# Changes over the Grazing Season in Crude Protein and Digestibility of Fertilized Bermudagrass

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**Story in Brief**

Bermudagrass is the most widely grown warm-season perennial grass in Arkansas. This popularity is, in part, due to its productivity when grown in well-drained soils with moderate fertility. A problem with bermudagrass, however, is that forage quality can decline substantially in the middle to late summer. Digestibility and crude protein (CP) of bermudagrass pasture were measured every two weeks during a two-year grazing study to relate changes in CP and digestibility with the nutrient needs of feeder steers. Nitrogen (N) fertilization was split applied to pastures each year at the start and middle of the experimental period. Crude protein was high (> 12%) in the early season, but quickly declined below values needed to maintain moderate weight gains. However, CP levels increased following the second application of N to acceptable levels. Digestibility steadily declined during both seasons and was consistently below a level that is required for moderate weight gain. Split application of N fertilizer kept CP above an acceptable level for most of the two seasons; however, low digestibilities in the middle to late summer indicate that animal performance on bermudagrass during this time is limited by inadequate energy.

## Introduction

Animal performance on bermudagrass typically declines during the middle to late summer. Studies at Booneville have shown that the average daily gain (ADG) of feeder steers grazing common bermudagrass pastures can approach 2 lbs/day in the early growing season, but short-term ADG generally falls to less than 1.25 lbs/day between late June and August. Daily gains over the entire season average between 1.25 to 1.5 lbs/day. Although the summer slump in calf weight gains can be partially attributed to the adverse effects of high ambient temperature and humidity on forage intake, these climatic conditions can also negatively affect forage quality.

It is possible that feeding small amounts of supplemental grains could cost-effectively boost the ADG of calves on bermudagrass pasture, but studies are needed to determine the extent that protein and (or) energy of bermudagrass forage are deficient and further determine when these deficiencies occur during the grazing season. Therefore, digestibility and crude protein (CP) were monitored during a two-year grazing study with common bermudagrass. Pastures were grazed with variable stocking rates to maintain high forage availability (2500 to 3000 lbs dry matter [DM]/acre).

## Materials and Methods

The grazing study was conducted in 1993 and 1994 near Booneville in northwest Arkansas. Three treatments (1 lb/steer/day of a protein supplement, 1 lb/steer/day of a protein supplement plus Bovatec®[2], or no supplementation) were assigned to six 1.7-acre pastures of common bermudagrass in 1993 and to nine pastures in 1994 in a randomized complete block design. Three tester steers were assigned randomly to each pasture (initial body weight [BW] = 625 lbs in 1993 and 587 lbs in 1994). Put-and-take steers were used to vary stocking rate in order to maintain total forage availability between 2500 and 3000 lbs DM/acre so that steer ADG would not be limited by low forage availbility.

Nitrogen (N) was split applied to the pastures at the start and midpoint of the study at a rate of 75 lbs N/acre. Fertilizer was applied on June 7 and August 12, 1993, and on May 10 and July 22, 1994. Phosphorus (P) and potassium (K) were not applied because soil tests indicated these nutrients were not deficient for moderate bermudagrass growth. Grazing was initiated on June 17, 1993, and May 27, 1994, and was terminated in both years after 112 days of grazing.

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[2] The use of trade names in this manuscript does not imply endorsement by the USDA or ARS of the products named, or criticism of similar ones not mentioned.

Forage samples were taken from each pasture within a week after placing steers on pasture and then at two-week intervals by clipping herbage from three randomly placed quadrats (194 $in^2$) to a 3-inch height. These samples represented the upper layer of the pasture that is readily accessible for grazing. The remaining forage was clipped to ground level to represent forage in the lower layer that is less accessible. Wet chemistry procedures were used to determine CP and in vitro organic matter digestibility on 25% of the samples. These analyses were used to develop calibration equations for estimating CP and in vitro organic matter (OM) digestibility for the remainder of the samples by near infrared reflectance spectroscopy.

Nutritive value data were averaged over treatments and replications, and analyzed for each forage canopy layer with a split plot in time model that evaluated year, the linear, quadratic, and cubic terms for days on pasture, and interactions between year and regression terms. Higher order terms were removed from the model if shown to be not significant ($P > .10$).

## Results and Discussion

Seasonal trends for CP in upper and lower pasture layers were similar ($P > .10$) between the two years (Fig. 1). Crude protein in the upper layer was initially above NRC (1996) requirements for 600-lb steers gaining 1.8 lbs / day (9.5 %), but declined (linear: $P < .001$) towards the middle part of the season to deficient levels for that level of production. It did, however, gradually increase (quadratic and cubic: $P < .01$) to sufficient levels in the second-half following the second application of ammonium nitrate. Although CP appeared to be deficient for a part of the season, over the entire grazing season it averaged .4 percentage units higher than the animal requirement. The second application of ammonium nitrate apparently provided enough nitrogen to boost the CP status of the pastures above steer needs.

Crude protein in the lower pasture layer followed a similar trend over the season to that of the upper layer; however, CP was consistently lower than the animal requirements. Over the entire grazing season, CP in the lower layer averaged 1.3 percentage units lower than the specified NRC requirement. The lower layer contained primarily mature leaf and stem tissues that contain less nitrogen than the immature leaf that comprised the upper layer.

Seasonal trends in digestibility for the upper pasture layer were similar ($P > .10$) between the two years (Fig. 2). Digestibility declined gradually in the first half of the season, but stabilized or slightly increased in the second half (quadratic: $P < .01$). For most of the season, digestibility averaged 8.7% lower than the NRC requirement for total digestible nutrients (TDN) in 600-lb steers gaining 1.8 lb / day (60.0%).

Seasonal trends in digestibility for the lower pasture layer were different ($P < .10$) between the two years. Digestibility in 1993 declined linearly ($P < .05$) over the season, but in 1994 it stabilized in the latter part of the season. Low rainfall in July and August in 1993 (2.6 in.), as compared to 1994 (9.1 in.), probably reduced growth in this layer. Digestibility of forage in the lower layer was substantially lower than the previously specified requirement for TDN. Digestibility over the season averaged 13.3% lower than required. Low nutritive value of forage in this layer agrees with work by Aiken (1998) that showed reductions in CP and digestibility over time during the grazing periods for rotationally stocked paddocks of bermudagrass.

Protein supplementation in this study provided an increase in steer performance (Aiken and Brown, 1996), ADG being 1.34, 1.50, and 1.58 lbs / day, respectively, for no supplementation, protein supplementation, and protein supplementation plus Bovatec® treatments. Grigsby et al. (1989) also reported slight increases in steer ADG on bermudagrass pastures with various protein supplements. Aiken and Brown (1996) concluded, however, that the response to protein supplementation was probably because most of the protein supplement served as a source of energy rather than protein.

## Implications

Split application of ammonium nitrate kept CP of the bermudagrass at levels close to those required for moderate weight gain. Bermudagrass digestibility declined to inadequate levels to support desired weight gains, indicating that energy is a major limiting factor in producing moderate steer weight gain on bermudagrass in middle to late summer.

## References

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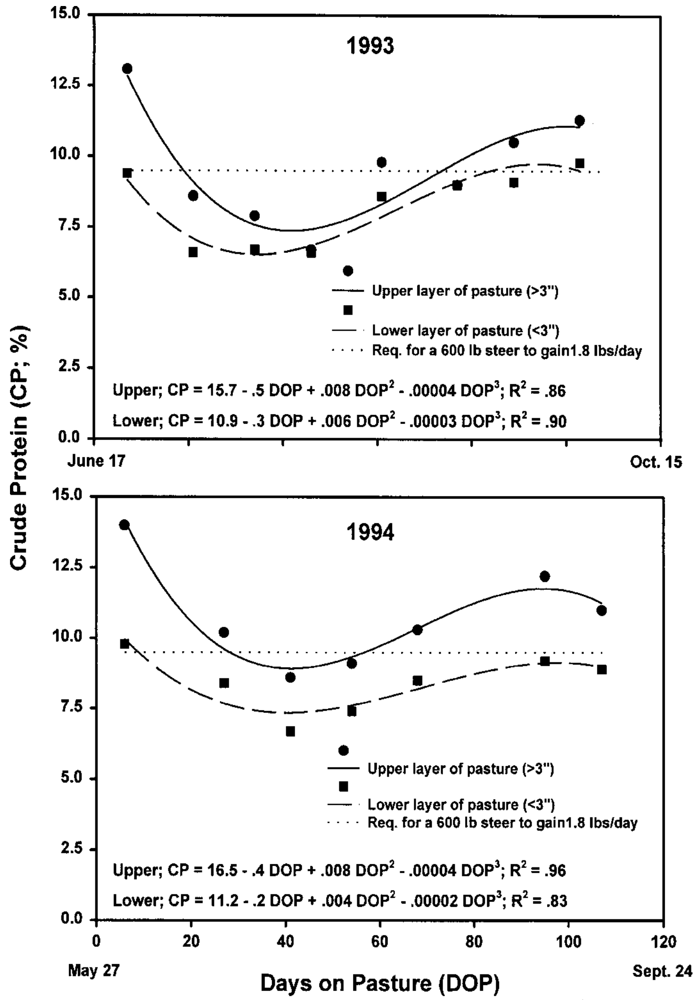


Fig. 1. Regressions (trends) between crude protein and days on pasture for the upper layer and lower layers of bermudagrass pasture in 1993 (grazing initiated on June 17) and 1994 (grazing initiated on May 29). A reference line shows the requirement for a 600-lb steer to gain 1.8 lbs/day (NRC, 1996).

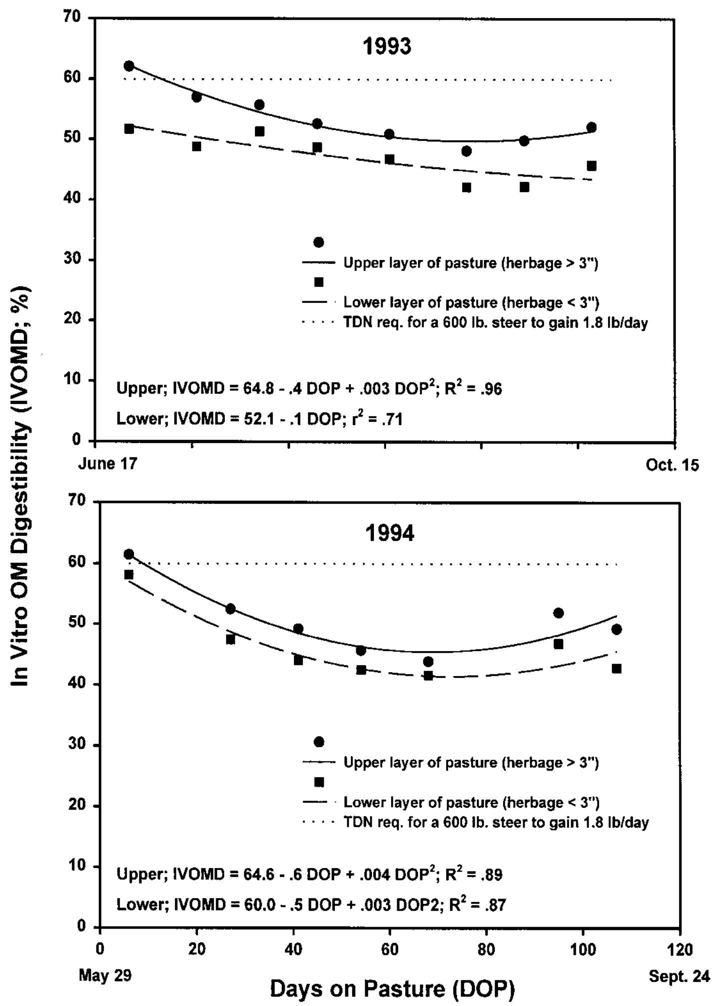


Fig. 2. Regressions (trends) between digestibility and days on pasture for the upper layer and lower layers of bermudagrass pasture in 1993 (grazing initiated on June 17) and 1994 (grazing initiated on May 29). A reference line shows the total digestible nutrients (TDN) requirement for a 600-lb steer to gain 1.8 lbs/day (NRC, 1996).