RE-EVALUATION OF SUGARCANE GERMPLASM COLLECTIONS
WITH RESPECT TO EARLY MATURITY

C.C. Lo and A.L. Hour
Taiwan Sugar Research Institute
Tainan, Taiwan, Republic of China

ABSTRACT

A total of 998 varieties and clones of sugarcane conserved at Taiwan Sugar Research Institute germplasm collection were re-evaluated for early maturity at cane age of 8-, 9-, 10- and 11-months. Brix reading of the investigated germplasm showed a wide distribution indicating that early maturing varieties and clones were available and could be detected for use. Groups of varieties released from Canal Point (CP), Fiji (LF), Queensland (Q) and Taiwan (ROC) were found to be early maturing and have high sugar. As a result, 19 early maturing varieties and hybrid clones were selected for use as the additional parents in our breeding program. The utilization of germplasms is more important than the conservation and characterization of them. The use of the wild canes and related plants directly for hybridization breeding would be successful only through a long-term project. Man-made hybrid clones at hand in the germplasm collection could provide valuable resources of specific characters for use in hybridization breeding through a re-evaluation process.

Key words: Brix, germplasm, early maturity.

INTRODUCTION

During the past years, many foreign sugarcane varieties and Saccharum clones have been introduced into Taiwan Sugar Research Institute (TSRI) for the aim of extending germplasm resources. Introduced varieties and clones are usually evaluated for their agronomic characters after the release from quarantine nursery. Those with acceptable performance or having useful characters will be selected for use as hybridization parents. The remainder are conserved in the germplasm collection.

Selection of sugarcane varieties for early maturity has been one of the prime objectives of sugarcane breeding at TSRI. However, we have found only a limited number of parent varieties with this characteristic in our active collection. On the other hand, this useful character might have been undetected in the clones in the conserved germplasm collection because of negligence in the past. In this paper, detection of early maturity or use in the breeding program is reported as an example to emphasize the importance of re-evaluation of conserved germplasm.
MATERIALS AND METHODS

A total of 998 varieties and clones of sugarcane conserved in the TSRI germplasm collection were evaluated for early maturity and sugar content with the aid of a hand refractometer. Three stalks for each variety of clone were sampled at random and the Brix was measured at the middle part of stalks during the maturing season from September through December at the cane age of 8-, 9-, 10- and 11- months, respectively. The number of tested materials are summarized in Table 1. Mean and variance of Brix for population were calculated in this investigation. Varieties and clones with top 5% of Brix reading were selected for evaluation.

TABLE 1. Number of sugarcane germplasm re-evaluated for early maturity and high sugar.

<table>
<thead>
<tr>
<th>Date of investigation</th>
<th>Age of cane (month)</th>
<th>No. of varieties and clones</th>
<th>No. of active parent varieties included</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sept. 15</td>
<td>8</td>
<td>392</td>
<td>392</td>
</tr>
<tr>
<td>Oct. 13</td>
<td>9</td>
<td>993</td>
<td>382</td>
</tr>
<tr>
<td>Nov. 17</td>
<td>10</td>
<td>998</td>
<td>391</td>
</tr>
<tr>
<td>Dec. 18</td>
<td>11</td>
<td>974</td>
<td>371</td>
</tr>
</tbody>
</table>

RESULTS

The maturation status in the conserved sugarcane germplasm has been obtained as a result of monthly investigation of juice Brix sampled from cane stalks. A wide range of distribution in Brix was found in each month of investigation (Figure 1). It indicated that a high complexity of sugar content existed in the conserved germplasm, and there will be a possibility of selection of useful individuals in this population on the basis of sugar content. It is also feasible to detect early maturing materials in the very early month of maturation in September since a large number of varieties and clones have been detected with comparatively high reading of Brix.

Brix of the varieties of different breeding origins tended to differ. Among the groups classified, the varieties released from Canal Point (CP), Fiji (LF), Queensland (Q) and TSRI (ROC) and hybrid clones showed earlier maturation and higher sugar content. The groups of Co, M, POI and Saccharum spp. (mostly S. officinarum and S. sinense) were late maturing and low in sugar. Earliness and high sugar in the
FIGURE 1: Frequency distribution of BRX or superficial germination measured at different cane ages.
materials seemed to be unrelated to the location of their origin, i.e. regardless of being tropical or subtropical.

It is evident that the better performance of the ROC varieties and TSRI hybrid clones in early maturity and sugar content would be attributed to the emphasis put upon the selection of early maturity in recent years. The F varieties released in the early years by TSRI were inferior in this respect because early maturity was not considered as important as the other breeding objectives at that time.

As a result, from this investigation a total of 19 varieties and hybrid clones among the top 5% of Brix reading were selected after the re-evaluation of conserved germplasm for early maturity and high sugar content. Among the newly selected parent varieties, the Canal Point group was outstanding. Two old varieties of TSRI, F-69 and F-148 were also selected for re-utilization.

DISCUSSION

Collection of sugarcane germplasm is an international concern. It has made great contributions to sugarcane improvement. Many sugarcane breeding institutes around the world have participated in the collection and conservation of sugarcane germplasm (Berding and Roach1, Lo et al2, Nagatomi et al10, Roach14, Ochoa15). Efforts on the characterization and evaluation of sugarcane germplasm have been made by many sugarcane breeders (e.g. Nagarajan and Somarajang, Naidu1, Roach15). Sturgess emphasized the necessity of promotion on the characterization of sugarcane germplasm through international cooperation.

Characterization of a total of 1,412 clones of sugarcane germplasms maintained at TSRI had been accomplished in 1985 (Lo, unpublished). Eighteen characters were investigated and described. The database consists of the code number, variety name, parents, morphology, sugar content, yield potential, disease resistance, flowering characters and importation records.

The utilization of germplasm should be more important than its conservation and characterization. The use of germplasm in hybridization breeding might be considered from two aspects: the use of wild canes and the use of man-made hybrid clones.

The contribution of the wild Saccharum species to the development of modern sugarcane varieties is well known. Saccharum relatives were also used in sugarcane breeding. The use of wild canes and related plants directly for hybridization breeding is time-consuming and is expected to be successful only as a long-term project through a series of 'nobilization' backcrosses. In the utilization of noble canes for crossing parents, reluctance in flowering, failure in photoperiodic treatment, susceptibility to diseases and failure to survive in the conservation fields are problems
commonly encountered. Off-season flowering of S. spontaneum and Miscanthus plants is also a limitation when they have to cross with sugarcane clones, although the flowering could often be synchronized with photoperiodic treatments.

In a routine breeding program, breeders expect to achieve an accumulation of the desirable genes into progeny varieties through hybridization processes. Under this premise, man-made hybrid clones existing in the conservation collection would contain such genes if the desirable specific characters had been subjected to selection before hybridization. Therefore, a re-evaluation of useful characters existing in the germplasm collection, particularly in man-made hybrid clones, was realized recently in our breeding program. Since early maturity is now a prime objective of the program, investigation of the maturation status by means of Brix measurement appears to be a useful approach. The results obtained in this study showed that a number of man-made hybrid clones conserved in the germplasm collection could be re-evaluated for use as the early maturing parents in the breeding program. Many breeders indicated that juice quality, including Brix, of sugarcane is heritable (Ines and Mariotti14, Miller and James7, Rao13, Singh et al16, Skinner et al17), and that maturity in sugarcane could be improved by selection pressure (Bond2, Breaux3, Milligan et al8, Skinner et al17).

The aim of this paper is to remind other breeders to investigate the more intensive use of valuable germplasm materials at hand.

REFERENCES


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UNE RE-EVALUATION DU PATRIMOINE GENETIQUE DE LACANNE A SUCRE PAR RAPPORT A LA MATURITE PRECOCE.

C.C. Lo et A.L. Hour
Taiwan Sugar Research Institute
Tainan, Taiwan, République de Chine

RESUME

Une collection comprenant 998 variétés et clones de canne à sucre conservées à l’Institut de Recherches Sucrières de Taiwan, a été re-évaluée pour la maturité précoce à 8, 9, 10 et 11 mois. Une distribution suffisamment large de Brix fut relevée indiquant la disponibilité des variétés et clones précoces pour l’exploitation ultérieure. Les groupes de variétés de Canal Point (CP), de Fidji (LF), du Queensland (Q) et de Taiwan (ROC) étaient à la fois les plus précoces et les plus riches. Conséquemment, 19 variétés y compris des hybrides précoces furent sélectionnées comme géniteurs pour renforcer la gamme de parents utilisables dans le programme d’hybridation. L’utilisation du patrimoine génétique est plus importante que leur conservation ou leur caractérisation. L’exploitation des espèces sauvages et apparentées, directement dans le programme d’hybridation ne peut réussir qu’à long terme. Les hybrides commerciaux disponibles immédiatement dans les collections constituent d’inestimables ressources en caractères spécifiques, pour une éventuelle exploitation dans un programme d’hybridation à travers un procédé de re-évaluation.

Mots clés : Canne à sucre, patrimoine génétique, Brix, maturation précoce.
RESUMEN

Un total de 998 variedades y clones del banco de germoplasma de caña de azúcar del "Taiwan Sugar Research Institute" fue revaluado para maduración temprana a las edades de 8, 9, 10 y 11 meses. El Brix mostró una amplia distribución, lo que indica que hay disponibilidad de materiales de maduración temprana. Se encontró que hay grupos de variedades de Canal Point (CP), Fiji (LF), Queensland (Q) y Taiwan (ROC) con maduración temprana y alta producción de azúcar. Se seleccionaron 19 variedades y clones como progenitores adicionales en el programa de mejoramiento. La utilización del germoplasma es más importante que su conservación y caracterización. El uso directo en el programa de mejoramiento de cañas silvestres y plantas relacionadas, tendría éxito sólo mediante un proyecto a largo plazo. Los clones obtenidos por el hombre, disponibles en un banco de germoplasma, podrían ser un recurso genético valioso para caracteres específicos en un programa de mejoramiento mediante un proceso de revaluación.

Palabra claves: Brix, germoplasma, maduración temprana.