**Recent results from the Guyana variety development programme using quality as a selection criteria in stage**

**by**
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## ABSTRACT

In order to improve the effectiveness of the Variety Selection Programme in Guyana, in which seedlings were traditionally selected from Stage I to II, based on visual observations; quality was introduced in 2005, as one of the principal criteria for selection in the early stages. Seedlings were assessed as families. 269 families have been evaluated over a period of two years. Approximately 40 seedlings were grown from each family, at the time of maturity, each seedling was brixed; the family mean was established and compared to the commercial quality standard. Results have indicated that a number of family means were better than the Standard DB7869 which ranged from 17.5 – 22.0˚. Using a criterion of rejection of family mean brix <20º , at least 40% of the families of the previous selection procedure would have been rejected at this stage, providing the opportunity to focus on families with greater sugar productivity potential. In some cases brix values of 26˚ and over were recorded for individual seedlings. The results from this procedure are being utilized in the identification of parents for future D and DB crosses.

**Keywords**: quality; selection; family.

## INTRODUCTION

The success of a sugarcane breeding programme is dependent on the effectiveness of the selection procedure. Selection in sugarcane is applied to all stages of breeding, in choice of parents, in crosses made, progeny testing and in seedling and clonal populations. (J. C. Skinner,1971. The most important feature of any sugarcane improvement programme is the long and expensive process of variety selection.

In the Varietal selection programme, as pointed out by Kennedy (2004), the early selection methods relied mainly on visual characters of the seedling population with no attention being paid to sucrose content.

With an aim of improving the effectiveness of sugar production in the Caribbean given the constraints on area and yield, Kennedy conducted studies and a special parental population with very high sucrose content was developed. The products from this programme are now being used as parents in commercial breeding programmes and their progeny are now being evaluated across the region including Guyana.

Guyana is positioned at 6˚ N 58˚ W and is divided into four ecological zones. Sugarcane is grown on the coastland where the annual rainfall averages about 1980 mm, the daily temperature ranges between 31˚ C and 22˚ C and the relative humidity is 80% (Encarta), conditions which do not allow for ripening. Because of these constraints and the need to develop new improved varieties, which may yield more sugar per unit area at a minimum cost, the Breeding and Selection Department of the GUYSUCO Agricultural Research Centre has embraced a strategy to evaluate clones for quality at the initial stage.

In Guyana the examination of progeny from two crossing programmes is conducted annually. Seedlings raised from the Guyana crossing programme are referred to as Demerara Series (D) and seedlings raised from the West Indies Central Sugarcane Breeding Station's (CBS) programme are referred to as the Demerara-Barbados Series.

The selection procedure used for both the Demerara and the Demerara-Barbados series commences with the evaluation of a large number of seedlings derived from true seed in Stage I. The traditional selection procedure at the seedling stage was done by visual assessment in the ratoon cycle. The clones are compared to the commercial standard and based on visual observations of a number of morphological characteristics; clones are advanced to higher selection stages. In order to not discard superior varieties, selection rates from original seedlings are approx. 20% of the population. In the advanced stages of evaluation, the clones are selected for high yield and quality, resistance to diseases and other agronomic characteristics.

## MATERIALS AND METHOD

The family assessment exercise was conducted over a two year period in four experimental fields. Included in the evaluation were 35 families from the Demerara 2004 Series; 157 from the DB2004 Series and 77 families from the DB2005 Series. Approximately 40 seedlings were grown from each family and planted in observation plots along with the standard commercial variety DB7869, while the larger population was planted simultaneously in another section of the field. The seedlings were planted in field at 60cm (2 feet) intervals with a single stool of the standard at the beginning and the end of each family. Rows are 1.5m (5') apart on a ridge and furrow layout.

At the time of harvest at age 46 to 53 weeks, each seedling was brixed. Within each stool juice was collected from three cane stalks at the fifth internode from the TVD, this was then tested using a hand held refractometer. The family mean was established and compared to the commercial standard. Families exhibiting Brix values > 20˚ were identified for further assessment.

Seven to nine months after harvesting as plants, selections were made in the entire population by traditional methods.

## RESULTS AND DISCUSSIONS.

Thirty-five (35) families from the Demerara 2005 crossing programme (D'05) were tested in CM44. Table 1 shows the twenty-three families from which selections were done. It was evident that those families that satisfy the quality criteria also exhibited the desirous agronomic characteristics since visual selection has resulted in approximately 40.4% being selected when mean brix >19.5º (current commercial mean) was used as a 2nd layer of selection. Traditional selection conducted on the 23 families showed that the families (7036, 7073, 7030) with the highest mean brix ranked 6th ,7th , and 8th respectively in selection percentages. The highest selection rate (7.2%) was obtained from 7052 whose mean family brix was ranked 20th. Mangal et.al (1994-1997) argued that family indicating superior brix should indicate selection percentage higher than those families of less quality or family selection is not effective. However, traditional selection is subjective and focuses mainly on phenotypic character; the family selection approach does introduce an objective measurement of quality and yield as primary selection criteria.

In table 2 the highest selection rates were obtained from families # 910,879,883, 973 (31.8, 20.7, 17.4 and 17.3 %) that satisfied the criterion mean brix > 20º. This result contrasts with the 1994 – 1997 findings obtained in Guyana where selection was highest in poorer families. However since the selections were based on visual criteria, a significant number of selections were made from the poorer quality families and only one clone was selected from the highest quality family.

Of the 70 DB2004 families evaluated in CM45 (Figure 1) 26 (37%) had mean brix >20˚. 24 % of the families fell within the 17.1˚ – 19.0˚ brix range. The minimum family mean recorded was 13.1˚ and the maximum was 23.0˚.

While in CM63 (Figure 2.) 71% of the 87 DB2004 families were selected for further evaluation. Brixes of these families as indicated in figure 2. ranged from 17.1˚ to 24.9˚, unlike those in CM45 which ranged from 13.1˚ to 23.0˚; the reason being that the families evaluated in CM63 were primarily categorized as high quality or having genes which predispose them to exhibit better quality than their counterparts which were mainly families derived from the multipurpose crossing programme.

Seventy-seven of the families of the DB2005 Series, which were received from WICSCBS for family assessment, were established in CM 59.  Data presented in Figure 3. shows that mean family brixes ranged from 16.0˚ to 22.9˚ with twenty-six (34%) of the families evaluated meeting the criteria of > 20˚ brix..

Figure 4 – shows a summary of the number of families with individual seedlings expressing a Brix value > 23.0˚ (the mean Brix value of the quality Standard DB51362). Of the 269 families that were evaluated, 152 families had individual seedlings expressing brix values exceeding the current commercial standard DB7869 by 5.5 to 6.9 units.

The probability of selecting a quality seedling is greater in the families exhibiting the acceptable mean brix value, as observed in figure 5 where frequencies of 42 to 87% was obtained from these families, while the frequency was lower in the poorer families.

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# CONCLUSION

Family selection when established properly can be an effective tool in identifying quality families thus eliminating in at the earliest possible time poor families that will result in a waste of resources. This supports findings reported by Bennet – Easy (1997). The gross weight of the family plots will further improve the effectiveness of selection.

Testing of genotypes singly at the seedling stage will improve the effectiveness of the selection process.

## REFERENCES


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**Table.1 Mean Selection Rates of D 2005 Families.**

| Code # | Parents | Mean family brix | Range of family brixes | % selection to stage II |
|---|---|---|---|---|
| 6004 | WI79492 * POLY | 14.1 | 8.0 - 22.4 | 2.3 |
| 6007 | WI79492 * POLY | 15.0 | 10.5 - 19.8 | 0.7 |
| 3029 | D 89290 * POLY | 17.8 | 11.3 - 21.7 | 2.9 |
| 7052 | D 96291 * POLY | 17.9 | 9.8 - 21.8 | 7.2 |
| 7070 | D 9044 * POLY | 18.1 | 12.9 - 23.4 | 6.3 |
| 6005 | WI76403 * POLY | 18.2 | 12.6 - 21.8 | 1 |
| 3018 | D 89349 * POLY | 18.2 | 14.3 - 24.1 | 2.1 |
| 7082 | D 93409 * POLY | 18.3 | 13.8 - 22.6 | 0.5 |
| 3027 | D 8026 * POLY | 18.3 | 12.5 - 22.9 | 1.2 |
| 7085 | D 8976 * POLY | 18.5 | 13.2 - 22.4 | 0.5 |
| 7083 | D 93224 * POLY | 18.7 | 10.0 - 22.8 | 0.5 |
| 7049 | D 9044 * POLY | 19.1 | 13.4 -22.0 | 3.5 |
| 7010 | D 8976 * POLY | 19.2 | 11.7 - 23.0 | 6.9 |
| 7067 | D 91175 * POLY | 19.5 | 16.2 - 22.2 | 3.6 |
| 3026 | DB9314 * POLY | 19.7 | 15.2 - 23.6 | 1 |
| 7071 | DB79327 * POLY | 19.7 | 12.8 - 26.4 | 4.5 |
| 7026 | DB89186 * POLY | 19.8 | 12.5 - 23.2 | 1.8 |
| 6003 | WI79535 * POLY | 19.9 | 14.4 - 23.6 | 0.2 |
| 7078 | D 7078 * POLY | 19.9 | 12.6 - 27.3 | 1.4 |
| 7035 | D 8976 * POLY | 19.9 | 14.3 - 24.5 | 4.9 |
| **7030** | **D 8691 * POLY** | **20.1** | **11.3 - 24.2** | **4.1** |
| **7073** | **D 9119 * POLY** | **20.1** | **13.9 - 23.2** | **4.3** |
| **7036** | **D 9086 * POLY** | **20.1** | **15.1 - 23.9** | **4.4** |

**Table.2 - Summary of Selection Rates and Brix values of DB 2004 families in CM 45**

| Code # | Parents | Mean family brix | Range of family brixes | % Selection |
|---|---|---|---|---|
| 632 | D 9083 * Polycc | 17.9 | 9.8  - 22.2 | 15.0 |
| 874 | B 89640 * Polycc | 18.1 | 14.1 - 22.8 | 14.0 |
| 871 | D 89262 * Polycc | 18.7 | 11.8 - 23.7 | 16.9 |
| 641 | DB8935 * Polycc | 18.9 | 17.2 - 21.9 | 11.7 |
| 872 | DB8958 * Polycc | 19.2 | 12.9 - 23.3 | 15.5 |
| 887 | B 85342 * PolyMPc | 19.3 | 13.5 - 23.2 | 14.2 |
| 750 | DB8958 * Polycc | 19.7 | 16.1 - 23.1 | 10.0 |
| 877 | R 570 * Polycc | 19.8 | 18.0 - 22.8 | 14.9 |
| 911 | DB88175 * Polycc | 19.9 | 14.0 - 22.3 | 11.7 |
| 809 | B 85342 * Polycc | 20.0 | 14.8 - 23.8 | 3.6 |
| 950 | DB88175 * Polycc | 20.1 | 16.6 - 22.8 | 11.8 |
| 949 | DB8958 * Polycc | 20.2 | 15.7 - 25.7 | 7.9 |
| 939 | D 8415 * Polycc | 20.3 | 17.9 - 23.2 | 0.0 |
| 878 | D 8928 * Polycc | 20.3 | 15.6 - 23.7 | 16.7 |
| 943 | D 8928 * Polycc | 20.3 | 11.6 - 22.8 | 17.3 |
| 12 | B 85342 * WI79461 | 20.4 | 13.8 - 23.8 | 4.9 |
| 863 | WI9101 * Polycc | 20.5 | 14.4 - 23.5 | 3.9 |
| 655 | B 78436 * Polycc | 20.5 | 16.0 - 23.2 | 5.3 |
| 944 | DB88112 * Polycc | 20.5 | 14.4 - 24.7 | 15.7 |
| 92 | B 85342 * B 74612 | 20.6 | 15.2 - 23.4 | 4.8 |
| 488 | R 570 * Polycc | 20.6 | 16.8 - 22.4 | 7.2 |
| 724 | BT84118 * Polycc | 20.6 | 13.0 - 24.4 | 15.7 |
| 910 | DB8755 * Polycc | 20.7 | 17.3 - 23.2 | 31.8 |
| 661 | B 97263 * Polycc | 20.8 | 15.2 - 25.3 | 7.6 |
| 649 | B 89491 * Polycc | 20.8 | 16.9 - 24.7 | 9.0 |
| 956 | B 881104 * Polycc | 20.9 | 17.4 - 23.4 | 10.8 |
| 651 | B 9356 * Polycc | 21.2 | 15.2 - 24.6 | 14.4 |
| 966 | uk | 21.3 | 17.7 - 23.7 | 8.2 |
| 879 | D 9083 * Polycc | 21.4 | 13.7 - 24.5 | 20.7 |
| 947 | DB87141 * Polycc | 21.5 | 15.4 - 25.4 | 4.5 |
| 849 | B 89640 * B 89529 | 21.5 | 16.2 - 24.0 | 6.5 |
| 664 | B 85342 * Polycc | 21.6 | 15.8 - 24.6 | 3.8 |
| 883 | B 85342 * Polycc | 21.6 | 19.0 - 24.2 | 17.4 |
| 646 | B 031549 * Polycc | 22.1 | 20.2 - 23.4 | 3.5 |
| 905 | B 89640 * Polycc | 22.2 | 18.1 - 24.9 | 6.2 |
| 492 | WI96916 * PolyMPc | 23.0 | 20.0 - 25.6 | 1.6 |

**Figure1. Mean brix value of the families of the DB2004 Series in CM45**

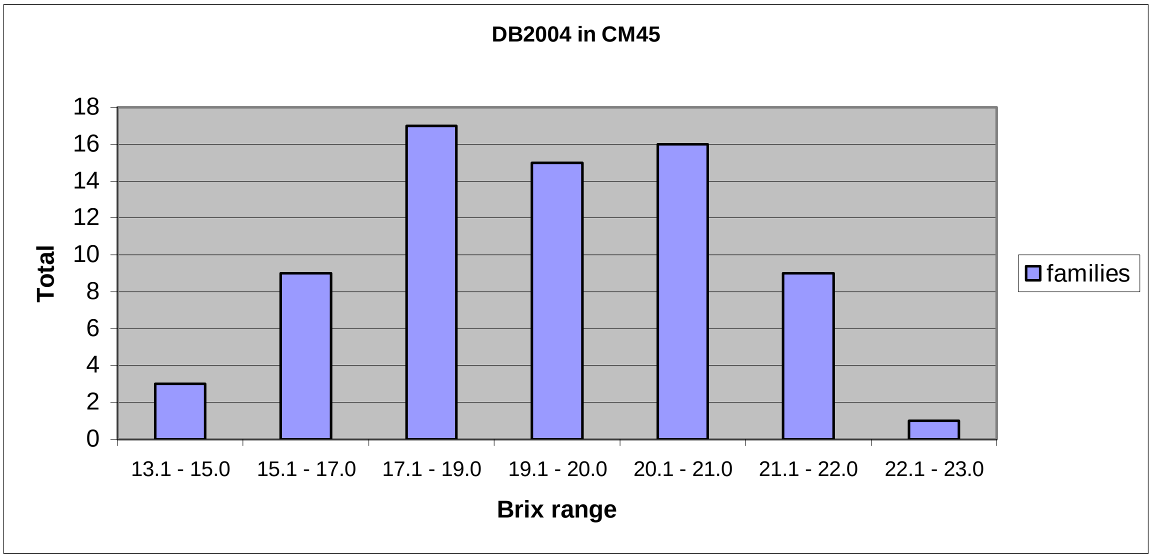


**Figure 2. Mean Brix values of the families from the DB2004 Series in CM63**

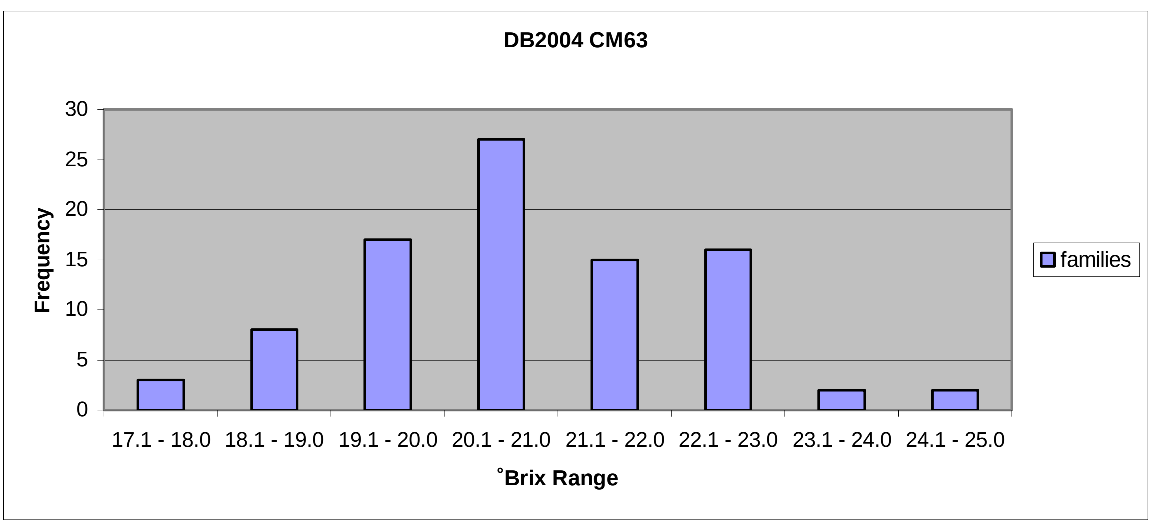

**Figure 3**. Mean Family Brixes of the DB2005 Series in CM59

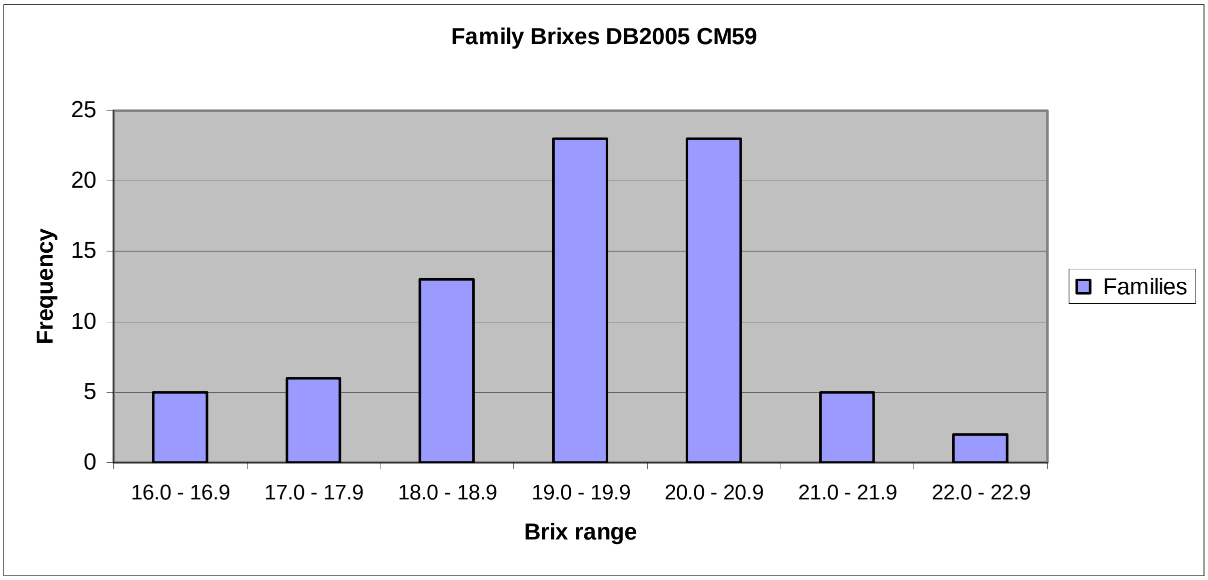


**Figure 4. Families with individual seedlings with Brix values >23.0˚**

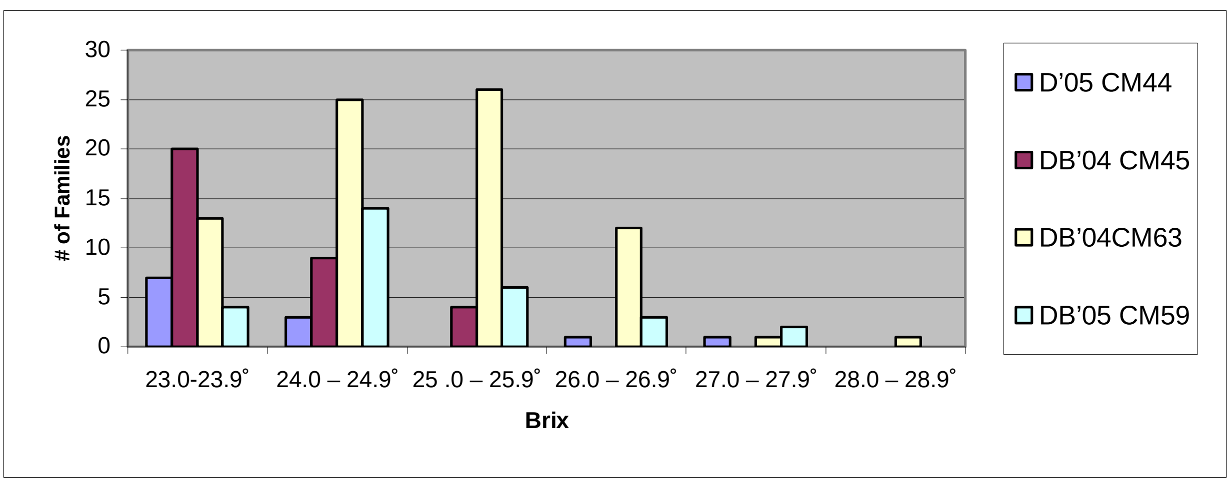

**Figure 5: Frequency of High Brix Seedlings within Families**