Silva, Hudsonkléio Da Costa; Anunciação Filho, Clodoaldo José; Bastos, Gerson Quirino; Dutra Filho, João Andrade; Simões Neto, Djalma Euzébio
Repeatibility of agroindustrial characters in sugarcane in different harvest cycles1

Repeatibility of agroindustrial characters in sugarcane in different harvest cycles[1]

Repetibilidade de caracteres agroindustriais em cana-de-açúcar em diferentes ciclos de colheita

Hudsonkléio Da Costa Silva[2], Clodoaldo José Anunciação Filho[2], Gerson Quirino Bastos[2], João Andrade Dutra Filho[2]* and Djalma Euzébio Simões Neto[2]

ABSTRACT - In commercial cultivation of sugarcane, knowledge about the repetition of agroindustrial characters is essential to identify long-lived genotypes in production cycles, which when selected, will contribute to the significant increase in productivity. This work evaluated the agroindustrial performance of 16 sugarcane genotypes in the sugarcane microregion Litoral Norte of Pernambuco in four harvest cycles and the regularity in the repetition of characters. The experiment was conducted in the agricultural area of São José sugar mill, Igarassu, state of Pernambuco, Brazil. The experiment was carried out following a randomized block design with four replications. The variables evaluated were: tons of POL per hectare (TPH), tons of cane per hectare (TCH), fiber (FIB), adjusted POL% (PCC), soluble solids content (BRIX), and total recoverable sugar (TRS). The variance analysis detected significant differences among the genotypes along the four harvest seasons, indicating genetic variability and possibility of success in the selection of superior genotypes. Estimates of repeatability coefficient point to regularity in the repetition of agro-industrial characteristics allowing to identify genotypes with the highest longevity. The genotypes SP79-1011, RB863129, RB92579, RB813804, RB982559 e RB982613 presented best agroindustrial performance, and two evaluations based on TPH and TCH characters are enough to select superior genotypes with 90% predictability of their actual values.

Key words: Longevity. Productivity. Repetition of characters. Selection. *Saccharum* spp.

RESUMO - No cultivo comercial da cana-de-açúcar, conhecimentos relacionados à regularidade na repetição de caracteres agroindustriais, em diferentes ciclos de colheita, são essenciais na identificação de genótipos com maior longevidade nas soqueiras. Tais genótipos contribuirão para o aumento significativo da produtividade. O objetivo deste trabalho foi avaliar o desempenho agroindustrial de 16 genótipos de cana-de-açúcar na microrregião canavieira do Litoral Norte de Pernambuco em quatro ciclos de colheita, examinando a regularidade da repetição de caracteres. O experimento foi conduzido na área agrícola da Usina São José, município de Igarassu. Utilizou-se o delineamento experimental de blocos casualizados com quatro repetições. Foram avaliadas as variáveis: toneladas de pol por hectare (TPH), toneladas de cana por hectare (TCH), fibra (FIB), pol % corrigida (PCC), teor de sólidos solúveis (BRIX) e açúcar total recuperável (ATR). A análise de variância revelou diferenças significativas entre as médias dos tratamentos nos quatro ciclos de colheita, indicando variabilidade genética e possibilidade de sucesso na seleção de genótipos superiores. As estimativas do coeficiente de repetibilidade apontam regularidade na repetição dos caracteres agroindustriais, sendo possível identificar genótipos de maior longevidade nas soqueiras. Constatou-se ainda que os genótipos SP79-1011, RB863129, RB92579, RB813804, RB982559 e RB982613 apresentam melhor desempenho agroindustrial, e que duas avaliações com base nos caracteres TPH e TCH indicam ser suficientes para selecionar genótipos superiores com 90% de previsibilidade dos seus valores reais.

Palavras-chave: Longevidade. Produtividade. Repetição de Caracteres. Seleção. *Saccharum* spp.

INTRODUCTION

Genetic improvement programs underline the importance of sugarcane in both the economic and social scenarios in Brazil (DUTRA FILHO *et al.*, 2012). Currently, the sugarcane sector relies on a large portfolio of varieties developed by these improvement programs or introduced varieties (SOUZA *et al.*, 2012). In the past 30 years, genetic improvement played an outstanding role in the development of the sugarcane sector in Brazil. Productivity figures rose 30%, increasing sugar yield per ton of chopped sugarcane, accompanied by an improvement in the quality of the product (BARBOSA; SILVEIRA, 2012).

In the state of Pernambuco (PE), Brazil, experiments with sugarcane are carried out based on three harvest cycles on average, namely plant cane, 1st ratoon, and 2nd ratoon (SOUZA *et al.*, 2012). The data obtained in these studies enable the evaluation of the magnitude of the interactions between genotype and harvest, which usually are significant. These interactions influence clone selection and are used to identify materials that are more long-lived (MELO *et al.*, 2009). The efficient identification of long-lived genotypes in sugarcane genetic improvement programs depends mainly on the spatial and temporal repeatability of characters under selection (CUENYA; MARIOTTI, 1993).

The repeatability coefficient is used in the study of characters of perennial plants, since these characters are expressed more than once during a plant's lifetime (CARDOSO, 2006; CHIA *et al.*, 2009; MANFIO *et al.*, 2011; SOARES *et al.*, 2008; SOUZA SOBRINHO *et al.*, 2010). Estimation of the repeatability coefficient is based on more than one phenotypic evaluation of each individual plant. The aim is to measure the potential of these plants to express the characters studied (VENCOVSKY, 1973). The repeatability coefficient also affords to estimate the number of phenotypic evaluations (or replications) that have to be conducted in each individual plant so that the selection of new genotypes is successful, minimizing time and overall costs in the development and introduction of new varieties (CRUZ; REGAZZI; CARNEIRO, 2012; NEGREIROS *et al.*, 2008).

According to Danner *et al.* (2010), the repeatability coefficient allows assessing the reliability of a selection based on a phenotypic character, that is, whether the selected genotypes will retain their superiority indefinitely. It also affords to determine the minimum number of evaluations of each individual plant in the effort to select genotypes effectively.

Using repeatability estimates obtained by principal component analysis (PCA) to select new sugarcane varieties in the state of Alagoas, Brazil, Santos *et al.* (2004) obtained values above 0.5 for fiber (FIB) and tons of cane per hectare (TCH) with accuracy in excess of 84%. However, characters like adjusted POL% (PCC), tons of POL per hectare (TPH), and purity (PZA) exhibited poor reproducibility between cycles, with low accuracy (approximately 74%). The authors concluded that at least five evaluations are necessary to select varieties with 80% predictability for TPH, TCH, PCC, and FIB.

Based on these considerations, the present study evaluated the agroindustrial performance of 16 sugarcane genotypes grown in the sugarcane production microregion in the northern coast of PE throughout four harvest cycles. Reproducibility of characters was also assessed to determine the number of evaluations based on the main agroindustrial characters necessary to select new sugarcane varieties grown under the edaphic-climatic conditions of the microregion.

MATERIALS AND METHODS

The experiment was carried out in Engenho Mulata, a sugarcane plantation area of the São José sugar mill, in the sugarcane microregion Litoral Norte de Pernambuco, municipality of Igarassú, PE, Brazil (8°45'S, 35°00'W, 45 m a.s.l.). Annual mean temperature is 24.8 °C, and mean rainfall is 1715.7 mm (KOFFLER *et al.*, 1986).

Due to the fact that this was a field experiment and that the conditions were variable, a randomized complete block design with four repeats was used. In total, 16 sugarcane genotypes were used (Table 1).

Each quadrat was defined by five 8-m lines 1 m apart. Plants were spaced 1 m from one another. Fertilization and pH adjustments were conducted according to the sugarcane production system adopted by the sugar mill.

The agroindustrial characters (i) TPH, (ii) TCH, (iii) FIB; (iv) PCC, (v) soluble solids (BRIX), and (vi) total recoverable sugars (TRS) were evaluated, since they are the most important parameters in sugarcane production. Briefly, TCH was determined weighing (kg) all culms in a quadrat. Next, the weigh of the quadrat was converted in TCH using the equation:

TCH = Total parcel weight x 10 / used area of the quadrat in m²

TPH was calculated using the equation:

TPH = TCH X PCC/100

While BRIX was analyzed in the laboratory using a refractometer and the homogenized pool of the juice

Table 1 - Identification and origin of the 16 sugarcane genotypes used in experiments conducted in the microregion Litoral Norte de Pernambuco, Engenho Mulata, plantation area of the São José sugar mill, municipality of Igarassú, PE, Brazil

Genotypes	Origin
SP79-1011	COPERSUCAR
RB863129	RIDESA
RB92579	RIDESA
RB813804	RIDESA
RB982559	RIDESA
RB982613	RIDESA
RB72454	RIDESA
SP81-3250	COPERSUCAR
RB982541	RIDESA
RB982615	RIDESA
RB982590	RIDESA
RB982586	RIDESA
RB982580	RIDESA
RB982603	RIDESA
RB982630	RIDESA
RB982754	RIDESA

of 10 culms obtained randomly in each quadrat. The methodology developed by Fernandes (2003) was used to calculate FIB, PCC, and TRS. The evaluations were conducted along four agricultural cycles: plant cane, 1st ratoon, 2nd ratoon, and 3rd ratoon.

Hartley's test (> QMR / < QMR) was used to evaluate the existence of similar residual variances and thus assess the conditions to carry out the analysis of covariance of the experiments.

The covariance analysis of experiments considering the four harvest cycles was carried out according to the statistical model proposed by Cruz (2006)

$$Y_{ijk} = \mu + (b/c)_{jk} + g_i + c_k + gc_{ik} + \varepsilon_{ijk}$$

where

Y_{ijk} is the evaluation of the ith genotype in the jth block in the kth harvest;

μ: overall mean;

$(b/c)_{jk}$: effect of block j on harvest k;

g_i: effect of treatment (or genotype) i;

c_k: effect of harvest k;

gc_{ik}: effect of the interaction between genotype i and harvest k; and

ε_{ijk}: random error associated with evaluation ijk.

The fixed effects were the effect of means (μ) and genotypes (g), while block (b), harvest (c), interaction between genotype and harvest (gc), and experimental error (ε) effects were considered random. The results of the covariance analysis of the four harvest cycles were obtained using the statistical design in Table 2.

According to Cruz (2006), mean heritability is calculated using the equation:

$$H^2 = \frac{\hat{\varphi}_g^2}{(QMG/cr)}$$

Means were grouped using the Scott-Knott test at 5% probability. This test was used because means compared using the Tukey test are difficult to interpret due to ambiguity. The repeatability coefficient was calculated using the covariance analysis with two factors, namely the principal component analysis (PCA) (ABEYWARDENA, 1972) and structural data analysis (MANSOUR; NORDHEIM; RUTLEDGE, 1981), and the two methods

Table 2 - Statistical design used to obtain the results of the covariance analysis of experiments conducted in Engenho Mulata, plantation area of the São José sugar mill, in the sugarcane microregion Litoral Norte de Pernambuco, municipality of Igarassú, PE, Brazil

FV	GL	E(QM)	F
Blocks/harvests	(r-1)c	$\sigma^2 + g\sigma_h^2$	
Harvests (c)	c − 1	$\sigma^2 + g\sigma_h^2 + g\sigma_c^2$	QMC/QMB
Genotypes (g)	g − 1	$\sigma^2 + {}_{rl}g\sigma_{gc}^2 + \sigma^{rg}$	QMG/QMGC
Interaction g x c	(c − 1)(g −1)	$\sigma^2 + {}_{rl}g\sigma_{gc}^2 + \sigma^{rg}$	QMGC/QMR
Residuals	(g-1)(r − 1)c	σ^2	
$\ell = g/(g-1)$			

were compared. Means were grouped considering the means of genotypes in the four harvests, since genetic improvement of sugarcane requires the best genotype considering its performance not only in plant cane, but also in all harvests.

Repeatability analyses were conducted using the model adapted from Cruz, Regazzi and Carneiro (2012), expressed by the expression:

$$Y_{ijk} = \mu + g_i + a_j + ga_{ij} + b_{(j)k} + \varepsilon_{ij}$$

where

$Y_{ijk:}$ is the evaluation of the ith genotype in the jth harvest in the kth repeat;

μ: overall mean;

g_i: effect of the ith genotype under the permanent effects of harvest (i = 1, 2, ...,p);

a_j: effect of the jth harvest (j = 1, 2, ...η);

ga_{ij}: effect of the interaction between genotype and harvest;

$b_{(j)K}$: effect of the kth block (k = 1, 2, ...K) on the jth harvest;

$\varepsilon_{ij:}$ experimental error defined by the temporary effects of harvest on the jth measurement of the ith genotype.

After analysis of variance, the repeatability coefficient was obtained using the equation:

$$r = \frac{C\hat{o}v(Yij, Yij')}{\sqrt{V(Yij)V(Yij')}} = \frac{\sigma_g^2}{\sigma_y^2} = \frac{\sigma_g^2}{\sigma^2 + \sigma_g^2}$$

Therefore, the number of measurements to predict the actual value of individuals was obtained using the equation

$$\eta o = \frac{R^2(1-r)}{(1-R^2)r}$$

The repeatability coefficient was estimated using the PCA using the matrix of phenotypic variances and covariances, according to the statistical model developed by Cruz, Regazzi and Carneiro (2012)

$$Y_{ij} = \mu + g_i + a_j + \varepsilon_{ij}$$

However, in this case, the covariance matrix was obtained as:

$$r = \sigma_y^2 = \begin{bmatrix} 1 & \rho & \cdots & \rho \\ \rho & 1 & \cdots & \rho \\ \cdots & \cdots & \cdots & \cdots \\ \rho & \rho & \cdots & 1 \end{bmatrix}$$

where

$$V(Yij) = V(Yij') = \sigma_g^2 + \sigma^2 = \sigma_y^2$$

$$Cov(Yij, Yij') = (\hat{\sigma}_g^2 + \sigma^2)\rho = \rho\sigma_y^2$$

The characteristic root was obtained using the equation:

$$\lambda_l = \sigma_y^2[1 + (\eta - 1)\rho]$$

The corresponding eigenvector was given by the equation:

$$\alpha'_l = [1/\sqrt{\eta} \cdots 1/\sqrt{\eta}]$$

The repeatability coefficient estimate was calculated using the equation:

$$r\hat{\rho} = \frac{\hat{\lambda}_1 - \sigma_y^2}{\sigma_y^2(\eta - 1)}$$

The repeatability coefficient estimate was obtained using structural data analysis considering the parametric matrix of correlations between genotypes in each pair assessed using the equation:

$$r = \frac{\alpha' R\hat{\alpha} - 1}{\eta - 1}$$

where

$$\alpha'_l = [1/\sqrt{\eta} \cdots 1/\sqrt{\eta}]$$

Here

$$\alpha'_l R\hat{\alpha} = 1 + \frac{2}{\eta}\sum_j \sum_{<j'} rjj'$$

Therefore

$$r = \frac{2}{\eta(\eta-1)}\sum_j \sum_{<j'} rjj'$$

This equation gives the repeatability coefficient estimate as the arithmetic mean of phenotypic correlations between genotypes, considering each pair of measurements.

The determination coefficient was obtained using the equation:

$$R^2 = \eta r/[1 + r(\eta - 1)]$$

The number of measurements necessary to predict the actual value of an individual was obtained using the equation:

$$\eta_0 = R^2(1 - r)/(1 - R^2)r$$

All genetic-statistical analyses were conducted in the Genes software (Cruz, 2006).

RESULTS AND DISCUSSION

The analysis of variance identified highly significant statistical differences at 1% probability ($p < 0.01$) between genotypes for all characters assessed (Table 3). This result indicates the genetic variability between genetic materials analyzed in different agricultural years and respective harvest cycles. This is an advantageous feature in improvement programs, showing that it is possible to select superior genotypes based on these characters that, according to Silva *et al.* (2009), are some of the most important variables in sugarcane production.

Significant differences were observed for all characters between harvest cycles (plant cane, 1st ratoon, 2nd ratoon, and 3rd ratoon), indicating that these cycles are contrasting environments. In this case, according to Melo *et al.* (2006), climatic conditions during agricultural years affect the characters evaluated in selection processes.

Similarly, significant statistical differences were observed for the characters TPH, TCH, and FIB in the interaction between genotype and harvest. This shows the different behaviors of genotypes considering these characters in the cultivation of plant cane, 1st ratoon, 2nd ratoon, and 3rd ratoon, and afforded to identify long-lived materials.

The coefficients of variation (C.V.) oscillated between low and medium values, indicating good experimental accuracy. These results agree with the findings published by Couto *et al.* (2013) in a study that revealed that tonnage of ratoons and tonnage of sugar per hectare presented the highest C.V. classification ranges.

The Scott-Knott test revealed the formation of groups of superior genotypes for all characters assessed, except BRIX (Table 4).

Considering character TPH, genotypes SP79-1011, RB863129, RB92579, RB813804, RB982559, and RB982613 presented the highest sugar productivity, forming group 'a'. for TCH, genotypes SP79-1011, RB863129, RB92579, and RB813804 stood out in agricultural productivity, forming group 'a'. For FIB, genotypes RB813804, RB982559, RB982586, RB982603, and RB982630 had the highest FIB, forming group 'a'. Regarding PCC, genotypes SP79-1011, RB92579, RB813804, RB982559, RB982613, RB72454, RB982541, RB982580, and RB982630 presented the highest levels of saccharose in sugarcane juice, forming group 'a'. For TRS, genotypes SP79-1011, RB813804, RB982559, RB982613, RB72454, RB982541, RB982580, and RB982630 had the best performance, forming group 'a'.

Mean heritability coefficients were high for all characters, demonstrating the robustness of phenotypic value as indicator of genetic value (Table 5). According to Dutra Filho *et al.* (2001), these results enable more favorable conditions to select plants based on these characters, and signal the success of the recombination of the genotypes assessed.

Repeatability coefficients above 0.5 indicate that these characters are regularly repeated during the harvest cycles considered. For Venchosvsky (1973), the repeatability coefficient may be used as a parameter to measure the potential of a given character to be genetically expressed. Cruz, Regazzi, and Carneiro (2012) claim that high repeatability values are desirable, since a genotype is expected to preserve its initial genetic superiority. This superiority is expressed by the repeatability coefficient: the higher the value, the lower the number of repeat measurements to predict the actual value of an individual. In other words, the results of the present study confirm the possibility to select superior, more long-lived genotypes in ratoons, which means that it is possible to renew sugarcane

Table 3 - Summary of the covariance analysis of groups of experiments conducted in Engenho Mulata, plantation area of the São José sugar mill, in the sugarcane microregion Litoral Norte de Pernambuco, municipality of Igarassú, PE, Brazil

FV	DF	Mean squares					
		TPH	TCH	FIB	PCC	BRIX	TRS
Genotypes	15	77.71**	4561.24**	5.83**	5.64**	6.03**	479.70**
Harvest	3	14.98*	1167.48**	6.14**	7.56**	21.68**	456.20**
G x H	45	4.10*	228.94**	1.28**	0.74^{ns}	0.90^{ns}	65.43^{ns}
Residual	180	2.48	138.86	0.68	0.76	0.92	67.87
Means		8.72	68.88	13.80	12.70	18.09	127.71
C.V. (%)		18.09	17.10	5.98	6.85	5.30	6.45
>QMR / <QMR		1.45	1.60	2.21	1.56	1.76	2.35

** and * indicate significance at 1% and 5% probability, respectively, in the F test; $^{(ns)}$, not significant in the F test; (G x H), Interaction between genotype and harvest

Table 4 - Grouping of mean values of agroindustrial parameters in sugarcane genotypes evaluated in experiments conducted in Engenho Mulata, plantation area of the São José sugar mill, in the sugarcane microregion Litoral Norte de Pernambuco, municipality of Igarassú, PE, Brazil

	Variables					
Genotypes	TPH t ha^{-1}	TCH t ha^{-1}	FIB%	PCC%	BRIX%	TRS kg/t
SP79-1011	11.56 a	89.68 a	13.69 b	13.01 a	18.51 a	130.86 a
RB863129	11.47 a	94.68 a	13.31 b	12.23 b	17.36 a	122.92 b
RB92579	10.88 a	85.87 a	13.26 b	12.70 a	17.91 a	127.19 b
RB813804	10.81 a	82.18 a	14.21 a	13.11 a	18.38 a	131.85 a
RB982559	10.39 a	78.31 b	14.59 a	13.32 a	18.91 a	133.76 a
RB982613	10.05 a	74.43 b	13.28 b	13.68 a	19.18 a	136.57 a
RB72454	9.32 b	70.68 b	13.57 b	13.23 a	18.52 a	132.19 a
SP81-3250	9.25 b	75.25 b	13.73 b	12.46 b	18.04 a	125.67 b
RB982541	9.07 b	69.93 b	13.37 b	12.94 a	18.12 a	129.64 a
RB982615	8.67 b	73.87 b	13.45 b	11.75 b	16.79 a	118.96 b
RB982590	8.33 b	67.31 b	13.48 b	12.38 b	17.90 a	125.03 b
RB982586	6.80 c	59.75 c	15.34 a	11.44 b	17.20 a	116.19 b
RB982580	6.57 c	50.25 c	13.13 b	13.15 a	18.49 a	132.42 a
RB982603	6.33 c	51.93 c	14.45 a	12.31 b	17.97 a	124.40 b
RB982630	5.37 c	41.43 d	14.21 a	12.97 a	18.31 a	129.63 a
RB982754	4.55 c	36.50 d	13.78 b	12.53 b	17.79 a	126.03 b

Means followed by identical letters belong to the same group in the Scott-Knott test

Table 5 - Heritability and repeatability of agroindustrial characters in sugarcane genotypes assessed in groups of experiments carried out in Engenho Mulata, plantation area of the São José sugar mill, in the sugarcane microregion Litoral Norte de Pernambuco, municipality of Igarassú, PE, Brazil

	TPH	TCH	FIB	PCC	PZA	BRIX	TRS
H^2	0.95	0.95	0.78	0.87	0.82	0.85	0.86
Repeatability M1	0.82	0.83	0.47	0.62	0.53	0.59	0.61
Repeatability M2	0.83	0.84	0.50	0.63	0.55	0.61	0.62
Repeatability M3	0.85	0.86	0.65	0.64	0.57	0.60	0.65
Repeatability M4	0.82	0.83	0.48	0.63	0.54	0.60	0.62

H$_2$: mean heritability; M1: ANOVA; M2: PCA (Correlation); M^3: PCA (covariance); M4: structural data analysis

plantations at longer intervals, reducing production costs considerably.

However, it is important to highlight that the repeatability coefficient of the character FIB calculated by PCA was higher than 0.5, different from the value obtained by analysis of variance. Chia *et al.* (2009) revealed that the PCA isolates the effect of alternating treatments, since this component is included in the experimental error.

Table 6 shows that selection of sugarcane varieties based on TPH and TCH obtained using all methods two evaluations (cane plant and 1st ratoon) are enough, considering the predictability of 90% of the actual value of genotypes.

In 16 experiments with sugarcane, Ferreira *et al.* (2005) determined that three evaluations are necessary to select superior genotypes based on TCH with a predictability value of 80%. However, it is important

Table 6 - Determination of the number of evaluations (harvests required) to select sugarcane genotypes grown in Engenho Mulata, plantation area of the São José sugar mill, in the sugarcane microregion Litoral Norte de Pernambuco, municipality of Igarassú, PE, Brazil

Characters	TPH	TCH	FIB	PCC	BRIX	TRS
R^2			M1			
0.80	0.89	0.84	4.51	2.41	2.79	2.53
0.85	1.27	1.19	6.39	3.42	3.95	3.58
0.90	2.01	1.89	10.15	5.43	6.28	5.69
0.95	4.24	3.98	21.43	11.47	13.25	12.00
0.99	22.10	20.74	111.64	59.74	69.03	62.55
R^2			M2			
0.80	0.71	0.66	2.18	2.29	2.63	2.13
0.85	1.01	0.94	3.09	3.24	3.73	3.01
0.90	1.60	1.49	4.91	5.15	5.92	4.78
0.95	3.38	3.15	10.36	10.88	12.50	10.10
0.99	17.62	16.40	53.97	56.67	65.11	52.60
R^2			M3			
0.80	0.82	0.77	4.05	2.32	2.59	2.46
0.85	1.16	1.09	5.74	3.28	3.66	3.48
0.90	1.84	1.74	9.12	5.21	5.82	5.53
0.95	3.87	3.67	19.25	11.00	12.29	11.68
0.99	20.18	19.11	100.28	57.32	64.01	60.86
R^2			M4			
0.80	0.82	0.78	4.33	2.34	2.61	2.48
0.85	1.16	1.10	6.13	3.32	3.70	3.51
0.90	1.85	1.75	9.74	5.27	5.87	5.58
0.95	3.90	3.70	20.57	11.12	12.39	11.78
0.99	20.33	19.27	107.16	57.93	64.56	61.39

M1: ANOVA; M2: PCA (Correlation); M³: PCA (covariance); M4: structural data analysis

to underline that, as reliability increases, so does the number of evaluations rise. For example, in the present study, four evaluations on average were required to select a superior genotype with 95% reliability, independently of the method used. Resende (2002) showed that determination coefficients above 80% are suitable to predict the actual value of an individual and, therefore, the number of evaluations required to select varieties. So, the PCA method (covariance) indicates that, for a selection based on FIB, PCC, and TRS, two harvests are enough considering predictability of 80% for the value of genotypes. Nevertheless, when BRIX is used, three evaluations are required. In the present study, the selection of superior genotypes at 90% predictability using TPH and TCH is appropriate, and it is not necessary to increase the number of evaluations, which enables cost reduction.

CONCLUSIONS

1. The selection of superior genotypes has to be based on TPH and TCH;

2. Genotypes SP79-1011, RB863129, RB92579, RB813804, RB982559, and RB982613 exhibited the best agroindustrial performance;

3. Two evaluations are enough to select superior genotypes in the experimental stage of the sugarcane improvement process, under the edaphic-climatic conditions of the sugarcane microregion Litoral Norte de Pernambuco.

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