Vegetative Growth And Maturation In Three Sugarcane Varieties

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Resumo

O objetivo foi comparar três cultivares (RB 72-454, RB 86-7515, IAC 86-2480), com relação aos parâmetros tecnológicos, biométricos, fisiológicos, bromatológicos e produtividade. As cultivares foram plantadas na UNOESTE, no esquema de blocos ao acaso. Para os parâmetros bromatológicos a cultivar IAC 86-2480 apresentou valores inferiores estatisticamente de fibra bruta, no entanto esta mesma cultivar apresentou teores superiores de extrativo não nitrogenado, nutrientes digestivos totais e material mineral. Para análise fisiológica a IAC 86-2480 foi classificada no grupo de menor transpiração (E). A IAC 86-2480 apresentou índices interessantes para uma cultivar de potencial forrageiro, contudo a baixa produtividade comprometeu este potencial. As cultivares não apresentaram diferenças estatísticas para biometria e tecnologia.

Palavras-chave: Cana-de-açúcar, biométricos, bromatológicos, fisiológicos.

Abstract

The objective was to compare three cultivars (RB 72-454, RB 86-7515, and IAC 86-2480), in relation to the technological, biometric, physiological, bromatological and productivity. The cultivars were planted at UNOESTE, in random blocks. For the bromatological parameters, the cultivar IAC 86-2480 presented statistically lowers values for crude fiber, however this same cultivars presented higher contents of nitrogen free extract, total digestive nutrients and mineral material. In the physiological analysis, the IAC 86-2480 was classified as the group with the lowest evaporation (E). The IAC 86-2480 presented interesting indices as a variety with potential for use in animal feed, however, its potential was undermined by the low productivity. The cultivars did not present any statistical differences for biometry and technological parameters.

Key words: biometric, bromatological, physiological, sugarcane.

Resumen

El objetivo fue comparar tres cultivares (72-454 RB, RB 86-7515, 86-2480 IAC) con respecto a los parámetros tecnológicos, la biometria, fisiológico y bromatológico. Los cultivares se sembraron en UNOESTE, en el esquema de bloques al azar. Para la bromatologia IAC 86-2480 mostraron valores estadísticamente inferiores de fibra cruda, sin embargo, este cultivar mostraron mayores niveles de extracto libre de nitrógeno, nutrientes totales digestivos y materiales minerales. Para analizar los efectos fisiológicos del IAC 86-2480 fue colocado en el grupo inferior de la transpiración (E). El IAC 86-2480 presenta las tasas de interés para un cultivar de potencial forrajero, pero la baja productividad ha comprometido este potencial. Los cultivares no mostraron diferencias estadísticamente significativas en la biometría y la tecnología.

Palabras-clave: caña de azúcar, biometria, fisiologia, tecnología.

1 INTRODUCTION

Brazilian sugarcane production in the 2011/2012 harvest is estimated at 588.9 million tons, cultivated in an area of 8.43 million hectares. This volume is 5.64% lower than the previous harvest of 623.9 million tons. 88.18% of the harvest in the country is grown in the South East region, and in the state of São Paulo, a harvest of 320.6 million tons is expected, for a farming area of 4.4 million hectares (CONAB, 2011). Alleoni *et al.* (1995), studying the variety RB 735275, associated biometry with productivity. Casagrande (1991) and Lima & Catâneo (1997) agree with the dependence of sugarcane productivity on the biometric variables, and believe these, in turn, are dependent on the environmental and genetic variables, and by extension, on location where the crop is grown. Various factors influence the production and maturation of the sugarcane, the main ones being edaphoclimatic interaction, crop management, and the variety selected (Cesar et al., 1987). Brazil is one of the most traditional sugarcane producing countries, and the crop can be grown all year round, almost throughout its territorial extension, with the exception of Amazonia and the States of Santa Catarina and Rio Grande do Sul. There are various soil types, which are influenced by the different climates, resulting in different production environments. This results in differentiated physiological characteristics, arising from the different genetic activities of the varieties (Dias, 1997). The factors which influence the production and quality of sugarcane require ongoing study, under different aspects. The objective of the trial was to compare three varieties of sugarcane (RB 72-454, RB 86-7515, and IAC 86-2480), in terms of their technological, biometric, physiological and bromatological parameters, in the West region of the state of São Paulo. The aim of these comparisons was to detect possible differences between these varieties, and determine their potential for industrial use, or animal feed.

2 MATERIAL AND METHODS

For this study, three varieties of sugarcane were used (IAC 86-2480, RB 86-7515 and RB 72-454). The varieties were planted in November 2006, in a research area in Campus II of UNOESTE. They were planted in random blocks, with three blocks and nine parcels, comprised of five lines of ten meters in length, spaced 1.3m apart. The analysis was subdivided in time (sample 1 – December; sample 2 – January; sample 3 – February; sample 4 – March; sample 5 - April) (3 varieties x 3 blocks x 5 samplings).

The following biometric analyses carried out were: Height of the plants during the growth process; Leaf area; Dry weight of the aerial parts; Dry weight of the roots, and upper and lower diameters of the stem.

After ten months of vegetative growth, the monthly technological analyses were begun, to determine the technological parameters (Residual Bagasse Weight -RBW, Fiber, Pol % in juice, Brix % in juice, Reducing Sugar – RS % in juice, Purity, Total Reducing Sugar – TRS % in juice, Pol in Sugarcane – PS, Brix in Sugarcane - BS, Reducing Sugar in Sugarcane – RS, Total Reducing Sugar in Sugarcane – TRS and Recoverable Total Sugar - RTS, according to Fernandes (2003).

The following physiological parameters were measured using a Hansatech FMS-2 modulated field fluorometer: quantum (Fv/Fm) and effective (ΔF/Fm') potential of the FSII, non-photochemical quenching coefficient [NPQ = (Fm-Fm')/Fm'] of the fluorescence, and electron transport rate (ETR = DFFF * ΔF/Fm' * 0.5 * 0,84, where DFFF used the density of the photosynthetic photon flux) (Bilger et al., 1995). The Fm and Fv values indicate maximum and variable fluorescences, respectively, determined after 30 minutes of adaptation to the dark, and Fm' indicates the maximum fluorescence of the plants in the presence of light. The measurements for gas exchanges (A, CO_2 assimilation, gs, stomatic conductance, E, evaporation, Ci, and intercellular CO_2 concentration) were carried out using a portable infrared gas exchange meter (model CIRAS-2, PPSystem, UK). Three samplings were carried out during the growth period. The measurements for fluorescence and gas exchange were carried out between 9:30 and 11:30 on days with no clouds, on totally expanded leaves, without signs of damage or nutritional deficiency.

The Leaf Area was determined using a portable leaf area meter (model LI-3000A, Li-Cor, USA).

The bromatological analyses were performed according to the methodology of Silva & Queiroz (1990) and showed the following variables (Mineral Material - MM, Lipids - EE, Crude Fiber – CF, Crude Protein – CP, Nitrogen Free Extract – NFE and Total Digestible Nutrients - TDN).

All the data were submitted to variance analysis (ANOVA, $p<0.05$) and to the Tukey measurement comparison test ($p<0.05$), according to Gomes (1990).

3 RESULTS AND DISCUSSIONS

The results obtained in the biometry did not present any statistical differences between the varieties tested for the variables of lower diameter, stem height, and leaf area, but only presented different behavior for the months, a fact which is in agreement with the results reported by Alleoni et al. (1995). The results were analyzed using the program ORIGIN 6.0, in order to observe these behaviors in graph form. The different varieties showed high growth, at that moment, which was relatively similar. Differences were observed in relation to upper diameter, with variety RB 86-7515 presenting faster growth in upper diameter (Figure 1). In the statistical analysis, the upper diameter was the only biometric variable which presented differences, RB 86-7515 and RB 72-454 being those which presented the largest diameters, and as reported by Lima & Catâneo (1997) the productivity of sugarcane depends on the biometric growth parameters, therefore good performance would be expected in these varieties.

In Table 1 the results for the technological parameters and % of leaves did not show any statistical differences at a level of 5%. However, the parameter agriculture productivity did present statistical differences, and these results partially disagree with those cited by Landell (2002), who reports that the variety IAC 86-2480 has good agriculture productivity and excellent technological characteristics, with all varieties showing good agriculture productivity. However, variety RB 72-454 produced, on average, 20 to 25 tons more stem and 24 to 30 tons more biomass. As the crop management was the same for the varieties studied, it can be inferred that the edaphoclimatic conditions in Presidente Prudente, as reported by Cesar et al. (1987), promote similar technological contents to the three varieties studied.

In the bromatological parameters, the variety IAC 86-2480 presented higher values for NFE (nitrogen free extract) and TDN (total digestible nutrients) and MM (mineral material), and was also classified as the variety with the lowest crude fiber - interesting factors for its use as animal feed, and which are in agreement with the findings of Vilela & Melo (1992), who obtained higher gains in weight when using the variety IAC 86-2480 in cattle feed, due to the higher digestibility values and lower fiber contents, even when compared with the use of up to 10% more in the variety RB 72-454.

In the physiological parameters studies, only E (evaporation) showed a statistical difference, with RB 86-7515 presenting higher values, a fact which is in agreement with the results reported by UDOP (2007), who state that variety has rapid growth, tolerance to drought, and adapts well to sandy soils.

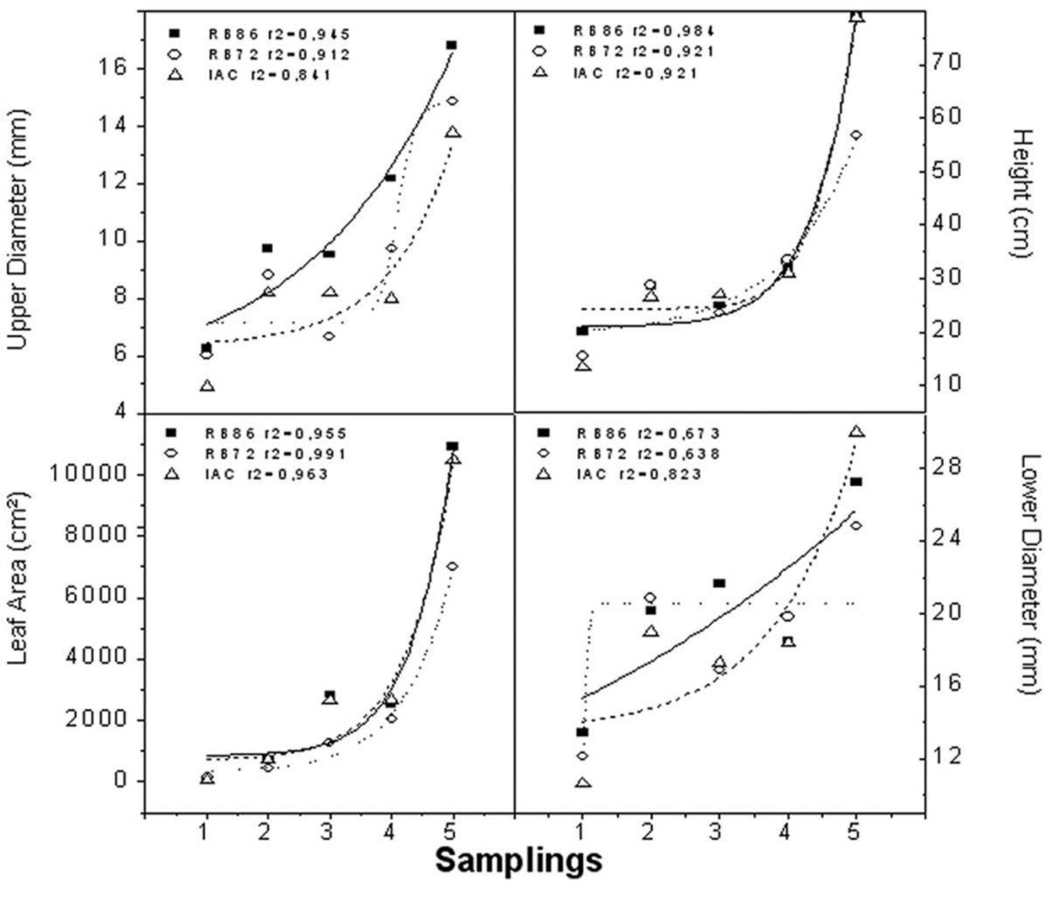

Figure 1 - Presentation of the curves obtained from the biometric results, according to their respective samplings.

Table 1 - Results obtained for the parameters evaluated.

Parameters Evaluated	Technological			General Average
	RB		IAC	
	86-7515	72-454	86-2480	
	Varieties			
RBW	147,8	144.4	142.9	145,0
FIBER (%)	12.7	12.5	12.3	12.5
BRIX (% in juice)	18.1	17.3	17.7	17.7
POL (%in juice)	11.9	11.9	11.6	11.6
PURITY (%in juice)	65.7	65.8	65.1	65.5
RS (%in juice)	1.4	1.4	1.5	1.4
TRS (% in juice)	13.9	13.4	13.6	13.6
BS	15.1	14.5	15.0	14.9
PS	10.0	9.6	9.8	9.8
RS	1.2	1.2	1.2	1.2
TRS	11.6	11.3	11.4	11.4
RTS	102.2	98.9	100.7	100.6
	Leaves (after nine months)			
Leaf Area(cm^2)	442.3	403.9	224.8	357.0
Dry Material (g)	**659.0^A**	**620.4^{AB}**	**434.5^B**	**571.3**
	% leaves and productivities			
% leaf	7.95	9.17	9.33	8.81
Stem (t ha^{-1})	**120.00^B**	**145.83^A**	**123.5^B**	**129.77**
Leaf (t ha^{-1})	10.3	14.66	11.08	12.01
Biomass (t ha^{-1})	**130.33^B**	**160.5^A**	**136.5^B**	**142.44**
	Biometrics			

Upper Diam. (mm)	**$10,88^{A}$**	**9.20^{AB}**	**$8,60^{B}$**	**9,56**
Lower Diam. (mm)	20,16	23,93	19,05	21,04
Height (cm)	41,33	31,62	35,37	36,10
Leaf Area (cm^2)	3397,40	2165,50	3310,67	2957,85
		Bromatological (%)		
DM	30.93	30.88	30.72	30.34
LIPIDS	0.42	0.53	0.25	0.40
MM	2.29^{B}	2.85^{A}	2.76^{A}	2.6
CF	**23.13^{A}**	**23.60^{A}**	**19.42^{B}**	**22.05**
CP	1.69	1.57	1.48	1.58
NFE	**72.47^{AB}**	**71.44^{B}**	**76.09^{A}**	**73.33**
TDN	**57.86^{AB}**	**57.18^{B}**	**61.71^{A}**	**58.92**
		Physiological (gas exchanges)		
E mmol H_2O m^{-2} s^{-}	**$4,21^{A}$**	**$3,40^{B}$**	**$3,49^{AB}$**	**3,7**
gs mmol m^{-2} s^{-1}	192,33	164,61	152,95	169,93
A µmol CO_2 m^{-2} s^{-1}	25,49	17,40	16,76	19,88
EUAµmolCO_2mmol H_2O^{-1}	7,28	8,89	5,76	7,31
		Physiological (chlorophyll-a fluorescence)		
ΔF/Fm'	0,23	0,28	0,32	0,28
NPQ	1,25	1,43	1,2	1,29
ETR µmol electrons m^{-2} s^{-1}	137,11	155,66	135,99	142,92
Fv/Fm	0,76	0,78	0,75	0,76

Upper case letters denote the difference between the varieties studied at the level of 5%, by the Tukey test

4 CONCLUSIONS

-The variety IAC 86-2480 presented bromatological indices which were more in keeping with those of varieties with potential for use in animal feed;

-The varieties tested don't present statistical differences for the biometry and technological parameters.

-Due to the lower productivity index, the use of the variety IAC 86-2480 is considered inappropriate.

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