

# 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

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Interest in grazing cover crops or winter annuals has increased in recent years. Iowa research on grazing winter annuals has been concentrated in southern Iowa, but because of differences in growing conditions, data on growth potential from the northern half of the state is needed. Similar interest has been developing on utilizing 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, in order to measure and demonstrate the applicability in northern Iowa at the Northeast Research and Demonstration Farm at Nashua

## Materials and Methods

Two years of a winter annual/summer annual forage rotations have been completed. Eight winter annual treatments were established at the Northeast Research and Demonstration Farm October 30, 2020, and October 4, 2021, with four replications of each treatment. First year treatments include Elbon cereal rye, Willow Creek forage winter wheat, Flex 719 Brand triticale and Thompson hard red winter wheat, each with and without 50 lb. nitrogen (N) fertilizer/acre. This was an exact replication of the trials at the southern Iowa research farms. Second year treatments included KWS Progas cereal rye, Hazlet cereal rye, Triticale, and Thompson hard red winter wheat, each with and without 50 lb. N. These varieties were based on forage yield recommendations from Albert Lea Seed House. Each were seeded at a target rate of 100 lb. of seed/acre and replicated four times in 10-ft. by 60-ft. plots. Dry conditions in the fall of 2020 and spring of 2021 delayed germination and growth. Fifty lb. of N/acre as urea was spread on half the plots April 6, 2021, and April 5, 2022, as the forage started to break dormancy and just ahead of predicted rainfall. Plots were mechanically harvested with the 3-ft.-wide Carter Harvester May 26, 2021, and May 31, 2022, and tested for nutrient analysis.



The two-year average yield and quality data is in Table 1.

All forage was removed from the plots and four summer annuals were drilled into these same plots June 9, 2021, and June 21, 2022, at a target rate of 40 lb./acre. The treatments in 2021 were hybrid brown mid-rib (BMR) pearl millet, Japanese millet, Piper sudangrass and dwarf BMR sorghum sudangrass. The 2022 treatments were ExCeed BMR hybrid pearl millet, Viking BMR brand hybrid 200 and 232 sorghum sudangrass, and Piper sudangrass, each with either 50 or 100 lbs. of N/acre. Fifty lb. of N/acre as urea was applied to all plots June 11, 2021, and July 8, 2022, and sprayed with 32 oz./acre Roundup Powermax® June 13, 2021, and June 20, 2022, to kill winter annual forage regrowth. In 2021, less than 1.5 in. of rain fell during the month of June (Table 6). An additional 50 lb./acre of N as urea was applied July 14, 2021 or July 23, 2022 to half the plots. First cutting was harvested August 3 in both years with the Carter harvester. In 2021, the Japanese millet had a few seed heads showing at harvest but no seed heads were visible on the Pearl millet, sorghum sudangrass or sudangrass. In 2022, no seed heads were visible at the first harvest in any plot. Two passes on the north and south sides were cut with a discbine and the center 10-14 ft. was left unmowed for a comparison to a single harvest system. All mowers were set to leave at least 8-10 in, residue height. Mowed forage was baled as wet hay/baleage and removed from plots on August 6 both years. The second harvest was cut September 14, 2021, and September 22, 2022, using the Carter harvester on the earlier harvested plot sections. In the uncut sections, 5 ft. 3 in. of row (1/10,000<sup>th</sup> acre) were hand harvested, weighed and sampled. The remaining forage was mowed as low as possible and removed from the plots. In 2022, a leaf blight limited the yield and quality of the Piper hybrid sudangrass, but did not affect the other treatments. Disease damage started to appear in late July and continued to worsen throughout the season and the Iowa State University Plant and Insect Diagnostic Clinic reported the blight was caused by the same pathogen that causes Northern Corn Leaf Blight in corn. The 2-year average summer annual forage yields and quality are in Tables 2, 3 and 4.

**Table 1. Cool season forage average yield and quality.**

	0 lb. nitrogen				50 lb. nitrogen			
	% DM	Ton/AC	CP, %	TDN OARDC	% DM	Ton/AC	CP, %	TDN OARDC
<b>Cereal rye</b>								
2021 Elbon	29.31	2.39	11.54	55.42	24.64	2.34	14.60	57.22
2022 Progas	28.21	3.47	9.81	61.86	26.26	3.97	12.63	63.76
2022 Hazlet	27.93	3.66	11.15	62.09	24.89	4.37	12.81	63.48
<b>Triticale</b>								
2021 Flex 719	18.17	1.93	17.76	55.93	18.06	2.22	18.48	56.45
2022 VNS	22.12	3.33	14.17	63.6	20.50	3.89	11.34	62.00
<b>HR winter wheat</b>								
2021 Willow Creek Forage Wheat	20.00	1.56	19.05	57.16	17.50	1.72	21.70	57.41
2021 Thompson HR	21.91	1.81	18.02	56.44	19.83	1.98	20.69	60.13
2022 VNS	26.02	3.04	14.23	63.13	23.35	3.64	9.8	62.12

**Table 2. First cutting warm season forage yield and quality.**

	50 lb. nitrogen				100 lb. nitrogen			
	% DM	Ton/AC	CP, %	TDN OARDC	% DM	Ton/AC	CP, %	TDN OARDC
<b>Pearl millet</b>								
2021 Pearl Millet	22.92	1.19	14.52	58.89	21.49	1.66	16.43	58.03
2022 ExCeed BMR	17.05	1.70	14.03	63.07	18.16	1.82	16.95	64.73
<b>Sorghum sudangrass</b>								
2021 Sorghum Sudangrass	19.75	2.03	12.99	58.22	18.75	2.17	16.24	58.21
2022 Viking 200 BMR	17.41	2.54	12.83	60.41	17.48	2.90	13.1	60.96
2022 Viking 232 BMR	16.44	2.86	14.59	63.67	16.61	2.72	12.82	62.39
<b>Hybrid sudangrass</b>								
2021 Piper	21.73	2.25	16.45	62.57	19.25	2.02	17.10	60.96
2022 Piper	18.38	2.15	13.91	60.27	17.42	2.00	15.62	62.25
Japanese Millet 2021	22.03	1.11	15.70	55.47	21.25	1.61	17.79	57.87

**Table 3. Second cutting warm season forage yield and quality.**

	50 lb. nitrogen				100 lb. nitrogen			
	% DM	Ton/AC	CP, %	TDN OARDC	% DM	Ton/AC	CP, %	TDN OARDC
<b>Pearl millet</b>								
2021 Pearl Millet	24.63	2.51	8.29	63.07	23.16	3.00	9.25	63.07
2022 ExCeed BMR	21.23	2.66	8.67	64.88	18.71	3.19	10.75	64.98
<b>Sorghum sudangrass</b>								
2021 Sorghum Sudangrass	22.88	2.06	9.19	63.48	21.25	2.51	11.48	63.67
2022 Viking 200 BMR	20.46	2.48	9.96	65.08	18.23	3.46	10.19	65.18
2022 Viking 232 BMR	20.66	2.56	9.67	63.84	19.98	2.75	11.05	64.32
<b>Hybrid sudangrass</b>								
2021 Piper	23.50	2.42	9.94	62	23.75	3.10	12.66	60.27
2022 Piper	22.93	1.68	12.89	63.7	20.84	1.75	14.41	64.19
Japanese Millet 2021	33.00	2.26	10.16	62.12	30.50	2.73	10.25	60.41

## Results

A winter annual/summer annual forage system can be used to break up the traditional corn/soybean rotation and produce 9-12 tons of forage feed on a dry matter basis. The results indicated the second cutting warm season grasses responded positively to additional nitrogen fertilizer with increased dry matter yields. The sorghum sudangrass hybrids had higher yields in the single harvest system while the millets and sudangrass had higher yields in the double harvest system.

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**Table 4. Single harvest warm season forage yield and quality.**

	50 lb. nitrogen				100 lb. nitrogen			
	% DM	Ton/AC	CP, %	TDN OARDC	% DM	Ton/AC	CP, %	TDN OARDC
<b>Pearl millet</b>								
2021 Pearl Millet	31.19	2.54	10.93	49.60	32.38	5.56	9.41	49.61
2022 ExCeed BMR	23.20	3.35	8.35	65.12	22.64	3.44	9.04	65.26
<b>Sorghum sudangrass</b>								
2021 Sorghum Sudangrass	38.93	5.44	5.73	49.61	34.60	4.93	12.24	51.06
2022 Viking 200 BMR	29.14	7.42	7.43	65.68	29.55	7.37	9.13	66.58
2022 Viking 232 BMR	29.23	6.71	5.36	65.2	31.44	7.48	6.99	64.99
<b>Hybrid sudangrass</b>								
2021 Piper	41.92	4.45	5.65	49.55	39.97	4.28	6.98	52.43
2022 Piper	32.11	2.66	10.28	63.25	30.15	2.78	9.68	62.93
Japanese Millet 2021	42.73	2.78	7.11	52.98	39.55	3.33	10.24	49.61

**Table 5. Yield comparison of single and double harvests.**

	50 lb. nitrogen		100 lb. nitrogen		
	Double harvest	Single harvest	Double harvest	Single harvest	
<b>Pearl millet</b>					
2021 Pearl Millet		3.70	2.54	4.66	5.56
2022 ExCeed BMR		4.36	3.35	5.01	3.44
<b>Sorghum sudangrass</b>					
2021 Sorghum Sudangrass		4.09	5.44	4.68	4.93
2022 Viking 200 BMR		5.02	7.42	6.36	7.37
2022 Viking 232 BMR		5.42	6.71	5.47	7.48
<b>Hybrid sudangrass</b>					
2021 Piper		4.67	4.45	5.12	4.28
2022 Piper		3.83	2.66	3.75	2.78
Japanese Millet 2021		3.37	2.78	4.34	3.33

**Table 6. Precipitation (inches) during the growing season.**

	Apr	May	June	July	Aug	Sept	Oct	Nov	Total
2022	3.62	4.10	5.22	2.55	6.74	1.03	0.75	2.02	26.03
1976-2021 average	3.61	4.50	5.38	4.53	4.80	3.51	2.71	1.75	30.79
2021	0.63	3.48	1.42	2.53	10.58	1.61	4.50	2.02	26.77
1976-2020 average	3.68	4.52	5.47	4.57	4.67	3.56	2.68	1.74	30.89