EFFECT OF PLANT AGE AND N AND P FERTILIZATION ON MINERAL COMPOSITION OF ANDROPOGON GAYANUS

D. E. Morillo[1], A. Caraballo1, J. Faría-Mármol1 and L. R. McDowell[2]

[1]Fondo Nacional de Investigaciones Agropecuarias, Apartado 1316, Maracaibo, Venezuela.

[2]Department of Animal Science, University of Florida, Gainesville, FL 32611-0691.

ABSTRACT

Mineral concentrations of *Andropogon gayanus* Kunth, as affected by age of regrowth, 42 and 63 days (six and four cuttings); rate (kg/ha/year) of N fertilizer, 0, 100 and 200, and of P2O5, 0 and 75, were evaluated on a sandy-loam Aridisol (pH 5.5) in Venezuela, using a split-split-plot experimental design with two replications. Forage mineral concentrations did not differ (P>0.05) among ages. Mean Ca, P, Mg, Na were: 0.20, 0.11, 0.10 and 0.029 %, and regarded as deficient for ruminants. Only K (1.21 %) was considered adequate. Mean Fe, Zn, Cu, Mn and Co were 57, 24, 2.7, 133 and 0.11 ppm, with severe Cu and Zn deficiencies. Fertilizer N did not influence (P>0.05) mineral composition. Forage P increased (P<0.05) and forage Co decreased (P<0.05) with P fertilization. Deficiency problems in ruminants consuming this forage are likely.

KEYWORDS

Andropogon gayanus, age, fertilizers, N, P, mineral composition, Venezuela.

INTRODUCTION

Andropogon gayanus Kunth is a promising forage grass for many ecosystems of tropical America, including the well-drained savannas of Venezuela, Colombia and Brazil; and humid sub-humid tropical forest of Central America (CIAT, 1992). The importance of this species lies in its high dry-matter yield, excellent adaptation to very infertile soils, moderate response to increased soil fertility and drought tolerance (Thomas and Grof, 1986). Mineral concentrations in plants are influenced by many soil and others factors such as stage of growth, plant parts, climate and fertilizer application (Minson, 1990). Elements most likely to be widely involved in mineral problems of grazing livestock in tropical areas are phosphorus, sodium, and copper (Underwood, 1981; McDowell, 1992). However, little information is available on mineral composition of A. gayanus growing in semi-arid regions. The objective of this study was to evaluate mineral concentrations of *A. gayanus* as affected by two ages of regrowth and different levels of N and P fertilization in a tropical dry forest in Venezuela.

MATERIALS AND METHODS

The experiment was conducted on an *A. gayanus* pasture located approximately 30 km southwest of Maracaibo, Venezuela (10½ 32' N and 71½ 42' W). Soil was a sandy loam Aridisol with pH 5.5. Average soil Ca, Mg, Na, K and P concentrations were: 0.6, 0.3, 0.1 and 0.17 meq/100g soil, and 6 ppm, respectively. Mean annual rainfall and temperature are 600 mm and 28 ½C, respectively. Total rainfall during the trial (252 days) was 453 mm. A split-split-plot experimental design with two replications was used. Treatments were determined through the factorial combination of two ages of regrowth, 42 and 63 days, in the main plots (108 m^2), three rates of N fertilization, 0, 100 and 200 kg/ha/year, in the sub-plots (36 m^2), and two of P, 0 and 75 kg P^2O^5/ha/year, in the sub-sub-plots (18 m^2). Nitrogen was divided in two similar urea applications, one at the beginning of the trial and the other one at the end of the rainy season. Phosphorus was supplied in a single application of triple superphosphate at the beginning of the study. In each plot, forage available 15 cm above the ground from one-m^2 area was cut using hand shears, weighed, and dried at 55½C. A subsample (ca. 0.5 kg) consisting of ten grab samples was processed for mineral analysis. Calcium, P, K, Mg, Na, Fe, Zn, Cu, Mn and Co were determined according to the procedures compiled by Fick *et al*. (1979). Data from six and four cuttings every 42 and 63 days, respectively were analyzed over the total evaluation period. An analysis of variance appropriate to the experimental design was used and least-square mean comparisons were conducted using Duncanís multiple range test. Results are discussed in relation to mineral requirements of grazing ruminants.

RESULTS AND DISCUSSION

Mean mineral concentrations of *A. gayanus* as affected by age of regrowth are given in Table 1. No differences between ages were detected (P>0.05). Since some elements such as P, Na, K and Cu usually tend to decrease with maturity (Minson, 1990; McDowell, 1992) a trend to stabilization after long regrowth intervals may have resulted. Plant age has also had inconsistent effects on most microelement concentrations (Underwood, 1981). Average Ca, P, Mg, Na, Zn and Cu as well as over 80 % of the individual values for these nutrients are inadequate for ruminants when compared to the critical concentrations for deficiency (CC) summarized by McDowell (1992), while mean K, Fe and Mn are considered adequate. These results are similar to those reported by Little (1989). Lower Ca, P and K and higher Mg values were found in *A. gayanus* pastures on an Ultisol in Venezuela (Faría-Mármol and Barreto, 1983). Nitrogen fertilizer rates did not influence (P>0.05) mineral concentrations of *A. gayanus*. Noller and Rhykerd (1974) concluded that the effect of N fertilizers on mineral uptake by plants are inconsistent. Applied P fertilizer (Table 2) influenced forage P concentration, which was increased (P-0.05) from 0.09 to 0.12 % with 98 % of deficient values, and forage Co, which declined from 0.13 to 0.10, with 61 % deficient values. Effect of applied P on forage P can be expected in is severely P-deficient soils (Whitehead, 1966).

Results of the present study may have been influenced by the relatively long cutting intervals, the low soil fertility of the experimental site and the low rainfall during the trial. Deficiencies of most minerals would be likely in ruminants fed this grass unless adequate mineral supplements are provided.

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Table 1
Average mineral concentrations (dry basis) of *Andropogon gayanus* as affected by the age of regrowthz.

Item	Age of regrowth, day% 42	63	Overall	SEy	CCx	below CC
Ca, %	0.20	0.19	0.20	0.01	0.30	91
P, %	0.11	0.11	0.11	0.01	0.25	98
Mg, %	0.10	0.11	0.10	0.06	0.18	97
K, %	1.2	1.2	1.2	0.06	0.60	11
Na, %	0.028	0.029	0.029	0.026	0.080	98
Fe, ppm	59	54	58	5	50	52
Mn, ppm	127	141	133	7	40	0
Zn, ppm	25	24	24	1	30	81
Cu, ppm	2.9	2.5	2.7	0.1	8	99
Co, ppm	0.11	0.12	0.11	0.01	0.10	61

z Least-square means based on 72 and 48 observations for 42 and 63 days, respectively, and
did not differ among ages, P>0.05.
y Standard error of the least-square means.
x Critical level for deficiency.

Table 2
Average mineral concentrations (dry basis) of *Andropogon gayanus* as affected by the rate of P fertilizer[z]

Item	Rate of P2O5, kg/ha/year 0	75	SEy	CCx
Ca, %	0.18	0.21	0.01	0.30
P, %	0.09a	0.12b	0.01	0.25
Mg, %	0.10	0.11	0.06	0.18
K, %	1.2	1.2	0.1	0.6
Na, %	0.028	0.030	0.026	0.080
Fe, ppm	54	59	4.6	50
Mn, ppm	138	130	7	40
Zn, ppm	24	24	1	30
Cu, ppm	2.8	2.6	0.3	8
Co, ppm	0.13b	0.10a	0.01	0.10

z Least-square means based on 60 observations.
y Standard error of the least-square means.
x Critical level for deficiency.
a, b Means on the same line with different superscripts differ, P<0.05.