Performance and Economics of Fall Grazing Cover Crops Compared to a Traditional Drylot System of Fall-Calving Cow-Calf Pairs

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Summary and Implications

The objective of this study was to evaluate cow and calf performance while strip grazing a cover crop mix consisting of radishes, turnips, oats, and common vetch (CC) compared to a traditional, drylot management system (CON) of the Iowa State University Beef Teaching Farm fall-calving herd. The study was repeated for 3 consecutive years to account for weather variation.

Each growing season presented a unique situation. With a targeted seeding date of August 1st each year, yields ranged from 2,750 – 4,830 lbs of dry matter per acre, averaging 3,952 lbs. The greatest yield was observed in 2019 while the lowest yield occurred in 2020 with drought conditions restricting growth. Growth in 2021 was intermediate, but peak yield occurred after grazing began due to a delayed killing frost. Turnout dates ranged from early-November to mid-December, and fall pairs grazed for an average of 32 days, ranging from 17 – 45 days.

Despite fluctuation in cow body weights between treatments over the years, calves on CC had equal to or greater average daily gain and final body weights compared to calves on CON. Over the 3 years, CC calves gained an average of 0.36 lbs more per head per day than their CON counterparts. This advantage may be a reflection of CC dams producing a higher quality milk due to the high-quality forage diet and the ability of calves to graze alongside their dam.

An economic analysis of the 3-year project revealed a 29% average reduction in calf cost of gain of cow-calf pairs grazing cover crops ($1.11/lbs of gain) compared to cow-calf pairs fed in a drylot setting ($1.57/lb of gain). Compared to the standardized drylot in this scenario, this efficiency boost emphasizes the value of extending the grazing season, especially in times of high feed costs.

Introduction

Feed costs account for approximately 60% of the total cost of production for a cow-calf herd. For fall-calving herds, feed availability and feed quality are sometimes inadequate to meet the nutrient requirements of lactating females through the fall and winter months and feed is often expensive. Cover crops provide an opportunity to reduce dependence on stored feed and reduce feed costs. However, limited data are available on cover crop utilization by cattle including cow and calf performance and economics when grazing cover crops. Thus, the objective of this study was to evaluate fall calving cow and calf pair performance when grazing a cover crop mix (CC) compared to a traditional, drylot management system (CON) and the subsequent economic impact.

Materials and Methods

In the fall of 2019, winter of 2020, and fall of 2021, fall calving, purebred Angus, purebred Simmental, and composite cow-calf pairs (40, 40, and 36 pairs, respectively) were utilized in a study at the Iowa State University Beef Teaching Farm to evaluate cow and calf performance while strip grazing a cover crop mix of oats, radishes, turnips, and common vetch ("The Producer" mix, Millborn Seeds, Brookings, SD; 21, 35, and 18 acres seeded each year respectively; CC) compared to the traditional, drylot management system used at the farm (CON). Individual body weights (BW) of both cow and calves were collected on two consecutive days at the beginning of the trial in years 1 and 2. In year 3, only a single day weight was collected. Cow body condition scores were collected by two independent personnel at the beginning and end of study with averages reported. Pairs were allotted to treatment by cow age, BW, calf sex, calf age (40, 78, and 48 days for year 1, 2, and 3 respectively), and breed composition. Pairs strip-grazed the cover crop (34, 45, and 17 days, respectively) to maximize forage utilization with cows given access to fresh forage approximately every 2 days, and then were pulled into a drylot setting for 2 days prior to consecutive day weights off test to account for gut fill differences between the two treatment groups. When in the drylot, CC-fed pairs were fed the same diet as CON-fed pairs.

The CON-fed cows were fed different diets each year to keep feed costs competitive with current markets, but all

diets were formulated to meet or exceed cow requirements and were fed to meet dry matter intake requirements at a dry matter intake of approximately 2.2% of BW (Table 1). The total mixed ration was delivered once daily with 63, 50, and 62 lbs (as-fed) delivered in year 1, 2 and 3 respectively. = Regardless of treatment group, cows were offered free choice mineral during the study. Cover crop seeding dates, grazing days, and other information can be found in Table 2. For CC cows, a cornstalk bale was offered while grazing as well to aid in offsetting nitrate or sulfur toxicity risks as well as help maximize dry matter intake.

Each year, forage samples were taken shortly before turnout and while grazing. On each sampling date, a forage yield sample was taken for every 5-10 acres. As the strip grazing management progressed, forage samples were not taken if little to no forage remained in the grazed quadrant(s). Yield samples were collected by utilizing a 20”x20” square or yardstick and clipping the oats and vetch to a 1-2” height mimicking grazing height. Whole brassica plants were pulled with the top and root collected separately. One nutrient quality sample was taken for each species per sampling date, selected by walking in a random zig-zag pattern throughout the field. Vetch was only measured in year 1 due to lack of establishment in years 2 and 3. Oats were only sampled in year 1 and 2 because very few oats successfully established in year 3.

Results and Discussion

The forage yield prior to turnout and intermediate yield collections are illustrated in Figure 1. Drought conditions limited growth in year 2. In year 3, forages continued to grow following turnout, due to a delayed killing frost in the fall, and peak yield was achieved mid-grazing. A wide variation in yield uniformity throughout the field existed.

Brassicas dominated forage growth in all three years. Therefore, nitrate and sulfur toxicity were two concerns as brassicas are prone to accumulating both to levels that exceed threshold recommendations to avoid toxicity. In year 1, oats and brassicas contained levels of nitrate that would be considered toxic by most recommendations (above 2100 ppm NO3-N). In years 2 and 3, no samples contained concerning levels of nitrate. Across all three years, brassica tops contained the most sulfur, followed by bottoms (0.58% and 0.45%, respectively) and exceed the recommended maximum tolerable sulfur levels of 0.50% in a high forage diet. Oats contained the lowest sulfur concentration with vetch, only sampled in year 1, being intermediate. No health impacts due to nitrate or sulfur were observed, likely in part due to diet selectivity.

Forage quality measures are reported in Table 3. Vetch, a legume, was higher in crude protein, but lower in energy than the annual forages. Oats and brassica tops were similar in energy, with brassica bottoms having the lowest protein and highest energy. In general, cooler weather in the fall allows cool season forages to have higher fiber digestibility than if grown in the spring, resulting in a very high quality, grazable feed. Across all three years, nitrate did not differ and averaged lower values than toxicity thresholds. The forage was not fertilized any of the years, which likely hindered yield potential as well as reduced nitrate concentrations. While the cover crop diet was a significantly higher quality diet than the control diet, CC performance may become limited by forage intake and the high energy, high rumen degradable protein causing a very rapid passage rate.

Results of cow and calf performance are found in Table 4. Due to the shorter grazing period in 2021, only single day BW were taken, and therefore, only raw values are reported. Cows on the CC treatment lost weight in year 2 and 3 while CON-fed cows lost weight during year 1 only. However, weight loss during peak lactation, the production period coinciding with this study, is often expected. For 2019 and 2021, despite the differences in cow BW gain or loss between treatment groups, the final body condition score during the grazing period was not. In year 1 and 3, calf average daily gain was approximately 0.5 lb/d greater for CC calves compared to those in the drylot setting. This is likely due to CC calves consuming the higher quality feedstuff themselves as well as their dams producing higher quality milk, though these factors were not directly assessed in this study.

The drought conditions of 2020 hindered forage establishment; therefore, grazing delayed study initiation until December and ended in February. Initial BW were approximately 125 lbs lighter and a full body condition score (average of 4.3) lower than normal for the cow herd, reflecting the summer drought conditions. The CON diet was formulated to add weight back on cows. Despite the CC cows gaining BW while grazing in 2019, CC cows lost BW in 2020. While the feed value of the cover crop exceeded the CON diet, CC cows were limited on forage availability while grazing in the winter hindering their ability to add BW. Each snowfall event decreased forage height and increased forage waste. Final calf BW and average daily gain did not vary between treatment groups in 2020, likely a reflection of the cow diet quality and overall intake.

An economic analysis was conducted to evaluate the costs and returns of grazing cover crops compared to a drylot situation (Table 5). Daily dietary costs were calculated utilizing current feed prices for the CON diets each year and cover crop establishment costs plus the 3-year average cornstalk price for the CC diet. A yardage charge was assigned to each treatment to account for bedding, fuel, insurance and taxes, maintenance and repairs, utilities, building depreciation, and other miscellaneous expenses. Assuming a producer would implement cover crops behind corn silage, a land rent charge was assigned to the CC treatment at $11/acre assuming 1 acre of cornstalks would last 1 cow 1 month. No land rent was charged to CON diet since they were held in a drylot setting and those associated costs would be included in the yardage charge. Labor hours were not measured in this study. Thus, corresponding labor charges were left out of this analysis. A three-year study of Iowa cattlemen estimated 9 hours of labor per cow per year

in a limited grazing or drylot situation and 10 hours of labor per cow per year in an extensive grazing situation. Labor in a drylot situation would include daily feeding, bedding, and hauling manure. Labor in an extensive grazing situation would include cover crop establishment, temporary fencing, and managing water infrastructure.

Simply looking at total inputs per cow per day excluding labor and infrastructure, the 3-year average of the CC-diet has a 15% cost savings advantage over the 3-year average of CON-diet. When accounting for calf average daily gain while on test, the calf cost of gain is more favorable for CC calves due to heavier weights of CC calves. In this 3-year study, fall grazing of cover crops by fall-calving cow-calf pairs resulted in a 29% reduction or $0.46/lb savings in calf cost of gain compared to pairs in a drylot system fed a ration formulated to meet or exceed cow requirements. The efficiency boost found in this study emphasizes the value of extending the grazing season, especially in times of high feed costs. During this study, we were fortunate to have adequate forage to graze all 3 years; however, that might not always be the case, so producers need to carefully evaluate and weigh the return-on-investment potential.

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Table 1. Nutrient composition of total mixed rations fed to cows in a drylot setting (CON), dry matter basis

	Year 1[1]	Year 2[2]	Year 3[3]
Dry matter, %	56.4	55.3	60.2
Crude protein, %	11.4	9.5	9.7
Total digestible nutrients, %	68.3	70.3	68.0
Pounds delivered	63	50	62

[1]55% corn silage, 30% oat hay, and 15% dried distillers grains.
[2]55% corn silage, 23% hay, 20% corn, and 3% protein pellet.
[3]62% corn silage, 23% hay, and 15% corn mill screenings.

Table 2. Summary of forage and cattle management for cows grazing cover crop mix (CC)

Year	Cover crop seeding date	Grazing days	Turnout date	Removal date	Peak forage yield, lbs DM/acre	# of pairs	# of acres grazed
2019	8/7	34	11/6	12/10	4,827	20	21
2020	7/31	45	12/16	1/31	2,755	20	35
2021	8/9	17	11/19	12/5	4,275	18	18

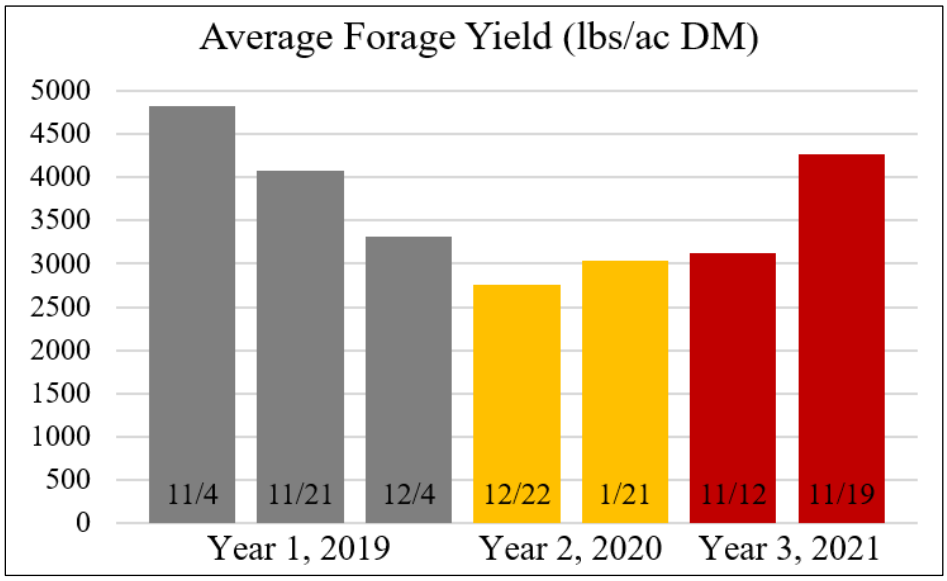

Figure 1. Average forage yield (lbs of DM per acre).

Table 3. Forage nutrient analysis results[1,2]

	Oats	Brassica Tops	Brassica Bottoms	Vetch[3]
DM, %	18.45[b]	16.39[b]	10.01[a]	15.37[b]
CP, % DM	21.66[b]	22.96[b]	18.83[a]	27.85[b]
aNDF, % DM	44.10[c]	21.12[b]	15.14[a]	25.40[b]
Ca, % DM	0.724[a]	3.203[b]	1.499[a]	1.650[a]
P, % DM	0.416	0.493	0.554	0.460
Mg, % DM	0.198[a]	0.298[c]	0.218[ab]	0.227[abc]
K, % DM	2.127	2.722	2.742	2.033
S, % DM	0.264[a]	0.581[c]	0.451[b]	0.300[ab]
NO_3-N, % DM	985	995	1131	578
NEm, Mcal/cwt	0.826[b]	0.860[b]	0.900[c]	0.773[a]
Neg, Mcal/cwt	0.544[b]	0.570[b]	0.603[c]	0.493[a]

[1]Abbreviations: DM = Dry Matter, CP = Crude Protein, aNDF = Neutral Detergent Fiber, Ca = Calcium, P = Phosphorus, Mg = Magnesium, K = Potassium, S = Sulfur, NO_3-N = Nitrate-nitrogen, NEm = Net Energy for maintenance, NEg = Net Energy for gain.

[2]Values with different superscripts differ ($P \leq 0.05$)

[3]Values reported from Year 1 (2019) only due to limited growth in Year 2 (2020) and Year 3 (2021)

Table 4. Comparison of cow and calf performance when grazing the cover crop (CC) or fed a total mixed ration (CON)[1]

	CON	CC	SEM	*P*-value
Cow performance				
Fall 2019 grazing				
IBW	1300	1258	60.2	0.49
IBCS	5.2	5.2	0.15	0.97
FBW	1286	1278	56.6	0.88
FBCS	5.5	5.4	0.14	0.60
ADG/L	-0.37	0.30	0.437	0.13
Fall 2020 grazing				
IBW	1147	1154	70.6	0.92
IBCS	4.3	4.2	0.17	0.57
FBW	1209	1126	68.4	0.23
FBCS	4.8	3.6	0.17	<0.01
ADG/L	1.33	-0.80	0.352	<0.01
Fall 2021 grazing[2]				
IBW	1333	1325		
IBCS	5.2	5.1		
FBW	1366	1296		
FBCS	5.4	5.1		
ADG/L	1.74	-1.52		
Calf performance				
Fall 2019 grazing[3]				
IBW	131	134	10.4	0.75
FBW	186	215	13.5	0.04
ADG	1.49	2.10	0.141	<0.01
Fall 2020 grazing				
IBW	201	211	16.5	0.57
FBW	294	303	17.7	0.58
ADG	1.96	1.97	0.133	0.96
WW	433	434	23.7	0.94
Fall 2021 grazing				
IBW	160	174		
FBW	191	214		
ADG	1.65	2.10		
WW	386	389		

[1]Abbreviations: IBW = initial body weight; IBCS = initial body condition score; FBW = final body weight; FBCS = final body condition score; ADG/L = average daily gain/loss.
[2]No statistical analyses were ran due to the short grazing period.
[3]Weaning weights not available.

Table 5. Economic comparison of grazing a cover crop mix (CC) or feeding a total mixed ration in a drylot setting (CON)

	CON			
	Average	**Year 1**	**Year 2**	**Year 3**
Diet cost, cow/day	$2.07	$1.76[1]	$2.03[2]	$2.41[3]
Yardage charge[4]	$0.60	$0.60	$0.60	$0.60
Land rent, cow/day[5]	-	-	-	-
Total inputs, cow/day	**$2.67**	**$2.36**	**$2.63**	**$3.01**
Calf average daily gain, lbs/day[6]	1.70	1.49	1.96	1.65
Cost of gain, $/lbs of calf gain	**$1.57**	**$1.58**	**$1.34**	**$1.82**
	CC			
	Average	**Year 1**	**Year 2**	**Year 3**
Diet cost, cow/day[7]	$1.44	$1.44	$1.44	$1.44
Yardage charge[4]	$0.47	$0.47	$0.47	$0.47
Land rent, cow/day[5]	$0.37	$0.37	$0.37	$0.37
Total inputs, cow/day	**$2.28**	**$2.28**	**$2.28**	**$2.28**
Calf average daily gain, lbs/day[6]	2.06	2.10	1.97	2.10
Cost of gain, $/lbs of calf gain	**$1.11**	**$1.09**	**$1.16**	**$1.09**
Difference in calf cost of gain	**$0.46**	**$0.49**	**$0.18**	**$0.73**

[1]Assumes corn silage priced at $40/ton, oat hay at $100/ton, and dried distillers grains at $85/ton.
[2]Assumes corn silage priced at $38/ton, hay at $120/ton, corn at $3.82/bu, and protein pellet at $0.43/lb.
[3]Assumes corn silage priced at $57/ton, hay at $125/ton, and corn mill screenings at $4.56/bu (or 80% the price of corn).
[4]Calculated using values from Iowa Cow-Calf Production – Exploring Different Management Systems: Appendix A. Economic Comparison Results, 2019.
[5]Assumes $11/acre cornstalk rent (ISU Cash Rental Rate Survey, 2021) divided by 30 days to determine cost per day for CC.
[6]Calf average daily gain during the study.
[7]Calculated using seed costs at $1.00/lb, seeding rate of 20 lbs/acre, and drilling cost at $16.50/acre (ISU Custom Rate Survey, 2021). Total establishment costs ($36.50) were then divided by 3-year average grazing days (32 days) to determine cost per day. Additionally, $0.30 was added to account for free-choice access to cornstalk bales while grazing CC (assumed intake of 10 lbs/hd/day at $35/bale).