Cow-Calf Production from Alfalfa-Grass or Smooth Bromegrass Pastures Rotationally Grazed at Three Stocking Rates

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Summary

Pastures containing alfalfa-grass or smooth bromegrass were stocked with .6, .8, or 1.0 cow-calf units per acre to compare cow and calf production in rotational grazing systems managed for optimum forage quality. To remove excess forage early in the grazing season, yearling heifers or steers grazed with the cows in each pasture at a stocking rate of .6 ccu per acre for the first 28, 37, and 40 days of grazing in years one, two, and three. Live forage density and days of grazing per paddock were estimated by sward height. Cows, calves, and yearlings were weighed and cows condition scored every 28 days. All cows grazed for 140 days unless forage became limiting. The cows on the smooth bromegrass pasture stocked at 1.0 cow-calf units per acre were removed after 119 days in 1994, 129 days in 1995, and 125 days in 1996. Cows on one of the alfalfa-grass pastures stocked at 1.0 ccu per acre were removed after 136 days of grazing in 1996 because of lack of forage. Alfalfa-grass pastures tended to have a more consistent supply of forage over the grazing season than the bromegrass pastures. Cows grazing the alfalfa-grass pastures had greater seasonal weight gains and body condition score increases and lower yearling weight gains than the smooth bromegrass pastures. Daily and total calf weight gains and total animal production also tended to be greater in alfalfa-cool season grass pastures. Increasing stocking rates resulted in significantly lower cow body condition increases and yearling weight gains, and also increased the amounts of calf and total growing animal produced.

Introduction

Incorporating legumes into pastures may improve economic returns from grazing by decreasing the need for nitrogen fertilizer because legume species fix nitrogen into soil; legumes also have a high nutritive value , which may increase animal performance. Grazing by rotational stocking offers producers many benefits including improved plant persistence. Legumes are more sensitive to time and frequency of defoliation, therefore, rest periods incorporated in rotational stocking help maintain legumes in a forage stand. Improved forage quality and yield resulting from more timely use are other advantages. Rotational stocking can also increase animal production per acre by allowing higher stocking rates.

Even in a rotational grazing system, grazing at excessively high stocking rates may adversely affect individual animal weight gains, body condition, and reproductive performance. Furthermore, because of the rapid growth of cool-season forage species in mid spring, stocking rates that are excessive in mid to late summer are inadequate to optimize forage use during the spring. Consequently, some method of removing excess forage, such as hay harvest or lead-grazing with growing animals, is necessary to optimize forage utilization.

To effectively manage a rotational system, stocking rate and the grazing and rest times per paddock must interact to result in optimum production per acre without damaging the stand longevity of a given forage mixture. The objective of this project was to compare cow and calf production from grass and grass-legume pastures grazed at three stocking rates in a rotational system managed for optimum forage quality.

Materials and Methods

Pasture management

In April 1992, a 30-acre field was seeded with "WL hybrid 321" alfalfa and "Barton" smooth bromegrass at rates of 10 and eight pounds per acre with a nurse crop of oats. Two cuttings of hay were harvested from this field in 1992. Because of poor establishment, smooth bromegrass was frost-seeded into the alfalfa on March 1, 1993. However, establishment was again poor. On August 5, 1993, smooth bromegrass and orchardgrass were drilled into the alfalfa at seeding rates of eight and six pounds per acre. This seeding was successful. In the spring of 1994, the alfalfa-grass pasture was divided into six 5-acre pastures, each of which was divided into eight paddocks. A 20-acre smooth bromegrass pasture was divided into four 5-acre pastures that were also divided into eight paddocks. Smooth bromegrass pastures were fertilized each spring with 100 pounds of nitrogen.

Cow-calf management

On May 12, 1994; May 12, 1995; and May 10, 1996; 40 Angus X Simmental X Charolais cows with calves were allotted to pastures on the basis of cow weight and condition score to graze in a rotational system. Replicate pastures containing the alfalfa-grass mixture were stocked at .6, .8, and 1.0 cow-calf units (ccu) per acre. Two of the four pastures containing smooth bromegrass were stocked at .8

ccu per acre whereas the two remaining smooth bromegrass pastures were stocked at .6 or 1.0 ccu per acre in 1994 and 1995. In 1996, only three smooth bromegrass pastures were available so each stocking rate was assigned to one pasture. To remove excess forage growth early in the grazing season, yearling beef cattle were stocked in each pasture at a rate of .6 ccu/ac for the first 28, 37, and 40 days of grazing in 1994, 1995, and 1996, respectively. To remove the rapidly growing forage the first 28 days of the trial, animals grazing the smooth bromegrass were moved between paddocks daily. For the rest of the grazing season, cows in smooth bromegrass pastures were moved when 50% of the forage was removed as determined by a falling plane meter (8.8 lbs/yd^2). Because bloat may be a problem in cows that are rapidly rotated in alfalfa pastures, animals were moved when 33% of the forage was removed for the first 28 days of grazing and when 50% of the forage was removed thereafter. In excessively wet conditions, persistence of legume species such as alfalfa will be adversely affected even in a rotational grazing system. Therefore, one paddock in each of the alfalfa-grass pastures was designated as a sacrifice paddock for grazing when more than one inch of rain had fallen within a 24-hour period. Cows were returned to the grazing rotation after 24 hours with no precipitation. Sacrifice paddocks were grazed for 13, 5 ,and 14 days in 1994, 1995 and 1996 as a result of precipitation. Because grazing at a high stocking rate may reduce the length of the grazing season, it was decided to conclude grazing of individual pastures if sward height dropped below 5 cm (approximately 500 pounds of live dry matter per acre). Grazing the smooth bromegrass pasture at 1.0 ccu per acre ended on September 9 (119 days of grazing) in 1994, on September 18 (129 days of grazing) in 1995, and September 13 (126 days of grazing) in 1996. One alfalfa-grass pasture stocked at 1.0 ccu/ac was also removed from pasture September 23 (138 days of grazing) in 1996 because of lack of forage. Grazing of all other pastures continued for 140 days.

Water was available in each paddock of each pasture as well as from a central tank. Cattle had access to a trace mineral mixture.

Forage density, measured with a falling plane meter (8.8 lb/yd^2), was determined daily in six locations in each grazed paddock. Forage quantity and botanical composition were determined by hand-clipping a .25-square-meter area in 12 locations in each pasture every 28 days. The total amount of forage produced was determined by hand-clipping two .25-square-meter locations inside and outside an exclosure every 28 days. All hand-clipped samples were sorted as live grass, legume, or weed, or dead forage.

Cows and calves were weighed and cows condition scored (1=very thin, 5=moderate, 9=obese) at 28-day intervals. In 1994, cows were bred by artificial insemination 72 hours after a second injection of Lutalyse. Four days later, five bulls were placed in the pastures and rotated at 12-hour intervals among pastures for 30 days. In 1995 and 1996, cows were implanted with Syncromate, removed from pastures for five days after the implant was removed to observe estrus, and were artificially inseminated. Cows were then returned to pastures and five bulls were rotated at 12-hour intervals among pastures for 45 days.

Results and Discussion

Days of grazing were affected by species ($P = .04$), stocking rate ($P < .01$), and species x stocking rate ($P < .01$). Alfalfa-grass pastures and lower stocking rates provided more days of grazing, although neither the low nor intermediate stocking rates on either forage species were affected.

Sward heights were greater in bromegrass pastures than in alfalfa-grass pastures early in the grazing season. By July, however, alfalfa-grass pastures had higher sward heights and estimated live yield than the bromegrass pastures stocked at equal stocking rates. Pastures stocked at .6 ccu/ac had more available live forage than pastures stocked at .8 and 1.0 ccu/ac within each species throughout the grazing season. This result implies that although N-fertilized bromegrass may outyield alfalfa-cool season grass pastures in the early summer, the presence of alfalfa in the pasture extends forage yields later in the summer.

Total yields of live and digestible dry matter, however, did not differ between pastures containing N-fertilized smooth bromegrass or an alfalfa-grass mixture (Table 1). Similarly, the allowance of total, live and digestible dry matter per cow did not differ between N-fertilized bromegrass and alfalfa- grass pastures. The live forage in alfalfa-grass pastures was 2% more digestible than the forage from the N-fertilized smooth bromegrass pastures, however, there was no difference between the two species for in vitro digestibility (IVDDM) of total forage.

Increasing the stocking rate decreased both the yields and allowances of total, live and digestible dry matter. Stocking rate did not affect the concentration of digestible dry matter in either the total or live forage.

Neutral detergent fiber (NDF) and acid detergent fiber (ADF) concentrations in both live and total forage were greater in smooth bromegrass pastures; however, the rate of NDF or ADF accumulation over the grazing season was not affected by forage species or stocking rate (Table 2). Crude protein concentrations in the live and total forage were also greater from N-fertilized smooth bromegrass pastures. Live forage crude protein concentrations decreased over the grazing season for all treatments except the smooth bromegrass pasture with the high stocking rate which showed a slight increase in CP concentration. The alfalfa-grass pastures stocked at the intermediate level and the smooth bromegrass pasture at the low stocking rate showed the most rapid decline in crude protein concentrations in total available forage. In vitro digestibility (IVDDM) concentrations of live and total forage were not affected by species or stocking rate; however, the decrease in digestibility over the grazing season was more rapid in alfalfa-grass pastures than smooth bromegrass pastures. Increasing the stocking rate also tended to slow the decline in the digestibility of live forage.

Yearling average daily gain did not vary among years; however, production per hectare did vary (Table 3). There was a tendency for N-fertilized smooth bromegrass pastures to produce more kilograms of yearling per hectare. Yearlings grazed pastures early in the season when smooth bromegrass is more productive than alfalfa; therefore, forage may not have been as limiting a factor. Pastures stocked at the lowest rates also averaged 10 kg more yearling production than the highest stocked pastures although this difference was not significant. Average daily gain tended to increase with decreasing stocking rate ($P = .11$)

Growing animal production per acre increased with increasing stocking rate ($P < .05$; Table 3). Stocking rate also affected cow, calf, and yearling production per acre ($P = .13$) with the intermediate stocking rate producing the greatest amount, followed by the high and low stocking rates, respectively.

Forage species did not affect cow weight or body condition gains (Table 3). Cows stocked at the highest rates showed the least change in condition ($P < .10$) and also gained the least amount of weight ($P < .10$). This effect may have been greater if cattle were not removed from pastures when forage allowances became limiting. This implies that forage allowance was a limiting factor for cows at the high stocking rates, however, this did not seem to adversely affect reproductive performance. Forage dry matter intake was similar for cows on all treatments.

Implications

Although calf production did not differ between alfalfa-grass and N-fertilized smooth bromegrass pastures, cow weight and body condition tended to increase on alfalfa-grass pastures. This effect is probably caused by greater growth of the legume species later in the season. Production may be optimized by using a combination of cool-season grasses early in the grazing season and a legume-grass pasture in mid to late season. Increasing the stocking rate of rotationally grazed pastures can increase calf production per acre. It can also result in less available forage per cow, decreasing the weight gains of cows and length of the grazing season. Legume persistence may also be adversely affected.

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Table 1. Forage heights, yields, and allowances shown by month.

	Forage species (f) and stocking rate (s)						P>F[a]		
	AG			SBG					
Item & Month	1.48	1.98	2.47	1.48	1.98	2.47	fx mo	sx mo	fxsx mo
Sward height, cm							<.01	<.01	NS
May	16.8± .82	16.1± .82	15.5± .82	17.7±1.16	16.4±.92	16.1±1.16			
June	25.8±1.15	22.1±1.15	17.7±1.15	26.2±1.63	21.0±1.29	20.8±1.63			
July	20.1±1.16	16.6±1.44	14.2±1.16	22.0±1.64	17.2±1.29	17.7±1.64			
Aug.	17.3±.60	14.2±.60	10.2±.60	14.8±.85	10.8±.67	9.9±.85			
Sept.	12.2±.39	9.2±.39	5.2±.43	10.0±.55	6.1±.43	4.1±.55			
Total forage yield, kg/ha							<.01	<.01	.08
May	1935.5±195.75	1988.3±195.75	2381.8±195.75	2150.8±276.83	2272.0±218.85	1694.2±276.83			
June	3655.6±188.07	3060.4±188.07	2814.0±188.07	3692.9±265.97	3819.7±210.27	3377.8±265.97			
July	3588.3±244.54	2545.3±244.54	2393.2±244.54	3778.6±345.83	3270.5±273.40	3070.2±345.83			
Aug.	3544.0±146.10	3096.9±146.10	2395.2±146.10	3581.2±206.61	2568.3±163.34	2577.9±206.61			
Sept.	2546.9±144.73	1852.6±144.73	1075.9±144.73	2042.1±204.68	1647.6±161.81	1054.9±204.68			
Live forage yield, kg/ha							<.01	<.01	.02
May	1612.6±154.14	1712.7±154.14	1957.9±154.14	1897.2±217.99	2108.5±172.34	1181.7±217.99			
June	3210.8±163.21	2574.1±163.21	2394.4±163.21	3236.3±230.81	3235.5±182.47	2837.2±230.81			
July	2413.5±177.40	1566.0±177.40	1402.0±177.40	2553.3±345.83	1928.8±273.40	1467.5±345.83			
Aug.	1743.8±67.53	1399.7±67.53	967.0±67.53	1470.1±95.51	1079.0±75.50	820.2±95.51			
Sept.	1283.6±81.97	947.7±81.97	463.5±81.97	714.0±115.93	511.9±91.65	306.8±115.93			
Total forage allowance, kg/cow							<.01	<.01	.19
May	1307.8±102.30	1004.2±102.30	964.3±102.30	1453.2±144.67	1147.5±114.37	685.9±144.67			
June	2470.0±112.64	1545.6±112.64	1139.3±112.64	2495.2±159.30	1922.2±125.93	1367.5±159.30			
July	2424.5±139.97	1285.5±139.97	968.9±139.97	2553.1±197.95	1659.8±156.50	1243.0±197.95			
Aug.	2394.6±91.95	1564.1±91.95	969.7±91.95	2419.7±130.03	1297.1±102.80	1043.7±130.03			
Sept.	1720.9±99.84	935.6±99.84	435.6±99.84	1379.8±141.19	832.1±111.62	427.1±141.19			
Live forage allowance, kg/cow							<.01	<.01	.10
May	1089.6±89.80	865.0±89.80	792.7±89.80	1281.9±127.00	1064.9±100.40	478.4±127.00			
June	2169.5±100.41	1300.0±100.41	969.4±100.41	2186.7±142.01	1634.1±112.27	1148.7±142.01			
July	1630.8±113.81	790.9±113.81	567.6±113.81	1725.2±160.95	974.1±127.24	594.1±160.95			
Aug.	1178.2±44.00	706.9±44.00	391.5±44.00	993.3±62.23	545.0±49.20	332.1±62.23			
Sept.	867.3±55.03	478.7±55.03	187.6±55.03	482.4±77.82	258.5±61.52	124.2±77.82			

Table 2. Changes in cow, calf, and yearling weights, changes in cow body condition scores, and cow forage intake.

	Forage species (f) & stocking rate(s)							P > F[a]		
	AG			SBG						
	1.48	1.98	2.47	1.48	1.98	2.47	SEM[b]	f	s	f x s
Cow										
Weight change, kg	66	45	34	45	46	21	6.48	NS	<.01	NS
Condition score change	0.60	0.32	0.17	0.47	0.61	-0.03	.18	NS	.07	NS
DMI, % BW	2.49	2.51	2.78	3.37	2.83	2.53		NS	NS	NS
Days of grazing	140	140	139.3	140	140	124.7		<.01	<.01	<.01
Calf										
kg/day	1.15	1.22	1.12	1.14	1.16	1.09	.03	NS	.05	NS
kg/ha	237	336	385	237	320	335	8.81	.16	<.01	.06
Yearling										
kg/day	0.84	0.68	0.59	1.00	0.91	0.82	.90	.19	.11	NS
kg/ha	44	37	31	51	47	41	4.68	.13	NS	NS

[a]NS, no significance.

[b]SEM, forage x species.

Table 3. Monthly change in chemical composition of forage.

Item and forage component	Forage species (f) and stocking rate (s)									
	AG			SBG				P>F[a]		
	1.48	1.98	2.47	1.48	1.98	2.47	SEM[b]	f	s	fxs
	% units/month									
NDF										
Live	1.52	-0.30	1.27	0.93	0.18	0.77	.68	NS	.19	NS
Total	1.72	1.04	2.81	2.12	1.40	6.20	1.63	NS	.17	NS
ADF										
Live	0.93	0.08	-0.48	0.28	-0.49	-0.79	.46	.09	.07	NS
Total	1.81	0.67	1.02	1.28	0.70	0.59	.49	NS	.22	NS
IVDDM										
Live	-2.80	-1.51	-1.26	-1.69	-1.48	-0.98	.74	.03	NS	NS
Total	-5.58	-5.13	-5.02	-5.96	-6.90	-7.23	.81	.03	NS	NS
CP										
Live	-0.97	-1.53	-0.31	-1.47	-0.37	0.70	.36	.19	.01	.09
Total	-0.98	-1.63	-0.34	-1.49	-0.38	0.68	.37	.18	.01	.08

[a]NS, no significance.

[b]SEM, forage x stocking rate.