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Stockpiling Bahiagrass – Management and Nutritive Value for On-Farm Use

Abstract

This on-farm demonstration evaluated stockpiled bahiagrass (*Paspalum notatum* Flüggé) at two Alabama locations to assess forage yield, nutritive value, and potential for extending fall grazing. In Year 1, fertilized pastures in St. Clair County produced 885 lb DM/ac more biomass than unfertilized Montgomery County pastures, though forage quality was similar (7% CP, 63% TDN). Year 2 yields averaged 3,889 lb DM/ac despite warmer, drier conditions. Forage fiber and nutrient concentrations varied by location, harvest date, and interactions. Stockpiled bahiagrass provided 30 to 40 extra grazing days annually but may require protein supplementation for beef cattle.

Keywords: Stockpiling, bahiagrass, nutritive value, yield

Abbreviations: ADF = acid detergent fiber; ADL = acid detergent lignin; AOAC = Association of Official Analytical Chemists; BCS = body condition score; BW = body weight; CP = crude protein; DM = dry matter; hd = head; kg = kilograms; N = nitrogen; NDF = neutral detergent fiber; SAS = SAS Institute, Inc.; SEM = Standard error of the mean; TDN= total digestible nutrients

Introduction

In the southeastern United States, cattle producers are continually seeking sustainable grazing strategies that will support their cattle herd for a greater number of calendar days and into the winter months. One method producers use to extend the grazing season is fall stockpiling. This practice involves suspending the use of a grazed pasture for a period to allow the accumulation of the forage in the fall until a killing frost. Stockpiling ensures that there is enough forage available to support the cattle herd, ideally for a month or more, bridging the gap until cool-season forages are grazable (Vasco et al., 2023). By optimizing forage availability, stockpiling can reduce the reliance on supplemental feeds and the associated costs of hay or silage production and use during the fall transition period.

Stockpiling warm-season grasses is one method of extending forage availability to provide moderate cattle nutrition during the fall and early winter, depending on the forage species utilized. According to Evers et al. (2004), stockpiled warm-season perennial grasses should provide 8 to 14% crude protein (CP) and more than 50% total digestible nutrients (TDN) through January, making them a viable option for sustaining productivity in cattle with low nutritional demands. Among these grasses, bahiagrass (*Paspalum notatum* Flüggé) and bermudagrass (*Cynodon dactylon* [L.] Pers.) are commonly used for stockpiling in the southeastern United States due to their high productivity and resilience to early winter temperatures.

Bahiagrass is adapted to the sandy soils of tropical and subtropical regions. It is most productive from April through October, with forage quality declining during the hottest and driest months, particularly in July and August. Bahiagrass is a C_4 species which makes it well suited for high temperatures and low moisture environments (Wang et al., 2021). Its ability to maintain water balance under stressful conditions is partly attributed to biogenic silica, which is commonly found in tropical forage species (Wang et al., 2021). Bahiagrass responds well to N fertilization, which increases yield potential. The nutritive value of ‘Pensacola’ bahiagrass has been reported to be 11.3% CP, 65.7% NDF, and 32.3% ADF across harvest frequencies (Cuomo et al., 1996). Bahiagrass was selected for this study due to its widespread use by beef cattle operations across central and lower Alabama, as well as its tolerance to low soil pH and fertility, resilience to close grazing, and ability to withstand harsh climatic conditions (Gates et al., 2004).

This study was conducted to address the limited research on the nutritive value of stockpiled bahiagrass throughout the fall stockpiling period. These findings will provide insights into how this grazing system could affect animal performance and identify potential strategies for improvement.

Materials and Methods

Research sites

A two-year on-farm demonstration was conducted at sites located in Montgomery County, AL (32.15° N, -86.36° W) and St. Clair County, AL (33.49° N, 86.32° W). Soils at the Mongomery location were Izagora fine sandy loam (Fine-loamy, siliceous, semiactive, thermic Aquic Paleudults) and the St. Clair location had Dewey loam soils (Fine, kaolinitic, thermic Typic Paleudults; Web Soil Survey, 2019). Both locations had well-established stands of bahiagrass at the study's onset (10+ years of age). In late August, producers grazed the pastures to a height of approximately 3 in before removing the cattle to allow for forage accumulation. At both locations, cattle began grazing the stockpiled forage in late October or early November each year.

Weather data were sourced from Weather Underground (TWC Product and Technology LLC 2014, 2025). In Montgomery, the average monthly temperature during the experimental period (August, September, October and November) ranged from 56 – 84°F in 2023 and 62 – 95°F in 2024 (Table 1). In Montgomery County, the total monthly rainfall during the experimental period ranged from 2.6 – 3.7 in in 2023, and 0 – 4.5 in in 2024 (Table 2). In St. Clair, the average monthly temperature ranged from 66 – 81°F in 2023 and 61 – 82°F in 2024 (Table 1). In 2023 and 2024, the total monthly precipitation ranged from 0.03 – 6.9 in and 0 – 5.6 in, respectively (Table 2).

Table 1. Mean monthly temperature (°F) during the stockpiling period in Montgomery County, AL and St. Clair County, AL

Month	Montgomery County[1]		St. Clair County[1]	
	2023	**2024**	**2023**	**2024**
	------------------------°F--------------------------			
August	84	95	81	82
September	77	77	76	75
October	66	67	66	67
November	56	62	55	61

[1]TWC Product and Technology LLC 2014, 2025.

Table 2. Total monthly precipitation (in) during the stockpiling period in Montgomery County, AL and St. Clair County, AL

Month	Montgomery County, AL[1]		St. Clair County, AL[1]	
	2023	**2024**	**2023**	**2024**
	----------------------------in.------------------------------			
August	3.46	0.35	6.85	0.98
September	3.27	4.53	1.93	5.55
October	2.60	0.04	0.28	0.00
November	3.74	2.72	0.94	4.53
Season Total	**13.1**	**7.6**	**10.0**	**11.1**

[1]TWC Product and Technology LLC 2014, 2025.

At the Montgomery location, Year 1 samples were collected on October 18, November 2, and November 17, 2023. The 15-ac field was not fertilized prior to grazing. Cow-calf pairs were introduced to the pasture and began strip grazing on November 1. Grazing continued until December 8, providing a 31-d grazing period. The producer grazed 25 Angus cows (approx.1,200 lb body weight [BW]) and their calves (approx. 500 lb BW). The producer observed that the lactating cattle reduced body condition score (BCS) from 6 to 5 in the final week of grazing the stockpiled bahiagrass. The producer removed 15 head, while leaving 10 head and offered hay supplementation. In Year 2, samples were taken on October 10, October 24, November 7, and November 21, 2024. The producer did not apply any fertilizer and used the same number of head of lactating Angus cows (approx.1,200 lb BW) and calves (approx. 500 lb BW) as in Year 1. For Year 2, 30 days of additional grazing was achieved. This year, cattle were provided a 50% soybean and 50% corn gluten as a pelleted feed supplemented at 1% BW/head/d. They were fed 4 times per week.

At the St. Clair location, Year 1 samples were collected on October 5, October 19, November 2, November 17, and November 28, 2023. The 10-ac field was fertilized with 60 lb. N/ac at the initiation of the stockpiling period. The producer began strip grazing cattle on November 7 with two mature bulls (approx. 2,200 lb BW) and one cow (approx. 1,200 lb BW). Cattle maintained BW and BCS throughout the stockpiling period. Grazing concluded on December 12, providing 35 days of grazing. Alternatively, in Year 2 at this location the pasture was not fertilized. Forage samples were collected on October 9, October 23, November 8, and November 20, 2024. The producer began grazing one heifer (approx.1,000 lb BW) and one bull (approx. 2,200 lb BW) on October 15. The cattle were able to graze an additional 30 days with residual forage remaining in the field. In both years, the cattle were not provided with any feed supplementation during the grazing period.

Forage Sampling

A 1ft^2 quadrat was used to randomly sample 15 locations within each field to obtain representative measurements of stockpiled forage quantity and nutritive value. Within each quadrat, bahiagrass height was measured at the densest point of the canopy. The forage was then harvested using cordless grass shears (Makita, La Miranda, CA, USA) and sampled to a 1 in height. The collected samples were placed in labeled paper bags for drying. The forage samples were dried at 131°F for at least 72 h until a consistent weight was achieved. After drying, the samples were weighed and then stored until grinding.

Sample Processing and Analysis

Year 1 samples were homogenized by date and location. In contrast, Year 2 samples were analyzed on an individual sample basis.

Forage *in vitro* true digestibility (IVTD) assessment followed the procedures described by Vogel et al. (1999). Rumen fluid was collected from two cannulated steers (1,300 lb BW) at the Auburn University Stanley P. Wilson Beef Teaching Center (Auburn, AL). Rumen fluid from both steers was combined and transported to the Auburn University Ruminant Nutrition Laboratory in two preheated (100°F) 2 qt thermoses. Approximately 1 qt of rumen inoculum (fluid and digesta) was collected from two ruminally fistulated steers (approx. 3 years of age and approx. 1,085 lb BW) located at the Auburn University Stanley P. Wilson Beef Teaching Center (Auburn, AL). The donor steers were on a primarily perennial warm-season forage-based diet and were periodically supplemented with the same pelleted feed used in the on-farm demonstration study herein. Digestibility was measured at eight incubation time points (0, 2, 4, 8, 12, 24, 48, and 72 h).

Dry matter (DM) was determined by using procedures from Association of Official Agricultural Chemists (AOAC, 2000). Neutral detergent fiber (NDF) and acid detergent fiber (ADF) were analyzed using an ANKOM^{2000} Fiber Analyzer (Ankom Technologies, Macedon, NY, USA) using the procedures of Vogel et al. (1999). Acid detergent lignin (ADL) was performed using the sulfuric acid method (AOAC, 2000) using the ANKOM Daisy^{II} incubator (Ankom Technologies, Macedon, NY, USA). Forage samples were sent to the Cumberland Valley Analytical Services (Cumberland Valley Analytical Services, Waynesboro, PA) for evaluation of crude protein (CP) using the Dumas combustion method and calculated as N × 6.25 (Official Methods of Analysis, 17th edition. 2000). Forage total digestible nutrients (TDN) were calculated as [105.2 - (0.667 × NDF)] × 0.88 (NRC, 2016).

Statistical Analysis

Data was evaluated using PROC GLIMMIX of SAS 9.4 (SAS Institute, Inc., Cary, NC SAS Institute Inc.). A generalized linear mixed model was fit for each response variable, which included DM yield, forage height, NDF, ADF, ADL, CP, and TDN.

In Year 1, due to the compositing of forage samples, location was considered a fixed effect, and harvest was considered a random variable. In Year 2, location, harvest and their interaction (harvest × location) were considered fixed effects. Denominator degrees of freedom were adjusted using the 2nd order Kenward-Roger approximation method (ddfm = kr2; Kenward and Roger, 2009). Means separation of fixed effects was performed using the Tukey-Kramer adjustment (Kramer, 1956). Differences among responses were declared when $P < 0.05$.

Results and Discussion

Forage Yield

In Year 1, St. Clair County forage yield was less than Montgomery County ($P = 0.01$; Table 3). Although the average height of bahiagrass did not differ throughout the season ($P = 0.14$), St. Clair forage stands were generally taller. These differences can be attributed to forage management practices. The producer in St. Clair applied 60 lb N/ac at the beginning of the stockpiling season, which likely contributed to the increased forage yield and height (Table 3). This is supported by a study on stockpiled bahiagrass in South Alabama that reported that bahiagrass that received 60 lb N/ac in early September produced 1,432 lb DM/ac, while the unfertilized plots yielded 1,229 lb DM/ac (Agar et al., 2023). The overall greater yields observed in this study may also be attributed to regional climatic differences and the producer stocking fewer cattle per hectare (approx. 628 lb BW/ac).

Table 3. Year 1 (2023) forage yield (lb DM/ac) and forage height (in) of stockpiled bahiagrass grown in Montgomery County, AL and St. Clair County, AL

2023			
Item	Montgomery	St. Clair	SEM[1]
Heights (in)	11	13	1.2
Yield (lb DM/ac)	2,346a	3,232b	373.8

[a, b]Means within a row without common superscripts are different ($P \leq 0.05$).

[1]SEM = standard error of the mean.

In Year 2, forage yield did not differ across locations ($P = 0.78$; Table 4), harvest date ($P = 0.33$; Table 5), or their interaction ($P = 0.23$). A study conducted in Florida on Pensacola bahiagrass reported an average yield of 900 lb DM/ac after four weeks of fall regrowth (Brown and Mislevy, 1988), whereas yields in the current study ranged from 2,879 to 4,670 lb DM/ac. The higher yields observed in Alabama may be influenced by regional climatic differences and varied regrowth management strategies. In Year 2, forage height exhibited an interaction across harvests (every two weeks during the growing season), with Harvest 1 taller than Harvest 4 ($P = 0.01$; Table 5). This decrease in height could be due to the combination of dry conditions late in the growing season and forage entering dormancy for the winter (Shelton, 2025). These findings suggest that producers should carefully evaluate the cost-benefit ratio of fertilizer application in relation to forage yield, optimizing their management strategy to maximize efficiency and economic returns.

Table 4. Year 2 (2024) forage yield (lb DM/ac) and forage height (in) of stockpiled bahiagrass grown in Montgomery County, AL and St. Clair County, AL

2024			
Item	Montgomery	St. Clair	SEM[1]
Heights (in)	14	15	0.9
Yield (lb DM/ac)	3,989	3,797	751.6

[a, b]Means within a row without common superscripts are different ($P \leq 0.05$).

[1]SEM = standard error of the mean.

Table 5. Year 2 (2024) forage yield (lb DM/ac) and forage height (in) across harvests of stockpiled bahiagrass grown in Montgomery County, AL and St. Clair County, AL

2024				
Item	Harvest 1	Harvest 2	Harvest 3	Harvest 4
Height (in)	17a ± 0.6	15ab ± 0.2	14bc ± 0.2	13c ± 0.2
Yield (lb DM/ac)	2,879 ± 295.6	4,033 ± 359.6	4,670 ± 359.6	3,992 ± 359.6

[a, b]Means within a row without common superscripts are different ($P \leq 0.05$).

[1]SEM = standard error of the mean.

Nutritive Value

During Year 1, there were no differences between locations in NDF ($P = 0.92$) or ADF ($P = 0.46$; Table 6). In comparison, a study on stockpiled bermudagrass reported NDF values ranging from 67.3 to 73.5% and ADF ranging 29.3 to 33.1% (Scarbrough et al., 2006). The lower fiber values in bahiagrass suggest greater digestible nutrients and improved cattle digestibility. The ADL fraction, which represents the indigestible components of the forage, also did not differ between locations ($P = 0.06$). One limitation of stockpiling is that forage tends to accumulate lignin in the stems, diverting energy from leaf development. While this is beneficial for DM yield, digestibility tends to decline (Redfearn, 2017). It was expected that TDN did not vary between locations (P = 0.92) as it was calculated using NDF values. Agar et al. (2023) found TDN values across varying stockpiling lengths averaged 62.5% in South Alabama.

Results from the present study indicate differences in CP between the two locations (P = 0.02; Table 6). This variation is likely due to the forage in Montgomery remaining in a more vegetative state compared the more mature, under grazed bahiagrass at St. Clair. Across both locations, these values were found to be lower than previous studies which found CP ranging from 11 - 14% (Agar et al., 2023).

Table 6. Nutritive values (% DM basis) of stockpiled bahiagrass grown in Montgomery County, AL and St. Clair County, AL in Year 1 (2023).

2023			
Item[2]	Montgomery	St. Clair	SEM[1]
NDF	51.1	51.0	1.78
ADF	25.6	26.4	1.09
ADL	6.2	5.1	0.52
TDN	62.6	62.7	0.01
CP	7.3a	6.9b	0.16

[a, b]Means within a row without common superscripts are different ($P \leq 0.05$).

[1]SEM= standard error of the mean.

[2]NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; TDN = total digestible nutrients; CP = crude protein.

In Year 2, forage ADL was greater in Montgomery than in St. Clair (P = 0.01; Table 7). Lignin concentration also varied by harvest date, with Harvest 4 having the greatest lignin concentration and Harvest 2 the lowest (P = 0.05; Table 8). When examining location × harvest, most Montgomery harvests exhibited greater ADL values than those from St. Clair, except for St. Clair's fourth harvest ($P < 0.01$). Montgomery's third harvest had the greatest ADL at 7.6%, while St. Clair's second harvest had the lowest at 5.7%. Forage ADL is a measure of lignin in the plant which varies based on environmental conditions and maturity (Patton and Leonard, 1942). Interestingly, St. Clair's second harvest consistently had the lowest NDF, ADF, and ADL values, indicating reduced fiber content, improved animal intake potential, and greater potential digestibility.

Total digestible nutrients were influenced by location ($P = 0.01$; Table 7), harvest ($P < 0.01$; Table 8), and their interaction ($P = 0.01$). St. Clair had a greater seasonal TDN than Montgomery. Across locations, Harvest 2 had the greatest TDN, while Harvest 4 had the lowest. These values exceed the requirements of a dry beef cow which requires TDN of 52% (NRC, 2016). A significant location × harvest interaction in Year 2 showed that St. Clair's second harvest had the greatest TDN at 71.4%, whereas Montgomery's third harvest had the lowest at 64.1%. This was directly correlated to ADL values.

Crude protein only differed between locations ($P = 0.01$; Table 7), similar to Year 1. A previous study on stockpiled bahiagrass reported CP levels of 14.9% after four weeks of regrowth and *in vitro* organic matter digestibility (IVOMD) of 54.5% (Brown and Mislevy, 1988). In comparison, dry beef cows require approximately 8% CP (NRC, 2016). The lower CP in the current study could be attributed to the maturity of the forage in a stockpiled management system, which accumulates less N as it matures. Another consideration in this study is that nutritive value was based on samples clipped to 1 in. stubble, from the soil surface, which may be different than what the cattle actually consumed. In St. Clair, the lower stocking rate, likely resulted in cattle selectively grazing only the top portion of the bahiagrass canopy, which typically has a greater nutritive value than lower portions of the plant (Hughes et al., 2010).

Table 7. Nutritive value (% DM basis) of stockpiled bahiagrass grown in Montgomery County, AL and St. Clair County, AL in Year 2 (2024).

2024			
Item[2]	Montgomery	St. Clair	SEM[1]
NDF	44.8a	39.7b	1.54
ADF	23.7	23.5	0.93
ADL	7.2a	6.1b	0.41
TDN	66.3b	69.3a	0.90
CP	7.7a	6.5b	0.31

[a, b]Means within a row without common superscripts are different ($P \leq 0.05$).

[1]SEM = standard error of the mean.

[2]NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; TDN = total digestible nutrients; CP = crude protein.

Table 8. Nutritive value (% DM basis) across harvests of stockpiled bahiagrass grown in Montgomery County, AL and St. Clair County, AL in Year 2 (2024).

2024				
Item[2]	Harvest 1	Harvest 2	Harvest 3	Harvest 4
NDF	40.1ab ± 2.72	39.7b ± 0.82	44.0a ± 0.82	45.2a ± 0.82
ADF	25.4a ± 1.64	21.1b ± 0.50	23.4a ± 0.50	24.4a ± 0.50
ADL	6.7ab ± 0.72	6.1b ± 0.22	6.7ab ± 0.22	7.0a ± 0.22
TDN	69.1ab ± 1.60	69.3a ± 0.48	66.7b ± 0.48	66.0b ± 0.48
CP	7.8a ± 0.55	7.0a ± 0.17	6.7a ± 0.17	7.0a ± 0.17

[a, b]Means within a row a without common superscripts are different ($P \leq 0.05$).

[1]SEM = standard error of the mean.

[2]NDF = neutral detergent fiber; ADF = acid detergent fiber; ADL = acid detergent lignin; TDN = total digestible nutrients; CP = crude protein.

Conclusion

Stockpiling forage is an effective way to extend forage availability for beef cattle during the winter months. This study evaluated the yield and nutritive value of stockpiled bahiagrass in Montgomery County and St. Clair County, AL, over two years. Despite limited rainfall at the onset of stockpiling for both years, forage yields were greater than those reported in previous studies in Alabama. In Year 1, St. Clair County had greater yields which were associated with N fertilization; however, this location did not apply fertilizer in Year 2. Both years and locations produced forage with adequate nutritive value to meet the maintenance needs for dry cattle, although CP supplementation may be necessary for animals with greater nutritional demands.

Overall, results from this study indicate that stockpiled bahiagrass meets or exceeds the requirements of a dry beef cow with approximate values of 8% CP, and 52% TDN, though CP supplementation may be needed (NRC, 2016). Stockpiling bahiagrass effectively increased forage dry matter yield and reduced dependence on hay feeding during the fall-winter transition in Alabama beef operations. Both locations averaged approximately 32 additional grazing days. This practice bridged the forage gap until cool-season forages are productive, contributing to more cost-effective cattle management during the winter. These findings highlight the importance of fertilizer application decisions, grazing strategies and forage management to optimize yield and nutritive value of stockpiled bahiagrass.

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Conflicts of Interest

The authors declare that there is no conflict of interest.

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