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PHENOTYPIC CORRELATIONS OF MAJOR YIELD CHARACTERS IN SUGARCANE (*SACCHARUM OFFICINARUM* L.)

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Phenotypic correlation coefficients were computed for various morphoeconomic characters in sugarcane. The most important economic character-the sucrose was found to be negatively correlated with height whereas, it had a significantly positive association with cane thickness and leaf area. Among the other characters highly significant positive correlation was observed between plant height and number of tillers, plant height and internode length and cane thickness and leaf area, while highly significant negative correlations existed between leaf area, plant height and tillering.

INTRODUCTION

Outside the tropics the sugarcane is propagated exclusively through clonal means and crop never enters sexual reproduction phase under normal soil and climatic conditions. The genetic variability for different morpho-economic characters is, therefore, limited and evolution of new and more productive canes has thus been slow. The success of sugarcane breeding programme is greatly dependant on the efficiency of clonal selection. Selection pressure to a particular trait often results in the negative shift of other vital attributes which frustrates the breeders through retarded progress. Thus the knowledge about the extent and type of association of some major genetic characters in sugarcane is of fundamental importance to synthesize and select better clones from the plant material having only limited genetic variability. Present studies were therefore, planned to obtain reliable information about the interrelationship of economically important morphological characters as also their correlation with sucrose contents. Such an information will be of vital significance in boosting the efficiency of our breeding programmes.

REVIEW OF LITERATURE

The information about correlation of major yield characters in sugarcane

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is meager. However, some more pertinent researches are briefly reviewed heretofore.

Herbert and Henderson (1959) found a negative phenotypic correlation between number of stalks per plot and the number of stalks per stool. A negative association ($r = -0.52$) between stalk and juice brix was also observed by George (1962). This negative relationship was observed to have far reaching consequences in cane breeding as it posed serious limitations to obtaining maximum sugar yield per unit area. Mariotti (1971) also reported a negative correlation between stalk diameter and number of tillers per cane, the 'r' value being 0.096. However, a positive but non-significant correlation between stalk diameter and stalk length (0.071) and between stalk length and number of tillers per plant (0.188) was recorded. While a significant correlation between refractometer brix and sucrose contents as also between purity and sucrose contents was observed by Richard (1975).

Phenotypic associations calculated could at best be important for the purpose of orientation rather than prediction in a crop improvement programme, However, the genotypic correlation may be much more valuable. In this context Brown (1965) estimated a non-significant genotypic correlation between brix and fibre contents. The phenotypic correlations calculated were though significant but were relatively low while the genotypic correlations were high and significant. Observations on genotypic, environmental and clonal correlations among general agronomic traits of sugarcane varieties were also reported by Brown *et al.* (1969) from a population having wider genetic base. A negative genotypic correlation (-0.054) was estimated between sucrose per cent dry weight and cane yield with an analogous association between number of stalks per unit area and sucrose per cent fresh weight. They also obtained a positive and moderately high genotypic correlation (0.57) between fibre per cent dry weight and cane yield. Legendre (1970) estimated genotypic correlation between yield components using segregating material from a cross CP 48-103XCP 33-224. He however, found no adverse correlation of morphological characters which could drastically curtail progress in sugarcane breeding programme.

MATERIALS AND METHODS

The studies were conducted in the Department of Plant Breeding and

Genetics, University of Agriculture, Faisalabad during the year 1977-78. The experimental material comprised 27 progenies (clones of sugarcane) produced from the following genetically diverse parental varieties :

1. Col. 8 2. BL-4 3. AU-16 4. 2770 5. L-4 6. Col. 80
7. Col. 8 8. Col. 285 9. Col. 205 10. Col. 29 11. Col. 72
12. Col. 7 13. L-3 14. BL-19.

In addition 3 commercial varieties viz., Col. 54, L-116 and L-118 were also included in the studies.

The sowing was done in the field during the Ist week of March 1977 using complete randomized block design with 10 replications. All 30 clones were represented in each replication having 10 guarded plants raised from single eyed setts. The plant to plant and row to row distance was kept 3 ft. Experimental population received normal agronomic and plant protection care. Data on the following six characters were recorded :

1. Number of Tillers per Plant:

Tillers per plant were counted at the time of maturity from the 10 guarded plants of each variety in each replication. The average was then computed.

2. Internode Length :

The internode length was measured in centimeters from the central internode of the most vigorous stalk in each of the 10 stools, selected for number of tillers in each replication.

3. Cane Thickness :

The cane thickness was measured in centimeters by a vernier caliper from the centre of internode selected and measured for internode length.

4. Leaf Area :

Maximum length and breadth of the middle leaf of the stalk selected for internode length was measured in centimeters and the leaf area was then computed using the following formula:

$$\text{Length} \times \text{Breadth} \times 0.75$$

5. Plant Height

Plant height was measured in decimeters at the time of maturity from the stalks selected for nodal length.

6. Sucrose Contents :

Sucrose contents were obtained by the standard method suggested by Spencer and Meade (1963).

Statistical Analysis:

Coefficient of phenotypic correlations between yield components and sucrose contents were computed using the standard formula -

$$r_{xy} = \frac{n \Sigma xy - \Sigma x . \Sigma y}{\sqrt{[n \Sigma x^2 - (\Sigma x)^2] [n \Sigma y^2 - (\Sigma y)^2]}}$$

RESULTS AND DISCUSSION

The mean values for various plant characters are presented through Table I, while the calculated correlation coefficients appear in Table 2.

As is obvious from the table the correlation coefficients calculated for sucrose percentage gave positive values for all characters except for plant height where it was negative and highly significant. The 'r' value being -0.36, However, the sucrose contents varied in the varieties under study from 11.69 to 16.32. The highest value of 16.32 was obtained in a newly developed clone AUS-2 which was closely followed by a standard variety, L-118 giving mean value of 16.08 Negative association between stalk length and sucrose has also been reported by George (1962), while Brown *et al.* (1969) observed a negative association between per cent dry weight of sucrose and the cane yield. Among the positively correlated characters, the highest and significant correlation value of 0.425 was recorded for leaf area and sucrose, showing thereby that larger the leaf surface more the chances for accumulating higher quantity of sucrose which is obviously accomplished through exposure of larger photosynthetic surface to energy radiations. It can, therefore, be suggested that canes having larger photosynthetic foliar surface may ultimately excel in producing sugar per unit area.

Mean values for plant height ranged from 20.86 to 33.41 decimeters.

Table 1 : *The mean values and range of various morphological characters in 30 genetically diverse varieties of sugarcane.*

Genotype	Number of tillers per plant	Cane thickness (in cms)	Plant height (in decimeters)	Internode length (in cms)	Leaf area (in sq. cms)	Sucrose content %
AUS-1	9.8	2.58	23.22	16.78	491.70	15.14
AUS-2	7.9	2.09	21.09	18.10	424.27	16.32
AUS-3	9.5	1.84	25.70	15.42	278.53	13.20
AUS-4	12.8	2.37	23.05	15.73	398.55	14.90
AUS-5	12.1	1.97	30.28	15.80	267.50	12.19
AUS-6	11.8	1.94	23.29	16.54	345.76	13.63
AUS-7	10.1	1.91	28.48	16.55	372.06	13.42
AUS-8	7.6	2.10	23.32	15.41	389.79	13.54
AUS-9	4.0	3.17	23.13	15.16	652.50	13.03
AUS-10	10.7	1.70	24.60	14.75	311.50	15.03
AUS-11	8.7	1.63	24.24	15.49	298.71	14.66
AUS-12	10.5	2.59	26.29	16.01	420.41	13.71
AUS-13	7.5	2.06	23.77	14.60	352.41	14.80
AUS-14	7.8	1.97	22.25	16.80	324.82	13.29
AUS-15	9.4	1.68	28.30	17.72	232.55	15.06
AUS-16	10.6	2.21	26.60	15.66	374.55	14.93
AUS-17	13.3	1.73	24.49	15.67	414.17	16.05
AUS-18	6.8	1.94	24.18	13.69	354.05	15.40
AUS-19	11.1	2.29	22.07	13.64	393.50	13.92
AUS-20	11.6	2.03	26.91	17.80	435.92	15.01
AUS-21	8.3	1.38	24.05	15.08	277.22	11.69
AUS-22	13.8	2.82	33.41	19.39	258.21	13.13
AUS-23	11.1	1.91	25.59	16.08	454.88	14.44
AUS-24	6.5	2.03	25 91	13.64	273.19	13.23
AUS-25	10.3	2.13	26.81	14.63	339.71	13.91
AUS-26	10.1	2.67	23.96	15.54	299.34	15.86
AUS-27	9.4	2.16	24.54	15.33	416.20	15.47
L-118	6.4	2.43	20.86	15.99	505.81	16.08
L-116	6.1	2.66	24.45	15.51	596.37	14.55
Col. 54	8.6	2.02	24.80	14.66	422.99	15.00
Range	4-13.3	1.38-3.17	20.86-33.41	13.64-19.39	232.55-652.56	11.69-16.32

Table 2 : *Simple Correlation Coefficients of various yield components.*

Character	Plant height	Cane thickness	Number of tillers per plant	Leaf area per leaf	Internode length
Sucrose Percentage	-0.360**	0.274*	0.042 N.S.	0.425**	0.030 N.S.
Plant Height		0.023 N.S.	0.432**	-0.446**	0.378**
Cane Thickness			-0.190*	0.593**	0.063 N.S.
Number of tillers per plant				-0.410**	-0.038 N.S.
Leaf area per leaf					-0.125

** Significant at 1% level.
* Significant at 5% level.

Variety AUS-22 being the top scorer. As for the correlation, it had a highly significant and negative correlation with leaf area (-0.446) whereas it had highly significant positive correlation with internode length (0.378) The trend therefore, indicates that most of the height enhancement was achieved by the varieties through enlargement of the internodes and not through the addition of new internodes. For producing taller cane one should therefore, focus his attention on selection for a better internode length. Another significant feature was the highly significant positive correlation between plant height and number of tillers (r = 0.432). This may be due to a strong competition between the individual stalks to expose their canopies to sunlight and radiation which has resulted in an enhanced apical growth more often at the cost of lateral one particularly in stools producing relatively larger number of stalks. The idea is also supported by the fact that

a significantly negative correlation was observed for number of tillers and cane thickness. The value being –0.19 Legendre (1978) and Mariotti (1971) also reported similar findings. Cane thickness had a significant positive correlation with leaf area. The correlation coefficient value was 0.593, it clearly suggests that a larger photosynthetic surface is inevitable for the production of thicker stalks as more and more energies would be required to support both lateral and apical growth of plant. Therefore, for better cane tonnage, attention should be paid to select varieties which have more leaf area. As for the number of tillers per plant, it had highly significant but negative correlation with leaf area (–0.410) and only non-significant negative correlation with internode length (–0.038).

The correlation coefficients calculated for leaf area and internode length also gave a negative but non-significant value (–0.125). The range was 232.55 – 652.56 sq. centimeters and the highest value was recorded in variety AUS-9. The trend of the data however, suggests an inverse relationship between these two characters. An increment in the internode length would possibly decrease the leaf area.

An overview of the research data in the present studies obviously points to the possibility of synthesizing a better cane through the combination of stalk thickness and larger leaf area which give higher sucrose percentage. Efforts to increase tonnage through height may not lead to the expected increase in sucrose per unit area, as the plant height has shown significantly negative correlation with sucrose. Attention therefore, should be focused on recovering a thicker cane with better leaf area. Second focal point is of tillering which has a highly positive correlation with height but negative correlation with thickness. Some compromise on this character would therefore, be essential to achieve progress in tonnage.

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