Evaluating rotations of winter annual and summer annual forages for yield, nutritional value, and economic sustainability as forage resources for beef cattle in northern Iowa

DOI:10.31274/air.13905

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Summary and Implications

A winter annual/summer annual forage system can be used to break up the traditional corn/soybean rotation and produce 6-7 tons of forage feed on a dry matter basis. The first year of data indicated the warm season grasses responded positively to additional nitrogen fertilizer with increased dry matter yields, crude protein and energy levels, however cool season grass responses were variable.

Introduction

Interest in grazing cover crops or winter annuals has increased in recent years. Iowa research on grazing winter annuals has concentrated in southern Iowa. With the differences in growing conditions in northern Iowa, data on growth potential is needed from the northern half of the state. Similar interest has been developing on the use of summer annuals to fill in the traditional summer slump of Iowa pastures. This project is designed to replicate the current winter annual/summer annual project underway at McNay, Armstrong and Neely-Kinyon research farms, but to measure and demonstrate the applicability in northern Iowa at the Northeast Research and Demonstration Farm at Nashua.

Materials and Methods

Eight winter annual treatments replicating the plots in southern Iowa were established at the Northeast Research and Demonstration Farm on October 20, 2020. Treatments include Elbon cereal rye with and without 50 pounds(#) nitrogen (N) fertilizer per acre (ac.), Willow Creek forage winter wheat with and without 50# N, Flex 719 Brand triticale with and without 50# N and Thompson hard red winter wheat with and without 50# N. Each were seeded at 100 pounds(#) of seed per ac. and replicated 4 times in 10'x60' plots. Due to dry conditions, fall growth was minimal. Spring growth was also slow due to dry conditions (Table 1). Fifty #N/acre as urea was spread on half the plots on April 6, 2021. Plots were mechanically harvested with the 3-foot-wide Carter Harvester on May 26, 2021 and tested for nutrient analysis. Yield and quality data is in Table 2.

All forage was removed from the plots and four summer annuals were drilled into these same plots on June 9, at 100 lbs/ac. The treatments were hybrid brown mid-rib (**BMR**) pearl millet, Japanese millet, Piper Sudangrass and BMR sorghumXsudangrass each with either 50 or 100 pounds of nitrogen per acre. Fifty pounds of nitrogen per acre as urea was applied to all plots on June 11, and sprayed with 32 oz/ac Roundup Powermax® on June 13 to kill winter annual forage regrowth. Less than 1.5" of rain fell during the month of June. An additional 50 lb/ac of nitrogen as urea was applied July 14, to half the plots, and 0.98" of rain fell that same day. First cutting was harvested on August 3, with the Carter harvester. The Japanese millet had a few seed heads showing at harvest but no seed heads were visible on the Pearl millet, sorghumXsudangrass or sudangrass. Two passes on the north and south sides were cut with a discbine and the center 10-14' was left unmowed for a comparison to a single harvest system. All mowers were set to leave at least 8-10" residue height. Mowed forage was baled as wet hay/baleage and removed from plots on Aug. 6. On Aug. 17, 80% of the uncut Japanese millet had seed heads present, while no seed heads were seen in the uncut Pearl millet, less than 1% of the sorghumXsudangrass had seeded out and 10% of the uncut sudangrass had seeded out. The second harvest was cut September 14 using the Carter harvester on the earlier harvested plot sections. In the uncut sections, 5 feet 3 inches of row (1/10,000th acre) were hand harvested, weighed and sampled. The remaining forage was mowed as low as possible and removed from the plots. The summer annual forage yields and quality are in Tables 3, 4 and 5.

Winter annuals were drilled into the plots on October 4, 2021 to repeat the rotation.

Results and Discussion

Cereal rye was the earliest maturing winter annual forage, producing seed heads about a week prior to the harvest date, and that maturity was reflected in the yield, dry matter, protein and fiber levels of the feed. The cereal rye also did not respond to the extra 50# of nitrogen with increased yield while the other three species did have

increased yields, protein and energy from the additional nitrogen (Table 2).

On the warm season plots, we saw little response to the additional nitrogen since it was applied less than 3 weeks prior to the first harvest date (see Tables 3-6). Positive yield and protein responses were seen from the additional nitrogen in the second cutting of all varieties.

Calendar year 2021 was an abnormally dry year with the exception of the month of August, as shown in Table 1. This likely reduced the potential yield for the winter annual forages and the first cutting of the summer annual forages, however additional research is needed to determine long-term yields.

Acknowledgements

The authors would like to thank the Iowa Beef Center mini-grant for funding this project, Ken Pecinovsky at Northeast Research and Demonstration Farm for managing the plots, and Welter Seed & Honey, Melbourne Seed, and Margaret Smith and Albert Lea Seed for donating seed.

Table 1. Precipitation (inches) during the 2021 growing season at the ISU NE Research Farm, Nashua, IA.

	Apr	May	June	July	Aug	Sept	Oct	Nov	Total
2021	0.63	3.48	1.42	2.53	10.58	1.61	4.50	2.02	26.77
1976-2020 Avg	3.68	4.52	5.47	4.57	4.67	3.56	2.68	1.74	30.89

Table 2. Cool season forage yield & quality.

	% DM	Ton/ AC	Plant HT, in	CP, %	aNDF, %	aNDF om, %	Ash, %	NFC, %	TDN OAR DC	NEg OAR DC	NEm OAR DC
0 Nitrogen											
CEREAL RYE (ELBON)	29.31	2.39	44.50	11.54	61.81	59.88	8.72	18.84	55.42	27.81	53.30
TRITICALE (Flex 719 Brand)	18.17	1.93	27.25	17.76	49.57	47.81	13.31	19.72	55.93	31.04	56.83
FORAGE WHEAT (WillowCreek)	20.00	1.56	21.75	19.05	45.72	43.91	14.04	21.16	57.16	33.21	59.21
HR WINTER WHEAT (Thompson)	21.91	1.81	22.88	18.02	49.29	46.70	12.98	21.06	56.44	31.81	57.67
50# Nitrogen											
CEREAL RYE (ELBON)	24.64	2.34	41.50	14.6	58.18	57.24	8.37	18.56	57.22	31.46	57.29
TRITICALE (Flex 719 Brand)	18.06	2.22	26.75	18.48	47.95	46.11	13.74	20.02	56.45	32.04	57.92
FORAGE WHEAT (WillowCreek)	17.50	1.72	23.25	21.70	44.51	42.85	14.09	19.86	57.41	34.56	60.69
HR WINTER WHEAT (Thompson)	19.83	1.98	22.88	20.69	47.96	46.28	8.39	24.49	60.13	37.58	64.02

Table 3. First cutting warm season forage yield and quality.

	% DM	Ton /AC	Plant HT, in	CP, %	aNDF, %	aNDF om, %	Ash, %	NFC, %	TDN OAR DC	NEg OAR DC	NEm OAR DC
50# Nitrogen											
PEARL MILLET	22.92	1.19	28.75	14.52	48.08	47.05	11.46	24.44	58.89	33.73	59.77
JAPANESE MILLET	22.03	1.11	33.63	15.70	56.14	54.91	10.31	18.43	55.47	29.54	55.19
SORGHUM SUDANGRASS	19.75	2.03	45.25	12.99	52.83	51.25	9.81	24.06	58.22	32.19	58.09
HYBRID SUDANGRASS	21.73	2.25	71.88	16.45	52.3	51.29	7.92	20.75	62.57	39.27	65.9
100# Nitrogen											
PEARL MILLET	21.49	1.66	32.75	16.43	51.11	49.20	11.39	20.88	58.03	33.32	59.33
JAPANESE MILLET	21.25	1.61	36.63	17.79	54.14	53.15	9.52	18.22	57.87	33.61	59.65
SORGHUM SUDANGRASS	18.75	2.17	45.00	16.24	54.13	52.13	9.85	20.00	58.21	33.46	59.49
HYBRID SUDANGRASS	19.25	2.02	69.25	17.1	52.28	51.31	7.93	21.46	60.96	37.39	63.81

Table 4. Second cutting warm season forage yield and quality.

	% DM	Ton /AC	Plant HT, in	CP, %	aNDF, %	aNDF om, %	Ash, %	NFC, %	TDN OAR DC	NEg OAR DC	NEm OAR DC
50# Nitrogen											
PEARL MILLET	24.63	2.51	29.87	8.29	60.07	54.75	16.24	19.35	49.60	18.37	43.14
JAPANESE MILLET	33.00	2.26	39.37	10.16	58.14	51.09	14.32	22.95	52.98	23.93	49.11
SORGHUM SUDANGRASS	22.88	2.06	36.75	9.19	61.73	56.12	16.16	16.96	49.61	18.80	43.59
HYBRID SUDANGRASS	23.50	2.42	65.87	9.94	65.17	58.41	15.01	15.57	49.55	18.99	43.80
100# Nitrogen											
PEARL MILLET	23.16	3.00	31.87	9.25	60.31	56.35	15.61	17.62	49.61	18.78	43.58
JAPANESE MILLET	30.50	2.73	44.12	10.25	62.24	55.22	14.64	19.9	49.61	19.13	43.95
SORGHUM SUDANGRASS	21.25	2.51	41.37	11.48	61.23	56.06	15.07	15.78	51.06	21.82	46.84
HYBRID SUDANGRASS	23.75	3.10	70.37	12.66	62.67	59.23	11.83	15.49	52.43	24.17	49.37

Table 5. Single cutting warm season forage yield and quality.

	% DM	Ton /AC	Plant HT, in	CP, %	aNDF, %	aND Fom, %	Ash, %	NFC, %	TDN OAR DC	NEg OAR DC	NEm OAR DC
50# Nitrogen											
PEARL MILLET	31.19	2.54	62	10.93	61.79	58.52	11.56	16.70	54.48	26.37	51.75
JAPANESE MILLET	42.73	2.78	64	7.11	60.48	56.79	12.44	22.54	54.18	24.31	49.52
SORGHUM SUDANGRASS	38.93	5.44	91	5.73	57.91	55.21	10.76	27.6	55.92	26.11	51.46
HYBRID SUDANGRASS	41.92	4.45	107	5.65	66.59	65.17	7.89	20.86	55.5	25.49	50.79
100# Nitrogen											
PEARL MILLET	32.38	5.56	63	9.41	61.78	59.78	11.86	17.92	53.55	24.37	49.58
JAPANESE MILLET	39.55	3.33	62	10.24	57.07	52.83	12.91	22.48	55.11	26.89	52.31
SORGHUM SUDANGRASS	34.60	4.93	88	12.24	58.34	55.99	12.58	17.00	55.09	27.71	53.20
HYBRID SUDANGRASS	39.97	4.28	115	6.98	63.69	61.02	7.54	23.39	57.7	29.05	54.65

Table 6. Yield comparison of single and double harvest dates.

	1st Cut Ton/Ac	2nd Cut Ton/Ac	Combined Ton/Ac	Single Cut Ton/Ac
50# Nitrogen				
PEARL MILLET	1.19	2.51	3.70	2.54
JAPANESE MILLET	1.11	2.26	3.37	2.78
SORGHUM SUDANGRASS	2.03	2.06	4.09	5.44
HYBRID SUDANGRASS	2.25	2.42	4.67	4.45

	1st Cut Ton/Ac	2nd Cut Ton/Ac	Combined Ton/Ac	Single Cut Ton/Ac
100# Nitrogen				
PEARL MILLET	1.66	3.00	4.66	5.56
JAPANESE MILLET	1.61	2.73	4.34	3.33
SORGHUM SUDANGRASS	2.17	2.51	4.68	4.93
HYBRID SUDANGRASS	2.02	3.10	5.12	4.28