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Character Associations and Path Analysis for Fibre Yield in Sugarcane

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ABSTRACT: *Seventy seven genotypes of sugarcane were evaluated in second clonal stage to study the character associations among fibre yield and its component characters. Significant positive association of fibre yield was observed with shoot population at 240 DAP (0.510), number of millable canes per plot (0.507), single cane weight (0.459), fibre content (0.389), CCS yield (0.686) and cane yield (0.779). Path analysis revealed that cane yield and fibre content exhibited highest positive direct effect on fibre yield and almost all the traits exerted their positive indirect effects via cane yield. Hence, cane yield and fibre content are the major contributing characters to fibre yield.*

Keywords: *sugarcane, fibre yield, path analysis*

INTRODUCTION

Generally the main objective of sugarcane breeding is to develop varieties capable of producing high cane yield and CCS yield per unit land area. The recent awareness on the advantages of using green fuel for generation of power and use of gasohol to reduce automobile emission have resulted in setting up of a number of cogeneration plants in various sugar mills. To achieve these goals of increased sugar, alcohol and cogeneration, sugar industries need special varieties to meet their specific requirement of raw materials. As sugar production scenario is changing, varietal needs have started changing. Hence, breeding programmes must integrate new traits such as high fiber, high biomass and high total sugars in addition to yield and juice quality.

One of the major bottlenecks in the electrification of the rural areas for house hold and industrial purposes is the non availability or the heavy loss of energy during the power transmission from far away sources. Setting up of power generation units in rural areas based on bagasse will help in fulfilling the energy needs of the rural areas thus improving the standard of living and rural economy. In addition, sugarcane can be cultivated as an energy crop in marginal lands as well as in regions where the climate is not suitable for sugar extraction (Rao *et al*. 1979). Sugar factories with co-generation facility demand for high fibre varieties up to 16% as it helps in increasing the baggase availability (Natarajan, 2000).

Statistical correlation coefficient is a measure that denotes the magnitude and direction of interrelationship between any two casually related variables (Singh and Narayanan, 1993). The association between two or more characters is due to pleiotropic gene action or linkage (Falconer, 1989). In plant breeding correlation coefficient analysis measures the mutual relationship between two plant characters and it determines characters association for genetic improvement of yield and other economic traits. The character associations will help in the selection of superior genotypes from divergent population based on more than one interrelated characters. However, correlation coefficients, sometimes, may be misleading and thus, need to be partitioned into direct and indirect effects. It is important for a breeder to know how other characters influence a particular character. Hence, path coefficient analysis was carried out to partition correlation coefficient into direct and indirect effects. The present study was conducted to obtain the information on the association of various characters with fibre yield.

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MATERIAL AND METHODS

Seventy three genotypes in second clonal stage along with four checks viz., Co 6907, Co 7219, 2003 V46 and Co 86032 were planted in a randomized block design with two replications during April, 2011. Each entry was planted in 2 rows of 5 m length spaced at a distance of 80 cm between rows with 4 three budded setts per meter as seed rate. Fibre content and fibre yield was estimated as follows.

Fibre Content (%)

Fibre content was estimated from 3 randomly selected canes harvested at 360 days after planting (DAP). These were further sub-sampled to include top, middle and bottom portion from each cane. This cane sample was split vertically and the split cane was cut into small bits of 1 cm length. All the bits of cane were pooled and by sub-sampling 250 g of fresh cut cane sample was obtained for analysis. 250 g of cut cane sample was transferred to the bowl of the "Rapipol extractor" and 2 litres of water was added to the bowl. The motor was run for 5 minutes so that the cane bits were sheared into fibre. The contents of the bowl were then transferred to a muslin cloth filter and the fibrous material was washed in running water under the tap till the material was free from juice and dissolved solids. Then the fibre from the filter was transferred to a previously weighed cloth bag and the water was squeezed out. The contents of the bag were dried in an oven at 100 °C and then the dry weight of the sample plus bag was obtained.

Fibre content was calculated as per the formula given by Thangavelu and Rao (1982).

$$\text{Fibre content (\%)} = \frac{A - B}{C} \times 100$$

Where:

A = Dry weight of bag + bagasse after drying (g)

B= Dry weight of bag alone (g)

C= Fresh weight of cane (g)

Fiber Yield (t ha^{-1})

Fibre yield was calculated by the following formula

$$Fibre\ yield\,(t\,ha^{-1}) = \frac{Fibre\ per\ cent\ cane}{100} \times Cane\ yield\,(t\,ha^{-1})$$

RESULTS AND DISCUSSION

The phenotypic correlation coefficients between fibre yield and its component characters and inter correlations among different traits were estimated in second clonal stage and the results are presented in Table 1. Fibre yield showed significant positive association with shoot population at 240 DAP (0.510), number of millable canes per plot (0.507), single cane weight (0.459), fibre content (0.389), CCS yield (0.686) and cane yield (0.779).

The results further indicated that it is possible to combine both high fibre and high sugar content in the same genotype as there was no significant positive or negative correlation between brix or pol and fibre content. This suggested that they are independent of one another and so selection could be made for these traits in a new variety that would have both increased sugar and increased fibre, thus satisfying the future demands of the sugar industries. These results are in conformity with the findings of Kennedy (2008). The independence of these two characters viz., fibre and brix which compete for the same source material i.e., the product of photosynthesis; might be attributed to the fact that the two characters use the photosynthetic product at different times of growth phases. Fibre, a function of the structure of the stem is accumulated during growth phase, whereas sugar is accumulated during ripening phase. These results are encouraging for the prospect of developing multipurpose cultivars that have both high fibre and high sugar content. These cultivars would increase the amount of bagasse produced in sugar mills leading to a higher quantity of bagasse available for co-generation.

The direct and indirect effects of six characters on fibre yield are presented in Table 2. Shoot population at 240 DAP exerted negligible negative direct effect on fibre yield (-0.006). But its substantial indirect effects through cane yield (0.390), number of millable canes (0.074) and fibre content (0.049) resulted in significant positive correlation of this character with fibre yield (0.510).

Number of millable canes showed a relatively low positive direct effect on fibre yield (0.122). It also exhibited high indirect positive effect through cane yield (0.495) and negligible positive indirect effect through CCS yield (0.002). These positive indirect effects resulted in higher correlation coefficient of this character with fibre yield (0.507) compared to its direct effect.

Single cane weight exerted very low direct effect on fibre yield (0.098). But its substantial positive indirect effect through cane yield (0.506) resulted in significant correlation with fibre yield (0.459).

Fibre content recorded the high positive direct effect on fibre yield (0.629). But its indirect effects through number of millable canes (-0.017), cane

Table 1
Phenotypic Correlation Coefficients between Fibre Yield and its Component Characters in Sugarcane

	Stalk diameter	*Stalk volume*	*No. of millable canes*	*Single cane weight*	*Fibre content*	*Brix %*	*Sucrose %*	*Commer-cial cane sugar %*	*Juice puritiy %*	*Pol % cane*	*Juice extraction %*	*Total sugars %*	*Biomass per cane*	*Theoretical yield of alcohol*	*Comm-ercial cane sugar yield*	*Cane yield*	*Fibre yield*
	SD	SV	NMC	SCW	FC	BRIX	SUC	CCS	JP	P%C	JE	TS%	BM	TYA	CCSY	CY	FY
SP240	-0.112	-0.034	0.609**	0.013	0.078	-0.127	-0.178	-0.189	-0.252*	-0.191	0.039	0.041	-0.198	0.028	0.351**	0.487**	0.510**
SD		0.884**	0.060	0.149	-0.268*	0.005	-0.003	-0.040	-0.011	0.047	0.074	-0.166	0.385**	-0.148	0.115	0.172	-0.015
SV			0.119	0.165	-0.215	-0.134	-0.154	-0.182	-0.126	-0.116	0.053	-0.225*	0.540**	-0.242*	0.113	0.241*	0.083
NMC				-0.201	-0.141	-0.002	-0.062	-0.107	-0.195	-0.029	0.291*	0.138	-0.215	0.079	0.526**	0.618**	0.507**
SCW					-0.194	-0.063	-0.072	-0.117	-0.038	-0.035	-0.238*	-0.068	0.376**	-0.064	0.533**	0.632**	0.459**
FC						0.095	0.106	0.144	0.060	-0.099	-0.388**	0.188	-0.147	0.135	-0.174	-0.253*	0.389**
BRIX							0.967**	0.903**	0.444**	0.948**	-0.054	0.359**	-0.196	0.389**	0.411**	-0.048	0.011
SUC								0.970**	0.654**	0.979**	-0.052	0.415**	-0.170	0.440**	0.397**	-0.104	-0.038
CCS									0.723**	0.943**	-0.061	0.412**	-0.187	0.447**	0.357**	-0.170	-0.080
JP										0.643**	-0.006	0.396**	-0.017	0.388**	0.202	-0.189	-0.153
P%C											0.027	0.379**	-0.148	0.414**	0.436**	-0.051	-0.116
JE												-0.281*	-0.052	-0.290*	-0.021	0.035	-0.207
TS%													-0.187	0.919**	0.272*	0.052	0.176
BM														-0.165	0.015	0.129	0.008
TYA															0.256*	0.011	0.107
CCSY																0.846**	0.686**
CY																	0.779**

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

Table 2
Direct and Indirect Effects of Component Characters on Fibre Yield at Phenotypic level in Second Clonal Stage of Sugarcane

	Shoot population at 240 DAP	*No. of millable canes*	*Single cane weight*	*Fibre content*	*Commercial cane sugar yield*	*Cane yield*	*Fibre yield*
	SP240	*NMC*	*SCW*	*FC*	*CCSY*	*CY*	*FY 'r'*
SP240	-0.006	0.074	0.001	0.049	0.001	0.390	0.510**
NMC	-0.004	0.122	-0.020	-0.089	0.002	0.495	0.507**
SCW	0.000	-0.025	0.098	-0.122	0.002	0.506	0.459**
FC	0.000	-0.017	-0.019	0.629	-0.001	-0.202	0.389**
CCSY	-0.002	0.064	0.052	-0.109	0.004	0.677	0.686**
CY	-0.003	0.075	0.062	-0.159	0.004	0.800	0.779**

Residual effect = 0.159

weight (-0.019) and cane yield (-0.202) were negative which resulted in a reduction in the total correlation of fibre content with fibre yield to 0.389.

CCS yield recorded the lowest positive direct effect (0.004) on fibre yield. The total correlation coefficient of CCS yield with fibre yield was significant and was of higher magnitude (0.686) which was due to the positive indirect effects via cane yield (0.677), number of millable canes (0.064) and cane weight (0.052).

Among all the components, cane yield showed the highest positive direct effect (0.800) on fibre yield. Its negative indirect effects through fibre content (-0.159) and shoot population at 240 DAP (-0.003) reduced the total correlation to 0.779, despite a higher direct effect.

Residual effect was found to be very low (0.159) which suggested that most of the variation in fibre yield was mainly due to these six characters.

Path analysis results revealed that cane yield and fibre content exhibited highest positive direct effect on fibre yield and almost all the traits exerted their positive indirect effects via cane yield. Hence, cane yield and fibre content are the major contributing characters to fibre yield. A genotype selected for fibre yield should have moderate fibre content coupled with high cane yield since these two traits are negatively correlated.

REFERENCES

Falconer, D. S. (1989), *Introduction to Quantitative Genetics*. 3rd Edn. Longman. Burnt Mill.

Kennedy, A.J. (2008), Prospects for combining high sucrose content with increased fibre to generate multipurpose cane varieties. *29th Conference of West Indies Sugar Technologists, Montego Bay, Jamaica*, April 21-25. Published on CD.

Natarajan, U.S. (2000), Breeding for quality improvement in sugarcane. *Paper presented in the winter school on Sugarcane Breeding and Genetics in Retrospect and Prospects*: 16-21.

Rao, J.T., Ethirajan, A.S., Sankarnarayan, P., Natarajan, B.V and Bhagyalakshmi, K.V. (1979), Energy Crisis – Sugarcane a candidate. *Indian Sugar*. 29: 77-80.

Singh, P and Narayanan, S.S. (1993), *Biometrical techniques in Plant Breeding*. Kalyani Publisher, Ist (Ed). New Delhi-110 002: 74-78.

Thangavelu, S and Rao, C.K. (1982), Comparison of Rapi pol extractor and cutex cane shredder methods for direct determination of fibre in *Saccharum* clones. *Proc. Ann. Conv. Sug. Tech. Assoc. India*. 46: 15-21.