Estimated productivity of sugarcane through the Agro-Ecological Zone method

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ABSTRACT

The estimate of the potential sugarcane productivity through agroclimatic models aids in the agricultural planning of the crops and the quantification of the yield for a given region. For these estimated values to be considered robust there is a need for validating the performance of such models in different areas and agricultural varieties. Hence, the aim of this study was to validate the Agro-Ecological Zone (AEZ) method with fifteen sugarcane varieties in the region of the Vale do São Patrício, state of Goiás, Brazil. We evaluated the data referring to the cane-plant (one-and-a-half-year sugarcane), as well as the first and second sugarcane ratoons (both with one-year cycles) in an irrigated and dry farming system. The productivities obtained in dry farming were corrected due to the occurrence of a water deficit in the crop. The results indicated that the AEZ method presented productivity estimates more satisfactory for the one-year cultivation cycles (ratoon cycles) for all varieties studied, with the model adjusting best to the CTC15 variety (RMSE = 8.70 t ha^{-1}; MAE = 6.05 t ha^{-1}; d = 0.99).

Keywords: bioenergy; water deficit; water balance; agricultural planning; harvest forecast.

INTRODUCTION

The enhancement of the sugarcane sector needs tools that aid in predicting yield in different regional scales, aiming at improving the productive process, collaborating with strategic decision-making throughout the harvest, and contributing with the continuity of development of the sector (Scarpari & Beauclair, 2009).

The use of prediction models that consider soil, climate, and plant parameters in the agrosystem modeling is recommended for sugarcane by some authors (see Oliveira *et al.*, 2012a; Caetano & Casaroli, 2017) as it allows reliable productivity estimates. The sugarcane production system is high affected by climatic conditions (Loarie *et al.*, 2011; Marafon, 2012; Oliveira *et al.*, 2012a; Marin & Carvalho, 2012). Among the climatic factors that determine sugarcane productivity are solar radiation, temperature, and water availability, which interfere with the accumulation of biomass at the stem (Inman-Bamber *et al.*, 2002).

Specifically, sugarcane shows satisfactory growth when grown in areas exposed to solar energy from 18 to 36 MJ m^{-2} d^{-1}, photoperiod between 10 and 14 hours (Monteiro, 2012) and air temperature between 25 and 35 °C (Doorenbos & Kassam, 1979). The water demand for sugarcane is in the range of 1,500 to 2,500 mm evenly distributed during development (Doorenbos & Kassam, 1979).

There are several prediction models in the scientific literature used to estimate the productivity of sugarcane, such as CANEGRO (Thompson, 1976), CANESIM (Singels & Donaldson, 1998) and APSIM-Sugarcane (Bull & Tovey, 1974). One of the most employed agrometeorological models for harvest forecasting and widely used with sugarcane is the Agro-Ecological Zone method by Food and Agriculture Organization – FAO (Doorenbos & Kassam, 1979). This methodology stands out due to its low requirement of input data (e.g., meteorological and crop data), presenting results close to reality (Oliveira *et*

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al., 2012b) and having as a premise the absence of limitations in terms of the mineral nutrition of the plants and damages caused by diseases and, or, pests (Barbieri & Silva, 2008). However, the potential productivity estimated by this model may still be penalized by water deficit, optimizing the estimate of real productivity (Gouvêa *et al.*, 2009).

The state of Goiás, Brazil, is the second leading national producer of sugarcane (Companhia Nacional de Abastecimento - Conab, 2020) and presents a vast potential for the expansion of this crop. This is due to the lower cost of lands when compared to traditional areas of occupation of the crop (e.g., São Paulo), besides the suitable terrain, infrastructure, and average distance to the main consumer markets (Silva & Miziara, 2011). On the other hand, Goiás presents disadvantages compared to the state of São Paulo such as a more significant water deficit (Marin & Nassif, 2013; Araújo *et al.*, 2016), and difficulty in the adoption of varieties adapted to the edaphoclimatic conditions of the region (Campos *et al.*, 2014a, 2014b).

In Goiás, the sugarcane varieties used commercially are still imported from breeding programs developed in other states, mainly São Paulo and Minas Gerais (Rede Interuniversitária para o Desenvolvimento do Setor Sucroalcooleiro – RIDESA, 2010). According to the sugarcane varietal census conducted by the Instituto Agronômico de Campinas (IAC), the most cultivated variety in the state of Goiás is RB86-7515, representing 20.1% of the varieties planted in the region. This variety was launched in the late 90s and developed, therefore, in the pre-mechanized period of planting and harvesting. However, the census also indicated that new varieties (for example, CTC4) are being incorporated, which means that genetic diversification and more modern materials are entering the fields (Braga Júnior *et al.*, 2019).

The hypothesis for the study is: i) the Agro-Ecological Zone method is suitable to estimate the productivity of the sugarcane cultivated in state of Goiás. The aim this study was to apply the Agro-Ecological Zone method in different sugarcane varieties cultivated in the Cerrado of Goiás under irrigated and dry systems to determine which varieties have their productivities better estimated for the region of study, given that the knowledge of such data contributes to the validation of the performance of this model. Also, we investigated which variety presented superior productivity for the studied conditions, seeking to identify which one shows the best suitability to the region's climate.

MATERIAL AND METHODS

The experiment was conducted with fifteen commercial sugarcane varieties, with the collection of productivity data referring to the harvest years of 2011/12 (cane-plant), 2012/13 (first sugarcane ratoon), and 2013/14 (second sugarcane ratoon). The experimental area was located in the municipality of Goinésia, GO, Brazil (15º12'S; 48º59'W; altitude of 580 m), which has a climate of type Aw according to Köppen, denominated savanna tropical and characterized by a dry winter (May-October) and rainy summer (September-April). The municipality presents an average annual rainfall of 1,519 mm. During the experiment, the average maximum and minimum air temperatures were 30.8 and 19.2 °C, respectively, and the average accumulated rainfall per harvest year was 1,136.7 mm (Figure 1). Plants were cultivated in Oxisol Hapludox, corresponding to a Red Yellow Latosol distrophic (Empresa Brasileira de Pesquisa Agropecuária – Embrapa, 2006).

For installation of the experiment the area was prepared 180 days before. Soil chemical and physical analysis was made in the layers: 0-0.5 and 0-0.60 m, respectively. For reach base saturation of 50%, dolomitic limestone was applied and incorporated with soil tillage (heavy harrow). Then, phosphate (P_2O_5) and gypsum were applied, 100 kg ha^{-1} and 2,250 kg ha^{-1}, respectively, and incorporated with breaking of clods and with leveling disk harrow.

In sugarcane planting (April 29th, 2011) was applied 115 kg P_2O_5 (triple super phosphate) ha^{-1} and 0.05 kg ha^{-1} of Phipronil insecticide 800 WG in furrow (deep of 0.35 m), and used stalks with three vegetative buds in line. Then was applied irrigation depth of 40 mm to stimulate sugarcane growth.

In the harvest years of 2011/12 and 2012/13, the entire experimental area was irrigated with the objective of supplying 50% of the water need of the crop. For irrigation management, carried out with the aid of the Irriger® application, we used temperature and relative air humidity, solar radiation, and wind speed data stemming from an automatic meteorological station located 4.0 km from the experimental area. in the harvest year of 2013/14, the sugarcane was cultivated without the use of irrigation.

The replenishment of water was performed from a self-propelled irrigation bar of model Turbomaq 140/GSV/350-4RII, with an application range of 54 m, with a free span from the bar to the ground, varying between 1.0 - 4.0 m. We used the LDN Spray-type sprinkler with Senninger # 21 nozzles and 20 psi Senninger pressure regulator.

The experimental design used was of random blocks. The treatments consisted of fifteen commercial sugarcane varieties of distinct agronomic characteristics (Table 1), with four repetitions. The experimental parcels were composed of four lines, with 15 m of length and a spacing of 1.5 m (90 m^2).

For the sugarcane productivity estimate, we used the Agro-Ecological Zone (AEZ) method – FAO Model (Doorenbos & Kassam, 1979):

$$PP = PPB_P \,.\, C_{LAI} \,.\, C_R \,.\, C_C \,.\, C_M \,.\, N_D \quad (1)$$

where PP is the potential productivity (t MS ha^{-1} d^{-1}), PPB$_P$ is the gross photosynthetic yield of dry matter from a standard crop (t MS ha^{-1} d^{-1}); C$_{LAI}$ is the correction of the leaf area index (for LAI < 5, $C_{LAI} = 0.0093 + 0.185\,LAI – 0.0175\,LAI^2$; and for LAI $\geq$ 5, C_{LAI} = 0,5); C$_R$ is the correction for breathing losses (maintenance and growth), (for T < 20 °C, $C_R = 0.6$; and for T $\geq$ 20 °C, $C_R = 0.5$); C$_C$ is the correction for the harvested part of the crop, (sugarcane $C_C = 0.75$); C$_M$ is the correction to consider the moisture of the harvested part (sugarcane $C_M = 0.8$); and N$_D$ is the total period of the crop cycle (days).

The potential productivity of the second sugarcane ratoon was corrected due to the occurrence of a water deficit, thus obtaining an achievable productivity (PR, t ha^{1} d^{-1}):

$$PR = PP \,.\, \left[1 - K_y \,.\, \left(1 - \frac{ETR}{ETc}\right)\right] \quad (2)$$

where k$_y$ is the factor of sensitivity to the water deficit of the crop in each development stage (adopting for sugarcane 0.75; 0.5; and 0.1 for the stages sprouting, establishment, and vegetative growth; crop formation; and maturation, respectively), ETR is the actual evapotranspiration (mm d^{-1}), and ETc is the crop evapotranspiration (mm d^{-1}). The ETc was obtained through the product of the reference evapotranspiration (ETo, mm d^{-1}), determined using the Penman-Monteith method (Allen *et al.*, 1998), with the crop coefficient (Table 2).

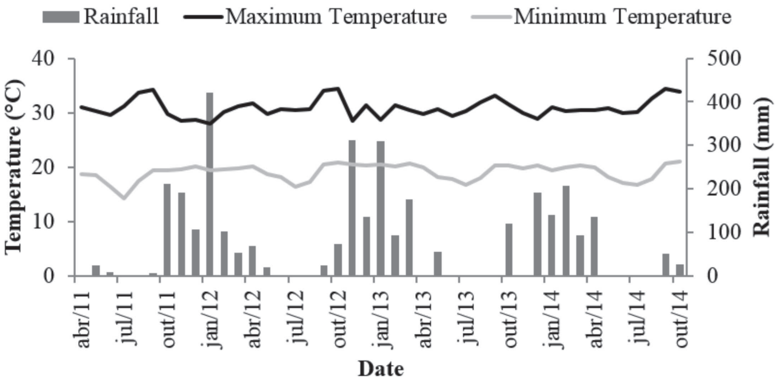

Figure 1: Maximum and minimum air temperatures and accumulated rainfall during the experiment, Goianésia, GO, Brazil.

Table 1: Agronomic information of sugarcane varieties used in the experiment

Treatment	Variety	Varietal characteristics				
		Height	**Average diameter**	**Tillering**	**Productivity**	**Cycle**
T 1	CTC2	M*	M	M	H	M
T 2	CTC4	M-H	F-M	M-H	H	M
T 3	CTC9	M	M	M	M	E
T 4	CTC11	M	M	H	H	M-C
T 5	CTC15	M	M	M-H	H	M-C
T 6	CTC18	H	M	M-H	M	E-M
T 7	IAC87-3396	M-H	M	M	M-H	E-M
T 8	IAC91-1099	M	M	H	M-H	E-M
T 9	IACSP94-2094	M	F	H	M	M-C
T 10	IACSP94-2101	M-H	F-M	M-H	M	M-C
T 11	IACSP95-5000	M-H	M	M	M-H	M-C
T 12	RB867515	H	M	M	H	M-C
T 13	RB92579	H	M	H	H	M-C
T 14	RB966928	M	M	H	H	E-M
T 15	SP86-0042	M	M	M	M	M-C

*M: medium. H: high, M-H: medium to high, F: fine, F-M: fine to medium, E: early, C: coarse, E-M: early to medium, M-C: medium to coarse.

Source: Centro de Tecnologia Canavieira - CTC (2011), Landell *et al*. (2005, 2007), Rede Interuniversitária para o Desenvolvimento do Setor Sucroalcooleiro – RIDESA (2010), Copersucar (2003).

The ETR was obtained through the daily sequential water balance (Thornthwaite & Mather, 1955). For the daily sequential water balance, we used the value of the available water capacity (AWC) equal to 71.47 mm, with this value having been obtained from physical-water analyses of the soil and Equation 3:

$$AWC = (FC - PWP) . Z \tag{3}$$

where FC is field capacity ($cm^3 cm^{-3}$), PWP is permanent wilting point ($cm^3 cm^{-3}$), and Z is average effective depth of the root system (mm) of the sugarcane varieties studied (Z = 600 mm).

The sugarcane harvest was performed mechanically, with the first cut occurring on September 7th, 2012, and the second and third cuts on September 13th, 2013, and October 16th, 2014, respectively. A crawler harvester (John Deere model 3510) was used and a transhipment truck with a high-flotation tire and a load cell device with a display positioned inside the truck cabin. The mass was determined from the harvest of each line. On the harvest date, ten industrialized cane stalks was collected for the determination of technological analyzis (Bidoia & Bidoia, 2008). These stalks were cut, and sent to the laboratory. To determine the chemical parameters, Consecana's methodology (Conselho dos produtores de cana-de-açúcar, açúcar e etanol do Estado de São Paulo – Consecana, 2006) was used.

We performed an analysis of variance ($\alpha = 0.05$) on the productivity data of the different varieties, considering the cane-plant and ratoon cycles and only the ratoon cycles, and comparing the means using the Tukey test at 5% error probability. The performance of the results of the AEZ method was tested from Pearson's correlation coefficient (r), the root-mean-square error (RMSE), the mean absolute error (MAE), and the Willmott's agreement index (d). RMSE and MAE are used to measure the ability that numerical models have in reproducing reality, with values equal to zero indicating perfect simulation. As RMSE and MAE are little affected by outliers, they are considered precise and robust measures. Another advantage is that they have the same dimensions as the analyzed variable (Fox, 1981). Willmott's agreement index expresses the quality of the adjustment (accuracy) which is related to the approximation of the estimated values in relation to those observed. Their values range from zero to 1 indicating no agreement and perfect agreement, respectively (Willmott, 1985). Also, we determined the error (E, %) among the observed (v_o) and estimated (v_e) values:

$$E\% = \frac{|V_o - V_e|}{V_o} . 100 \tag{4}$$

Table 2: Values for the sugarcane ratoon crop coefficient (Kc)

Crop age (months)	Development Stage	Crop Coefficient (Kc)
0-1	From planting until 0.25 of cover	0.55
1-2	From 0.25 to 0.50 of cover	0.80
2-2.5	From 0.50 to 0.75 of cover	0.90
2.5-4	From 0.75 until complete cover	1.00
4-10	Maximum utilization	1.05
10-11	Beginning of maturation	0.80
11-12	Maturation	0.60

Source: Allen *et al.* (1998).

RESULTS AND DISCUSSION

From the analysis of variance of the productivities, one may observe that the varieties did not statistically differ among themselves ($p > 0.05$) in terms of productivity, for all the cycles investigated.

Campos *et al.* (2014a) recommend the cultivation of varieties IAC91-1099 and CTC15 in a regime of supplementary irrigation, for the Cerrado region, for presenting satisfactory productivity and industrial yield. Silva *et al.* (2014) assessed the agroindustrial productive potential of eight sugarcane varieties irrigated during two harvest years in the area of Jaú, SP, Brazil, and found that, among other cultivars, IAC91-1099 stood out positively in terms of productivity. In the second cut, the variety presented productivity over 115 t ha^{-1} for the one-year cycle.

The potential productivity values of sugarcane for the plant, first ratoon, and second ratoon cycles were estimated through the AEZ method and compared with the average productivities (Figure 2), and its performance was tested (Table 3).

The AEZ method overestimated the potential productivity values for the plant cycle (one-and-a-half-year sugarcane) in all varieties investigated, while for the ratoon cycles (one-year cycles), the estimated productivity values came close those observed in the field, with such data approximating the 1:1 line (Figure 2).

The variety that resulted in the most significant discrepancy in its productivity values estimated by the AEZ method was CTC18, presenting an RMSE of 100.32 t ha^{-1} and an MAE of 76.74 t ha^{-1}. In turn, the data estimated for CTC15 were those that best fit (RMSE = 60.07 t ha^{-1} and MAE = 40.37 t ha^{-1}) (Figure 2). This amplitude in the estimate observed from the calculation of the errors may not be interesting since it does not collaborate with decision-making in production processes. Despite the errors having been considered high, according to the Pearson coefficients the data estimated correlated satisfactorily with those observed and also presented performance varying from good to excellent according to Willmott's agreement index (Willmott *et al.*, 1985). Such results reinforce the importance of evaluating the performance of the productivity estimation model in relation to the productivity data obtained in the field based on different statistical indices.

To determine if there was a significant difference between the productivity data estimated by the AEZ method and those observed, we performed the analyses of variance. We observed that the values observed did not statistically differ from those estimated ($p > 0.05$), thus corroborating with Willmott's agreement index.

Although it is a generic model, the AEZ method has been used in different studies as a sugarcane harvest forecasting tool (Marin & Carvalho 2012; Gouvêa *et al.*, 2009), presenting results of quite satisfactory estimates.

Marin & Carvalho (2012) evaluated the performance of the sugarcane crop in the state of São Paulo, Brazil, through the potential productivity estimation model of AEZ and stated that such application may be used as a strategic tool in the agricultural sector, contributing for better taking advantage of the productive potential of the crop, given that it contributes to the definition of areas and varieties more suitable for a given region.

Although the analysis of variance, the Pearson coefficient, and the agreement index point to a reasonable

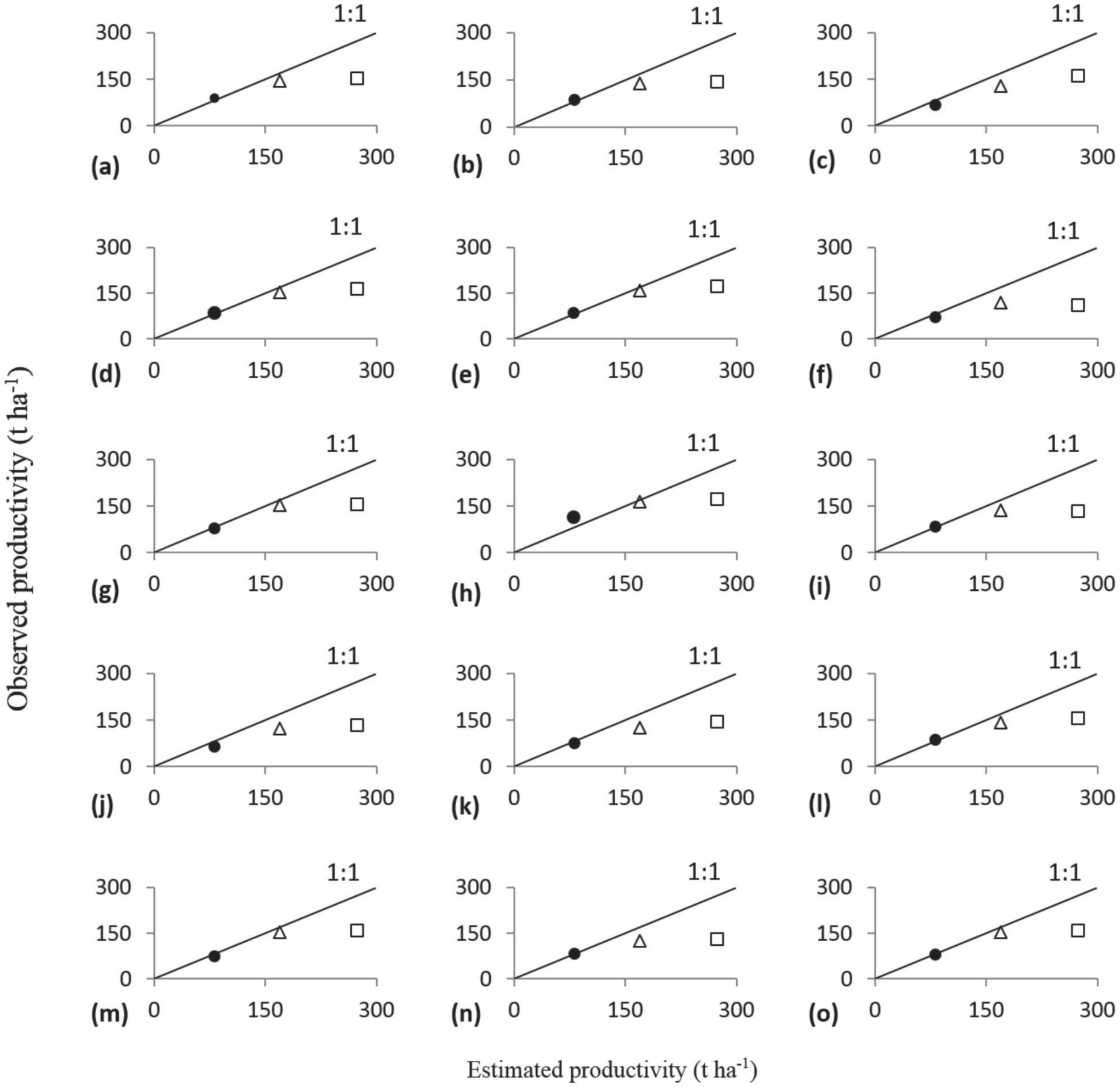

Figure 2: Relations among the productivities estimated by the Agro-Ecological Zone method and those observed for varieties CTC2 (a), CTC4 (b), CTC9 (c), CTC11 (d), CTC15 (e), CTC18 (f), IAC87-3396 (g), IAC91-1099 (h), IACSP94-2094 (i), IACSP94-2101 (j), IACSP95-5000 (k), RB867515 (l), RB92579 (m), RB966928 (n), and SP86-0042 (o) in the cane-plant cycle (□) and the first (△) and second (●) cycles of sugarcane ratoon, Goianésia, GO, Brazil.

adjustment of the model to the data, the values obtained by the AEZ method for the cane-plant cycle (one-and-a-half-year sugarcane) are overestimated (Figure 2), leading to the imprecision in the estimates. For the plant cycle, we found errors (Table 4) varying from 60.5% (CTC15 variety) to 151.6% (CTC18).

Caetano & Casaroli (2017) used the standard AEZ method with adjustments considering water deficit and productivity loss to estimate the productivity of sugarcane (cane-plant and cane-ratoon cycles) in Santo Antônio de Goiás (Goiás, Brazil). The results were also overestimated with RMSE and MAE ranging from 14.2 to 46.1 t ha^{-1} and 13.9 to 45.6 t ha^{-1}.

One hypothesis to justify the overestimation of the productivity obtained by the AEZ method for the one-and-a-half-year sugarcane is the fact that the model considers the total period of the crop cycle in days and assumes that, in this period, the plant accumulates dry matter. However, in the phenological phase of maturation of sugarcane, an intense accumulation of dry matter does not occur because the rate of vegetative growth is little expressive compared to the other stages (Santos *et al.*, 2015). We emphasize that the duration of the maturation phase in the one-and-a-half-year sugarcane is of around sixty days, while in the one-year cycle this phenological phase is smaller, of approximately thirty days (Doorenbos & Kassam, 1979). Hence, the overestimations are more propitious to occur in the one-and-a-half-year sugarcane.

The vegetative growth of sugarcane is restricted in the maturation phase because the photoassimilate (sucrose) required for the expansion of the plant tissues is translocated to be stored in the stems. We stress that the natural maturation of sugarcane requires a water deficit and/or temperatures below 20 ºC (Cardozo & Sentelhas, 2013).

Still, this overestimation was expected for both the cycles and may be associated with the fact that only the water deficiency is the limiting factor of productivity, not considering other factors that are important in determining the crop productivity such as diseases, pests, nutritional shortages, and improper management (Doorenbos & Kassam, 1979).

Therefore, we performed new statistical analyses considering only the ratoon cycles (one-year cycles), finding expressively smaller errors (%) (Table 4).

Table 4: Error of the values estimated in relation to those observed (E, %) for the sugarcane cultivars for the cane-plant cycle and the first and second cycles of the sugarcane ratoon

Variety	**Sugarcane cycle**		
	Plant	**1st ratoon**	**2nd ratoon**
CTC2	79.8%	19.1%	10.9%
CTC4	94.2%	23.4%	6.6%
CTC9	73.5%	33.8%	17.3%
CTC11	68.0%	10.2%	7.6%
CTC15	60.5%	9.5%	4.1%
CTC18	151.6%	47.4%	15.9%
IAC87-3396	76.4%	11.2%	0.5%
IAC91-1099	62.1%	2.6%	26.8%
IACSP94-2094	108.8%	24.2%	1.7%
IACSP94-2101	110.2%	43.8%	29.5%
IACSP95-5000	89.0%	38.7%	8.3%
RB867515	76.3%	23.0%	5.4%
RB92579	74.1%	12.4%	6.6%
RB966928	109.7%	35.0%	3.2%
SP86-0042	74.1%	11.1%	0.7%

Table 3: Coefficients of Pearson's correlation (r), root-mean-square error (RMSE, t ha^{-1}), mean absolute error (MAE, t ha^{-1}), and Willmott's agreement index (d) of the sugarcane cultivars for the cane-plant cycle and for the first and second cycles of sugarcane ratoon

Variety	**RMSE**	**MAE**	**d**	**r**
CTC2	71.98	52.77	0.84	0.9119
CTC4	78.81	56.80	0.81	0.8706
CTC9	71.58	56.84	0.87	0.9762
CTC11	64.60	44.30	0.88	0.8949
CTC15	60.07	40.37	0.90	0.9211
CTC18	100.32	76.74	0.70	0.7641
IAC87-3396	69.04	45.26	0.87	0.8569
IAC91-1099	62.84	46.20	0.86	0.8686
IACSP94-2094	84.39	58.93	0.78	0.7865
IACSP94-2101	88.54	71.09	0.80	0.9208
IACSP95-5000	79.21	60.73	0.82	0.9689
RB867515	70.73	51.53	0.85	0.9465
RB92579	68.06	46.65	0.88	0.8768
RB966928	86.36	63.19	0.76	0.8882
SP86-0042	67.84	44.57	0.87	0.8681

When performing the analyses considering only the sugarcane ratoon cycles, we found a better adjustment of the estimated values to those obtained in the field (Figure 3), obtaining better performance of the AEZ method (Table 5). Again, variety CTC15 obtained the best estimate value (RMSE = 8.70 t ha^{-1}; MAE = 6.05 t ha^{-1}), and the productivity estimate for CTC18 was the least satisfactory (RMSE = 32.12 t ha^{-1}; MAE = 21.87 t ha^{-1}). According to the agreement index (d), the AEZ method obtained excellent performance ($d > 0.85$) for the estimation of productivity for all varieties except CTC18, whose performance was very good ($0.76 < d \leq 0.85$), according to Willmott *et al.* (1985).

The analyses of variance of the estimated and observed productivities in the first and second ratoon cycles (both one-year cycles) indicated there was no significant difference between them, with the p-values being higher than the significance level adopted ($p > 0.05$). Hence, one may state that the AEZ method presented good results of estimated productivity for all sugarcane varieties investigated.

Oliveira *et al.* (2012b) studied the AEZ method for the macroregion of the Triângulo Mineiro, Brazil, for productivity data of plant and first-cut ratoon, isolatedly, finding that the AEZ method presented a satisfactory adjustment for the first ratoon cycle, explaining 89% of

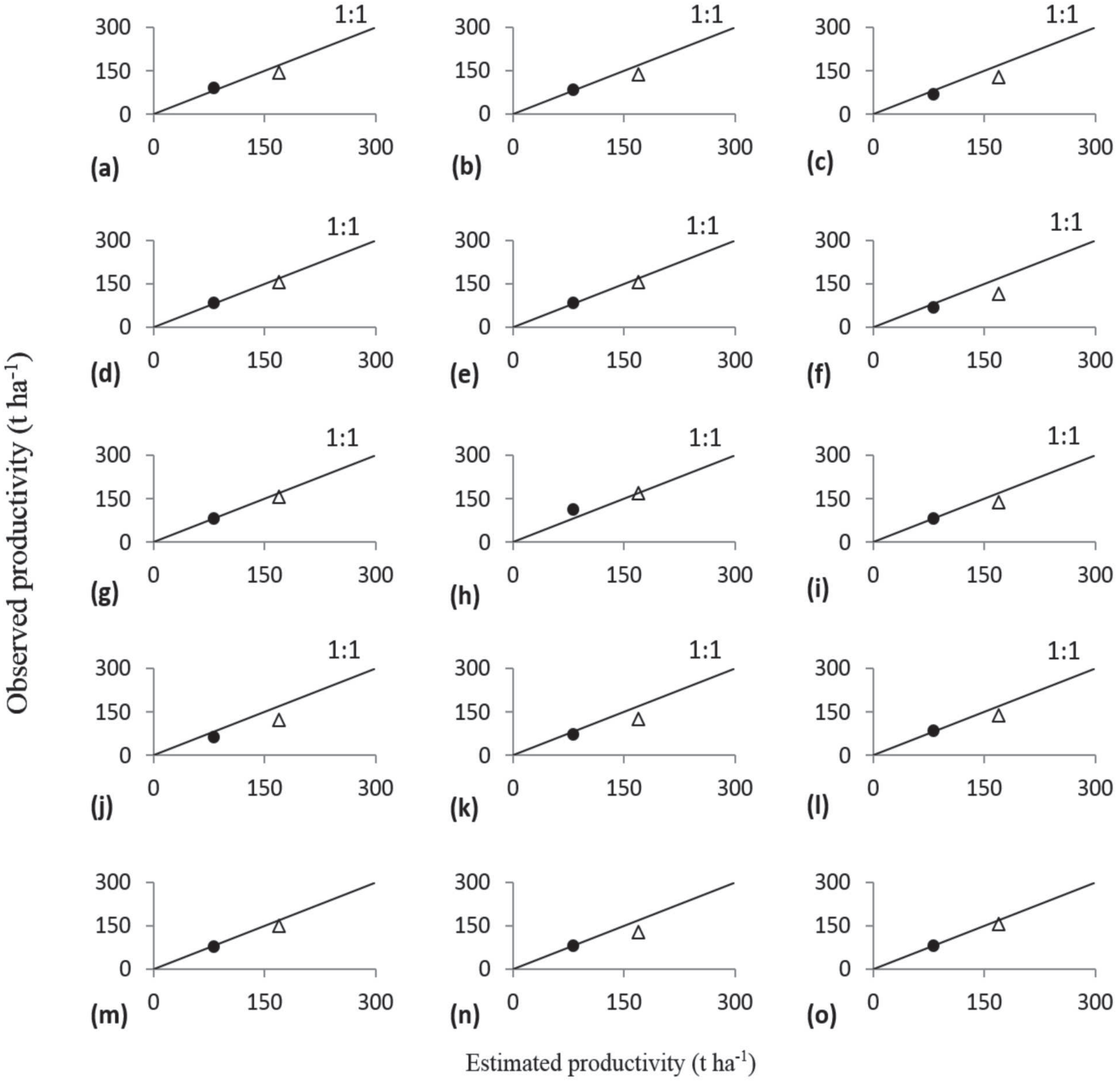

Figure 3: Relations among the productivities estimated by the Agro-Ecological Zone method and those observed for varieties CTC2 (a), CTC4 (b), CTC9 (c), CTC11 (d), CTC15 (e), CTC18 (f), IAC87-3396 (g), IAC91-1099 (h), IACSP94-2094 (i), IACSP94-2101 (j), IACSP95-5000 (k), RB867515 (l), RB92579 (m), RB966928 (n), and SP86-0042 (o) for the first (△) and second (●) cycles of sugarcane ratoon, Goianésia, GO, Brazil.

Table 5: Coefficients of the root-mean-square error (RMSE, t ha^{-1}), mean absolute error (MAE, t ha^{-1}), and Willmott's agreement index (d) for the sugarcane cultivars for the first and second cycles of sugarcane ratoon

Variety	RMSE	MAE	d
CTC2	16.69	12.35	0.96
CTC4	18.86	12.62	0.94
CTC9	25.68	18.26	0.91
CTC11	9.82	7.44	0.99
CTC15	8.70	6.05	0.99
CTC18	32.12	21.87	0.83
IAC87-3396	9.83	5.81	0.99
IAC91-1099	17.34	11.33	0.96
IACSP94-2094	19.07	11.47	0.95
IACSP94-2101	31.64	23.35	0.85
IACSP95-5000	27.55	17.85	0.88
RB867515	18.52	12.12	0.95
RB92579	11.17	7.89	0.99
RB966928	25.43	15.54	0.89
SP86-0042	9.75	5.81	0.99

the variability of the data observed in the field. The accuracy of the method for the first ratoon ($\beta = 0.90$) and the precision ($R^2 = 0.89$) were superior to those for the cane-plant.

Barbieri & Silva (2008) adjusted the AEZ method to predict the monthly accumulation of dry matter of sugarcane considering the one-year cycle and verified a linear relation among the observed and estimated values with a determination coefficient (R^2) equal to 0.9458.

CONCLUSION

For the cultivation conditions adopted, the sugarcane varieties did not show significant difference in productivity.

The Agro-Ecological Zone method may be recommended for the estimation of sugarcane productivity in the Cerrado region for all fifteen varieties studied, presenting, however, better results in cane fields with one-year cycles.

Considering the all fifteen varieties studied, the agrometeorological model of the Agro-Ecological Zone method estimated the sugarcane productivity of the Cerrado region more satisfactory for variety CTC15.

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