Evaluation of Stockpiled Berseem Clover and Brown Midrib Sorghum x Sudangrass as Supplements for Grazed Cornstalks in Beef Cow Wintering Systems

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Summary

Berseem clover and oats were incorporated into a corn-oat/berseem clover rotation in 1994-1996. Two cuttings of oat-berseem clover hay were harvested during the summer before forage was stockpiled for winter grazing. In 1995, brown midrib sorghum x sudangrass hybrid was seeded into a field adjacent to a corn field. This was repeated in 1996 with a standard sorghum x sudangrass hybrid. After corn harvest in 1994-1996, Charolais x Angus x Simmental cows and heifers in midgestation were allotted to corn crop residue, corn crop residue-berseem clover, and corn crop residue-sorghum x sudangrass fields at 2.5 acres/cow, or to a drylot. Berseem clover had greater concentration of digestible organic matter and crude protein than corn crop residues. Corn crop residue digestible organic matter concentration was lower than berseem clover and the brown midrib sorghum x sudangrass, but was higher than that of the standard sorghum x sudangrass hybrid in 1996. Cows grazing corn crop residues without complementary forages required an average of 2,374 less lb. hay per cow than cows maintained in a drylot in 1994-1996. In 1994 and 1996, simultaneous grazing of berseem clover with corn crop residues did not reduce hay feeding more than feeding corn crop residues alone, yet did significantly reduce the amount of hay needed in 1995 to maintain cows by 358 and 376 lb. hay per cow compared with grazing corn crop residues without complementary forage.

Introduction

Feeding stored feeds is the single largest cost in cow-calf production. Therefore, enterprise profitability may be improved by extending the grazing season into the fall and winter. Corn crop residues provide a forage resource for winter grazing of beef cows. In previous experiments, cows grazing corn crop residues needed 0.9 ton less hay to maintain body condition than cows maintained in a drylot. However, corn crop residues have low concentrations of energy, protein, phosphorus, and vitamin A and must be supplemented with other feedstuffs that supply these nutrients. The need for supplementation becomes particularly apparent late in the winter, because weather damage further reduces forage nutritive value by leaching and metabolism of soluble nutrients, leaving poorly digested fiber.

Stockpiled grass and legume forages grazed in winter maintain levels of energy and protein at a higher rate than corn crop residues and have reduced the amount of hay needed to maintain cows by 1.25 ton/cow compared with maintaining cows in a drylot. Berseem clover is an annual legume that has recently been used in short term crop rotations. Similar to other legumes, berseem clover has high concentrations of energy and protein. Therefore, if stockpiled for winter grazing, berseem clover may be used to supplement corn crop residues if simultaneously grazed with cornstalks.

Weathering removes the soluble nutrients from forages during winter, leaving primarily fiber. Therefore, including a fiber with a high digestibility may be valuable in winter grazing systems. Brown midrib and other hybrids of sorghum x sudangrass generally have a low concentration of lignin, and therefore provide a highly digestible fiber.

The objectives of this experiment were to evaluate the nutritive value of stockpiled berseem clover, brown midrib sorghum x sudangrass, and standard sorghum x sudangrass hybrid forages, and to determine the amount of hay needed to maintain cows grazing corn crop residues either without stockpiled forages, simultaneously grazed with berseem clover, or sequentially grazed with the two sorghum x sudangrass hybrids.

Materials and Methods

In the springs of 1994 through 1996, "Bigbee" berseem clover and "Frank" forage oats were seeded into replicate five-acre fields adjacent to 25-acre corn fields. Hay was harvested from the oat-berseem clover fields in two cuttings. In midsummer of 1995, a brown midrib sorghum x sudangrass hybrid was seeded into replicate three-acre fields at the end of two seven-acre fields. This

was repeated in 1996 with a standard sorghum x sudangrass hybrid.

After grain harvest, replicate 10-acres fields of corn-crop residues were fenced with each five-acre berseem clover field to be grazed simultaneously. The fields containing sorghum x sudangrass and corn crop residues were fenced to be grazed sequentially. The remaining replicate 15-acre fields of corn crop residues were also fenced to be grazed. On November 3, 1994, November 9, 1995, and December 4, 1996, Charolais x Angus x Simmental cows and heifers in midgestation were allotted to each corn crop residue, corn crop residue-berseem clover, and corn crop residue-sorghum x sudangrass field at 2.5 acres/cow. In addition, 14 cows in 1994 and 12 cows in 1995 and 1996 were allotted to replicate drylots. All cows were supplemented with hay as necessary to maintain a body condition score of five. Winter treatments were utilized for 140 days to March 10 in the winter of 1994-95, 114 days to March 1 in the winter of 1995-96, and 98 days to March 12 in the winter of 1996-97.

Cows were weighed monthly. Body condition was visually scored on a nine-point scale by two individuals biweekly. Corn stalks and sorghum x sudangrass were sampled from four 4-m^2 locations monthly in grazed and ungrazed areas of the fields. At the end of the experiment, corn crop residues and sorghum x sudangrass were also sampled from two 4-m^2 exclosures in each field. Berseem clover was sampled in twelve .25-m^2 locations monthly in grazed and ungrazed areas of the field during the experiment and from four .25-m^2 areas within exclosures at the end of the experiment.

Results and Discussion

In 1994, there was no difference in the initial yields of total or digestible organic matter of corn crop residues or berseem clover (Table1). In contrast, organic matter yield at the initiation of grazing in 1995 was greater for corn crop residues than for berseem clover or brown midrib sorghum x sudangrass. Digestible organic matter yield was greater for brown midrib sorghum x sudangrass than for the other two forages. However, in 1996, initial organic matter yields of the sorghum x sudangrass and organic and digestible organic matter yields of berseem clover were greater than those of corn crop residues. In 1994, rates of loss for both total and digestible organic matter were greater for corn crop residues than berseem clover. In 1995 and 1996, however, the rates of total and digestible organic matter loss were greater from berseem clover and the sorghum x sudangrass hybrids than for corn crop residues. The rates of total and digestible organic matter loss were greater from grazed than ungrazed areas of the field only in 1995, implying the amounts of total and digestible organic matter lost to weather were equal to those losses by animal consumption.

In 1995, corn crop residues had a higher initial concentration of organic matter than berseem clover and the sorghum x sudangrass hybrid, but not in the other two years (Table 2). Furthermore, in all three years of the experiment, corn crop residues had higher initial concentrations of neutral detergent fiber, acid detergent fiber, and acid detergent insoluble nitrogen and lower initial concentrations of crude protein than the other forages. Corn crop residue digestible organic matter concentration was lower than berseem clover in each year, and lower than the brown midrib sorghum x sudangrass used in 1995, but was higher than digestible organic matter of the standard sorghum x sudangrass hybrid used in 1996. In 1995 and 1996, berseem clover had lower initial concentrations of neutral detergent fiber and acid detergent fiber and greater initial concentrations of crude protein and acid detergent insoluble nitrogen than brown midrib sorghum x

Table 1. Initial and daily changes in the yields of total and digestible organic matter of corn crop residues, berseem clover, and brown midrib sorghum x sudangrass forages.

	Initial, lb./ac			Change, lb./ac/day					
				Corn crop residues (CCR)		Berseem clover (BC)		Brown midrib sorghum x sudangrass (SS)	
Year	CCR	BC	SS	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed
				Organic matter					
1	5293	4730	-	-14.3	-10.1	2.9	-1.7	-	-
2	4878	4125	4163	-17.4	-4.3	-20.6	-20.3	-24.7	-17.1
3	4117	5875	5144	-1.6	7.7	-25.3	-26.9	-32.4	-13.1
				Digestible organic matter					
1	2497	2593	-	-9.2	-8.5	-6.0	-7.3	-	-
2	2422	2506	2815	-10.6	-5.0	-13.8	-13.5	-19.9	-12.6
3	1717	2754	1972	-5.2	-1.3	-15.7	-16.6	-13.7	-8.4

sudangrass. However, while the digestible organic matter concentration of berseem clover was lower than the brown midrib sorghum x sudangrass hybrid used in 1995, it was higher than the standard sorghum x sudangrass hybrid used in 1996. The low initial organic matter digestibility of berseem clover in 1996 was probably caused by weather losses, which occurred before the initiation of grazing on December 4. The difference in organic matter digestibility of the sorghum x sudangrass hybrids was likely because of the high concentration of lignin in the standard hybrid used in 1996 as shown by the high acid detergent fiber concentration. In 1994 and 1996, the rate of decrease in organic matter concentration was greater for corn crop residues than for berseem clover or standard sorghum x sudangrass, implying greater soil contamination of corn crop residues. In 1995, however, the rates of organic matter loss was greater in berseem clover or brown midrib sorghum x sudangrass than corn crop residues. Over the winter in each year, the rates of increase in neutral detergent fiber and acid detergent fiber and the rate of decrease in digestible organic matter were greater for berseem clover than corn crop residues. In 1995 and 1996, rates of increase in the concentrations of neutral detergent fiber and acid detergent fiber in berseem clover were also greater than the sorghum x sudangrass hybrids. However, while the rate of change in digestible organic matter concentration did not differ between berseem clover and brown midrib sorghum x sudangrass in 1995, the rate of decrease in digestible organic matter concentration of berseem clover was greater than that of the standard sorghum x sudangrass used in 1996. The rate of change in acid detergent insoluble nitrogen did not differ between forage species, implying that protein digestibility decreased at an equal rate across the three forage species. The greater rates of loss in the concentrations of total and digestible organic matter, and a greater rate of increase in the concentrations of acid detergent fiber from grazed than nongrazed areas of the corn crop residue and berseem clover fields, imply that cows selectively grazed portions of the plants with lower fiber concentrations and greater digestibility.

Table 2. Initial and daily changes in the compositions of corn crop residues, berseem clover, and sorghum x sudangrass forages.

	Initial, %			Change, % units/day					
				Corn crop residues (CCR)		Berseem clover (BC)		Sorghum x sudangrass (SS)	
Yr.	CCR	BC	SS	Grazed	Ungrazed	Grazed	Ungrazed	Grazed	Ungrazed
				Organic matter, % of dry matter					
1	90.6	91.4	-	-.18	-.14	-.04	-.04	-	-
2	93.6	88.6	87.8	-.01	-.01	-.09	.01	-.11	-.04
3	92.3	92.6	93.7	-.23	-.20	-.08	-.27	-.03	-.02
				Digestible organic matter, % of organic matter					
1	47.2	54.7	-	-.09	-.09	-.16	-.16	-	-
2	49.7	60.6	67.6	-.08	-.06	-.12	-.08	-.22	-.06
3	41.7	46.9	38.4	-.11	-.09	-.12	-.12	-.04	-.07
				Neutral detergent fiber, % of organic matter					
1	77.7	60.1	-	.02	-.01	.08	.06	-	-
2	76.5	43.4	64.3	.01	-.02	.11	.12	.04	.05
3	77.0	60.1	74.8	0	-.02	.11	.11	.07	.07
				Acid detergent fiber, % of organic matter					
1	49.5	40.1	-	.07	.03	.11	.09	-	-
2	48.3	29.3	38.1	.05	.01	.12	.07	.07	.07
3	46.7	47.3	50.5	.03	.01	.04	.06	.04	.04
				Crude Protein, % of organic matter					
1	5.2	14.1	-	.01	.01	.02	.02	-	-
2	4.7	17.3	11.2	0	0	-.04	0	-.01	-.02
3	4.9	17.5	5.5	.01	.02	0	0	-.01	-.01
				Acid detergent insoluble nitrogen, % of total N					
1	24.2	16.9	-	.14	.06	.10	.08	-	-
2	17.9	13.5	7.0	.03	.03	.06	.01	.06	.05
3	17.6	18.4	17.0	.13	.09	-.01	.05	.07	.05

Table 3. Weight and condition score changes of cows maintained in a drylot or by grazing corn crop residues without or with stockpiled berseem clover or sorghum x sudangrass forage.

Yr.	Item		Winter system			
				Corn crop residues		
			Drylot	w/o complementary forage	w/ berseem clover	w/ sorghum x sudangrass
1	Body weight, lb.	Initial	1410[a]	1395[b]	1388[c]	-
		Seasonal change,				
		Early	78.5	15.4	71.1	-
		Late	126.5	124.5	101.4	-
		Total	205.0	139.9	172.5	-
	Condition score	Initial	5.1	5.2	5.2	-
		Seasonal change,				
		Early	.36	-.25	.44	-
		Late	.75	.45	.46	-
		Total	1.11[a]	-.20[b]	.89[ab]	-
2	Body weight, lb.	Initial	1388	1401	1399	1366
		Seasonal change,				
		Early	73.5[ac]	-9.7[b]	90.4[a]	7.9[bc]
		Late	33.0	89.5	40.9	68.0
		Total	106.5	79.6	131.3	75.9
	Condition score	Initial	5.3	5.4	5.4	5.5
		Seasonal change,				
		Early	.29[a]	-.08[b]	.76[c]	.26[a]
		Late	-.75[ab]	-.30[a]	-.84[b]	-.75[ab]
		Total	-.46[ab]	-.38[ab]	-.08[a]	-.50[b]
3	Body weight, lb.	Initial	1406	1430	1401	1379
		Seasonal change,				
		Early	51.9[a]	-32.5[b]	-10.5[b]	-5.5[b]
		Late	-30.6[a]	51.5[b]	17.5[c]	-29.0[a]
		Total	21.3	19.0	7.0	-34.5
	Condition score	Initial	5.0	5.1	5.0	4.9
		Seasonal change,				
		Early	.29[a]	-.13[b]	0[b]	.67[c]
		Late	-.33[a]	-.19[a]	-.42[ab]	-.84[b]
		Total	-.04	-.32	-.42	-.17

[abc]Differences between means with different superscripts are significant.

In 1994 and 1995, cows grazing corn crop residues with berseem clover or maintained on hay in a drylot had greater bodyweight gains during the first half of the winter than cows grazing corn crop residues (Table 3). However, there was no difference in bodyweight gains between cows grazing corn crop residues or berseem clover during the second half of the winter or the entire winter season. Because of the lower nutritional quality of the berseem clover used in 1996, cows grazing corn crop residues with berseem clover had lower weight gains early in the grazing season than cows maintained in the drylot, but had greater weight gains during the last half of the grazing season than cows maintained in the drylot. As a result, no differences in weight changes were observed over the entire winter grazing season. Although hay supplementation was to be controlled to maintain a body condition score of five, seasonal body condition score increases were greater for cows grazing corn crop residues and berseem clover or maintained in a drylot than for cows grazing corn crop residues in the winter of 1994. In the first half of the winter of 1995, cows grazing corn crop residues with stockpiled berseem clover had greater increases in body condition than cows grazing corn crop residues or maintained in a drylot. In contrast, cows grazing corn crop residues and berseem clover had greater losses of body condition than cows grazing corn crop residues supplemented with alfalfa-grass hay during the second half of the winter in 1995-96. However, because of the increase in body condition that occurred during early winter, cows grazing corn crop residues with berseem clover had less loss of body condition during the entire winter season than did cows grazing corn crop residues with or without brown midrib sorghum x sudangrass forage or maintained in a drylot. Total seasonal changes in body condition did not differ between treatments, however, there were differences in body condition score changes between treatments in the first or second half of the grazing season.

In each year, cows grazing corn crop residues without stockpiled forage required considerably less hay to maintain body condition than cows maintained in a drylot, averaging 2,374 lb. less hay per cow (Table 4). The low amounts of hay needed by cows grazing corn crop residues in 1994 and 1995 likely resulted from the considerable amount of ear droppage that occurred in this field because of insect damage. In 1994 and 1996, supplementation of corn crop residues with stockpiled berseem clover did not affect the amount of hay required to maintain the body condition of cows. In 1995, however, simultaneous grazing of berseem clover and corn crop residues reduced the amount of hay required to maintain a cow slightly compared to grazing corn crop residues without a complementary forage. Furthermore, because of the hay produced from the oat-berseem clover fields, this system resulted in a surplus of hay during the interval for the grazing experiments.

Table 4. Amounts of hay produced and fed to cows maintained in a drylot or by grazing corn crop residues without or with stockpiled berseem clover or sorghum x sudangrass forage.

		Winter System		
		Corn Crop Residues		
Item	Drylot	W/o complementary forage	w/ berseem clover	w/ sorghum x sudangrass
Hay production, lb./ac	0[a]	0[a]	1815[b]	-
Year 1	0[a]	0[a]	2364[b]	0[a]
Year 2	0[a]	0[a]	3552[b]	0[a]
Year 3				
Hay fed, lb./cow				
Year 1	4118[a]	1432[b]	1613[b]	-
Year 2	3881[a]	774[b]	416[c]	398[c]
Year 3	2840[a]	1511[b]	1313[b]	541[c]
Hay balance, lb./cow				
Year 1	-4118[a]	-1432[b]	-99[c]	-
Year 2	-3881[a]	-774[b]	1562[c]	-398[c]
Year 3	-2840[a]	-1511[b]	1704[c]	-541[d]

[abc]Differences between means with different superscripts are significant.

Although there was considerable difference in the nutritive quality of the sorghum x sudangrass hybrids used in the two years, sequential grazing of corn crop residues and either sorghum x sudangrass hybrid resulted in less hay required to maintain cows than grazing corn crop residues alone. This similarity in performance may imply that the availability of sorghum x sudangrass, even in high snow cover, contributes to its value in a winter grazing system. It seems likely that if the standard sorghum x sudangrass hybrid had been harvested for stored forage during the summer or planted later in the season in a double cropping system, its nutritive value and utility in the winter grazing system would have improved.

Implications

The results of this experiment imply that corn crop residues will considerably reduce the need of gestating beef cows for hay compared with maintenance in a drylot. Stockpiled berseem clover provides supplemental nutrients to cows grazing corn crop residues early in the winter season, further reducing the need for hay. Weather damage to berseem clover is considerable, limiting its nutritive value over the entire winter grazing season. Therefore, berseem clover is most effective as a supplement to corn crop residues during late fall and early winter. Brown midrib sorghum x sudangrass forage has a high digestibility at the initiation of the winter and loses its digestible organic matter concentration at a low rate. As a result, stockpiled brown midrib sorghum x sudangrass forage can provide relatively high-quality forage late in the winter. Unfortunately, the brown midrib sorghum x sudangrass hybrid is still in the experimental stage of development and is not currently available to the public. Because of their lower nutritive value standards, sorghum x sudangrass hybrids are not as effective in a sequential grazing season as brown midrib hybrids. However, they do stand above deep snow and may provide forage late in the season, thereby reducing stored hay needs, particularly if managed to maintain nutritive value.

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