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RELATIVE CONTRIBUTION OF GENETIC AND ENVIRONMENTAL EFFECTS ON NON-SUGAR COMPOUNDS OF CANE JUICE

Santiago Ostengo[1], María Inés Cuenya[1], Silvia Zossi[2] and Mónica Balzarini[3]

[1]Sección Caña de Azúcar, Subprograma Mejoramiento Genético de la Caña de Azúcar. Estación Experimental Agroindustrial Obispo Colombres. Tucumán, Argentina.
[2]Sección Química de Productos Agroindustriales, Estación Experimental Agroindustrial Obispo Colombres. Tucumán, Argentina.
[3]Estadística & Biometría. Facultad de Ciencias Agropecuarias-Universidad Nacional de Córdoba and Consejo Nacional de Ciencia y Tecnología de Argentina (CONICET). Córdoba, Argentina.

Introduction

Sugar cane juice is composed of sugars, water and soluble and insoluble substances known as non-sugar compounds.

Non-sugar compounds

- **salts of organic and inorganic acids**
- **carboxylic acids**
- **amino acids**
- **soluble polysaccharides**
- **starch**
- **waxes**
- **flavonoids**
- **polyphenols**





- Brix°
- Pol% juice
- Recoverable sugar
- Sucrose (HPLC)

All these characteristics are directly influenced by the sucrose content of the juice.

- **Purity**

Non-sugar compounds have a detrimental role in factory processes, because they cause adverse effects on sugar quality and recovery.

Therefore it is necessary to consider them as quality indicators of sugar cane juice.







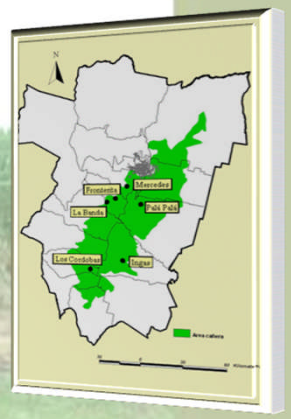




The aim of this work was to estimate the relative contribution of genotype, environment and interaction effects on a set of non-sugar compounds related to sugarcane juice quality.

Materials and methods

- Special determinations associated with non-sugar components were performed in a set of 10 sugarcane genotypes.
- Multi-environment trials conducted at six sites of the target region of the sugarcane breeding program of Tucumán, Argentina.



- **Starch, ash, phosphate and phenols contents and juice colour** were analyzed in a sample of 10 stalks taken at random from each plot during the beginning of harvest season (May), in two consecutive years/crop ages (first and second ratoon).
- In addition, **sucrose content (%)** was assessed in order to include it in the analysis of genetic correlations among these variables.



Laboratory test

The stalk samples, cleaned and correctly topped, were processed in the laboratory with a shredder ("Open cell" approx. 95%) and juice was extracted with a hydraulic press (240 kg / cm^2).



Starch	mg/kg°Bx	**spectrophotometry**	Godshall (2004) Zossi *et al.* (2008)
Ash	g/100 g	**conductimetry**	ICUMSA (2005)
Phosphate	mg/kg°Bx	**spectrophotometry**	ICUMSA (2005)
Phenols	mg/kg°Bx	**spectrophotometry**	Clarke *et al.* (1985)
Colour	UI	**spectrophotometry**	ICUMSA (2005)
Sucrose	g/100 g	**HPLC**	ICUMSA (2005)

ICUMSA (International Commission for Uniform Methods of Sugar Analysis)

Statistical Analyses

✓ A multi-environment mixed linear model was adjusted.

$$y_{ijhk} = \mu + G_i + \underline{L_j} + A_h + \underline{B(L)_{k(j)}} + \underline{GL_{(ij)}} + GA_{(ih)} + \underline{LA_{(jh)}} + \underline{GLA_{(ilh)}} + \varepsilon_{ijhk}$$

Genotype [G] ; Location [L]; Crop age/year [A]; Block within location [B(L)]

✓ The effects of genotype, location and the interactions were considered as random in order to estimate variance components associated with these effects.

✓ Likelihood ratio test was used to test the significance of variance components.

✓ Correlations genetically determined were assessed through a Biplot, using multivariate techniques that combine evaluated traits.



Results

As for **ash**, **juice colour** and **starch** the main component of variance was associated with **genotype effect**

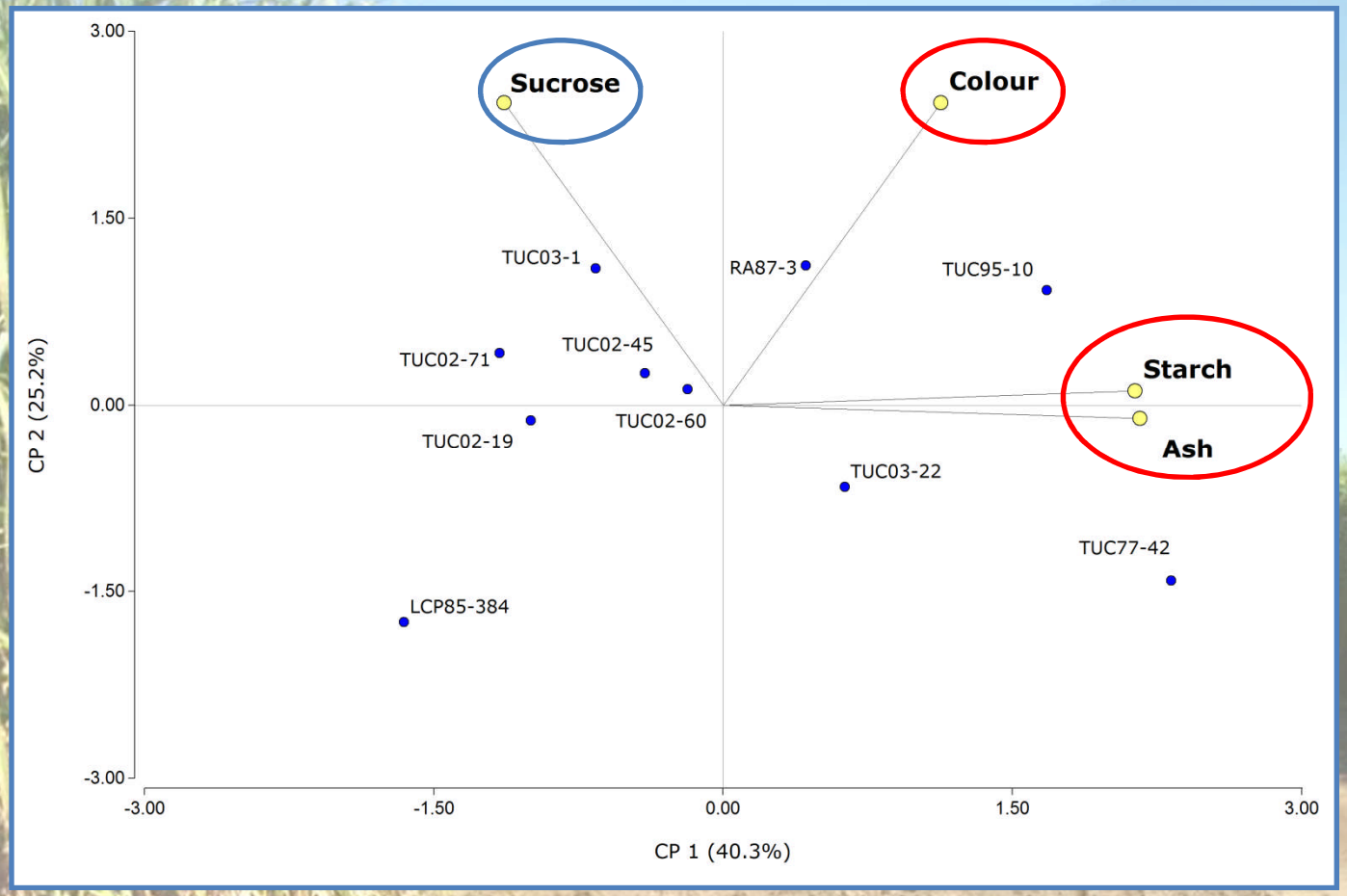
Effects	ASH EST.	ASH *p*	ASH %	COLOUR EST.	COLOUR *p*	COLOUR %	STARCH EST.	STARCH *p*	STARCH %
Genotype [G]	0.01452	<0.001	**77.5**	3024703	<0.001	**63.2**	181988	<0.001	**47.6**
Location [L]	0.00338	0.043	**18.1**	572105	0.584		0	-	
GL	0.00042	0.317		234387	0.403		0	-	
GA	0.00000	-		221737	0.237		1625	1.000	
LA	0.00083	0.020	**4.4**	894291	0.002	**18.7**	61448	0.009	**16.1**
GLA	0.00000	-		866427	0.003	**8.1**	139223	<0.001	**36.4**

EST.: variance estimated

***p*:** probability value according to LRT

%: percent contribution of the effects of non-error variability

Analysis of genetically determined correlations



Ash and starch content and juice colour showed negative genetic correlation with sucrose content.

In the case of **phosphate** and **phenolic compounds**, **environment** was the principal source of variation.

	PHOSPHATE			PHENOLS		
Effects	**EST.**	***p***	**%**	**EST.**	***p***	**%**
Genotype [G]	0	-		3051	0.439	
Location [L]	0	-		51774	0.584	
GL	699	0.527		17974	0.074	
GA	1735	0.003	**13.9**	0	-	
LA	10758	<0.001	**86.1**	92922	<0.001	**79.8**
GLA	594	0.371		23478	0.002	**20.2**

EST.: variance estimated

***p*:** probability value according to LRT

%: percent contribution of the effects of non-error variability

Identifying the main source of variability for each non-sugar component will facilitate the development of useful strategies for the characterization of sugarcane genotypes regarding industrial quality.



Thanks for your attention !!

santiagostengo@eeaoc.org.ar

Analysis of genetically determined correlations

