Performance of Mid-late Sugarcane clones in AICRP(S) Trials for Quality traits and Red rot resistance

ABSTRACT

A field experiment was conducted to evaluate the performance of mid-late sugarcane pre-release clones for CCS yield and its contributing characters along with red rot disease resistance. Observation on brix per cent, sucrose (%), purity (%), extraction (%), fibre (%), CCS (%), cane yield (t/ha), and CCS yield (t/ha). From the results, it could be concluded that the mid-late maturing clone, CoC 14337, was found to be the best among the test clones for sucrose per cent and CCS yield along with resistance to red rot disease. Another clone, CoA 14323, was the next-best entry, with higher CCS yield, sucrose percent and red rot resistance, compared to the better standard. As a result, clones CoC 14337 and CoA 14323 were identified as the promising entries (clones) and could be forwarded for further yield evaluation trials before being released as a new sugarcane variety suitable for East Coast Zone of India.

Key Words: *Sugarcane, mid-late clones, quality, Sucrose %, CCS % and CCS yield*

1. INTRODUCTION

"Sugarcane (*Saccharum* spp. hybrid) is a major commercial crop grown for sugar production in both tropical and subtropical regions of the world. Sugarcane is the main source of sugar in India, and in addition to sugar production, it creates a larger industrial base by producing by-products such as molasses, filter cakes, bagasse, and so on for further use in other sectors, as well as green fodder and concentrates for cattle. This creates job opportunity in agriculture and industry" [1].

"India is the second-largest producer of sugarcane next to Brazil in terms of area (48.67 lakh ha) and production (376.91 million metric tonnes). In India, Tamil Nadu ranks fourth in area and production next to Uttar Pradesh, Maharashtra, and Bihar and ranks first in productivity. In Tamil Nadu, sugarcane was grown in an area

of 1.31 lakh hectares, producing 14.12 million tonnes of sugarcane with a productivity of 107.62 t/ha" [2].

"Development of variety for different maturity groups is important breeding process in sugarcane cultivation to achieve higher recoveries in sugar mills. Sugarcane production and productivity is mainly depends on the proper selection of varieties, season and appropriate agronomic practices, as well as application of balanced nutrients". [3]. "Non-adoption of any of the components leads to a reduction in sugarcane production, which affects not only cane growers and sugar mills, but also the national economy as a whole" [3]. "Sugarcane red rot disease, caused by *Collectotrichumfalcatum* Went, is prevalent in all sugarcane growing areas. Most of the high yielding and high quality varieties, such as CoC 671, CoC 90063, CoC 8001, CoC 85061, and CoC 92061, are susceptible to the disease" [4].

Mid-late varieties are planted in February-March, and harvest occurs in February and March the following year, giving farmers a higher yield due to the north-east monsoon and more water shoots**.** Because mid-late varieties have high sucrose content and cane should be supplied throughout the crushing season after the early season canes are harvested [5]. Hence, the present investigation was conducted to evaluate the mid-late maturing sugarcane clones for high sucrose content, high cane yield, CCS yields, and their contributing traits along with red rot disease screening in the Zonal Varietal Trials of AICRP on sugarcane.

2. MATERIALS AND METHODS

The field experiment was conducted at Sugarcane Research Station, Cuddalore, India (latitude; 11º 46' North; longitude: 79º.46' East; altitude: 4.60 m MSL) during 2017-18. The experimental materials consist of six clones *viz*., Co 13028, Co 13029, Co 13031, CoA 14323, CoC 14337 and PI 14377 and three check varieties (Co 06030, Co 86249 and CoV 92102). The experimental trial was planted in Randomized Block Design with three replications. The plot size was six rows of five meter length following spacing of 90 cm in a row with a seed rate of twelve buds per meter. Recommended agronomic practices, need based plant protection control measures were followed

uniformly for maintain a good crop. The data recorded during the cropping period was comprised of the cane yield, CCS yield and quality parameters.

Observation on brix per cent (%), sucrose (%), purity (%) and CCS (%) were recorded on the 10th month (10m) and 12th month (12m) after planting, and all other quality parameters were recorded at harvest. Each test clone's cane sample was collected for quality analysis, and juice was extracted using a power crusher and tested for Brix percent and sucrose percent using a method recommended by [6]. Sucrose per cent was calculated as per Schmitz's tables. CCS per cent was determined as per the following formula.

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

The CCS yield was estimated based on CCS per cent and cane yield. All the collected data were statistically analysed by statistical procedures described by [7].

2.1. Screening of sugarcane clones for resistance to red rot disease

2.1.1. Plug method

The test clones were planted in two rows, with two canes from each 20 clump inoculated using the plug method. *Colletotricum falcatum* pathotypes CF 06 (CoC 67I) inoculums were prepared in sterile distilled water with the spore load of 10^6cfu/ml and inoculated in the middle of the third exposed inter-node from the bottom in each cane with an IISR inoculator and sealed with China clay. After two months of incubation, the inoculated canes were split open longitudinally along the point of inoculation and graded on a 0-9 scale.

The top condition was scored as green 0; yellow / Dry 1. Lesion widths above inoculated internodes were scored 1, 2, and 3. White spots are assigned a 1 for restricted type and a 2 for progressive type. The number of nodes crossed above the inoculated inter-node was scored as 1 if one node crossed, 2 if two nodes crossed, and 3 if three nodes crossed. The disease reaction was classified using the average score. The clones were classified as Resistant (R) (0 to 2.0), Moderately Resistant (MR) (2.1 to 4.0), Moderately Susceptible (MS) (4.1 to 6.0), Susceptible (S) (6.1 to 8.0), and Highly Susceptible (HS) (above 8.0) [8].

2.1.2. Nodal method

The nodal cotton swab method was used to inoculate two canes in each of 20 clumps. The cane's leaf sheath was as nearly removed as feasible, and the lowermost node was inoculated by wrapping cotton swabs dipped in freshly made inoculum suspension around the cane and covering the nodal region. The cotton swab was held in place by parafilm being wrapped around it. Two months after inoculation the cotton was removed and the nodal region was scraped with a knife. The reaction was recorded as susceptible (S) if the lesion spread into the stalk and as resistant (R) if no lesions developed [9].

3. RESULTS AND DISCUSSION

The analysis of variance of the present study revealed that all characters in the study were significantly different among treatment mean squares. The results revealed that there was an amble scope for selecting a better genotype. The variation in CCS yield and quality contributing traits among the varieties may be attributed due to their differences in genetic makeup. Mean performance of different quality, and its contributing traits in Zonal Varietal Trial was furnished in Table 1 & 2.

3.1. Evaluation of sugarcane clones for yield and quality traits

3.1.1 Brix per cent (%)

Brix per cent at maturity stage (Total Soluble Solids) plays an important role and determine the sugar recovery per cent of the genotype [5]. In the present study, the brix per at 10^{th} month was varied from 20.45 (CoA 14323) to 18.91 (Co 86249). During harvest, it was ranged from 21.50 (CoA 14323) to 19.81 (Co 86249). The test entries *viz*., CoA 14323(21.50), PI 14377(21.10%) CoC 14337 (21.02%), and Co 13031 (20.90%) recorded numerically superior performance over best standard Co 06030(20.75%). These results are in agreement with the findings of [10] and studied a number of mid-late maturing sugarcane clones and found different levels of Brix per cent in zonal varietal trials pertaining to AICRP on sugarcane.

3.1.2 Sucrose per cent

The sucrose per cent is useful in deciding the quality of sugarcane genotype and it influences the sugar recovery and sugar production. In the present investigation, sucrose per cent at 10th month, was ranged from 16.10 (CoA 14323) to 14.66 (Co 86249). Only three clones namely, CoA 14323 (16.10%), PI 14377 (16.01%) and CoC 14337(15.83%) recorded numerically superior value over standard Co 06030 (15.81%). At harvest, sucrose per cent ranged from 18.12 (CoA 14323) to 17.35 (Co 86249). Among the test clones, five test clones *viz*., CoA 14323 (18.12), PI 14377 (17.96%), CoC 14337 (17.93%), Co 13031 (17.92%) and Co 13029 (17.85%) were recorded superior performance over the better standard Co 06030, which recorded 17.81 per cent. The results are almost similar as demonstrated by [11].

3.1.3 Purity per cent

Purity per cent of the cane juice at harvest is important quality trait, it was deciding the quality of genotype and it influences the sugar recovery and sugar production in sugar mills. In the present trial, purity per cent at 10th month varied from 86.45 (CoA 14323) to 83.94 (Co 86249). During harvest it was ranged from 90.65 (Co 13031) to 88.21 (Co 13029). The test entries *viz*., Co 13031 (90.65%), PI 14377 (90.36%), CoA 14323 (90.24%) and CoC 14337 (90.12%) were expressed superior performance over the best check variety Co 06030 (90.01%). The present results are in similarity to the findings of [12].

3.1.4 CCS per cent at harvest

Commercial cane sugar (CCS) per cent is the best tool for breeders and millers for identification of high quality genotypes [13]. The CCS per cent during 10th month in the present study varied from 09.97 % (Co 86249) to 10.77 (PI 14377). The CCS per cent at varied from 13.01% (CoA 14323) to 12.21 (Co 86249). Only three test entries *viz*., CoA 14323 (13.01%), CoC 14337 (12.92%) and PI 14377 (12.81%) were recorded numerically superior performance over best standard CoV 92102, which recorded 12.78%. This discussion shows a close briefness with [13].

3.1.5 Pole per cent (cane) at harvest

The pole per cent in cane is important trait for deciding the quality of sugarcane genotype and it was influences the sugar recovery and sugar production. In the present

investigation, pole per cent at harvest varied from 14.25 (CoA 14323) to 13.05 (Co 86249). For this trait, three clones namely CoA 14323, PI 14377 (14.11%) and CoC 14337 (14.03%) were expressed superior performance over the better standard Co 06030, which recorded 13.85 per cent.

3.1.6 Extraction per cent at harvest

Extraction per cent of cane juice at harvest is important quality character, it was deciding the quality of genotype and it influences the sugar recovery and sugar production in sugar mills. In the present study, extraction per cent varied from 50.92 (CoA 14323) to 49.30 (Co 86249). Among the test clones, only two clones namely, CoA 14323 (50.92%) and PI 14377 (50.71%) were recorded superior value over the check variety CoV 92102 (50.11%) [14].

3.1.7 Fibre per cent at harvest

Fibre per cent at maturity, in the present investigation revealed that, it was ranged from 13.56 (Co 13029) to 12.94 (CoA 14323). Among the test clones, only one clone Co 13029 (13.56%) recorded superior performance over the better standard Co 06030 (13.42%).

3.1.8 Cane Yield (t/ha)

“Cane yield is a major trait to find out the economic potential of a genotype. It is the combination of functions like environmental response 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” [5]. In the present study, the maximum cane yield was recorded in CoC 14337(142.10t/ha) and minimum in Co 86249 (114.65t/ha). All the clones were recorded numerically superior value over the standard variety Co 06030 (121.98 t/ha). The similar work was already reported by [15].

3.1.9 CCS Yield (t/ha)

The higher Commercial Cane Sugar (CCS) yield of clones may be attributed to relatively more average cane yield and commercial cane sugar percent. In the present experiment, CCS yield was ranged from 18.37 t/ha (CoC 14337) to 13.99 t/ha (Co

86249). Among the six clones evaluated, all the test clones recorded numerically superior performance over the best standard Co 06030 (15.58 t/ha). This discussion shows a close succinctness with those of [16 & 17].

3.2 Reaction of sugarcane clone to red rot disease

The results of red rot disease reaction for different mid-late maturing clones are given in **Table 3.** The clones *viz*., Co 13028, Co 13029, Co 13031, CoA 14323 and CoC 14337 were found to be Moderately Resistant (MR) and PI 14377 was Moderately Susceptible (MS) by plug method of inoculation. For nodal method of inoculation, all the test clones were found resistant. The similar results of red rot screening for sugarcane clones were already reported by [18].

4. CONCLUSION

Evaluation and identification of sugarcane clones for different maturity groups is of paramount importance in sugarcane cultivation to get higher recoveries in sugar mills. The early maturing sugarcane varieties are chosen in the beginning of crushing season for higher sugar recoveries. Identification of promising sugarcane clones 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. In the present study, On the basis of overall performance of different clones evaluated, the test clones *viz*., CoC 14337 and CoA 14323 were exhibited better performance in terms of cane yield, CCS yield and its contributing traits along with red rot resistance. Hence it was concluded that the selected sugarcane clones could be evaluated in further breeding trials for confirmation and the best promising clone could be released as a new sugarcane variety for east coast zone of India.

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Table 1. Performance of mid-late sugarcane clones for quality traits in Zonal Varietal Trial

S.No.	Clone/ Std	Brix (%)		Sucrose (%)		Purity (%)		CCS (%)	
		(10 m)	(12 m)	(10 m)	(12 m)	(10 m)	(12 m)	(10 m)	(12 m)
1	Co 13 028	19.68	20.41	15.42	17.64	85.42	89.67	10.53	12.65
2	Co 13 029	19.40	20.23	14.97	17.85	84.70	88.21	10.08	12.68
3	Co 13 031	20.04	20.90	15.51	17.92	85.24	90.65	10.52	12.77
4	CoA 14323	20.45	21.50	16.10	18.12	86.45	90.24	10.74	13.01
5	CoC 14337	19.81	21.02	15.83	17.93	85.34	90.12	10.64	12.92
6.	PI 14 377	20.19	21.10	16.01	17.96	85.42	90.36	10.77	12.81
	Standard								
1	Co 06030	19.61	20.75	15.81	17.81	85.17	90.01	10.61	12.77
2	Co 86249	18.91	19.81	14.66	17.35	83.94	88.75	9.97	12.21
3.	CoV 92102	19.62	20.70	15.74	17.80	85.25	89.91	10.62	12.78
	S.Ed.	0.25	0.14	0.10	0.08	0.23	0.17	0.10	0.04
	CD (0.05)	0.73	0.42	0.30	0.23	0.67	0.52	0.31	0.13
	CV (%)	2.15	1.18	1.10	0.74	0.46	0.33	1.72	0.59

CCS **-** Commercial Cane Sugar, 10m –10th month after planting, 12m- 12th month after planting

Table 2. Performance of mid-late sugarcane clones for quality traits in Zonal Varietal Trial

S. No.	Clone / Std.	Pol. (%) (cane) (12 m)	Extraction.(%) (12 m)	Fibre (%) (12 m)	Cane yield (t/ha)	CCS yield (t/ha)
1.	Co 13 028	13.74	49.71	13.31	128.74	16.28
2.	Co 13 029	13.44	49.05	13.56	129.51	16.42
3.	Co 13 031	13.86	49.05	13.15	124.50	15.90
4.	CoA 14 323	14.25	50.92	12.94	131.87	17.16
5.	CoC 14 337	14.03	49.94	13.24	142.10	18.37
6.	PI 14377	14.11	50.71	13.27	132.94	17.04
	Standard					
1.	Co 06 030	13.85	50.03	13.42	121.98	15.58
2.	Co 86249	13.05	49.30	13.33	114.65	13.99
3.	CoV 92102	13.75	50.11	13.06	119.77	15.31
	S.Ed.	0.08	0.17	0.08	3.43	0.43
	CD (0.05)	0.22	0.52	0.24	10.30	1.30
	CV (%)	0.94	0.61	1.07	4.67	4.63

CCS **-** Commercial Cane Sugar, 12 m- 12th month after planting

Table 3. Screening of sugarcane clones for resistance to red rot disease by plug method of Inoculation and Nodal Cotton Swab method.

S. No	Entry/ Clone	Red rot disease (Plug Method)		Nodal Method
		Score	Disease Reaction	
1.	Co 13028	3.5	MR	R
2.	Co 13029	2.2	MR	R
3.	Co 13031	3.8	MR	R
4.	CoA 14323	2.3	MR	R
5.	CoC 14337	3.7	MR	R
6.	PI 14 377	4.1	MS	R
	Check			
7.	CoC 671 (S)	9.0	HS	S
8.	Co 86249 (R)	2.0	R	R
9.	CoV 92102	4.5	S	R