

Late-summer nitrogen fertilization rate effects on herbage mass, nutritive value, and fertilizer recovery efficiency of stockpiled bermudagrass

L.V. Bautista Romero¹, M.S. Castillo¹, G.L. Miller², A.L. Woodley³, Bessy Velazquez¹, and James D. Clothier²

¹Forage and Grassland Program, ²Turfgrass Management and ³Sustainable and Organic Soil Fertility, Crop and Soil Sciences Department, NC State University, Raleigh, North Carolina

INTRODUCTION

Stockpiling is a forage management strategy in which herbage is allowed to accumulate in the field for deferred grazing. This practice has not been well evaluated in the upper Southeast U.S. Coastal Plain, where bermudagrass [*Cynodon dactylon* (L.) Pers.] is the dominant forage species. If effective, stockpiled bermudagrass could extend the grazing season and reduce winter feeding costs. Therefore, information is needed to assess its potential to provide adequate nutrition during winter and to inform livestock management decisions.

OBJECTIVES

- Determine the effect of N fertilizer rate on herbage mass (HM), crude protein (CP), in vitro organic matter digestibility (IVOMD) and nitrate (NO₃-N) concentration from October to January.
- Assess the nutritive value of the leaf and stem components, and its relationship with canopy herbage mass and nutritive value.
- Estimate nitrate-N concentrations, N removal and fertilizer N recovery efficiency (FNRE).

MATERIALS & METHODS

Experimental Sites and Statistical Design

Seven on-farm locations that included bermudagrass 'Midland 99' (n = 3), 'Ozark' (n=2), 'Tifton 44' (n=1) and 'Coastal' (n=1) across the NC Coastal Plain physiographic region (Fig 1). Bermudagrasses were stockpiled starting mid-August.

Treatments: Factorial combination (4 x 4) of four harvest dates (October, November, December, and January) and four N fertilizer rates (0, 45, 90, and 135 kg ha⁻¹)

Experimental Design: Randomized complete block design with a split-plot restriction on randomization, replicated four times. Main-plot was the harvest date and sub-plot factor was N rate. Experimental unit size was 10 m² (2 x 5)

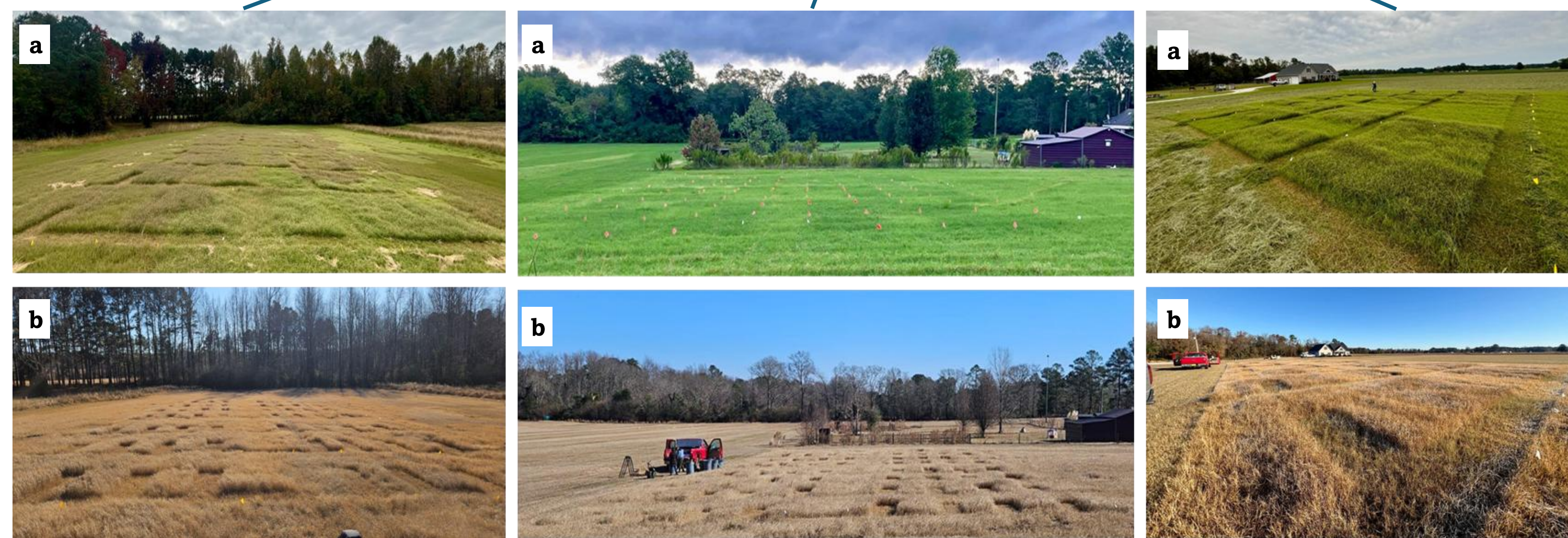
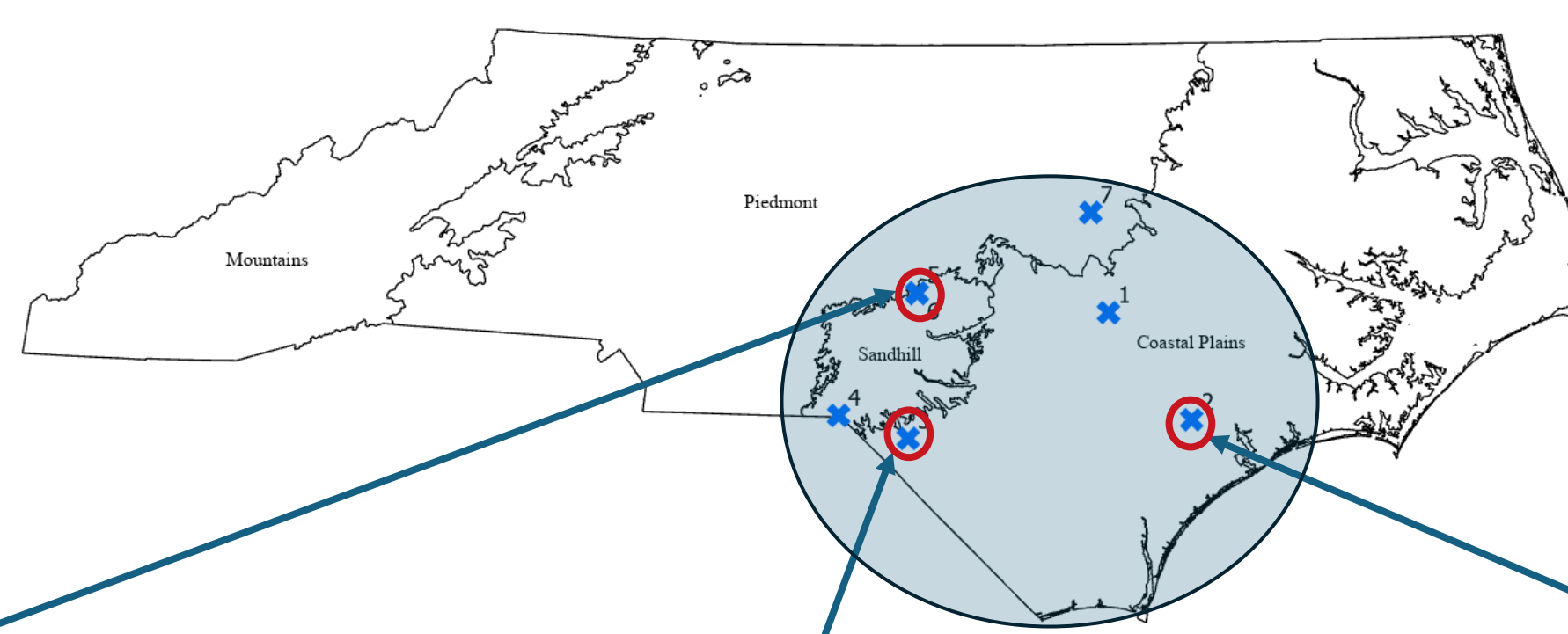


Figure 1. Experimental plots harvested in October (a) and January (b) in three different locations.

RESULTS AND DISCUSSION

Nutritive Value of the Leaf and Stem Components

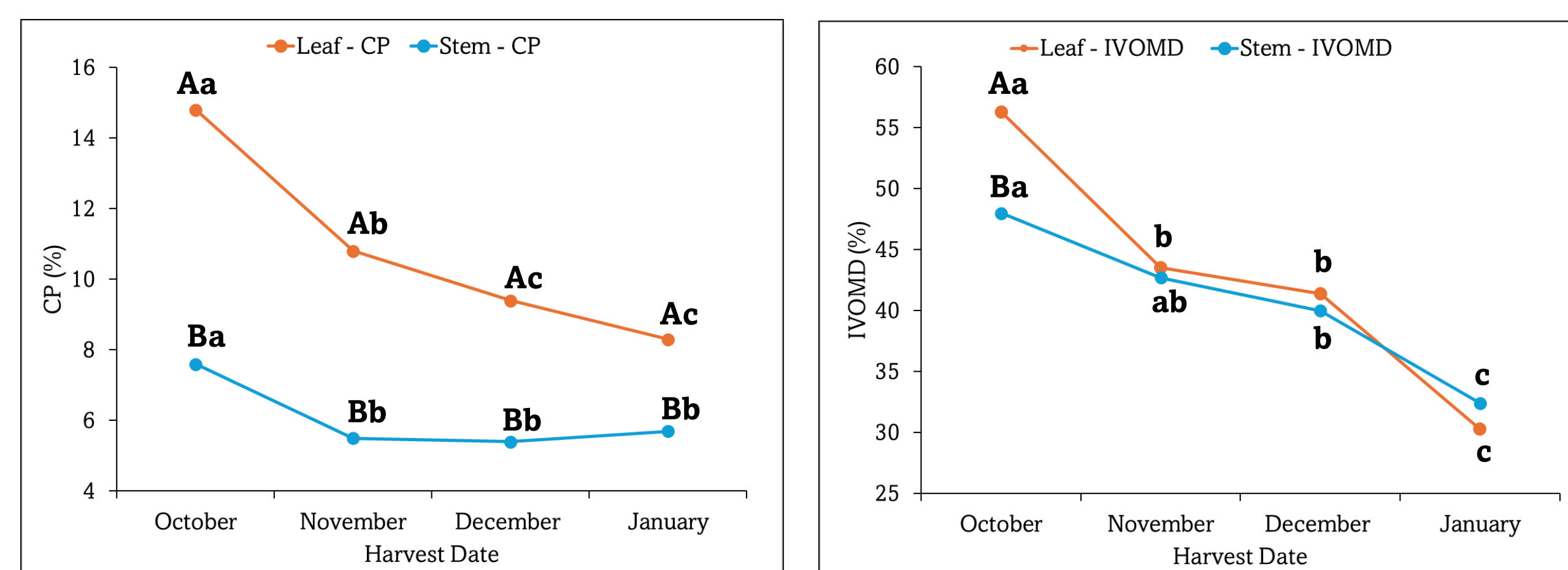


Figure 2. Crude protein (CP) (left figure) and in vitro organic matter digestibility (IVOMD) (right figure) as a function of harvest date. Means sharing a common letter are not statistically different (i.e., $p < 0.05$). Uppercase letters compare components by harvest date; lowercase letters compare harvest dates by component.

The CP concentrations were consistently higher in leaves than stems and declined with seasonal progression. In contrast, IVOMD was greater in leaves only in October, whereas by January it was lowest and did not differ between plant components (Fig. 2).

Herbage Mass

Herbage mass (HM) increased with increasing N rates at all harvest dates, although the response magnitude declined by approximately twofold from October to January (Fig. 3). Lower HM in January is primarily attributed to leaf losses, as evidenced by lower leaf-to-stem ratios.

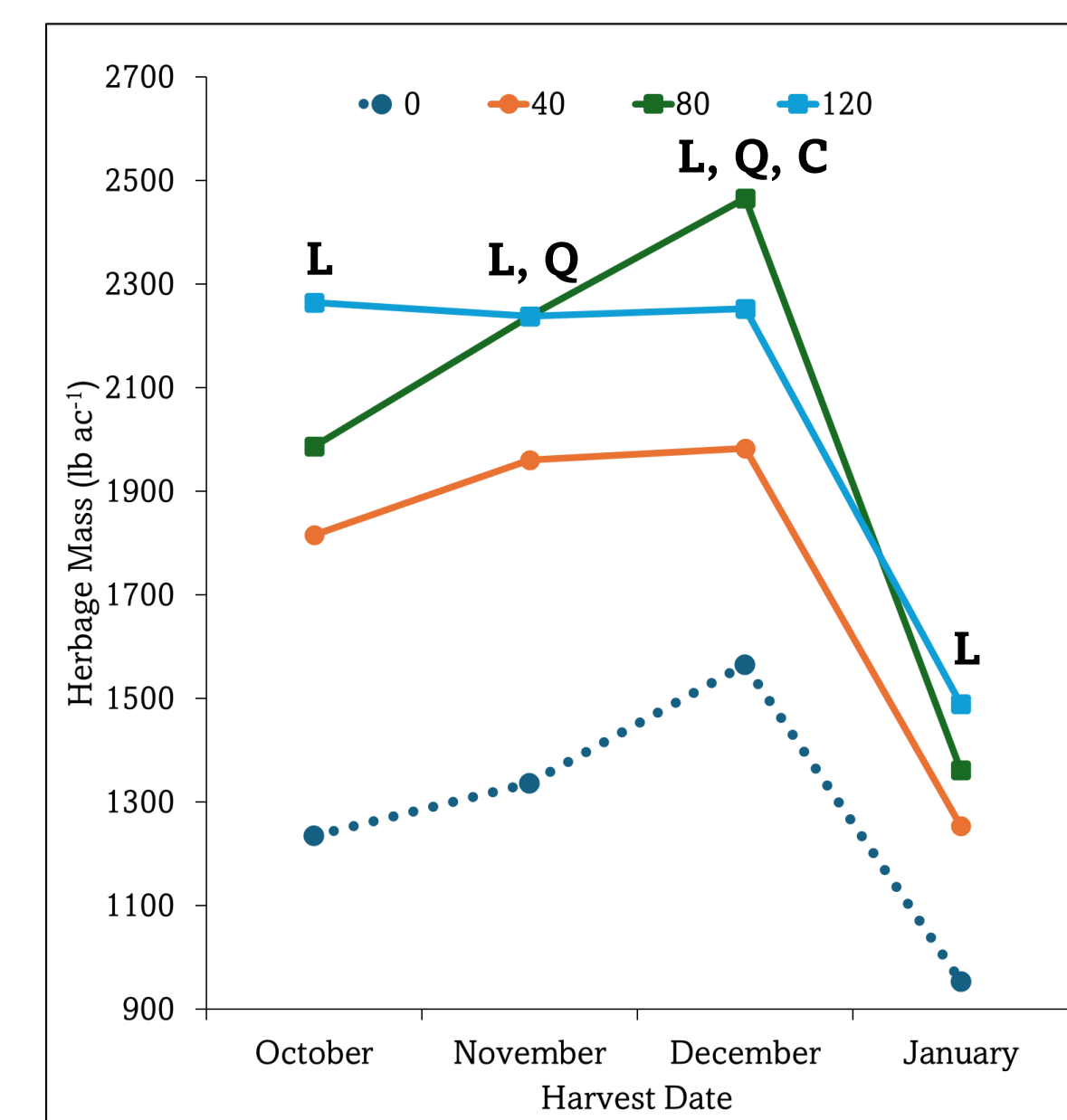


Figure 3. Herbage mass of bermudagrass as a function of harvest date and N fertilizer rate (0, 40, 80, and 120 lb ac⁻¹). Letters represent significant orthogonal polynomial contrast (L, linear; Q, quadratic; C, cubic) for the effect of N fertilizer rate within harvest dates. Data are means of seven environments across the NC Coastal Plain physiographic region.

Fertilizer Nitrogen Recovery Efficiency

Fertilizer Nitrogen Recovery Efficiency (FNRE) decreased with increasing N rates and as harvest was delayed from October to January (Table 1). Overall, greater FNRE was observed at earlier harvests and lower N rates, while the decline in January is likely associated with leaf losses, as indicated by reduced leaf-to-stem ratios (data not shown).

Table 1. Fertilizer N recovery efficiency as a function of harvest date and N fertilizer rate.

Harvest date	N rate (lb ac ⁻¹)		
	40	80	120
October ^a	31Aa	21Ba	21Ba
November	31Aa	20Ba	14Cb
December	19Ab	21Aa	13Bc
January	13 c	10 b	9d
SE ^b	20	20	22

^a Means not sharing any letter are statistically different, i.e., $p < 0.05$.

^b Standard error

Uppercase letters compare N fertilizer rates within harvest date;

lowercase letters compare harvest dates within N fertilizer rate.

Tissue Nitrate-N Concentration

Plant tissue nitrate-N concentrations responded to both harvest date and N rate, yet all values remained below toxicity thresholds, indicating no risk to livestock consumption (Fig. 4).

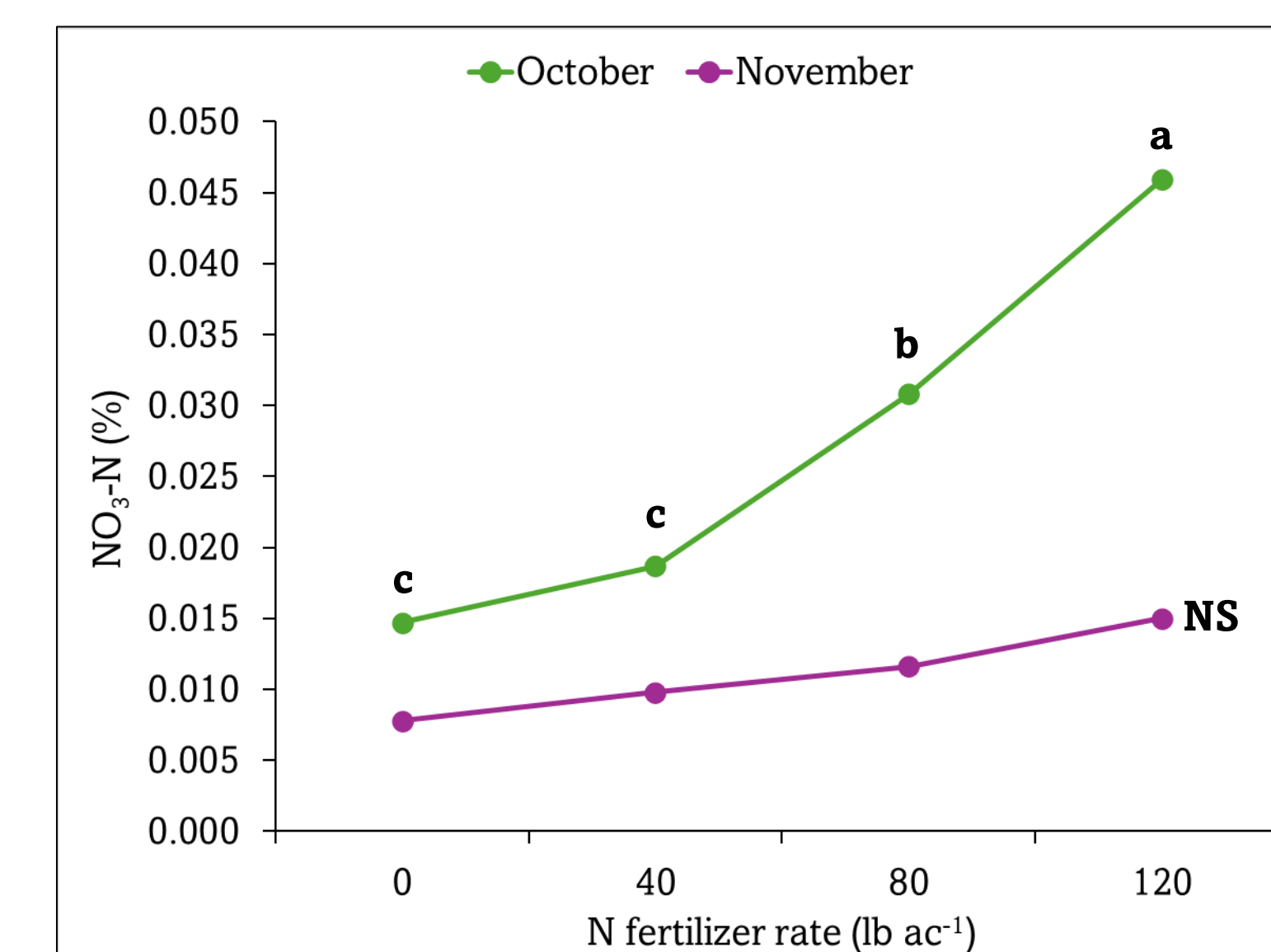


Figure 4. Tissue nitrate-N (NO₃-N) concentration as a function of harvest date (October and November) and N fertilizer rate. Means not sharing any letter are statistically different (i.e., $p < 0.05$) to compare N rates by harvest date. NS = not significant.

Nitrogen Removal

Nitrogen removal increased with N fertilization rate at each harvest date but was consistently lower in January than in October. This decline is likely associated with tissue losses, particularly leaves as reflected by lower leaf to stem ratio in January.

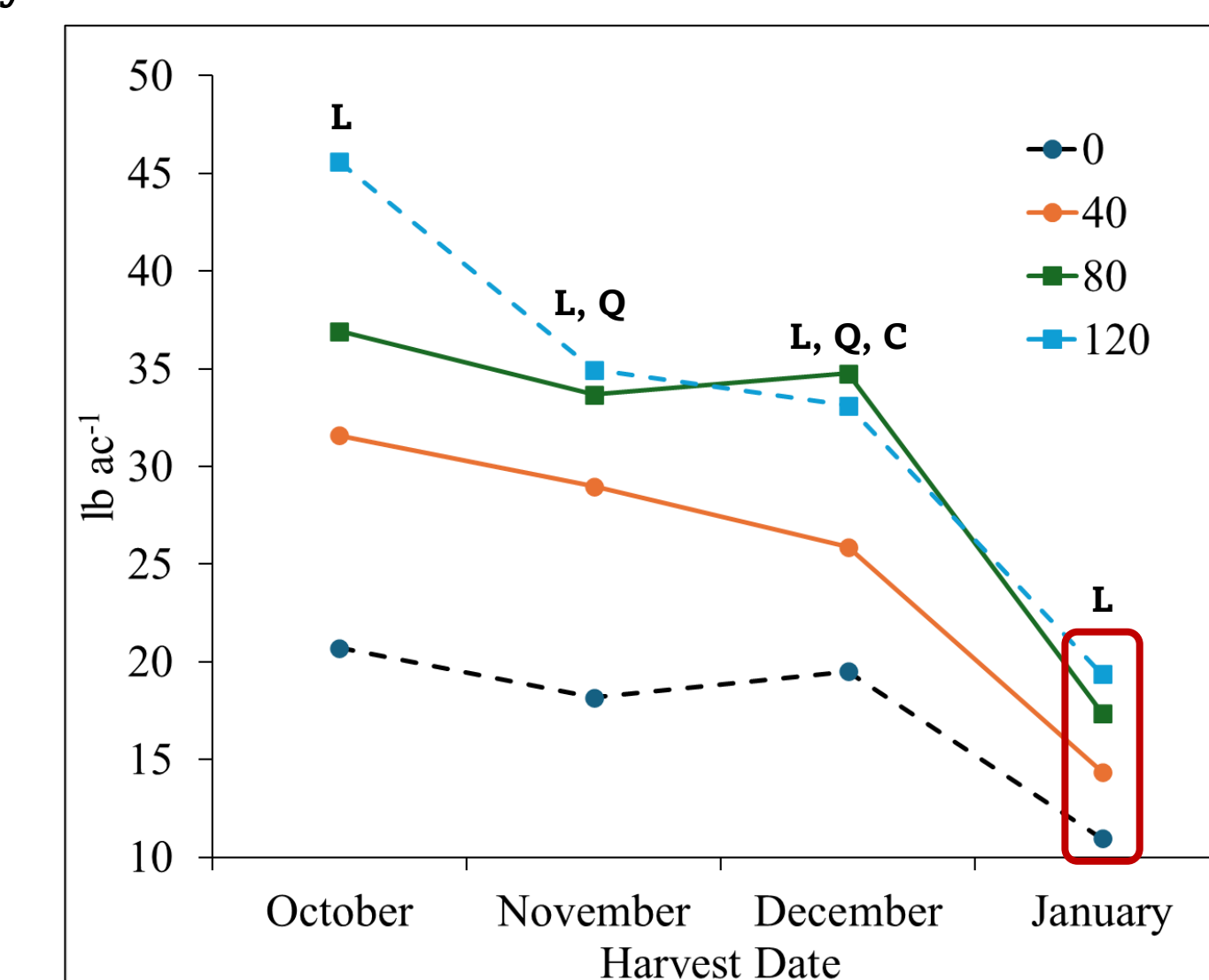


Figure 5. Nitrogen removal of bermudagrass as a function of harvest date (October, November, December, and January) and N fertilizer rate (0, 40, 80, and 120 lb ac⁻¹) from seven on-farm locations. Orthogonal polynomial contrast, L = linear; Q = quadratic and C = cubic for the effect of N fertilizer rate within harvest date.

CONCLUSIONS

- ✓ The leaf component consistently had greater nutritive value than the stem component; however, the leaf to stem ratio rapidly declined as harvest date was delayed from October to January.
- ✓ Nitrogen fertilization increased HM, N removal, and CP, but did not affect IVOMD and reduced FNRE.
- ✓ Delaying harvest from October to January consistently had negative effects on all response variables. Hence, stockpiled bermudagrass should be best utilized by October and, at most, December; January utilization will be of limited value to grazing livestock.
- ✓ Low IVOMD values indicate that energy supplementation will be required for most cattle grazing stockpiled forage at any date, and CP supplementation will be needed depending on livestock class.

ACKNOWLEDGMENTS

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