Forage Production and Quality, Livestock Performance and Cost Comparison for Winter Cereal Forages

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Summary

Three winter cereal forages for cattle grazing and hay production were evaluated at the Central Grasslands Research Extension Center (CGREC). Our objective was to determine the forage production potential and heifer beef cow performance of the winter cereals rye, triticale and wheat.

Winter rye produced the greatest amount of forage in May, and was the most cost effective for grazing heifers and producing hay. Willow Creek winter wheat had the highest nutritional quality in May, but was the poorest forage producer and lowest in livestock performance.

Winter rye and winter triticale had an acid detergent lignin (ADL) content greater than 5% by June 8. Usually we recommend grinding hay with an ADL content greater than 4% to increase intake efficiency.

All three winter cereal forage types had a calcium-to-phosphorus ratio less than 1.2:1 throughout the grazing period. An imbalance in the calcium-to-phosphorus ratio can lead to potential health issues unless calcium is supplemented.

Based on the results from this study, winter rye was the superior winter cereal for grazing cattle during May and early June. Winter triticale appears to be the best option for producing good-quality hay if the planned harvest is early June. Willow Creek winter wheat would not be recommended as a spring grazing winter cereal, but it is the best option if producing hay in mid to late June.

Introduction

Annual forages are a common feedstuff for the livestock industry and are planted each year in North Dakota. Approximately 2.65 million acres of hay were harvested in North Dakota in 2019 (U.S. Department of Agriculture - National Agricultural Statistics Service, 2020).

Annual cereal crops, including winter cereals, are popular hay types for forages. Winter cereals also are popular for cover crops to protect the soil from erosion.

Winter cereal forages are biennial cereal crops sown in late summer to early fall. In this experiment, we tested three winter cereal types, rye, triticale and wheat – Willow Creek.

Winter rye is considered the most winter-hardy of all cereal grains and is fast-growing the following spring. Winter triticale is a hybrid developed by crossing winter wheat and winter rye.

Winter triticale is considered more winter-hardy than winter wheat but less than winter rye, and often is considered superior to rye for silage, hay and pasture. Winter wheat – Willow Creek has good winter-hardiness, is later maturing than rye and triticale, and is considered a high-quality forage.

Our study objective was to compare the forage production potential and heifer beef cow performance of three winter cereals: rye, triticale and wheat – Willow Creek.

Photos by Kevin Sedivec

Table 1. Precipitation and average temperature during the growing seasons of the study period September 2019 through June 2020 at the Central Grasslands Research Extension Center near Streeter (North Dakota Agricultural Weather Network, 2020).

Month	Precipitation (inches)		Percent of Normal		Average Temperature (F)		Departure from Average (F)	
	2019	2020	2019	2020	2019	2020	2019	2020
September	4.44		218		58		1	
October	2.59		136		36		-8	
April		0.64		59		37		-5
May		1.81		74		51		-3
June		1.35		39		67		4

Study Area

This study was conducted at the CGREC from September 2019 to June 2020. Experimental plots at the CGREC were on gravelly sandy loam soils (USDA, Natural Resources Conservation Service, 2020). Precipitation was above normal when we seeded the winter cereals and during the fall growth period in September and October 2019 but below normal during the spring growing period in 2020 (Table 1). The average temperature was 8 degrees below normal in October 2019 and 3 to 5 degrees F cooler than the long-term average in April and May 2020 (Table 1).

Procedures

- We tested winter rye, winter triticale and winter wheat – Willow Creek.
- Each species was seeded in a 10-acre field, with three replicated fields per forage type totaling nine 10-acre fields.
- The study design was a randomized block design and analyzed using a general linear model in SAS (SAS version 9.4; SAS Inst. Inc., Cary, N.C.). Means were separated using the post hoc test Duncan's Multiple Range Test (Duncan, 1955).
- Each study field was fertilized with 73.1 pounds/ acre of nitrogen (urea, MAP), 19.2 pounds/acre of phosphorus (MAP) and 12 pounds/acre of potassium (potash) in May 2019, then seeded to spring triticale. The spring triticale was harvested for hay in July 2019.
- All fields have been in no-till for 14 years or more. All fields were sprayed with 1 quart of glyphosate + 1 ounce of Sharpen/acre to kill volunteer yellow foxtail (*Setaria pumila*) on the same day each field was seeded.
- The winter cereals were seeded Sept. 5, 2019.
- All varieties were seeded at 90 pounds/acre.
- Each field was grazed with yearling heifers from May 11 through June 8, 2020.
- The stocking rate was projected using the May 8, 2020, clipping. Winter rye was stocked at 2.49 heifers per acre, winter triticale at 1.45 heifers per acre and winter wheat at 1.43 heifers per acre.
- Livestock performance was determined by collecting two-day weights prior to turnout and after grazing ended.
- Hay from winter rye and triticale were harvested at the milk to soft dough stage June 8, 2020.
- All nutritional analysis was conducted at the North Dakota State University Nutrition Lab using AOAC standards (AOAC, 2019).
- Total digestible nutrients were determined using acid detergent fiber content and the energy equation for grass (98.625-[1.048*ADF]).

Results

Winter rye was the highest-producing cereal on June 1 at 3,610 pounds/acre, followed by winter triticale and winter wheat at 3,177 and 1,771 pounds/acre, respectively (Figure 1). Winter rye was also the most productive May 8 and May 22 (Figure 1).

Crop residue after grazing was lowest in the winter wheat – Willow Creek treatment, mainly due to lower production in May (Figure 1).

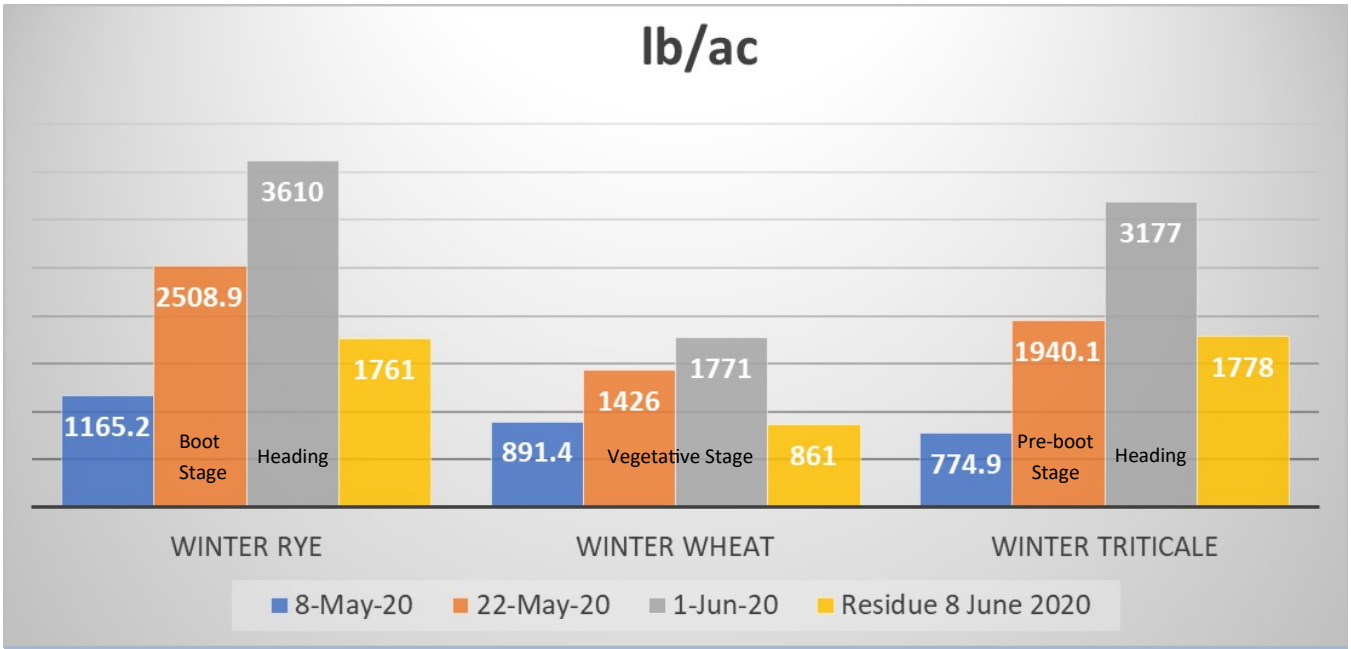

Figure 1. Forage production by winter cereals on May 8, May 22 and June 1 at Central Grasslands Research Extension Center near Streeter, N.D., in 2020.

The percent of crop residue was 49%, 49% and 56% for winter rye, wheat and triticale, respectively.

Willow Creek winter wheat was highest in crude protein and total digestible nutrients (TDN) throughout May (Table 2). Winter triticale and Willow Creek were below 3% acid detergent lignin (ADL) in May (Table 2). Winter rye and winter triticale were above 5% ADL by June 8, indicating a low palatable hay at this time (Table 2).

All winter cereal types provided the minimum requirements of phosphorus for a yearling heifer when grazing in May and early June (National Research Council, 2016). However, all three winter cereals were deficient in calcium by the end of May (National Research Council, 2016).

The calcium-to-phosphorus ratio ranged from 0.5:1 to 0.65:1 on May 22 for the winter cereals, and ranged from 0.67:1 to 0.85:1 on June 1. All winter cereals were below the minimum recommended threshold of 1.2:1 calcium-to-phosphorus ratio for cows grazing at this period (National Research Council, 2016).

Winter rye performed best for livestock performance. Heifers gained 0.97 pound/day on the winter rye (Table 3). Heifers on the winter triticale gained 0.04 pound/day, while on the winter wheat – Willow Creek, they lost 0.06 pound/day.

The Willow Creek performance can be explained due to lack of available forage throughout the grazing period. The stocking rate for all three winter cereals was based on a fast growth rate in May. Willow Creek

Table 2. Forage quality content for winter rye, winter triticale and winter wheat – Willow Creek at Central Grasslands Research Extension Center near Streeter, N.D., in 2020.

Winter Cereal Crop	Crude Protein (%)			Acid Detergent Lignin (%)			Total Digestible Nutrients (%)			Calcium (%)		Phosphorus (%)	
	May 22	June 1	June 8	May 22	June 1	June 8	May 22	June 1	June 8	May 22	June 1	May 22	June 1
Rye	8.7	6.7	6.6	2.4	4.2	5.6	68.6	61.2	58.0	0.20	0.19	0.39	0.28
Triticale	10.4	7.8	7.8	2.3	2.8	5.2	70.8	65.7	59.0	0.25	0.20	0.40	0.27
Wheat, Willow Creek	12.3	9.2	N/A	2.4	2.5	N/A	71.4	69.2	N/A	0.30	0.22	0.46	0.26

Table 3. Heifer average daily gain (pounds/day) by winter cereal type grazed from May 11 through June 8, 2020, at Central Grasslands Research Extension Center near Streeter, N.D.

Winter Cereal Crop	Average Daily Gain
Rye	0.97
Triticale	0.04
Wheat, Willow Creek	-0.06

grows much slower in May (see Figure 1) than winter rye and triticale, so the stocking rate would be too high for May grazing.

The cost to graze heifers on the winter rye was $1.02 per day and much cheaper than winter triticale and winter wheat – Willow Creek (Figure 2). The cost to graze heifers on the winter triticale was $2.03/head per day, with the higher costs, compared with winter rye, a function of less forage produced and cost of seed. Due to the slow growth rate of Willow Creek in May, the costs to graze heifers on this forage type was also high due to lower forage production.

The cost to produce hay was $51.27, $65.85 and $110.96 per ton for winter rye, triticale and wheat, respectively, when harvested June 1 (Figure 2).

Due to Willow Creek's slow growth in May, harvesting for hay on June 1 would not be recommended. Willow Creek was still in the vegetative growth stage on June 1 and would be much more economical to harvest in mid to late June.

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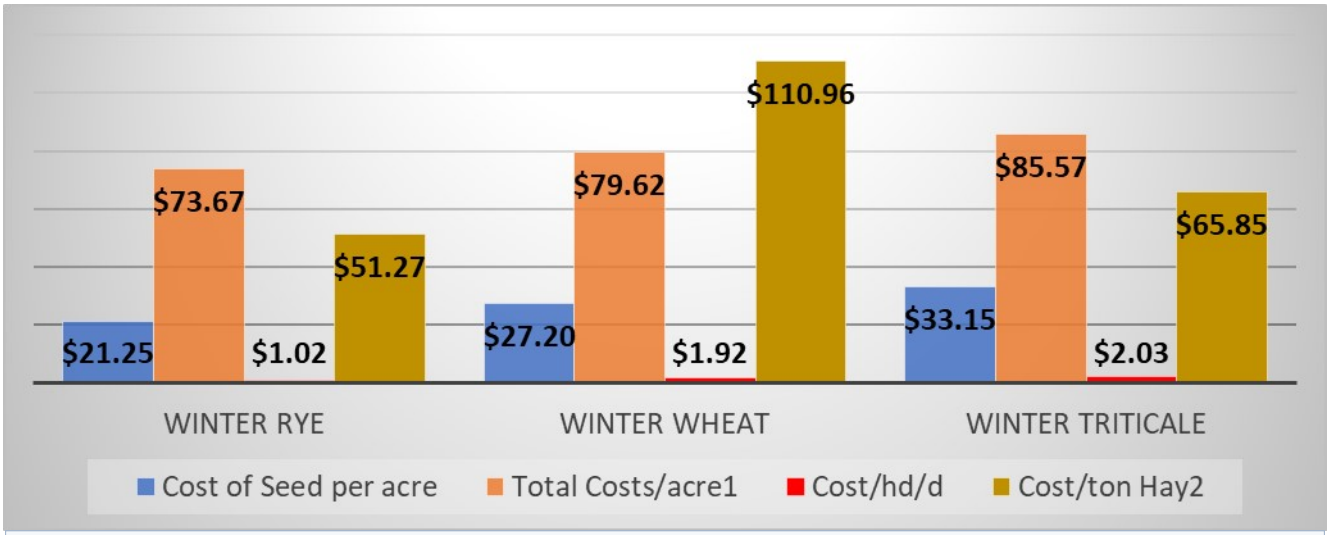

[1] Total costs per acre includes custom farm rates (USDA, Agricultural Statistics Service, 2020) for no-till seeding rate ($17.80/acre), custom herbicide application ($6.57/acre), actual cost of herbicide (glyphosate + Sharpen; $5.60/acre), land rent ($22.45/acre) and seed cost (winter rye - $21.25/acre, winter wheat - $27.20/acre, winter triticale - $33.15/acre). Total land rental rate would be $44.90/acre (USDA, Agricultural Statistics Service, 2020); however, we dedicated 50% of the cost toward the winter cereal, 50% for the second crop (cover crop). Grazing period May 11-June 8 (29 days).

[2] Cost per ton of hay includes total costs per acre + cost for swathing ($9.66/acre) and baling ($9.47/acre).

Figure 2. Total costs per acre, cost to graze heifers per day and cost to harvest hay by winter cereal type at Central Grasslands Research Extension Center near Streeter, N.D., in 2020.