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INITIAL BIOMASS PRODUCTION AND SOLUBLE CARBOHYDRATE PARTITIONING OF CONTRASTING ELEPHANTGRASS GENOTYPES

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Abstract

The initial growth and soluble carbohydrate (SC) partitioning were examined in the following classes of elephantgrass (*Pennisetum purpureum* Schum.) genotypes: *Dwarf* (Anão, Mott and Roxo); *Cameroon* (Cameroon, Cameroon Piracicaba and Vruckwona); *Embrapa hybrids* (CNPGL F27-5 and Pioneiro); *Interspecific hybrids* (Hexaploide 201, Mercker X 23-A and Napier X 23-A; *Mercker* (Mercker Comum, Mercker Pinda and Teresópolis); and *Napier* (E.C. Itapemirim, Mineiro and Napier). After a 60-day growing period, total, leaf, stem and root FW and DW and stem, stem base, leaf and root SC content were determined. Cameroon-class cultivars showed the highest leaf and stem DW and whole stem SC levels. Cv. Napier exhibited the highest stem base SC content, suggesting superior regrowth capability. Dwarf-class cultivars showed reduced leaf DW and low stem base SC levels, indicating poor regrowth potential. Embrapa hybrids were high on both leaf and root SC contents, and the implications of such an attribute need to be verified.

Keywords: biomass production, soluble carbohydrates, cultivars, elephantgrass, genotypes

Introduction

Interest on the utilization of elephantgrass in rotationally grazed systems for milk production is increasing in tropical regions. However, the species exhibits a seasonal growth behavior, with sharp drops in biomass production and forage quality during dry or cold seasons. Consequently, farmers are forced to seek other feeding strategies under those conditions, often rendering pasture management high in cost. Approaches to find the major causes for seasonal growth have led to conflicting conclusions (Passos, 1999).

It has been demonstrated that elephantgrass genotypes differ on dry matter and crude protein production (Santana et al., 1994). On the other hand, soluble carbohydrate levels in the basal portion of the stem are believed to directly affect plant regrowth capability (Passos, 1999). Leaf soluble carbohydrate contents, in turn, do decrease in response to reductions in temperature (Ito and Inanaga, 1988) and a possible relation of this pattern to growth inhibition should not to be ruled out. Further understanding of these relationships are hampered by the fact that carbohydrate levels have not yet been examined in distinct elephantgrass genotypes.

The purpose of this study was to verify the initial biomass production and soluble carbohydrate partitioning in contrasting elephantgrass genotypes as an assessment of their potential for subsequent forage production.

Material and Methods

The experiment was conducted in a randomized complete block design, with 17 treatments and four replications. Treatments consisted of the following morphologically distinct classes of elephantgrass cultivars: (A) *Dwarf*: Anão, Mott and Roxo Anão; (B) *Cameroon*: Cameroon, Cameroon Piracicaba and Vruckwona; (C) *Embrapa hybrids*: CNPGL F27-5 and Pioneiro, (D) *Interespecific hybrids*: Hexaploide 201, Mercker X 23-A and Napier X 23-A; (E)

Mercker: Mercker Comum, Mercker Pinda and Teresópolis; and (F) *Napier*: E.C. Itapemirim, Mineiro and Napier.

One-node stem sections were sprouted in aerated water and transferred, after eight days, to black plastic pots containing 5 kg of finely mashed red-yellow latosol (oxisol, pH 5.5) properly limed and fertilized. Plants were grown under greenhouse conditions (180-240 $\mu mol.m^{-1}.s^{-1}$ radiation, 12 h photoperiod, 27-30^{o}C, sprinkler irrigation triggered at 65±5% R.H. and below) for 60 days and then harvested for the evaluations. Soil was dried at greenhouse temperature and the root system carefully removed. Biomass production was measured through FW values of stems, leaves and roots and, after forced air oven drying (75^{o}C for three days), through their DW levels.

Samples of stems, leaves and roots were ground to a fine powder and determinations of soluble carbohydrate levels performed according to Passos et al. (1999). Levels in stem bases (basal 10 cm) were determined separately and these results subsequently pooled to the corresponding data from the remaining section of the stem in order to obtain whole stem soluble carbohydrate values.

The data were statistically analyzed and significant differences ($P<0.05$) were clustered by Scott-Knott grouping test.

Results and Discussion

Parameters related to biomass production are summarized in Table 1. There were significant differences in FW for all studied plant parts except the roots, with a trend for the highest means for cv. Vruckwona. Results on DW were similar among cultivars for the total plant tissue and roots. In turn, cvs. Cameroon Piracicaba and Hexaploide 201 exhibited the best leaf DW results, whereas all cultivars showed higher stem DW levels than cvs. Roxo Anão, Hexaploide 201 and Mott. The examination of soluble carbohydrate partitioning (Table 2) also revealed interesting trends. The highest contents were found as follows: cv. Napier for the stem base, cv. Vruckwona for the whole stem, cvs. CNPGL F27-5, Cameroon and Pioneiro for the leaves, and cvs. Pioneiro and CNPGL F27-5 as leading the superior cluster for the roots.

Our data indicate that, besides showing higher FW, genotypes with intense initial growth, such as the Cameroon-class cultivars, are prone to have higher leaf and stem DW and whole stem carbohydrate levels. Regrowth potential, as estimated by soluble carbohydrate content in stem bases (Passos, 1999), is more pronounced in cv. Napier, which, in contrast, shows lower whole stem soluble carbohydrate levels. All dwarf genotypes are low in leaf DW and exhibit the poorest stem base carbohydrate contents, confirming previous observations of limited long-term potential for utilization under grazing conditions (Rodrigues et al., 1987). On the other hand, Embrapa hybrids have greater leaf and root soluble carbohydrate levels, and further research is needed to verify possible implications of this pattern on long-term growth and forage quality.

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Table 1 - Biomass attributes of contrasting elephantgrass genotypes following a 60-day-growth period under greenhouse conditions[1].

Cultivar	Total FW (g)	Total DW (g)	Leaf FW (g)	Leaf DW (g)	Stem FW (g)	Stem DW (g)	Root FW (g)	Root DW (g)
Cameroon Piracicaba	326.7 C	69.5 A	123.6 A	26.6 A	149.3 B	25.7 A	33.6 A	14.0 A
Mineiro	399.3 C	76.8 A	104.5 A	21.8 B	192.0 A	39.9 A	46.3 A	17.0 A
Napier	448.6 B	78.8 A	111.1 A	22.1 B	200.9 A	33.2 A	64.0 A	18.4 A
Vruckwona	567.9 A	104.5 A	129.6 A	26.2 A	226.9 A	28.9 A	44.6 A	15.9 A
Hexaploide 201	393.0 C	57.7 A	115.9 A	17.0 C	124.7 B	14.5 B	38.3 A	10.6 A
Cameroon	438.1 B	77.5 A	117.5 A	22.8 B	195.1 A	24.5 A	32.9 A	11.1 A
Pioneiro	380.5 C	74.3 A	71.7 B	15.5 C	163.9 A	31.8 A	37.6 A	14.0 A
Anão	444.3 B	74.9 A	89.5 B	17.4 C	169.5 A	26.5 A	39.7 A	15.0 A
Mercker Pinda	384.6 C	69.3 A	72.5 B	15.1 C	176.8 A	32.2 A	43.7 A	14.6 A
Napier X 23-A	398.5 C	59.2 A	73.9 B	14.2 D	187.0 A	29.9 A	25.0 A	8.2 A
Roxo Anão	340.3 C	56.2 A	65.9 B	12.8 D	126.2 B	17.5 B	40.6 A	14.4 A
Teresópolis	377.4 C	70.9 A	68.6 B	13.8 D	157.6 A	28.0 A	50.8 A	13.5 A
Mercker Comum	392.7 C	79.1 A	85.7 B	17.1 C	169.6 A	30.3 A	60.5 A	20.6 A
CNPGL F27-5	341.4 C	64.5 A	62.6 B	13.2 D	138.3 B	23.9 A	35.0 A	12.7 A
E. C. Itapemirim	355.9 C	83.7 A	76.7 B	12.9 D	111.5 B	13.9 B	43.9 A	12.3 A
Mott	208.0 D	32.4 A	64.3 B	12.0 D	71.4 B	10.4 B	20.6 A	7.6 A
Mercker X 23-A	354.7 C	57.0 A	69.9 B	12.9 D	151.5 B	25.3 A	51.3 A	11.7 A

[1]For each column, means followed by the same letter are not significantly different by Scott-Knott grouping test.

Table 2 - Soluble carbohydrate partitioning ($mg.g^{-1}$) of contrasting elephantgrass genotypes following a 60-day-growth period under greenhouse conditions[1].

Cultivar	Stem Base	Whole Stem	Leaf	Root
Cameroon Piracicaba	68.1 E	128.6 C	62.3 B	16.6 B
Mineiro	87.7 C	123.6 C	46.3 B	16.7 B
Napier	139.3 A	107.3 C	56.0 B	16.8 B
Vruckwona	83.1 C	208.7 A	64.9 B	16.1 B
Hexaploide 201	88.5 C	154.7 B	82.6 A	17.7 A
Cameroon	84.6 C	166.8 B	54.2 B	15.8 B
Pioneiro	75.4 D	133.4 C	67.9 A	21.0 A
Anão	65.5 E	110.5 C	57.5 B	16.6 B
Mercker Pinda	102.1 B	98.7 C	49.0 B	17.0 B
Napier X 23-A	71.6 D	121.7 C	55.0 B	18.2 A
Roxo Anão	66.3 E	140.7 C	61.4 B	13.1 C
Teresópolis	109.3 B	132.9 A	51.1 B	16.2 B
Mercker Comum	72.1 D	90.7 C	53.4 B	13.8 C
CNPGL F27-5	62.5 E	117.4 C	83.8 A	19.2 A
E. C. Itapemirim	30.4 F	123.3 C	45.6 B	17.7 A
Mott	63.3 E	127.0 C	54.4 B	17.7 A
Mercker X 23-A	104.0 B	141.3 C	53.5 B	18.1 A

[1]For each column, means followed by the same letter are not significantly different by Scott-Knott grouping test.