ADOPT Final Report-Project #20170461

Project Identification

1. **Project Title: Delaying the stage of maturity at swathing to increase winter grazing days for swath grazed barley.**

2. **Project Number: 20170461**

3. **Producer Group Sponsoring the Project:** Saskatchewan Forage Council (SFC)

4. **Project Location(s):**

    - LFCE Beef Research and Teaching Unit, Clavet, SK (Drs. Greg Penner and Bart Lardner)
    - Hafford, SK (Brian Yasieniuk, cooperator. Jenifer Heyden, Saskatchewan Ministry of Agriculture, and Chelsey Siemens, Saskatchewan Forage Council ADOPT Coordinator, data collection and project management)
    - Abbey, SK (Beau and Bevin Smith, cooperators. Dr. Brittany Wiese, South West Animal Health Centre, data collection and project management)

5. **Project start and end dates**: May, 2018 to January, 2020

Objectives and Rationale

7. **Project Objectives**

The objective of this project is to demonstrate that altering the maturity at harvest for barley used in swath grazing can increase grazing days without negatively affecting cow performance.

A secondary objective is to help producers learn to identify the differences between the relevant stages of crop maturity and a comparison of grazing at the soft dough stage vs the hard dough stage.

The current recommendations for the timing of swathing for cereals used in swath grazing or green feed systems are based on recommendations for silage. While the silage-based stages of maturity were a good reference point, recent research funding by the Saskatchewan Ministry of Agriculture has demonstrated that delaying harvest from soft dough to hard dough for barley results in a marked increase in the yield of digestible dry matter (Rosser et al., 2016). Admittedly, much of the increase in the dry matter yield arises from a greater contribution of the cereal grain to the whole crop biomass as indicated by increased starch content (Rosser et al., 2013, 2016). Clearly, the starch in the kernels is digestible as starch digestibility values still exceed 90% (Rosser et al., 2016, 2017) resulting in a forage that has a greater energy value. While the work by Rosser et al. (2013, 2016, 2017) was promising, the studies were not suitable for a field-scale validation.

To verify whether delaying maturity at harvest could translate into improved grazing days, a field-scale, three-year study was initiated at the Western Beef Development Centre. Data obtained in years 1 and 2 were strongly supportive of altering the stage of maturity at harvest from soft dough to hard dough for barley and from late milk to hard dough for oat (O'Keefe et al., 2017). In fact, delaying maturity at harvest increased grazing days by 17 days when 20 cows grazed 8 ha paddocks. Thus, when correcting for the number of cows and area of land, delaying maturity at swathing increased cow days, on average, by 42.5 d/ha. Cow body weight was not affected by stage of maturity suggesting this approach could be a viable strategy to increase forage yield and grazing days.

Based on the above information, it is clear, that altering the recommendations for the maturity at harvest can markedly increase forage yield without increasing cost and can provide a significant advantage for beef cattle producers.

8. Project Rationale

This project has the potential to demonstrate a technology that can increase forage yield without affecting forage costs. As a result, we can reduce the cost of swath grazing and obtain more grazing days per hectare. Increasing the awareness of the technology and how to differentiate between soft dough and hard dough can help improve the profitability of the cow-calf sector in Saskatchewan. As a result, the primary benefit of this ADOPT project will be increased awareness, and hopefully adoption. This can be achieved through two primary outputs.

1. Demonstration at field days will increase peer-to-peer communication and accelerate adoption based on first-hand visual appraisal of the methodology. This aspect is a unique contribution from the ADOPT proposal that has not been possible in the past or ongoing research projects.
2. Preparation of materials (fact sheet with video and images) to help producers identify the stage of maturity at harvest such that they have the ability to alter their management and adopt the process. This material will also provide producer testimonials and support for the harvest strategy.

Methodology and Results

9. Methodology

At each site, AC Rosser barley (Clavet), CDC Nasser oats (Abbey), or a mixture of 50% CDC Maverick barley and 50% CDC Baler oats (Hafford) was seeded and managed following regional recommendations. Three regions were targeted due to differences in soil characteristics and precipitation: Clavet, Hafford, and Abbey, Saskatchewan. The entire area (30 acre fields) were considered one field until the point of harvest. The fields were then divided into two equal portions, trying to balance for natural variation in the landscape. The standing crop was swathed at the soft dough stage and at the hard dough stage using the same swathing equipment within each region. Prior to swathing, random samples of the standing crop was had cut (10 cm stubble height) to determine yield and nutrient composition using a 0.25 m^2 quadrat. A portion of these samples were stored in a freezer to arrest further curing in the swath. These samples were used to provide a visual hands-on tool to assist producers in identifying barley at the soft dough and hard dough stages at the field days. Detailed photographs were taken to help assess the stage of maturity. Such information was not previously available from a swath grazing point of reference.

The swathed crop was allowed to cure in the swath until grazing. Immediately prior to grazing, samples of the swath were collected for nutrient analysis to demonstrate changes in composition from the time of swathing to the time of grazing. For grazing, an equal number of cows were turned into each paddock with the two maturities separated using electric fence. Cows were provided approximately 3 days of forage allocation to optimize utilization of the available forage. At Calvet, 56 cows grazed the two treatments concurrently. At Hafford (330 cows) and Abbey (200 cows) cows grazed the two treatments in sequence, since it was not possible to split the herd equally taking cow age, weight, and condition into account. The number of grazing days achieved (considering field size and number of cows) was reported. Field days were held while cows were grazing the fields to enable producers to see how cattle respond and the increased biomass arising from delaying maturity at harvest. This also allowed producers to visually assess residual biomass after grazing. The primary variable to indicate treatment success was grazing days. In addition, quadrat predicted yield and quality analysis of the swathed forages will provide important demonstration information. Photographs and stored plant material have also been collected, and these will serve as useful material to further the adoption of this technology.

Table 1. Seeding and swathing details for three sites ADOPT #20170461

Project Location	Seeding Date	Swathing Date- Soft dough	Swathing Date- Hard Dough
Clavet (LFCE)	May 29, 2018	August 1, 2018	August 8, 2018
Hafford (Yasieniuk)	June 25, 2019	September 24, 2019	October 24, 2019
Abbey (Smith)	May 29, 2019	August 30, 2019	September 17, 2019

10. Results

Delaying the stage of maturity at swathing increased the grazing days available at the Clavet and Abbey sites. Grazing days were the same for the soft dough and hard dough treatments at the Hafford site (Table 2). Because the Abbey and Hafford sites were grazed sequentially instead of concurrently, differences in temperature during the grazing period may have affected the results.

Table 2. Grazing days for ADOPT #20170461

Project Location	Paddock Size (ac)	Number of Cows	Grazing Days Soft Dough	Grazing Days Hard Dough	Cow days/ ac Soft Dough	Cows days/ ac Hard Dough
Clavet (LFCE)	15	56	56	77	209	287
Hafford (Yasieniuk)	14	330	10	10	235	235
Abbey (Smith)	36, 33	200	4	4	22.2	24.2

For the Clavet site, the predicted yield (on a dry matter basis) was higher for the treatment swathed at the hard dough stage. For the Hafford and Abbey sites, the predicted yield (DM basis) was higher for the treatments swathed at the early dough stage, contrary to expectations. Variability throughout the field, as well as dry early growing conditions resulting in uneven maturity, may have played a role in these results.

Table 3. Quadrat yield estimates for ADOPT #20170461

Project Location	Treatment	Predicted yield, mT/ac DM basis	Average weight ¼ m^2 As is (lbs)	Dry Matter (%)	Average weight ¼ m^2 DM basis (lbs)
Clavet (LFCE)	Soft dough	3.8			
	Hard dough	4.1			
Hafford (Yasieniuk)	Soft dough	9.18	4.53	27.5	1.25
	Hard dough	8.45	2.18	52.9	1.15
Abbey (Smith)	Soft dough	5.14	0.3	47.7	0.14
	Hard dough	3.67	0.21	48.8	0.10

Forage quality at swathing was determined by hand cutting samples (1/4 m^2 quadrats at 10 cm stubble height) immediately prior to swathing (Table 4). Crude protein decreased with delayed maturity at the Clavet site but increased at the other two locations. ADF and NDF decreased with maturity at all sites. Lignin decreased with maturity at the Clavet and Hafford sites but increased slightly with maturity at the Abbey site. Starch increased with maturity at the Clavet and Abbey sites, but decreased with maturity at the Hafford site, which was contrary to expectations. Starch content in general was lower than expected at the Hafford site. At all sites, TDN increased with maturity.

Table 4. Forage quality at swathing for ADOPT #20170461

Project Location	Treatment	CP (%)	ADF (%)	NDF (%)	Lignin (%)	Starch (%)	TDN (%)
Clavet (LFCE)	Soft dough	14.3	25.3	45.8	4.0	20.8	67.4
	Hard dough	12.9	23.0	42.3	3.7	28.3	69.7
Hafford (Yasieniuk)	Soft dough	11.0	36.1	59.4	5.72	8.1	61.4
	Hard dough	12.0	27.4	49.6	3.72	6.4	65.6
Abbey (Smith)	Soft dough	14.0	25.0	43.0	3.7	20.2	69.4
	Hard dough	15.0	24.8	41.1	3.94	20.8	69.9

Forage quality at grazing was determined by collecting samples from the swath immediately prior to grazing (Table 5). These results reflect the changes that occurred while the forage weathered in the swath. In general, crude protein decreased, ADF, NDF, and lignin increased, and TDN decreased when comparing samples collected prior to grazing to those collected at swathing.

Table 5. Forage quality at grazing for ADOPT #20170461

Project Location	Treatment	CP (%)	ADF (%)	NDF (%)	Lignin (%)	Starch (%)	TDN (%)
Clavet (LFCE)	Soft dough						
	Hard dough						
Hafford (Yasieniuk)	Soft dough						
	Hard dough						
Abbey (Smith)	Soft dough	8.7	35.7	57.9	5.01	21.7	63.2
	Hard dough	11.8	30.8	55.6	4.22	22.1	66.2

Extension/Promotion Activities:

Three field days were held to provide first-hand information transfer to local producers. The details for these field days are as follows:

1. LFCE Field Day December 5, 2018
Determining the Optimal Maturity at Harvest for Dry-preserved Cereals- Dr. Greg Penner
Impacts of Delaying Maturity of Harvest on Performance of Beef Cattle- Dr. Bart Lardner
ADOPT Project Design- Caleb Eidsvik
In Field Comparison of Grazing- Dr. Greg Penner

2. Hafford, SK Field Day December 17, 2019
Determining the Optimal Maturity at Harvest for Dry-preserved Cereals- Dr. Greg Penner
ADOPT Project Design- Chelsey Siemens and Brian Yasieniuk
In Field Comparison of Grazing- Dr. Greg Penner

3. Abbey, SK Field Day January 23, 2020
Determining the Optimal Maturity at Harvest for Dry-preserved Cereals- Dr. Greg Penner
ADOPT Project Design- Chelsey Siemens and Beau Smith
In Field Comparison of Grazing- Dr. Greg Penner

Extension materials produced:

1. A pamphlet was prepared and distributed at the LFCE field day, which included results from the LFCE site.
2. A sign acknowledging the Ministry and industry partners was displayed at all field days.
3. A power point presentation containing detailed photos from the Hafford and Abbey sites has been prepared for future extension opportunities.

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11. Conclusions and Recommendations

Supporting Information

12. Acknowledgements

The Saskatchewan Ministry of Agriculture was acknowledged at three field days using signage designed for this project, and was acknowledged on the posters and online advertising for the three field days.