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Efficacy of Grazing Stockpiled Perennial Forages for Winter Maintenance of Beef Cows

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Abstract
In a three year study, wintering systems utilizing the grazing of stockpiled perennial hay crop forages or corn crop residues were compared to maintaining cows in a drylot. In the summer of 1992, two cuttings of hay were harvested (June 22 and August 2) from three 10-acre fields containing "Johnstone" endophyte-free tall fescue and "Spreador II" alfalfa, and one cutting of hay was harvested from three 10- acre fields of smooth brome grass. "Arlington" red clover was frost-seeded into the smooth bromegrass fields in 1993 and into tall fescue-alfalfa and smooth bromegrass fields into 1994. Two cuttings of hay were harvested from all fields in subsequent years, and three-year average hay yields for tall fescue-alfalfa and smooth bromegrass-red clover were 4,336 and 3,481 pounds per acre, respectively. Regrowth of the forage following the August hay harvest of each year was accumulated for winter grazing. Following a killing frost in each year, two fields of each stockpiled forage were stocked with cows in midgestation at two acres per cow. Two 10-acre fields of corn crop residues were also stocked at two acres per cow, following the grain harvest. Mean dry matter forage yields at the initiation of grazing were 1,853, 2,173 and 5,797 pounds per acre for fields containing tall fescue-alfalfa, smooth bromegrass-red clover, and cornstalks, respectively. A drylot was stocked with 18 cows in 1992 and 1993 and 10 cows in 1994. All cows were fed hay as necessary to maintain a body condition score of five. During grazing, mean losses of organic matter were -6.4, -7.6, and -10.7 pounds per acre per cow from tall fescue-alfalfa, smooth bromegrass-red clover, and cornstalk fields. Average organic matter loss rates from stockpiled forages due to weathering alone were equal to only 30% of the weathering losses of the corn crop residues. In vitro digestibility of both stockpiled forages and cornstalks decreased at equal rates during grazing each year, with respective annual loss rates of .14, .08, and .06% per day. Cows grazing corn crop residues required an average of 1,321 pounds per cow less hay than cows maintained in the drylot to maintain equivalent body condition during the grazing season. Cows grazing tall fescue-alfalfa or smooth bromegrass-red clover had body weight gains and condition score changes equal to cows maintained in a drylot but required 64% and 62% less harvested hay than cows in the drylot during the grazing season. Over the entire stored forage cows grazing tall fescue-alfalfa and smooth bromegrass-red clover required an average of 2,390 and 2,337 pounds per cow less than those maintained in the drylot. Because less hay was needed to maintain cows grazing stockpiled forages, average annual excesses of 5,629 and 3,868 pounds of hay dry matter per cow remained in the stockpiled tall fescue-alfalfa and smooth bromegrass-red clover systems.

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Summary

In a three year study, wintering systems utilizing the grazing of stockpiled perennial hay crop forages or corn crop residues were compared to maintaining cows in a drylot. In the summer of 1992, two cuttings of hay were harvested (June 22 and August 2) from three 10-acre fields containing "Johnstone" endophyte-free tall fescue and "Spreador II" alfalfa, and one cutting of hay was harvested from three 10-acre fields of smooth brome grass. "Arlington" red clover was frost-seeded into the smooth bromegrass fields in 1993 and into tall fescue-alfalfa and smooth bromegrass fields into 1994. Two cuttings of hay were harvested from all fields in subsequent years, and three-year average hay yields for tall fescue-alfalfa and smooth bromegrass-red clover were 4,336 and 3,481 pounds per acre, respectively. Regrowth of the forage following the August hay harvest of each year was accumulated for winter grazing. Following a killing frost in each year, two fields of each stockpiled forage were stocked with cows in midgestation at two acres per cow. Two 10-acre fields of corn crop residues were also stocked at two acres per cow, following the grain harvest. Mean dry matter forage yields at the initiation of grazing were 1,853, 2,173 and 5,797 pounds per acre for fields containing tall fescue-alfalfa, smooth bromegrass-red clover, and cornstalks, respectively. A drylot was stocked with 18 cows in 1992 and 1993 and 10 cows in 1994. All cows were fed hay as necessary to maintain a body condition score of five. During grazing, mean losses of organic matter were -6.4, -7.6, and -10.7 pounds per acre per cow from tall fescue-alfalfa, smooth bromegrass-red clover, and cornstalk fields. Average organic matter loss rates from stockpiled forages due to weathering alone were equal to only 30% of the weathering losses of the corn crop residues. *In vitro* digestibility of both stockpiled forages and cornstalks decreased at equal rates during grazing each year, with respective annual loss rates of .14, .08, and .06% per day. Cows grazing corn crop residues required an average of 1,321 pounds per cow less hay than cows maintained in the drylot to maintain equivalent body condition during the grazing season. Cows grazing tall fescue-alfalfa or smooth bromegrass-red clover had body weight gains and condition score changes equal to cows maintained in a drylot but required 64% and 62% less harvested hay than cows in the drylot during the grazing season. Over the entire stored forage cows grazing tall fescue-alfalfa and smooth bromegrass-red clover required an average of 2,390 and 2,337 pounds per cow less than those maintained in the drylot. Because less hay was needed to maintain cows grazing stockpiled forages, average annual excesses of 5,629 and 3,868 pounds of hay dry matter per cow remained in the stockpiled tall fescue-alfalfa and smooth bromegrass-red clover systems.

Introduction

Profitability of beef cow-calf production is directly related to the amount of stored feed required to maintain cattle through the winter. Approximately one-third of the costs of cow-calf production results from this need for stored feed. Therefore, strategies which increase the number of days that animals are able to graze should increase profitability. One system that would reduce the amount of stored feed necessary to maintain beef cows is the grazing of stockpiled perennial forages during the winter. In this system, forage regrowth from the late summer and early fall is allowed to accumulate for grazing during the late fall and winter. This system has been used successfully in states south of Iowa. Because the efficacy of stockpiled grazing appears to be weather-dependent, use of this system in Iowa has been limited. Proper management of stockpiled grazing systems, however, may overcome this disadvantage, particularly in southern Iowa.

The objective of this study was to evaluate weight change, condition score change, and hay feeding of cows grazing stockpiled forages, grazing corn crop residues, or maintained in a drylot.

Materials and Methods

In 1990, endophyte-free tall fescue (var. Johnstone) and alfalfa (var. Spreador II) were seeded at 11.2 and 9.0 kg/ha into a 30-acre field at the McNay Outlying Research Farm near Chariton, Iowa.

In the summer of 1992, two cuttings of hay were harvested as large round bales from the field containing the tall fescue-alfalfa mixture, and one cutting was harvested from an adjacent 10-acre field containing a perennial stand of smooth bromegrass. Hay was harvested twice annually from all fields in subsequent years (Table 1). Residual forage growth following the second harvest of each year was stockpiled for grazing by cattle during the winter. In the autumn of 1992, each field was divided with electric fencing into three 10-acre fields, two of which were designated as replicate pastures to be grazed during the winter. The remaining field of each forage species was a control field for comparison of botanical responses to grazing, and was harvested for hay but not grazed. All large round hay bales harvested from grazed and nongrazed fields were weighed, and two bales from each 10-acre field per harvest were randomly selected and core-sampled with a bale probe in two locations. Core samples were weighed and dried to determine percent dry matter (DM) and total DM yield. All bales were stored outdoors on ground, and bales sampled to determine DM yield were set aside for determination of DM recovery after weathering.

On March 1, 1993, red clover (var. Arlington) was frost-seeded into the smooth bromegrass fields at a rate of eight pounds per acre. To limit adverse effects of competition between the smooth bromegrass and red clover, cattle were allowed to graze on all smooth bromegrass fields at a heavy stocking rate for three days in May. To maintain legume densities of stands in 1994 , red clover was frost-seeded into both smooth bromegrass and tall fescue-alfalfa fields at four pounds per acre. Samples for the determination of botanical composition in the grazed and nongrazed tall fescue-alfalfa smooth bromegrass fields were collected by hand from twelve .25-square-meter locations within each 10-acre field in the spring and autumn of each year. These samples were hand-sorted, dried at 65°C for 48 hour and weighed. Percentages of live grass, live legume, live weed, and dead material were determined.

In autumn of each year, all fields designated for grazing were subdivided into four 2.5-acre paddocks with temporary electric fencing. Grazing was initiated each year on the stockpiled forage pastures following a killing frost, and this date was designated as day 0 of the winter grazing experiment. In addition, following the grain harvest in each year, an 20-acre field of corn crop residues was divided into two 10-acre pastures with temporary electric fencing; these were then subdivided into four 2.5-acre paddocks. Corn crop residue grazing began as soon as the harvest was complete and fences were in place.

To determine changes in yield and chemical composition of forages because of grazing or weathering in tall fescue-alfalfa and smooth bromegrass fields during the experiment, forage samples were collected by hand from twelve randomly selected .25-square-meter locations prior to the initiation of grazing. Additional samples were taken from grazed and nongrazed areas in each pasture monthly through January (unless prevented by ice cover) and after the termination of grazing. Samples from grazed areas were collected from three randomly selected .25-square-meter locations within each grazed paddock. Samples from nongrazed areas were collected from three randomly selected .25-square-meter locations in nongrazed paddocks while available and then from a .25-square-meter location within the caged exclosures within each paddock after all paddocks were grazed. Corn crop residue samples were taken from one 4-square-meter area within each paddock prior to the initiation of grazing. During the trial, grazed corn crop residue samples were taken from two 4-square-meter areas within each grazed paddock. Samples from nongrazed areas were taken from two randomly selected 4-square-meter areas within nongrazed paddocks while available and then from two 4-square-meter caged exclosures. All corn crop residue within grazed and nongrazed sample areas was collected, weighed, subsampled, dried. Samples were then chemically analyzed for concentrations of *in vitro* organic matter digestibility (IVOMD), neutral detergent fiber (NDF), acid detergent fiber (ADF), crude protein (CP), acid detergent insoluble nitrogen (ADIN), and ash. Because soil contamination at different sampling dates can vary greatly, all chemical concentration values of grazing systems are reported on an organic matter basis.

In 1992 and 1993, 48 mature, medium-frame Simmental X Angus X Jersey beef cows in midgestation (mean BW, 1,116 lbs; mean condition score, 5.3) from a four-treatment summer grazing experiment were blocked by summer treatment and allotted to four wintering systems: grazing of stockpiled tall fescue-alfalfa forage; grazing of stockpiled smooth bromegrass without (1992) or with (1993 and 1994) red clover forage; grazing of corn crop residues; or a drylot hay-feeding system. Each replicate pasture was stocked at a rate of .5 cows per acre, and 18 cows were placed in a single drylot. In 1994, only 40 cows were available from the summer grazing experiment, so 10 cows were stocked in the drylot. To equalize gut fill across treatments, cow weights were measured before allotment and after the end of each experiment after two day *ad libitum* access to hay. Cows also were weighed after approximately 75 days of grazing each year. Body condition was measured once every two weeks by visual scoring using a nine-point scale.

Pastures and corn fields in the grazing treatments were strip-grazed, with ungrazed paddocks opened as needed for forage availability. Cows in all grazing treatments were initially placed in the paddock in which a permanent water source and supplemental mineral were available. After all paddocks on a pasture were opened for grazing, cows were supplemented with hay either when the average body condition of the cows on a given pasture dropped below a score of 5 (nine-point scale) or weather conditions such as heavy snow or ice cover severely impeded grazing. Large round hay bales used to maintain the cows in the drylot and supplement the cows in the grazing systems were taken from the first hay harvest (1992 and 1994) or second cutting (1993) of the tall fescue-alfalfa or smooth bromegrass without or with red clover fields. All bales were weighed before being offered to cows. In January and March of each year, one bale from each harvest and field was weighed and core-sampled at depths of 9 and 30 inches at four locations around the bale. Sampled hay was analyzed for DM and chemical composition. Total dry matter hay fed and DM recoveries were calculated, and chemical composition of the hay was determined.

Results and Discussion

In 1993, total dry matter yields from summer hay harvests of tall fescue-alfalfa and smooth bromegrass with or without red clover were 932 and 1,413 pounds per acre lower, respectively, than the total yields of 1992. The average DM hay yields of tall fescue-alfalfa fields were greater than those of smooth bromegrass-red clover during the first two years of the study; however in 1994, tall fescue-alfalfa fields yielded 1,016 pounds per acre less than smooth bromegrass-red clover. Differences in hay yields between grazed and nongrazed fields in 1995 following the three years of stockpiled grazing were 517 and -1,332 pounds per acre in the tall fescue-alfalfa and smooth bromegrass with red clover, which could indicate a negative effect of winter grazing on the persistence of smooth bromegrass. Annual hay yields are highly influenced by rainfall and temperature, however, and more research would be needed to confirm any such interaction. Variability in DM recovery (pounds of DM hay at feeding per pounds of DM hay at harvest) and nutrient compositions of large round hay bales stored outdoors is influenced by differences in precipitation levels. The mean DM recoveries from bales harvested in 1992, 1993, and 1994 were 92, 87, and 84%, respectively.

The percentage of live forage in stockpiled fields varied among years, and was consistently greater at the autumn sampling date; however no significant differences were observed between grazed and nongrazed fields (Table 2). Concentrations of grass, legumes, or weeds were not significantly affected by grazing. The percentage of live forage at the autumn sampling date in tall fescue-alfalfa fields was greater than that in the smooth bromegrass with or without red clover in all years. Legume levels decreased in the tall fescue-alfalfa pastures after the first year , but increased in both smooth bromegrass and tall fescue-alfalfa fields when red clover was seeded in subsequent years. In 1994, weed populations of the tall-fescue alfalfa field were significantly greater than those of the smooth bromegrass-red clover fields.

Because hay was harvested only once from smooth bromegrass pastures in 1992, initial forage yield available for winter grazing was greater than in subsequent years (Table 3). Initial yields in 1994 for both tall fescue-alfalfa and smooth bromegrass-red clover pastures were lower than the yields of previous years; however, this difference was attributed to below-average precipitation levels in the summer. Differences in organic matter (OM) yield and *in vitro* organic matter digestible (IVOMD) yield at the initiation of grazing varied greatly among years. At the initiation of grazing each year, pastures containing tall fescue-alfalfa or smooth bromegrass with or without red clover had lower OM yields than those of corn crop residue fields, which had average OM yields of 5,154 pounds per acre. The mean intial IVOMD yields of tall fescue-alfalfa, smooth bromegrass-red clover and corn crop residues were 937, 1,004 and 2,239 pounds per acre, respectively. Both of the stockpiled perennial hay crop systems produced a more highly digestible forage than corn crop residues. Initial IVDOM yields, however, were greater for the corn crop residues in all years due to the greater total yield.

Rates of OM disappearance in each year varied, as did the effects of residue species and/or grazing on those rates. In the first year, the mean disappearance rate of OM was 11 pounds per acre per day for all treatments, with no differences between grazing system, or in areas grazed as opposed to nongrazed areas. However, when precipitation levels in the fall and winter were below normal in the second year, the disappearance rate of OM from grazed areas was 7.3 pounds per acre per day greater than from areas not grazed, implying the influence of weathering on OM loss differences among years. Effects of both residue species and grazing on rates of OM disappearance were evident in year 3. Differences in IVOMD yield losses between grazed and nongrazed areas were also observed in years 2 and 3. Corn crop residues tended to have greater IVOMD yield losses in years 1 and 3 when precipitation levels were greater than year 2; however the *in vitro* organic matter digestibility decreased at mean rates of -.14, -.08 and -.06 % per day in years 1, 2, and 3, respectively, with no differences among tall fescue-alfalfa, smooth bromegrass-red clover, or corn crop residues. Therefore differences among these systems in loss rate of IVOMD yield can be attributed to the physical removal of material, by precipitation or selective grazing by cows.

At the initiation of grazing, mean concentrations of neutral detergent fiber were 63.8, 66.8, and 89.5 for tall fescue-alfalfa , smooth bromegrass, and corn crop residues, with no variation among years. Effects at day 0 of year, species of residue, and year by species were observed for ADF, CP, and ADIN. Concentrations of ADF decreased by 6.6% in smooth bromegrass after year 1 while CP increased, corresponding with the addition of red clover to those fields, although IVDOM only increased 2% from year 1 to year 2. In tall fescue-alfalfa fields, little variation in ADF and CP among years occurred with three-year means of 38.3 and 14.3% for ADF respectively. Corn crop residues varied greatly in ADF among years, ranging form 53% (year 1) to 69% (year 2). ADIN concentration at day 0 increased with each subsequent year in all treatments.

As OM yields of corn crop residues or dormant grass and legume forages decrease over time due to weathering or selective grazing by cattle, plant cell solubles tend to decrease leaving greater levels of cell wall constituents. This causes concentrations of cell wall components such as neutral detergent fiber, acid detergent fiber, and acid detergent insoluble nitrogen (indigestible nitrogen) to increase over time. Rates of concentration increase differed among species of residual forage for NDF and ADF (Table 4) in year 1, and NDF in year 3. In year 2, NDF concentration changes in grazed areas were .072 % per day greater than the rates in areas not grazed. Nongrazed areas in year 2 also had lower rates of change for ADF and ADIN. Concentrations of crude protein in grazed areas decreased at greater rates in yr 1, but no effects were observed in other years. Rates of ADIN increases in 1994-95 by residues of tall fescue-alfalfa, smooth bromegrass-red clover and corn crops differed by species and or grazing, and three-year mean rates differed ADIN for species and grazing. These differing rates of change in CP and ADIN also may indicate a difference in selection by cows grazing different residues.

Three-year mean body weight increases were greater for cows grazing tall fescue-alfalfa than for those grazing smooth bromegrass with or without red clover. In 1992-1993, the mean body weight increases of cows grazing corn crop residues were greater than those of cows grazing smooth bromegrass or in the drylot (Table 5). Body condition scores of cows in the corn crop residue fields, however decreased rapidly early in the grazing season, and supplementation with hay began on November 27. Cows grazing tall fescue-alfalfa were not supplemented until January 25 and were offered 1663 pounds of DM hay per cow less than cows grazing corn crop residues while maintaining equivalent body weight gains. No differences were observed in body weight or condition score between cows in the tall fescue-alfalfa and smooth bromegrass-red clover systems in subsequent years. In 1993-1994, average decreases in body weight (-10.6 pounds)and condition score (-.07) were observed for cows grazing corn crop residues or maintained in the drylot. In 1994-1995, no differences in body weight change or condition score change were observed between systems.

Cows on the tall fescue-alfalfa and smooth bromegrass-red clover grazing systems required lower amounts of DM hay in all years than those grazing cornstalks or maintained in a drylot (Table 6). Average DM hay consumption by cows grazing tall fescue-alfalfa or smooth bromegrass red clover was 1,334 and 1,418 pounds per cow compared to 2,331 pounds per cow required by cows grazing corn crop residues. Cows consuming hay in the drylot had an average requirement of 3,691 pounds per cow, which was greater than all three winter grazing systems. Cows grazing smooth bromegrass-red clover were offered slightly greater levels of supplemental hay than cows grazing tall fescue-alfalfa in year 2, and both stockpiled grazing systems required increased levels of supplemented hay in year 3 than in previous years. The latter effect is likely a result of decreased forage yields at the initiation of grazing in that year. The tall fescue-alfalfa and smooth bromegrass-red clover systems produced excess of amounts of forage averaging 7,336 and 5,546 pounds per cow over what was needed to maintain the cows in those systems during the grazing period. If the amount of hay required to maintain cows through the entire stored feeding season is calculated (Table 7), these two systems required an average of 2,390 and 2,337 pounds per cow less hay than the total stored forage required by cows maintained in the drylot. Although cows grazing corn crop residues required more supplemental hay than did those grazing stockpiled perennial grass crop forages, they still required 1,394 pounds per cow less hay than those in the drylot.

Implications

Greater acceptance and use of forage-based livestock systems such as this should add profit to a cow-calf operation. The decreased use of stored feeds in both the stockpiled and corn crop residue grazing systems not only decreases costs for cow-calf operations, but enhances environmental quality by keeping land in sod-forming grasses or by eliminating fall tillage. Because of the improved animal performance, greater forage quality, and lower yield losses of stockpiled perennial forage pastures when compared to corn crop residues, systems utilizing corn crop residues in late autumn followed by grazing of stockpiled forages in the spring could reduce stored feed requirements even further. Additional study is needed to further explore this possibility.

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Table 1. Date of hay harvests and initiation and termination of grazing in each year for fields containing tall fescue-alfalfa, smooth bromegrass with or without red clover, and corn crop residues.

Grazing system	Item	Year 1992-93 1	1993-94 2	1994-95 3
Tall fescue-alfalfa				
	Hay harvest			
	First cutting	June 1	June 22	June 24
	Second cutting	August 11	August 2	August 10
	Grazing			
	Initiation	October 22	October 19	October 27
	Termination	March 9	March 9	March 10
Smooth bromegrass-red clover				
	Hay harvest			
	First cutting	June 1	May 27[1]	June 24
	Second cutting	----	August 6	August 10
	Grazing			
	Initiation	October 22	October 19	October 27
	Termination	March 9	March 9	March 10
Corn crop residues				
	Grazing			
	Initiation	October 29	November 1	October 27
	Termination	March 9	March 9	March 10

[1]All fields were grazed heavily for one week.

Table 2. Botanical composition of grazed and nongrazed tall fescue-alfalfa and smooth bromegrass with or without red clover as a percentage of total live forage yield.

		Forage system							
		Tall fescue-alfalfa				Smooth bromegrass[1]			
Date	Field(s)	Live	Grass	Legume	Weed	Live	Grass	Legume	Weed
		% DM	------% of live-----			% DM	------% of live-----		
1992									
May 27	Grazed[1]	94.9	54.8	40.7	4.5	96.7	97.9	.9	1.2
	Hayed	95.2	56.7	36.9	6.4	96.4	98.7	.3	.9
October 2	Grazed	50.3	51.5	47.4	1.1	--	91.6	8.4	0
	Hayed	47.1	42.7	54.9	2.3	73.9	97.7	1.3	1.0
1993									
May 26	Grazed	96.9	63.4	31.3	5.3	98.0	98.1	1.6	.3
	Hayed	93.3	67.2	30.9	1.9	89.8	83.3	15.4	1.3
October1	Grazed	93.1	81.0	10.7	8.4	86.9	58.8	39.5	1.6
	Hayed	90.3	89.3	2.0	8.7	91.2	55.9	28.8	15.2
1994									
May 25	Grazed	85.2	73.4	19.3	7.3	94.0	57.8	41.4	.8
	Hayed	68.9	97.5	1.1	1.4	84.4	68.5	30.2	1.3
October 6	Grazed	55.0	64.5	30.5	5.0	53.8	70.3	27.5	2.4
	Hayed	51.8	86.7	8.2	5.1	60.5	55.3	44.0	.7
1995									
June 1	Grazed	94.6	67.3	26.0	6.6	94.3	85.6	13.4	1.0
	Hayed	75.4	84.7	12.9	2.3	89.3	80.1	18.7	1.1

[1]Refers to fields consisting of smooth bromegrass-red clover.
[2]Grazed: stockpiled; hayed: not stockpiled.

Table 3. Initial yields of dry matter (DM), organic matter (OM), and *in vitro* organic matter digestibility (IVOMD) and rates of disappearance from grazed and nongrazed areas of fields containing tall fescue-alfalfa (TFA), smooth bromegrass(SB), and corn crop residues (CR).

	Initial			Change per day (lbs/acre)					
	lbs/acre			Grazed			Nongraze		
Item	TF-A	SB	CR	TF-A	SB	CR	TF-A	SB	CR
DM yield									
1992	1955	2929	5510	-8.5	-14.5	-7.8	-5.9	-11.6	-13.2
1993	2022	1840	5452	-6.0	-3.9	-8.7	.4	.9	4.2
1994	1582	1751	6428	-6.7	-5.5	-14.9	-.3	4.3	-8.7
OM yield									
1992	1760	2618	5173	-7.7	-13.7	-8.9	-5.4	-10.5	-13.2
1993[b]	1840	1674	4343	-6	-4.5	-9.4	-.4	.4	2.0
1994[ab]	1410	1585	5946	-5.5	-4.8	-13.7	-.4	3.8	-10.0
IVDOM yield									
1992	1065	1362	2437	-5.3	-7.5	-11.8	-5.1	-6.8	-10.7
1993[a]	981	839	1929	-3.8	-3.0	-6.4	-1.7	-1.1	-1.5
1994[ab]	764	809	2351	-3.4	-3.0	-7.3	-1.2	.51	-5.1

[a]Significant effect of species.
[b]Significant effect of grazing.

Table 4. Initial concentrations and rates of change over time of NDF, ADF, CP, and ADIN from grazed and nongrazed areas of tall fescue-alfalfa, smooth bromegrass-red clover, or corn crop residues.

				Change, % per day					
	Initial %			Grazed			Nongrazed		
Item	TF-A	SB	CR	TF-A	SB	CR	TFA	SB	CR
NDF, % OM									
1992[a]	63.5	72.0	87.6	.09	.04	.18	.09	.06	.12
1993[b]	61.9	61.9	91.3	.18	.23	.12	.12	.13	.05
1994[b]	65.9	66.6	89.5	.09	.10	.04	.09	.07	.05
ADF, % OM									
1992[a]	38.6	46.3	53.6	.09	.04	.19	.08	.07	.16
1993	37.5	39.8	69.5	.16	.21	.18	.11	.08	.10
1994	38.7	41.8	55.7	.07	.07	.04	.09	.04	.04
CP, % OM									
1992[ab]	15.3	9.7	4.1	-.01	.01	.00	.00	.02	.01
1993	13.8	17.0	6.3	-.01	-.01	-.01	.00	-.01	-.01
1994	13.9	15.1	4.7	-.01	.00	.00	-.01	.00	.00
ADIN, % N[1]									
1992[ab]	3.0	4.0	10.5	.16	.11	.27	.11	.10	.15
1993[b]	9.1	10.8	24.9	.06	.09	.15	.04	.04	.10
1994	13.5	16.7	28.9	.05	.05	.03	.04	.04	.03

[1]N = total nitrogen (crude protein / 6.25).
[a]Significant differences among species in rate of change over time.
[b]Significant effect of grazing on rate of change over time.

Table 5: **Initial measure and seasonal changes of body weight and condition score for cows in different wintering systems.**

	Yr	Wintering system TF	SB	CR	DL
Body Weight, Initial					
	1992-93	1106	1132	1121	1088
	1993-94	1119	1182	1167	1136
	1994-95	1173	1173	1180	1155
Change[1]					
	1992-93	63.7[a]	-9.0[b]	29.3[a]	5.1
	1993-94	80.7[a]	52.0[ac]	-14.1[b]	-7.1[bc]
	1994-95	51.6	55.6	39.0	31.1
Condition score[2] Initial					
	1992-93	5.1	5.1	5.6	5.5
	1993-94	5.1	5.1	5.6	5.3
	1994-95	5.4	5.4	5.4	5.4
Change					
	1992-93	.3	-.3	.2	-.17
	1993-94	.2[a]	.3[a]	-.08[b]	-.05[a]
	1994-95	.1	.1	0	-.35

[1]Change over 140 day grazing season.
[2]Nine-point scale: 1 = emaciated, 9 = obese.
[abcd]Means with unlike superscripts are significantly different.

Table 6. Total DM hay yields from summer harvest, initial DM forage, total DM hay offered to cows, and hay balance for different wintering systems.

		Wintering system TF	SB	CR	DL
1992-93	Item				
	Total hay yield ,	5174	3624	–	–
	Hay fed, lbs/cow	1310[a]	1074[a]	2972[b]	3413[c]
	Hay balance[1], lbs/cow	9036[a]	6174[b]	-2972[c]	-3143[d]
1993-94					
	Total hay yield, lbs/acre	4242	2212	–	–
	Hay fed, lbs/cow	931[a]	1310[a]	1868[b]	4101[c]
	Hay balance, lbs/cow	7552[a]	3116[b]	-1868[c]	-4101[d]
1994-95					
	Total hay yield, lbs/acre	3592	4608	–	–
	Hay fed, lbs/cow	1760[a]	1865[ab]	2088[bc]	3359[d]
	Hay balance, lbs/cow	5422[a]	7349[b]	-2088[c]	-3359[d]

[1]Hay balance = hay produced per cow - hay fed per cow.
[abcd]Differences between means with different superscripts are significant.

Table 7. Three year average hay yields, hay fed and hay balance for the winter grazing period and the winter grazing season of different wintering systems.

	Wintering system			
Item	TF	SB	CR	DL
Grazing season				
Hay fed, lbs/cow	1334[a]	1418[a]	2370[b]	3691[c]
Hay balance[1], lbs/cow	7336[a]	5546[b]	-2370[c]	-3691[d]
Total season				
Hay fed, lbs/cow	3041[a]	3094[b]	4037[c]	-5431[d]
Hay balance, lbs/cow	5629[a]	3868[b]	-4037[c]	-5431[d]

[1]Hay balance = hay produced per cow - hay fed per cow.
[abcd]Differences between means with different superscripts are significant.