Electronic Journal of Plant Breeding, 6(1): 292-297 (Mar 2015)
ISSN 0975-928X

Research Note

Evaluation of sugarcane clones for quantitative yield and quality characters in aicrp trials for early season

M.Shanmuganathan, K.Annadurai, R.Nageswari and M.Asokhan
Sugarcane Research Station, Sirugamani – 639 115, Trichy (Dist).
Email: shanagri@gmail.com

(Received: 12 Sep 2014; Accepted:07 Dec 2014)

Abstract
Performance of eight early maturing sugarcane clones *viz.,* Co 09002, Co 09003, Co 09004, Co 09005, Co 09006, Co 09007, CoN 09071 and CoN 09072 and three check varieties CoC 671, Co 94008 and Co 85004 was studied in initial varietal trial at Sugarcane Research Station, Sirugamani during 2012 – 13. The trials were laid out in randomized block design with three replications. Recommended cultural and agronomic practices were followed to raise the crops. Data were recorded for germination percentage, number of tillers, number of shoots, number of millable cane, stalk length (cm), stalk diameter (cm), single cane weight (kg), cane yield (t/ha), brix%, sucrose%, purity%, CCS%, extraction% and CCS (t/ha). On the basis of overall performance, two clones *viz.,* Co 09004 and Co 09006 were found to be better for cane yield (138.96 and 136.61 t/ha) and CCS yield (18.70 and 18.67 t/ha) over the early maturing standard variety CoC 671 (131.51 t/ha and 17.74 t/ha). These clones could be tested for the confirmation of the results obtained on cane yield and sugar yield under varied agro climatic conditions for identification of best cultivar.

Keywords
Sugarcane, early maturing, clones, cane yield, CCS yield, Brix%, Sucrose% and CCS%

Sugarcane (*Saccharum* spp. hybrid) is a major source of sugar, catering to seventy per cent of the world's requirement. Sugarcane is the only source of sweetness *viz.,* sugar, jaggery and Khandasari under Indian conditions. In Tamil Nadu, it is grown in an area of 3.95 lakh hecters producing 42.22 million tones of cane with a productivity of 107 t/ha (Sugar India, 2013).

Development of varieties for different maturity groups is of paramount importance in sugarcane cultivation to realize higher recoveries in sugar mills. The proper choice of varieties, season and suitable agronomic technologies coupled with balanced nutrient application play an important role in sugarcane production. Non adoption of any one of the components leads to reduction in sugarcane production which in turn not only affects the cane growers and sugar mills, but also affects adversely the economy of the nation as a whole (Prasada Rao *et al.,* 2011).

The early maturing sugarcane varieties are chosen in the beginning of crushing season for higher sugar recoveries. Besides, the influence of season is less pronounced on early maturing varieties and in late planted conditions, growing of early maturing clones facilitate recovery of higher sugar yield.

Production and productivity of sugarcane is governed by varieties, season and agronomic package of practices besides balanced nutrition. Among the components, varieties play paramount role in sugar mills. Hence it is imperative to identify new sugarcane varieties to replace the deteriorating commercial varieties through which the overall productivity could be stabilized.

Therefore, to meet the immediate need of sugarcane farming community and sugar factory, there is a need of more number of early maturing, high sugar varieties having high tonnage, good ratooning ability to meet the challenges for improving sugar recovery, especially during the beginning of the crushing season. Hence, the research efforts were made to identify early maturing clones with sustained high cane and sugar yields at Sugarcane Research Station, Sirugamani during 2012-13.

The field experiment was conducted during early season of 2012-13 with eight clones *viz.,* Co 09002, Co 09003, Co 09004, Co 09005, Co.09006, Co 09007, CoN 09071, CoN 09072 as test early clones and CoC 671, Co 94008 and Co 85004 as standards at Sugarcane Research Station, Sirugamani. The experiment was planted in randomized block design with three replications. The plot size was five rows of five meter length spaced at 90 cm with a seed rate of twelve buds per meter. Recommended agronomic, pest and disease control practices were carried out uniformly for raising good crop. The data recorded during the entire course of study was comprised of the yield and quality parameters.

Among these parameters, data on germination percentage, number of tillers and number of shoots were recorded at 30, 120 and 240 days after planting, while all other parameters were recorded at 10th month. For quality analysis, the cane samples were taken from each clone and juice was extracted by power crusher and analysed for Brix and Pol as per the method suggested by Meade and Chen (1977). Sucrose percent was calculated as per Schmitz's tables. CCS% was calculated as per the following formula.

CCS% = (Sucrose % - 0.4 (Brix % - Sucrose %)) x 0.75

Then, the CCS yield was determined based on CCS percent and cane yield. All the collected data were statistically analysed by standard statistical method described by Panse and Sukhatme (1978).

Results and Discussion

The analysis of variance (ANOVA) of the present study revealed that all characters except purity% under study recorded significant difference among the treatment mean squares (Table.1). This result reveals that there was an amble scope for selecting a better clone. The variation in cane yield and yield components among the varieties may be attributed due to their differences in genetic makeup. Mean data of different yield and its contributing traits are furnished in Table.2 and they are categorically described as follows,

Germination percentage (at 30 DAP):The most critical factor which determines the varietal potential to exploit the available resources and ultimately effects the cane stand. The germination percentage at 30 DAP ranged from 56.02 (Co 85004) to 82.10 (Co 09006) with a mean value of 66.79%. The test clone Co 09006 recorded significantly higher germination (82.10%) than the best standard CoC 671 (72.53%) which was on par with the test clone Co 09005 (74.14%).

Number of tillers (x 1000/ha) at 120 DAP:Tillering potential of a clone ultimately effects cane yield positively. Number of tillers varied from 146.54 (CoN 09072) to 185.46 (Co 09004) with a mean value of 169.33 (x 1000/ha). The test clone Co 09004 (185.46 x 1000/ha) recorded numerically better performance in producing more number of tillers than the best standard CoC 671 (181.71 x 1000/ha). Similar reports were reported by Tiwari and Chatterjee (1998).

Number of shoots (x 1000/ha) at 240 DAP:The trait number of shoots directly influences the cane yield as it is the combined interaction of germination and tillering. The number of shoots ranged from 117.67 (CON 09072) to 145.16 (Co 09004) with an average of 132.73 (x 1000/ha). Three clones viz., Co 09004, Co 09006 and Co 09007 recorded numerically better performance in producing more number of shoots than the best standard CoC 671 (137.85 x 1000/ha). This is in agreement with those referred by Panhwar *et al.* (2008).

Stalk length (cm):Height of a cane contributes materially towards final cane yield. According to Jackson and MC Rae (2001) under good growing conditions, individual seedling clones may produce up to about 2.0m of cane can be planted to the next selection stage. The stalk length varied from 185 (CON 09072) to 246 (Co 09003) with a mean of 218 cm. Two clones viz., Co 09003 (246) and CON 09071 (241 recorded numerically superior performance than the best standard CoC 671 (237 cm).The research work carried out by Panhwar et al. (2006) is in accordance with the present finding.

Stalk diameter (cm):Canes that grow tall and thin may be more prone to lodging; the tall clones with thick stalked canes that resist lodging may have great potential to be the high yielding varieties in future. Stalk diameter is an important yield contributing character and large stalk diameter would enhance the acceptability of varieties from commercial point of view. The stalk diameter ranged from 1.94 cm (Co 85004) to 2.89 cm (Co 09004) with average diameter of 2.49 cm. The test clone Co 09004 (2.89 cm) was the only clone recorded numerically superior performance than the best standard CoC 671 (2.84 cm). This finding is analogous with Junejo *et al.* (2010) who also found variable cane thickness among the twelve genotypes under their study.

Single cane weight (kg):Single cane weight is the product of its length, girth and contributes substantially towards final cane yield. This trait ranged from 1.10kg (CoN 09071) to 1.62 kg (Co 09006) with mean single cane weight of 1.38 kg. Two clones *viz.,* Co 09006 (1.62 kg) and Co 09004 (1.60 kg) recorded numerically better performance than the best standard Co 94008 (1.58 kg). The research work carried out by Sabitha and Prasada Rao, 2008 is in accordance with the present finding.

Number of millable cane (x 1000/ha) at 10th month:It directly influences cane yield as it is the combined interaction of germination and tillering. It ranged from 95.75 (CoN 09072) to 116.91 (Co 09004) with a mean of 107.71 (x 1000/ha). None of the clones recorded significantly higher number of millable cane at harvest over the best standard CoC 671 (113.93 x 1000/ha). However, Co 09004 and Co 09006 were found on a par with the best standard CoC 671.

Cane yield (t/ha):Cane yield is a major parameter to find out the economic potential of a variety. It is the combination of functions like environmental responses and genetic potential of a strain. High cane yielding varieties showed best environmental response and hence revealed good performance of cane yield as compared to the other varieties. The increase in cane and sugar yield in our country is mainly due to an increase in the acreage (Hashmi, 1995). Therefore, the evolution of high yielding clones is urgently needed which could increase the cane and sugar yield per unit area. Cane yield/ha ranged from 105.48 (CoN 09071) and 138.96 (Co 09004) with a mean of 122.70 t/ha. Two clones *viz.,* Co 09004 (138.96 t/ha) and Co 09006 (136.6 t/ha) recorded numerically superior performance in influencing cane yield than the best standard CoC 671 (131.51 t/ha).

The search of varieties that, besides having desirable characteristics, exhibit high sugar content is an important aspect in sugarcane breeding. Sugar recovery stands the factor of prime importance both from millers and breeding point of view. The data regarding mean performance of CCS yield and its attributing characters of different early sugarcane clones are presented in Table 3 and the important characters are categorically described as follows,

Brix% at 10th month:Brix% (Total Soluble Solids) plays an important role in determining the sugar recovery per cent of the sugarcane. In present study, the Brix% varied from 18.12 (Co 09002) to 22.34 (CoC 671) with a mean of 20.72%. None of the test clones recorded significantly higher Brix% than the best standard (CoC 671). These results are in agreement with the findings of Keerio *et al.* (2003) who studied a number of sugarcane varieties and found different levels of Brix%.

Sucrose% at 10th month:The sucrose % is useful in deciding the quality of sugarcane and it influences the sugar recovery and sugar production in sugar mill. Juice sucrose % at 10th month ranged from 16.78 (Co 09002) to 19.68 (Co 09006) with a grand mean of 18.46%. The test clone Co 09006 (19.68%) was statistically on a par with the best standard CoC 671 (19.59%) for this trait. The results are almost same as demonstrated by Hapase *et al.* (2013).

CCS% at 10th month:CCS% is the best judgment method of a strain's quality for breeders and millers. The CCS% of the present study varied from 11.61 (CoN 09071) to 13.66 (Co 09006) with mean CCS% of 12.81. The test clone Co 09006 recorded numerically superior performance in producing more CCS% than the best standard CoC 671 (13.50%). This discussion shows a close conciseness with Panhwar *et al.* (2006).

CCS (t/ha):CCS yield of present work ranged from 12.23 t/ha (CoN 09071) to 18.70 t/ha (Co 09006) with mean CCS yield of 15.78 t/ha. Two clones *viz.*, Co 09004 (18.70 t/ha) and Co 09006 (18.67 t/ha) observed numerically superior performance for this trait when compared to the best standard CoC 671 (17.74 t/ha). This discussion shows a close conciseness with those of Charumathi *et al.* (2013). The higher CCS yield in clones may be attributed to relatively more average cane yield and subsequent commercial cane sugar percentage. There are varieties capable of giving higher cane yields and fairly good recovery leading to higher per acre sugar production.

From this study, it could be concluded that the early maturing clone, Co 09004 was found to be better for cane yield, sugar yield and most of the yield related attributes like number of tillers, number of shoots, stalk diameter, number of millable cane over the early maturing varieties CoC 671, Co 94008 and Co 85004. Another early maturing clone, Co 09006 was found to be better for germination percentage, single cane weight and CCS% to the early maturing varieties CoC 671, Co 94008 and Co 85004. Hence, these two early maturing clones could be tested for the confirmation of the results for better cane and sugar yield under varied agro climatic conditions for identification of the best cultivar.

References

Charumathi, M., Prasada Rao, K. and Adilakshmi, D.A. 2013. Promising high yielding and sucrose rich early maturing clones suitable for east coast zone. Sugar Journal 2013 - 43rd Annual Convention of SISSTA, 1-10.

Hapase, R.S., Talekar, S.D., Repale, J.M. and Doule, R.B. 2013. Sugar productivity assessment of early maturing sugarcane genotypes in Peninsular India. Sugar Journal 2013 – 43rd Annual Convention of SISSTA, 29-33.

Hashmi, S.A. 1995. It is time to take stock, Sugar Technologist Convention. The DAWN, Karachi, Wednesday, August 30 pp : 8.

Jackson, P. and Mc Rae, T.A. 2001. Selection of sugarcane clones in small plots- Effects of plot size and selection criteria. Crop science, **41**: 315-322.

Junejo, S., Kaloi, G.M., Panhwar, R.N., Chohan, M., Junejo A.A. and Soomro, A.F. 2010. Performance of some newly developed sugarcane genotypes for some quantitative and qualitative traits under Thatta conditions. *The J. of Animal & Pl. Sci.,* **20**(1): 40-43.

Keerio, H.K., Panhwar, R.N., Memon, Y.M., Araien, M.Y., Chohan, M. and Qazi, B.R. 2003. Qualitative and quantitative performance of some promising and commercial sugarcane varieties under Agro-climatic condition of Thatta. Pak. J. of applied sciences., 3(10-12): 670-673.

Meade, C.P. and Chen, J.C.P. 1977. Cane sugar hand book, 10th Edn. John Wiley & Sons Inc, New York.

Panhwar, R.N., Chohan, M., Panhwar, D.B., Memon, M.A., Memon Y.M. and Panhwar, M.A. 2008. Relative cane yield and quality appraisal of divergent sugarcane clones in 4th cycle under Thatta climatic conditions. *Pak.Sugar J.*, **23**(1): 15-20.

Panhwar, R.N., Panhwar, D.B., Memon, M.A., Unar, G.S., Chohan, M., Kaloi, G.M. and Mari, A.H. 2006. Comparative growth and quality assessment of diverse sugarcane clones in 3rd cycle under Thatta Agro ecological condition. Pak. Sugar J., **21** (6): 2-6.

Panse, V.G. and Sukhatme, P.V. 1978. Statistical methods for Agricultural Workers. ICAR, New Delhi.

Prasada Rao, K., Charumathi, M. and Naidu, N.V. 2011. 2005 A 128 – A Promising early maturing sugarcane clone suitable for Andhra Pradash. Sugar Journal 2011 – 41st Annual Convention of SISSTA : 1 – 4.

Sabitha, N. and Prasada Rao, K. 2008. Promising high yielding and sucrose rich early maturing sugarcane clones for Andhra Pradesh. Sugar Journal 2008 - 39th Annual convention of SISSTA : 11 - 14.

Sugar India year book. 2013. Edited by Ajit Narde and published by Anekant Prakashan, Jaysingpur, Dist. Kolhapur (MS), India.

Tiwari, R.J. and Chatterjee, A. 1998. Evaluation of early and mid – late sugarcane (*Saccharum officinarum*) varieties for yield of millable cane and quality of jaggery. Indian J. of Agri. Sci., **68** (5): 255 – 257.

Table.1. Mean square values and their significance for yield, quality and its attributing traits.

Source of varia-tion	df	Mean sum of squares													
		Germi-nation % 30 DAP	No. of tillers (x' 000 /ha) 120 DAP	No. of shoots (x 000 /ha) 240 DAP	Stalk length (cm)	Stalk diam-eter (cm)	Single cane weight (Kg)	NMC at 10 m (‘000/ ha)	Cane yield (t/ha)	Extracti-on% (10 m)	Brix% (10 m)	Sucrose % (10 m)	Purity % (10 m)	CCS% (10 m)	CCS (t/ha)
Treat	10	199.30**	436.47**	204.26**	1294.28**	0.32**	0.12**	132.33**	353.84**	81.22**	5.00**	3.45**	6.35NS	1.62**	14.08**
Error	20	8.99	27.68	58.61	89.78	0.01	0.01	48.62	45.38	7.10	0.26	0.16	3.01	0.11	0.68
Total	32	73.72	155.58	101.13	464.42	0.10	0.04	88.60	141.26	29.93	1.73	1.28	5.63	0.67	5.10

Table 2. Mean data on cane yield and their contributing characters of early maturing sugarcane clones

Sl. No.	Clone	Germination % (30 DAP)	No. of tillers (' 000/ha) (120 DAP)	No. of shoots (' 000/ha) (240 DAP)	Stalk length (cm)	Stalk diameter (cm)	Single cane weight (Kg)	NMC at 10 m (‘000/ha)	Cane yield (t/ha)
1	Co 09002	68.90^{cd}	165.85^{cd}	131.05^{bcd}	200^{bc}	2.28^{f}	1.29^{cd}	105.80^{abcde}	119.55^{cde}
2	Co 09003	69.98^{bcd}	172.91^{bc}	134.81^{abcd}	246^{a}	2.74^{bcd}	1.38^{bc}	112.56^{abc}	124.78^{bcd}
3	Co 09004	61.57^{ef}	185.46^{a}	145.16^{a}	236^{a}	2.89^{a}	1.60^{a}	116.91^{a}	138.96^{a}
4	Co 09005	74.15^{b}	168.42^{c}	135.55^{abcd}	198^{bc}	2.05^{g}	1.13^{e}	108.30^{abcd}	108.90^{ef}
5	Co 09006	82.10^{a}	181.00^{ab}	143.23^{ab}	231^{a}	2.76^{abc}	1.62^{a}	114.32^{ab}	136.61^{a}
6	Co 09007	66.28^{de}	177.97^{ab}	138.94^{abcd}	212^{b}	2.61^{d}	1.57^{a}	110.19^{abcd}	129.05^{abc}
7	CoN 09071	56.48^{fg}	159.37^{de}	128.17^{cde}	241^{a}	2.24^{f}	1.10^{e}	100.26^{de}	105.48^{f}
8	CoN 09072	58.10^{fg}	146.54^{f}	117.67^{e}	185^{c}	2.44^{e}	1.25^{cde}	95.75^{e}	117.99^{cde}
9	CoC 671	72.53^{bc}	181.71^{ab}	137.85^{abc}	237^{a}	2.84^{ab}	1.50^{ab}	113.93^{ab}	131.51^{ab}
10	Co 94008	68.52^{cd}	155.79^{e}	123.39^{de}	209^{b}	2.62^{cd}	1.58^{a}	101.81^{cde}	123.07^{bcd}
11	Co 85004	56.02^{g}	167.65^{cd}	127.28^{cde}	204^{b}	1.94^{g}	1.21^{de}	105.03^{bcde}	113.75^{def}
	Mean	66.79	169.33	132.73	218	2.49	1.38	107.71	122.70
	SEd	2.45	4.30	6.25	7.74	0.07	0.08	5.69	5.50
	CD at 5%	5.12	8.96	13.04	16.14	0.15	0.16	11.87	11.47
	CV %	4.49	3.11	5.77	4.34	3.49	6.67	6.47	5.49

Electronic Journal of Plant Breeding, 6(1): 292-297 (Mar 2015)
ISSN 0975-928X

Table 3. Mean data on cane quality and their contributing characters of early maturing sugarcane clones

Sl. No.	Clone	Extraction % (10 m)	Brix % (10 m)	Sucrose % (10 m)	Purity % (10 m)	CCS % (10 m)	CCS (t/ha)
1	Co 09002	45.02^{f}	18.12^{d}	16.78^{d}	92.59	11.85^{cd}	14.17^{ef}
2	Co 09003	51.31^{cd}	21.16^{b}	18.82^{b}	88.95	13.06^{b}	16.31^{cd}
3	Co 09004	57.24^{ab}	21.54^{ab}	19.32^{ab}	89.72	13.45^{ab}	18.70^{a}
4	Co 09005	50.79^{cde}	19.44^{c}	17.31^{cd}	89.10	12.02^{cd}	13.11^{fg}
5	Co 09006	58.49^{a}	22.09^{a}	19.68^{a}	89.10	13.66^{a}	18.67^{a}
6	Co 09007	60.64^{a}	21.00^{b}	18.91^{b}	90.07	13.20^{ab}	17.01^{bc}
7	CoN 09071	47.37^{def}	19.49^{c}	16.93^{d}	86.84	11.61^{d}	12.23^{g}
8	CoN 09072	53.04^{bc}	20.09^{c}	17.76^{c}	88.40	12.28^{c}	14.49^{ef}
9	CoC 671	56.75^{ab}	22.34^{a}	19.59^{a}	87.69	13.50^{ab}	17.74^{ab}
10	Co 94008	49.96^{cde}	21.03^{b}	18.69^{b}	88.87	12.96^{b}	15.92^{cd}
11	Co 85004	46.60^{ef}	21.63^{ab}	19.25^{ab}	89.06	13.36^{ab}	15.20^{de}
	Mean	52.47	20.72	18.46	89.13	12.81	15.78
	SEd	2.18	0.42	0.32	1.42	0.27	0.67
	CD at 5%	4.54	0.87	0.67	2.95	0.56	1.40
	CV %	5.08	2.47	2.14	1.95	2.57	5.21