



## Research Note

### Sugarcane for Diversified Uses

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#### Abstract

Seventy three genotypes selected from the first clonal stage were evaluated for diversified uses *viz.*, biomass per cane, fibre yield, theoretical yield of alcohol, commercial cane sugar (CCS) yield and cane yield in second clonal stage during 2011-12. Based on the mean performance of the genotypes *viz.*, 2010T-152 and 2010T-53 showing high performance for biomass, fibre yield, CCS yield, theoretical yield of alcohol and cane yield; the genotypes *viz.*, 2010T-146 and 2010T-84 showing higher performance for biomass, fibre yield, CCS yield and cane yield; the genotypes *viz.*, 2010T-4, 2010T-103, 2010T-72 showing higher performance for fibre yield, CCS yield, theoretical yield of alcohol and cane yield; the genotypes *viz.*, 2010T-115, 2010T-387 and 2010T-285 showing higher performance for fibre yield, CCS yield and cane yield could be suggested for promotion as varieties for respective diversified uses. The genotypes 2010T-16, 2010T-18, 2010T-82, 2010T-88, 2010T-103, 2010T-124, 2010T-153, 2010T-229, 2010T-239, 2010T-344, 2010T-347 and 2010T-416 selected by the index method could serve as potential genetic stocks in sugarcane breeding for diversified uses.

#### Keywords

Diversified uses, fibre, alcohol

Sugarcane is an important cash crop and raw material for sugar industry which is the second largest agro based industry of India. It assumes an important position in the economy of the country. Sugarcane serves as the major source for a variety of products such as sugar, jaggery, molasses, bagasse and filter cake out of which sugar and jaggery are meant for daily use as consumable products while other byproducts have industrial significance. It is realized that sugar production alone will not be able to make the industry profitable and under such circumstances diversification is necessary for successful growth of the industry. Sugarcane, which is also considered as an important bio energy crop belongs to the category of C4 plants which converts the solar energy effectively into high quality and low cost raw materials for sugar and ethanol (Bruce *et al.* 2005). Molasses and bagasse are the byproducts of sugar industry which form the feedstock for ethanol production and cogeneration respectively. National policy on biofuels proposed to scale up the blending from 5% to 20% by 2017. The target is difficult to achieve due to limited availability of bioethanol that to a greater extent comes from sugarcane molasses apart from a smaller proportion from grains. This necessitates significant increase in domestic ethanol production by developing varieties which yield higher ethanol. More than 500 sugar industries in the country have a potential to generate electricity of 5000 MW. However, the current installed capacity is only 2200 MW which is due to under utilization of

full capacity of the industry to generate required quantity of bagasse and lack of energy canes with high fiber. Sugar factories with co-generation facility demand for high fibre varieties up to 16% as it helps in increasing the bagasse availability (Natarajan, 2000).

Generally the main objective of sugarcane breeding is to develop varieties capable of producing high cane yield and CCS yield per unit area. The recent awareness on the advantages of using green fuel for generation of power and use of gasohol to reduce automobile emission have resulted in setting up of a number of cogeneration plants in various sugar mills. To achieve these goals of increased sugar, alcohol and cogeneration, sugar industries needs a special varieties to meet their specific requirement of raw materials. Sugarcane breeders traditionally breed varieties for high sucrose and high stalk yield. As sugar production scenario is changing, varietal needs have started changing. Hence, breeding programmes must integrate new traits such as high fiber, high biomass and high total sugars in addition to yield and juice quality.

The present investigation was carried out at Agricultural Research Station, Perumallapalle (Acharya N.G.Ranga Agricultural University), situated in the Southern Agro-climatic Zone of Andhra Pradesh with seventy three genotypes of sugarcane that were planted in a randomized block

design with two replications during April, 2011. Each entry was planted in 2 rows of 5 m length spaced at a distance of 80 cm between rows with 4 three budded setts per meter as seed rate.

Observations were recorded on each entry 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<sup>3</sup>), single cane weight (kg), fibre content (%), Brix (%), sucrose (%), CCS (%), juice purity (%), pol % cane, juice extraction (%), total sugars (%), fibre yield (tha<sup>-1</sup>), CCS yield (tha<sup>-1</sup>), theoretical yield of alcohol (g/100ml) and cane yield (tha<sup>-1</sup>).

The genotypes were scored based on mean performance for diversified uses *viz.*, biomass, fibre yield, theoretical yield of alcohol, cane yield and commercial cane sugar yield in second clonal stage. The technique of Discriminant function developed by Fisher (1936) was adopted for construction of selection indices which when applied to select plants can bring about effective improvement in a character compared to straight selection.

To achieve the goals of increased sugar, alcohol and cogeneration, sugar industries need special varieties to meet their specific requirement of raw materials. Furthermore a prosperous blend of all these characters would be a reward to all the sugarcane stakeholders. Hence, a comprehensive evaluation of seventy three genotypes for diversified uses was carried out. A total of fifty one genotypes which showed higher *per se* performance than the general mean for at least one of the diversified uses *viz.*, cane yield, fibre yield, biomass per cane, theoretical yield of alcohol and commercial cane sugar yield were considered and scored relatively based on the *per se* performance and the results are presented in the Table 1 and Table 2.

The genotypes *viz.*, 2010T-124, 2010T-344 and 2010T-84 performed significantly superior to general mean for biomass per cane. The genotypes *viz.*, 2010T-146, 2010T-285 and 2010T-115 showed superior performance over general mean for fibre yield. The genotypes *viz.*, 2010T-4, 2010T-53 and 2010T-146 recorded significantly superior performance over general mean for CCS yield. The genotypes *viz.*, 2010T-72, 2010T-16 and 2010T-88 showed significantly higher performance than general mean for theoretical yield of alcohol. For cane yield, the genotypes *viz.*, 2010T-146, 2010T-115 and 2010T-84 showed higher performance (Table 3).

The genotypes 2010T-152 and 2010T-53 showed higher *per se* performance for all the five diversified uses *viz.*, cane yield, fibre yield, biomass per cane, theoretical yield of alcohol or commercial cane sugar yield. The two genotypes 2010T-146 and 2010T-84 showed higher *per se* performance for the four characters *viz.*, biomass per cane, fibre yield, commercial cane sugar yield and cane yield. Further, the genotype 2010T-146 showed highest performance for cane yield and fibre yield among all the genotypes evaluated.

The genotypes 2010T-4, 2010T-103, 2010T-72, 2010T-229 and 2010T-58 were identified as the best for four uses *viz.*, fibre yield, commercial cane sugar yield, theoretical yield of alcohol and cane yield. The genotype 2010T-109 showed higher *per se* performance for biomass per cane, commercial cane sugar yield, theoretical yield of alcohol and cane yield.

The genotypes 2010T-115, 2010T-387, 2010T-285 and 2010T-347 recorded higher *per se* performance for fibre yield, commercial cane sugar yield and cane yield. The genotype 2010T-344 showed higher *per se* performance with respect to biomass per cane, commercial cane sugar yield and cane yield, while the genotype 2010T-184 recorded higher mean values for commercial cane sugar yield and cane yield. The genotype 2010T-258 was good for fibre yield and cane yield.

The genotypes 2010T-16, 2010T-88 and 2010T-18 were found to be best for ethanol but the cane yield was low, while 2010T-124 recorded the highest biomass per cane but it showed poor performance for other characters. These genotypes may be used in the crossing programmes to produce genotypes with high cane yield and other desirable characters as well.

Based on the mean performance of the genotypes for five diversified uses, the genotypes *viz.*, 2010T-152 and 2010T-53 showing high performance for biomass, fibre yield, CCS yield, theoretical yield of alcohol and cane yield; the genotypes *viz.*, 2010T-146 and 2010T-84 showing higher performance for biomass, fibre yield, CCS yield and cane yield; the genotypes *viz.*, 2010T-4, 2010T-103, 2010T-72 showing higher performance for fibre yield, CCS yield, theoretical yield of alcohol and cane yield; the genotypes *viz.*, 2010T-115, 2010T-387 and 2010T-285 showing higher performance for fibre yield, CCS yield and cane yield could be suggested for promotion as varieties for different diversified uses.



Using the best index, the top 10 per cent of the clones for five diversified uses *viz.*, biomass, fibre yield, CCS yield, theoretical yield of alcohol and cane yield were selected (Table 4). Comparison of the means of selected population with that of the original population revealed that there was sizable improvement in the target characters. In addition to the genotypes *viz.*, 2010T-4, 2010T-53, 2010T-72, 2020T-84, 2010T-115, 2010T-146, 2010T-152 and 2010T-285 suggested for promotion as varieties for diversified uses, the genotypes 2010T-16, 2010T-18, 2010T-82, 2010T-88, 2010T-103, 2010T-124, 2010T-153, 2010T-229, 2010T-239, 2010T-344, 2010T-347 and 2010T-416 selected by the index method could serve as potential genetic stocks in sugarcane breeding for diversified uses.

#### References

- Bruce, S., Dien, Nagle, N., Vijay Singh., Moreau, R.A., Tucker, M.P., Nichols, N.N., Johnston, D.B., Cotla, M.A., Hicks, K.B., Nguyen, Q and Bothast, R.J. 2005. Review of process for producing corn fiber oil and ethanol from "Quick fiber". *International Sugar Journal*. **107**(1275): 187-190.
- Fisher, R.A. 1936. The use of multiple measurements in taxonomic problem. *Annals of Eugenics*. **7**: 179-88.
- Natarajan, U.S. 2000. Breeding for quality improvement in sugarcane. Paper presented in the winter school on Sugarcane Breeding and Genetics in Retrospect and Prospects: 16-21.



**Table 1. Scoring of genotypes based on mean performance for diversified uses in Second clonal stage in sugarcane**

S. No.	Genotypes	Biomass	Fibre yield	CCS yield	Theoretical yield of alcohol	Cane yield	Total Score
1	2010T-146	1	5	4	0	5	15
2	2010T-4	0	3	5	1	4	13
3	2010T-103	0	3	3	3	3	13
4	2010T-152	1	1	3	2	4	12
5	2010T-72	0	2	2	4	3	12
6	2010T-84	3	2	2	0	3	12
7	2010T-115	0	5	3	0	3	12
8	2010T-53	1	2	4	1	2	11
9	2010T-285	0	5	2	0	2	9
10	2010T-344	4	0	1	0	3	9
11	2010T-387	0	3	3	0	2	8
12	2010T-109	3	0	1	2	1	7
13	2010T-229	0	2	1	3	1	7
14	2010T-347	0	3	1	0	3	7
15	2010T-58	0	1	2	2	1	6
16	2010T-16	0	0	1	4	0	5
17	2010T-88	0	0	1	4	0	5
18	2010T-124	5	0	0	0	0	5
19	2010T-20	0	0	2	2	0	4
20	2010T-83	3	1	0	0	0	4
21	2010T-374	2	2	0	0	0	4
22	2010T-184	0	0	3	0	1	4
23	2010T-18	0	0	0	3	0	4
24	2010T-173	1	0	0	3	0	4
25	2010T-15	0	0	0	3	0	3
26	2010T-82	0	0	1	2	0	3
27	2010T-153	3	0	0	0	0	3
28	2010T-239	0	0	0	3	0	3
29	2010T-26	0	0	0	3	0	3
30	2010T-258	0	1	0	0	2	3



**Table 1. Contd.,**

S. No.	Genotypes	Biomass	Fibre yield	CCS yield	Theoretical yield of alcohol	Cane yield	Total Score
31	2010T-171	0	1	1	0	0	2
32	2010T-369	0	0	2	0	0	2
33	2010T-358	2	0	0	0	0	2
34	2010T-172	2	0	0	0	0	2
35	2010T-55	0	0	0	2	0	2
36	2010T-416	2	0	0	0	0	2
37	2010T-355	1	0	0	0	0	1
38	2010T-368	1	0	0	0	0	1
39	2010T-430	0	0	0	1	0	1
40	2010T-144	1	0	0	0	0	1
41	2010T-340	0	0	0	1	0	1
42	2010T-366	0	0	0	0	1	1
43	2010T-8	0	0	0	1	0	1
44	2010T-161	0	0	1	0	0	1
45	2010T-313	0	0	0	0	1	1
46	2010T-335	1	0	0	0	0	1
47	2010T-408	0	1	0	0	0	1
48	2010T-240	0	1	0	0	0	1
49	2010T-365	1	0	0	0	0	1
50	2010T-183	1	0	0	0	0	1
51	2010T-208	1	0	0	0	0	1
	<b>Mean</b>	<b>1.65</b>	<b>16.86</b>	<b>13.06</b>	<b>9.63</b>	<b>119.23</b>	
	CD	0.15	1.96	1.44	1.05	13.32	

Score		Biomass	Fibre yield	CCS yield	Theoretical yield of alcohol	Cane yield
1	Mean+1CD	1.80	18.82	14.50	10.68	132.55
2	Mean+2CD	1.95	20.78	15.94	11.73	145.87
3	Mean+3CD	2.10	22.74	17.38	12.78	159.19
4	Mean+4CD	2.25	24.70	18.82	13.83	172.51
5	Mean+5CD	2.40	26.66	20.26	14.88	185.83
0	≤ Mean	1.65	16.86	13.06	9.63	119.23



**Table 2. Genotypes identified for diversified uses**

S. No.	Diversified uses	No. of uses	Genotypes
1	Biomass + Fibre yield + Commercial cane sugar yield + Theoretical yield of alcohol + Cane yield	5	2010T-152, 2010T-53
2	Biomass + Fibre yield + Commercial cane sugar yield + Cane yield	4	2010T-146, 2010T-84
3	Fibre yield + Commercial cane sugar yield + Theoretical yield of alcohol + Cane yield	4	2010T-4, 2010T-103, 2010T-72, 2010T-229, 2010T-58
4	Biomass + Commercial cane sugar yield + Theoretical yield of alcohol + Cane yield	4	2010T-109
5	Fibre yield + Commercial cane sugar yield + Cane yield	3	2010T-115, 2010T-387, 2010T-285, 2010T-347
6	Biomass + Commercial cane sugar yield + Cane yield	3	2010T-344
7	Commercial cane sugar yield + Cane yield	2	2010T-184
8	Fibre yield + Cane yield	2	2010T-258



**Table 3. Top ranking sugarcane genotypes based on mean performance for diversified uses**

Rank	Biomass per cane (kg)		Fibre yield (t ha <sup>-1</sup> )		CCS yield (t ha <sup>-1</sup> )		Theoretical yield of alcohol (g/100ml)		Cane yield (t ha <sup>-1</sup> )	
	Genotype	Mean	Genotype	Mean	Genotype	Mean	Genotype	Mean	Genotype	Mean
1	2010T-124	2.85	2010T-146	30.06	2010T-4	20.73	2010T-72	14.67	2010T-146	205.49
2	2010T-344	2.33	2010T-285	27.16	2010T-53	19.75	2010T-16	14.01	2010T-115	171.13
3	2010T-84	2.2	2010T-115	27.09	2010T-146	18.91	2010T-88	13.93	2010T-84	169.48
4	2010T-153	2.17	2010T-347	23.4	2010T-152	18.52	2010T-18	13.65	2010T-152	166.63
5	2010T-83	2.13	2010T-4	23.12	2010T-103	17.75	2010T-103	13.37	2010T-4	165.41
6	2010T-109	2.07	2010T-387	22.66	2010T-115	17.41	2010T-239	13.19	2010T-347	160.05
7	2010T-416	1.98	2010T-103	22.13	2010T-387	17.33	2010T-15	13.13	2010T-103	159.82

**Table 4. Top ranking genotypes based on the best selection index for diversified uses in sugarcane**

Rank	Biomass per cane (kg)			Fibre yield (t ha <sup>-1</sup> )			Commercial cane sugar yield (t ha <sup>-1</sup> )			Theoretical yield of alcohol (g/100 ml)			Cane yield (t ha <sup>-1</sup> )		
	Genotype	Mean	Index score	Genotype	Mean	Index score	Genotype	Mean	Index score	Genotype	Mean	Index score	Genotype	Mean	Index score
1	2010T-84	2.20	4794	2010T-115	27.09	547	2010T-115	17.41	675	2010T-88	13.93	216	2010T-84	169.48	1959
2	2010T-124	2.85	4713	2010T-146	30.06	526	2010T-146	18.91	652	2010T-53	10.23	211	2010T-146	205.49	1763
3	2010T-146	1.80	4696	2010T-347	23.40	488	2010T-103	17.75	626	2010T-239	13.19	207	2010T-124	120.35	1758
4	2010T-344	2.33	4510	2010T-103	22.13	479	2010T-72	16.00	614	2010T-4	10.83	204	2010T-152	166.63	1500
5	2010T-153	2.17	4494	2010T-72	20.63	470	2010T-347	13.89	610	2010T-18	13.65	203	2010T-344	154.50	1464
6	2010T-4	1.70	4486	2010T-4	23.12	454	2010T-4	20.73	598	2010T-16	14.01	203	2010T-4	165.41	1429
7	2010T-416	1.98	4385	2010T-285	27.16	451	2010T-229	14.32	589	2010T-82	11.47	203	2010T-153	107.86	1405
<b>Mean of the above seven genotypes</b>		2.15			24.80			17.00			12.47			155.67	
<b>Population mean</b>		1.57			15.80			12.02			9.16			110.80	
<b>% gain over Population mean</b>		136.59			156.92			141.40			136.19			140.50	