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Character Association Studies in First Clonal Generation of Sugarcane (*Saccharum* spp.)

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ABSTRACT

The correlation studies in first clonal stage involving 429 genotypes and four checks revealed that NMC at harvest, number of green leaves at 90, 120, 240 DAP and at maturity, biomass per cane, internode number, internode length, stalk length, stalk diameter, stalk volume, single cane weight, HR brix and HR brix yield showed positive and significant association with cane yield and also among themselves indicating that simultaneous selection for these characters would result in the improvement of cane yield in sugarcane. Path analysis revealed that HR brix yield, single cane weight and number of millable canes exhibited high positive direct effects on cane yield indicating that these were the major contributing characters to cane yield in sugarcane.

Key words : Correlations, Path analysis, Sugarcane.

Sugarcane is an important cash crop of India. In India sugarcane is grown in sub tropical and tropical climatic regions. Sugarcane crop serves as the major source for a variety of products such as sugar, jaggery, molasses, bagasse, filter cake out of which sugar and jaggery are meant for daily use as consumable products while other byproducts have industrial significance. 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. The present study was conducted to obtain the information on the association of various characters with cane yield. The path coefficient analysis was also carried out to partition correlation coefficient into direct and indirect effects.

MATERIAL AND METHODS

The experimental material consisted the clones selected from the seedling nursery raised from the fluff obtained from 36 crosses comprising of 14 biparental crosses, 7 polycrosses and 15 general collections along with four checks viz., Co 6907, Co 7219, 2003 V46 and Co 86032 were used in this study. Four hundred and twenty nine genotypes selected from seedling nursery based on phenotypic evaluation were planted in July 2010. Each genotype was planted in two rows of 2.5 m length spaced at 80 cm apart with 4 three budded setts per meter in augmented design along with four checks viz., Co 6907, Co 7219, 2003 V46 and Co 86032. The material was planted in eleven blocks. Each block had 39 genotypes and four checks. Fertilizers were applied at recommended dose of 224:112:112 kg ha^{-1} N, P_2O_5 and K_2O respectively. Cultural practices like weeding, irrigation, earthing up and propping were followed to maintain good crop growth. Observations were recorded for the traits viz., no. of tillers at 120 DAP, shoot population at 180, 240 DAP, NMC at harvest, no. of green leaves at 90, 120, 240 DAP and at maturity, biomass per cane (kg), internode number, internode length (cm), stalk length (cm), stalk diameter (cm), stalk volume (cm^3), single cane weight (kg), HR brix (%), HR brix yield (tha^{-1}) and cane yield (tha^{-1}).

The simple correlation coefficients were calculated as per Panse and Sukhatme (1985). Significance was tested by referring to the correlation coefficient table at (n-2) df. The estimates of direct and indirect contribution of

Table 1. Phenotypic correlation coefficients between cane yield and its components in first clonal stage of sugarcane.

	Shoot population		NMC at harvest	Number of green leaves at				Biomass per cane	No. of Inter-nodes	Inter-node length	Stalk length	Stalk diameter	Stalk volume	Single cane weight	HR Brix	HR Brix yield	Cane Yield
	180 DAP	240 DAP		90 DAP	120 DAP	240 DAP	Maturity										
	SP 180	SP240	NMC	NGL 90	NGL 120	NGL 240	NGLM	BM	IN No.	IN L	SL	SD	SV	SCW	HRB	HRBY	CY
T 120	0.508**	0.389**	0.052	0.098*	0.008	-0.274**	-0.038	-0.110*	-0.027	-0.031	-0.064	-0.104*	-0.122*	-0.129**	-0.016	-0.050	-0.046**
SP 180		0.362**	-0.049	-0.058	-0.246**	-0.322**	-0.142**	-0.086	-0.134**	0.046	-0.106*	0.014	-0.063	-0.099*	0.002	-0.063	-0.083
SP240			0.053	0.030	-0.055	-0.731**	-0.062	-0.118*	-0.059	-0.020	-0.070	-0.089	-0.110*	-0.165**	-0.123*	-0.074	-0.062
NMC				0.294**	0.334**	0.096	0.182**	0.158**	0.186**	0.204**	0.307**	-0.089	0.117*	0.124*	0.081	0.677**	0.716**
NGL90					0.546**	0.173**	0.175**	0.123*	0.195**	0.064	0.213**	-0.006	0.122*	0.145**	0.159**	0.315**	0.291**
NGL120						0.231**	0.174**	0.232**	0.188**	0.053	0.219**	0.066	0.179**	0.228**	0.171**	0.425**	0.383**
NGL240							0.561**	0.442**	0.553**	-0.063	0.440**	0.169**	0.398**	0.461**	0.173**	0.372**	0.362**
NGLM								0.596**	0.989**	-0.194**	0.722**	0.131**	0.545**	0.562**	0.032	0.418**	0.482**
BM									0.592**	0.154**	0.630**	0.532**	0.802**	0.842**	0.063	0.585**	0.654**
IN No.										-0.196**	0.729**	0.134**	0.551**	0.560**	0.034	0.418**	0.482**
IN L											0.504**	-0.059	0.233**	0.171**	0.052	0.244**	0.242**
SL												0.073	0.647**	0.611**	0.083	0.552**	0.601**
SD													0.778**	0.488**	0.019	0.235**	0.263**
SV														0.770**	0.072	0.522**	0.579**
SCW															0.064	0.662**	0.743**
HRB																0.431**	0.118*
HRBY																	0.925**

** Significant at 1% level

* Significant at 5% level

T 120 – Tiller number per plot at 120 DAP
SP 180 – Shoot population per plot at 180 DAP
SP 240 – Shoot population per plot at 240 DAP
NMC – Number of millable canes per plot at harvest
GL 90 – Number of green leaves per plant at 90 DAP
GL 120 – Number of green leaves per plant at 120 DAP
GL 240 – Number of green leaves per plant at 240 DAP
GLM – Number of green leaves per plant at maturity
BM – Biomass per cane at harvest (kg) ‘

IN No – Number of internodes per cane
INL – Internode length (cm)
SL – Stalk length (cm)
SD – Stalk diameter (cm)
SV – Stalk volume (cm^3)
SCW – Single cane weight (kg)
HRB – HR Brix (%)
HRBY – HR Brix yield (tha^{-1})
CY – Cane

Table 2. Phenotypic path coefficients among fourteen characters of cane yield in first clonal stage of sugarcane

	NMC at harvest	Number of green leaves at 90 DAP	120 DAP	240 DAP	Maturity	Biomass per cane	Internode number	Internode length	Stalk length	Stalk diameter	Stalk volume	Single cane weight	HR Brix	HR brix yield	Cane yield "r"
	NMC	GL90	GL120	GL240	GLM	BM	IN No	IN L	SL	SD	SV	SCW	HRB	HRBY	CY
NMC	**0.297**	0.002	-0.005	-0.001	0.001	-0.001	-0.015	-0.015	0.023	0.003	0.004	0.042	-0.014	0.394	0.716**
GL90	0.087	**0.008**	-0.008	-0.002	0.001	-0.001	-0.016	-0.005	0.016	0.000	0.004	0.049	-0.028	0.183	0.291**
GL120	0.099	0.005	**-0.015**	-0.002	0.001	-0.001	-0.016	-0.004	0.016	-0.002	0.006	0.077	-0.030	0.247	0.383**
GL240	0.029	0.001	-0.003	**-0.010**	0.004	-0.002	-0.046	0.005	0.033	-0.005	0.014	0.157	-0.031	0.217	0.362**
GLM	0.054	0.001	-0.003	-0.005	**0.008**	-0.003	-0.082	0.014	0.054	-0.004	0.019	0.191	-0.006	0.243	0.482**
BM	0.047	0.001	-0.003	-0.004	0.005	**-0.005**	-0.049	-0.011	0.047	-0.016	0.027	0.286	-0.011	0.341	0.654**
IN No	0.055	0.002	-0.003	-0.005	0.008	-0.003	**-0.083**	0.014	0.055	-0.004	0.019	0.190	-0.006	0.243	0.482**
IN L	0.061	0.001	-0.001	0.001	-0.002	-0.001	0.016	**-0.071**	0.038	0.002	0.008	0.058	-0.009	0.142	0.242**
SL	0.091	0.002	-0.003	-0.004	0.006	-0.003	-0.060	-0.036	**0.075**	-0.002	0.022	0.207	-0.015	0.321	0.601**
SD	-0.026	0.000	-0.001	-0.002	0.001	-0.002	-0.011	0.004	0.005	**-0.031**	0.027	0.166	-0.003	0.137	0.263**
SV	0.035	0.001	-0.003	-0.004	0.004	-0.004	-0.046	-0.017	0.048	-0.024	**0.034**	0.261	-0.013	0.304	0.579**
SCW	0.037	0.001	-0.003	-0.004	0.004	-0.004	-0.046	-0.012	0.046	-0.015	0.026	**0.339**	-0.011	0.385	0.743**
HRB	0.024	0.001	-0.002	-0.002	0.000	0.000	-0.003	-0.004	0.006	-0.001	0.002	0.022	**-0.177**	0.251	0.118*
HRBY	0.201	0.003	-0.006	-0.004	0.003	-0.003	-0.035	-0.017	0.041	-0.007	0.018	0.225	-0.077	**0.582**	0.925**

Residual effect = 0.154

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

Bold diagonal values indicate direct effects

various characters were calculated through path analysis as suggested by Wright (1921) and elaborated by Dewey and Lu (1959).

RESULTS AND DISCUSSION

Phenotypic correlation coefficients between cane yield and its component characters were presented in the Table 1. All the traits except tillers at 120 DAP, shoot population at 180 and 240 DAP showed positive significant association with cane yield. The cane yield per hectare recorded positive and significant association with NMC at harvest (0.716), number of green leaves at 90 (0.291), 120 (0.383), 240 DAP (0.362), at maturity (0.428), biomass per cane (0.654), number of internodes (0.482), internode length (0.242), stalk length (0.601), stalk diameter (0.263), stalk volume (0.579), single cane weight (0.743), HR brix (0.118) and HR brix yield (0.925).

The results pertaining to the correlation studies in first clonal stage revealed that NMC at harvest, number of green leaves at 90, 120, 240 DAP and at maturity, biomass per cane, internode number, internode length, stalk length, stalk diameter, stalk volume, single cane weight, HR brix and HR brix yield showed positive and significant association with cane yield and also among themselves indicating that simultaneous selection for these characters would result in the improvement of cane yield in sugarcane.

Positive and significant association of shoot population at 120 DAP (Singh et al., 2005); number of millable canes (Dagar et al., 2004); stalk length, stalk diameter and single cane weight (Sabitha et al., 2008) with cane yield were reported in sugarcane.

The correlation coefficient of different component characters with cane yield was further partitioned into direct and indirect effects by path analysis and the results are presented in Table 2. Cane yield was considered as resultant variable and NMC at harvest, number of green leaves at 90, 120, 240 DAP and at maturity, biomass per cane, internode number, internode length, stalk length, stalk diameter, stalk volume, single cane weight, HR brix and HR brix yield were considered as causal variables which exhibited significant positive correlation with cane yield.

Path analysis revealed that HR brix yield (0.582), single cane weight (0.339) and number of millable canes(0.297) exhibited high positive direct effect on cane yield and the other characters viz., number of green leaves at 90, 120, 240 DAP and maturity, biomass, internode number, internode length, stalk length, stalk diameter, stalk volume and HR brix also exhibited their indirect positive effects on cane yield via these characters indicating that these were the major contributing characters to cane yield in sugarcane. Hence, direct selection for HR brix yield, single cane weight and number of millable canes would be helpful for the improvement of cane yield in first clonal stage. These three characters showed significant positive correlation among themselves and with number of green leaves at 90, 120 DAP and at maturity, biomass per cane, internode number, internode length, stalk length, stalk volume and HR brix indicating that indirect selection based on these characters may be given importance in first clonal stage. Residual effect was found to be very low (0.154) which indicated that almost all the yield attributing characters were included. These results are in tune with the findings of Chandrakanth et al., (2007) and Sirisha et al., (2010) for number of millable canes; Patel et al., (2006), Rahman et al., (2008), for single cane weight and Ram et al., (2000) for brix yield.

The results revealed that in first clonal stage selection based on HR brix yield, single cane weight and number of millable canes would be helpful for the improvement of cane yield in sugarcane.

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