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Observations of Forage Quality and Calf Gain when Grazing Double Cropped Forage following Wheat Harvest

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Summary

A 2-year cover crop grazing study was conducted following wheat harvest to evaluate the quality and yield of a 5-way forage annual forage mix in addition to cattle performance. In 2013, gain of steer calves was 2.03 lb/day, while 2014 steer calves had gain of 1.55 lb/day. Above ground forage production was 1.08 and 1.72 tons/acre in 2013 and 2014, respectively. Daikon radish and purple top turnip (brassicas) were high in sulfur and low in fiber. Fall forage production of brassica and oat based mixes following wheat grain harvest provide 97 to 137 lb of gain per acre.

Introduction

Planting annual forages in August after wheat harvest may provide producers with an alternative grazing source for backgrounding spring born calves in the winter. The objective of this study was to determine forage production and quality of a double cropped annual forage mix (cover crops used for forage), in addition to calf growth when grazed from October to December.

Procedure

Field and planting details

Dryland wheat fields at University of Nebraska-Lincoln Agricultural Research and Development Center (ARDC) near Mead NE were planted to a 5 way annual forage mix (brassicas, oats and sorghum) on August 17, 2013 and August 15, 2014 following wheat harvest in July (Table 1). Two treatments with three replications per treatment were applied: grazed cover crops (double crop annual forage) and ungrazed cover crops. Within year, the same 5-way annual forage mix was utilized for the double cropped forage and the cover crop (Table 1). In 2013, there was no N applied to the field, and in 2014, 210 lbs N from liquid feedlot manure from a confinement barn was applied to the field.

Forage production measurements

Initial forage mass was measured in the last week of October in both years. In 2013, only above ground forage mass, which did not include any tubers, was determined. In 2014, the forage was separated by species, and the tubers (roots) of the radishes and turnips were separated from the tops such that in addition to above ground biomass, total biomass production which included the tubers of the turnips and radishes, and production of each species could be determined. To measure biomass, three randomly selected 3.28 × 2.33 ft. areas in each paddock were sampled. In 2013, calves were provided access to the entire paddock; while in 2014, calves were initially given access to half of their paddock and 22 d later (Dec. 4th) the interior fences were removed and calves were given access to the whole paddock. This was because there was concern that the calves would not completely utilize all the forage, especially the tubers.

In 2014, quality samples were collected on Nov. 25 and Dec. 17 by randomly clipping the grasses and brassica tops and pulling tubers at fifteen locations within the ungrazed paddocks. Samples were separated by species, and the radishes and turnips were separated into leaf and tuber. All samples were freeze dried. Samples were analyzed for DM in 105°C oven and CP, NDF, ADF, sulfur, and organic matter on the freeze-dried, ground samples.

Stocking rate and grazing

To determine cattle grazing groups, 2013 steer calves (initial BW= 450 ± 35 lb) and 2014 steer calves (initial BW = 585 ± 8 lb) were limit fed a 50:50 diet of alfalfa hay and Sweet Bran® for five days, and then weighed three consecutive days prior to grazing to adjust for rumen fill. On day two of weighing, calves were assigned to paddocks based on weight blocks. On day three of weighing, calves were implanted with Ralgro® in both years. In both years, grazing was initiated in Mid-November and steers were provided free choice mineral supplement (Table 2).

Table 1. Seeding rate of cover crop/double cropped annual forage by year

Forage Type	2013 Seeding Rate (% of full seeding rate)	2014 seeding rate (% of full seeding rate)
Crimson Clover	1 lb/acre (10%)	—
Daikon Radish[a]	—	3 lb/acre (30%)
Oats	15 lb/acre (13%)	15 lb/acre (13%)
Purple Top Turnip	2 lb/acre (40%)	3 lb/acre (60%)
Sorghum	1 lb/acre (3%)	5 lb/acre (17%)
Sunflower	2 lb/acre (22%)	—
Safflower[b]	—	4 lb/acre (44%)
Total	21 lb/acre (88%)	27 lb/acre (161%)

Note. Percentages indicate the percent of the full seeding rate of each species (based on the number of seeds per lb.) as compared to planting a 100% of a monoculture of that specific species
[a]Changed crimson clover to daikon radish in 2014
[b]Changed sunflower to safflower in 2014

Table 2. Composition of free choice mineral provided to cattle in 2014 (DM basis)

Guaranteed Analysis	
Calcium (Ca)	18.90–22.70%
Phosphorus (P), minimum	1.50%
Salt (NaCl)	15.70–18.90%
Magnesium (Mg), minimum	2.00%
Copper (Cu), minimum	1.000 ppm
Selenium (Se), minimum	26.40 ppm
Zinc (Zn), minimum	3.750 ppm
Vitamin A, minimum	100,000 IU/lb
Vitamin D_3, minimum	10,000 IU/lb
Vitamin E, minimum	50 IU/lb
Active Drug Ingredient	
Monensin (as Monensin Sodium)	1200 g/ton

Table 3. Calf performance and forage yield (DM-basis) of forage

Item	2013	2014
Calf performance		
Initial BW, lb	450 ± 35	585 ± 8
Ending BW, lb	555 ± 39	664 ± 30
ADG, lb/d	2.03 ± 0.40	1.55 ± 0.57
Gain per acre, lbs	97 ± 4	137 ± 6
Forage production		
Above ground biomass, tons/acre	1.08 ± 0.39	1.76 ± 0.31
Below ground biomass, tons/acre	—	0.70 ± 0.34

Note. Means reported with standard deviation

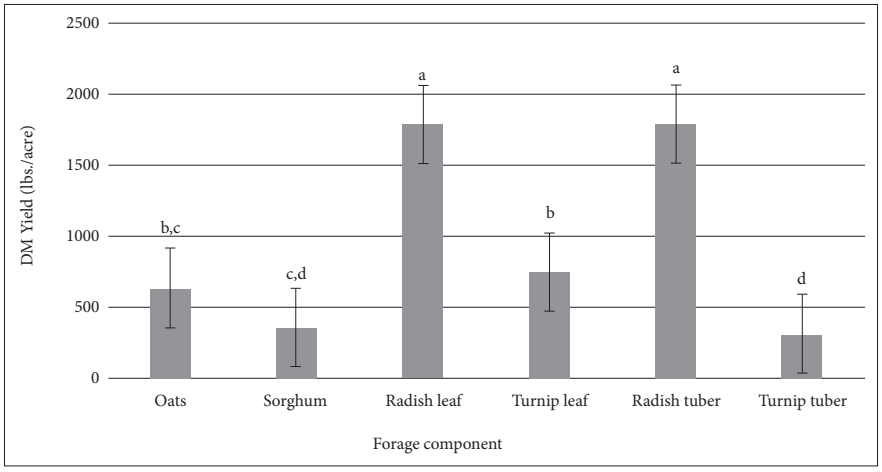

Figure 1. Total biomass yield (lb DM/acre) of forage components in October 2014 prior to start of grazing.

In 2013, the calves were stocked at 1 calf per ton of aboveground forage mass which was equal to 1 calf per acre (450 lb BW/ac). In 2014, calves were stocked 1 calf per ton of above ground biomass (excluded radish and turnip tubers), which was equal to 1.7 calves per acre (995 lb BW/ac). Calves grazed for 48 d in 2013 and 52 d in 2014. At termination of grazing, calves were brought back to the feedlot and limit fed a 50:50 alfalfa and Sweet Bran® diet for five days followed by weighing three consecutive days to determine final body weight.

Forage nutrient data were analyzed with the MIXED procedure of SAS (SAS Institute, Inc., Cary, N.C.) with sample as experimental unit.

Results

Forage production

In year 1, the aboveground forage mass was 1.01 ± 0.39 tons/acre, however; in year 2, there was a numerically greater yield at 1.76 ± 0.31 tons per acre (Table 3). However, the number of seeds per acre (as indicated by the percentage of the full seeding rate of each specific species as compared to planting 100% of a monoculture of that specific species) for the pastures was twice as much as in year 1 (Table 1). In year 2, total biomass (top growth and tubers of brassicas) was approximately 2.39 ± 0.44 tons per acre. Therefore, above ground biomass was 74% of the total biomass produced. The production of DM that each species contributed to the total biomass is shown in Figure 1. In 2014, the radish produced the most biomass accounting for 60% of the total biomass, followed by turnip at 17%, oats at 16% and sorghum at 10%. Safflower was not detectable.

Forage quality

The nutrient content of the forage mix in October of 2013 was reported in Table 4. The low ADF content observed in the 2013 mix suggests the forage was highly digestible and thus, high in energy. The 2014 nutrient analysis of the forage mix is shown in Table 4. Again, the mix had a relatively low ADF content. ADF content increases with plant maturity as more cellulose and lignin, structural plant components, are formed. Therefore, the energy content of the forage

is reduced as ADF content increases. Both the 2013 and 2014 forage were moderate in CP (12.2 and 19.6 % CP, respectively). However, the high S content of the 2014 mix may be a concern. The high S content of the mix is caused by the contribution of the leaf and tuber of the brassicas (radish and turnip; Table 5). The brassicas' leaf and tubers were significantly lower in NDF (fiber measurement correlated to intake) than the grasses (oat and sorghum). The sorghum had the greatest ADF and thus, may have contributed the least amount of energy. The ADF content of the oats and radish leaf did not differ. The ADF content of the radish tuber did not differ from the radish or turnip leaf but was greater than the turnip tuber. This may suggest the turnip tuber provides a significant amount of energy when consumed. However, the radish leaf provided significantly more protein than the other components of the mix. Given the relatively low seed cost of the brassicas, the high DM yield and the high quality of the forage; brassicas appear to be an excellent feed source for growing cattle. However, the high S and low NDF of the brassicas may be reason to include a grass in the mix to possibly reduce sulfur toxicity issues. The maximum tolerable level for dietary sulfur is 0.40% (NRC, 1996). When planting in early August, oats appear to yield more than sorghum.

Table 4. Nutrient composition of forage (DM basis) in late October prior to the start of grazing

Nutrient	2013	2014
OM, %	86.5 ± 1.78	82.0 ± 4.28
NDF, %	49.1 ± 10.4	35.0 ± 18.0
ADF, %	23.1 ± 2.28	25.1 ± 9.62
CP, %	12.2 ± 4.71	19.6 ± 4.36
S, %	0.63 ± 0.15	0.55 ± 0.25

Note. Means reported with standard deviation

Table 5. 2014 mean nutrient composition of annual forages in early December

	Oats	Sorghum	Radish Leaf	Turnip Leaf	Radish Tuber	Turnip Tuber	SEM	*P*-value
Nutrient[a]	% on DM basis							
OM, %	90.3^{b}	88.1^{c}	85.1^{d}	84.5^{d}	89.5^{b,c}	88.2^{b,c}	0.72	< 0.01
NDF, %	54.1^{c}	67.8^{b}	41.7^{d}	38.7^{d}	28.4^{e}	16.7^{f}	2.0	< 0.01
ADF,%	29.8^{c}	42.0^{b}	25.9^{c,d}	25.2^{d}	21.8^{d}	11.8^{e}	1.6	< 0.01
CP, %	14.3^{c}	15.6^{c}	25.3^{b}	17.5^{c}	14.7^{c}	15.9^{c}	1.2	< 0.01
S, %	0.19^{d}	0.21^{d}	0.71^{b}	0.62^{b,c}	0.56^{c}	0.60^{c}	0.033	< 0.01

Note. Average of samples taken on November 25th and December 17th
[a]OM (Organic Matter)-measure of the dry matter of the forage without mineral included; NDF (Neutral Detergent Fiber)-measure of the fiber negatively correlated to intake; ADF (Acid Detergent Fiber)-measure of less or indigestible fiber (cellulose and lignin) negatively correlated to energy of diet; CP (Crude Protein)-measure of the nitrogen of forage used for protein; S (Sulfur)-measure of sulfur in forage
[b,c,d,e,f]Means within a row with different superscripts differ ($P < 0.05$)

Cattle performance

The calves from year 1 had an ADG of 2.03 ± 0.40 lb/d, while the calves from year 2 had an ADG of 1.55 ± 0.57 lb/d (Table 3). However, due to the greater forage production and stocking density in year 2, gain per acre was numerically greater in year 2 (137 ± 6 lb/acre) than year 1 (97 ± 4 lb/acre).

These data suggest that there is an opportunity for forage production after wheat harvest for grazing. The brassicas (daikon radish and purple top turnip) produced high quality forage (low ADF and moderate CP). While no sulfur toxicity issues were observed in the current experiment, the high S and low NDF of brassicas may increase risk of sulfur toxicity. More research on grazing high-sulfur brassicas is needed before accurate recommendations can be developed. Grazing an annual forage mixture, consisting mainly of brassicas and oats, after summer wheat harvest provides moderate gains for growing calves for 50 d in early winter.

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