Sequential Grazing Systems for Beef Cattle Production

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Summary

A grazing study was conducted to evaluate the impact of legumes and warm-season grasses on season-long productivity of complementary grazing systems. Eight complementary and four continuous grazing systems were evaluated. Cool-season pastures used for the study consisted of smooth bromegrass alone or in mixture with birdsfoot trefoil, alfalfa, or kura clover. Warm-season pastures were monocultures of big bluestem or switchgrass. Pastures were established at the McNay Research Farm near Chariton, IA, over a two-year period starting in 1994. Grazing systems were designed on the basis of a fixed seasonal carrying capacity and pastures were stocked accordingly with growing cattle throughout the grazing period in 1997, 1998, and 1999. In 1997, animals that grazed warm-season pastures during the summer gained less weight than those that grazed cool-season pasture for the entire season, and there were no differences in total gains due to cool-season pasture species. Growing conditions in 1997 were cool and wet and therefore very conducive to growth of cool-season species. In 1998, animals grazing big bluestem pastures during summer performed as well or better than those remaining on cool-season pastures at a lower stocking rate. Birdsfoot trefoil and kura clover pastures produced higher gains regardless of which summer pasture was grazed. Results in 1999 were similar to those in 1998 except that birdsfoot trefoil pastures did not produce as well. Production from switchgrass pastures was improved in 1999 by removing initial spring growth as hay prior to the summer grazing period.

Introduction

Pasture productivity in Iowa is often limited by low productivity of cool-season grasses during summer. This uneven seasonal distribution of forage production could be improved by including species in pasture systems that perform better under higher temperatures. Warm-season grasses produce most of their growth during summer when cool-season grasses are semi-dormant. By using cool-season and warm-season pastures in a sequential system it should be possible to improve seasonal productivity.

The overall objective of this project is to evaluate the productivity of sequential grazing systems for beef cattle production on marginal land in southern Iowa. Specific objectives are to: 1) evaluate the impact of legumes on the productivity of cool-season pastures grazed in the spring and fall, 2) evaluate warm-season grasses for summer grazing, and 3) determine the effects of pasture sequence on the productivity of season-long grazing systems.

Materials and Methods

Eight sequential and four continuous grazing systems are being evaluated to determine the impacts of legumes and warm-season grasses on season-long productivity of grazing systems. Pastures were established at the McNay Research Farm (40^{o} 55' N, 93^{o} 20' W) near Chariton, IA, on a Grundy-Haig soil. Smooth bromegrass (*Bromus inermis* Leyss. cv. Bounty) was planted into twelve 3-acre pastures in early spring 1996. At the same time birdsfoot trefoil (*Lotus corniculatus* L. cv. Norcen), alfalfa (*Medicago sativa* L. cv. Alfagraze), and kura clover (*Trifolium ambiguum* Bieb. cv. Rhizo) were each planted into three of the pastures. All seeding was done into dead sod using a no-till drill. Seeding rates were 12 lb/acre for smooth bromegrass, 5 lb/acre for birdsfoot trefoil, and 8 lb/acre for alfalfa and kura clover. Pastures were blocked by soil characteristics such that each legume treatment and a control (N-fertilized) pasture occurs in each of three blocks. Big bluestem (*Andropogon gerardii* Vitman cv. Roundtree) and switchgrass (*Panicum virgatum* L. cv. Cave-in-Rock) were established into an adjacent set of six 4.5-acre pastures during the summer of 1994 using corn as a companion crop. Big bluestem was seeded at 8.0 lb/acre and switchgrass was seeded at 5.5 lb/acre, both with corn at a population of 15,000 plants/acre.

The grazing systems were designed on the basis of a fixed seasonal carrying capacity, and pastures were stocked with growing cattle (*Bos taurus*) throughout the 1997, 1998, and 1999 grazing seasons. Stocking densities for cool-season pastures were 2 animals per acre during spring and fall grazing seasons, and 0.7 animals per acre during the summer. Warm-season pastures were stocked with 1.8 animals per

Table 1. Dates and number of days cool- and warm-season pastures were grazed in 1997, 1998, and 1999.

Sequence	1997	1998	1999
Start	13-May	13-May	13-May
WS	10-Jul	24-Jun	8-Jul
CS	3-Sep	18-Aug	19-Aug
End	1-Oct	18-Sep	23-Sep
Total Days	141	128	133
CS	86	72	91
WS	55	56	42

acre. Animals were weighed at approximately 4-week intervals during the grazing period to determine performance achieved from each component of the system. Grazing of cool-season pastures began 13 May each year, and cattle were rotated to summer pastures based on grazing readiness of warm-season grasses. Two steers remained on cool-season pasture throughout the summer grazing period to serve as a control and to evaluate the effects of legumes on summer pasture productivity. At the end of the summer grazing period all cattle were returned to their original pasture for the remainder of the grazing season. Grazing was terminated each year when available forage became limiting. Dates of grazing cool and warm-season pastures are presented in Table 1. The grazing experiment will be continued through the 2001 grazing season.

Pastures were sampled biweekly during the grazing period each year. Available forage was determined by clipping the forage within six randomly assigned 2-ft^2 subplots, and subsamples were collected for forage quality analysis. Botanical composition of the grass-legume pastures will be determined using the constituent differential method. Forage will be analyzed for forage quality parameters including total nitrogen, fiber constituents and *in vitro* dry matter digestibility. Samples will be collected and analyzed using the same procedures in 2000 and 2001.

Data from the grazing experiment were analyzed using the statistical procedures for the multiple tester assignment technique. All tests of significance were made at the 0.10 probability level unless otherwise noted.

Results and Discussion

During the first year of grazing (1997) species composition of all cool-season pastures was very diverse and did not represent the desired binary grass-legume mixtures. Apparently, by disturbing the soil and suppressing grass competition a very diverse legume seed bank was activated. All of the cool-season pastures contained large numbers of legumes species in addition to the intended one. As a consequence, there were no differences in season-long animal performance due to the cool-season pasture grazed initially in the spring (Table 2). However, by the end of that grazing season and in subsequent years the sown legume species became more dominant in the pastures and exerted an effect in subsequent years. In 1998, systems containing kura clover and birdsfoot trefoil produced more total gain for systems in which warm-season grasses were included. However, pastures containing alfalfa produced as well those containing kura clover and birdsfoot trefoil for systems inwhich cool-season pastures were grazed all season. In 1999, systems containing kura clover produced more gain than those containing any other or no legume.

Table 2. Total, cool-season, and warm-season liveweight gains of cattle grazing various sequences of cool and warm-season pastures.

Initial Pasture[1]	Summer Pasture[2]	Total Gain			Cool-Season Gain			Warm-Season Gain		
		1997	1998	1999	1997	1998	1999	1997	1998	1999
			lb / animal							
SB	BB	241	209	194	139	143	126	102	66	68
SB	SG	247	177	222	167	140	141	80	37	81
SB	CS	283	202	227	204	116	144	79	86	83
SB+BT	BB	243	236	191	161	148	132	82	88	59
SB+BT	SG	226	190	195	147	135	134	79	55	61
SB+BT	CS	298	238	208	192	166	138	106	72	70
SB+KC	BB	275	258	215	179	176	162	96	82	53
SB+KC	SG	230	192	257	147	156	186	83	36	71
SB+KC	CS	281	243	256	169	169	164	112	74	92
SB+A	BB	236	192	209	156	124	163	80	68	46
SB+A	SG	241	177	223	156	112	157	85	65	66
SB+A	CS	291	238	226	183	159	168	108	79	58

[1] SB = smooth bromegrass, BT = birdsfoot trefoil, KC = kura clover, A = alfalfa.
[2] BB = big bluestem, SG = switchgrass, CS = cool-season pasture.

Table 3. Total, cool-season, and warm-season average daily gains of growing cattle grazing various sequences of cool and warm-season pastures.

Initial Pasture[1]	Summer Pasture[2]	Total Gain			Cool-Season Gain			Warm-Season Gain		
		1997	1998	1999	1997	1998	1999	1997	1998	1999
		lb / animal / day								
SB	BB	1.71	1.64	1.45	1.62	1.99	1.38	1.85	1.18	1.63
SB	SG	1.75	1.39	1.67	1.94	1.94	1.55	1.45	0.66	1.94
SB	CS	2.01	1.58	1.70	2.37	1.61	1.58	1.44	1.53	1.98
SB+BT	BB	1.72	1.85	1.43	1.87	2.06	1.45	1.49	1.57	1.40
SB+BT	SG	1.60	1.48	1.48	1.71	1.88	1.47	1.44	0.98	1.46
SB+BT	CS	2.11	1.86	1.57	2.23	2.31	1.52	1.93	1.29	1.67
SB+KC	BB	1.95	2.02	1.60	2.08	2.44	1.78	1.75	1.47	1.27
SB+KC	SG	1.63	1.50	1.92	1.71	2.17	2.04	1.51	0.65	1.68
SB+KC	CS	1.99	1.90	1.93	1.97	2.35	1.80	2.04	1.32	2.19
SB+A	BB	1.67	1.50	1.57	1.81	1.72	1.79	1.45	1.22	1.10
SB+A	SG	1.71	1.38	1.68	1.81	1.56	1.73	1.55	1.16	1.57
SB+A	CS	2.06	1.86	1.68	2.13	2.21	1.85	1.96	1.40	1.38

[1] SB = smooth bromegrass, BT = birdsfoot trefoil, KC = kura clover, A = alfalfa.
[2] BB = big bluestem, SG = switchgrass, CS = cool-season pasture.

There were large differences in total gain and seasonal average daily gain due to the summer pasture grazed (Tables 2 and 3). In 1997, those animals that grazed warm-season pastures during the summer gained less weight than those that grazed cool-season pasture for the entire season. Rates of gain for animals grazing warm-season pastures began to level off during the second half of the summer grazing period whereas animals grazing cool-season pasture continued to gain weight during this period. These differences continued into the final grazing period when all cattle were on cool-season pasture. It is not clear why animals that grazed warm-season pasture in the summer failed to recover when moved to cool-season pasture. Apparently, there were carry-over effects related to adaptation of their digestive system to the relatively low quality summer pastures. Growing conditions in 1997 were cool and wet and therefore very conducive to growth of cool-season species. In 1998, animals grazing big bluestem pastures during summer performed as well or better than those remaining on cool-season pastures at a lower stocking rate. Production from switchgrass pastures was improved in 1999 by removing initial spring growth as hay prior to the summer grazing period.

One of the more striking results of this experiment to date is the large impact that year has on performance of the various systems. Most of this variation is due to differences in temperature and precipitation between years. The productivity of the species included in the study has been variable with respect to prevailing climatic conditions with different combinations of species producing the highest gains in each of the three grazing seasons. This suggests that the stability of grazing systems over time might be improved by including a higher diversity of species.

Implications

Grazing systems using a combination of cool and warm-season pastures that are grazed sequentially can improve seasonal productivity. Including legumes in cool-season pastures, and particularly kura clover, enhances cool-season gain and, therefore, also improves seasonal productivity.

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