



Forage Production, Quality and Cost Comparison for Selected Varieties of Forage Oats, Forage Barley and Spring Triticale

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Summary

Annual cool-season cereal forages are excellent feed sources for livestock. Determining which forage type to plant becomes the question. Forage oats were the highest-producing cereal crop, ranging from 2.6 to 3.7 tons/acre. Forage oat varieties Everleaf 126 and Goliath were the highest producing of all 10 cereal forage varieties. On average, the spring triticale varieties had the highest crude protein content, with all over 11% at the early dough stage. Among the oat varieties, only the forage oat Goliath had a crude protein content greater than 11%.

The forage barley varieties, along with BYS FT spring triticale, contained the lowest levels of acid detergent lignin: less than 4%. Total digestible nutrients also were highest in the forage barley varieties and BYS FT spring triticale. The forage oat varieties were the lowest cost forages to produce based on seed cost, with the Everleaf 126 the lowest at \$9.05 per ton of forage.

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 2018 (U.S. Department of Agriculture - National Agricultural Statistics Service, 2019), with alfalfa comprising 1.47 million acres and other hay types 1.2 million acres. Annual cereal crops are a popular hay type planted for spring and summer forages.

The awnless forage barley was developed for drier climates in the late 1970s and 1980. Forage barley can produce good-quality hay but tends to be lower quality than oats and triticale. Barley can be established on well-drained soils and is considered to be the earliest maturing small grain.

Forage oats have been popular in cover crop mixtures and can make exceptional hay with good tonnage and high quality. Oats can be established on well-drained, fertile soils. Many varieties of forage oats have been developed for the northern Plains, with the age of maturity varying among varieties.

Spring triticale is a hybrid developed by crossing wheat and rye. Drought tolerance is the primary advantage spring triticale has over other spring cereal forage crops. Trials conducted in Alberta, Canada, showed spring triticale to be higher yielding than barley or oats from 1995 to 2000 (Salmon et al., 2001).

Study Area

This study was conducted on the Central Grasslands Research Extension Center. Experimental plots were on soils of the Hecla-Ulen soil series and classified as loamy fine sands (USDA, Natural Resources Conservation Service, 2020). Precipitation was at or above average for all months of the study: May through August (Table 1). Average temperature was 1 to 5 degrees cooler than the long-term average for the duration of the study except in June (Table 1).

Table 1. Precipitation and average temperature during the study period May through August 2019 at the Central Grasslands Research Extension Center (NDAWN, 2020).

Month	Precipitation (inches)	Percent of Normal	Average Temperature (F)	Departure from Average (F)
May	2.99	122	49	-5
June	3.47	102	64	0
July	4.15	130	69	-1
August	2.52	109	64	-4

Procedures

- The trial was planted May 28, 2019, on 25- x 50-foot plots that previously were left fallow in 2017-2018.
- All plots have been no-till for five years or more. All plots were sprayed with 1 quart of glyphosate + 1 ounce of Sharpen/acre to kill volunteer yellow pigeon grass (*Setaria pumila*) on the same day the plots were seeded.
- Four varieties of forage oats (Goliath, 4010 Everleaf 126, Mustang 120, BYS FO), four varieties of spring triticale (Bunker, Merlin, BYS FT, 141) and three varieties of forage barley (Haymaker, Axcel, Hays) were studied. The Hays forage barley was heavily invaded by ground squirrels, impacting forage production and not included in the final analysis.
- All varieties were seeded at 90 pounds of PLS/acre and targeted harvest stage was early dough.
- 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 and the energy equation for grass ($98.625 - [1.048 * ADF]$).
- Study design was a randomized block design with four replications and was 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).

Results

Forage oats were the highest-producing cereal forages in 2019 (Table 2). Everleaf 126 and Goliath were the highest-producing forage oat. We found no difference in yield between the spring triticale and forage barley varieties (Table 2). All forage oat varieties and spring triticale Merlin Max had the best stand establishment, and forage oat varieties Everleaf 126, Goliath and BYS FO were best at suppressing weeds, with yellow foxtail the most common weed (Table 2).

Forage barleys Axcel and Haymaker and spring triticale BYS FT had the highest total digestible nutrient levels (Table 3). The Everleaf 126 forage oat was the poorest-performing forage in terms of crude protein, with Bunker triticale the superior forage in this trial. All the triticale varieties except 141 had a crude protein content greater than 11%. The forage barley varieties contained the lowest levels of acid detergent lignin, followed by forage oat BYS FO; all three were less than 4%. All forage cereal varieties provided the minimum requirements of phosphorus for 1,200-pound gestating and early lactating beef cattle (National Research Council, 2016). All forage cereal varieties provided the minimum requirements of calcium for gestating 1,200-pound beef cattle but were deficient for early lactating 1,200-pound beef cattle (National Research Council 2016).

Table 2. Plant characteristics, days to early dough, harvest date, stand establishment rating, weed suppression rating and yield for selected varieties of forage oats, forage barley and spring triticale at Central Grasslands Research Extension Center in 2019.

Cereal Crop ¹	Variety	Days to Early Dough	Plant Height	Harvest Day	Stand Establishment	Weed Suppression	Yield (100% DM) ²
			Inch		(1-10) 10 best	(1-10) 1 best	ton/ac
FO	Everleaf 126	66	41	Aug. 8	9	2	3.68 ^a
FO	Goliath	50	48	July 23	9	2	3.24 ^{ab}
FO	Mustang 120	50	48	July 23	8	4	2.67 ^{bc}
FO	BYS FO	50	44	July 23	9	2.5	2.57 ^{bcd}
ST	BYS FT	50	36	July 23	7	5	1.88 ^{cde}
ST	Merlin Max	50	37	July 23	8	4	1.75 ^{de}
ST	Bunker	50	39	July 23	5.5	6	1.41 ^e
ST	141	50	41	July 23	7	5	1.31 ^e
FB	Axcel	56	27	July 24	6.5	6	1.45 ^e
FB	Haymaker	56	31	July 24	4.5	7	1.34 ^e

¹ FO = Forage Oat, ST = Spring Triticale, FB = Forage Barley.

² Varieties with the same letter (a, b, c, d, e) are not statistically different ($P>0.05$).

Table 3. Forage quality content for selected varieties of forage oats, forage barley and spring triticale at Central Grasslands Research Extension Center in 2019.

Cereal Crop ¹	Variety	Crude Protein ¹	Acid Detergent Fiber ¹	Acid Detergent Lignin ¹	Total Digestible Nutrients ²	Calcium ³	Phosphorus ³
		%	%	%	%	%	%
FO	Everleaf 126	8.79 ^b	35.05 ^{ab}	4.59 ^a	61.90 ^{ab}	0.27	0.21
FO	Mustang 120	9.51 ^{ab}	35.15 ^{ab}	4.15 ^{ab}	61.78 ^{ab}	0.24	0.21
FO	BYS FO	9.88 ^{ab}	35.53 ^{ab}	3.99 ^b	61.39 ^{ab}	0.27	0.27
FO	Goliath	11.03 ^{ab}	37.19 ^a	4.54 ^{ab}	59.65 ^b	0.22	0.21
ST	BYS FT	11.01 ^{ab}	33.66 ^{ab}	4.27 ^{ab}	63.35 ^{ab}	0.23	0.27
ST	Bunker	11.99 ^a	35.81 ^{ab}	4.34 ^{ab}	61.10 ^{ab}	0.22	0.27
ST	Merlin Max	11.44 ^{ab}	36.64 ^{ab}	4.70 ^a	60.23 ^{ab}	0.27	0.27
ST	141	10.39 ^{ab}	36.65 ^a	4.36 ^{ab}	60.21 ^b	0.25	0.23
FB	Axcel	10.47 ^{ab}	32.29 ^b	3.47 ^c	64.78 ^a	0.28	0.22
FB	Haymaker	9.66 ^{ab}	33.35 ^{ab}	3.44 ^c	63.67 ^{ab}	0.28	0.22

¹ FO = Forage Oat, ST = Spring Triticale, FB = Forage Barley.

² Varieties with the same letter (a, b, c, d, e) are not statistically different ($P>0.05$).

³ We found no difference ($P>0.05$) among varieties in calcium or phosphorus content.

Because all input costs were the same for planting and harvesting the 10 forage cereal crops studied in 2019, the only variable would be seed cost. The cost to produce 1 ton/acre of forage was lowest for all four forage oat varieties, ranging from \$9.05 per ton seed cost for Everleaf 126 forage oats to

\$12.61 per ton seed cost for BY S FO forage oats. The seed cost to produce 1 ton/acre of Merlin Max spring triticale was \$12.37. All other varieties ranged from \$19.15 to \$21.49 per ton for seed cost (Figure 1).

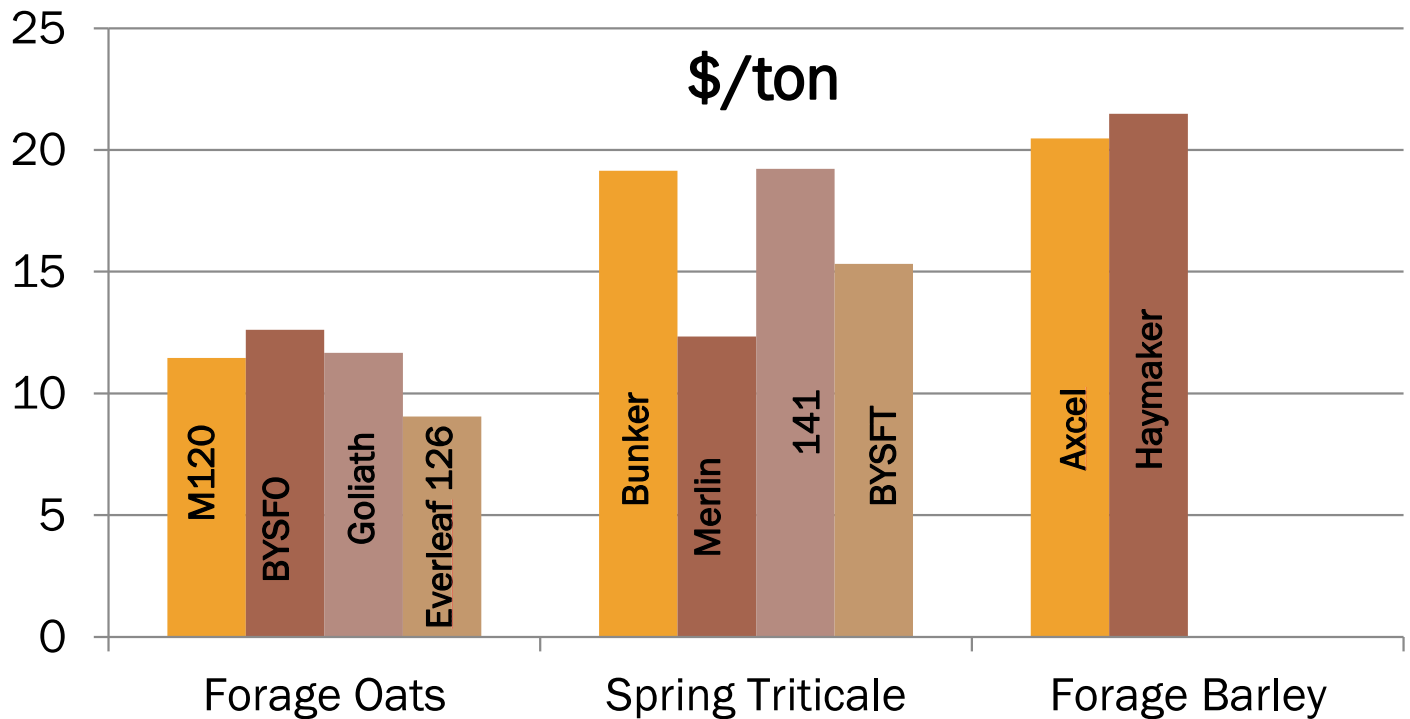


Figure 1. Cost to produce a ton of forage based on seed cost in 2019.

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