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Short Communication

Stability analysis of cane and jaggery yield in elite sugarcane genotypes (*Saccharum* spp.)

S. S. Guddadamath*, Sanjay B. Patil and B. M. Khadi

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Abstract

An investigation was carried out with eight sugarcane genotypes along with four checks to study the phenotypic stability of cane yield, jaggery yield and its components under four environments. The G × E component of variation was significant for single cane weight, number of millable canes, commercial cane sugar percent (CCS %), cane yield, sugar yield, jaggery yield and per cent jaggery recovery. The genotypes, SNK 07680 and SNK 07337 were found stable for cane yield (132.60 and 105.66 t/ha, respectively), sugar yield (14.44 and 12.70 t/ha, respectively) its component characters such as sucrose percentage (16.81 and 16.31, respectively). The genotype SNK 07680 was stable for CCS% (11.98). Genotype SNK 07658 showed adaptability to unfavorable environment for single cane weight, number of millable canes and sucrose percentage. SNK 07680 and SNK 07337 genotypes were stable for jaggery recovery (10.09 and 9.60 % respectively) and jaggery yield (13.71 t/ha and 11.44 t/ha respectively).

Key words: Sugarcane, stability, G x E interaction, sucrose percentage, jaggery yield

In the context of increasing demand for jaggery in both domestic and international markets, concerted efforts are needed to encourage this cottage industry for the production of jaggery. It is of high medicinal and nutritive values and also for its export potential [1]. The present popular commercial varieties are being utilized for jaggery production, but the cane and jaggery productivity is moderate across diverse regions.

Limited information regarding the stability of cane and jaggery yield parameters is available in sugarcane which could be used in further breeding programmes for crop improvement. Hence the present investigation was planned to evaluate and screen the elite sugarcane genotypes along with commercially grown varieties over environments and to select the genotypes on the basis of stability parameters for cane and jaggery yield and its important component characters.

Twelve newly developed genotypes along with four checks *viz.*, Co 94012, Co 86032, Co 92005 and CoM 0265, were evaluated at four locations having across four diverse environments namely E1, (Agricultural Research Station, Sankeshwar), E2, (S. Nijalingappa Sugar Institute, Belgaum), E3, (Shegunsi, Belgaum) and E4, (R&D unit, Nandi Sugars, Hosur, Bijapur), in randomized block design with three replications during the crop season 2012-13. Each treatment plot comprised of 6 rows of 6 m length spaced with 90 cm apart. Observations were recorded for characters *viz*., cane height (m), cane girth (cm), single cane weight (kg), number of millable canes ('000/ ha), sucrose (%), commercial cane sugar (%), cane yield (t/ha), sugar yield (t/ha), jaggery yield (t/ha) and jaggery recovery (%). Five randomly selected canes were used to record cane height, cane girth, single cane weight, sucrose and commercial cane sugar. The data were analysed for stability parameters, *viz.*, mean (μ), regression coefficient (bi) and deviation from regression (S^2d_i) using the model proposed by Eberhart and Russell [2].

The pooled analysis of variance (ANOVA) revealed that environments, genotypes, genotype × environment interaction components of variation was significant for all the characters indicating the presence of substantial amount of variation among the genotypes over environments (Table 1). Genotypes

*Corresponding author's e-mail: somu.guddu@gmail.com
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also exhibited significant interaction with environments for all the traits studied which indicated that genotypes behaved differently under each environment for the expression of the characters of interest. It means the particular variety may not exhibit the same phenotypic performance under different environment or different variety may respond differently to a specific environment. Variance due to environment, genotype and G × E interactions were highly significant for cane yield, sucrose (%) and sugar yield. The linear environmental source of variance was significant for the traits *viz.,* cane height (m), cane girth (cm), number of millable canes ('000/ha), sucrose (%), commercial cane sugar (%), cane yield (t/ha), signifying the role of environment on the expression of these traits.

The G × E (linear) as well as pooled deviation mean squares were found significant for single cane weight, number of millable canes, cane yield, sucrose%, sugar yield, jaggery recovery% and jaggery yield indicating the presence of both predictable and non-predictable components. The importance of both linear and non-linear sensitivity for the expression of these traits was thus evident. However, linear component was significantly higher than the non-linear portion of the G × E interaction supporting the earlier findings [3-5]. Eberhart and Russell [2] discussed stability of genotypes in terms of three parameters *viz.,* genotypic mean (μ), regression or linear response (b_i) and deviation from the linearity (S^2d_i). According to this model an ideally stable variety is one that confirms high mean values, unit regression or linear response and no deviations from the linearity.

All the genotypes were linearly predictable for sucrose percentage (Table 1) because of non significant deviation from regression except SNK 071013 and SNK 071138 which recorded significant deviation from regression (1.121 and –1.400 respectively) and significant regression coefficient (1.994 and 2.213 respectively). Genotypes SNK 07337, SNK 07680, Co 94012 and Co 86032 were stable across locations for sucrose %. SNK 07658 showed high mean with non significant deviation from regression and regression coefficient close to unity indicating its adaptability to unfavorable environment. Commercial cane sugar % (CCS %) and CCS yield being important quality (sugar yield) parameters for which genotypes like SNK 07342, SNK 07360, SNK 071013 and SNK 071138 were unpredictable as they exhibited significant deviation from the regression. Whereas SNK 07337, SNK 07680 and SNK 658 were stable and superior as compared to popular standard

Table 1. Pooled analysis of variance for stability analysis for cane and jaggery parameters in Clonal-VII over four locations

Source of variation	df	Cane height (cm)	Cane girth (cm)	Single cane weight (kg)	No. of millable canes ('000/ha)	Sucrose %	CCS %	Sugar yield (t/ha)	Cane yield (t/ha)	Jaggery recovery (%)	Jaggery yield (t/ha)
Genotype	11	373.39**	0.101*	0.247**	14397.9**	3.94**	1.39**	16.86**	837.5**	4.48**	22.04**
Environment + (G x E)	36	2388.41**	0.217*	0.049	1902.2*	0.79**	2.02	3.94	321.8	1.15*	4.55**
Environments	3	75.48**	0.118*	0.212*	2418.3**	0.86*	6.75*	9.01*	846.5**	0.98*	3.35**
Genotype x Environment (G x E)	33	2484.78**	0.125**	0.034**	1855.3**	0.78**	1.82**	3.48**	274.1**	1.16**	4.66**
Environments (Lin.)	1	150.97*	0.531*	0.637	7254.8**	2.57**	13.51*	27.04	2539.5**	1.97	6.70
Genotype x Environment (linear)	11	2644.80	0.014	0.017*	1960.4**	1.55**	2.38*	3.71*	307.9*	0.87*	5.25*
Pooled deviation	24	2231.77**	0.026	0.039**	1652.6**	0.36**	1.21	3.08**	235.8**	1.33**	3.72**
Pooled error	88	442.2	0.018	0.013	602.2	0.73	0.43	1.77	92.9	0.04	1.29

Table 2. Stability parameters for sugar yield and jaggery yield parameters

Clone	Sucrose %			CCS Yield (t/ha)			Cane Yield (t/ha)			Jaggery recovery %			Jaggery yield (t/ha)		
		b_i	S²di		b_i	S²di		b_i	S²di		i	S^2di		i	S^2di
SNK 07337	16.31	1.012	0.011	12.7	1.011	0.007	111.92	1.011	5.003	10.09	0.967	0.05	11.44	0.961	0.003
SNK 07344	16.24	1.093	-0.192	10.42	1.831*	-1.041*	90.4	-1.313*	-121.61*	9.55	1.411*	-1.310*	8.85	-2.12**	-1.066
SNK 07360	15.93	1.312	0.124	10.38	1.043	0.061	90.98	1.594	82.21*	8.82	1.632*	0.66	8.53	1.11	0.311
SNK 07342	16.78	1.382	-0.793	9.61	1.612*	0.083	80.22	1.897*	90.34*	9.36	1.132	0.105	7.7	-1.230*	-1.122
SNK 07658	15.28	0.997	0.029	11.97	1.019	0.006	109.35	0.905	5.003	9.6	0.981	0.072	10.89	0.911	0.019
SNK 07680	16.81	1.002	0.011	14.44	1.016	0.008	120.41	1.005	3.001	11.32	1.009	0.04	13.71	1.01	0.012
SNK 071013	16.58	1.994*	1.121*	9.22	-2.210*	-1.052*	78.13	1.254*	101.18*	8.69	0.769	0.601	7.25	-1.740*	-1.254*
SNK 071138	15.13	2.123*	-1.400*	10.65	-2.650*	-1.153*	98.95	-2.344*	-91.23*	8.52	0.83	0.577	8.66	2.110*	-1.111
	Checks														
Co 94012	18.32	1.003	0.005	13.36	1.014	0.042	101.47	1.113	8.08	7.89	1.530*	0.478	8.52	-2.432*	2.044*
Co 86032	15.89	1.029	0.011	10.97	1.015	0.002	97.37	1.044	9.04	9.85	1.02	0.055	9.84	1.08	0.031
Co 92005	16.27	1.212	-0.027	11.68	1.042	0.002	100.34	-1.197*	90.29*	9.05	1.133	0.09	10.05	1.099	0.098
CoM 265	16.35	1.193	0.053	12.26	1.234	1.133*	104.2	-1.102	10.1	8.88	1.114	-0.086	10.12	1.29	0.243
Mean	16.23			11.05			98.65			9.3			9.63		
C.D. @ 5 %	0.56			2.26			11.15			0.69			1.61		
C V %	4.93			10.24			12.58			7.96			12.66		

check Co 86032 for quality parameters. The same genotypes (SNK 07337 and SNK 07680) recorded significantly superior cane yield (111.92 t/ha and 120.41 t/ha respectively) compared to popular check Co 86032 (97.37 t/ha). These genotypes are stable across the location for cane yield as indicated by their high mean coupled with non significant deviation from regression and regression coefficient close to unity (Table 2). Similar results have been reported earlier [6], for cane yield, whereas rest of the characters were not stable across locations.

All the genotypes were predictable for jaggery recovery, except SNK 07344, SNK 07360 and Co 94012 as they exhibited significant deviation from regression (1.411, 1.632 and 1.530 respectively). The genotype SNK 07680 was stable across environments for jaggery recovery as seen by its non significant deviation from regression and regression coefficient close to unity. Whereas SNK 07337 and SNK 07658 were adaptable to unfavorable environment as they showed high mean with regression coefficient lesser than unity. The same trend was observed for jaggery yield where in SNK 07680 was stable across locations for jaggery yield and SNK 07337 and SNK 07658 were adaptable to unfavorable environment as they showed high mean with regression coefficient less than unity (Table 2).

The genotypes SNK 07680 and SNK 07337 were stable across locations for cane yield and jaggery yield because of their high mean and also they are significantly superior (population mean) compared to commercial check Co 86032 which is most popular variety cultivated and occupied major area in peninsular India. These genotypes, SNK 07680 and SNK 07337, also have commercially acceptable CCS% (11.98 % and 11.31% respectively) and CCS yield (14.44 t/ha and 12.70 t/ha respectively).

The present study revealed that SNK 07680 and SNK 07337 were stable for most of the characters *viz*., single cane weight, number of millable canes, sucrose%, CCS yield, cane yield and jaggery yield. Similarly, SNK 07658 was stable for cane weight, CCS% and CCS yield. Overall, the outstanding genotypes were SNK 07680, SNK 07337 for cane yield, sugar yield and jaggery yield, and SNK 07658 for sugar yield. These genotypes were superior to other genotypes and checks by their *per se* performance and stability.

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