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# GENETIC VARIABILITY AND CORRELATION STUDIES IN SUGARCANE

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## ABSTRACT

**The genetic variability, heritability, genetic advance and correlations were studied for ten characters, viz., millable canes/clump, internodes/cane, stalk weight, stalk girth kg-brix, sucrose content in juice, purity coefficient, invert sugar, ccs/cane and fibre content of 35 treatments (11 parents and 24 $F_1$). The phenotypic and genotypic coefficient of variance indicated that selection may be done for kg-brix, millable canes/clump, invert sugar, ccs/cane, stalk weight and internodes/cane. These characters are of great value to the breeder for selection. The millable canes/clump, internodes/cane, stalk weight, kg-brix and ccs/cane(kg) are positively and significantly associated with each other. Positive significant association of stalk girth was found with stalk weight, kg-brix, invert sugar, ccs/cane. Therefore, millable canes/clump, internodes/cane, stalk weight, kg-brix, ccs/cane and stalk girth should be given due weightage during selection.**

**Key words:** Kg-brix, genetic variability, heritability, genetic advance.

The genetic variability and correlations for quantitative and qualitative characters are of great value in selecting desired types. For a planned breeding programme to improve yield and juice quality, complete information on the genetic variability and interrelationship in different quantitative and qualitative characters is necessary. Therefore, the present investigation aims to assess the variability and relative importance of different characters with the help of certain genetic parameters like coefficient of variability, heritability and genetic advance, and the interrelationship among different quantitative and qualitative characters was studied.

## MATERIALS AND METHODS

The line × tester (8× 3) crosses including lines Co 7004, Co 7314, Co 7717, CoS 659, BO 70, CP 44/101, POJ 2878 and Q 68; and testers Co 775, Co 1148 and Co 6904 were made at Sugarcane Breeding Institute, Coimbatore, during October-November, 1979. The seedlings of each cross and nursery from single bud of each parent were raised at the U.P. Council of Sugarcane Research, Shahjahanpur, in 1980. The 30 seedlings taken per replication of each 35 treatments (11 parents + 24 $F_1$) were transplanted in randomized block design in four replications, with 6.00 × 2.70 m plot size having three rows 90 cm apart. The seedlings were spaced

at 60 cm within row. In each treatment, 20 seedlings were tagged randomly, in each treatment. Thus, total 80 seedlings per treatment were used for recording observations on millable canes/clump, internodes/cane, stalk weight (kg), stalk girth (cm), kg-brix, sucrose content in juice (%), purity coefficient, invert sugar, ccs/cane (kg), and fibre content (%).

The kg-brix was calculated by the following formula of Miller [1].

$$\text{kg-brix} = \text{brix} \times \text{cane yield} \times 0.70$$

The ccs content (%) was calculated with the help of Winter and Carp formula published by Prinsen-Geerlings [2].

$$\text{ccs } \% = S - 0.4\ (B-S) \times 0.73$$

$$S = \text{Sucrose } B = \text{Brix}$$

$$\text{ccs/cane (kg)} = \frac{\text{ccs\%} \times \text{cane yield (kg)}}{100}$$

Sucrose content (%) was calculated with the help of Schmitz's table. The purity coefficient was determined as

$$\text{Purity coefficient} = \frac{\text{Sucrose \%}}{\text{Corrected brix}} \times 100$$

The invert sugar was estimated with the help of Lane-Eynon Volumetric method [3].

$$\text{Invert sugar} = \frac{\text{Factor}}{\text{Specific gravity} \times \text{burate reading}}$$

Fibre content (%) was recorded with the help of "dry substance method" suggested by Blake [4].

The phenotypic and genotypic coefficient of variability (PCV, GCV) were calculated according to the method suggested by Burton [5], heritability (broad sense) and genetic advance (GA) as per Johnson et al. [6]. The formula developed by Robinson et al. [7] was adopted for the calculation of correlations.

## RESULTS AND DISCUSSION

Analysis of variance (Table 1) showed significant differences among all the characters. The highest PCV, GCV were recorded for kg-brix, followed by millable canes/clump, invert sugar, ccs/cane and stalk weight, but it was low for purity coefficient and sucrose content in juice. The slight edge of PCV over GCV indicated a good scope for making selection for these characters.

The estimate of heritability of a character provides a measure of the effectiveness of selection for that character. Internodes/cane showed the highest heritability (79.80%), followed by kg-brix (68.74%), stalk weight, (65.88%), and millable canes/clump (65.85%), whereas fibre content showed the lowest heritability (34.76%). Moderate heritability values were recorded for all the remaining characters. The

highest GA (as % of mean) was obtained for kg-brix (56.68), followed by millable canes/clump (40.05), internodes/cane (37.06), invert sugar (29.91), stalk weight (29.67, and ccs/cane (28.57) (Table 1). Heritability alone may mislead during selection, therefore, genetic advance and heritability should be taken into consideration during selection programme [6]. In the present study, high heritability (more than 50%) was recorded for number of millable canes/clump, internodes/cane, stalk weight, stalk girth, kg-brix and ccs/cane(kg), which were accompanied by high GA, except for stalk girth (Table 1).

**Table 1. Analysis of variance, range, mean, variability, heritability and genetic advance as % of mean**

| Character | M. S | | Range | Mean+SE | GCV | PCV | Herita-bility | G.A, % of mean |
|---|---|---|---|---|---|---|---|---|
| | treat-ment d.f. 34 | error d.f 102 | | | | | | |
| Millable canes/ clump | 17.7** | 2.03 | 4.25–12.28 | 8.26±1.01 | 22.1 | 27.2 | 65.8 | 40.0 |
| Internodes/cane | 149.6** | 8.36 | 16.7–42.24 | 29.47±2.10 | 17.5 | 19.6 | 79.9 | 37.1 |
| Stalk-weight, (kg) | 0.3** | 0.03 | 0.69–2.01 | 1.35±0.12 | 18.3 | 22.5 | 65.9 | 29.7 |
| Stalk-girth (cm) | 0.2** | 0.03 | 1.52–2.74 | 2.13±0.12 | 8.6 | 11.4 | 57.4 | 14.1 |
| Kg-brix | 1.1** | 0.11 | 0.38–2.58 | 1.48±0.23 | 31.3 | 37.8 | 68.7 | 56.7 |
| Sucross content in juice (%) | 5.7** | 2.25 | 12.71–17.56 | 15.13±0.79 | 6.9 | 10.0 | 47.4 | 9.9 |
| Purity coefficient | 14.7** | 3.70 | 80.64–89.95 | 85.29±1.36 | 1.9 | 3.0 | 42.5 | 2.6 |
| Invert sugar (%) | 0.2** | 0.05 | 0.41–1.13 | 0.77±0.16 | 21.5 | 34.6 | 38.8 | 29.9 |
| ccs/cane (kg) | 0.4** | 0.001 | 0.07–0.21 | 0.14±0.02 | 20.1 | 25.9 | 59.8 | 28.6 |
| Fibre content (%) | 5.5** | 1.76 | 8.27–13.49 | 10.88±9.37 | 8.4 | 14.2 | 34.8 | 14.8 |

**Significant at 1% level.

The results presented in Table 2 clearly indicate that the genotypic correlations were higher than the phenotypic correlations. The millable canes/clump, internodes/cane, stalk weight, kg-brix and ccs/cane were positively and significantly associated with each other at genotypic and phenotypic levels. Gills et al. [8] and Bathla [9] also reported similar results. The characters stalk weight, kg-brix, invert sugar and ccs/cane have significant positive association with stalk girth at genotypic and phenotypic levels. Sucrose content in juice was also positively and significantly associated with purity coefficient and ccs/cane, but invert sugar was negatively associated with sucrose content in juice and purity coefficient. These findings confirm the earlier reports [9–11], which clearly indicated that millable canes/clump, internodes/cane, stalk weight, kg-brix, ccs/cane, and stalk girth should be given due weightage during selection.

**Table 2. Genotypic (G), Phenotypic (P), and environmental (E) correlation coefficients between 10 characters in sugarcane**

| Character | | Internodes/ cane | Stalk weight | Stalk girth | Kg-brix | Sucrose % in juice | Purity coefficient | Invert sugar | ccs/cane (kg) | Fibre (%) |
|---|---|---|---|---|---|---|---|---|---|---|
| Millable canes/ clump | P | 0.63** | 0.38* | −0.11 | 0.79** | −0.20 | −0.04 | 0.40* | 0.24 | 0.32 |
| | G | 0.63** | 0.64** | −0.15 | 0.88** | −0.47** | −0.25 | 0.91** | 0.45** | 0.63** |
| | E | 0.09 | −0.13 | −0.03 | 0.61** | 0.14 | 0.21 | −0.13 | −0.13 | 0.03 |
| Internodes/ cane | P | | 0.60** | 0.15 | 0.65** | −0.27 | 0.05 | 0.47** | 0.46** | 0.35* |
| | G | | 0.73** | 0.32 | 0.83** | −0.40* | 0.07 | 0.86** | 0.59** | 0.63** |
| | E | | 0.26 | −0.24 | 0.15 | −0.07 | −0.03 | −0.01 | 0.21 | 0.05 |
| Stalk weight | P | | | 0.37* | 0.72** | −0.08 | 0.14 | 0.34* | 0.87** | 0.05 |
| | G | | | 0.51* | 0.88** | −0.13 | 0.28 | 0.72** | 0.94** | 0.27 |
| | E | | | 0.17 | 0.39¶ | −0.02 | 0.08 | −0.06 | 0.76** | −0.14 |
| Stalk girth | P | | | | 0.15 | 0.25 | 0.21 | −0.08 | 0.48** | −0.08 |
| | G | | | | 0.21 | 0.29 | 0.46** | −0.11 | 0.63** | 0.03 |
| | E | | | | 0.05 | 0.22 | 0.03 | −0.06 | 0.28 | −0.17 |
| Kg-brix | P | | | | | −0.01 | 0.15 | 0.32 | 0.65** | −0.18 |
| | G | | | | | −0.22 | 0.05 | 0.86** | 0.78** | 0.48** |
| | E | | | | | 0.29 | 0.28 | −0.29 | 0.43** | −0.12 |
| Sucrose content in juice | P | | | | | | 0.73** | −0.62** | 0.33* | −0.13 |
| | G | | | | | | 0.89** | −0.75** | 0.45** | −0.18 |
| | E | | | | | | 0.60** | −0.53** | 0.23 | −0.09 |
| Purity coefficient | P | | | | | | | −0.37* | 0.43** | −0.05 |
| | G | | | | | | | 0.40 | 0.54** | −0.09 |
| | E | | | | | | | −0.36* | 0.32 | −0.03 |
| Invert sugar | P | | | | | | | | 0.07 | 0.20 |
| | G | | | | | | | | 0.41* | 0.39 |
| | E | | | | | | | | −0.25 | 0.09 |
| ccs/cane (kg) | P | | | | | | | | | −0.01 |
| | G | | | | | | | | | 0.21 |
| | E | | | | | | | | | −0.21 |

*, **Significant at 5% and 1% levels, respectively.

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