Forage Nutritional Quality Evaluation of Bahiagrass Selections

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Bahiagrass plant breeding efforts in the past have been based on increasing forage yield. Selection for increased yield also resulted in a concurrent increase in bahiagrass forage quality.

Summary

Bahiagrass (Paspalum notatum Flugge) is the major pasture forage in Florida. A bahiagrass selection breeding program has been ongoing since 1960 at the Coastal Plain Experiment Station at Tifton, Georgia to increase forage yield in 'Pensacola' (P. notatum var. sanese Flugge) bahiagrass. However, the impact of selection for forage yield on forage nutritional quality is unknown. Forage quality was evaluated from four 'Pensacola' derived selection cycles (C) of bahiagrass (C0 - 'Pensacola', C4, C9 - 'Tifton 9', and C23). A total of 175 plants per cycle were grown together in a field at NFREC, Quincy. Forage from individual one-yr old plants was harvested by hand on October 3, 2000 and again on November 15, 2000. The samples were dried, ground, and analyzed using near-infrared reflectance spectroscopy (NIRS) for dry matter (DM), in vitro dry matter digestibility (IVOMD), neutral detergent fiber (NDF), and crude protein (CP). Cycle means (% DM basis combined over both harvest dates) for IVOMD, NDF and CP were 49.7, 81.0 and 14.2; 50.3, 79.7 and 13.7; 52.8, 78.7 and 13.2; and 52.0, 78.5 and 12 .9 for C0, C4, C9 and C23, respectively. The greater average IVOMD of C4 vs. C0 was different (P = 0.03) as well as C9 vs. C4 (P < 0.001). Therefore, in addition to increased forage yield, there was evidence that forage quality (IVOMD) also increased with advancing selection cycle. Selection for improved nutritional quality through plant breeding may be possible.

Introduction

Bahiagrass is the major pasture forage crop in Florida and throughout the southern Gulf Coast. As a C_4 tropical grass, its forage nutritional quality is low, lower than typically noted for C_3 temperate grasses, such as ryegrass, at comparable stages of growth and development.

Dr. G. W. Burton, a plant breeder with USDA ARS, Tifton, GA, developed and used restricted recurrent phenotypic selection (RRPS) breeding procedure to improve bahiagrass forage yield. Starting in 1960, Burton selected plants annually for 24 yr using this procedure, which resulted in morphology of the plants towards a more upright growth habit as well as greater forage mass. Whether or not forage nutritional quality was improved is not known. Thus, the objective of this research was to evaluate nutritional quality of bahiagrass selections from four 'Pensacola' derived RRPS selection cycles.

Material and Methods

Bahiagrass seed from four RRPS selec-

tion cycles [C0 (Pensacola), C4, C9 (Tifton 9) and C23] were obtained from G. W. Burton, USDA-ARS, Coastal Plain Experiment Station, Tifton, GA, and used in this study. From this seed supply, a total of 175 plants of each cycle were grown in a greenhouse and then transplanted during July 1999 to a field at NFREC Quincy, FL (30.3° N Lat.). Beginning September 1999, foliage was harvested every 6 to 8 wk. Harvest consisted of the total top growth that occurred at 4 in above the crown of the individual plants. On August 15, 2000, all plant crowns were hand clipped to 4 in diameter and the foliage clipped to 4 in height. On October 2, 2000 and again on November 15, 2000, foliage growth of individual plants was cut by hand to a common height of 4 in. Foliage was dried, weighed and recorded. In all, an average of 164 forage samples per cycle per harvest was obtained. Forage was not obtained from all 175 plants per cycle per harvest due to some plant attrition or plants not having sufficient forage.

The dried forage samples were ground and analyzed for DM, IVOMD, NDF and CP using NIRS. The NIRS was calibrated from a subsample of 275 samples which were analyzed using wet chemistry procedures.

Data were analyzed using GLM of SAS. The model included harvest date and cycle. The individual plant was the experimental unit. Significant effects were separated using LSMEANS comparison with the PDIFF option of SAS.

Results

The values obtained for IVOMD and NDF in this study were typical of late grazing season bahiagrass; however, the CP values were greater. The bahiagrass plants were well fertilized during the study which could explain the greater CP concentrations. October and November samplings were done rather than during the late spring and summer mo as forage quality is typically lowest for bahiagrass during autumn. Differences noted would be more meaningful than earlier sampling when quality values would overall be higher.

When combined over both harvests, an increase in IVOMD and decreases in NDF and CP concentrations were noted when going from C0 to C4 (P=0.03; P<0.001; P<0.001, respectively), and again from C4 to C9 (P<0.001 for all; Table 1). A small decrease (P<0.01) in IVOMD was noted from C9 to C23. While IVOMD was lower for C23 compared with C9, the value was still greater when compared with C4 or CO (P<0.01). The further decrease noted with NDF of C23 vs. C9, however, was not significant (P>0.10). The trend for a decrease in CP was continued as the decrease between C9 and C23 was significant (P<0.01). The peak at C9 for IVOMD was mostly the result of the drop in IVOMD for C23 compared with C9 (P<0.01) noted for the November harvest; values were similar (P>0.10) for the October harvest (Figure 1).

The November harvest samples were greater (P<0.01) in IVOMD (52.4 vs. 50.1%) and CP (14.6 vs. 12.5%) than the October harvest samples; NDF was similar (P>0.10; 80 vs. 79%; Figure 1). The increases noted were probably a reflection of the cooler weather during the 6 wk prior to the November harvest than prior to the October harvest.

Forage yield has been reported previously. As expected, an increase with increasing selection cycle was noted, peaking at C9 (60% increase vs. C0) with no further increase with C23.

From these results, there was evidence that forage nutritional quality did increase with advancing selection cycle. This finding is based on the increase in IVOMD and the decrease in NDF as selection cycle increased from 0 to 23, in particular from C0 to C9. Crude protein concentration actually decreased with increasing selection cycle; however, animal nutritionists often place more emphasis on IVOMD and NDF as determinants of forage nutritional quality than CP. While the bahiagrass RRPS selection goal was to increase forage yield, results of our study indicated evidence of a concurrent improvement in forage nutritional quality.

In addition, variation for each parameter

measured within each cycle was noted, and this variation was consistent across the cycles. For example, the variation (one standard deviation) for IVOMD averaged 2.8 (range of 2.7 to 2.9). This variation is desirable for plant breeding improvement. Therefore, breeding for improved forage quality within a cycle, as well as across cycles, may be possible.

Table 1. Composition of bahiagrass cycles (% dry matter basis; combined over both harvests).

	Selection cycle				
Item	C0	C4	C9	C23	SE[a]
IVOMD[b]	49.7	50.3	52.8	52.0	0.10
NDF[c]	81.0	79.7	78.7	78.5	0.10
Crude protein[d]	14.2	13.7	13.2	12.9	0.09

[a]Standard error of the mean, n = average of 164/cycle/harvest.

[b]*In vitro* organic matter digestibility. C0 vs. C4, $P < 0.03$; C4 vs. C9, $P < 0.001$; C9 vs. C23, $P < 0.01$.

[c]Neutral detergent fiber. C0 vs. C4, $P < 0.001$; C4 vs C9, $P < 0.001$; C9 vs. C23, $P > 0.10$.

[d]C0 vs. C4, $P < 0.001$; C4 vs. C9, $P < 0.001$; C9 vs. C23, $P < 0.01$.

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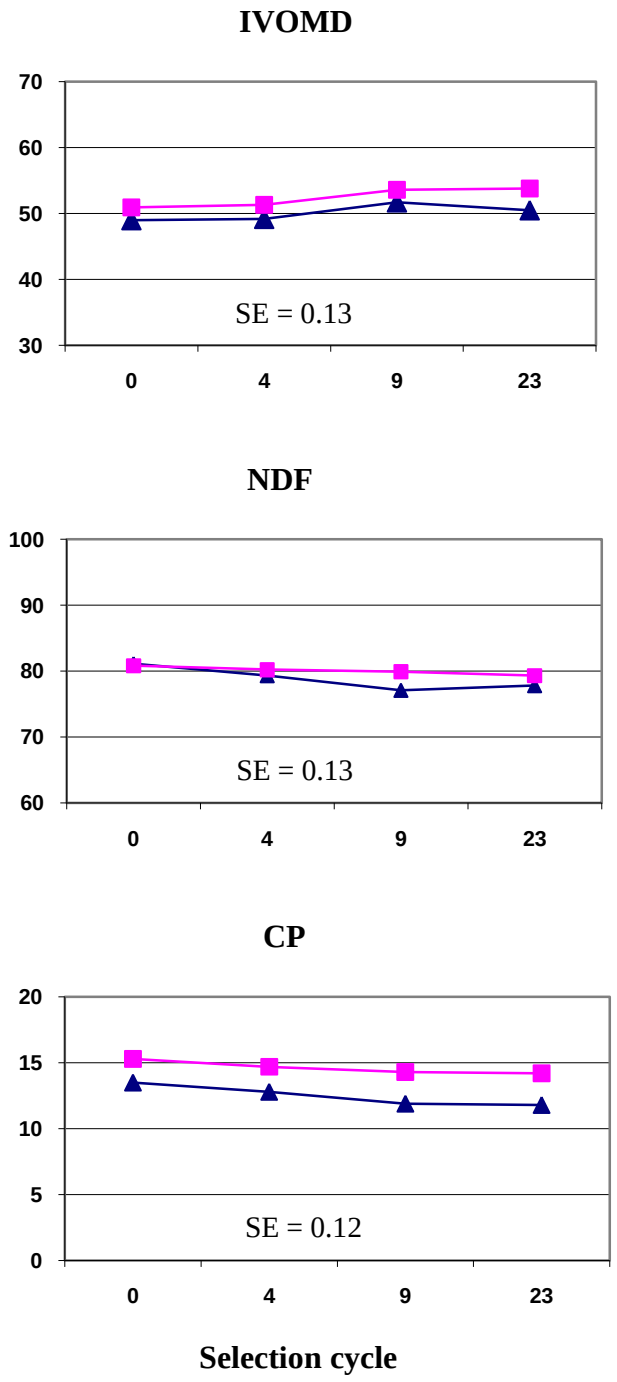

Figure 1. Mean values for each harvest of bahiagrass selection cycles (%, DM basis; ▲ = Oct. harvest and ■ = Nov. harvest). IVOMD = *in vitro* organic matter digestibility; NDF = neutral detergent fiber; CP = crude protein.