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Character association and path coefficient analysis for cane yield and quality characters in fourth clonal generation (C4) of Sugarcane (*Saccharum* sp. complex)

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ABSTRACT

Thirty five clones of sugarcane were evaluated to study the character association for 14 yield and quality characters. There was a significant character association recorded among the clones at both phenotypic and genotypic level. Cane yield and Commercial cane sugar (CCS) yield were found to have significant positive correlation with germination, number of tillers, and number of millable canes (NMC). Cane height (m), cane thickness (cm) and cane weight (kg), whereas the quality characters like, juice Brix per cent, juice purity per cent and cane yield had shown a significant positive correlation with CCS yield. The partition of correlation into direct and indirect effects indicated that, number of tillers, number of millable canes (NMC), cane height, cane width, cane weight, juice weight, CCS per cent and juice extraction per cent had a high direct effect on cane yield . On the basis of results, it can be concluded that selection program for improving genotypes for cane yield would be effective, if it is based on the number of tillers, number of millable canes, cane weight, and CCS per cent.

Keywords : Correlation, clone, path coefficient, sugarcane

Sugarcane is one of the most important cash crops in India. In spite of its high sale value, well acceptability among growers is still in doubt due to yield and quality factors. Therefore, much focused approaches are necessary to improve its cane yield and juice quality attributes. In India, sugarcane is cultivated in diverse agro climatic condition in an area of 3.99 m ha with a total cane production of 236 Mt**.** (Anonymous, 2005). Uttar Pradesh stands first both in area (2.03 million ha) and production (112 million t) of sugarcane in the country. But the productivity and sugar recovery per cent (55.5 t ha^{-1} and 9.81%) in U.P. are lower than national average (59.1 t ha^{-1}, 10.22 %). The productivity of sugarcane in Uttaranchal is (59.8 t ha^{-1}) but sugar recovery (9.75%) per cent in Uttaranchal is lower than the national average. To increase cane yield and sugar recovery per cent in Uttar Pradesh and Uttaranchal, high yielding cum sugared varieties with good ratooning ability and resistance ability to various diseases and pests are required. Inter relationships amongst several cane and quality characters are suggested by (Balasundram and Bhagyalkshmi, 1978 and Reddy and Khan, 1984) for effective selection.

The correlation between characters and are interrelated but selected on the basis of significance, hence path analysis is used to augument it through the partition of direct and indirect effects.

In view of the above facts present investigation was carried out in fourth generation (C4) of clonal trial with the objectives to determine various cane and quality characters at both phenotypic and genotypic levels along with the determination of path analysis, direct and at phenotypic level.

Thirty five sugarcane clones, including twenty eight advanced clones and seven checks *viz.* Co-1148, CoJ-64, CoS-8436, CoS-767, CoPant-90223, CoPant-84212 and CoPant-84211 obtained from a different cross combination were evaluated in fourth clonal generation (C4) of sugarcane. The experiment was laid down in RBD with 3 replications at the Crop Research Centre of Govind Ballabh Pant University of Agriculture and Technology, Pantnagar (Uttarakhand) during the year 2005-06. The plot size of each entry represented 4 rows of 5 meter lengths spaced at 0.75 meters apart. Recommended agronomic practices were adopted to raise the crop. Five randomly selected stalks per plot were used to record observations on 14 characters (mentioned in table 1 & 2) at the 11 months stage. The correlation coefficients were computed at genotypic and phenotypic level (Searle, 1961). Path coefficient analysis was done by following Wright (1921) and elaborated by Dewey and Lu (1959).

The phenotypic and genotypic correlation coefficients are presented in table 1. Genotypic correlations were generally higher in magnitude than

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phenotypic correlations. Directions of genotypic and phenotypic correlation were almost same. Germination per cent exhibiting significant positive correlation with the number of tillers (0.347), number of millable canes (NMC) (0.283) and cane height (0.356), whereas highly significant positive correlation with cane yield (0.411) and commercial cane sugar yield (CCS) (0.393) at 11 months age. Results are in tune with (Reddy and Khan, 1984) except for cane height.

Number of tillers had highly significant positive with a number of millable canes (NMC) (0.638) (Singh *et al.*, 1983; Reddy and Khan, 1984) and significant positive correlation with cane yield (0.365) Reddy and Khan (1984) and CCS yield (0.342).

Number of millable canes (NMC) had highly significant positive correlation with cane yield (0.582) (Legendre, 1970; Mali, 1980; Reddy and Khan, 1984; Pillai and Ethiranjan, 1993; Ramesh and Verghese, 1995) and CCS yield (0.495) (Kundu and Gupta, 1997; Pal *et al.*, 1998, Verma *et al.*, 1999). While it showed significant negative correlation with cane weight (-0.282) Das and Jena (1996), total juice weight (-0.372) and juice extraction percent at 11 months (-0.309).

Cane height (cm) had shown highly significant positive correlation with cane weight (0.544) (Naidu *et al.*, 1998), juice weight (0.408), cane yield (0.458) (Legendre, 1970; Reddy and Khan, 1984; Dosado *et al.*, 1976) and CCS yield (0.453) (Pal *et al.*, 1998). While it had a significant positive correlation with cane thickness (0.323). But cane height had highly significant negative correlation with purity per cent (-0.535), juice sucrose (-0.293) and CCS per cent at 11 months (-0.301) (Balasundram and Bhagyalakshmi, 1978 a).

Cane width (cm) had highly significant positive correlation with cane weight 11 months (0.767) (Verma *et al.*, 1988; Singh *et al.*, 1981; Kundu and Gupta, 1997), juice weight (0.615), juice Brix at 11 months (0.898) (Verma *et al.*, 1988), cane yield (0.533) and CCS yield (0.544) Ishaq *et al.*, 1998)., whereas highly significant negative correlation with juice extraction per cent (-0.862).

Cane weight (kg) had highly significant positive correlation with juice weight (0.792), juice Brix (0.576) (Walker, 1965), sucrose (0.652) (Balasundram and Bhagyalakshmi, 1978 a), and purity (0.752), and CCS percent at 11 months (0.686) (Balasundram and Bhagyalakshmi, 1978 a), cane yield (0.600) and CCS yield (0.612) (Reddi and Reddi, 1986; Resobalortega *et al.*, 1991).

Juice weight (kg) had a highly significant positive correlation with juice Brix (0.669), juice sucrose per cent (0.913), and juice purity percent (0.641). It had also a significant positive correlation with juice extraction per cent (0.409), cane yield (0.352) and CCS yield (0.337).

Juice Brix percent had shown a highly significant positive correlation with sucrose (0.993) (Singh *et al.*, 1985; Milligan *et al.*, 1990; Pal *et al.*, 1998), CCS percent (0.985) (Nosheen and Ashraf, 2003; Battan *et al.*, 1985) and juice extraction percent (0.502).

Juice sucrose per cent had shown highly significant positive correlation with CCS per cent (0.998). Juice purity per cent at 11 months age showed significant positive correlation with juice extraction at 11 months (0.938) and CCS yield (0.674) (Das *et al.*, 1996; Hapase and Repale, 1999) and CCS per cent (0.324) (Kundu and Gupta, 1997).

Juice purity at 11 months age showed positive significant correlation with juice extraction per cent, but significant negative association with cane yield.

Commercial cane sugar (CCS) per cent at 11 months age showed highly significant positive correlation with juice sucrose percent (0.998) (Patel *et al.*, 1993; Pal *et al.*, 1998; Das *et al.*, 1996, 1997), juice Brix % (0.985) (Nosheen and Ashraf, 2003; Battan *et al.*, 1985) and cane weight (0.686) (Balasundram and Bhagyalakshmi, 1978 a) and significant positive correlation with juice purity per cent (0.304) (Kundu and Gupta, 1997). However, it had a significant negative correlation with cane height (-0.301) (Balasundram and Bhagyalakshmi, 1978 a). Juice extraction percent at 11 months age had a significant negative correlation with cane yield (-0.360) and CCS yield (-0.364).

Commercial cane sugar (CCS) yield at 11 months age showed highly significant positive correlation with juice purity (0.674) (Das *et al.*, 1996 ; Hapase and Repale, 1999), cane weight (0.612) (Reddi and Reddi, 1986; Resobalortega *et al.*,1991), cane width (0.554) Ishaq *et al.*, 1998), no. of millable canes (NMC) (0.495), cane height (0.453) (Pal *et al.*, 1998) and significant positive correlation with germination (0.393), tiller (0.342), and juice weight (0.337).

Cane yield had a significant positive correlation with CCS yield (0.934) (Jackson, 1994; Reddy and Somarajan, 1994; Kundu and Gupta, 1997; Hapase and Repale, 1999; Verma *et al*,. 1999).

To describe the phenotypic correlation values further path coefficient analysis was done to identify characters having significant direct and indirect effects on cane yield (Table 2.). Juice extraction per cent showed high and positive direct effect (2.71) followed by cane width (2.27), cane weight (1.71), number of millable canes (NMC) (0.732), juice weight (0.511) and CCS yield (0.484). (Reddy and Khan, 1984) reported similar results for number of tillers followed by, (Singh and

Table 1: Phenotypic & Genotypic correlation coefficients between different characters in sugarcane

Name /No. of Characters	Germination % (1)	No. of tillers (2)	Millable canes (NMC) (3)	Cane height (cm) (4)	Cane width (cm) (5)	Cane weight (kg) (6)	Juice Weight (kg) (7)	Juice Brix % (8)	Juice Sucrose % (9)	Juice Purity % (10)	CCS % (11)	Juice extraction % (12)	CCS yield ($t.ha^{-1}$) (13)	Cane yield ($t.ha^{-1}$) (14)
(1)	—	0.347*	0.283*	0.356*	0.232	0.189	0.158	- 0.027	- 0.029	- 0.019	- 0.030	- 0.020	0.393*	0.411*
		0.378	0.329	0.411	0.313	0.237	0.209	- 0.108	- 0.109	- 0.280	- 0.109	- 0.077	0.451**	0.491**
(2)		—	0.638**	0.180	- 0.138	- 210	- 0.297*	- 0.071	- 0.067	0.015	- 0.065	- 0.205	0.342*	0.365*
			0.810**	0.268	- 0.210	- 0.259	- 0.409*	- 0.212	- 0.212	- 0.441**	- 0.212	- 0.359*	0.394	0.449
(3)			—	- 0.022	- 0.141	- 0.282*	- 0.372*	- 0.254	- 0.266	- 0.159	- 0.271	- 0.309*	0.495**	0.582**
				- 0.029	- 0.136	- 0.272**	- 0.434*	- 0.337	- 0.344**	- 0.126	- 0.348*	- 0.511**	0.470	0.558**
(4)				—	0.323*	0.544**	0.408*	- 0.273	- 0.293**	- 0.535**	- 0.301*	- 0.153	0.453**	0.458**
					0.406	0.612**	0.520**	0.669**	0.614**	- 0.228	0.588**	- 0.226	0.538	0.521
(5)					—	0.767**	0.615**	0.898**	0.104	0.138	0.110	- 0.862**	0.554**	0.533**
						0.830**	0.738**	0.131	0.144	0.118	0.151	- 0.243	0.650	0.611**
(6)						—	0.792**	0.576**	0.652**	0.725**	0.686**	- 0.141	0.612**	0.600**
							0.929**	0.117	0.116	0.205	0.116	- 0.230	0.665	0.633
(7)							—	0.669**	0.913**	0.641**	0.131	0.409*	0.337*	0.352*
								0.146	0.144	0.205	0.143	0.131	0.498	0.462**
(8)								—	0.993**	0.159	0.985**	0.502**	0.177	- 0.170
									0.100	0.239	0.100	0.137	0.122	- 0.182
(9)									—	0.272	0.998**	0.121	0.181	- 0.171
										0.227	0.100	0.145	0.116	- 0.188
(10)										—	0.324*	0.938**	0.674**	- 0.490**
											0.222	0.827**	- 0.879	- 0.833**
(11)											—	0.176	0.182	- 0.171
												0.148	0.114	- 0.191
(12)												—	- 0.364*	- 0.360*
													- 0.533	- 0.569**
(13)													—	0.934**
														0.951**

** Significant at 5 % level , ** Significant at 1 % level . rp (Phenotypic) – Upper value rg(Genotypic) – Lower value*

Table 2: Phenotypic path coefficient analysis showing direct and indirect effect of various characters on cane yield .

Characters	Correlation with cane yield	Direct effects	Indirect effect *via*												
			Germination %	No. of tillers	Millable canes (NMC)	Cane height (cm)	Cane width (cm)	Cane weight (kg)	Juice weight (kg)	Juice Brix %	Juice Sucrose %	Juice purity %	CCS %	Juice extraction %	CCS yld. ($t.ha^{-1}$.)
Germination %	**0.411***	**-0.510**	-	0.327	0.480	-0.869	1.690	1.280	0.317	-0.44	-2.17	-2.33	0.900	2.06	0.207
No. of tillers	**0.365***	**0.459**	-0.363	-	0.654	-1.958	2.16	1.597	0.447	-0.510	-2.58	-2.14	0.876	2.34	0.284
NMC**0.582***	**0.732**	-0.334	0.411	-	-1.99	1.94	1.59	0.467	-0.562	-2.45	-2.42	1.05	2.39	0.322	
Cane height (cm)	**0.458****	**-2.40**	-0.184	0.374	0.607	-	1.92	1.47	0.443	-0.486	-2.17	-1.54	0.759	1.97	0.244
Cane width (cm)	**0.533****	**2.27**	-0.379	0.438	0.625	-2.03	-	1.66	0.447	-0.525	-2.65	-2.14	0.907	2.34	0.060
Cane weight (kg)	**0.600****	**1.71**	-0.381	0.429	0.681	-2.07	2.20	-	0.458	-0.554	-2.64	-2.35	1.02	2.40	0.211
Juice weight (kg)	**0.352***	**0.511**	-0.316	0.401	0.668	-2.08	1.98	1.533	-	-0.624	-2.61	-2.30	1.090	2.55	0.184
Juice Brix %	**-0.170**	**-0.648**	-0.353	0.362	0.635	-1.80	1.843	1.462	0.493	-	-2.57	-2.50	1.18	2.60	0.023
Juice Sucrose %	**-0.171**	**-2.79**	-0.398	0.425	0.645	-1.87	2.16	1.61	0.479	-0.598	-	-2.49	1.10	2.61	0.070
Juice Purity%	**-0.490****	**-2.82**	-0.421	0.349	0.628	-1.31	1.72	1.42	0.418	-0.574	-2.46	-	1.21	2.53	0.076
CCS %	**-0.171**	**1.26**	-0.362	0.317	0.611	-1.44	1.629	1.37	0.440	-0.606	-2.43	-2.70	-	2.52	0.061
Juice extraction %	**-0.360***	**2.71**	-0.388	0.396	0.647	-1.75	1.96	1.51	0.481	-0.623	-2.68	-2.64	1.179	-	0.078
CCS yield (t/ha)	**0.934****	**0.484**	-0.008	0.002	0.277	-0.004	-0.002	0.241	-0.084	0.005	-0.049	-0.301	-0.054	0.367	-

Residual factor = 0.0005

Sharma, 1983; Singh *et al*., 1985; Reddi and Reddi, 1986 ; Chaudhary and Singh, 1994; Naidu *et al*,. 1998) for number of millable canes (NMC), by (Balasundram and Bhagyalakshmi, 1978 b; Kang *et al.,* 1983; Kang *et al.*, 1989) for cane width , by (Reddy and Khan, 1984; Kang *et al.*,1989; Chaudhary and Singh, 1994; Ramesh and Verghese,1995; Sukhchain *et al*,. 1997 ;Naidu *et al.*, 1998) for cane weight. Similar reports for CCS were observed by (Gowda and Saravanan, 2016).

While negative direct effect was observed by Juice Sucrose per cent (-2.79) followed by Juice Brix (-0.648) on cane yield. Similar results for Juice sucrose per cent as observed by (Reddy and Khan, 1984; Pal *et al.*, 1998) followed by (Kang *et al.*, 1983; Singh *et al.*, 1994; Pal *et al.*, 1998) for juice Brix. The residual factor value (0.0005) is very low indicates that characters considered in the study was sufficient and justified for cane yield.

REFERENCES

Anonymous, 2005. Statistics. Indian Sugar,.Pp.61-72.

Balasundram, N. and Bhagyalakshmi, K.V. (1978 a). Path analysis in sugarcane. *Indian J. Agric. Res*., **12**(4): 215-18.

Balasundram, N. and Bhaglayakshmi, K.V. (1978 b). Variability, heritability and association among yield and yield components in sugarcane. *Indian J. Agric. Sci.*, **48**: 291-95.

Battan, K.R., Choudhary, B.S. and Kadian, S.P. 1985. Studies on correlation and path coefficient analysis for quality attributes in sugarcane. *Agric. Sci. Digest* **5**: 87-89.

Choudhary, A.K. and Singh, J.R.P. 1994. Correlation and path coefficient studies in early maturing Sugarcane crop. Coop. *Sugar,* **25**: 305-07.

Das, P. K., Jena, B.C., Nayak, N. and Parida, A.K. 1996. Correlation and path coefficient analysis of cane yield in sugarcane. Coop. *Sugar*, **27** (7): 509-12

Dewey, D.R. and Lu, K.H. 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. *Agron. J*. **51** (9): 515-18.

Dosdao, V.G., Geolings, E. and Gcolings, R. 1976. Factors affecting yield of sugarcane. I plant characters associated with yield of sugarcane. I plant characters associated with yield among HYUS. *Proc. Philippines Sug. Tech. Annual. Conv. 24th*: 67-75.

Fisher, R. A., and Yates, F. 1963. Statistical Tables for Biological, Agricultural and Medical Research. 6th Ed. Oliver & Boyd, Edinburgh and London, 146 P.

Gowda, S. N. S. and Saravanan, K. 2016. Correlation and Path Analysis for Yield and Quality Attributes in Sugarcane . *Int. J. Sci. Tech. Eng*., **3**(2): 133-37.

Hapase, R.S. and Repale, J. M. 1999. Variability, correlation and path analysis in sugarcane. *Proc. of 61st Annual Convention of Sugarcane Technologies Association of India*. New Delhi. India. 7-9 September. 1999

Hooda, R.S., Babu, C.N. and Khairwal, I.S. 1979. Association and path analysis of nine charaters in progenies of four sugarcane crosses at settling stage. *Indian J. Agric. Sci*., **49**(12): 931-35.

Ishaq, N.M., Misari, S.M., Echekwa, C.A., Olorunju, P.E. and Gupta, U.S. 1998. Variability and correlation studies in sugarcane. *Agriculture Tropica at subtropica, Prague (Czech Republic)*,**31**: 45-52.

Kang, M.S., Sosa, O. and Miller, J. D. 1989. Path analysis for per cent fiber and cane and Sugar, yield in sugarcane. *Crop. Sci*., **29**(6): 1481-83.

Kang, M.S., Miller, J.D. and Tai, P.Y.P. 1983. Genetic and Phenotypic path analysis and heritability in Sugarcane. *Crop Sci*., **23**(4): 643-47.

Kundu, S. and Gupta, M.L. 1997. Variability and characters correlation studies in (*Saccharum officinarum*) clones. *Indian Sugar*, **46**(11): 889-93.

Legendre, B.L. 1970. Sampling for hand refractometer Brix in single stool Sugarcane nurseries .ISSCT. Sugarcane Breeders Newsletter, 25:25.

Milligan, S.B., Gravois, K.A., Bischoff, K.P. and Martin, F.A. 1990. Crop effects on genetic relationship among sugarcane traits. *Crop Sci*., **30**(4): 927-31.

Naidu, N.N., Prasada Rao, K., Rajabopa Rao, V., Malikarjuna Rao, T.K.V.V. and Bhupal Rao, J.V.R. 1998. Selection Parameters for cane yield in sugarcane under plant and ratoon crops. *Indian Sugar*, **48**: 187-91.

Nosheen, N.E. and Ashraf, M. 2003. Statistcial analysis of certain trials that influence sugar recovery of related sugarcane varieties. *Indian J. Agric. Sci*., **42**: 142-48.

Pal, R., Chaudhary, B.S., Mehla, A.S. and Kadian, S.P. 1998. Studies on character interrelationship in clonal generation of sugarcane (Saccharum complex hybrid). *Indian Sugar*, **47**(11): 907-11.

Patel, M. M., Patel, H.S., Patel, A.D. and Patel, M.P. 1993. Correlation and path analysis in sugarcane. *Indian Sugar*, **43**(6): 365-68.

Pillai, S.V. and Ethirajan , A.S. 1993. Correlation between yield and components at three stages of relation in sugarcane. *Sugarcane*, **4**: 6-10.

Ramesh, V. and Verghese, S. 1995. Correlation and path coefficient analysis of yield and its attributes of sugarcane. *Indian Sugar*, **44**: 769-72.

Reddy, K.R. and Khan, A.Q. 1984. Association among yield and quality characters in sugarcane. *Indian J. Agric. Sci.*, **54**(8): 645-50.

Reddy, C.R. and Reddi, M.B. 1986. Degree of genetic determination correlations and genotypic and phenotypic path analysis in sugarcane. *Indian J. Genet*., **46**(3): 550-57.

Reddy, O.U.K. and Somarajan, K.G. 1994. Genetic variability and charater association in interspecific hybrid of sugarcane. *Indian J. Genet*., **54**(1): 32-36.

Resobalortega, L., Barter Batista, J., Granado Rajas, C. and Fonsca Batista, L. 1991. Repeatability heritability and association between characters in sugarcane. ARAC Revista De La Association de Technios Azucarevos de cuba. 50: 27-35.

Singh, H. and Sharma, H.L.1983. Path coefficient analysis of cane yield in sugarcane. *Indian Sugar, Crops J*., **9**: 7-9.

Singh, R.K., Tehlan, R.S. and Taneja, A.D. 1985. Investigation on some morphological and quality traits in relation to cane and sugar yield. *Indian Sugar,*. **35**: 267-71.

Singh, R.R., Tripathi, B.K. and Lal, S. 1981. Variability and correlation studies in sugarcane. *Indian Sugar*, **31**: 457-59.

Sukhchain; Sandhu, D. and Saini, G.S. 1997. Interrelationship among yield and commercial cane sugar, and their component traits in autumn plant of sugarcane. *Euphytica*, **95**: 109-44.

Verma P.S., Shri Pal and Karma, N.K. 1999. GeneticVariability and correlation studies in sugarcane. *Indian Sugar*, **49**: 125-28.

Verma, P.S., Dhaka, R.P.S. and Singh, H. N. 1988. Genetic variability and correlation studies in sugarcane. *Indian J. Genet*., **48**: 213-17.

Walker, D.I.T. 1965. Some correlation in sugarcane relation in Barbados. Proc. ISSCI. 12th Cong. 950-955.

Wright, S.1921. Correlation and causation. *J. Agric. Res*., **20**: 257-87.