Evaluation of Hay-Type and Grazing Tolerant Alfalfa Hybrids in Season-Long or Complementary Rotational Stocking Systems for Beef Cows

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Summary

Pastures containing hay-type and grazing tolerant alfalfa hybrids were grazed in a season-long or complimentary rotational stocking system with N-fertilized smooth bromegrass. The pastures were stocked at a seasonal density of .8 cow-calf pairs per acre for 120 days. Pastures were intensively managed by daily strip-stocking with the assumptions that 50% of live forage was available and daily live dry matter consumption of each cow-calf pair was 3.5% of the cow's body weight. First-cutting forage was harvested as hay from 40% of pasture acres to remove excess forage growth early in the grazing season. Forage was grazed from the remaining 60% of each pasture for the first 44 days of the experiment and then from the entire pasture thereafter. Live forage yields, estimated by monthly clippings, were greater in May and September on the season-long alfalfa pastures compared with the complementary pastures and on the alfalfa pastures compared with the N-fertilized smooth bromegrass pastures. The proportions of legumes in the live dry matter in pastures with grazing tolerant and hay-type alfalfas in the season-long grazing systems declined by 70% and 50%, respectively, in the 120 day trial. The proportions of legumes in the live dry matter in pastures with grazing tolerant and the hay-type alfalfas in the complementary grazing system declined 60% and 42%, respectively, in the 120 day trial. Cows grazing either alfalfa hybrid by either management system had greater weight gains during the breeding and grazing seasons and greater increases in body condition score pre-breeding and during the breeding season than the cows that grazed N-fertilized smooth bromegrass for the entire season. Also, cows grazing either alfalfa in the season-long system had greater breeding season increases in body condition score than cows grazing alfalfa in the complementary system with N-fertilized smooth bromegrass. Daily gains and seasonal gains of calves from cows grazing the alfalfa pastures tended to be greater than those grazing N-fertilized smooth bromegrass. Within alfalfa treatments, calves of cows grazing alfalfa pastures in the season-long system tended to produce more pounds per acre than those of cows grazing alfalfa in the complementary systems.

Introduction

Because of its ability to fix nitrogen and, thereby, reduce needs for nitrogen fertilizers and the productivity and nutritional quality of its forage, incorporation of alfalfa into cool season grass pastures seems advantageous. However, problems with bloat and poor plant persistence has limited the use of alfalfa in pastures.

In a previous experiment, we found that calf production was nearly 15% greater in the alfalfa-grass pastures that were rotationally stocked at 1 cow-calf unit per acre for a 140 day grazing season than smooth bromegrass pastures fertilized with 100 pounds nitrogen per acre. However, daily seasonal gains of yearlings that grazed with the cows for the first 28 to 42 days of the grazing season were 25 to 33% greater from N-fertilized smooth bromegrass pastures than from the alfalfa-grass pastures. These results imply that greater animal production may result from grazing N-fertilized smooth bromegrass early in the grazing season and an alfalfa-grass mixture in mid- to late-season when productivity of the cool season grass is reduced. Furthermore, because problems with alfalfa persistence seem to result from grazing under muddy conditions, limiting the use to alfalfa to only mid- and late-season might reduce persistence problems.

The objective of this project was to determine cow-calf productivity, forage productivity, and legume persistence of alfalfa-grass pastures stocked by either season-long or complementary rotational systems.

Materials and Methods

In the spring of 1997, 50-acres of cropland at the Iowa State University Beef Nutrition Research Center were divided into ten 5-acre fields. Soils were tested and fertilized with lime, P, and K, according to recommendations. Replicate fields were seeded with 'Barton' smooth bromegrass over the entire 5 acres (season-long smooth bromegrass treatment), a mixture of 'Barton' smooth bromegrass and 'Affinity' alfalfa over the entire 5 acres (season-long hay-type alfalfa treatment), a mixture of 'Barton' smooth bromegrass and 'Amerigraze' alfalfa over the entire 5 acres (season-long grazing tolerant alfalfa treatment), 'Barton' smooth bromegrass over 3 acres and a mixture of 'Barton' smooth bromegrass and 'Affinity' alfalfa over 2 acres (complementary hay-type alfalfa treatment), and 'Barton' smooth bromegrass over 3 acres and a mixture of 'Barton' smooth bromegrass and 'Amerigraze' alfalfa over 2 acres (complementary grazing tolerant alfalfa treatment).

In May 1998, each smooth bromegrass pasture was fertilized with 100 pounds nitrogen per acre. Pastures were divided into 10 paddocks with a lane. Three waters were available in each pasture.

On May 18, 1998, four Simmental x Angus x Charolais cows (1 primiparous and 3 multiparous) with calves were allotted at a stocking rate of .8 cow-calf pairs per acre to each pasture based on cow weight, condition score, and age and calf sex. Cows grazing the smooth bromegrass pastures received a mineral supplement with a high magnesium concentration while those grazing alfalfa received a mineral supplement containing poloxalene to prevent bloat.

For the first 44 days of grazing, the 60% of each pasture nearest the water hydrant were rotationally strip-stocked to control bloat and forage maturity. In pastures with the complementary treatments, this area of the pastures was planted in smooth bromegrass. Daily allowance of strip-grazed forage was calculated assuming that a cow-calf pair consumes 3.5% of the cow's initial body weight per day as live forage as estimated with a sward stick at a harvest efficiency of 50%. First harvest forage from the remaining 40% of each pasture was mowed on June 1 and removed on June 16. These paddocks were incorporated into the grazing system after a minimal regrowth period of 33 days post-mowing and each total pasture was grazed for 120 days. However, grazing would have been terminated in any pasture if the average pasture sward height would have been less than 5 cm.

Cows were time-bred by artificial insemination on June 23 following estrus synchronization with prostaglandin. Five bulls were placed in pastures and rotated every 12 hours for the following 42 days.

Live forage mass was estimated from forage sward heights using a falling plane meter (8.8 pounds per square yard). Available forage mass in areas of the fields that were only grazed or sequentially harvested and grazed were determined by hand-clipping twelve and eight .25 square meter locations, respectively. Clipped forage samples were hand-sorted into dead forage and live grass, legume, and broadleaf weed species. Each fraction was weighed, dried, and ground. A composite of live forage was prepared from the grass, legume, and broadleaf weed fractions for chemical analysis. Cows and calves were weighed and cows were conditioned scored (1=very thin, 5=moderate, 9=obese) monthly.

Results and Discussion

Total (Figure 1) and live (Figure 2) forage masses were greater ($p<.05$) from the alfalfa pastures in May and September compared with the N-fertilized smooth bromegrass pastures and in the pastures containing the season-long hay-type or grazing tolerant alfalfa systems compared with pastures containing the complementary hay-type or grazing tolerant alfalfa systems. In June, July, and August, there were no differences in total and live forage masses of pastures with either species or grazing system. The high forage yields in all pastures in May implies that earlier initiation of grazing may have better utilized the early spring growth.

There were no differences in mean forage sward heights (Figure 3) of pastures with either species or grazing system as cows were moved into the pastures for the grazing trial. In May, June, and August, there were no differences in the sward height of pastures of either species or grazing systems as cows were moved off the pastures. However, in July and September, the hay-type and grazing tolerant alfalfa treatments under both grazing systems had greater ($p<.05$) off sward heights than the season-long N-fertilized smooth bromegrass pastures. In September, the season-long alfalfa treatments had greater ($p<.05$) off sward heights than the complementary alfalfa pastures. Sward heights of forages as animals were removed from the pastures imply that the assumption that cow-calf pairs consumed 3.5% of the cow's weight for the calculated length of rotation did remove approximately 50% of the forage. Using the measurement of sward heights as animals entered and were moved from paddocks showed that an average of 43% of initial forage remained when animals were removed from pastures.

As designed, the proportions of legumes in the paddocks of the season-long alfalfa pastures (Table 1) that were only grazed were higher ($p<.05$) than those containing smooth bromegrass in either the season-long or complementary systems at the initiation of grazing. Although the proportion of legumes in the season-long alfalfa pastures decreased over the grazing season, the proportion of legumes in the paddocks of the season-long alfalfa pastures that were only grazed were still higher ($p<.05$) than those containing smooth bromegrass at the end of the grazing season. Similar to those paddocks that were only grazed, the proportion of alfalfa in those paddocks that had been harvested for hay (Table 2) was higher than those containing smooth bromegrass at the beginning of the season. The paddocks containing hay-type alfalfa that had been harvested for hay had a greater ($p<.05$) proportion of alfalfa than the grazing tolerant alfalfa paddocks that had been harvested for hay, in June and July (Table 2). Also, in the months of June and July, the hay-type and grazing tolerant alfalfa season-long alfalfa paddocks had a greater proportion ($p<.05$) of alfalfa compared to the hay-type and grazing tolerant complementary alfalfa paddocks all of which had been harvested for hay. The proportion of alfalfa in the hayed paddocks at the end of the grazing season for the hay-type and grazing tolerant alfalfa was 46% and 31%, respectively. These proportions are higher than the proportions of alfalfa found in the paddocks that had only been grazed. These values were 37% and 19% in the hay-type and grazing tolerant alfalfa, respectively.

There were no significant differences between treatments in the first cutting hay yields taken from the mid-season paddocks (Table 3) or in the average number of days of grazing per paddock (Table 4). The length of grazing in each paddock tended to decline as the grazing season progressed.

The cows grazing the hay-type or grazing tolerant alfalfa pastures under either grazing system had higher breeding and seasonal weight gains ($p<.05$) compared to the cows grazing N-fertilized smooth bromegrass season-long (Table 5). The cows grazing the hay-type alfalfa had higher breeding weight gains ($p<.10$) than the cows grazing the grazing tolerant alfalfa pastures under either management system. The cows grazing the hay-type or grazing tolerant season-long alfalfa pastures had higher breeding ($p<.10$) and seasonal ($p<.05$) weight gains than the cows grazing the complementary alfalfa pastures.

The cows grazing the hay-type and grazing tolerant alfalfa pastures under either management system had higher prebreeding and breeding condition score increases ($p<.05$) compared to the cows grazing the season-long N-fertilized smooth bromegrass. The cows grazing the grazing tolerant alfalfa had higher prebreeding condition score increases ($p<.10$) compared to the cows grazing the hay-type alfalfa under either management system. The cows grazing the hay-type and grazing tolerant season-long alfalfa pastures had lower prebreeding condition score increases ($p<.10$) but higher breeding condition score increases ($p<.10$) compared to the cows grazing under the complementary grazing system.

There were no significant differences in the rebreeding efficiencies and the calving interval days of the cows.

The calves grazing the hay-type and grazing tolerant alfalfa under both management systems tended to produce higher daily and seasonal gains. These differences were not significant though. The calves grazing the season-long hay-type or grazing tolerant alfalfa pastures tended to produce higher daily and seasonal gains even though these differences were not significant. Total animal production was higher ($p<.05$) on all alfalfa pastures compared to season-long N-fertilized smooth bromegrass pastures. Total animal production was also higher ($p<.10$) on the season-long alfalfa pastures than the complementary hay-type or grazing tolerant alfalfa pastures.

Implications

The incorporation of alfalfa into smooth bromegrass pastures resulted in more total production from the cows and calves, higher seasonal weight changes in the cows, and higher prebreeding and breeding condition scores. Compared to the 'Affinity', the hay-type alfalfa, the grazing tolerant alfalfa, 'Amerigraze', resulted in lower cow breeding weights, higher prebreeding condition scores, and a lower legume percentage in the live dry matter in June and July of the mid-season paddocks. Furthermore, compared to the season-long grazing of alfalfa, the complementary grazing of alfalfa resulted in lower animal production from the cows and calves, lower seasonal weight changes in the cows, lower breeding weights, and a higher legume percentage in the live dry matter at grazing termination.

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Figure 1. Monthly total forage mass from alfalfa/smooth bromegrass and smooth bromegrass pastures under different grazing management conditions.

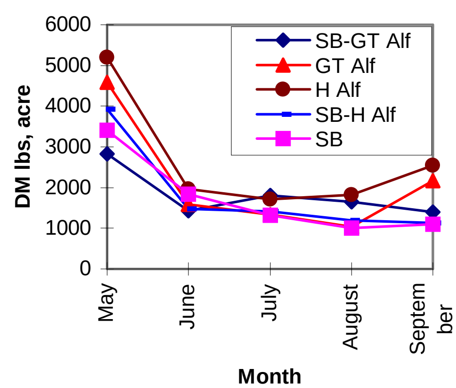

Figure 2. Monthly live forage mass from alfalfa/smooth bromegrass and smooth bromegrass pastures under different grazing management conditions.

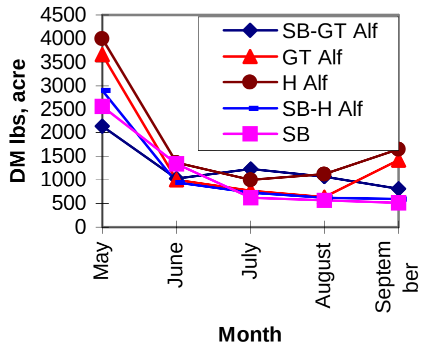

Figure 3. Sward heights prior to and after paddock grazing of alfalfa/smooth bromegrass and smooth bromegrass pastures under different grazing management conditions.

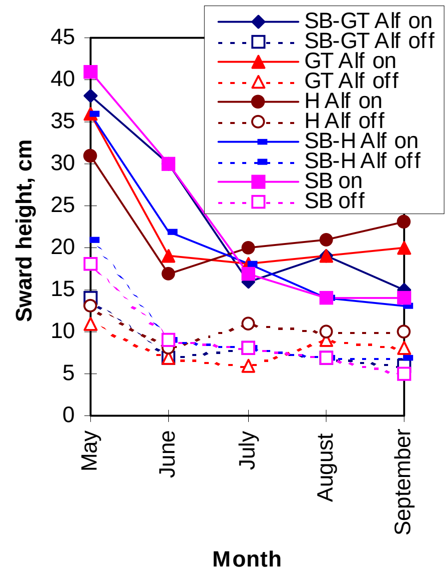

Table 1. Legume percentage of live dry matter in full-season paddocks of alfalfa/smooth bromegrass and smooth bromegrass.

	Forage species (f), alfalfa type (a), and grazing management (g)							
	Smooth	Grazing Tolerant Alfalfa		Hay-Type Alfalfa		Significance[a]		
Month	Bromegrass	Season	Comp	Season	Comp	f	a	g
May	0%	80%	4%	87%	1%	*	NS	*
June	0%	76%	1%	74%	3%	*	NS	*
July	0%	55%	3%	69%	2%	*	NS	*
August	0%	38%	3%	45%	1%	*	NS	*
September	0%	19%	1%	37%	0%	*	NS	*

[a]Significance:*, p<.05.

Table 2. Legume percentage of live dry matter in mid-season paddocks of alfalfa/smooth bromegrass and smooth bromegrass.

	Forage species (f), alfalfa type (a), and grazing management (g)							
	Smooth	Grazing Tolerant Alfalfa		Hay-Type Alfalfa		Significance[a]		
Month	Bromegrass	Season	Comp	Season	Comp	f	a	g
May	6%	78%	85%	90%	83%	*	NS	NS
June	0%	100%	78%	100%	100%	*	*	*
July	0%	87%	60%	83%	88%	*	*	*
August	0%	54%	35%	53%	57%	*	NS	NS
September	0%	28%	34%	43%	48%	*	NS	NS

[a]Significance:*, p<.05.

Table 3. First cutting hay yields from mid-season paddocks in alfalfa/smooth bromegrass and smooth bromegrass pastures[a].

	Smooth Bromegrass	Grazing Tolerant Alfalfa		Hay-Type Alfalfa	
Yield		Season	Comp	Season	Comp
DM lbs/acre	2297	2392	1073	2010	2423

[a]No significant differences between treatments were observed.

Table 4. Average days of grazing per paddock in alfalfa/smooth bromegrass and smooth bromegrass pastures[a].

	Smooth Bromegrass	Grazing Tolerant Alfalfa		Hay-Type Alfalfa	
Month		Season	Comp	Season	Comp
May	5.1	3.8	4.4	3.3	4.0
June	3.5	2.4	4.4	2.3	2.8
July	2.0	2.1	1.9	2.6	2.2
August	1.6	2.3	2.6	2.6	1.9
September	2.0	2.8	1.9	3.1	1.8
Average	2.8	2.7	3.0	2.8	2.5

[a]No significant differences between treatments were observed.

Table 5. Cow weight, condition score, rebreeding efficiency, and calf production from alfalfa/smooth smooth bromegrass pastures and smooth bromegrass pastures.

	Forage species (f), alfalfa type (a), and grazing management (g)							
	Smooth Bromegrass	Grazing Tolerant Alfalfa		Hay-Type Alfalfa		Significance[a]		
Item		Season	Comp	Season	Comp	f	a	g
Cow weight, lb								
Initial	1397	1322	1377	1305	1338	NS	NS	NS
Change	-71	6	-69	43	-46	**	NS	**
Prebreeding	-38	-11	-12	-9	-23	NS	NS	NS
Breeding	1	35	-27	63	34	**	*	*
Postbreeding	-34	-18	-30	-11	-57	NS	NS	NS
Condition Score								
Initial	5.4	5.1	5.1	5.1	5.2	NS	NS	NS
Change	-0.3	0.2	0.0	0.0	-0.3	NS	NS	NS
Prebreeding	-0.2	0.0	0.2	-0.1	0.0	**	*	*
Breeding	0.0	0.3	-0.3	0.4	0.0	**	NS	*
Postbreeding	-0.1	-0.1	0.1	-0.3	-0.3	NS	NS	NS
Rebreeding efficiency, %	63	88	100	88	100	NS	NS	NS
Calving interval, days	371	363	361	376	364	NS	NS	NS
Calf weight change								
lb/day	2.35	2.56	2.45	2.75	2.54	NS	NS	NS
lb/acre	225.6	245.6	235.6	264.2	243.8	NS	NS	NS
Total animal production								
lb/acre[b]	155.1	251.6	167.1	306.9	198.1	**	NS	*

[a]Significance:**,p<.05;*,p<.10.

[b]Cow and calf.