Pak. J. Agri. Sci., Vol. 44(4), 2007

MORPHOGENETIC BEHAVIOUR OF SOME AGRONOMIC TRAITS OF SUGARCANE (*Saccharum officinarum* L.)

Farooq Ahmad Khan, M. Yasir Iqbal and Muhammad Sultan
Department of Plant Breeding & Genetics, University of Agriculture, Faisalabad

To make studies on sugarcane as ratoon crop, data for different traits like plant height (cm), number of tillers per plant, number of leaves per plant, cane diameter (cm), leaf area (cm^2), inter-nodal distance (cm), cane weight (kg) and dry matter contents (g) were recorded and subjected to analysis of variance. Comparison of accession means & correlation were made for 13 local sugarcane accession viz. SPF-232, SPF-234, CP 43-33, RB 82-5336, CPF-235, CP72-2086, BF-129, Triton, CoL-54, CoJ-84, Shakarganj (SPSG-26), CoJ-64 and CP 77-400 (as standard). The experiment was conducted in the research area of department of Plant Breeding & Genetics, University of Agriculture, Faisalabad.

Keywords: Sugarcane, millable cane weight, dry matter contents, cane diameter, internodal distance, correlation

INTRODUCTION

Sugarcane *(Saccharum* spp.) is an important industrial and cash crop in Pakistan and food crop of tropics and sub-tropics. It is cultivated in about 74 countries between 40°N and 32.5 °S, encompassing half the glob. Scientists call it photosynthetically efficient, in that it synthesis sucrose from sunlight, air, and water better then just about any other plant on the earth. Pakistan occupies an important position in cane producing countries of the world. It ranks at the fifth position in cane acreage and almost 14th position in sugar production. Sugarcane is grown on an area of more or less one million hectares in Pakistan (Anonymous, 2005). It's production in 2004-2005 was 33.048 million tons and area under cultivation was 644.65 thousand hectares and it's yield was 51.28 ton/ha. (Anonymous, 2006).The sugar recovery level is much below the international standards. The climatic and other conditions are same but the yield and sucrose recovery level in Pakistan is far behind the respective levels in India. A comparison of yield and recovery in Pakistan and India reveals that in Indian Punjab these are 70 tones per hectare and 9.39% against those of 43 tonnes and 7.80% in Pakistan Punjab (Dawn Economic and Business Review Agriculture and Technology Sugar Policy, April, 2006(b)). Recovery of sugar cane is increased from the current average of 8.32% to 10/11 percent by cultivation of suitable and appropriate cane varieties. The main reason of low cane yield in Pakistan is the cultivation of cane as ratoon crop on 50% area of Pakistan. So present studies were conducted to evaluate such sugarcane accessions that will give better yield and results in ratoon conditions. In present studies, attempts were made to determine the genetic interaction between various morphological traits and also to determine correlation studies among different cane varieties. The informations thus obtained from the experiment may help to formulate the appropriate selection strategy to develop the clones of best commercial merits and suitable for cultivation in different environments of Pakistan and to give better results.

MATERIALS AND METHODS

Thirteen local sugarcane accessions or varieties namely SPF-232, SPF-234, CP 43-33, RB 82-5336, CPF-235, CP72-2086, BF-129, Triton, CoL-54, CoJ-84, Shakarganj (SPSG-26), CoJ-64 and CP77-400 (as standard) were planted in the experimental area of department of Plant breeding and Genetics, University of Agriculture, Faisalabad during 2002-2003. The experiment was laid out in Randomized Complete Block Design (RCBD) with three replications. Each variety was accommodated in a plot having 4 rows of 52 m lengths with row to row-spacing 90cm and plant-to-plant spacing 30cm. The crop was raised as ratoon and was harvested on November 2003. All agronomic practices were kept normal for all the 13 genotypes. Data on plant height (cm), number of tillers per plant, number of leaves, cane diameter (cm), leaf area (cm^2), internodal distance (cm), cane weight (kg) and dry matter contents (g) were collected from 10 randomly selected stalks from each replication.

Statistical analysis

The data collected for various characters were analyzed by standard analysis of variance technique as given by Steel and Torrie, (1980). Coefficient of variability was calculated according to following formula:

$$CV = \frac{SD}{\bar{X}} \times 100$$

Where
CV = Coefficient of variability
SD = Standard deviation
X = Mean

Phenotypic and genotypic correlation coefficients were calculated as outlined by Steel and Torrie, (1980).

$$rp = \frac{M_{ij}}{\sqrt{(M_{ii})\,(M_{jj})}}$$

Where
rp = Phneotypic correlation coefficient
M_{ij} = The mean project of genotypes for all i^{th} and j^{th} traits, respectively.

$$rg = \frac{COVgij}{\sqrt{(\sigma^2 g_i)\,(\sigma^{-2} g_j)}}$$

rg = Genotypic correlation coefficient
COVgij = Genotypic covariance of ith and jth traits.
$\sigma^2 go$ = Genotypic variance of trait I.
$\sigma^{-2} g_j$ = Genotypic variance of trait J.

Standard errors of genotypic correlation coefficients (S.E. of rg) were calculated as given by Lathrop et al.. (1985).

$$S.E. = \frac{1-r^2 g}{\sqrt{2}} \quad \frac{[S.E.\ h^2 x] \times [S.E.\ h^2 y]}{\sqrt{h^2 x \times h^2 y}}$$

rg = Genotypic correlation coefficient between the traits x & y.
$h^2 x$ = Habitability of the x trait
$h^2 y$ = Habitality of the y trait

Genotypic correlation coefficients were considered significant if their absolute value exceeded twice their respective standard error. Phenotypic correlation coefficients were tested using t-test (Steel and Torrie, 1980) as given below:

$$t = \frac{rp}{\sqrt{1-rp/n-2}}$$

Where
rp = phenotypic correlation coefficient
n-2 = error degree of freedom

RESULTS AND DISCUSSIONS

The data (Table-1) revealed that differences among genotypes were highly significant for all the characters. It was observed that weight of millable cane (2.36) had strong association with final yield of sugarcane. Highest coefficient of variability was shown by the traits like number of tillers per plant (18.88%) and number of leaves per plant (18.88%), while the lowest coefficient of variability was shown by the dry matter contents

Table 1. Statistical analysis for various morphological traits in sugarcane

SOV	d.f.	Number of tillers per plant	Number of leaves per plant	Plant height	Cane diameter	Leaf area	Internodal distance	Fresh cane weight	Dry matter content
Replication	2	0.538	0.949	2079.523	0.003	52.779	2.266	0.022	0.00
Genotype	12	17.590**	7.603**	5785.129**	0.258**	5230.911**	21.385**	12.214**	0.117**
Error	24	2.788	1.199	1.199	0.016	103.386	1.055	0.044	0.00
0.00									

Table-2. Data on coefficient of variation for different traits studied in sugarcane

Characters	Coefficient of variation
Number of tillers per plant	18.88%
Number of leaves per plant	18.88%
Plant height	4.26%
Cane diameter	4.95%
Leaf area	3.17%
Internodal distance	9.03%
Fresh cane weight	2.36%
Dry matter content	1.01%

(1.01%). Table 3 revealed that the correlations between of number of tillers per plant with number of leaves, cane height and internodal distance were positive and significant at genotypic level but was positive and highly significant at phenotypic level with cane height. Correlation of number of tillers per plant were positive and non-significant with cane diameter, leafs area, cane weight and dry matter contents at genotypic level, while at phenotypic level number of tillers per plant were positive and non-significant with number of leaves per plant, cane diameter, leaf area, internodal distance, cane weight and dry matter content. Sing *et al.* (1981) also reported that the number of tillers was positively correlated with cane yield. Chaudhry and Singh (1994) found positive

Table 3. Genotypic and phenotypic correlation coefficients among various plant characters in sugarcane

Entry	Leaves per plant	Plant height	Cane diameter	Leaf area	Internodal distance.	Fresh cane weight	Dry matter contents
Tillers	0.2314*	0.7351*	0.1717 N.S.	0.0228 N.S.	0.2395*	0.1503 N.S.	0.1477 N.S.
	0.2692 N.S	0.6629**	0.169 N.S.	0.0258 N.S.	0.1914 N.S.	0.1389 N.S.	0.1428 N.S.
Leaves per plant		-0.055 N.S.	-0.47 N.S.	0.1743*	-0.381 N.S.	-0.289 N.S.	-0.171 N.S.
		-0.071 N.S.	-0.417**	0.1755 N.S.	-0.332**	-0.276 N.S.	-0.155 N.S.
Plant Height			0.5263*	0.4089*	0.6316*	0.5932*	0.5145*
			0.5**	0.3952**	0.6124**	0.5831**	0.5074**
Cane Diameter				0.1822*	0.605*	0.7538*	0.7502*
				0.4794**	0.5432**	0.7343**	0.7263**
Leaf area					10.5*	0.538*	0.5375*
					0.4794**	0.531**	0.5319**
Internodal Distance						0.6174*	0.4875*
						0.5959**	0.4733**
Fresh Cane Weight							0.7907*
							0.7888**
Dry Matter contents							1
							1

association of number of millable cane with height of cane and cane width. Correlation of number of leaves per plant with leaf area was positive and significant while with all other traits it was negative and non significant at genotypic and phenotypic level. At genotypic level plant height was significantly and positively correlated with cane diameter, leaf area, internodal distance, stalk weight and dry matter contents Verma *et al.* (1999) found significant and positive association of cane height with internodes/cane and yield. At phenotypic level, plant height was correlated positively and high significantly with cane diameter, leaf area, internodal distance, stalk weight and dry matter contents. Das *et al.* (1996) showed that stalk weight was positively correlated with height of millable canes and stalk diameter. It was reflected from the Table 3 that cane diameter was positively and significantly correlated with leaf area, internodal distance, stalk weight and dry matter at genotypic level. Das *et al.* (1996) found that stalk diameter was significantly and positively correlated with number of internodes. At phenotypic level, cane diameter was positively and highly significant correlated with internodal distance, stalk weight, dry matter content and juice contents. Das *et al.* (1996) found positive association among stalk height, plant height and cane diameter. At genotypic level, it was reflected from the table 3, the leaf area was positively and significantly correlated with internodal distance, stalk weight and dry matter content. At phenotypic level, the leaf area was correlated positively and highly significant with internodal distance, stalks weight and dry matter. It was revealed from the table 3 that the internodal distance was positively and significantly correlated with stalk weight and dry matter contents. At phenotypic level, internodal distances was correlated positively and highly significantly with stalk weight and dry matter content. Madhavi *et al.* (1991) found positive association among number of internodes, average internodal length and number of internodes. Table 3, it also revealed that the stalk weight was positively and significantly correlated with dry matter dry matter content at phenotypic level. Tyagi *et al.* (2000) found that stalk weight had a significant and positive association with stalk girth, stalk length and number of nodes. Madhavi *et al.* (1991) found positive association of cane weight with cane diameter and length.

From these studies it could be concluded that highest coefficient of variability was shown by the number of tillers per stool and number of leaves per plant; while plant height, cane diameter, leaf area and internodal distance had positive and significant correlation with millable can weight that in turn showed a major contribution towards the final cane yield, however cane diameter, height and internodal length cane be exploit successfully for further and future cane improvement programmes.

REFERENCES

Anderson, E. 1957. A semi graphical method for the analysis of complex problems. Prov. Natl. Acad. Sci. Wash, 43: 923-927.

Anonymous, 2005. FAO production year book. Sugar and Sweetener.

Anonymous. 2006. Annual Report, Pakistan Sugar Mills Association, Islamabad.

Chaudhry, A.K. and J.R.P. Singh. 1994. Correlation and path coefficient studies in early maturing clones of sugarcane (*Saccharum* spp. Complex). Coop. Sugar, 25: 7-8, 305-307.

Das, P.K., B.C. Jena, N. Nayak, and A.K. Parida. 1996. Correlation and Path analysis of cane yield in sugarcane. Coop. Sugar. 27: 7, 509-512.

Madhavi, D., C.R. Reddy, P.M. Reddy, C.L.K. Reddy, K.R. Reddy and K.H.P. Reddy. 1991. Correlation studies in sugarcane. Coop. Sugar. 22: 6, 379-381.

Singh, H.N., S.B. Singh, P.S. Verma and R.V. Singh. 1981. Correlation and path analysis in sugarcane. Ind. J. of Agri. Res. 15(2): 126-130.

Singh, H.N., S.B. Singh and T.K. Singh. 1981. Selection parameters in sugarcane. Ind. J. of Agri. Sci. 51(8): 562-566.

Spencer, G.L. and G.P. 1959. Cane sugar hand book. Jhon Willey and Sons Inc. NY. Chappman and Hall Ltd. London: 390.

Steel, R.G.D. and J.H. Torrie. 1980. Principles and procedures of statistics. McGraw Hill Book Co. Inc. New York, USA.

Tyagi, S.D. and D.N. Singh. 2000. Correlation and heritability studies in sugarcane. Ind. Sugar 50(5): 303-308.

Verma, P.S., S. Pal; N.K. Karma and S. Pal. 1999. Genetic variability and correlation studies in sugarcane. Ind. Sugar. 49: 2, 125-128.