Analysis of a Sheep Cover Crop Grazing Trial in Southwestern North Dakota[1]

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The objective of this study was to evaluate forage production and potential for late-season sheep gains on a single-cropped cover crop planting in Southwestern North Dakota in hopes to increase forage availability later into the fall and subsequently reduce feedlot dependency. Our research suggests there was little difference in ewe body weight gain for ewes grazing two cover crop mixtures, but ewes grazing mixed-grass prairie exhibited a significant reduction in ADG when compared to the ewes grazing cover crops.

SUMMARY

Determining forage value and potential livestock production from cover crop plantings gives sheep producers an alternative to supplemental feeding of ewes grazing rangelands or being forced to enter into drylot feeding, hopefully decreasing both labor and feed costs. Cover crops provide numerous environmental benefits, including soil health improvements, increased soil moisture for future crop yields, and as an excellent food and cover source for many wildlife species. Although cover crops have related expenses, the environmental benefits, coupled with the availability of late-season forage, may make them appealing to farm/ranch operations.

During this study, bred brood ewes were placed in one of nine different paddocks with a total of three different treatments during October (2010, 2011, and 2012). Treatments consisted of two different spring cover crop plantings and an idled mixed-grass prairie paddock that served as a control. Ewes gained an average of 0.28 lbs/day on the cover crop plantings and lost approximately 0.03 lbs/day on the mixed-grass control. Our research suggests that standing cover crops can provide substantial forage with adequate nutritional value to bred ewes to length the grazing season, delaying the onset of supplemental feeding or entry into the drylot.

INTRODUCTION

Finding ways to increase the length of the grazing system is a common way for livestock managers to reduce feed costs (Adams et al., 1994). Grazing annual forages as a supplemental late-season food source for livestock can serve as a way to increase the grazing season while providing high-quality forages for livestock (Neville et al., 2008). Cover crops have grown in popularity across much of the US as a way to provide multiple benefits to farm lands, including nutrient cycling efficiency and soil and water conservation (Franzluebbers and Stuedemann, 2006). Livestock grazing of cover crops has had variable effects on soil quality and subsequent crop production, but overall has shown increased economic returns and diversity (Franzluebbers and Stuedemann, 2006; Bell et al., 2011). Our study assessed the forage suitability of two different cover crop mixes compared with mixed-grass prairie for gestating Rambouillet ewes.

PROCEDURES

All procedures were approved by the NDSU Animal Care and Use Committee. The study was conducted at the Hettinger Research Extension Center near Hettinger, North Dakota, in Adams County. The study area receives approximately 16 inches of precipitation annually, with the average summer temperature (June through August) approximately 66°F (NDAWN, 2012).

Grazing Treatments. The grazing study utilized three different treatments randomly allotted to 9 paddocks (1.6 ac; n = 3): cover crop treatment 1, designed as a species mixture targeting pollinators (insects), wildlife, and soil health benefits (**CC1**), cover crop treatment 2, designed as a forage crop for livestock and for soil health benefits (**CC2)**, and the mixed-grass range control consisting of smooth bromegrass, crested wheatgrass, and alfalfa (**CON**). The CC1 treatment utilized seed mixtures containing 16, 9, 2, 2, 1.6, 1, and 0.6 lb/ac for oats, forage soybean, Proso millet, milo, purple-top turnip, sweet clover, and forage radish, respectively ($26.36/ac.). The CC2 treatment utilized planting rates of 3.6, 3, and 1.6 lb/ac for purple-top turnips, Proso millet, and forage radish, respectively ($22.22/ac). CC1 and CC2 treatments were annually sprayed with glyphosate prior to planting. Planting occurred in mid-June, with fertilizer (11-52-0) applied to both CC1 and CC2 at 50 lb/ac at the time of planting.

Vegetative data was collected at the onset of the research trial during each of the three years. Peak production was determined in late-July in each paddock by species for each species present using nine 1/4 m^2 frames per paddock and extrapolated to determine average total lbs/ac/species for each treatment. Concurrently, vegetation clippings were dried and sent to Midwest Laboratories Inc. for nutrient analysis.

Animals. One hundred and eight Rambouillet ewes bred to lamb approximately on January 15 were utilized to evaluate livestock performance. Two-day weights were taken at the beginning and end of the grazing period. Ewes were stratified by weight and randomly assigned to one of 9 paddocks (12 ewes per paddock). Each of the nine paddocks was grazed for approximately 30 days in October during 2010, 2011, and 2012.

Statistical Analysis. Data were analyzed using the MIXED procedure of SAS (SAS Inst., Inc, NC). Paddock served as the experimental unit (n = 3). The covariance structure was Autoregressive. The fixed effect included in the model was treatment. Treatment, year, and treatment x year interactions were evaluated. When a significant F-test was observed ($P \leq 0.05$), LS Means was used to partition effects. Significance was determined at $P \leq 0.05$. All interactions that were not significant were removed from the model.

RESULTS AND DISCUSSION

Animals and forage production. Treatment, year, and treatment x year effects are listed in Table 1. Average daily gain of pregnant Rambouillet ewes was significantly affected ($P = 0.02$) by treatment, with a treatment by year interaction ($P = 0.91$) present, and a year effect ($P < 0.01$). Average daily gain was higher for CC1 and CC2 than CON (0.27, 0.30, and -0.03 lb/d, respectively). Forage quantity did not appear to be the reason for this difference, as no effects were observed for treatment, year, or treatment x year ($P \geq 0.76$).

Nutrient Analysis. Nutrient analysis of CC1, CC2, and CON are listed in Table 1. Treatment x year interactions were observed ($P \leq 0.02$) for CP, TDN, NE_m, and NE_g. While variable across years, CC1 and CC2 tended to have higher CP concentrations relative to CON (11.84, 12.04, and 5.9%, respectively). This largely explains differences in body weight gains across treatments, as energy (expressed as TDN, NE_m, and NE_g) was not affected by treatment ($P \geq 0.19$), even though it was variable across the treatment x year interaction ($P \leq 0.01$). Additionally, ADF was greater ($P < 0.01$) for CON (44.97%) compared to CC1 and CC2 (30.94 and 27.99%, respectively), further explaining differences in performance.

Mineral Analysis. Treatment x year interactions were observed for Ca and Cu ($P \leq 0.02$). Similar to nutrient concentrations, variability existed between years, especially for the cover crop treatments (Table 1). However, CON had consistently lower Ca and Cu concentrations than CC1 and CC2. This trend for increasing concentrations of minerals in cover crop treatments is also present for S, P, K, Mg, and Zn, which exhibited a treatment effect ($P \leq 0.03$). However, two minerals, Fe and Mn exhibited a treatment effect ($P \leq 0.03$) in which CON was similar ($P \geq 0.05$) to either CC1 or CC2. In general, the cover crop treatments resulted in mineral concentrations that would be expected for grain-type annual forages, of which many were present in the cover crop plant seeding mixtures.

IMPLICATIONS

Cover crop plantings, either targeting wildlife use or forage for livestock, resulted in ADG in pregnant ewes that were significantly higher than when ewes grazed mixed-grass prairie in the early fall. These results suggest further research should be conducted to determine optimal planting mixtures and timing of grazing of cover crops being utilized as soil health amendments, wildlife habitat, and forage for sheep grazing.

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Table 1. Sheep production, vegetative biomass production, and feed nutrition analysis from a sheep cover crop grazing trial in Adams County, North Dakota, October 2010, 2011, and 2012[1]

	Cover Crop 1[2]				Cover Crop 2[3]				Mixed-Grass Prairie[4]					*P*-value		
Items	2010	2011	2012	Avg	2010	2011	2012	Avg	2010	2011	2012	Avg	SEM^{Trt}	Trt	Yr	Trt*Yr
ADG, #/d	0.66	-0.04	0.18	0.27^{x}	0.70	-0.09	0.30	0.30^{x}	0.42	-0.49	-0.03	-0.03^{y}	0.08	0.02	<0.01	0.91
Biomass, #/ac.	1966	2317	2356	2213	2200	1900	2252	2117	1982	1845	2015	1947	255	0.76	0.84	0.96
Nutrient Analysis																
CP, %	14.72^{de}	10.33^{bc}	10.49^{bcd}	11.84	15.17^{e}	7.97^{ab}	13.00^{cde}	12.04	6.22^{ab}	5.59^{a}	5.89^{a}	5.90	0.84	<0.01	0.13	0.02
Crude Fat, %	1.88	2.28	2.50	2.22	1.54	1.80	1.77	1.70	1.91	2.45	1.56	1.98	0.21	0.09	0.61	0.43
ADF, %	24.2	33.4	35.23	30.94^{y}	23.00	29.2	31.77	27.99^{y}	43.17	44.33	47.4	44.97^{x}	1.82	<0.01	0.13	0.65
Ash, %	11.06	8.04	6.08	8.93^{x}	12.13	7.07	8.79	9.33^{x}	8.44	6.19	6.32	6.98^{y}	0.47	<0.01	<0.01	0.11
TDN, %	63.07^{ab}	65.07^{cd}	66.33^{de}	64.82	62.23^{a}	66.83^{e}	64.03^{abc}	64.37	64.07^{bc}	65.90^{cde}	65.07^{cde}	65.01	0.37	0.21	0.02	<0.01
NE_M, Mcal/lb	0.64^{ab}	0.67^{cd}	0.69^{de}	0.66	0.63^{a}	0.69^{e}	0.66^{abc}	0.66	0.66^{bc}	0.68d^{e}	0.67cd^{e}	0.67	0.01	0.19	0.03	<0.01
NE_G, Mcal/lb	0.37^{ab}	0.40^{cd}	0.42^{de}	0.39	0.35^{a}	0.42^{e}	0.38^{abc}	0.39	0.38^{bc}	0.41^{ed}	0.40^{cde}	0.40	0.01	0.21	0.01	<0.01
Mineral Analysis																
S, %	0.343	0.313	0.143	0.27^{xy}	0.483	0.247	0.447	0.39^{x}	0.113	0.103	0.090	0.10^{y}	0.064	0.02	0.58	0.50
P, %	0.310	0.247	0.217	0.26^{x}	0.357	0.340	0.260	0.32^{y}	0.150	0.130	0.080	0.12^{z}	0.016	<0.01	0.01	0.86
K, %	2.71	1.98	1.55	2.08^{x}	2.70	1.77	1.65	2.04^{x}	0.52	0.54	0.22	0.43^{y}	0.11	<0.01	<0.01	0.15
Mg, %	0.420	0.350	0.333	0.37^{x}	0.523	0.313	0.393	0.41^{x}	0.117	0.157	0.093	0.12^{y}	0.040	<0.01	0.51	0.20
Ca, %	2.26^{b}	0.76^{a}	0.54^{a}	1.19	2.87^{b}	0.58^{a}	0.97^{a}	1.48	0.47^{a}	0.61^{a}	0.39^{a}	0.49	0.15	<0.01	<0.01	<0.01
Na, %	0.025	0.043	0.005	0.02	0.085	0.028	0.080	0.06	0.005	0.005	0.005	0.01	0.021	0.17	0.90	0.77
Fe, ppm	101.3	85.67	196.7	127.9^{y}	195.0	140.3	375.3	236.9^{x}	135.7	107.0	249.3	164.0^{y}	22.33	0.01	0.01	0.54
Mn, ppm	47.7	51.7	50.0	49.78^{y}	104.3	52.0	90.7	82.33^{x}	87.3	63.0	91.7	80.0^{x}	9.84	0.03	0.38	0.31
Cu, ppm	3.00^{abc}	3.67^{bcd}	6.00^{f}	4.22	4.33^{cde}	4.67^{def}	5.67^{ef}	4.89	2.67^{ab}	3.00^{abc}	2.00^{a}	2.56	0.28	<0.01	0.03	0.02
Zn, ppm	28.0	24.0	27.3	26.44^{y}	37.33	43.00	34.33	38.22^{x}	23.33	20.00	26.67	23.33^{y}	3.10	0.03	0.99	0.77

[1]Bolded items indicate main and interaction effects with highest order of significance.
[2]Cover crop mixture for pollinators (insects), wildlife, and soil health benefits (**CC1**).
[3]Cover crop mixture for livestock forage and soil health benefits (**CC2).**
[4]Mixed-grass prairie consisting of smooth bromegrass, crested wheatgrass, and alfalfa (**CON**).
[a,b,c,d,e] Means within a row, with a significant Trt*Yr interaction, without a common superscript differ ($P \leq 0.05$).
[x,y,z] Means within a row, with a significant Trt effect, without a common superscript differ ($P \leq 0.05$).