Annual Forages following Irrigated Winter Wheat

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Summary

A sorghum-sudangrass hybrid, oats, and foxtail millet were compared using two planting dates and two irrigation levels in western Nebraska following irrigated winter wheat. In 2012, regardless of planting date and irrigation level, the sorghum-sudangrass hybrid produced more dry matter tons than oats and millet (2.0 vs. 1.3 and 1.2, respectively). In 2013, the sorghum-sudangrass hybrid and oats produced more dry matter tons than millet (1.0 and 1.1 vs. 0.64, respectively). The earlier forages could be planted, the more dry matter tons were produced before frost. Across planting dates and water level, crude protein was 11–16% DM and total digestible nutrients were 62–67% DM.

Introduction

Western Nebraska is a low rainfall area with annual rainfall ranging from 8 to 18 inches per year. Precipitation usually occurs in the early spring benefitting the predominately cool season grasses of this high altitude (3800–5000 ft.) area. Unfortunately, limited summer rainfall and declining quality of cool season pastures creates a challenge for producers needing a forage resource in the fall. Additionally, many areas of the High Plains are under irrigation restrictions so limited water is available for crops and forages. Planting forages after irrigated winter wheat may allow producers to use a limited amount of water to produce additional forage for fall or winter grazing, or for baling as hay. The objective of this research was to evaluate three annual forages with two planting dates and two water levels to evaluate dry matter production, digestibility, measured as total digestible nutrients (TDN), and crude protein (CP) for beef cattle.

Methods and Materials

2012

Two summer annuals (brown mid-rib sorghum-sudangrass hybrid and White Wonder foxtail millet), and one cool season annual (oats), were planted at 25, 15, and 100 lb/ac., respectively, following irrigated winter wheat harvest in 2012. In 2012 wheat harvest was early due to the extreme heat and drought and forages were planted on

Table 1. Dry matter tons produced in 2012 for sorghum-sudangrass hybrid, oats, and foxtail millet harvested 9/26/2012

	Planting Date		Irrigation Level	
	7/18/2012	8/02/2012	4”	8”
	Tons/ac		Tons/ac	
Sorghum Sudangrass[a]	2.5[b]	1.5[c]	1.3[a]	2.7[c]
Oats	1.2[c]	1.3[c]	0.85[d]	1.7[b]
Foxtail Millet	1.3[c]	1.1[c]	0.87[d]	1.5[b]

[a]Means with different superscripts within planting date differ, means with different superscripts within irrigation level differ, $P < 0.05$.

Table 2. Crude protein and total digestible nutrients for sorghum-sudangrass hybrid, oats, and foxtail millet harvested 9/26/2012

	Planting Date				Irrigation Level			
	7/18/2012		8/02/2012		4”		8”	
	CP	TDN	CP	TDN	CP	TDN	CP	TDN
Sorghum-sudangrass hybrid[a]	10.6[b]	61.8[b]	13.4[d]	64.7[c]	13.5[b]	63.9[be]	10.6[c]	62.6[b]
Oats	14.2[de]	65.0[cf]	18.3[c]	68.2[de]	16.3[d]	66.4[de]	16.2[d]	66.8[cd]
Foxtail Millet	12.9[d]	66.5[ce]	16.0[d]	67.5[ef]	14.4[bd]	68.1[cd]	14.5[bd]	65.9[de]

[a]Means with different superscripts within planting date differ, means with different superscripts within irrigation level differ, $P < 0.05$.

Table 3. Crude protein and total digestible nutrients for sorghum-sudangrass hybrid, oats, and foxtail millet planted in 2012 and harvested either 9/26/2012 or 3/5/2013

	Harvested 9/26/2012			Harvested 3/5/2013		
	% CP	% TDN	NO_3-N	CP	TDN	NO_3-N, ppm
Sorghum-sudangrass hybrid[a]	15.9[b]	63.2[b]	3320	12.0[b]	62.5	1283
Oats	20.1[c]	66.6[c]	4276	13.7[c]	64.3	1216
Foxtail Millet	18.3[c]	67.0[c]	2641	11.8[b]	62.9	1195

[a]Means with different superscripts within a column differ ($P < 0.05$).

Table 4. Dry matter tons produced in 2013 for sorghum-sudangrass hybrid, oats, and foxtail millet harvested 10/8/13

	Planting Date		Irrigation Level	
	8/05/2013	8/20/2013	4”	5”
	Tons/ac		Tons/ac	
Sorghum-sudangrass hybrid[a]	1.22[b]	0.77[e]	1.04[b]	0.95[b]
Oats	1.54[c]	0.65[e]	1.12[b]	1.06[b]
Foxtail Millet	1.00[d]	0.27[f]	0.66[c]	0.61[c]

[a]Means with different superscripts within planting date differ, means with different superscripts within irrigation level differ, $P < 0.05$.

Table 5. Crude protein and total digestible nutrients for sorghum-sudangrass hybrid, oats, and foxtail millet harvested 9/26/2012

	Planting Date				Irrigation Level			
	8/05/2013		8/20/2013		4”		5”	
	CP	TDN	CP	TDN	CP	TDN	CP	TDN
Sorghum-sudangrass hybrid[a]	10.1[b]	60.3[b]	13.2[ce]	63.3[bc]	10.9[b]	60.6[b]	12.3[b]	63.0[bc]
Oats	11.1[be]	65.8[c]	19.0[d]	69.9[d]	14.8[c]	64.2[bc]	15.2[cd]	71.5[d]
Foxtail Millet	13.5[c]	63.9[c]	19.2[d]	67.2[cd]	15.6[cd]	65.1[c]	17.2[d]	66.0[c]

[a]Means with different superscripts within planting date differ, means with different superscripts within irrigation level differ, $P < 0.05$.

Table 6. Average crude protein, total digestible nutrients, and nitrate concentration for sorghum-sudangrass hybrid, oats, and foxtail millet harvested 10/8/2013, crude protein and total digestible nutrients when harvested 3/13/2014

	Harvested 10/8/2013			Harvested 3/13/2014	
	% CP	% TDN	NO3-N, ppm	% CP	%TDN
Sorghum-sudangrass hybrid[a]	11.6[b]	61.8[b]	277	10.2[b]	55.0[b]
Oats	15.0[c]	67.8[c]	91	9.2[b]	65.0[c]
Foxtail Millet	16.4[c]	65.5[c]	314	11.6[c]	58.1[d]

[a]Means with different superscripts within a column differ ($P < 0.05$).

July 18th, and August 2nd. Fertilizer was broadcast supplying 50 lb. N/acre. Water was applied at two irrigation levels, 4” and 8”. Initially, the plan was to use 3” and 6” but the extreme drought conditions warranted higher levels of irrigation to compare a restriction to no restriction. Plots were harvested on September 26, 2012 for dry matter production. Subsamples of each plot were analyzed for crude protein (CP), total digestible nutrients (TDN), and NO_3-N. A subset of each plot was left standing throughout the winter and was subsampled again on March 5, 2013 and analyzed for CP, TDN, and NO_3-N. Generally, plots would not have been sampled for NO_3-N, but since 2012 was unusually hot and dry, NO_3-N accumulation was a concern.

2013

Sorghum-sudangrass hybrid, foxtail millet, and oats were planted at the same rate as in 2012, but in 2013, irrigated winter wheat was harvested in late July, and therefore, the planting dates were August 5, and 20, 2013. Additionally, Roundup Ultramax was applied to the whole plot area (32 oz/ac) on July 27, 2013 and again to the second planting date plots on August 22, 2013 to help control volunteer wheat growth. Sixty lb. of N per acre was also applied on August 22, 2013. To be consistent with 2012, 4” and 8” of irrigation were to be applied. However, due to irrigation system issues and above normal rainfall in September (8 inches), only 4” and 5” were applied. The plots were harvested on October 8, 2013 for dry matter, CP, TDN, and NO_3-N. Subsamples were left standing for subsequent CP and TDN analysis after the winter, and were harvested on March 13, 2014.

Results and Discussion

2012

The earlier planting date resulted in greater dry matter production of the sorghum-sudangrass hybrid but was not significantly different for the oats or foxtail millet ($P < 0.05$; Table 1). The 8” irrigation level significantly improved dry matter production for all three forages ($P < 0.05$; Table 1). The CP and TDN were not affected by water level within forage. However, CP and TDN were greater within forage, for the later planting date which was simply a function of less plant maturity (Table 2). All forages, when averaged across planting date and water level, had a CP value of 16–20% and a TDN level of 63–67% which would be considered a medium quality feed source for beef cattle (Table 3). The NO3-N levels were high (Table 3) (> 1500 ppm is considered unsafe for feeding even non-pregnant animals unless mixed with low nitrate feed to dilute the ppm to 1500 ppm or less) due to the drought conditions and immaturity of the forage at harvest. Results from the subsamples taken in March indicated the CP was 11–13% which is adequate to maintain rumen function (Table 3). The TDN was only slightly lower than the September harvest date indicating all three forages made an acceptable option for standing forage through the winter. The NO3-N values by March were below 1500 ppm. Therefore, nitrate toxicity while grazing the forages as standing hay in the winter would not have been an issue.

2013

The earlier planting date resulted in greater dry matter yield for all crops compared to the later planting date. The earlier planting date resulted in the greatest dry matter yield for oats followed by sorghum-sudangrass hybrid, and then foxtail millet (Table 4; $P < 0.05$). Irrigation level did not impact production within forage type. This was probably due to the rains in September and the issues with the irrigation system making the water levels only 1" different. At both irrigation levels the dry matter yield was similar for sorghum-sudangrass hybrid and oats which were greater than the foxtail millet ($P < 0.05$). The second planting date resulted in greater CP for all forages, and greater TDN for the oats, but similar TDN for the sorghum-sudangrass hybrid and foxtail millet (Table 5; $P < 0.05$). The 5" irrigation level resulted in greater TDN for the oats but similar TDN for each of the other two forages. The CP was similar within forage across irrigation treatment. The average CP and TDN regardless of planting date and irrigation level were greater for oats and foxtail millet than for sorghum-sudangrass hybrid when harvested 10/8/13 ($P < 0.05$; Table 6). The NO_3-N concentration was well below concern, most likely because 8.4 inches of rain was received in September. Therefore, NO_3-N concentration was not measured the following March as they would have been low then as well. Nitrate toxicity is generally not a problem unless the plant becomes stressed from drought or frost. Producers concerned about NO_3-N concentrations in forages or hay should send samples to a commercial laboratory for testing. Hays with nitrate toxicity potential can be blended with other hays or feedstuffs to reduce risk. The CP was greater in foxtail millet than sorghum-sudangrass hybrid and oats after the winter, while TDN was greatest for foxtail millet, oats were greater than sorghum-sudangrass hybrid ($P < 0.05$; Table 6). As in yr 1, the quality of the forages harvested in March had decreased from pre-frost levels, but values indicated they would be acceptable standing forage for fall and winter grazing.

Conclusion

Planting annual forages after irrigated winter wheat is harvested may be a beneficial way to utilize land for both crops and livestock. The earlier forages can be planted after wheat harvest, the more dry matter can be produced before frost. The window of opportunity for planting the forages appears to be fairly narrow since forages planted the third week of August produced substantially less dry matter than forages planted by the first week in August. The tradeoff for dry matter production is decrease quality. However, all forages in this two year study resulted in acceptable crude protein and digestibility for beef cattle regardless of dry matter production. Additionally, these forages could be used as standing hay for winter grazing as the quality did not drastically deteriorate throughout the winter.

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