Grazing Management: Strategies to Improve Animal Performance and Nutrient Cycling on Pensacola Bahiagrass Pastures

R. Lawton Stewart Jr., Jose C.B. Dubeux Jr., and Lynn E. Sollenberger
Agronomy Department
University of Florida
Gainesville, Florida

Introduction

Bahiagrass (*Paspalum notatum* Flügge) is an important resource to the beef cattle industry in Florida. It is the most widely planted grass in the state, covering approximately 2.5 million acres. Of this area, 90% is grazed by beef cattle. Nitrogen is generally the most limiting nutrient for bahiagrass growth, and research has shown a potentially large increase in yield and forage crude protein with increasing nitrogen fertilizer rate. Thus, there is potential to achieve greater livestock production on bahiagrass by increasing nitrogen fertilization rate.

Stocking method plays an important role in grazing systems. Because of its grazing tolerance and to minimize cost of production, most bahiagrass pastures in Florida are continuously grazed during the summer grazing season. Rotational grazing generally allows for a higher stocking rate and higher gains per unit land area, so potential exists to increase livestock production per acre on bahiagrass pastures by using rotational grazing.

Stocking rate is the number of animals per acre over an extended period of time. Stocking rate is generally considered to be the most important grazing management decision because it has a major impact on both forage production and performance of grazing animals. Increasing stocking rate often decreases individual animal production but increases animal production per acre up to a point, after which both production per animal and per acre decrease. Thus, stocking rate is a powerful tool influencing production of a pasture.

A large proportion of the nutrients consumed by grazing animals are returned to the pasture in excreta, however, distribution of excreta on the pasture is not uniform. Nutrient return tends to be concentrated in small areas that contain more nutrients than needed by plants, thus, losses to the environment may occur. Understanding the effect of pasture management on animal behavior and excreta distribution has potential to increase uniformity of nutrients in pasture soils, reduce nutrient losses, and increase fertilizer efficiency. This may lead not only to higher profitability of beef cattle production systems but also less environmental contamination.

The objective of this research was to evaluate animal performance, animal grazing behavior, pasture characteristics, and nutrient dynamics and cycling on grazed Pensacola bahiagrass managed at different intensities (defined by stocking rate, nitrogen fertilizer rate, and stocking method).

Methods

Two grazing experiments were performed at the Beef Research Unit, northeast of Gainesville, FL, on Pensacola bahiagrass pastures. The first experiment evaluated animal performance, forage response, and changes in soil nutrient concentrations of continuously stocked bahiagrass pastures. The treatments were combinations of stocking rate and nitrogen fertilizer rate and represented a wide range of management intensity. The treatments were LOW management (36 lb of nitrogen/acre/year with a stocking rate of 0.5 animal units/acre [AU, one AU = 1,100 lb live weight]), MODERATE (108 lb of nitrogen/acre/year and 1.0 AU/acre stocking rate), and HIGH (324 lb nitrogen/acre/year and 1.5 AU/acre stocking rate). Each treatment was replicated twice. Average daily gain of yearling crossbred beef heifers and weight gain per unit land area were measured, as were forage nutritive value, forage on offer, forage production, and changes in soil nutrient concentrations.

The second experiment evaluated forage responses to four rotational grazing and one continuous grazing treatment (HIGH treatment from Experiment 1) on bahiagrass pasture. The rotational grazing treatments all had a 21-day rest period between grazings, but they differed in number of pasture subunits (paddocks) and length of the grazing period on a given pasture subunit. Treatments had grazing periods of 21, 7, 3, and 1 day(s) per paddock on systems that included 2, 4, 8, and 22 paddocks, respectively. Each treatment was replicated twice. The nitrogen fertilizer rate and stocking rate of the HIGH management intensity treatment from Experiment 1 was imposed on all paddocks in Experiment 2. Cattle performance was not measured in this experiment and the focus was on forage responses and nutrient management and recycling. Forage responses measured included nutritive value, herbage mass, herbage accumulation, and changes in soil nutrient concentrations.

For both experiments, water, artificial shade (shade cloth), and mineral salt were provided. To mimic producer practice, these locations were not altered throughout the course of the experiment. In each pasture (Experiment 1) or pasture subunit (Experiment 2), three zones were defined based on their distance from shade and water. Zones were 0-25 feet, 25-50 feet, and greater than 50 feet from shade and water. Changes in soil nutrient concentration were measured by sampling soil in each of these zones before and immediately after each grazing season.

Preliminary Results

In Experiment 1, heifer average daily gain was greater for the LOW and MODERATE treatments than for HIGH (Table 1). This occurred mainly because the HIGH pastures had less forage per acre on average than LOW (Table 2) and less forage per animal than either MODERATE or LOW (Table 3). Management intensity also had an effect on the forage “in vitro” organic matter digestibility (IVOMD) and crude protein (CP). Both IVOMD and CP increased (Tables 4 and 5) as management intensity increased from LOW to HIGH. Animal gain per acre also increased with increasing management intensity, and was highest for HIGH and lowest for LOW (Table 6). The difference in stocking rate was the major factor causing animal gain per acre to be different among treatments. Cost of added nitrogen fertilizer per lb of additional animal gain over the LOW treatment was $0.25 for MODERATE and $0.55 for HIGH. These data suggest that intensification of grazed bahiagrass pasture management beyond the MODERATE level used in this experiment is unlikely to be economical.

In Experiment 2, the rotationally grazed treatments produced more forage per day than the continuously grazed High treatment (Table 7). In 2002, for example, growth rates for all of the rotational treatments were similar, but all of them had greater growth rates than the continuously stocked treatment. These findings support the idea that stocking method also affects the forage response. The rest period provided by the rotational treatments (21 days) probably had a major effect, allowing the bahiagrass to achieve a higher leaf area and to produce more growth than the pastures that were continuously defoliated.

The treatments imposed also had an effect on the soil nutrient concentrations, although the major effects are probably going to be noted by the end of a third year of research in October 2003. In Table 8, the results are shown for soil magnesium concentration. For pastures grazed rotationally with 1- or 3-day grazing periods per paddock (rapid rotations), nutrient concentrations in all three zones were nearly the same. For the 7-day and 21-day treatments as well as continuous stocking (HIGH), nutrients accumulated in areas of the pasture nearest to shade and water (Zones 1 and 2). The 21-day treatment also had the highest soil nitrate concentration (4.75 parts per million) in Zone 1.

Summary

The main findings of this project are:

1. Increasing management intensity of bahiagrass pastures can increase weight gain per acre, but the increase is not likely to be economical for HIGH levels of management intensity (high nitrogen rates and stocking rates).

2. Bahiagrass pastures produce more forage under rotational than continuous grazing suggesting that rotationally grazed pastures could carry more animals than continuously grazed pastures at the same fertilization rate.

3. Soil nutrient concentrations appear to be more uniform in rotationally than continuously grazed pastures and in rotationally grazed pastures if cattle graze each pasture subdivision for a short (1-3 days) rather than a longer (7-21 days) time. This suggests that grazing method may be a useful tool for avoiding some loss of nutrients to the environment.

Table 1. Average daily gain of beef heifers grazing Pensacola bahiagrass pastures managed at three intensities.

Treatment	Grazing season		Average
	2001	2002	
	----------lb/day----------		
LOW	1.08	0.93	0.99 a
MODERATE	1.10	0.84	0.97 a
HIGH	0.84	0.75	0.79 b

Table 2. Average forage on offer for Pensacola bahiagrass pastures managed at three intensities.

Treatment	Grazing season		Average
	2001	2002	
	----------lb/acre----------		
LOW	2,960	2,620	2,800 a
MODERATE	2,580	2,150	2,370 b
HIGH	2,530	2,290	2,410 b

Table 3. Forage per animal for Pensacola bahiagrass pastures managed at three intensities.

Treatment	Grazing season 2001	Grazing season 2002	Average
	lb forage/lb of animal liveweight		
LOW	4.46	4.02	4.24 a
MODERATE	1.99	1.68	1.84 b
HIGH	1.03	1.21	1.12 b

Table 4. In vitro organic matter digestibility (IVOMD) of Pensacola bahiagrass managed at three intensities.

Treatment	Grazing season 2001	Grazing season 2002	Mean
	%		
LOW	42.6	47.8	45.2 a
MODERATE	44.5	49.9	47.1 b
HIGH	45.3	53.6	49.3 c

Table 5. Crude protein concentration of Pensacola bahiagrass managed at three intensities.

Treatment	Grazing season 2001	Grazing season 2002
	%	
LOW	8.8 c	10.6 b
MODERATE	10.8 b	11.2 b
HIGH	12.5 a	14.1 a

Table 6. Beef cattle live weight gain per acre on Pensacola bahiagrass pastures managed at three intensities.

Treatment	Grazing season 2001	Grazing season 2002	Mean
	lb/acre		
LOW	98	125	112 a
MODERATE	205	223	214 b
HIGH	232	304	268 b

Table 7. Forage growth rate on Pensacola bahiagrass pastures under different grazing management treatments.

Treatment	Grazing season	
	2001	2002
	------------------------------------ lb/acre/day ------------------------------------	
Rotational - 1 day	49 ab	56 a
Rotational - 3 days	40 bc	71 a
Rotational - 7 days	63 a	61 a
Rotational - 21 days	60 a	64 a
Continuous - HIGH	30 c	39 b

Table 8. Soil magnesium concentration on Pensacola bahiagrass pastures under different grazing management treatments.

Treatment	Zones		
	1	2	3
	------------------------------------ parts/million ------------------------------------		
Rotational - 1 day	79 a	84 a	75 a
Rotational - 3 days	88 a	76 a	83 a
Rotational - 7 days	80 a	64 a	44 b
Rotational - 21 days	130 a	97 b	88 b
Continuous - HIGH	97 a	91 a	81 a

Notes: