Validation of Early Sugarcane Clones for yield and juice quality traits

ABSTRACT

The present investigation in sugarcane (*Saccharumspp*. hybrids) was carried out to validate the performance of early duration clones for cane yield and quality characters at sugarcane Research Station (TNAU) Cuddalore, Tamil Nadu. Observations were recorded fornumber of tillers (x1000/ha), cane length (cm), cane diameter (cm), single cane weight (kg), cane yield (t/ha) Brix (%), sucrose (%), Purity (%), CCS (%) and sugar yield (t/ha).Overall performance of field trial, the clone, CoC 11336 was found to be best for cane yield and its contributing traits like number of millable canes, cane length, cane diameter and single cane weight over the check CoA 92081. The same clone CoC 11336 was found to be top performer for CCS yield. The test clone CoA 12321 was the next entry for cane yield, quality and its contributing traits. The clone CoV 12356 was found to be better for quality traits *viz*.,brix %, sucrose %, CCS % and purity % over the check variety CoA 92081.Hence, these three early clones could be tested for the confirmation of the results for better cane yield and juice quality under different agro climatic locations for release of new sugarcane variety.

Key Words: *Sugarcane, Early maturing clone, cane yield and sugar yield*

1. INTRODUCTION

Sugarcane (*Saccharumspp*. hybrids) is one of the major agricultural cash cropsnext to cotton in Indiagrown extensively. It act as a major industrial cash crop, having potential to be a key crop in bio factory evolution as it produces high yield of valuable products like sugar, ethanol, bio-fibres, waxes, bio-plastic and biofuel [1]. Globally sugarcane is cultivated in an area of 25.97 million hectares producing 1.84

billion tons with the productivity of 70.85 t ha^{-1} [2]. India is next only to Brazil with respect to cane area. In India,it was cultivated in an area of 5130.75 thousand hectares with the production of 383892thousand tonnes with average productivity of 78.24 tonnes per hectare [3].

Varietal development in the sugarcane is a key factor to solve the problems of the sugar industries with respect to diversifying the gene pool of improved varieties for increasing both the cane yield and sugar yield. Hence, breeding programmes are aimingat development of cultivars with an early maturity along with high sugar content is one of themain objectives as demanded by sugar industries [4]. Early duration varieties haveadvantageous to both the growers and sugarindustries. They provide an efficient and reliablemeans of achieving increased sugar yields at thebeginning of the season [5], save the rawmaterial required for a given crop cycle andallow earlier commencement of the harvestingand the processing season, and ensureprofitability [6,7].

The early maturing sugarcane varieties are cultivated in December- January months and come first for harvesting in the beginning of crushing season. The influence of season is less pronounced on early maturing varieties than the late planted varieties. Cultivation of early maturing clones facilitateshigher sugar recovery and yield.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 farmers 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 present study was made to identify the early maturing clones withsustained high cane yield and CCS yield for variety release.

2. MATERIALS AND METHODS

2.1. Experimental Materials and site

The field experiment was conducted at Sugarcane Research Station (TNAU), Cuddalore, India (latitude; 11º 46’ North; longitude: 79º.46’ East; altitude: 4.60 m MSL).The experimental materials consist of seven test clones *viz*., CoA12321,CoA12322, CoA12323, CoOr 12346 and CoV 12356, CoC 12336 and CoC 11336 and three check varieties (Co 6907, CoC 01061 and CoA 92081). The

test clones and checks were planted in Randomized Block Design with two replications. The plot size was six rows of five meter length spaced at 120 cm with a seed rate of twelve buds per meter. Recommended agronomic practices, need based pest and disease management practices were carried out uniformly for raising good crop.

2. 2.Data Collection and Analysis

The data recorded during the entire course of study was comprised of the yield and quality characters.Observations on number of tillers (x1000/ha), number of millable canes (NMC), cane length (cm), cane diameter (cm), single cane weight (kg), cane yield (t/ha), brix (%), sucrose (%), purity (%), CCS (%) and CCS yield (t/ha).Among these parameters, data onnumber of tillers (x1000/ha) was recorded at 120^{th}days after planting (DAP), while all other parameters were recorded at harvest. For quality analysis, the cane samples were taken from each test clone and juice was extracted by power crusher and analysed for brix (%) and sucrose (%) as per the method suggested by [8]. 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 [9].

3. RESULTS AND DISCUSSION

The analysis of variance (ANOVA) of the present study revealed that all the characters showed significant difference among the treatment mean squares (Table1). The results revealed that there was an amble scope for selecting a better genotype. The variation in cane yield and yield components among the sugarcane clones may be attributed due to their differences in genetic makeup. Mean data of different yield and quality contributing traits were furnished in Table 2and they are categorically described as follows,

Number of tillers (x 1000/ha) at 120 DAP:

For this trait, number of tillers ranged from 137.28 (CoC 01061) to 120.65 (CoA 92081).The check variety CoC 01061recorded highest tiller counts (137.28/ha)followed by test clone CoC 11336 (132.51/ha). None of the test clones

were recorded higher number of tillers per hectare. Tillering potential of a clone ultimatelyincrease thecane yield and number of millable cane. This finding is analogous with Rakesh *et al*.[10].

Number of millable cane (x 1000/ha) at harvest:

Number of millable canes (NMC)were varied from 100.22 (CoA 92081) to 125.87 (CoC 01061). None of the clones recorded significantly higher number of millable cane during harvest over the best standard CoC 01061 (125.87 /ha). Among the test clones, the test clone CoC11336 recorded higher NMC (123.27/ha) followed by the CoOr 12346 (117.62/ha) and CoC 12336 (115.52 /ha).Number of millable cane directly influences cane yield as it is the combined interaction of the germination and tillering potential the clone [11].

Cane length (cm):

Height of a cane contributes materially towards final cane yield. According to Jackson and MC Rae [12]under good growing condition,individual seedling clones may produce up to about 2.0m cane length can be selected for next generation. In this trait, the highest cane length was recorded by CoC 11336 (301.45 cm) and shortest cane length by check variety Co 6907 (264.87 cm). Three test clones *viz*., CoC 11336 (301.45 cm), CoA 12321 (297.53 cm) and CoA 12322 (295.62 cm) recorded superior performance over the best standard CoC01061(282.45 cm).The similar research findings werealready reported by [13,14].

Cane diameter (cm):

In this trial, the cane diameter ranged from 2.35 cm (CoC 01061) to 2.95 cm (CoV 12356). All the test clones were recorded numerically superior performance than the best standard CoA 92081(2.73 cm) except two test clones and they are equivalent performance with best checks for cane diameter. 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 [15].

Single cane weight (kg):

Single cane weight is the product of its length and girth, contributes substantially towards final cane yield. The results on single cane weight inthe study,

ranged from 1.03 kg (CoC 01061) to 1.65 kg (CoC 11336). All the clones were recorded numerically superior performance over the best standard CoA 92081 (1.37kg). The similar kind of result was already reported by [16].

Cane Yield (t/ha):

Cane yield is an important parameter to find out the economic potential of a clone. It is the combination of functions like environmental responses and genetic potential of a genotype.High cane yielding varieties showed best environmental response and hence revealed good performance of cane yield as compared to the other varieties [17].Therefore, the evolution of high yielding clones are urgently needed it may increasethe cane yield per unit area. In the present study, the highest cane yieldwas recorded by CoC 11336 (134.45 t/ha) and minimum in Co 6907 (101.65 t/ha).All the clones were recorded numerically superior performance over the best standard CoA 92081(112.85t/ha.).The similar kind research works were already reportedby [18,19].

Juice Quality Traits

Brix% at Harvest:

Brix per cent (Total Soluble Solids) was plays an important role in determining the sugar recovery per cent of the sugarcane. In the present study, the brix per cent was varied from 21.14 (CoV 12356) to 19.60(CoC 12336). The test clone CoV 12356 (21.25%) recorded superior performance over the best check CoC 01061, which recorded 20.95%. Among the seven test clones, only two clones namely CoV 12356 (21.25 %) and CoA 12323 (21.10%) recorded higher brix value over the checks. These results are in agreement with the findings of [20], who studied a number of sugarcane varieties and found different levels of BrixPer cent.

Sucrose per cent at harvest:

The sucrose per cent is useful in deciding the quality of sugarcane and it influences the sugar recovery and sugar production in sugar mills. In this trial, sucrose per cent at harvest was ranged from 16.85(Co 6907) to 17.85(CoV 12356). The test clone CoV 12356 (17.85%) recorded superior performance over the best standard CoC 01061(17.61%). The test clone CoV 12356 recorded highest sucrose

per cent (17.85) followed by the test clone CoOr 12346 (17.72%) over the standard CoC 01061, which recorded 17.61%.The results are almost same as demonstrated by [21].

CCS per cent at harvest:

Commercial cane sugar per cent is the best tool for breeders and millers for identification of high quality genotypes. The CCS per cent of the present investigation ranged from 12.10 (Co 6907) to 12.96(CoV 12356). The three test clones *viz*., CoV 12356 (12.96 %), CoOr 12346 (12.80 %) and CoC 11336 (12.77%) recorded numerically superior performance over the best standard CoC01061 (12.75 %)[22].

Purity per cent at harvest:

The purity per cent in the present study varied from 88.17 (Co 6907) to 90.67 (CoV 12356). Only two clonesCoV 12356 (90.67 %) and CoA 12323 (90.52%) recorded superior performance over the best standard CoC 01061 (90.47 %). This discussion shows a close conciseness with [22, 23].

CCSYield (t/ha):

In this study, Commercial cane sugar (CCS)yield ranged from 12.30 t/ha (Co 6907) to 15.73 t/ha (CoA 12322). All the test clones were recorded numerically superior performance than the best standard CoA 92081(13.04t/ha). In AVT, the test clone CoC 11336 recorded higher CCS yield (16.62t/ha) followed by the clone CoC 10336 (15.83t/ha) and CoA 11323 (14.98t/ha) over the best standard CoC 01061(14.15t/ha).This discussion shows a close succinctness with those of [24]. The higher CCS yield of clones may be attributed to relatively more average cane yield and subsequent commercial cane sugar percentage. Thevarieties capable of giving higher cane yields and fairly good recovery leading to higher sugar production in unit area [25].

4. CONCLUSION

From the results of the present study, it could be concluded that the test clones, CoC 11336 and CoA 12321 were found to be best for yield and quality contributing traits *viz*., number of millable canes, cane length, cane diameter and single cane weight, sucrose per cent and CCS yield over the best check variety CoA

92081. Hence, these two clones namelyCoC 11336 and CoA 12321 could be promoted for the confirmation trials for cane yield and sugar yield under different agro climatic conditions for variety release.

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Table 1. Mean square values and their significance from ANOVA for cane yield and quality traits

Source of Variation	df	Mean square values										
		No. Of tillers	NMC	Stalk length	Stalk diameter	Single cane wt.	Cane Yield	Brix %	Sucrose %	Purity %	CCS %	CCSr Yield.
Variety	09	325.45	319.75	421.21	0.07	0.102	394.01	0.61	0.27	3.02	0.46	8.96
Error	17	107.17	105.13	111.90	0.01	0.011	47.99	0.07	0.07	1.33	0.04	0.97
Total	28	523.35	398.04	561.69	0.08	0.122	448.12	0.68	0.35	4.35	0.59	9.25

Table 2.Mean performance of early maturing sugarcane clones for yield and quality traits

S.No.	Clone	No. of tillers (x1000/ha)	NMC (x1000/ha)	Cane Length (cm)	Cane Diameter (cm)	Single Cane Wt. (kg)	Cane Yield (t/ha)	Brix (%)	Sucrose (%)	CCS (%)	Purity (%)	CCS yield(t/ha).
1.	CoA 12321	127.85	111.65	297.53	2.85	1.55	130.37	20.65	17.61	12.63	90.10	16.46
2	CoA 12322	123.52	101.36	295.62	2.73	1.42	127.75	20.45	17.10	12.47	89.75	15.93
3	CoA 12323	127.45	105.45	273.35	2.72	1.45	122.10	21.10	17.65	12.71	90.52	15.54
4	CoOr 12346	128.51	117.62	281.55	2.81	1.47	124.84	20.25	17.72	12.80	90.45	15.97
5	CoV 12356	125.64	96.87	276.15	2.95	1.35	119.75	21.25	17.85	12.96	90.67	15.50
6	CoC 12336	129.37	115.52	275.33	2.75	1.40	128.16	19.60	17.04	12.52	89.50	16.04
7	CoC 11336	132.51	123.27	301.45	2.90	1.65	134.45	20.75	17.72	12.77	90.15	17.17
	Check											
1	Co 6907	124.85	106.82	264.87	2.65	1.22	101.65	20.55	16.85	12.10	88.17	12.30
2	CoC 01061	137.28	125.87	282.45	2.35	1.03	108.37	20.95	17.61	12.75	90.44	13.82
3	CoA 92081	120.65	100.22	268.77	2.73	1.37	112.85	20.42	17.55	12.56	89.71	14.17
	CD (0.05%)	15.51	14.62	17.57	0.17	0.19	12.62	0.44	0.42	0.35	1.85	1.54
	CV (%)	7.55	7.42	4.85	3.72	8.28	6.37	1.27	1.32	1.55	1.05	5.63