2022 Research Report

from the

East Central Research Foundation

Project Title: Intercropping Spring and Winter Cereals for Silage and Grazing

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Principal Investigators:

Mike Hall[1] Heather Sorestad[1] and Charlotte Ward[2]

[1]East Central Research Foundation, Yorkton, SK.

[2]Saskatchewan Agriculture, Yorkton, SK.

Project Identification

1. **Project Number:** 20211076
2. **Producer Group Sponsoring the Project:** Saskatchewan Cattlemen's Association
3. **Project Location(s):** Yorkton, SK
4. **Project start and end dates (month & year):** April 2022 to February 2023
5. **Project contact person & contact details:**

Mike Hall, Research Coordinator

East Central Research Foundation/Parkland College
Box 1939, Yorkton, SK, S3N 3X3
Phone: 306-621-6032
Email: m.hall@parklandcollege.sk.ca

Objectives and Rationale

6. **Project objectives:**

The objective of this project was to demonstrate that various intercrops of spring and winter cereals can provide silage or greenfeed yields comparable to spring monocrops, with the additional benefit of fall grazing. This project will quantify the impact of a spring and winter cereal intercrop on the initial silage or greenfeed yield as well as the yield potential from the regrowth after harvest for fall grazing.

7. **Project Rationale:**

Perennial forage mixtures in the Yorkton area mainly consist of smooth brome and alfalfa. While these mixtures provide high first cut yield, their production in the fall, or in the year of establishment is poor. Seeding of cereals can provide some flexibility by providing forage when it may be in short supply. Seeding spring cereals with a winter cereal creates an opportunity to still harvest decent quantities of quality silage or greenfeed with the added advantage of providing fall grazing. Fall grazing winter cereals can also take some grazing pressure off perennial forage stands during the weeks leading up to the fall killing frost (six week critical period) and allow the perennial forages to build up their energy reserves prior to winter which decreases risk of winter-kill in perennial forage stands.

In the 2021 growing season, early fall rains resulted in significant regrowth on many annual spring cereals that producers were able to use to extend their grazing season. However, fall regrowth of spring cereals is not typical and should not be relied upon. The fall regrowth of winter cereals such as winter triticale and Italian ryegrass, after the spring cereal is harvested, can be relied upon. Moreover, the presence of winter cereal with a spring cereal means the forage as a whole can benefit from early and late season rainfall. Italian ryegrass and winter cereals such as winter triticale can utilize late season rainfall as they are still vegetative. In contrast, spring cereals are typically shutting down in late season.

Intercropping spring cereals with winter cereals or Italian ryegrass provides some resiliency to forage production when precipitation patterns are variable.

Methodology and Results

8. Methodology:

The trial was a 2-order factorial arranged in a Randomized Complete Block Design (RBCD) with 4 replicates. The first factor looked at spring cereals grown as a monoculture or with a companion crop of either Fridge winter triticale or Italian ryegrass. The second factor compared three spring cereals, which were CDC Haymaker oats, CDC Maverick barley and CDC SO-1 oats. All individual treatments are listed in Table 1. The trial was seeded with a 10 foot Seedmaster drill on 12 inch row spacing and plot size was 11 by 30 feet.

Table 1. Treatment list.

Trt #	Forage Crop(s)[1]
1	CDC Haymaker oats monoculture
2	CDC Maverick barley monoculture
3	CDC SO-1 oats monoculture
4	CDC Haymaker oats + Fridge winter triticale
5	CDC Maverick barley + Fridge winter triticale
6	CDC SO-1 oats + Fridge winter triticale
7	CDC Haymaker oats + Italian ryegrass
8	CDC Maverick barley + Italian ryegrass
9	CDC SO-1 oats + Italian ryegrass

[1]Companion crops of a spring and winter cereal will be seeded at ¾ the monocrop seeding rate

Plots were harvested using a forage harvester when the spring cereal had reached the soft dough stage. This initial harvest represented the silage or greenfeed yield. While yield data was only taken from the middle 4 rows of each plot to avoid edge effects, the entire plot was removed so there is no interference with the winter triticale or Italian ryegrass regrowth. In late fall, a second harvest was taken from plots containing winter triticale or Italian ryegrass. This represents forage potential for fall grazing. Dates of operations are listed in Table 2.

Table 2. Dates of operations in 2022.

Operation	Date
Pre-seed Herbicide Application	none
Seeding Date	May 26
Herbicide	Curtail M – June 13
Greenfeed Yield	Barley – August 4 Oats – August 15
Grazing Yield	September 22

9. Results:

Growing Season Weather

Mean monthly temperatures and precipitation amounts for Yorkton are listed in Table 3. A substantial hail event occurred on June 23. However, the crop recovered well as crop yields were very high due to timely rainfall.

The mean daily temperature from September 1 to September 22, 2022 as well as the total precipitation during that same time period were included in Table 3. On an average year, September precipitation could potentially contribute to additional forage regrowth for grazing. In 2022, the August precipitation was well above normal while the September precipitation was below normal. In 2022, the mean monthly temperatures were warmer than the historic average.

Table 3. Mean monthly temperatures and precipitation amounts for 2022 along with long-term normals (1981-2010) for Yorkton in Saskatchewan.

Location	Year	May	June	July	August	Sept	Avg. / Total
			Mean Temperature (°C)				
Yorkton	2022	10.6	15.7	18.6	18.9	14.3[1]	15.6
	Long-term	***10.4***	***15.5***	***17.9***	***17.1***	***11.1***	***13.1***
			Precipitation (mm)				
Yorkton	2022	137.9	57.9	38.4	90.8	13.4[2]	338.4
	Long-term	***51***	***80***	***78***	***62***	***45***	***317***

[1]Mean daily temperature for Sept 1 – Sept 22, 2022.

[2]Total precipitation for Sept 1 – Sept 22, 2022.

Seeding and Seedling Emergence

As shown in Table 2, the plots were seeded on May 26. Forage seed was seeded in the seed row, while monoammonium phosphate (11-51-0) and urea (46-0-0) was side-banded at a rate of 66.1 kg and 145.6 kg of product per hectare, respectively (74.3 kg nitrogen and 33.6 kg P_2O_5 actual nutrient per hectare).

The monocrop spring cereal treatments were to be seeded at a rate of 300 seeds/m^2 based on the 1000 kernel rates (kwt), with the intercrop or companion crops to be ¾ of the normal seeding rate at 225 seeds/m^2. Seeding rates for CDC Haymaker oats were higher than desired as the higher kwt for CDC Maverick barley was used in the calculation. The mono crop seeding rate for CDC Haymaker oats, CDC Maverick barley and CDC SO-1 oats resulted in emergence rates of

337, 273 and 222 plants/m^2, respectively (Table 4). Plant counts for spring cereals companion cropped with Fridge winter triticale represent the total population for both the spring and winter cereal, as distinguishing between the two species was not easy. In contrast, Italian ryegrass and the spring cereal were easily distinguishable and plant counts for each specie was done separately. Note the emergence rates for the spring cereals intercropped with Italian ryegrass have been reduced by approximately 25% as desired relative to the monoculture.

Table 4. Plant emergence by treatment.

Treatment	Cereal plant count (plants/m^2)	Italian ryegrass plant count (plants/m^2)
CDC Haymaker oats monoculture	337	-
CDC Maverick barley monoculture	273	-
CDC SO-1 oats monoculture	222	-
CDC Haymaker oats + Fridge winter triticale	338	-
CDC Maverick barley + Fridge winter triticale	299	-
CDC SO-1 oats + Fridge winter triticale	327	-
CDC Haymaker oats + Italian ryegrass	252	280
CDC Maverick barley + Italian ryegrass	195	276
CDC SO-1 oats + Italian ryegrass	175	390

Forage Yield

Forage plots were harvested for both greenfeed yield and again in late fall to assess the regrowth potential for grazing. The late fall harvest was only completed on the plots that contained winter triticale or Italian ryegrass as regrowth on the monoculture cereal plots was minimal and did not warrant a second forage harvest.

The main effects of cropping type and spring cereal variety on forage yields are presented in Table 5 in the appendices. No significant interactions between cropping type and spring cereal variety were detected which allows the discussion to focus on the main effects. Companion cropping with winter triticale significantly reduced greenfeed yield compared to the monocrop. In contrast, companion cropping with Italian ryegrass did not reduce green feed yield. This indicates that winter triticale was more competitive with the spring cereal relative to the slower growing Italian ryegrass. Winter triticale was also more productive in fall compared to the Italian ryegrass as indicated by a significantly higher grazing yield. When total greenfeed and grazing yield are considered together, the Italian ryegrass companion crop produced significantly more forage than the winter triticale companion crop and both companion crops produced significantly more forage than the monocrop alone. The yield reduction in the spring cereal caused by the more competitive winter triticale relative to the Italian ryegrass could not be compensated for by greater grazing yield of the winter triticale.

Focusing on the main effects of spring cereal variety, CDC Haymaker produced significantly more greenfeed yield than CDC SO-1 oats, which produced significantly more yield than CDC Maverick barley (Table 5). Differences in yield potential may have been influenced by differences in emergence and hail may have been more damaging to the more advanced barley. Grazing yield for the companion crop was significantly lower when it was in competition with CDC Haymaker oats. Grazing yields for the companion crops growing with CDC SO-1 oats or CDC Maverick barley did not differ. One might expect spring cereal competition with the companion crop should have been higher for the CDC SO-1 oats relative to the CDC Maverick barley since the oats were higher yielding and were harvested for greenfeed later. However, barley is quick establishing, and appears to have been just as competitive against companion crop regrowth as the CDC SO-1 oats. Overall, total forage yield (greenfeed + grazing), was significantly higher when companion cropping with CDC Haymaker oats relative to CDC Maverick barley. The greater yield and competitiveness of CDC Haymaker oats may have been influenced by its higher emergence rate relative to the other spring cereals. While no significant interactions were detected between cropping type and spring cereal variety, individual treatment means have been provided for reference in Table 6 in the appendices. Based on grazing yield, Italian ryegrass appears less competitive against the heavily seeded CDC Haymaker oats than the winter triticale.

Forage Quality

Treatment means for forage quality are not separated statistically, because each mean is based on single sample bulked over 4 replicates (Tables 7 and 8 in appendices). Focussing first on the main effects, acid detergent fibre (ADF) was higher and total digestible nutrients (TDN) were lower for the monocrop relative to the intercrops, due to more leafy material provided by the winter triticale or Italian ryegrass (Table 7). Numerically, the protein content of the greenfeed containing winter triticale was also higher compared to monocrop. However, this was not observed with the Italian ryegrass. Numerically, greenfeed containing barley provided about 2% more protein than the oats but TDN was highest and ADF was lowest for CDC SO-1 oats.

Forage quality for the grazing yields was numerically better for winter triticale relative to Italian ryegrass. Winter triticale had about 2% higher protein, 2% higher TDN and 2% lower ADF. The protein content of the companion crop was about 3% higher when grown with CDC Haymaker oats compared to the other spring cereals. If this difference is real, the reason for it is unclear. The reduced growth of the companion crop by the more competitive CDC Haymaker may be the reason for higher protein content. However, differences in TDN and ADF of the companion crop regrowth were not particularly large between the different spring cereals. Overall, TDN and ADF levels were not as good for the grazing yields compared to the greenfeed yields.

Individual treatment means are provided in Table 8 of the appendices for reference. However, all values are based on a single sample, making any perceived differences suspect. However, protein content of greenfeed containing CDC Maverick barley or grazing yields containing winter triticale were consistently higher.

10. Conclusions and Recommendations

The value of intercropping depends on the seasonal forage requirements of the producer. Does the producer require maximum greenfeed yields or is fall grazing an important part of their management. In other words, there was no greenfeed yield advantage by intercropping in this study. However, intercropping increased total forage production (greenfeed + grazing), with Italian ryegrass as the companion providing the highest total yield. While winter triticale provided more grazing yield than Italian ryegrass, the winter triticale significantly decreased greenfeed yield relative to the monocrop. In contrast, Italian ryegrass did not decrease greenfeed yield but still managed to provide a decent fall grazing yield. If initial greenfeed yield is a priority, Italian ryegrass was the better companion. However, precipitation during August was 50% above average during this study and this would have been particularly favourable for fall regrowth of the Italian ryegrass. The Italian ryegrass would have performed even more poorly relative to the winter triticale if fall conditions had been dry. Forage quality in terms of TDN and ADF were better for the greenfeed than the grazing yield. However, protein levels were higher for the grazing yield. The addition of a companion crop improved the ADF and TDN of the greenfeed and the using winter triticale increased greenfeed protein relative to the monocrop alone. Protein content of greenfeed containing CDC Maverick barley or grazing yields containing winter triticale were consistently higher.

Supporting Information

11. Acknowledgements:

This project was funded through the Agriculture Demonstration of Practices and Technologies (ADOPT) and Saskatchewan Cattlemen's Association.

Extension

Trial was discussed at the annual tour of the Yorkton research farm on July 14, 2022 by Charlotte Ward with Saskatchewan Agriculture. Plans are in place to create a Youtube video covering the results. The video will be made available from the ECRF channel.

12. Appendices

Table 5. Main Effects of Variety and Cropping Type on Dry Greenfeed and Grazing Yield.

	Greenfeed Yield (kg/ha)	**Grazing Yield (kg/ha)**	**Greenfeed + Grazing Yield (kg/ha)**
Cropping Type (CT)			
Monocrop	10,466 a	0 c	10,466 c
Winter Triticale Companion	8,273 b	3,452 a	11,725 b
Italian Ryegrass Companion	10,487 a	2,489 b	12,977 a
P-values	0.0007	<0.0001	0.0016
LSD	1,174	454	1,253
Variety (V)			
CDC Haymaker Oats	10,990 a	1,569 b	12,560 a
CDC Maverick Barley	8,521 c	2,242 a	10,763 b
CDC SO-1 Oats	9,715 b	2,130 a	11,845 ab
P-values	0.001	0.012	0.023
LSD	1,174	454	1,253
CT by V interaction	NS	NS	NS p=0.1

Table 6. Individual Treatment Mean Effects on Dry Greenfeed and Grazing Yield			
Treatment	**Greenfeed Yield (kg/ha)**	**Grazing Yield (kg/ha)**	**Greenfeed + Grazing Yield (kg/ha)**
1. CDC Haymaker oats monoculture	12,283 a	0 d	12,283 ab
2. CDC Maverick barley monoculture	8,298 c	0 d	8,298 c
3. CDC SO-1 oats monoculture	10,817 ab	0 d	10,817 b
4. CDC Haymaker oats + winter triticale	9,431 bc	3,035 ab	12,466 ab
5. CDC Maverick barley + winter triticale	7,988 c	3,622 a	11,610 ab
6. CDC SO-1 oats + winter triticale	7,401 c	3,699 a	11,100 b
7. CDC Haymaker oats + Italian ryegrass	11,257 ab	1,673 c	12,930 ab
8. CDC Maverick barley + Italian ryegrass	9,277 bc	3,105 ab	12,381 ab
9. CDC SO-1 oats + Italian ryegrass	10,928 ab	2,690 b	13,619 a
LSD	2,034	786	2,171

Table 7. Main Effects of Variety and Cropping Type on Greenfeed and Grazing Forage Quality			
	Crude Protein (%)	**TDN (%)**	**ADF (%)**
Greenfeed			
Cropping Type			
Monocrop	10.70	63.93	32.49
Winter Triticale	12.04	65.87	30.67
Italian ryegrass	10.4	65.59	30.93
Variety			
CDC Haymarker Oats	10.17	63.91	32.50
CDC Maverick Barley	12.24	64.87	31.61
CDC SO-1 Oats	10.73	66.61	29.97
Grazing			
Cropping Type			
Monocrop	Na	Na	Na
Winter Triticale	14.74	59.96	36.20
Italian ryegrass	12.23	57.61	38.40
Variety			
CDC Haymarker Oats	15.51	58.65	37.42
CDC Maverick Barley	12.88	59.22	36.90
CDC SO-1 Oats	12.06	58.49	37.57

Table 8. Individual Treatment Mean Effects on Greenfeed and Grazing Forage Quality on a Dry Matter Basis.

Treatment	Crude Protein (%)	TDN (%)	ADF (%)
Greenfeed			
1. CDC Haymaker oats monoculture	9.03	63.52	32.87
2. CDC Maverick barley monoculture	12.75	62.37	33.95
3. CDC SO-1 oats monoculture	10.33	65.90	30.64
4. CDC Haymaker oats + winter triticale	10.64	66.42	30.16
5. CDC Maverick barley + winter triticale	12.69	66.74	29.86
6. CDC SO-1 oats + winter triticale	12.78	64.46	31.99
7. CDC Haymaker oats + Italian ryegrass	10.84	61.80	34.48
8. CDC Maverick barley + Italian ryegrass	11.27	65.50	31.02
9. CDC SO-1 oats + Italian ryegrass	9.09	69.48	27.29
Grazing			
4. CDC Haymaker oats + winter triticale	16.60	59.12	36.99
1. 5. CDC Maverick barley + winter triticale	15.70	59.58	36.56
2. 6. CDC SO-1 oats + winter triticale	11.92	61.19	35.05
3. 7. CDC Haymaker oats + Italian ryegrass	14.43	58.19	37.86
4. 8. CDC Maverick barley + Italian ryegrass	10.06	58.85	37.24
5. 9. CDC SO-1 oats + Italian ryegrass	12.20	55.80	40.10

Abstract

Abstract/Summary:

A trial was established at the Yorkton research farm in 2022 to demonstrate that various intercrops of spring and winter cereals can provide silage or greenfeed yields comparable to spring monocrops, with the additional benefit of fall grazing. The study compared the spring cereals CDC Haymaker oats, CDC Maverick barley and CDC SO-1 oats in monoculture and companion cropped with either Fridge winter triticale or Italian ryegrass. The study found intercropping with Italian ryegrass provided greenfeed yield similar to the monocrop, but intercropping with winter triticale reduced the greenfeed yield by about 20%. However, total forage yield (greenfeed + fall grazing) was increased by intercropping. Intercropping with Italian ryegrass provided the greatest total forage yield, as it did not reduce greenfeed yield and it produced a decent amount of fall grazing. However, August precipitation was 50% above average and the Italian ryegrass would not have been so productive if conditions were dry. Despite moist conditions in fall, the winter triticale still provided 38% more grazing yield

compared to Italian ryegrass but this came at the expense of reduced greenfeed yield. Forage quality in terms of TDN and ADF were better for the greenfeed than the grazing yield. However, protein levels were higher for the grazing yield. The addition of a companion crop improved the ADF and TDN of the greenfeed and the using winter triticale increased greenfeed protein relative to the monocrop alone. Protein content of greenfeed containing CDC Maverick barley or grazing yields containing winter triticale were consistently higher. Companion cropping a spring and winter cereal can provide fall grazing with little to no loss of green feed yield and can improve feed quality.