PROMISING SUGARCANE CLONES FOR TROPICAL CONDITIONS OF ECUADOR: FIRST GROUP OF SELECTIONS

By

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Abstract

Sugarcane production in Ecuador presently depends on introduced cultivars, with 82% of the area being occupied by the old Australian cultivar Ragnar. Ecuadorian cane production has experienced a reduction in tonnage and sugar content in the last 20 years. This led to the establishment of the Sugarcane Research Centre of Ecuador (CPNCAE). Its main objective is to develop new local cultivars. In 1998, a selection program was initiated, using true seed from COPERSUCAR-Brazil. This produced the first group of selections, the 98 series. Eight promising clones have been selected from this series. Evaluations in plant crop showed four clones with better sugar production compared to Ragnar (ECSP98-425, ECSP98-169, ECSP98-168, ECSP98-499). Clone ECSP98-169 is stable and responds to the poor environments among the six locations, with 9.7 tonnes of sugar/ha compared to Ragnar with only 7.8 tonnes of sugar/ha. These results show that the selection program can produce promising clones that could be released in the next few years.

Introduction

The need for new cultivars to diversify the genetic base of sugarcane production in Ecuador is clear. More than 80% of commercial fields are planted with Ragnar. The dominance of one cultivar puts the industry at risk of diseases, and the recycling of cane seed for several years may lead to the accumulation of endemic parasites in a monoclonal cropping system (Comstock et al., 2001).

The Ecuadorian sugar industry has established a research centre to develop local cultivars selected under that tropical environment. A selection scheme was started in 1998, as soon as the breeding program was established (Castillo, 2003).

In order to generate new gene pools and genetic combinations, new sugarcane cultivars are produced by hybridisation and then reproduced clonally. Selection is applied to all stages of breeding, from parents to seedling populations produced by cross pollination. The best clones are selected for the next stages until a cultivar is released.

In order to be released, a clone must be evaluated in several trials in different environments and appropriate selection indices are applied, to identify the best performing clones in any specific production area. The time taken for selection and propagation in any population may range from 8 to 20 years (Skinner et al., 1987). Crosses could be made for different research stations and then planted in the areas where a new cultivar is needed.

Materials and methods

Crosses from COPERSUCAR-Brazil were planted at San Carlos Mill in 1998 and a selection program was initiated to generate the 98 series. The selected clones were included in all clonal selection stages until a Stage IV trial was established with eight clones: ECSP98-419, ECSP98-392, ECSP98-425, ECSP98-149, ECSP98-169, ECSP98-168, ECSP98-127, and ECSP98-499. The cultivar Ragnar was used as standard or check.
During the cycle 2002–2003, these clones and a local standard cultivar were evaluated in six locations. Clone ECSP98-127 was not included in the statistical analysis due to the lack of data from some locations. A randomised complete block design with three replications was used with plots of four rows by 10 m long. Data were collected for plant height (m) measured from the base to the last leaf with visible ligule, number of stems/m, tonnes cane/ha (TCH), kilograms sugar/l (kgSt), and tonnes sugar/ha (TSH). Statistical analysis was performed using MSTAT C (Michigan State University), and a stability analysis (Eberhart and Russell, 1966) was run to check on clonal performance across locations.

Results and discussion

The plant cane evaluation showed four clones with better sugar production as compared to Ragnar (ECSP98-425, ECSP98-169, ECSP98-168, ECSP98-499). Clone ECSP98-169 showed the highest mean along the six locations, with 9.6 tonnes of sugar/ha compared to Ragnar with only 7.9 tonnes of sugar/ha. The variable tonnes cane/ha (TCH) showed that six of the seven clones were superior to Ragnar. Clone ECSP98-169 had the highest TCH at 98.7 t, compared to Ragnar with 84.4 t (Table 1). Clone ECSP98-392 showed the highest value for sugar content expressed as kg sugar/l. However, its tonnage was rather low compared to other clones in the group.

Plant height did not show much variation between clones. All clones were taller than Ragnar (2.4 m) with a mean of 2.9 m. Ragnar and most of the clones shared the same statistical range for stems/m, except for ECSP98-425, with a good average stalk number of 8.2.

Table 1—Means from combined analysis of variance of six locations and seven clones of Stage IV and Ragnar in plant cane for TCH, TSH, plant height, and stem number (2002–2003).

<table>
<thead>
<tr>
<th>Clones</th>
<th>TCH</th>
<th>TSH</th>
<th>Plant height (m)</th>
<th>Stem number/m</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSP98-419</td>
<td>97.3 a*</td>
<td>7.5 b</td>
<td>2.7 cd</td>
<td>8.0 ab</td>
</tr>
<tr>
<td>ECSP98-392</td>
<td>70.5 b</td>
<td>7.3 b</td>
<td>2.8 bc</td>
<td>8.1 ab</td>
</tr>
<tr>
<td>ECSP98-425</td>
<td>95.1 a</td>
<td>8.5 ab</td>
<td>3.0 abc</td>
<td>6.9 b</td>
</tr>
<tr>
<td>ECSP98-149</td>
<td>86.5 a</td>
<td>7.3 b</td>
<td>3.1 ab</td>
<td>8.9 a</td>
</tr>
<tr>
<td>ECSP98-169</td>
<td>98.7 a</td>
<td>9.6 a</td>
<td>3.2 a</td>
<td>8.3 ab</td>
</tr>
<tr>
<td>ECSP98-168</td>
<td>89.0 a</td>
<td>8.3 ab</td>
<td>3.3 a</td>
<td>7.6 ab</td>
</tr>
<tr>
<td>ECSP98-499</td>
<td>93.3 a</td>
<td>8.8 ab</td>
<td>3.0 abc</td>
<td>8.5 a</td>
</tr>
<tr>
<td>Ragnar</td>
<td>84.5 ab</td>
<td>7.9 ab</td>
<td>2.4 d</td>
<td>8.9 a</td>
</tr>
<tr>
<td>Mean</td>
<td>89.4</td>
<td>8.2</td>
<td>2.9</td>
<td>8.2</td>
</tr>
<tr>
<td>C.V. (%)</td>
<td></td>
<td>16.8</td>
<td>19.3</td>
<td>12.3</td>
</tr>
</tbody>
</table>

* Means within the same column followed by different letters are significantly different (Tukey P < 0.01)

Experiments in different locations are suitable to test for stability parameters. Clone ECSP98-169 had the highest mean value for TCH, with a regression coefficient (bi) of 0.7, suggesting good performance for TCH under poor environments. Clones ECSP98-168 and ECSP98-419 responded mainly to good environmental conditions. Clones ECSP98-499 and Ragnar were the most stable among the six environments. All the regression coefficients (bi) and the deviation from the regression ($S^2_{di}$) were non significant (Table 2).

Table 2—Stability parameters (regression coefficient bi, deviation from regression $S^2_{di}$) for TCH of eight sugarcane clones planted in six locations under tropical conditions of Ecuador.

<table>
<thead>
<tr>
<th>Clones</th>
<th>Means</th>
<th>bi</th>
<th>$S^2_{di}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>ECSP98-169</td>
<td>98.7</td>
<td>0.70</td>
<td>-19.60</td>
</tr>
<tr>
<td>ECSP98-419</td>
<td>97.3</td>
<td>1.64</td>
<td>42.95</td>
</tr>
<tr>
<td>ECSP98-425</td>
<td>95.1</td>
<td>1.36</td>
<td>51.19</td>
</tr>
<tr>
<td>ECSP98-499</td>
<td>93.3</td>
<td>1.00</td>
<td>-25.88</td>
</tr>
<tr>
<td>ECSP98-168</td>
<td>89.0</td>
<td>1.67</td>
<td>-10.21</td>
</tr>
<tr>
<td>ECSP98-149</td>
<td>86.5</td>
<td>-0.02</td>
<td>46.59</td>
</tr>
<tr>
<td>Ragnar</td>
<td>84.5</td>
<td>0.93</td>
<td>42.29</td>
</tr>
<tr>
<td>ECSP98-392</td>
<td>70.5</td>
<td>0.68</td>
<td>-17.93</td>
</tr>
</tbody>
</table>

520
Conclusions
Most of the clones selected and evaluated in Stage IV are potential improved clones to provide an alternative to the dominant cultivar Ragnar. These results will be confirmed with future evaluations in first and second ratoon crops. Stability analysis in plant cane showed that clone ECSP98-169 with high yields performed well in poor environments.

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DES CLONES PROMETTEURS DE CANNE À SUCRE POUR LES RÉGIONS TROPICALES DE L’ÉQUATEUR : PREMIER GROUPE DE CLONES SÉLECTIONNÉS
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MOTS CLÉS: Canne à Sucre, Sélection, Amélioration Variétale, Clone.

Résumé
La production sucrière en Equateur dépend actuellement de variétés importées, avec 82% de la surface cultivée par la variété australienne Ragnar. Pendant les 20 dernières années, la production cannière équatorienne a connu une baisse de tonnage et de son taux de sucre, ce qui a mené à la création du Sugarcane Research Centre of Ecuador (CINCAE) dont l’objectif principal est le développement de nouvelles variétés locales. En 1998, un programme de sélection utilisant la semence de COPERSUCAR-Brazil a été lancé, produisant le premier groupe de clones sélectionnés, la série 98. Huit clones prometteurs ont été identifiés parmi ceux-ci. Les résultats en vierge ont montré que quatre clones (ECSP98-425, ECSP98-169, ECSP98-168 et ECSP98-499) avaient un meilleur taux de sucre que Ragnar. Le clone ECSP98-169 est stable et est adapté aux environnements les plus marginaux parmi les six sites plantés, avec un rendement de 9,7 tonnes de sucre/ha comparé à Ragnar qui produit seulement 7,8 tonnes de sucre/ha. Ces résultats prouvent que le programme de sélection peut produire des clones prometteurs qui pourraient être libérés dans les années à venir.
CLONES PROMISORIOS DE CAÑA DE AZÚCAR PARA LAS CONDICIONES TROPICALES DEL ECUADOR: PRIMER GRUPO DE SELECCIÓN

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PALABRAS CLAVE: Caña de Azúcar, Selección, Fitomejoramiento, Clones.

Resumen

La producción de caña de azúcar en Ecuador depende de variedades introducidas. La variedad comercial más cultivada con un 82% del total de área cultivada es la variedad Ragnar de origen australiano. La producción de caña en Ecuador ha experimentado una reducción en tonelaje y contenido azucarero durante los últimos 20 años. Esto ha hecho que se establezca el Centro de Investigación de Caña de azúcar del Ecuador (CINCAE), cuyo principal objetivo es el desarrollo de nuevas variedades locales. En 1988, un programa de selección se inició con la siembra de semillas provenientes de COPERSUCAR-Brasil. Esta siembra constituye el primer grupo de selección o la serie 98. Como resultado de este programa de selección un grupo de 8 clones promisorios han sido seleccionados. Las evaluaciones en caña planta mostraron cuatro clones con mejores producciones de azúcar comparadas con Ragnar (ECSP98-425, ECSP98-169, ECSP98-168, ECSP98-499). Clone ECSP98-169, es estable respondiendo a ambientes pobres, con un promedio de 9.7 toneladas de azúcar h⁻¹, comparada con Ragnar con 7.8 t de azúcar h⁻¹. Los resultados muestran que el programa de selección en CINCAE tiene clones promisorios que podrían ser entregados a los productores de caña.