

SHORT COMMUNICATION

Performance of newly developed sugarcane genotypes for morphological and quality traits in North Karnataka

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Abstract

Evaluation of sugarcane genotypes for morphological and quality Traits was conducted at the Sugarcane Research centre, Zadshahapur, SNSI Belagavi, Karnataka. The experiment was layout in RBD design with three replications during the years 2020-21 (AVT I plant) and 2021-22 (AVT II Plant and Ratoon). Eleven mid late genotypes viz., Co 14005, Co 15005, Co 15006, Co 15007, Co 15009, Co 15010, Co 15017, Co 15021, CoN 15071, CoSnk 15102 and PI 15131, and one early maturing genotype Co 11015 along with three standard checks (Co 86032, CoC 671 and Co 09004) were evaluated for cane yield (t/ha), NMC ('000/ha), stalk length (cm), stalk diameter (cm), single cane weight (Kg), sucrose %, Brix %, purity % and extraction %. Genotypes Co 15007, Co 15010, CoN 15071 and PI 15131 were best for the traits like cane yield, CCS yield, NMC, stalk length, stalk diameter, single cane weight and also quality character like purity and extraction percentage. The genotype Co 11015 recorded maximum 14.81%, 20.82% and 22.15% for CCS %, sucrose % and Brix % as compared to best standard Co 09004 (14.62%, 20.63% and 22.11% respectively).

Keywords: Sugarcane; Cane yield; CCS Yield; NMC; Quality traits

Introduction

Sugarcane is an important cash crop in India both sociologically and economically. It is the main sugar-producing crop (Junejo et al., 2010) accounting for approximately 80% of sugar production in the world (Islam et al, 2018; Sharma and Chandra, 2018). Sugarcane is cultivated in many of the countries with Brazil as the major producer followed by India, China, Pakistan, Thailand and Mexico. To meet the needs of increasing population, productivity per unit area need to be increased as there is very little scope for horizontal expansion of area under sugarcane. This is possible mainly through development of high yielding varieties, adoption of ideal agronomic practices and plant protection measures. Variety plays a vital role in both increasing and decreasing per unit area sugarcane yield, while use of unapproved, inferior cane quality varieties affects

the sugarcane production negatively (Mian, 2006). According to Glaz and Gilbert (2000), sugarcane production can only be improved through the adoption of promising varieties and technologies. Sugarcane breeding and better agronomic practices have contributed to a huge increase in sugarcane yield in the last 30 years (Abdul and Muhammad, 2018). Its wider adaptability to varying climatic conditions offers a steady economic base for the survival of the sugarcane industry as the world's population is increasing rapidly and creating the necessity for food and renewable energy supply (Skocaj et al., 2013). Improved cane yields, sucrose content, disease and pest resistance, and maintaining acceptable fibre levels for milling are usually the main breeding objectives in most sugarcane breeding programmes (Jackson, 2005). Sugarcane is complex polyploid plant. The heterozygous and polyploid nature of this crop has

resulted in development of greater genetic variability ref⁷. The information on the nature and the magnitude of variability present in the breeding material is of prime importance for a breeder to initiate any effective selection program. The effectiveness of selection depends largely on the genetic variability present in the breeding population and the heritability of the traits. It is necessary to identify traits with high genetic variation. The easiest way to estimate variance components is to test a large number of genotypes for two or more years and at two or more locations (Mayo, 1980).

Materials and methods

The study was conducted at Sugarcane Research Centre, Zhadshahapur, S. Nijalinagappa Sugar Institute Belagavi, Karnataka. The experiment was layout in RBD design with three replications during the year 2020-21 and 2021-22. The eleven mid late genotypes viz., Co 14005, Co 15005, Co 15006, Co 15007, Co 15009, Co 15010, Co 15017, Co 15021, CoN 15071, CoSnk 15102 and PI 15131 and, one early maturing genotype Co 11015 along with three standard checks (Co 86032, CoC 671 and Co 09004 respectively). These genotypes were evaluated during 2020-21 (I Plant crop), 2021-22 (II Plant and Ratoon crops). The genotypes of sugarcane were received under All India Coordinated Sugarcane Research Project (Sugarcane). Each entry was planted 6 meters long 8 rows at 1.2 meters row to row distance. Two budded sets (72 eye buds) with overlapping arrangement were planted in single row system. The setts were treated with Carbendazim 50 WP (Bavistin 50WP) @ 2 g per liter of water to avoid seed born disease and proper germination of sugarcane setts. After covering the setts with soil, fertilizer dose @ 300 kg nitrogen, 100 kg phosphorus and 100 kg potassium per hectare was applied as, one third nitrogen with full dose of

phosphorus and potassium at the time of planting as basal dose; the remaining nitrogen was applied in two splits at mention stage.

The observation was recorded for cane yield (t/ha), NMC ('000/ha), stalk length (cm), stalk diameter (cm) and single cane weight (kg). The juice quality analysis was done in the laboratory of S. Nijalingappa Sugar Institute Belagavi for the CCS %, sucrose %, Brix %, purity % and extraction %. The data were analyzed statistically using analysis of variance to test the superiority over the means of different varieties as suggested by Gomez and Gomez (1984).

Results and discussion

The results of the study revealed that there were highly significant differences in the mean values for cane yield and yield components. The results of the study presented in Table-1 (Plant I) revealed that the genotypes Co 15010 (20.26 t/ha CCS yield and 146.18 t/ha cane yield), Co 15021 (22.04 t/ha CCS yield and 162.74 t/ha cane yield) exhibited better performance compared to Co 86032 (19.81 t/ha CCS yield and 129.83t/ha cane yield). PI 15131 (19.82 t/ha CCS yield and 140.01t/ha cane yield) recorded higher CCS (t/ha) but slightly lower than the yield of standard check Co 86032 (19.81 t/ha and 140.17t/ha). The genotype Co 15010 exhibited better performance in the NMC (100.69 lacs/ha), stalk length (279.33cm), stalk diameter (2.88cm) and single cane weight (1.68kg) as compared to Co 86032 (101.23 '000s/ha, 279.33cm, 2.68cm and 1.66kg respectively). The genotypes Co 11015 (301.17cm), Co 14005 (300.50cm) and Co 15021 (301.67cm) showed higher stalk length as compared to standard check 09004 (295.00cm). Most of the genotypes viz., Co 15005 (2.72cm), Co 15006 (2.72cm), Co 15007 (2.90cm), Co 15010 (2.88cm), Co 15021 (2.93cm) and Co 15102 (2.83cm) were observed with thicker

Table 1 Average morphological data of AVT sugarcane genotypes over the seasons

Sl. No	Clone	CCS (t/ha)			Cane yield (t/ha)			NMC ('000/ha)			Stalk length (cm)			Stalk diameter (cm)			Single cane weight (kg)								
		I Plant	II Plant	Ratoon	Mean	I Plant	II Plant	Ratoon	Mean	I Plant	II Plant	Ratoon	Mean	I Plant	II Plant	Ratoon	Mean	I Plant	II Plant	Ratoon	Mean				
1.	Co 11015	18.68	21.89	16.27	18.95	126.54	142.50	113.57	127.54	85.34	106.79	90.65	94.26	301.2	304.2	221.6	275.6	2.43	2.55	2.60	2.53	1.61	1.55	1.63	1.60
2.	Co 14005	17.41	19.99	15.63	17.68	122.39	146.70	113.61	127.57	92.59	120.83	106.37	106.60	300.5	295.3	257.7	284.5	2.42	2.40	2.55	2.46	1.58	1.48	1.44	1.50
3.	Co 15005	16.58	19.85	17.82	18.08	119.72	140.49	130.77	130.33	93.44	110.96	103.25	102.55	264.5	308.0	264.5	279.0	2.72	2.60	2.60	2.64	1.49	1.77	1.69	1.65
4.	Co 15006	13.46	15.59	13.94	14.33	99.50	114.14	99.87	104.50	83.41	87.96	100.99	90.79	238.3	271.7	202.3	237.4	2.72	2.63	2.68	2.68	1.43	1.57	1.34	1.44
5.	Co 15007	15.94	16.57	14.62	15.71	109.29	120.87	104.47	111.55	69.98	85.42	78.56	77.99	293.5	339.7	284.0	305.7	2.90	2.57	3.00	2.82	1.81	1.82	2.25	1.96
6.	Co 15009	15.54	14.50	12.22	14.09	114.10	110.86	88.69	104.55	84.26	96.68	86.51	89.15	292.0	313.7	246.3	284.0	2.52	2.37	2.52	2.47	1.58	1.50	1.48	1.52
7.	Co 15010	20.26	21.24	17.39	19.63	146.18	156.68	126.81	143.22	100.69	126.00	105.32	110.67	284.2	299.7	262.8	282.2	2.88	2.53	2.75	2.72	1.68	1.61	1.64	1.64
8.	Co 15017	14.12	21.71	16.30	17.38	96.84	145.96	117.80	120.20	91.51	111.50	103.60	102.20	243.5	287.2	259.3	263.3	2.57	2.60	2.60	2.59	1.27	1.70	1.59	1.52
9.	Co 15021	22.04	18.20	13.01	17.75	162.74	128.61	93.85	128.40	91.67	110.34	84.48	95.49	301.7	293.5	265.3	286.8	2.93	2.45	2.60	2.66	1.97	1.44	1.68	1.70
10.	CoN 15071	14.64	20.67	19.58	18.30	102.86	158.22	144.05	135.04	88.50	102.31	102.99	97.93	288.8	342.2	275.8	302.3	2.42	2.80	2.70	2.64	1.38	2.11	1.81	1.76
11.	CoSuk 15102	17.96	17.36	13.51	16.28	128.70	126.10	97.72	117.51	76.54	101.70	93.94	90.73	288.3	301.7	289.8	293.3	2.83	2.25	2.38	2.49	1.91	1.47	1.65	1.67
12.	PI 15131	19.82	20.50	16.57	18.97	140.01	159.25	118.40	139.22	74.77	85.57	79.24	79.86	287.5	324.7	278.0	296.7	3.03	3.03	3.12	3.06	2.09	2.37	2.42	2.29
Standards																									
1.	Co 86032	19.81	17.57	14.46	17.28	142.64	140.17	106.69	129.83	101.23	130.56	98.01	109.93	279.3	310.2	249.7	279.7	2.68	2.55	2.87	2.70	1.66	1.61	1.83	1.70
2.	CoC 671	14.68	18.19	13.68	15.52	96.40	129.06	98.32	107.93	78.40	111.65	92.19	94.08	264.8	300.8	244.5	270.0	2.62	2.45	2.60	2.56	1.59	1.56	1.62	1.59
3.	Co 09004	19.60	21.34	17.66	19.54	141.08	135.52	124.20	133.60	88.35	96.53	98.63	94.50	295.0	325.8	296.7	305.8	2.60	2.57	2.65	2.61	1.84	2.01	1.83	1.90
Mean		17.37	19.01	15.51	17.30	123.27	137.01	111.92	124.07	86.71	105.65	94.98	95.78	281.5	307.9	259.9	283.1	2.68	2.56	2.68	2.64	1.66	1.70	1.73	1.70
SE(m)		1.57	1.36	0.86		11.65	7.86	6.34		4.36	4.03	3.64		10.67	11.09	14.78		0.08	0.09	0.09	0.12	0.11	0.11	0.11	
CD		4.56	3.95	2.50		33.76	22.77	18.38		12.62	11.69	10.56		30.91	32.13	42.81		0.24	0.25	0.26	0.34	0.31	0.31	0.31	
CV		15.69	12.42	9.62		16.38	9.94	9.82		8.70	6.61	6.65		6.56	6.24	9.85		5.39	5.88	5.70	12.41	10.82	10.82	10.67	

cane compared to Co 86032 (20.68cm) as well as overall mean value. Genotype Co 15021 performed better for stalk length (301.67cm), stalk diameter (2.93cm) and single cane weight (1.97cm) as compared to Co 09004 (295.00cm, 2.60 cm and 1.84kg respectively). Similar finding was reported by Khan et al, (2003) for single cane weight; Gouri et. at, (2020) for stalk length and stalk diameter.

The biochemical analysis (I Plant) revealed that the genotypes Co 11015 (14.80%, 20.86%, 22.34% and 93.38% respectively) and Co 15017 (14.60%, 20.68%, 22.40% and 92.30% respectively) showed better performance over the mean value for CCS%, sucrose%, brix % and purity %. Co 14005 (14.25%, 20.32% and 22.35%) and Co 15007 (14.59%, 20.75% and 22.65%) are best for character like CCS%, sucrose% and brix %. For the extraction % the genotype Co 15010 (68.47%) showed better performance than the standard check Co 86032 (65.02). PI 15131 (63.52%) showed higher percentage of extraction than the standard CoC 671 (63.40%) (Table 2).

The mean performance of Plant II, the genotypes Co 11015 (21.89t/ha) and Co 15017 (21.71 t/ha) showed higher CCS (t/ha) as compared to standard Co 09004 (21.34 t/ha). The genotypes Co 11015 (142.50 t/ha), Co 14005 (146.70 t/ha), Co 15010 (156.68 t/ha) Co 15017 (145.96 t/ha), CoN 15071 (158.22 t/ha) and PI 15131 (159.25 t/ha) exhibited the higher yield as compared to standard Co 86032 (140.17 t/ha).

In the biochemical analysis (Table 2), the genotypes Co 11015 (95.26%), Co 15017 (95.25%) and 15006 (94.00%) showed maximum purity % than the standards Co 86032 (90.69%) and CoC 671 (93.77%). The genotypes viz., Co 15006 (61.93%), Co 15017 (66.17%), Co 15021 (65.29%), CoN 15071 (63.18%), Co 150102

(62.16%) and PI 15131 (61.99%) showed better performance for extraction % as compared to standard Co 86032 (61.83%). The genotype Co 15005 exhibited the better performance for CCS% (14.11%), sucrose (19.94%) and brix (21.45%) over the mean value. The genotype Co 11015 showed excellent performance for CCS% (15.30%), sucrose (21.37%), brix (22.42%) and purity (95.26%) and showed best genotype for quality traits. The genotypes Co 15017 and Co 15021 showed better for traits like CCS% (14.98% and 14.16%), sucrose % (20.93% and 19.97%), brix % (21.95% and 21.39%), purity % (95.25% and 93.35%) and extraction % (66.17% and 65.29%) and these are best genotypes for quality traits.

The genotypes Co 15007 (339.67cm), Co 15009 (313.67cm), CoN 15071 (342.17cm) and PI 15131 (324.67cm) showed taller plant height as compared to Co 86032 (310.17cm) and Co 09004 (325.83cm). The genotypes PI 15131 and CoN 15071 showed thicker cane (3.03cm and 2.80cm) as compared to standard varieties. The genotypes CoN 15071 (2.11kg) and PI 15131 (2.37kg) exhibited the higher cane weight as compared to standard Co 09004 (2.01kg). In general the genotypes CoN 15071 and PI 15131 showed maximum plant height, thicker cane and high single cane weight as compared to standard Co 86032 and these two best genotypes for morphological traits (Table 2).

This suggested that all sugarcane genotypes were genetically variable and a considerable amount of variability existed among them, therefore, these sugarcane genotypes would respond positively to selection. It is accepted that sugarcane varieties are greatly affected by genetic makeup (El-Geddaway, et al., 2002). The variation in cane yield and yield components among the varieties may be attributed due to their dissimilarity in genetic makeup (Mali

Table 2 Quality analysis data of AVT Sugarcane genotypes over the seasons

Sl. No.	Clone	CCS %			Sucrose %			Brix %			Purity %			Extraction %		
		I plant	II plant	Mean	I plant	II plant	Mean	I plant	II plant	Mean	I plant	II plant	Mean	I plant	II plant	Mean
1	Co 11015	14.8	15.3	14.33	14.81	20.86	21.37	20.21	20.82	22.34	22.42	21.69	22.15	93.38	95.26	93.31
2	Co 14005	14.25	13.64	13.8	13.89	20.32	19.42	19.6	19.78	22.35	21.25	21.35	21.65	90.92	91.49	91.9
3	Co 15005	13.89	14.11	13.64	13.88	19.91	19.94	19.47	19.77	22.11	21.45	21.42	21.66	90.03	93.04	90.89
4	Co 15006	13.54	13.67	13.98	13.73	19.15	19.22	19.91	19.43	20.68	20.45	21.82	20.98	92.63	94	91.3
5	Co 15007	14.59	13.7	14	14.1	20.75	19.44	19.86	20.02	22.65	21.12	21.59	21.78	91.63	92.09	92.16
6	Co 15009	13.63	13.12	13.78	13.51	19.46	18.57	19.57	19.2	21.45	20.09	21.32	20.95	90.72	92.46	91.82
7	Co 15010	13.86	13.54	13.74	13.72	19.69	19.11	19.34	19.38	21.45	20.52	20.62	20.86	92.64	93.02	93.87
8	Co 15017	14.6	14.98	13.84	14.47	20.68	20.93	19.64	20.42	22.4	21.95	21.35	21.9	92.3	95.25	92.1
9	Co 15021	13.64	14.16	13.84	13.88	19.36	19.97	19.69	19.67	21.04	21.39	21.52	21.31	92	93.35	91.52
10	CoN 15071	14.31	13.09	13.6	13.67	20.27	18.41	19.04	19.24	21.94	19.62	20.05	20.54	92.41	93.85	94.92
11	CoSnk 15012	13.86	13.75	13.82	13.81	19.75	19.34	19.31	19.47	21.64	20.59	20.25	20.83	91.26	93.96	95.38
12	PI 15131	14.16	12.88	13.99	13.68	20.08	18.31	19.55	19.31	21.8	19.95	20.52	20.76	92.22	91.76	95.28
Standards																
1	Co 86032	13.92	12.52	13.56	13.33	19.75	17.88	19.12	18.92	21.47	19.72	20.49	20.56	92.06	90.69	93.36
2	CoC 671	15.22	14.01	13.92	14.39	21.39	19.71	19.9	20.33	22.71	20.99	21.95	21.88	94.17	93.77	90.68
3	Co 09004	13.9	15.75	14.22	14.62	19.76	21.96	20.16	20.63	21.57	22.92	21.85	22.11	91.62	95.87	92.3
	Mean	14.14	13.88	13.87	13.96	20.08	19.57	19.63	19.76	21.84	20.96	21.19	21.33	92	93.32	92.72
	SE(m)	0.3	0.47	0.34	0.36	0.59	0.28	0.3	0.52	0.4	0.99	1.44	1.44	2.76	1.91	2.33
	CD	0.88	1.37	0.69	1.04	1.7	0.82	0.86	1.52	1.16	2.86	4.17	4.18	8.01	5.54	6.75
	CV	3.72	5.92	2.99	3.1	5.19	2.49	2.34	4.33	3.26	1.86	2.67	2.69	7.81	5.48	6.9

and Singh, 1995). Panhwar, et al., (2008) reported great variability among the sugarcane genotypes for cane yield and yield components.

In ratoon crop and over the year the genotypes Co 11015 (21.89 t/ha and 113.57 t/ha), Co 15005 (17.82t/ha and 130.77t/ha), Co 15010 (17.39t/ha and 126.81 t/ha), CoN 15071 (19.58 t/ha and 144.05 t/ha) and PI 15131 (16.57t/ha and 118.40t/ha) showed higher CCS (t/ha) and cane yield (t/ha) as compared to standard Co 86032. The genotypes viz., Co 14005 (106.37 lac/ha), Co 15005 (103.25 lac/ha), Co 15006 (100.99 lac/ha), Co 15010 (105.32 lac/ha), Co 15017 (103.60 lac/ha) and CoSnk 15102 (102.99 lac/ha) exhibited higher NMC over the year. The genotypes Co 15007 and PI 15131 shows higher plant height (284.00cm and 278.00cm), thicker cane (3.00cm and 3.12cm) and single cane weight (2.25kg and 2.42kg) as compared to standard Co 86032 (259.90cm, 2.68cm and 1.73kg respectively) in ratoon crop (Table 1). The genotype PI 15131 showed better performance for CCS yield (16.57t/ha), cane yield (118.40t/ha), CCS % (13.99%), purity % (95.28%), extraction % (60.39%), stalk length (278.0cm), stalk diameter (3.12cm) and single cane weight (2.42kg) as compared to standard over the year. The genotype Co 11015 showed better performance for CCS yield (16.27 t/ha), cane yield (113.57t/ha), CCS % (14.33%), sucrose % (21.37%), brix % (21.69%) and purity (93.31%) over the year (Table 2).

Over the year 2020-21 (AVT 1) and 2021-22 (AVT 2 and ratoon), the genotype Co 15007, Co 15010, CoN 15071 and PI 15131 are the best genotypes for traits like cane yield (111.55 t/ha, 143.22 t/ha, 135.04 t/ha and 139.22 t/ha), CCS yield (15.71 t/ha, 19.63 t/ha, 18.30 t/ha and 18.97 t/ha), NMC (77.99 lac/ha, 110.67 lac/ha, 97.93 lac/ha and 79.86 lac/ha), stalk length (305.7cm, 282.2cm, 302.3 and 296.7cm), stalk diameter (2.82cm, 2.72cm, 2.64cm

and 3.06cm), single cane weight (1.96kg, 1.64kg, 1.76kg and 2.29kg) purity % (91.96%, 93.18%, 93.73% and 93.09%) and extraction % (61.15%, 61.80%, 60.37% and 62.10%). Similar findings reported by Prabha, (2021) for cane yield, CCS yield, single cane weight and NMC. The genotype Co 11015 exhibited higher mean value for CCS% (14.41%), sucrose% (20.82%) and Brix % (22.15%) as compared to standard Co 09004 (14.62%, 20.63% and 22.11%) and The genotype's Co 11015 is excellent performance over the mean value indicating the genotype better performance for the over the season for quality characters. Similar results were also reported by for CCS%, brix% and Sucrose % (Tena et al., 2016; Shikanda et al., 2017; Shitahun et al., 2018 and Singh et al., 2019).

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