Effects of Forage Sampling Method on Nutritive Value of Bahiagrass During the Summer and Fall

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This study suggests that when given the opportunity, cattle will selectively graze bahiagrass forage with greater nutritive value than hand-collected forage during the summer and fall.

Summary

A six-mon trial was conducted from June to November 2007 to evaluate the differences between forage and masticate samples of bahiagrass pastures at four research stations across Florida (Ona, Brooksville, Santa Fe, and Marianna) during the summer and fall. Eight ruminally cannulated steers were used for collection of masticate samples. Forage samples were collected by cutting the grass within a 0.8-ft^2 quadrat to approximately 1-in from the soil surface. High and low forage availabilities were designated to represent differences in forage quantities at each location. Forage mass, in vitro digestible organic matter, and crude protein concentrations were determined for each sample type. There were differences in forage mass, digestible organic matter, and crude protein between locations, as well as the state mean. The selection indices for digestible organic matter at the four locations were similar in value with a mean selection index of 19% for all locations. However, the selection indices for crude protein were much more varied by location ranging from -11 to 47%. For most summer and fall months, steers were able to select a diet that was greater in digestibility and crude protein in comparison to hand-collected forage samples.

Introduction

Florida pastures are comprised primarily of tropical and subtropical grasses, which are typically high yielding, but low in quality. Bahiagrass (*Paspalum notatum)* is the most commonly utilized forage in pasture grazing systems in Florida occupying approximately 2.5 million ac (Chambliss and Sollenberger, 1991), but also extends into the Gulf Coast Region. Currently, there is little published data dedicated to classifying subtropical forages on a year-round basis, whether by hand-sampling or collection of masticate samples, with even less data devoted to studying diet selection by cattle grazing subtropical pastures.

Previous research has shown an inverse relationship between maturity and quality of grasses during the summer months (Connor et al., 1963), while other studies have shown that when adequate forage is available for grazing, ruminants will selectively graze within those situations (Weir and Torell, 1959; Schlegel et al., 2000). When attempting to represent the diet of a grazing animal, research has illustrated how hand-collected forage samples are inaccurate in their estimations of selected material (Coleman and Barth, 1973; Russell et al., 2004). The objective of this study was to characterize the nutritive value of bahiagrass from four locations across the state of Florida during the summer and fall comparing sampling techniques, either by hand-sampling or collection of masticate sample, within pastures of varying levels of forage availability (FA) with the ultimate goal of better predicting available forage nutritive value and subsequent supplementation needs to meet Florida grazing cattle nutritional requirements.

Materials and Methods

Four locations were utilized for this project to represent the variation in the Florida pasture landscape, the locations included: Range Cattle Research and Education Center, Ona; USDA-Subtropical Agricultural Research Station, Brooksville; Santa Fe River Ranch Beef Unit, Alachua; and North Florida Research and Education Center, Marianna. The pasture sizes at each location were: 2.5 ac (Ona), 2.5 ac (Brooksville), 2.0 ac (Alachua), and 3.7 ac (Marianna). Bahiagrass (*Paspalum notatum)* was the primary forage of interest for this trial. However, there were different cultivars at each location. At the Ona research site, the bahiagrass cultivar used for the trial was Pensacola (*Paspalum notatum* cv. Suarae Parodi), while the cultivar found in Brooksville was primarily Argentine bahiagrass, which is similar to Pensacola, but may be more palatable. At the Alachua research site, the bahiagrass cultivar was Pensacola, while Marianna contained Pensacola bahiagrass. The selected pastures were managed at each location either by grazing or mowing to allow for differences in available forage mass. Pastures were not fertilized prior to or during the trial.

Forage and masticate samples were collected monthly (approximately every 30 d) from June to November 2007. Eight ruminally cannulated Angus or Brangus steers were used for this experiment with two steers at each location (one Angus and one Brangus) for collection of masticate samples. Forage availabilities were visually assigned to the selected pastures, as either HIGH or LOW, at each location to represent differences in forage quantity. Within each pasture, two individuals hand-clipped three forage samples each for a total of six samples per pasture. Hand shears were used to cut the forage within a 0.8-ft^2 quadrat to an approximate height of 1-in from the soil surface. Simultaneously, masticate samples were collected from the fistulated steers by initially emptying the rumen, allowing the steers to graze either the HIGH or LOW FA pasture for approximately one hour, then removing the selected material from the rumen. Forage and masticate samples were analyzed for forage mass, in vitro digestible organic matter (IVDOM), and crude protein (CP). The selection index (SI) for chemical composition was also calculated using the following equation, SI = {[(Masticate concentration – hand-collected forage concentration) / hand-collected forage concentration] * 100} + 100.

Data were analyzed as a split plot design with the whole plot completely randomized using the MIXED procedure of SAS. The experimental unit was steer or person for sample collection. Fixed effects in the model included FA, month, sampling type (masticate or hand-collection), and their interactions. Repetition (steer or person) within each FA was used for the repeated measures and random effect. The least squares means were determined. Means were separated using the P-diff option when protected by a significant F-value ($P<0.05$).

Results

Ona

At Ona, there were FA, month, and FA x month interactions ($P<0.05$) for forage mass during the summer and fall (Table 1). The forage mass of the HIGH and LOW FA increased from June to September with the high FA increasing nearly 13,500 lb/ac, whereas the low FA gained approximately 1,000 lb/ac each month from June to September. The HIGH and LOW FA decreased in forage mass from September to October with the HIGH FA gaining almost 3,000 lb/ac from October to November, while the LOW FA decreased by approximately 1,500 lb/ac during the same time period. Masticate samples were consistently greater (Table 2; $P<0.001$) in IVDOM concentration by 12.8% on average compared to hand-collected forage samples. Month also affected ($P<0.001$) IVDOM of both masticate and hand-collected samples. The variation between sample type and month ($P<0.001$) affected IVDOM concentration during the summer and fall. Likewise, the CP concentration of masticate samples (Table 3; $P<0.001$) averaged 3.2% greater than hand-collected forage samples during the summer and fall with the exception of July, which may have been influenced by the start of the summer growing season. As a result of the similar CP concentration of forage and masticate samples in July, a type x month

(P=0.03) effect was observed. Crude protein concentration of both masticate and forage samples (P<0.001) decreased from June to August. Forage CP concentration of both sampling types increased during September, yet decreased for the remainder of the fall season. The mean SI for Ona indicated an opportunity for selection of forage material that was 30% greater in IVDOM concentration and 28% greater in CP concentration compared to hand-collected forage values (Table 4).

Brooksville

There were no samples taken in July at the Brooksville location, because of sampling difficulties that month. During the remaining summer months, while there were significant FA and month effects (P=0.05 and P=0.009, respectively), there was no FA x month interaction (P<0.001) for forage mass at Brooksville (Table 1). Brooksville increased in forage mass from June to October with a slight decrease in mass during September and November. The FA and month effects were likely influenced by the almost 10,500 lb/ac gain in forage mass from June to October for HIGH FA, while the LOW FA gained nearly 4,800 lb/ac during the same time period. The forage mass of the HIGH FA was 50% greater than the LOW FA in October. There was a sample type effect for IVDOM concentration (Table 2; P<0.001) and sample type and month effects (Table 3; P<0.001) for CP concentration during the summer and fall. The steers were consistent in their selection of forage material, which resulted in the masticate IVDOM samples varying by less than 1% from June to November, while the hand-sampled forage IVDOM changed 6% during the sampling period. There was an inverse relationship between forage mass and CP concentrations of masticate and hand-collected forage samples during the summer and fall. The mean concentrations of IVDOM and CP were greater for masticate compared to hand-collected forage samples, which resulted in SI that were 15% greater in IVDOM concentration and 26% greater in CP concentration during the summer and fall (Table 4).

Santa Fe

Similar to Brooksville and Marianna, forage mass at SF (Table 1) was affected by FA (P=0.02), month (P<0.001). The FA x month interaction (P<0.001) was likely due to the similarity in results of the HIGH and LOW FA during October. The hand-collected forage decreased in IVDOM concentration (Table 2) from June (59.2%) to August (49.2%) yet increased in September (58.0%) and October (62.6%) and decreased during November (48.0%). The IVDOM concentration of the masticate samples varied little during the summer and fall with the exception of the lower nutritive value seen in June and November. However masticate samples were greater in IVDOM concentration compared to hand-collected forage samples with the exception of June. Crude protein concentration of hand-collected forage and masticate samples varied considerably during the summer and fall (Table 3) resulting in type and month effects (P<0.001), as well as a type x month interaction (P<0.001). The steers were able to select forage material that was 26% greater in IVDOM concentration during July and 40% greater in CP concentration during July with the other months eliciting less of a selection response (Table 4).

Marianna

Marianna experienced gains in forage mass in HIGH and LOW FA from June to September with FA (P=0.05) and month (P<0.001) effects, yet forage mass decreased during the remaining months (Table 1). The masticate IVDOM concentration differed between sampling type, as well as between months (P<0.001). Masticate sample IVDOM concentration (Table 2) was greater (mean= 63%) than hand-collected forage samples (mean= 53%) from June to November. The CP concentration of hand-collected forage and masticate samples (Table 3) were similar in value during each month of the summer and fall (P<0.001) with the exception of July and August. The selection indices (Table 4) indicate that the steers were able to select forage that was 16% greater in IVDOM concentration than hand-collected forage values during the summer and fall. The steers were also able to select forage that was 30% greater in CP concentration during July and 48% greater in CP concentration during August compared to hand-collected forage with the other months eliciting less of selection response.

State Mean

Forage mass (Table 1) was affected by month (*P*<0.001) and FA (*P*=0.03), while there was a tendency for a FA x month effect (*P*=0.06). All locations experienced either a decrease or no change in DMY from May to June with forage DMY not increasing until the latter end of the summer. Both HIGH and LOW FA increased in forage mass from June to September, when yields began to decline. The FA x month trend was likely influenced by the simultaneous gains and losses of forage mass for the HIGH and LOW FA during the trial. Masticate samples were consistently greater (Table 2; *P*<0.001) in IVDOM concentration compared to hand-collected forage samples, averaging 9% greater IVDOM concentration during the summer and fall. Steers were consistent in their selection of forage material, in that masticate IVDOM concentration only varied by 3% during the summer, while the hand-collected forage IVDOM concentration changed 11% during the sampling period. Month affected CP concentration of hand-collected forage and masticate samples (Table 2; *P*<0.001) during the summer and fall, resulting in a type x month interaction (*P*<0.001). The lack of rainfall in May and June may have influenced forage mass, as well as hand-collected forage chemical composition variation between months. At most locations, precipitation was less than the 30-yr average for all locations from May to November. Similar to IVDOM, CP concentration of masticate samples were consistently greater (*P*<0.001) than those of the hand-collected forage samples except in June. During this study, regardless of forage mass, steers selected forage material (Table 4) that was about 19% greater in IVDOM concentration on average compared to hand-collected forage samples. While there were no differences between month (*P*=0.16) in SI for CP concentration, there was no selection in June (-3%), while the other summer and fall months had a mean SI of 25%.

Conclusions and Implications

The results of this study indicate that while bahiagrass matures and its forage mass increases, grazing steers will select forage material with greater IVDOM and CP concentrations. When given the opportunity, cattle grazing bahiagrass forage will select a diet that is greater in nutritive value compared with hand-collected samples, which are normally gathered for estimation of available forage quality. The data collected in this study imply that forage samples collected by hand may under-estimate the nutritive value of the actual selected forage by cattle. The implications of this study indicate the opportunity to more closely match cow requirements with forage resources, based on available bahiagrass nutritive value and cow selection within those forage opportunities. If energy and protein supplementation can be more closely matched to cow requirements, then less N and other nutrient inputs would be added to the environment thus improving land and water quality, which is an important concern for Florida cattle producers.

Literature Cited

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Table 1. Effect of forage availability and month on overall mean forage mass (lb/ac)

		Month							P-value		
Location	FA[a]	June	July	Aug	Sept	Oct	Nov	SEM[d]	FA	Month	FA*Mo
Ona	H[b]	3,838	5,396	10,513	17,328	13,109	15,861	1,679	0.02	0.005	0.03
	L[c]	2,697	3,644	4,979	5,469	4,990	3,392				
Brooksville	H	972	na	8,689	8,446	11,457	10,643	1,555	0.05	0.009	0.33
	L	958	na	5,175	3,718	5,767	4,038				
Santa Fe	H	3,196	4,418	4,767	8,825	3,420	3,245	392	0.02	<0.001	<0.001
	L	1,346	3,528	3,596	2,647	3,318	2,254				
Marianna	H	1,164	2,750	8,575	8,378	8,110	3,443	874	0.05	<0.001	0.18
	L	836	2,110	3,743	5,728	5,210	2,212				
St. Mean	H	2,292	4,187	8,142	10,745	9,024	8,298	1,029	0.03	<0.001	0.06
	L	1,459	3,094	4,373	4,390	4,823	2,976				

[a]FA= Forage availability.

[b]H= High forage availability.

[c]L= Low forage availability.

[d]SEM= Standard error of the mean, n=12.

Table 2. Effect of sampling type and month on in vitro digestible organic matter (IVDOM, %)

		Month							P-value		
Location	Type[a]	June	July	Aug	Sept	Oct	Nov	SEM[d]	Type	Month	Type*Mo
Ona	F[b]	48.69	50.91	44.33	43.67	51.63	45.11	1.31	<0.001	<0.001	<0.001
	M[c]	54.90	56.59	56.96	68.13	69.53	59.74				
Brooksville	F	54.18	na	48.07	54.64	49.65	45.59	2.08	<0.001	0.009	0.42
	M	61.39	na	59.74	62.33	61.31	51.21				
Santa Fe	F	59.23	52.23	49.02	57.98	62.64	47.99	1.84	<0.001	<0.001	<0.001
	M	53.46	59.09	61.87	63.45	61.73	55.67				
Marianna	F	55.82	50.41	50.87	61.49	56.15	46.09	1.43	<0.001	<0.001	<0.001
	M	63.97	67.69	64.12	64.12	61.33	59.33				
St. Mean	F	54.51	51.23	48.12	54.92	55.04	46.24	1.47	<0.001	<0.001	0.08
	M	58.42	61.11	60.74	64.51	63.42	56.51				

[a]Type= Forage sampling type.

[b]F= Hand-sampled forage.

[c]M= Masticate.

[d]SEM= Standard error of the mean, n=48.

Table 3. Effect of sampling type and month on crude protein (CP, %)

		Month							P-value		
Location	Type[a]	June	July	Aug	Sept	Oct	Nov	SEM[d]	Type	Month	Type*Mo
Ona	F[b]	9.83	8.86	6.87	8.77	7.25	7.53	0.45	<0.001	<0.001	0.004
	M[c]	10.08	8.69	8.57	12.57	11.10	10.65				
Brooksville	F	12.24	na	8.39	6.93	7.69	6.89	0.42	<0.001	<0.001	0.17
	M	13.34	na	10.92	9.86	10.37	9.49				
Santa Fe	F	15.35	9.70	10.62	10.62	10.16	8.69	0.29	0.004	<0.001	<0.001
	M	11.64	13.70	12.00	8.98	11.49	9.98				
Marianna	F	17.30	10.58	8.82	8.48	9.41	10.00	0.43	<0.001	<0.001	<0.001
	M	16.72	13.65	12.87	8.83	10.62	10.49				
St. Mean	F	13.91	9.73	8.62	8.64	8.64	8.32	0.62	<0.001	<0.001	<0.001
	M	12.92	12.11	11.03	9.61	10.71	10.13				

[a]Type= Forage sampling type.
[b]F= Hand-sampled forage.
[c]M= Masticate.
[d]SEM= Standard error of the mean, n=48.

Table 4. Effect of month on steer selection index[a] of bahiagrass forage.

		Month							
Location	Analysis	June	July	Aug	Sept	Oct	Nov	SEM[d]	P-value
Ona	IVDOM[b]	113.76	111.15	129.22	157.49	136.13	132.01	8.06	0.07
	CP[c]	103.50	97.23	123.75	148.46	153.15	141.47	18.71	0.31
Brooksville	IVDOM	113.29	.	124.29	110.38	123.32	112.33	3.16	0.09
	CP	108.97	.	129.94	142.12	135.50	137.70	10.18	0.32
Santa Fe	IVDOM	90.79	113.14	126.00	109.53	98.78	116.17	6.64	0.09
	CP	79.07	140.93	112.21	86.90	113.05	115.47	15.24	0.21
Marianna	IVDOM	115.83	134.53	126.02	104.03	107.78	128.12	12.84	0.55
	CP	96.82	130.03	147.61	104.75	111.63	103.71	10.13	0.09
St. Mean	IVDOM	108.42	119.63	126.42	120.41	116.53	122.21	6.08	0.43
	CP	97.11	122.73	128.44	120.62	128.34	124.63	8.99	0.16

[a]{[(Masticate concentration – forage concentration) / forage concentration] * 100} + 100.
[b]IVDOM= In vitro digestible organic matter.
[c]CP= Crude protein.
[d]SEM= Standard error of the mean, n=12.