season for the establishment of forages due to hot and dry conditions following seeding. The 2019 growing season was also hot and dry, but the

forages were able to withstand more stress and outcompete weeds because they were better established. The only forage species that did not have higher percent coverage in the second year was sainfoin. Sainfoin appears to be less competitive, likely due to intolerance to salinity, which resulted in high weed populations.

Having the flexibility to seed forages in the fall allows producers to access areas that otherwise could not be seeded and helps alleviate the amount of seeding that needs to occur during very busy springs. Fall seeding also allows forages to take advantage of early spring moisture, which is particularly important during dry years as was experienced throughout this 2-year study. This early spring moisture can also help reduce surface salts when forage seedlings are trying to establish.

12. Acknowledgements:

The Conservation Learning Centre graciously acknowledged the Ministry's support through signage directly in field with the project, verbally during the Field Day and on the Field Day agenda handed out to all visitors. The CLC also thanks Nutrien Ag Solutions and NorthStar for providing forage seed.

13. Abstract:

The objective of this project was to determine how different forage species would respond to a fall versus spring seeding date. Cicer milkvetch, alfalfa, sainfoin, hybrid and meadow bromegrass, and timothy were late fall seeded on October 28th, 2017 and spring seeded May 17, 2018 in long plots that included different landscape positions. Emergence and stand coverage were measured for 2 years. Fall seeding of forages appears to be a viable option for producers in the Prince Albert region. The advantages of fall seeding appeared to be most noticeable in year one during plant establishment. The dry and hot summer of 2018 likely reduced the survival of spring seeded hybrid and meadow bromegrass. There appears to be no difference for the two bromegrasses and alfalfa between fall and spring seeding dates in year 2. However, under most landscape positions, sainfoin, timothy and cicer milkvetch did have better final stand coverage with the fall seeding date during two seasons of dry growing conditions. This demonstration was featured at the CLC Annual Field Day held July 26, 2018 and the annual Crop Talk event held March 21, 2019 in Prince Albert. This trial has reached at least 120 people.

Appendix:

Table A. Presence of spring emergence of forages seeded in the fall or spring across different landscape positions as of May 10, 2019.

Rep 1 Forage Species	Spring Plant Emergence (yes/no)					
	Upper		Mid		Lower	
	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding	Fall Seeding	Spring Seeding
Cicer milkvetch	yes	yes	Yes	Yes	yes	yes
Alfalfa	yes	yes	Yes	Yes	no	yes
Sainfoin	yes	yes	Yes	Yes	yes	yes
Hybrid bromegrass	yes	yes	Yes	Yes	yes	yes
Meadow bromegrass	yes	yes	Yes	Yes	yes	yes
Timothy	yes	yes	Yes	Yes	yes	no
Rep 2 Forage Species						
Cicer milkvetch	no	no	Yes	No	yes	yes
Alfalfa	yes	yes	Yes	Yes	yes	yes
Sainfoin	yes	yes	Yes	Yes	yes	yes
Hybrid bromegrass	yes	yes	Yes	Yes	yes	yes
Meadow bromegrass	yes	yes	Yes	Yes	yes	yes
Timothy	yes	yes	Yes	Yes	yes	yes