Evaluation of Year-round Forage Management Systems for Spring- and Fall-Calving Beef Cows (A Progress Report)

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Summary

A year-round grazing system for spring- and fall-calving cows was developed to compare animal production and performance, hay production and feeding, winter forage composition changes, and summer pasture yield and nutrient composition to that from a conventional, or minimal land system. Systems compared forage from smooth bromegrass-orchardgrass-birdsfoot trefoil pastures for both systems in the summer and corn crop residues and stockpiled grass-legume pastures for the year-round system to drylot hay feeding during winter for the minimal land system. The year-round grazing system utilized 1.67 acres of smooth bromegrass-orchardgrass-birdsfoot trefoil (SB-O-T) pasture per cow in the summer, compared with 3.33 acres of (SB-O-T) pasture per cow in the control (minimal land) system. In addition to SB-O-T pastures, the year-round grazing system utilized 2.5 acres of tall fescue-red clover (TF-RC) and 2.5 acres of smooth bromegrass-red clover (SB-RC) per cow for grazing in both mid-summer and winter for fall- and spring-calving cows, respectively. First-cutting hay was harvested from the TF-RC and SB-RC pastures, and regrowth was grazed for approximately 45 days in the summer. These pastures were then fertilized with 40 lbs N/acre and stockpiled for winter grazing. Also utilized during the winter for spring-calving cows in the year-round grazing system were corn crop residue (CCR) pastures at an allowance of 2.5 acres per cow. In the minimal land system, hay was harvested from three-fourths of the area in SB-O-T pastures and stored for feeding in a drylot through the winter. Summer grazing was managed with rotational stocking for both systems, and winter grazing of stockpiled forages and corn crop residues by year-round system cows was managed by strip-stocking. Hay was fed to maintain a body condition score of 5 on a 9 point scale for spring-calving cows in both systems. Hay was supplemented as needed to maintain a body condition score of 3 for fall-calving cows nursing calves through the winter.

Although initial condition scores for cows in both systems were different at the initiation of grazing for both winter and summer, there were no significant differences (P > .05) in overall condition score changes throughout both grazing seasons. In year 1, fall-calving cows in the year-round grazing system lost more (P < .05) body weight during winter than spring-calving cows in either system. In year 2, there were no differences seen in weight changes over winter for any group of cows. Average daily gains of fall calves in the year-round system were 1.9 lbs/day compared with weight gains of 2.5 lbs/day for spring calves from both systems. Yearly growing animal production from pastures for both years did not differ between systems when weight gains of stockers that grazed summer pastures in the year-round grazing system were added to weight gains of suckling calves. Carcass characteristics for all calves finished in the feedlot for both systems were similar.

There were no significant differences in hay production between systems for year 1; however, amounts of hay needed to maintain cows were 923, 1373, 4732 lbs dry matter/cow for year-round fall-calving, year-round spring-calving, and minimal land spring-calving cows, respectively. In year 2, hay production per acre in the minimal land system was greater (P < .05) than for the year-round system, but the amounts of hay required per cow were 0, 0, and 4720 lbs dry matter/cow for year-round fall-calving, year-round spring-calving, and minimal land spring-calving cows, respectively.

Introduction

Stored feeds make up almost half of the cost of production for cow-calf enterprises in Iowa. Therefore, any reduction in the amount of stored feeds needed to maintain cows through the winter can have an impact on overall costs of maintaining the herd. There are many resources available to farmers in Iowa that often go overlooked. Two of these resources are the use of corn crop residues and the use of stockpiled perennial forage for grazing during the winter. Depending on the area of the state, farmers have variable amounts of either corn crop residues or pasture that could be managed for winter grazing to reduce the amounts of stored feeds needed to maintain cattle. Therefore, there is a need to design and evaluate grazing systems to utilize such resources.

In a previous experiment, spring-calving cows utilizing 1.5 acres per cow of corn crop residues and 3 acres per cow of stockpiled forage for winter grazing required 390 lb hay dry matter/cow compared with 6,313 lb hay dry matter/cow for cows maintained in a drylot. Though the use of stockpiled forage reduces the amount of hay needed for the winter, it also produces excess forage during the summer months that must be managed to maintain forage quality. The use of stocker cattle to graze excess forage in early- to mid-summer was proven effective in removing excess forage and maintaining pasture quality for the cows and calves in the system. Because stocker cattle must be maintained during the winter months, spring calves that are kept will require more stored feeds compared with fall calves kept as stockers through the winter. Therefore, the addition of fall-calving cows to a year-round grazing system could prove to be a practical way to further reduce stored feed costs. Furthermore, fall-calving cows have lower nutritional requirements during the summer months and, therefore, can be used to graze pastures during the summer months after animals with higher nutrient requirements in a leader-follower stocking system.

The objectives of this experiment were to compare the amount of stored feeds needed to maintain cows and calves during winter and calf and stocker production from these systems in a year-round grazing system utilizing corn crop residue and stockpiled forages with a system utilizing winter feeding of hay produced from summer pasture.

Materials and Methods

Forage Systems

Two forage systems were compared (Table 1). The Minimal Land system utilized replicated 20 acre smooth brome-orchardgrass-birdsfoot trefoil (SB-O-T) pastures with a stocking rate of 6 spring-calving cows per pasture. During the winter, hay cut from these pastures was fed to cows in replicated drylots to maintain a body condition score of 5 (9-point scale). Spring calves were finished in a feedlot at weaning. Calving began while cows were in the drylot in late March and continued through April on the summer pastures. In April, cows began the grazing season by rotationally grazing four 1.25-acre paddocks in SB-O-T pastures. Forage in the remaining 15 acres of each pasture was harvested as first cutting hay and then incorporated into the rotational grazing scheme in July. If at any time forage was inadequate, hay was to be fed ad libitum to cows on the pasture.

Cattle stocked on the Year-Round grazing system included 6 spring-calving and 6 fall-calving cows. Spring-calving cows utilized replicated 15-acre corn crop residue (CCR) fields and replicated 15 acre stockpiled smooth brome-red clover (SB-RC) pastures for winter grazing. Fall-calving cows and their calves utilized replicated 15 acre endophyte-free tall fescue-red clover (TF-RC) pastures for winter grazing. Calves were to be weaned from fall-calving cows if 50% of the cows' condition scores fell to a condition score of 3 or lower. Otherwise, calves were weaned in early March. Cows strip-grazed CCR and stockpiled forages based on forage availability at the initiation of the grazing season. Spring- and fall-calving cows were supplemented with hay if the mean body condition score of each herd was less than 5 and 3, respectively, or if forage availability was limited by excessive snow or ice. Spring calving began in late March and continued through April. In late April, spring-calving cow-calf pairs and 12 stockers (6 yearling cattle and 6 fall calves) were moved to 20 acre SB-O-T pastures to lead-graze for 33% forage removal in front of the 6 pregnant fall-calving cows. First cutting forage from the TF-RC and SB-RC pastures was harvested as hay, and after a minimum of 28 days of regrowth, and spring- and fall-calving cows were moved to the SB-RC and TF-RC pastures, respectively, to strip-graze for approximately 42 days. Breeding of spring-calving cows was initiated on these pastures. Stockers remained on the SB-O-T pastures provided that forage availability was adequate. In early August, stockers were moved to a feedlot for finishing and spring- and fall-calving cows were rotationally stocked on the SB-O-T pastures until winter grazing was initiated.

Grazing Management

To initiate the experiment, first-cutting hay was harvested from TF-RC and SB-RC pastures in the summer of 1998. Second cutting forage in these pastures was grazed by five cow-calf pairs and one bull. In early August, 40 lb N/acre was applied to each of these pastures, and the forage was allowed to stockpile until early November. First-cutting hay for cows to be maintained in the drylot was cut from 10 acres of the SB-O-T pastures. Second-cutting forage from these pastures was incorporated into a rotational stocking system for eight cows.

On November 13, 1998, 24 spring-calving Angus-cross cows in midgestation were randomly assigned to either one of two drylots for the minimal land system or to one of two CCR fields (2.5 acres/cow) for the year-round grazing system. At the same time, 12 Angus-cross cows with calves were randomly assigned to one of two TF-RC pastures for the year-round grazing system. One bull was also assigned to each of the TF-RC pastures. Eighty-five days after initiation of grazing, spring-calving cows grazing CCR were moved to SB-RC pastures to graze for the remainder of the winter grazing season (approximately 81 days). Due to heavy snow cover, hay was offered to the spring-calving cows and fall-calving cows in the year-round grazing system on pasture to maintain condition scores of 5 and 3, respectively. Calves were weaned on March 3, 1999, and fed a hay-corn gluten diet until summer grazing was initiated. In addition, 12 calves from the previous season’s spring-calving cows were also maintained on a hay-corn gluten diet over winter until summer grazing was initiated.

Table 1. Summary of cow-calf movement though the year-round and minimal land grazing systems.

Winter calendar	**Forage system**		
	Year-round grazing		Minimal land
Month	Fall calving	Spring calving	Spring calving
November	Two groups of six fall calving cows with calves and one bull graze 7.5 acres of stockpiled endophyte-free tall fescue red clover (TF-RC) for 2 months (.54 ac/cow/mo).	Spring calves are weaned and fed hay in a drylot. Two groups of six spring calving cows graze 15 acres of corn crop residue per group for 2 to 3 months (.83 ac/cow/mo).	Spring calves are weaned and finished in a feedlot. Two groups of six cows are fed hay (summer production) in a drylot to maintain a body condition score of 5 (9 point scale).
January	Cows with calves graze an additional 7.5 acres of stockpiled TF-RC for 4 months (.62 ac/cow/mo). If needed, hay (summer production) to maintain body condition score greater than 3 (9 point scale).	Cows continue to graze corn crop residue.	Cows continue to be fed hay.
February	Cows continue to graze TF-RC pastures.	Cows are moved to graze 15 acres of stockpiled smooth bromegrass-red clover (SB-RC) per group for 3 to 4 months (.83 ac/cow/mo).	Cows continue to be fed hay.
March	Fall calves are weaned if not done previously (weaning criteria: calves weaned when 50% of cows' condition scores are 3 or lower). Cows continue to graze TFRC pastures.	Cows begin calving in late March and continue to early April.	Cows begin calving in late March and continue to early April.
Summer calendar			
April	Cows moved to summer pastures as pasture growth permits. Cows will follow-graze behind spring calving cows and stockers for 50% forage removal.	Cows moved to summer pastures as pasture growth permits. Cows and calves and stockers lead graze, for 34% forage removal, 20 acres of smooth brome-orchardgrass-birdsfoot trefoil (SB-O-T) per group.	Cows and calves rotationally graze 5 acres of a 20 acre smooth brome-orchardgrass-birdsfoot trefoil (SB-O-T) pasture per group (1.2 au/ac). Cows are rotated between paddocks daily.
May	First cutting hay baled on 15 acre TF-RC pastures. Cows continue follow grazing in SB-O-T pastures.	First cutting hay baled on 15 acre SBRC pastures. Cows and calves and stockers continue lead grazing in SB-O-T pastures.	First cutting hay baled from ungrazed portion of 20 acre pasture (15 acres). Cows and calves continue to graze 5 acres of SB-O-T pastures.
June	Cows moved to strip-graze 15 acre TF-RC pastures at .4 au/ac.	Breeding is initiated for cows. Cows and calves and one bull per group are moved to strip-graze 15 acres of SB-RC pastures at .47 au/ac. Stockers continue to graze in SB-O-T pastures at .3 au/ac at a 50% forage removal rate.	Breeding is initiated for cows. Cows and calves with one bull per group continue to graze 5 acres of SB-O-T pastures at 1.4 au/ac and at a 50% forage removal rate. If available forage becomes inadequate, hay will be fed ad lib.
July	Cows continue to graze TF-RC pastures.	Cows continue to graze SB-RC pastures.	The 15 hayed acres are incorporated into the rotational grazing system. Grazing is now over the entire 20 acres and is grazed at .35 au/ac.
August	Cows moved back to SB-O-T pastures to graze at .6 au/ac. Fall calving begins. TFRC pastures are fertilized.	Cows moved back to SB-O-T pastures to graze at .6 au/ac. Stockers are moved to the feedlot to be finished. SBRC pastures are fertilized.	Cows and calves continue to grazed 20 acres of SB-O-T pastures at .3 au/ac. Calves are weaned before cows are placed in drylot for the winter.
November	System is repeated	System is repeated	System is repeated

Notes:

1) An animal unit (au) is defined as 1 cow (with or without a calf), 2 stockers, or 1 bull.
2) Stockers are defined as fall calves weaned in March and spring calves from the previous calving season (yearlings).
3) When not grazing in the summer pastures, stockers are maintained on a hay-corn gluten feed diet.
4) Groups of cows (i.e., year-round fall calving, year-round spring calving, minimal land spring calving) are replicated. Each cow group has a total of 12 cows.
5) Pastures are replicated. Each system has two of each pasture described. For example: in January, one set of six cows (with calves) grazes one 15 acre TF-RC pasture, and the second set of six cows (with calves) grazes another 15 acre TF-RC pasture.
   Exception: a summer pasture is "shared" by one group of year-round fall-calving cows, spring-calving cows, and stockers. There are two of these "shared" summer pastures.

On April 22, 1999, both groups of six cows from the drylot in the minimal land system were assigned to one of two SB-O-T pastures and were rotationally stocked on 5 of the 20 acres. First-cutting hay was harvested from the remaining 15 acres of each pasture in June. This land was incorporated into a grazing system after a minimum of 28 days of regrowth, and the entire area of each pasture was grazed until October 28, 1999. In the year-round grazing system, spring- and fall-calving cows and stockers were assigned to one of two 20 acre SB-O-T pastures on April 22, 1999. Hay was harvested from SB-RC and TF-RC pastures in June. After a minimum of 28 days of regrowth, fall-calving cows were moved to the TF-RC pastures and spring-calving cows with calves were moved to the SB-RC pastures to graze until early August. Stockers remained on the SB-O-T pastures during this time. In August, cows grazing stockpiled pastures were then moved back to the SB-O-T pastures to graze until October 28, 1999, and stockers were removed and finished in a feedlot

The experiment was repeated on October 28, 1999, when spring-calves from the minimal land system were weaned and finished in the feedlot, and spring calves from the year-round grazing system were placed on a hay-corn gluten diet for maintenance during the winter. Cows in the Minimal Land system were again placed in a drylot and fed hay to maintain a body condition score of 5 throughout the winter. Cows in the year-round grazing system were moved to their respective pastures to initiate winter grazing. Approximately 80 days after initiation of grazing, spring-calving cows on CCR pastures were moved to SB-RC pastures to continue to graze through the winter. Fall calves were weaned March 3, 2000, and placed on a hay-corn gluten diet for the remainder of the winter.

Summer grazing was initiated for cows in both systems on April 26, 2000. Because of the lack of rain and the resulting poor forage growth in both summer and stockpiled pastures only 12.5 acres of pastures in the minimal land system and 7.5 acres of the TF-RC and SB-RC pastures in the year-round grazing system were harvested as hay. Paddocks not cut for hay in the Minimal Land system were incorporated into the rotational stocking system to maintain adequate forage for grazing on the pastures. Cows in the year-round grazing system grazed forage from all 15 acres of the TF-RC and SB-RC pastures in mid-summer. Because of inadequate forage on the SB-O-T pastures, cows in the year-round grazing system were moved to TF-RC and SB-RC pastures in May for two weeks and again from late June to early August.

Measurements

Through the winter grazing season, cows were scored for condition bi-weekly. Cow and calf weights were measured at initiation of grazing, at the transition from corn crop residue to stockpiled forage grazing, at weaning of fall calves, and at the end of the winter grazing period. In the summer, stocker, cow, and calf weights were measured, and cows were condition-scored monthly. Reproductive performance was determined by rectal palpation 45 days post-breeding and open cows were replaced at the time their calves were weaned.

During the fall and winter, corn crop residue was hand-sampled monthly in two 4-m^2 locations per paddock. Stockpiled forages were hand-clipped monthly in three .25-m^2 locations per paddock. To determine the effects of winter weather on forage quantity and quality, samples were collected from four 1-m^2 and two 24-m^2 grazing cages in the stockpiled forage pasture and corn crop residue fields, respectively. To estimate live forage mass and regulate grazing intervals, sward heights were measured with a falling plate meter (4.8 kg/m^2) in four locations per paddock when cows were moved into or out of a paddock. To measure forage quality and nutritive value of forages in pastures, forage samples were hand-clipped monthly in three .25 m^2 locations per paddock. Forage samples were weighed, dried to determine dry matter yield, and analyzed for organic matter, digestibility, fiber, crude protein, and unavailable protein.

Results and Discussion

Animal performance and production

Body condition score changes for cows in both the minimal land and year-round grazing systems were compared on chronological and physiological basis (Tables 2 and 3). As designed, all cows began both winter grazing seasons with a similar body condition score. Over winter and summer of year 1, no differences in overall body condition score change for the season were seen among cows from all three groups. In year two, body condition scores of fall-calving cows at the initiation of winter grazing were greater than spring-calving cows in the year-round grazing system, However, no difference in the change of condition score during winter and summer among all cow groups was seen in year 2. In both years, fall-calving cows lost condition after calving while nursing calves and grazing stockpiled forage; however, they were able to regain condition after weaning. Differences in condition score changes associated with different production stages were seen between fall-calving cows in the year-round grazing system and spring-calving cows from both the minimal land and year-round grazing systems. These differences could be largely due to the quantity and nutritional quality of forage available to the cows during the different seasons. However, the amount of forage available during the winter season was adequate enough so that fall-calving cows maintained enough condition to prevent calves from being weaned earlier than the first week of March and supplied cows with enough nutrients to allow them to regain condition before calving in August. Trends in body condition score changes for spring-calving cows in both the minimal land and year-round grazing systems were similar from midgestation to weaning for both years.

Table 2. Year 1 condition score changes (9 point scale) of spring- and fall-calving cows in the year-round grazing and minimal land systems.

			System		
	Date	Production stage	Fall calving	Spring calving	Spring calving
Winter 1					
Initial score	11Nov98		5.2	4.9	5.0
Overall change	22Apr99		-0.5	-0.3	-0.2
Summer 1					
Initial score	22Apr99		4.8	4.7	4.6
Overall change	28Oct99		1.1	0.3	0.8
		Midgestation	1.4^{a}	-0.4^{b}	-0.7^{b}
		Pre-calving	0.1	-0.1	-0.1
		Post-calving	0.3	0.2	0.6
		Pre-breeding	-0.7^{a}	1.1^{b}	0.4^{a}
		Breeding	-0.8^{a}	-0.8^{a}	0.2^{b}
		Late lactation	-0.8^{a}	0.7^{b}	0.4^{c}
		Post-weaning/weaning*	1.2^{a}	-0.6^{b}	-0.2^{b}

^{abc}Differences between means among different cow groups with different superscripts are significant, $P < .05$.
*Post-weaning for fall-calving cows, at weaning for spring-calving cows.

Table 3. Year 2 condition score changes (9 point scale) of spring- and fall-calving cows in the year-round grazing and minimal land systems.

			System		
			Year-round		Minimal land
	Date	Production stage	Fall calving	Spring calving	Spring calving
Winter 2					
Initial score	28Oct00		5.9^{a}	5.0^{b}	5.2
Overall change	26Apr00		0.2	0.7	0.4
Summer 2					
Initial score	26Apr00		5.8	5.5	5.6
Overall change	18Oct00		1.0	-.1	.3
		Midgestation	1.0	0.8	0.3
		Pre-calving	-0.1	0.1	-0.3
		Post-calving	1.1^{a}	0.1^{b}	-0.1^{b}
		Pre-breeding	-1.1^{a}	0.3^{b}	0.4^{b}
		Breeding	-0.1^{a}	-0.6^{b}	-0.5
		Late lactation	-1.2^{a}	0.4^{b}	0.2^{b}
		Post-weaning/weaning*	0.9^{a}	-0.5^{b}	0.0

^{ab}Differences between means among different cow groups with different superscripts are significant, $P < .05$.
*Post-weaning for fall-calving cows, at weaning for spring-calving cows.

Trends in body weight changes for cows over the grazing seasons, compared on a physiological basis were identical to those observed for condition score changes (Tables 4 and 5). Over the first winter, fall-calving cows had greater body weight losses than spring-calving cows in either system. Mean body weight gains during the second winter were greater than the first year and did not differ between cows in any treatment group. Similarly, body weight changes did not differ between cows in any group during both summers. Spring-calving cows in the minimal land system lost more body weight during the post-calving stage from calving to initiation of summer grazing than spring-calving cows in the year-round grazing system in both winter grazing seasons. Body weight gains during the post-calving period from the pre-calving weight in early August to the post-calving weight in late September for fall-calving cows in the year-round grazing system were greater than those measured between early March and late April for spring-calving cows in either system. Spring-calving cows in both the minimal land and year-round grazing systems regained body weight while nursing calves on summer pastures during the prebreeding and late lactation stages. Fall-calving cows lost body weight at similar physiological states. In spite of the differences in season, body weight gains of fall- and spring-calving cows in the year-round grazing system did not differ in either year and were greater than spring-calving cows in the minimal land system in year 1. However, bodyweight gains during the pre-calving period from late January through February for spring-calving cows in the minimal land system were greater than those in the year-round grazing system in year 1, but did not differ in year 2.

Table 4. Year 1 weight changes (lbs.) of spring- and fall-calving cows in the year-round grazing and minimal land systems.

			System		
			Year-round		Minimal land
	Date	Production stage	Fall calving	Spring calving	Spring calving
Winter 1					
Initial wt.	11Nov98		1213.7	1157.5	1165.0
Overall change	22Apr99		-66.5[a]	12.5[b]	-20.4[b]
Summer 1					
Initial wt.	22Apr99		1152.7	1173.2	1150.0
Overall change	28Oct99		84.5	3.0	99.4
		Midgestation	114.8[a]	115.4[a]	-9.6[c]
		Pre-calving	100.5	-82.9[b]	108.3[c]
		Post-calving	11.8[a]	-20.0[b]	-119.0[b]
		Pre-breeding	-142.7[a]	58.7[b]	10.4[b]
		Breeding	-23.0	-18.8	38.3
		Late lactation	-86.7[a]	62.5[b]	66.7[b]
		Post weaning/wean*	43.2[a]	-99.3[b]	-15.9

[abc]Differences between means among cow groups with different superscripts are significant, P < .05.
*Post weaning for fall-calving cows, weaning for spring-calving cows.

Table 5. Year 2 weight changes (lbs.) of spring- and fall-calving cows in the year-round grazing and minimal land systems.

			System		
			Year-round		Minimal land
	Date	Production stage	Fall calving	Spring calving	Spring calving
Winter 1					
Initial wt.	28Oct00		1237	1176	1231
Overall change	26Apr00		42.3	82.0	6.6
Summer 1					
Initial wt.	26Apr00		1250	1226	1237
Overall change	18Oct00		90.0	69.0	99.0
		Midgestation	82.5	121.3	89.8
		Pre-calving	-22.5	40.1	42.2
		Post-calving	186.0[a]	-79.4[b]	-125.3[c]
		Pre-breeding	-123.5[a]	40.5[b]	42.5[b]
		Breeding	75.5[a]	-32.0[b]	-41.5[b]
		Late lactation	-50.8[a]	111.5[b]	114.0[b]
		Post weaning/wean*	17.5	-36.0	-27.5

[abc]Differences between means among cow groups with different superscripts are significant, P < .05.
*Post weaning for fall-calving cows, weaning for spring-calving cows

Rebreeding rates for spring-calving cows in the year round grazing system were greater compared with rebreeding rates for spring-calving cows in the minimal land system (Table 6). In year 2, spring-calving cows in the minimal land system had a lower rebreeding rate compared with fall-calving cows in the year round grazing system. Rebreeding rates were greater for the year round grazing system overall compared to the minimal land system.

Table 6. Rebreeding rates for cows in the year-round grazing and minimal land system.

Year	Cow group	Percent rebred
1	Year-round, spring calving	100[a]
	Year-round, fall-calving	84
	Minimal land, spring-calving	83[b]
2	Year-round, spring calving	75
	Year-round, fall-calving	100[a]
	Minimal land, spring-calving	83[b]

[ab]Differences between means among different cow groups within the same year with different superscripts are significant, P < .05.

Birth weights for fall calves in the year-round grazing system were greater than birth weights for spring calves in the minimal land system in year 2 (Table 7). Weaning weights for calves in both systems did not differ in either year. Average daily gains for spring calves in the year-round grazing and minimal land systems did not differ in either year. However, daily weight gains of fall-calves in the year-round grazing system were lower than spring calves in either system in both years. When one considers only the fall and spring calf crops in the year-round grazing system, there was more growing animal production in the minimal land system. However, this does not consider the amount of growth of stockers grazing in summer pastures. Therefore, to determine the amount of growing animal production for the year-round grazing system, both fall and spring calves were added with stocker weights and divided by the total number of acres of perennial pasture used in the system. When this was done, growing animal production for both systems did not differ either year (Tables 8 and 9).

Table 7. Birth weights, weaning weights, and average daily gains of calves in both the minimal land and year-round grazing systems and stocker weights at initiation of summer grazing for the year-round grazing system.

	Systems		
	Year-round grazing		Minimal land
	Fall Calves	Spring calves	Spring calves
Birth weights, lbs.			
Year 1	--	93.9	96.1
Year 2	100.4[a]	93.5	90.6[b]
Weaning weights, lbs.			
Year 1	415.4	498.7	480.7
Year 2	468.8	544.9	548.9
Average daily gain, lb/day			
Year 1	1.8[a]	2.6[b]	2.5[b]
Year 2	2.0[a]	2.4[b]	2.5[b]
Stocker weights, lbs.			
Year 1	503.5	668.0	--
Year 2	552.0	737.2	--

[ab]Differences between means with different superscripts are significant, P<.05.

Table 8. Year 1 growing animal production by calves and stockers grazing in the year-round grazing and minimal land systems.

	Systems	
	Year-round grazing[a]	Minimal land[b]
Pre-weaning	Lb/ac perennial pasture[c]	
Fall calves (1998 to weaning)	24.2	--
Spring calves (1999 to weaning)	48.6	115.5
Stockers		
Spring calves (1998)	16.3	--
Fall calves (1998)	18.7	--
Total[c]	107.7	115.5

[a]Year-round grazing system consisted of 4.2 acres of perennial pasture per cow and 1.25 acres of cornstalks per cow.
[b]Minimal land system consisted of 3.3 acres of perennial pasture per cow.
[c]There was no significant difference between systems in total lb/acre production, P > .05.

Table 9. Year 2 growing animal production by calves and stockers grazing in the year-round grazing and minimal land systems.

	Systems	
	Year-round grazing[a]	Minimal land[b]
Pre-weaning	Lb/ac perennial pasture[c]	
Fall calves (1999 to weaning)	44.2	--
Spring calves (2000 to weaning)	54.2	137.5
Stockers		
Spring calves (1999)	20.5	--
Fall calves (1999)	15.6	--
Total[c]	134.5	137.5

[a]Year-round grazing system consisted of 4.2 acres of perennial pasture per cow and 1.25 acres of cornstalks per cow.
[b]Minimal land system consisted of 3.3 acres of perennial pasture per cow.
[c]There was no significant difference between systems in total lb/acre production, P > .05.

Table 10. Year 1 carcass data for both minimal land and year-round calves finished in the feedlot.

	Year-round		Minimal land
Carcass characteristic	Fall calves	Spring calves	Spring calves
Carcass wt. (lbs.)	817.2[a]	774.2[b]	646.9
Marbling	1065	1052	1061
REA (in.)	13.9	13.3	15.2
Backfat (in.)	.4[a]	.5	.7[c]
Kidney, pelvic and heart fat, %	2.5[a]	2.2[b]	2.1
Yield grade	2.7	2.8	2.4
Quality grade (ave.)	choice	choice	Choice

[abc]Differences between means among calf groups with different superscripts are significant, P < .05.

Carcasses of spring calves in the minimal land system finished immediately after weaning had lighter carcasses and greater backfat than either spring or fall calves in the year-round grazing system that were backgrounded in a drylot and grazed on summer pasture before being finished in a feedlot (Table 10). Carcasses of fall calves from the year-round grazing system weighed more and had higher proportions of kidney, pelvic, and heart fat than spring calves from the year-round grazing system. However, marbling scores, rib eye area, yield grades, and quality grades at harvest did not differ between the different calf groups.

Winter forage yield and composition

In year 1, no differences in hay production were observed between the year-round grazing and minimal land systems expressed either on a per acre or per cow basis. (Table 11). However, in year 2, hay yields per acre from the SB-O-T pastures in the minimal land system were greater than those from the TF-RC and SB-RC fields used in the year-round grazing system. Furthermore, because more area in the SB-O-T fields in the minimal land system was harvested as hay in year 2, hay production per cow in the minimal land system was greater than hay production from the year-round grazing system when expressed on a per cow basis. In both years, significantly more hay was fed to cows in the drylot in the minimal land system than the mean of cows grazing stockpiled pasture with or without corn crop residues in the year-round grazing system. Over the two years, fall-calving cows grazing stockpiled forages required a mean of 225 lb hay dry matter per cow less hay than spring-calving cows sequentially grazing corn crop residues and stockpiled forages. Because of the lack of difference in hay production and the differences in the amounts of hay required, cows maintained in a drylot in the minimal land system required 1,783 lbs hay dry matter/cow more than was produced, and the year-round grazing system resulted in a positive hay balance of 3,377 lbs/cow in year 1. In year 2, hay production from pastures in the minimal land system exceeded the amounts required by 2,486 lb hay DM/cow compared with an excess of 4,236 lb/cow in the year-round grazing system. However, spring-calves kept as stockers required 2,736 and 2,483 lb hay dry matter/calf, and fall-calves kept as stockers required 550 and 465 lb hay dry matter/calf for maintenance during winter. There was 1,825 and 2,719 lb more hay dry matter/cow-calf pair produced in excess of that needed for the year-round grazing system in years 1 and 2.

Table 11. Year 1 and 2 hay production, feeding and balance for the year-round and minimal land systems.

	System			
	Year-round			Minimal land
	Fall-calving	Spring-calving	System mean	
Year 1				
Hay production,				
Lb/harvested ac[c]	1598	2035	1817	1171
Lb/cow	3995	5088	4541	2926
Hay fed,				
Lb/cow	923[x]	1373[y]	1148[a]	4732[b]
Lb/cow-calf	1303[x]	4110[y]	2706	4732
Hay balance,				
Lb/cow	3071	3714	3393[a]	-1805[b]
Lb/cow-calf	2692	978	1835[a]	-1805[b]
Year 2				
Hay production,				
Lb/harvested ac[c]	1481	1907	1694[a]	2883[b]
Lb/cow	3703	4768	4236[a]	7206[b]
Hay fed,				
Lb/cow	0	0	0[a]	4720[b]
Lb/cow-calf	550[x]	2483[y]	1517[a]	4720[b]
Hay balance,				
Lb/cow	3703	4768	4236	2486
Lb/cow-calf	3153	2285	2719	2486

[ab]Differences between means of systems with different superscripts are significant, P < .05.
[c]Hay was harvested from tall fescue-red clover and smooth bromegrass-red clover fields from 2.5 ac/cow for fall- and spring-calving cows in the year-round grazing system and from smooth bromegrass-orchardgrass-birdsfoot trefoil pastures at 1.67 ac/cow for spring-calving cows in the ML system.
[xy]Differences between means within the year-round system with different superscripts are significant, P < .05.

Although no differences in initial organic matter yield and composition were observed in year 1 the initial yield and digestibility of OM of stockpiled TF-RC forages were greater than stockpiled SB-RC in year 2 (Figures 1 and 2). Concentrations of neutral detergent fiber, acid detergent fiber, and acid detergent insoluble nitrogen at the initiation of grazing did not differ between CCR or stockpiled TF-RC and SB-RC forages. The rates of change in the yields and digestibility of organic matter did not differ between CCR, TF-RC and SB-RC forages in grazed and ungrazed areas of the fields. In both years, concentrations of neutral detergent fiber and acid detergent fiber increased and the crude protein concentration of stockpiled TF-RC forage decreased at a greater rate than CCR throughout the winter.

Summer forage component

Dry matter masses for SB-O-T pastures in both minimal land and year-round grazing systems were greatest in early spring and then peaked again in later summer (Figure 3). In August of year 1, there was significantly more forage available in SB-O-T pastures in the year-round grazing system after 42 days of grazing by stockers than SB-O-T pastures in the minimal land system. Forage masses in the TF-RC and SB-RC pastures grazed by fall- and spring-calving cows in mid-summer were comparable to the SB-O-T pastures grazed by spring-calving cows in the minimal land system. However, apparently because their stocking rate was twice that of the minimal land system in late summer, dry matter masses of the SB-O-T pastures in the year-round grazing system at the termination of grazing were lower than the SB-O-T pastures in the minimal land system. Over the season, in vitro digestibilities of forage in the SB-O-T pastures of the year-round grazing system were lower than those in the minimal land system (Figure 4). However, the digestibility of the TF-RC and SB-RC pastures grazed by cows in the year-round grazing system were greater than forage in the SB-O-T pastures in either system.

Figure 1. OM masses of grazed and ungrazed corn crop residues, stockpiled tall fescue-red clover and stockpiled smooth bromegrass-red clover forages over winter in years 1 and 2.

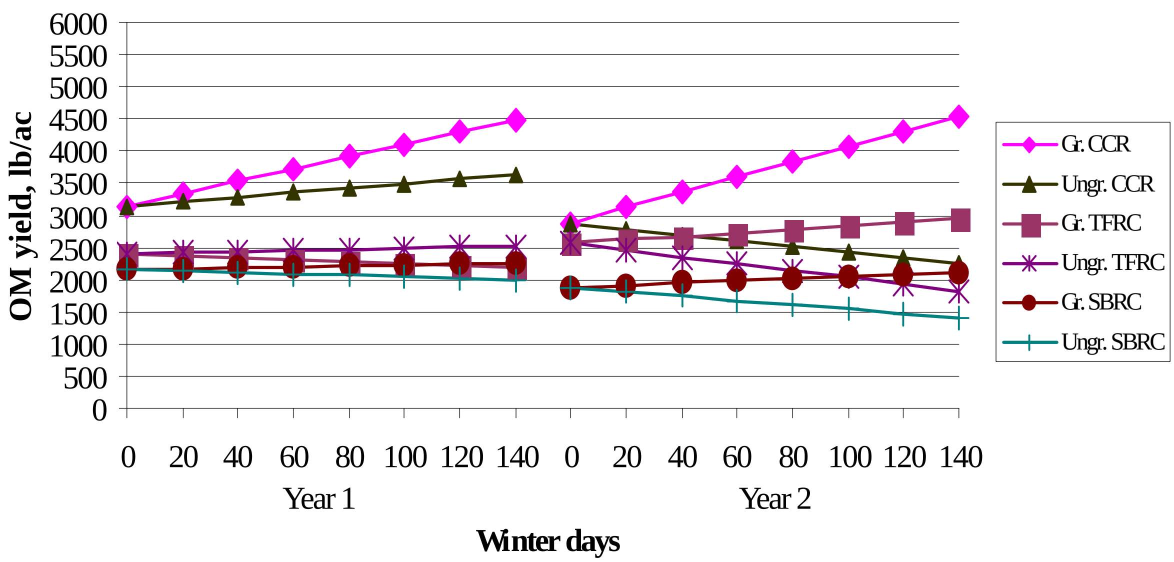


Figure 2. Concentrations of in vitro digestible OM of grazed and ungrazed corn crop residues, stockpiled tall fescue-red clover and stockpiled smooth bromegrass-red clover forages over winter in years 1 and 2.

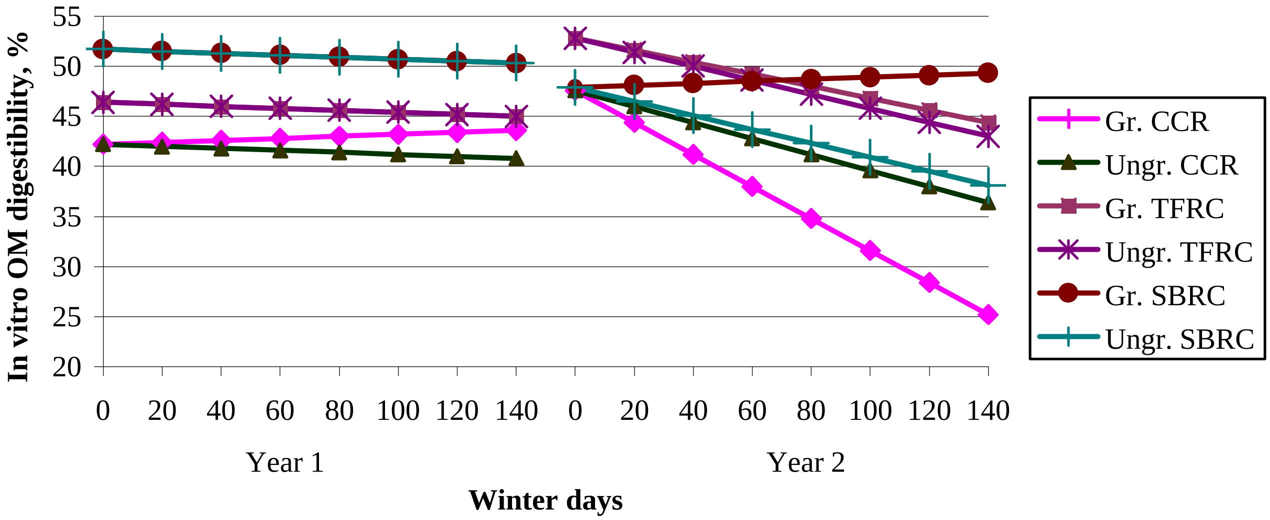


Figure 3. Forage dry matter masses of smooth bromegrass-orchardgrass-birdsfoot trefoil, tall fescue-red clover or smooth bromegrass-red clover pastures in the year-round grazing and minimal land systems.

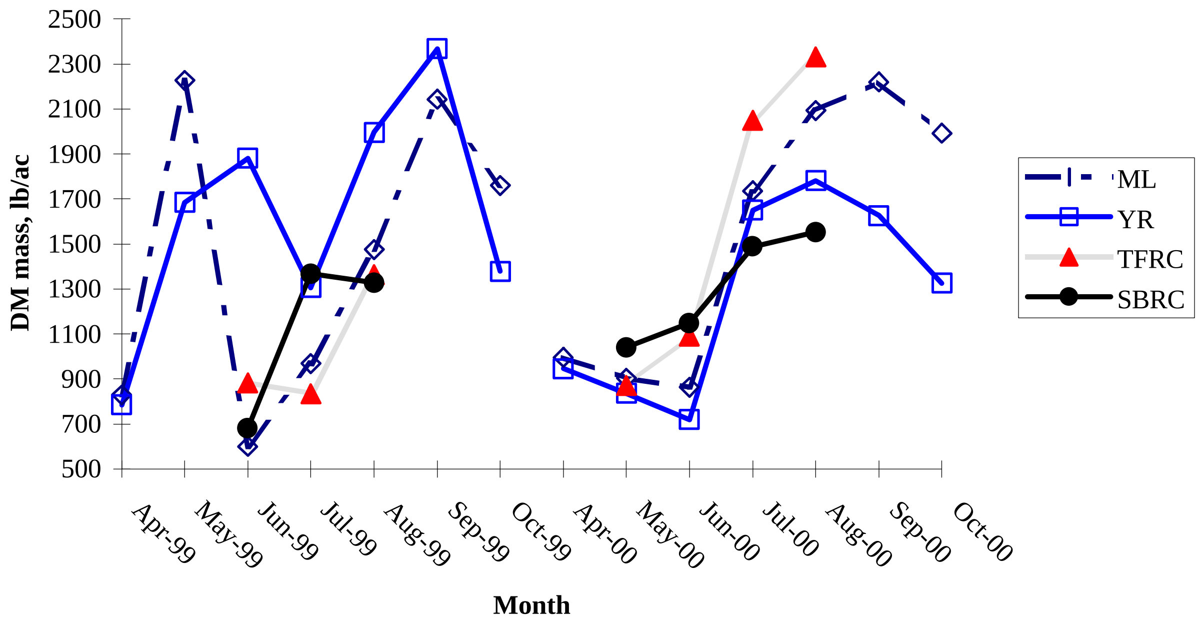
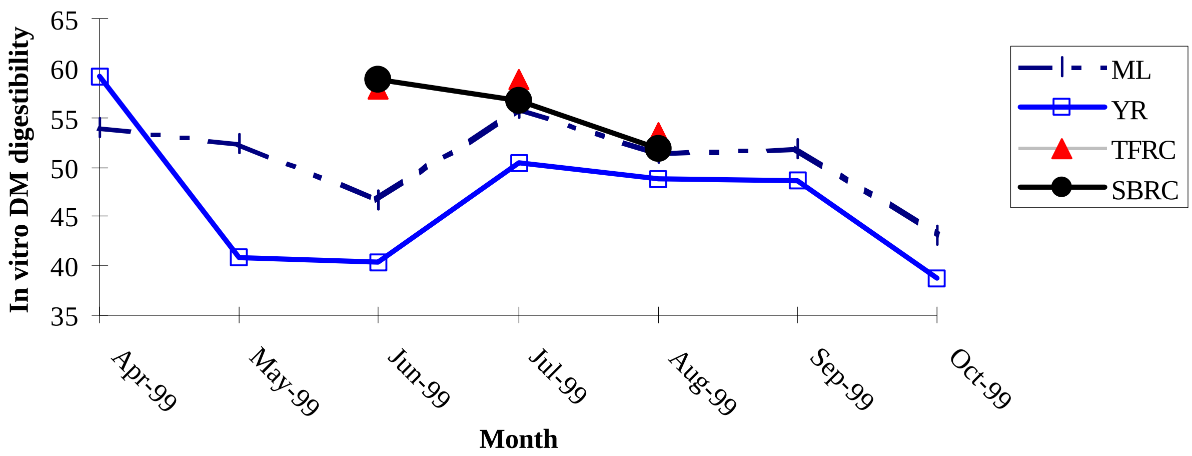


Figure 4. In vitro digestible dry matter concentration of smooth bromegrass-orchardgrass-birdsfoot trefoil, tall fescue-red clover or smooth bromegrass-red clover pastures in the year-round grazing and minimal land systems (1999).



Implications

When fall-calving cows are added to a year-round grazing system with spring-calving cows, a more economical source of stockers for summer pastures is added to the grazing system. In both winter grazing seasons, fall-calving cows and their calves were able to graze stockpiled pastures with little additional hay supplementation in year one and none in year two to maintain cow body condition scores until weaning compared with an average of 4,700 lb hay dry matter/cow required for cows maintained in a drylot. Whereas the previous season's spring calves are maintained through the entire winter, weaned fall calves are maintained for approximately 50 days before being turned out onto summer pastures; therefore, less stored feed is required for maintenance. When 60 and 75% of the 4.2 and 3.3 acres of perennial pasture allowed per cow are harvested as hay, there is approximately 1 ton of excess hay produced per cow-calf pair, and the yields and nutritional quality of forage in the summer pastures do not differ.

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