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SCREENING OF SUGARCANE GERMPLASM FOR TRAITS RELATED TO COGENERATION AND PAPER MAKING

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ABSTRACT

Sugarcane is one among the most efficient crops in the world in converting energy from sunlight into chemical energy that is usable as a fuel source for cogeneration and paper making purpose. Germplasm is the basic raw material with repository of beneficial traits. Constant evaluation and characterization of the existent, yet uncharacterized germplasm is useful and is the cornerstone for the development of new and better varieties. A systematic study was conducted to evaluate the one hundred and thirty one germplasm accessions including four checks for quality and yield attributes. All the varieties varied greatly for different traits. Germplasm accessions possessing traits related to cogeneration and paper making were grouped and elucidated. Germplasm accessions viz., 85R186, 97R383, BO91, 93R113, 97R7, 83V288, 97R424, 2000A213, 2002V2, 94A73, and 2005T89 are reservoirs for different parameters and they can be exploited in breeding programmes for production of promising sugarcane varieties suitable for cogeneration and paper making purpose.

KEY WORDS: Cogeneration, Germplasm, Paper making, Sugarcane

INTRODUCTION

Sugarcane (*Saccharum* spp.) is a large-stature perennial grass that is cultivated in approximately 80 nations in tropical, semi-tropical, and sub-tropical regions of the world, primarily for its ability to store high concentrations of sucrose in the stem. Approximately 70 per cent of the world's sugar supply in the form of sucrose originates from sugarcane. Sugarcane is one of the most efficient crops in the world in converting energy from sunlight into chemical energy that is usable as a fuel source. The fibrous residue, called bagasse, is used by most sugar mills to produce heat and steam for the operation of the mills. Sugarcane bagasse (fibrous residue) is the primary fuel source used in boilers, making most sugarcane mills effectively energy self-sufficient. Some mills also generate electricity (referred to as co-generation), and sell the excess to public utilities. Germplasm is the basic raw material where diversity of traits prevail and can be exploited for production of superior lines suitable for cogeneration and paper making purpose. High fibre content (Rao *et al.*, 2007), high biomass and higher total sugars (Govindaraj, 2009), optimum sugar content (Radhamani *et al.*, 2012) and high yield (Rakkiyappan and Pandiyan, 1992) are some of the traits useful in selecting varieties for cogeneration and paper making. The present study focus on screening and grouping of germplasm accessions of sugarcane for cogeneration and paper making and using them as parents in breeding programmes.

MATERIAL AND METHODS

The one hundred and thirty one germplasm accessions including four checks viz., 2003V46, Co6907, Co7219 and Co86032 were evaluated during 2012-13 at Agricultural Research Station, Perumallapalle, with plot size of 6m× 2R × 0.9m = 10.8 m^2 in augmented design II. Recommended package of practices were adopted to raise a healthy crop. Necessary prophylactic measures were taken to safeguard the crop from pests and diseases. The germplasm accessions were evaluated for the quality and yield attributes viz., single cane weight, sucrose per cent, CCS per cent, fibre per cent and cane yield.

The single cane weight was derived by averaging the weight of 10 canes harvested randomly from each accession in the plot at the time of maturity. Sucrose percentage was obtained by direct polarisation of the

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undiluted juice after clarification with 3 to 4 gm of dry lead subacetate with the help of polariscope. The polarisation reading was then converted into per cent of sucrose using Schmitz's tables (Hawaiian Sug. Tech. Association, 1931). The Commercial cane sugar (%) was estimated from the following formula:

CCS per cent = 1.05 (S) – 0.3 (B),
S = Sucrose per cent and B = Corrected Brix in juice

Fibre content was estimated from three randomly selected canes harvested at 360 days after transplanting. They were further sub-sampled to include top, middle and bottom portion from each cane. Cane was split vertically and the split cane was cut into small bits of 1cm length. All the bits of cane were pooled and 250g of fresh cut cane sample was taken for analysis. The 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 100^0C and then dry weight of the sample with bag was recorded. 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)

RESULTS AND DISCUSSION

All the germplasm accessions showed significant variation for the traits under study (Table 1). All the germplasm lines including checks were evaluated for the traits under study and an exercise was carried out for grouping the genotypes based on their *per se* performance related to cogeneration and paper making traits *viz*., high fibre percentage, low sucrose percentage, low CCS percentage and high single cane yield and cane yield per hectare (Table 3).

Single cane yield showed significant variation among the genotypes (Table 1). The range varied from 0.4 to 1.8 kg. Among the genotypes, single cane weight with more than 1.5 kg was recorded in 24 genotypes (Table 3). The genotypes *viz*., 2002V48, 2003T129, CoA7602, 92A326 and 92A10 recorded the highest single cane weight (1.8 kg) and the lowest single cane weight was observed in genotype SES594 (0.4 kg) followed by BO91 and CoS767 with 0.7 kg (Table 2). Ravishankar *et al.* (2004) reported that a high positive association was present between number of tillers per plant and single cane weight, hence, selection of clones based on these traits will be effective in improving the cane yield.

Variation for sucrose % among genotypes was significant (Table 1) and it ranged from 10.1 to 19.04 per cent (Table 2). The genotypes with <16.5 per cent of sucrose were observed to be 47 (Table 3). Among the genotypes, the highest sucrose percent was recorded in 94V101 and 97R183 with 19.04 per cent followed by 95V74 (18.99%) and 93A145 (18.79%). The least percentage of sucrose was observed in the genotype SES594 (10.1%) followed by 95V303 (13.52%) (Table 2). Genotypes with low sucrose percent are preferred for cogeneration and pulp making.

Commercial Cane Sugar (CCS) percentage showed significant variation among the genotypes (Table 1). Genotypes ranged from 6.15 to 13.57 percent for CCS percentage (Table 2). The genotypes with <11 percent of commercial cane sugar percentage were 34 (Table 3). Among the genotypes, the highest CCS percent was recorded in 97R183 (13.57%) followed by 95V74 (13.42%) and 93A145 (13.26%). The least percentage of CCS was observed in SES594 (6.15%) followed by 95V303 (9.47%) and 97R395 (9.67%) (Table 2).

Significant variation among the genotypes was observed (Table 1) for fibre percentage which was ranging from 9.0 to 27.80 per cent. A total of 20 genotypes possessed high fibre percentage (>16%). Among the genotypes, the highest fibre percent was recorded in SES594 (27.80%) followed by 94A73 (18.48%) and 2005T89 (17.92%). The least percentage of fibre was observed in 2004A107 (9.0%) followed by CoC671 (10.32%) and 90A278 (10.40%) (Table 2). Kadian and Mehla (2006) used fibre percentage for grouping and classification of genotypes useful for cogeneration. Babu *et al.* (2009) observed a significant positive correlation between rind hardness and fibre content and advocated

Table 1. Analysis of variance for traits related to cogeneration and pulp making in sugarcane using Augmented design II

S. No.	Trait	Mean Squares				Mean	C.D
		Block df = 2	Entries df = 114	Checks df = 3	Error df = 6		
1.	Single cane weight (kg)	0.0175	0.069**	0.020	0.017	1.33	0.45(5)
2.	Sucrose (%)	0.7252	2.059**	0.048	0.210	16.66	1.58(5)
3.	CCS (%)	0.1517	1.172**	0.050	0.016	11.62	0.44(5)
4.	Fibre (%)	0.2514	4.610**	1.530	0.313	14.04	1.93(5)
5.	Cane yield (t ha^{-1})	70.4680	507.190**	599.850	51.210	126.13	24.76(5)
6.	CCS yield (t ha^{-1})	0.0777	9.736**	21.410	0.211	14.69	1.59(5)

** Significant at 1% level

Table 2. Evaluation of 131 sugarcane germplasm accessions for cogeneration, pulp and paper making

S.No.	Clone number	Co7508	90A272	93A145	99V30	2000V59	83R23	93R44
1.	Single cane weight (Kg)	1.72	1.20	1.50	0.90	1.40	1.20	1.20
2.	Sucrose%	17.80	15.75	18.79	14.68	16.04	16.35	17.09
3.	CCS %	12.28	10.67	13.26	10.28	11.21	11.67	11.57
4.	Purity %	87.86	84.83	92.28	90.82	90.31	94.72	84.75
5.	Fibre %	12.44	12.56	12.32	13.92	14.20	14.48	15.32
6.	Cane yield (t ha^{-1})	149.98	125.52	150.60	101.25	131.25	127.30	101.23
7.	CCS yield (t ha^{-1})	18.42	13.39	19.97	10.41	14.71	14.86	11.71
S.No.	**Clone number**	**Co85004**	**Co94008**	**Co2001-13**	**Co2001-15**	**Co7219**	**CoT8201**	**83V15**
1.	Single cane weight (Kg)	1.70	1.50	1.50	1.60	1.40	1.60	1.40
2.	Sucrose%	17.00	16.95	16.73	15.82	17.61	17.88	16.97
3.	CCS %	12.13	11.87	11.73	11.10	12.29	12.68	11.98
4.	Purity %	94.64	90.83	91.10	91.14	90.03	93.32	92.42
5.	Fibre %	14.36	14.36	13.32	13.68	14.60	13.56	13.68
6.	Cane yield (t ha^{-1})	147.56	150.15	142.05	144.80	118.83	147.20	129.36
7.	CCS yield (t ha^{-1})	17.90	17.82	16.66	16.07	14.60	18.66	15.50
S.No.	**Clone number**	**2002V48**	**85R186**	**97R401**	**97R272**	**97R129**	**97R383**	**Co86032**
1.	Single cane weight (Kg)	1.80	1.20	1.60	1.40	1.20	1.60	1.30
2.	Sucrose%	16.97	14.68	15.80	18.27	16.99	14.66	17.82
3.	CCS %	11.98	10.32	10.96	12.73	12.09	10.18	12.39
4.	Purity %	92.42	91.42	88.94	89.75	94.08	89.05	89.29
5.	Fibre %	14.36	17.72	14.84	13.84	13.64	17.64	14.72
6.	Cane yield (t ha^{-1})	138.24	119.81	111.87	118.16	100.32	128.48	128.44
7.	CCS yield (t ha^{-1})	16.56	12.36	12.26	15.04	12.13	13.08	15.91
S.No.	**Clone number**	**Co99004**	**2003T129**	**81V48**	**2002A192**	**97A44**	**92A355**	**92A38**
1.	Single cane weight (Kg)	1.50	1.80	1.50	1.40	1.20	1.30	1.30
2.	Sucrose%	17.33	18.11	-	-	-	-	-
3.	CCS %	11.86	12.62	-	-	-	-	-
4.	Purity %	86.40	89.81	-	-	-	-	-
5.	Fibre %	12.44	16.56	15.44	14.64	13.72	12.44	11.48
6.	Cane yield (t ha^{-1})	125.00	131.04	157.50	124.04	122.76	115.44	138.32
7.	CCS yield (t ha^{-1})	14.82	16.54	-	-	-	-	-

S.No.	Clone number	90A278	92A54	CoS8346	BO91	BARAGUA	KHAKAI	81V99
1.	**Single cane weight (Kg)**	1.30	1.40	1.00	0.70	0.90	1.00	1.60
2.	**Sucrose%**	-	17.00	15.32	15.35	17.20	-	16.90
3.	**CCS %**	-	12.00	10.37	10.69	12.17	-	11.64
4.	**Purity %**	-	92.46	84.57	89.69	92.91	-	87.52
5.	**Fibre %**	10.40	15.32	13.12	16.36	10.84	15.52	12.56
6.	**Cane yield (t ha^{-1})**	107.85	140.70	62.50	108.00	110.00	-	100.00
7.	**CCS yield (t ha^{-1})**	-	16.88	6.48	11.54	13.38	-	11.64
S.No.	**Clone number**	**97A85**	**SES594**	**Co6907**	**84A125**	**CoA7602**	**CoC671**	**Co7717**
1.	**Single cane weight (Kg)**	1.50	0.40	1.10	1.20	1.80	1.40	1.00
2.	**Sucrose%**	17.36	10.10	17.46	16.74	16.72	17.36	15.53
3.	**CCS %**	11.98	6.15	12.49	11.82	11.72	11.98	10.58
4.	**Purity %**	88.05	70.58	95.32	92.43	90.82	88.05	85.74
5.	**Fibre %**	15.04	27.80	13.96	13.60	12.44	10.32	12.36
6.	**Cane yield (t ha^{-1})**	93.75	83.30	101.64	114.36	153.00	110.12	92.40
7.	**CCS yield (t ha^{-1})**	11.23	5.12	12.69	13.52	17.93	13.19	9.78
S.No.	**Clone number**	**Co975**	**Co1148**	**Co997**	**Co419**	**Co62399**	**Co364**	**Co38436**
1.	**Single cane weight (Kg)**	1.40	1.20	1.50	1.60	1.40	0.90	1.00
2.	**Sucrose%**	15.34	17.21	18.13	15.16	14.46	17.87	17.42
3.	**CCS %**	10.62	12.21	12.94	10.62	10.69	12.62	12.31
4.	**Purity %**	88.58	93.45	94.83	90.72	0.86	92.52	92.60
5.	**Fibre %**	12.84	13.76	15.72	12.08	11.28	15.76	13.60
6.	**Cane yield (t ha^{-1})**	87.50	78.00	97.50	138.40	136.08	75.00	104.16
7.	**CCS yield (t ha^{-1})**	9.29	9.52	12.61	14.70	14.54	9.46	12.82
S.No.	**Clone number**	**CoS767**	**2003V46**	**2004A75**	**2004A63**	**2004A55**	**2004A107**	**2004A103**
1.	**Single cane weight (Kg)**	0.70	1.50	1.20	1.30	1.30	1.40	1.50
2.	**Sucrose%**	16.04	18.29	-	17.60	15.51	16.54	16.52
3.	**CCS %**	11.19	12.82	-	12.12	10.44	11.68	11.65
4.	**Purity %**	90.01	90.94	-	87.52	83.75	92.35	92.19
5.	**Fibre %**	14.48	12.04	14.60	13.68	14.08	9.00	12.40
6.	**Cane yield (tha^{-1})**	87.50	153.90	111.60	104.65	136.50	145.88	153.60
7.	**CCS yield (t ha^{-1})**	9.79	19.73	-	12.68	14.25	17.04	17.89

S.No.	Clone number	2004A82	2006T34	2006T33	2006T10	2006T35	2006T13	2006T18
1.	**Single cane weight (Kg)**	1.40	1.20	1.60	1.20	1.00	1.50	1.40
2.	**Sucrose%**	15.32	15.83	16.65	18.33	17.89	15.98	14.46
3.	**CCS %**	10.51	11.12	11.20	13.01	12.73	10.86	10.01
4.	**Purity %**	86.97	91.40	83.62	94.45	94.09	85.37	88.60
5.	**Fibre %**	14.20	14.68	10.52	12.84	12.92	12.32	14.32
6.	**Cane yield (t ha^{-1})**	151.20	153.60	165.12	146.40	112.03	159.45	151.20
7.	**CCS yield (t ha^{-1})**	15.89	17.08	18.49	19.05	14.26	17.32	15.14
S.No.	**Clone number**	**2006T36**	**2006T23**	**2006T19**	**2006T8**	**2006T3**	**95V221**	**89V74**
1.	**Single cane weight (Kg)**	1.40	1.20	1.40	1.40	1.30	1.60	1.40
2.	**Sucrose%**	18.50	16.11	17.83	17.40	18.30	16.45	16.04
3.	**CCS %**	12.90	11.44	12.40	12.20	13.00	11.30	11.09
4.	**Purity %**	90.60	93.59	89.51	91.03	92.60	87.11	88.23
5.	**Fibre %**	16.08	11.00	13.60	12.08	17.20	11.36	12.76
6.	**Cane yield (t ha^{-1})**	145.60	129.60	145.60	147.98	127.40	153.92	143.92
7.	**CCS yield (t ha^{-1})**	18.78	14.83	18.05	18.05	16.56	17.39	15.96
S.No.	**Clone number**	**97V178**	**92V225**	**95V48**	**97V118**	**94V101**	**93V297**	**92V104**
1.	**Single cane weight (Kg)**	1.20	1.60	1.00	1.20	1.50	1.10	1.00
2.	**Sucrose%**	16.54	17.20	16.98	17.14	19.04	17.66	16.50
3.	**CCS %**	11.62	12.15	12.01	11.59	13.53	12.39	11.55
4.	**Purity %**	91.45	92.54	92.84	84.49	93.84	91.09	90.72
5.	**Fibre %**	13.68	14.56	12.48	15.32	12.52	12.60	12.16
6.	**Cane yield (t ha^{-1})**	117.55	156.16	95.46	102.34	124.80	114.40	112.32
7.	**CCS yield (t ha^{-1})**	13.66	18.97	11.46	11.86	16.89	14.17	12.97
S.No.	**Clone number**	**94V104**	**95V423**	**95V74**	**97V163**	**95V428**	**92V206**	**95V72**
1.	**Single cane weight (Kg)**	1.10	1.00	1.30	0.80	1.10	1.30	1.30
2.	**Sucrose%**	14.69	15.79	18.99	-	16.72	16.29	14.69
3.	**CCS %**	10.38	10.77	13.42	-	11.69	11.48	10.38
4.	**Purity %**	92.50	85.91	92.69	-	90.45	92.10	92.50
5.	**Fibre %**	11.36	12.40	16.12	16.64	15.52	13.48	14.84
6.	**Cane yield (t ha^{-1})**	114.40	94.60	124.41	82.24	109.82	121.68	107.51
7.	**CCS yield (t ha^{-1})**	11.87	10.19	16.70	-	12.84	13.97	11.16

S.No.	Clone number	94V108	97R199	97R267	97R276	93R113	97R7	97R183
1.	**Single cane weight (Kg)**	1.40	1.50	1.40	1.60	1.30	1.20	1.30
2.	**Sucrose%**	14.69	16.25	15.99	15.84	14.84	-	19.04
3.	**CCS %**	10.38	11.27	10.95	11.20	10.03	-	13.57
4.	**Purity %**	92.50	88.86	86.52	92.72	84.37	-	94.35
5.	**Fibre %**	13.00	13.84	13.08	15.68	17.84	16.52	14.88
6.	**Cane yield (t ha^{-1})**	143.64	145.05	148.51	123.84	128.31	118.44	143.52
7.	**CCS yield (t ha^{-1})**	14.91	16.35	16.26	13.87	12.87	-	19.47
S.No.	**Clone number**	**97R15**	**85A146**	**83V288**	**82V12**	**86V96**	**92R62**	**93R129**
1.	**Single cane weight (Kg)**	1.40	1.60	1.40	0.80	1.60	1.50	1.40
2.	**Sucrose%**	14.67	16.97	16.07	16.67	18.51	-	14.89
3.	**CCS %**	10.24	11.72	10.35	11.41	12.98	-	10.35
4.	**Purity %**	90.08	88.10	92.54	86.53	90.93	-	89.25
5.	**Fibre %**	15.40	13.24	17.16	14.84	14.24	14.68	15.28
6.	**Cane yield (t ha^{-1})**	149.10	144.80	125.33	85.12	145.15	-	126.45
7.	**CCS yield (t ha^{-1})**	15.27	16.97	12.97	9.71	18.84	-	13.09
S.No.	**Clone number**	**97R134**	**97R123**	**97R163**	**97R424**	**97R395**	**97R217**	**97R6**
1.	**Single cane weight (Kg)**	1.40	0.90	0.80	0.80	1.01	1.10	1.60
2.	**Sucrose%**	-	15.34	15.63	16.29	14.57	-	14.63
3.	**CCS %**	-	10.45	11.13	10.33	9.67	-	10.00
4.	**Purity %**	-	85.76	94.24	89.56	81.49	-	86.25
5.	**Fibre %**	12.60	16.16	13.68	17.52	14.28	15.12	12.00
6.	**Cane yield (t ha^{-1})**	105.84	92.16	99.84	106.50	95.14	87.78	104.96
7.	**CCS yield (t ha^{-1})**	-	9.63	11.11	11.07	9.20	-	10.50
S.No.	**Clone number**	**93R217**	**97R174**	**97R167**	**92A326**	**2000A213**	**2000A225**	**2005T16**
1.	**Single cane weight (Kg)**	0.80	1.10	0.80	1.80	1.30	1.30	1.60
2.	**Sucrose%**	15.60	16.53	-	15.99	-	16.55	18.08
3.	**CCS %**	11.00	11.70	11.19	10.95	-	11.84	12.59
4.	**Purity %**	92.00	93.04	-	86.52	-	95.21	89.68
5.	**Fibre %**	15.32	14.80	17.16	12.04	17.72	14.92	13.40
6.	**Cane yield (t ha^{-1})**	118.14	125.84	82.00	149.76	109.46	111.54	166.40
7.	**CCS yield (t ha^{-1})**	13.00	14.72	9.18	16.40	-	13.21	20.95

S.No.	Clone number	95V348	94V103	2002V2	95V303	92A10	88A189	94A73
1.	**Single cane weight (Kg)**	1.20	1.60	1.20	1.10	1.80	1.50	1.30
2.	**Sucrose%**	16.03	17.44	16.05	13.52	-	17.82	16.49
3.	**CCS %**	11.16	12.13	10.24	9.47	-	12.26	10.62
4.	**Purity %**	89.64	89.48	90.86	90.86	-	87.42	89.41
5.	**Fibre %**	15.32	12.64	16.00	13.44	14.16	12.56	18.48
6.	**Cane yield (t ha^{-1})**	104.04	155.65	125.52	113.52	126.70	152.10	149.56
7.	**CCS yield (t ha^{-1})**	11.61	18.88	12.85	10.75	-	18.65	15.88
S.No.	**Clone number**	**92A374**	**93A53**	**92A126**	**87A298**	**92A130**	**2005T89**	**2005T52**
1.	**Single cane weight (Kg)**	1.40	1.60	1.20	1.20	1.10	1.30	1.40
2.	**Sucrose%**	17.89	14.72	14.92	16.98	17.17	15.12	16.92
3.	**CCS %**	12.59	10.37	10.38	12.02	11.89	10.50	11.69
4.	**Purity %**	91.80	92.07	89.45	92.97	88.59	89.13	88.28
5.	**Fibre %**	13.84	12.00	15.44	10.84	14.88	17.92	13.64
6.	**Cane yield (t ha^{-1})**	120.67	173.76	137.28	118.75	127.57	140.40	148.40
7.	**CCS yield (t ha^{-1})**	15.19	18.02	14.25	14.27	15.17	14.74	17.35
S.No.	**Clone number**	**2004T67**	**2003T123**	**2005T50**	**2004T68**	**2003T121**		
1.	**Single cane weight (Kg)**	1.40	1.60	1.40	1.10	1.50		
2.	**Sucrose%**	16.94	18.29	18.27	16.97	17.21		
3.	**CCS %**	11.84	12.80	12.73	11.98	12.19		
4.	**Purity %**	90.31	90.71	89.75	92.42	93.20		
5.	**Fibre %**	14.36	17.64	13.24	13.92	14.64		
6.	**Cane yield (t ha^{-1})**	145.60	150.72	134.40	128.04	156.00		
7.	**CCS yield (t ha^{-1})**	17.24	19.29	17.11	15.34	19.02		

Table 3. Grouping of genotypes for traits related to cogeneration and pulp making in sugarcane

S. No.	Trait	Genotypes
1.	Single Cane Weight (Kg) (> 1.5 Kg)	Co7508, Co85004, Co2001-15, CoT8201, 2002V48, 97R401, 97R383, 2003T129, 81V99, CoA7602, Co419, 2006T33, 95V221, 92V225, 97R276, 85A146, 86V96, 97R6, 92A326, 2005T16, 94V103, 92A10, 93A53, 2003T123.
2.	High Fibre % (>16%)	85R186, 97R383, 2003T129, BO91, SES594, 2006T36, 2006T3, 95V74, 97V163, 93R113, 97R7, 83V288, 97R123, 97R424, 97R167, 2000A213, 2002V2, 94A73, 2005T89, 2003T123
3.	Cane yield (>100t ha^{-1})	Co7508, 90A272, 93A145, 99V30, 2000V59, 83R23, 94R44, Co85004, Co94008, Co2001-13, Co2001-15, Co7219, CoT8201, 83V15, 2002V48, 85R186, 97R401, 97R272, 97R129, 97R383, Co86032, Co99004, 2003T129, 81V48, 2002A192, 97A44, 92A355, 92A38, 90A278, 92A54, BO91, BARAGUA, Co6907, 84A125, CoA7602, CoC671, Co419, Co62399, Co38436, 2003V46, 2004A75, 2004A63, 2004A55, 2004A107, 2004A103, 2004A82, 2006T34, 2006T33, 2006T10, 2006T35, 2006T13, 2006T18, 2006T36, 2006T23, 2006T19, 2006T8, 2006T3, 95V221, 89V74, 97V178, 92V225, 97V118, 94V101, 93V297, 92V104, 94V104, 95V74, 95V428, 92V206, 95V72, 94V108, 97R199, 97R267, 97R276, 93R113, 97R7, 97R183, 97R15, 85A146, 83V288, 86V96, 93R129, 97R134, 97R424, 97R6, 93R217, 97R174, 92A326, 2000A213, 2000A225, 2005T16, 95V348, 94V103, 2002V2, 95V303, 92A10, 88A189, 94A73, 92A374, 93A53, 92A126, 87A298, 92A130, 2005T89, 2005T52, 2004T67, 2003T123, 2005T50, 2004T68, 2003T121.
4.	Low sucrose % (<16.5%)	90A272, 99V30, 2000V59, 83R23, Co2001-15, 85R186, 97R401, 97R383, CoS8346, BO91, SES594, Co7717, Co975, Co419, Co62399, CoS767, 2004A55, 2004A82, 2006T34, 2006T13, 2006T18, 2006T23, 95V221, 89V74, 92V104, 94V104, 95V423, 95V72, 94V108, 97R199, 97R267, 97R276, 93R113, 97R15, 83V288, 93R129, 97R123, 97R163, 97R424, 97R395, 97R6, 95V348, 2002V2, 95V303, 93A53, 92A126, 2005T89.
5.	Low CCS % (<11%)	90A272, 99V30, 85R186, 97R401, 97R383, CoS8346, BO91, SES594, Co7717, Co975, Co419,Co62399,2004A55,2004A82, 2006T13, 2006T18, 94V104, 95V423, 95V72, 94V108, 97R267, 97R7, 93R113,97R15, 83V288, 93R129, 97R123, 97R424, 97R395, 97R6, 92A326, 2002V2, 94A73, 2005T89.
6.	High fibre %, Low sucrose %, Low CCS %, High cane yield and High single cane weight	85R186, 97R383, BO91, 93R113, 83V288, 97R424, 2000A213, 2002V2, 94A73, 2005T89. (Genotypes for cogeneration and pulp making)

that it was beneficial for selection of erect and non-lodging canes suitable for mechanical harvesting and feedstock for co-generation. Radhamani *et al.* (2012) opined that high fibre sugarcane clones with optimum sugar and yield could be exploited for co-generation.

Cane yield showed significant variation among the genotypes (Table 1). The genotypes were ranged between 62.5 and 173.76 t ha^{-1}. There were 110 genotypes which produced more than 100 t ha^{-1} cane yield. Among them, 93A53 (173.76 t ha^{-1}) followed by 2005T16 (166.4 t ha^{-1}), 2006T33 (165.12 t ha^{-1}) and 81V48 (157.5 t ha^{-1}) showed higher cane yields in comparison to the check varieties *viz*., 2003V46 (153.9 t ha^{-1}), Co6907 (101.64t ha^{-1}), Co7219 (118.83 t ha^{-1}) and Co86032 (128.44 t ha^{-1}) (Table 2). The lowest cane yield was recorded by the genotype, CoS8346 (62.5 t ha^{-1}) followed by Co364 (75 t ha^{-1}), Co1148 (78 t ha^{-1}), 97R167 (82 t ha^{-1}), 87A298 (82.17t ha^{-1}) and 97R62 (82.42 t ha^{-1}). Rakkiyappan and Pandiyan (1992) opined that a variety meant for cogeneration purpose should contain high cane yield.

Rao *et al.* (2007) reported that new multipurpose cane varieties with very high fibre content were found to produce more biomass per hectare and a wide range of brix values when compared to the traditional sugarcane varieties. High fibre multipurpose cane varieties with acceptable levels of fermentable sugars would extend the supply of bagasse and contribute to fuel ethanol production. Babu *et al.* (2009) conducted an experiment to ascertain whether the rind hardness of cane can be used as an index for fibre content in sugarcane and concluded that there was a significant positive correlation between rind hardness and fibre content which is beneficial for selection of erect non lodging canes suitable for mechanical harvesting and feedstock for co-generation. In order to support cogeneration and ethanol production there is need for developing varieties capable of high biomass with high fibre content and higher total sugars (Govindaraj, 2009).

Based on the review of literature high fibre percentage, low sucrose percentage, low CCS percentage and high cane yield are the important traits that were considered for selecting a genotype for cogeneration, pulp and paper making. An exercise was made to identify genotypes showing combination of all these traits (Table 3). It was observed that the genotypes 85R186, 97R383, BO91, 93R113, 97R7, 83V288, 97R424, 2000A213, 2002V2, 94A73 and 2005T89 possess the aforesaid traits and can be considered as high biomass types useful for cogeneration, pulp and paper making. These genotypes can be better exploited in breeding programmes for generation of new promising lines suitable for cogeneration and paper making purposes along with other traits desirable by the farmers and industry.

CONCLUSION

Identification and development of the canes for cogeneration, pulp and paper making augments economic prosperity of sugar industries. Canes with traits like high fibre percentage, low sucrose percentage, low CCS percentage and high yield are suitable for allied uses in sugar industry. Among 131 germplasm accessions maintained at Agricultural Research Station, Perumallapalle, 11 accessions showed a combination of these traits. They are 85R186, 97R383, BO91, 93R113, 97R7, 83V288, 97R424, 2000A213, 2002V2, 94A73 and 2005T89. These accessions could be made as multipurpose and acceptable by farmers and industry by incorporating other useful traits in them.

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