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Studies of genetic parameters for productive traits in early maturing sugarcane clones and selection of superior clones

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Abstract

In an experiment, 16 early maturing sugarcane clones along with 2 checks were planted in Randomized Block Design with three replications during spring season 2016-17 at Dr. RPCAU, Pusa, Bihar to study the genetic parameters for productive traits in early maturing sugarcane clones and select the superior clones. The productive traits under studied were germination percentage at 45 & 90 days after planting (DAP), number of shoots at 120 & 240 DAP (000/ha), plant height at 150 days, 240 days (cm) & 300 days (at harvest), cane diameter (cm), fibre per cent, single cane weight (kg), number of millable cane (000/ha), juice quality traits viz, brix, pol & purity per cent at 8 & 10th months stage, respectively, CCS per cent, cane and sugar yield (tonne/ha) at harvest. Analysis of variance revealed that highly significant differences among the clones for all the productive traits under study. Maximum range was found for the trait plant height at 150 days followed by plant height at 240 days and cane yield. The phenotypic coefficient of variance was greater than genotypic coefficient of variance for all the traits. The traits namely, cane yield, sugar yield, single cane weight, number of shoots at 120 DAP, cane diameter and germination percentage at 90 DAP showed high heritability coupled with high genetic advance as per cent of mean. On the basis of *per se* performance of six productive traits the clones namely, CoP 15437, CoP 14436 CoP 11437, CoLk 12207 and CoP 12437 were selected as superior early maturing genotypes. All these clones can be utilized by the farmers as well as Sugar Factories to get high yield and high sugar in early phase of crushing and also its can be further utilization for sugarcane crop improvement programme.

Keywords: Genetic parameters, genetic variability, phenotypic variance, genotypic variance, PCV, GCV, genetic advance, heritability, early maturing sugarcane

Introduction

Sugarcane is a highly heterozygous and complex polyploidy in nature therefore, more need to study the genetic parameters and as this crop has resulted in generation of genetic variability during seedling stage. Sugarcane improvement involves hybridization followed by clonal selection. After hybridization large number of seedlings generated every year in which wide range of variability existed among the seedlings for cane & sugar yield and its component traits, therefore genetic variability is one of the important considerations in sugarcane crop improvement. Variability is measure by estimation of genotypic and phenotypic variance (σ^2_g and σ^2_p), genotypic and phenotypic coefficient of variation (GCV and PCV), heritability, genetic advance and genetic advance as per cent of mean. These genetic parameters help in selection for improvement of desired characters. Environment plays an important role in the expression of phenotype. The phenotypic variability which is observable includes both genotypic (heritable) and environmental variation (non-heritable). Hence, variability can be observed through biometric parameters like GCV, heritability (broad sense) and genetic advance. Development of varieties for different maturity group is of paramount importance in sugarcane cultivation to realize higher recoveries in sugar mills. Crushing early varieties at the start of season would increase the sugar recovery. Genetic variability for cane in the subtropical sugarcane gene pool has been found high which can be utilized for developing commercial varieties with high yield and sugar recovery. A clear cut understanding of variability of qualitative and quantitative characters of the breeding material is essential for breeder.

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Since the breeder is concerned with selection of superior genotypes for which the most suitable individuals from their phenotypic expression. Estimates of genotypic and phenotypic variance for various quantitative characters and their heritability are necessary. Estimates of heritability and genetic advance expected by selection for yield via its components are useful in designing an effective breeding programme. Selection for yield could be made more efficiently and effectively on the basis of productive traits. The pivotal of any breeding programme is the variation present in a gene pool along with flow of heritability. The variability can be statistically differentiated into heritable variation and non- heritable variation. It is the heritable variation which is selected for high productivity. Heritability provides the information regarding the proportion of total variation in a progeny which is transmissible from generation to generation. Genetic advance provides information on expected genetic gain resulting from selection of superior individuals and idea of the amount of reduction of environmental effects for comparing the range of variability present in a population with respect to cane and sugar yield along with their productive traits. Hence, it is necessary to select the genotypes on the basis of only those traits which showed high heritability coupled with high genetic advance as per cent of mean. Keeping these points in view an effective selection was made to select the superior genotypes of early maturing sugarcane in the present investigation which can be utilized by the farmers as well as Sugar Factories to get high yield and high sugar in early phase of crushing and also its can be further utilization for sugarcane crop improvement programme.

Materials and Methods

The material of this investigation comprises of 16 promising (including 2 checks) early maturing sugarcane clones *viz*, CoP 11436, CoP 11437, CoP 11438, CoSe 11451, CoLk 12207, CoLk 12208, CoP 12436, CoP 12437, CoSe 12451, CoP 14436, CoP 14437, CoP 15436, CoP 15437, BO 130, BO 153 (C) and CoSe 95422 (C). All the clones including two checks *viz*, BO 153 and CoSe 95422 were planted in Randomized Block Design with three replications during spring season 2016-17 at Dr. RPCAU, Pusa, Bihar followed all the recommended package and practices for raising sugarcane good crop. Three buded setts of all the clones were planted under field condition along with checks and from each replication each variety was planted in a plot of 4 rows of 3 meters length each with a spacing of 0.75 meter between rows. Follow Patel and Patel (2014) for sugarcane sett size, seed rate and sett treatment. Observation were recorded by selecting five random plants per genotype per replication for productive traits of cane yield and juice quality traits *viz*, germination percentage at 45 & 90 days after planting (DAP), number of shoots at 120 & 240 DAP (000/ha), plant height at 150 days, at 240 days (cm) & at harvest, cane diameter at harvest (cm), fibre per cent at harvest, single cane weight (kg), number of millable cane at harvest (000/ha), juice quality traits *viz*, brix, pol & purity per cent at 8 & 10th months stage, respectively, CCS per cent at harvest, cane and sugar yield (t/ha) at harvest.

Statistical analysis

The analysis of variance was carried out following usual procedure as suggested by Panse and Sukhatme (1967) [17]. In order to assess and quantify the genetic variability among the genotypes for the characters under study, Estimation of

variance components *viz*, phenotypic variances (σ^2p) and genotypic variances (σ^2g) were estimated using the following formula as suggested by Panse and Sukhatme (1967) [17].

$$\sigma^2g = \frac{MSS(\text{genotypes}) - \sigma^2e}{r}$$

$$\sigma^2p = \sigma^2g + \sigma^2e \text{ [When Cov. G x E=0]}$$

Where

σ^2e = Environmental variance i.e. error variance = MSS (error) and r = Number of replication

1. Genotypic coefficient of variability (GCV)

$$GCV = \sqrt{\frac{\sigma^2g}{\bar{x}}} \times 100$$

Where

σ^2g = Genotypic variance and \bar{X} = Population mean

2. Phenotypic coefficient of variability (PCV)

$$PCV = \sqrt{\frac{\sigma^2p}{\bar{x}}} \times 100$$

Where, σ^2p = Phenotypic variance and \bar{X} = Population mean
GCV and PCV values were categorized as low (0-10%), moderate (10-20%) and high (20% and above)

Heritability (Broad sense) in broad sense was estimated as the ratio of genotypic to the phenotypic variance and was expressed in percentage. It was calculated by the formula given by Johanson *et al.* (1955a) [11].

$$h^2 \text{ (Broad sense heritability)} = \frac{\sigma^2g}{\sigma^2p} \times 100$$

Where

σ^2g = Genotypic variance, σ^2p = Phenotypic variance and h^2 = Heritability (broad sense heritability) The heritability was categorized as low, moderate and high as given by Robinson *et al.* (1949) [19]. 0-30%: Low, 30-60%: Moderate and 60% and above: High.

Genetic advance was estimated by using the formula suggested by Lush (1949) [14] and followed by Johnson *et al.* (1955a) [11] and Allard (1960) [3].

$$\text{Genetic advance (G.A)} = K. \sigma p. h^2$$

Where, K = Selection differential which is 2.06 at 5% selection intensity in large sample from normally distributed population, Phenotypic standard deviation and h^2 = Heritability in broad sense

Genetic advance as percentage of mean was calculated by following formula:

$$GA \text{ (as per cent of mean)} = \frac{GA}{\bar{x}} \times 100$$

Where

GA = Genetic advance and \bar{X} = Mean of the character

Genetic advance as per cent mean was categorized as low, moderate and high as given by Johnson *et al.* (1955a) [11]. It is as follows.

0-10%: Low

10-20%: Moderate
20% and above: High

All the statistical analyzed data are being presented in Table 1, 2 and 3. Observed data are also presented in Graph 1, which showed Estimate of ECV, GCV, PCV, h^2 & GAM of characters in early maturing Sugarcane clones.

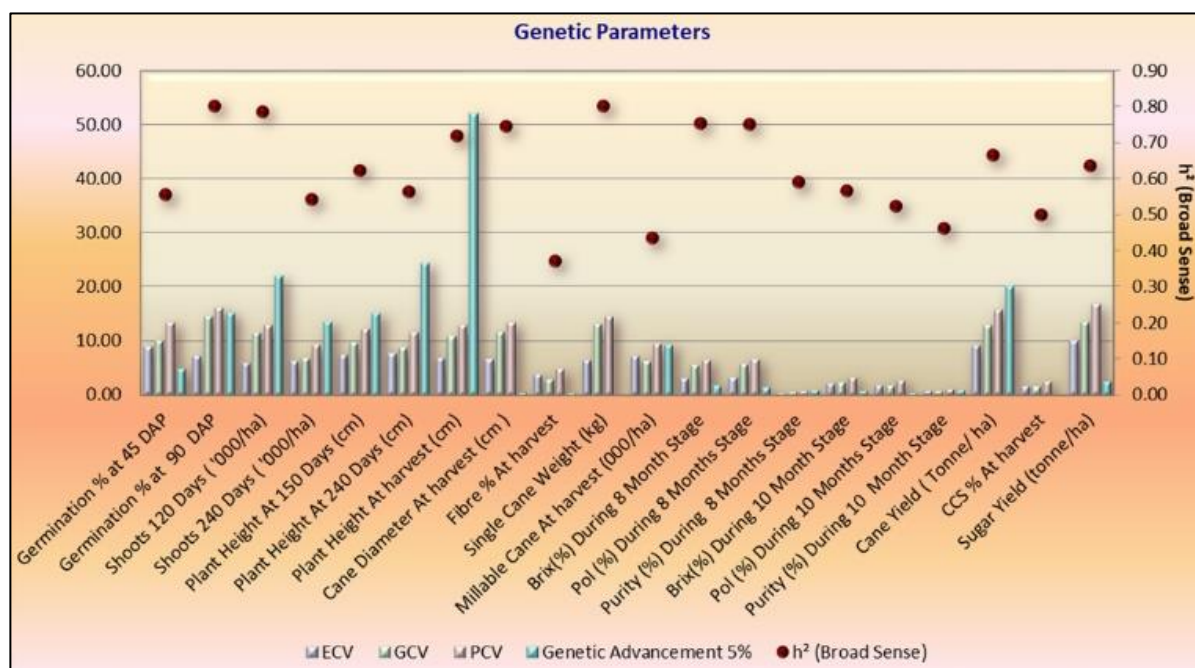
Results and Discussion

Variability among the early maturing sugarcane clones is the present need of sugarcane improvement programme. The analysis of variance as per overview given in Table 1 clearly indicated that highly significant differences were found among the clones for all the characters under studied. Similar results were also reported by earlier workers Ebid, *et al.* (2015) [8], Hiremath and Nagaraja (2016) [9], Tena *et al.* (2016) [24], Agrawal and Kumar (2017) [1, 2] and Kumar *et al.* (2017) [13], it means there were sufficient variability existed in the early maturing sugarcane for cane and sugar yield. Therefore wide range for the such traits *viz.*, cane and sugar yield favor towards selection of high cane yield as well as high sugar containing clones. In present investigation it was found that phenotypic variation for all the characters under study were higher than the genotypic variances. This may be due to the non-genetic factor which played an importance role in the manifestation of these characters. This result was in accordance with the findings of Doule and Balasundaram (2002) [7] for brix and sucrose juice percentage, purity coefficient, commercial cane sugar, pol per cent cane and CCS per plot. Wide range of phenotypic and genotypic variance were observed for cane height at harvest followed by plant height at 240 DAP and purity per cent during 10 month stage from the perusal of Table 2. The assessment of heritable and non-heritable component in the total variability observed is indispensable in adopting suitable breeding procedure. The heritable portion of the overall observed variation can be ascertained by studying the component of variation such as GCV, PCV, heritability and genetic advance as per cent of mean. The high phenotypic coefficient of variance was observed for sugar yield followed by germination per cent at 90 DAP, cane yield and single cane weight from the perusal of Table 3. However, high genotypic coefficient of variation was observed for germination per cent at 90 DAP followed by sugar yield, single cane weight, these results are in agreement with Dilnesaw *et al.* (2016) [6], Swamy Gowda *et al.* (2016) [22], Bairwa *et al.* (2017) [4] and Mehareb and Abazid (2017) [16]. Study of *per se* performance of individual genotypic suggest the importance of the materials under study and it becomes first hand information for the breeders. The mean of different quantitative character including sugar yield and cane yield as performed by the available clones suggested that selection of desirable clone based on the characters from material evaluated, can be effective. Heritability estimates are useful in deciding the character to be considered while making selection, but selection based on this factor alone may limit the progress, as it is prone for change with environment, material etc. (Johanson *et al.* 1955) [11]. In other words, estimate of heritability have a role to play in determining the effectiveness of selection for a character, provided they are considered in conjugation with the genetic advance as per cent of mean as suggested by Panse (1942) and Johanson *et*

al. (1955) [11]. In this study, heritability for the characters namely germination percentage at 90 DAP, single cane weight, number of shoots at 120 DAP, brix per cent during 8 month stage, pol per cent during 8 month stage, cane diameter, plant height at harvest, cane yield and plant height at 150 days found to be high in sugarcane from the perusal of Table 3. So, these characters may be used as selection criteria in sugarcane for further improvement of clones. These findings were in confirmation with the results of earlier workers namely Chaudhary (2001) [5] for stalk diameter and single cane weight, Kumar *et al.* (2004) [12] for single cane weight, stalk girth and stalk height, Thippeswamy *et al.* (2001) [25] for germination percentage and cane yield, Jamoza *et al.* (2014) [10] for stalk diameter and stalk weight and Dilnesaw *et al.* (2016) [6] for cane yield. High genetic advance was observed for the characters *viz.*, germination percentage at 90 DAP, number of shoots at 120 DAP, Cane diameter at harvest, single cane weight, cane yield and sugar yield. Similar results were also reported by earlier workers Mali *et al.* (2010) [15] for number of tillers and single cane weight, Ebid *et al.* for stalk weight, Sanghera *et al.* (2015) [20] for stalk length and number of shoots. The coefficient of variance indicated the extent of variability present in the character and does not indicate the heritable portion. This could be ascertained from the heritability estimates which in broad sense include both additive and non-additive gene effects and in narrow sense include the portion of heritable variation which is due to additive component (Lush, 1949) [14]. Assessing merits and demerits of a particular characters as it enables plant breeders to decide the course of selection procedures be followed under a given situation. Hence, direct selection can be done through these characters for future improvement of clones for higher cane and sugar yield in early maturing sugarcane clones. In order to make selection more effective, six characters were used in present investigation *viz.* selection based on *per se* performance of characters namely, cane yield, sugar yield, single cane weight, cane diameter, germination percentage at 90 DAP, number of shoots at 120 DAP as these characters showed high heritability coupled with genetic advance as per of mean as indicated in Table 3. Therefore, instead of 20 traits indicated in Table 4, only six traits should be observed for further improvement in early maturing sugarcane clones to select superior clones. Selection based on *per se* performance of cane yield, sugar yield, single cane weight, cane diameter, germination percentage at 90 days and number of shoots at 120 days was effective. Same trend follow by Shanmuganathan *et al.* (2015) [21] and in his studied the most of the traits were same *viz.*, 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⁻¹), brix, sucrose, purity, CCS, extraction (%) and CCS (t ha⁻¹) for better cane yield and CCS yield. Table 5 indicates the *per se* performance of desire six traits with their ranks and overall pooled rank. Based on overall pooled ranking finally the clones namely, CoP 15437, CoP 14436 CoP 11437, CoLk 12207 and CoP 12437 were selected as better early maturing clones. This outcome will be helpful to sugarcane grower as tonnage in early while in sugar industry their sustenance by enhancing sugar recovery and it will be also helpful for further crossing programme in sugarcane improvement.

Table 1: Analysis of variance for twenty characters in early maturing sugarcane clones

S. N.	Characters	Mean sum of Square		F-Value
		Treatment (d.f= 15)	Error (d.f= 30)	
1.	Germination percentage at 45 DAP	40.12**	8.36	4.80
2.	Germination percentage at 90 DAP	220.75**	16.72	13.19
3.	Number of shoots at 120 DAP (000/ha)	482.73**	40.07	12.04
4.	Number of shoots at 240 DAP (000/ha)	313.91**	68.70	5.56
5.	Plant height at 150 days (cm)	321.22**	53.76	5.97
6.	Plant height at 240 days (cm)	951.58**	194.23	4.89
7.	Plant height at harvest (cm)	3007.51**	344.63	8.72
8.	Cane diameter at harvest (cm)	0.34**	0.03	9.89
9.	Fibre per cent at harvest	0.76**	0.27	2.78
10.	Single cane weight (kg)	0.04**	0.003	13.20
11.	Number of millable cane at harvest (000/ha)	206.63**	61.94	3.33
12.	Brix per cent during 8 month stage	3.61**	0.35	10.30
13.	Pol per cent during 8 month stage	2.84**	0.28	10.16
14.	Purity per cent during 8 month stage	1.37**	0.25	5.37
15.	Brix per cent during 10 month stage	1.05**	0.21	4.95
16.	Pol per cent during 10 month stage	0.53**	0.12	4.33
17.	Purity per cent during 10 month stage	2.05**	0.57	3.60
18.	Cane yield (tonne/ha)	512.19**	73.16	7.00
19.	CCS per cent at harvest	0.21**	0.05	4.01
20.	Sugar yield (tonne/ha)	8.93**	1.43	6.25

**Graph 1:** Estimate of ECV, GCV, PCV, h² & GAM of characters in early maturing Sugarcane clones**Table 2:** Range, mean, genotypic and phenotypic variance of the characters in early maturing sugarcane clones.

S. N.	Characters	Range	Mean	σ_g^2	σ_p^2
1	Germination percentage at 45 DAP	27.10 - 39.10	32.12	10.58	18.94
2	Germination percentage at 90 DAP	44.55 - 75.11	56.80	68.01	84.73
3	Number of shoots at 120 DAP (000/ha)	82.24-124.33	104.96	147.55	187.62
4	Number of shoots at 240 DAP (000/ha)	108.67-145.02	130.56	81.15	150.44
5	Plant height at 150 days (cm)	80.12-121.21	97.48	89.73	142.91
6	Plant height at 240 days (cm)	152.00-203.41	179.11	252.62	446.63
7	Plant height at harvest (cm)	178.67-309.00	271.03	887.62	1232.26
8	Cane diameter at harvest (cm)	2.23-3.18	2.72	0.10	0.13
9	Fibre per cent at harvest	12.75-14.72	13.37	0.16	0.43
10	Single cane weight (kg)	0.71-1.19	0.86	0.012	0.015
11	Number of millable cane at harvest (000/ha)	98.57-122.60	108.96	48.23	110.17
12	Brix per cent during 8 month stage	16.34-20.27	18.13	1.08	1.43
13	Pol per cent during 8 month stage	14.01-17.55	15.79	0.85	1.13
14	Purity per cent during 8 month stage	85.80-88.67	87.12	0.37	0.62
15	Brix per cent during 10 month stage	19.97-21.93	20.79	0.27	0.49
16	Pol per cent during 10 months stage	17.51-18.95	18.21	0.13	0.25

17	Purity per cent during 10 months stage	86.30-89.13	87.64	0.49	1.06
18	Cane yield (tonne/ha)	71.83-119.68	93.17	147.34	219.50
19	CCS per cent at harvest	12.02-12.96	12.54	0.05	0.10
20	Sugar yield (tonne/ha)	8.91-15.12	11.70	2.50	3.92

(σ_g^2) Genotypic variance, (σ_p^2) Phenotypic variance

Table 3: Estimate of GCV, PCV, h^2 , GA and GAM of characters in early maturing Sugarcane clones

S. N.	Characters	GCV	PCV	h^2	GA 5%	GAM 5%
1	Germination percentage at 45 DAP	10.13	13.55	55.9	5.01	15.60
2	Germination percentage at 90 DAP	14.52	16.20	80.3	15.22	26.79
3	Number of shoots at 120 DAP(000/ha)	11.57	13.05	78.6	22.19	21.14
4	Number of shoots at 240 DAP (000/ha)	6.92	9.39	54.3	13.72	10.51
5	Plant height at 150 days (cm)	9.67	12.26	62.4	15.36	15.76
6	Plant height at 240 days (cm)	8.87	11.80	56.5	24.60	13.74
7	Plant height at harvest (cm)	10.99	12.95	72.0	52.09	19.22
8	Cane diameter at harvest (cm)	11.70	13.53	74.8	0.56	20.85
9	Fibre per cent at harvest	3.01	4.9	37.3	0.51	3.78
10	Single cane weight (kg)	13.12	14.64	80.3	0.21	24.22
11	Number of millable cane at harvest (000/ha)	6.37	9.63	43.8	9.47	8.67
12	Brix per cent during 8 month stage	5.75	6.62	75.6	1.87	10.31
13	Pol per cent during 8 month stage	5.85	6.78	75.3	1.65	10.46
14	Purity per cent during 8 month stage	0.69	0.91	59.3	0.97	1.11
15	Brix per cent during 10 month stage	2.54	3.37	56.9	0.82	3.94
16	Pol per cent during 10 month stage	2.02	2.78	52.6	0.55	3.01
17	Purity per cent during 10 month stage	0.80	1.17	46.5	0.97	1.12
18	Cane yield (tonne/ha)	12.98	15.90	66.7	20.35	21.84
19	CCS per cent at harvest	1.82	2.57	50.1	0.33	2.61
20	Sugar yield (tonne/ha)	13.51	16.93	63.7	2.60	22.61

Phenotypic Coefficient of Variance (PCV), Genotypic Coefficient of Variance (GCV), Heritability (h^2), Genetic Advance (GA) and Genetic Advance as per cent of Mean (GAM)

Table 4: Mean performance of sixteen early maturing sugarcane clones for all the characters

S.N.	Clones	Germination % at 45 DAP	Germination % at 90 DAP	No. of shoots at 120 DAP (000/ha)	No. of shoots at 240 DAP (000/ha)	Plant height at 150 days (cm)	Plant height at 240 days (cm)	Plant height at harvest (cm)	Cane diameter at harvest (cm)	Fibre % at harvest	Single cane weight (Kg)
1.	CoP 11437	32.00	62.88	112.31	145.02	101.28	196.10	303.33	2.57	12.86	0.88
2.	CoSe 12451	39.11	75.11	95.30	120.55	103.14	166.21	284.80	2.38	13.10	0.74
3.	CoP 12437	28.44	49.11	98.88	124.11	96.48	182.43	287.30	3.02	12.75	0.92
4.	CoP 14436	30.89	62.11	118.67	142.27	98.89	159.12	258.16	3.06	13.31	0.89
5.	CoP 14437	33.55	57.78	102.32	130.48	110.00	173.00	267.14	3.00	12.97	0.96
6.	CoP 15437	30.66	69.99	124.33	131.48	121.21	202.71	309.00	3.08	13.00	1.19
7.	CoP 15436	35.33	60.33	109.27	143.16	92.18	178.89	285.10	3.18	12.95	0.86
8.	CoP 11436	33.99	48.89	104.48	138.57	89.68	152.00	305.00	2.40	13.26	0.76
9.	CoP 11438	30.22	44.55	110.23	122.11	88.22	200.23	257.00	3.02	13.23	0.86
10.	CoLk 12208	27.11	58.00	84.61	138.27	104.65	160.11	272.60	2.36	13.77	0.80
11.	CoSe 11451	27.77	45.77	98.39	123.62	80.12	165.21	178.00	2.40	13.77	0.77
12.	BO 130	27.99	50.22	101.27	130.18	90.39	188.02	281.67	2.50	13.56	0.76
13.	CoP 12436	33.77	50.44	94.86	119.26	102.14	202.18	265.20	2.48	13.78	0.81
14.	CoLk 12207	38.89	56.77	82.24	108.67	104.41	203.41	289.19	3.12	13.81	0.94
15.	CoSe 95422 (C)	33.77	62.44	119.59	132.44	92.11	160.41	242.67	2.23	14.72	0.72
16.	BO 153 (C)	30.44	54.44	122.55	138.81	84.81	175.81	250.29	2.80	13.17	0.84
	GM	32.12	56.80	104.96	130.56	97.48	179.11	271.03	2.72	13.37	0.86
	CD 5%	4.82	6.82	10.56	13.82	12.23	23.24	30.96	0.31	0.87	0.09
	CV	9.00	7.19	6.03	6.35	7.52	7.78	6.85	6.79	3.90	6.50
	SEm \pm	1.67	2.36	3.65	4.78	4.23	8.05	10.72	0.11	0.30	0.03

Table 4: Cont.....

S.N.	Clones	No. of millable cane at harvest (000/ha)	Brix(%) during 8 month stage	Pol (%) during 8 month stage	Purity (%) during 8 month stage	Brix(%) during 10 month stage	Pol (%) during 10 month stage	Purity (%) during 10 month stage	Cane yield (tonne/ha)	CCS % at harvest	Sugar yield (tonne/ha)
1.	CoP 11437	108.11	19.47	16.98	87.20	21.93	18.95	86.37	95.42	12.96	12.36
2.	CoSe 12451	119.30	16.43	14.37	87.40	20.70	18.21	88.17	87.98	12.57	11.06
3.	CoP 12437	121.38	17.77	15.41	86.90	20.37	18.08	88.73	110.90	12.53	13.89
4.	CoP 14436	116.21	18.53	16.19	87.37	21.30	18.56	87.07	104.36	12.75	13.30
5.	CoP 14437	98.57	18.47	16.07	87.10	21.20	18.56	87.53	95.17	12.78	12.15
6.	CoP 15437	100.17	18.40	15.99	87.07	20.80	18.31	88.07	119.68	12.64	15.12

7.	CoP 15436	108.18	19.40	17.03	87.70	20.37	17.61	86.73	92.77	12.05	11.18
8.	CoP 11436	105.37	18.73	16.33	87.13	20.33	17.89	87.97	80.01	12.40	9.92
9.	CoP 11438	108.80	20.27	17.55	86.60	21.93	18.93	86.30	93.41	12.94	12.08
10.	CoLk 12208	117.67	18.03	15.74	87.43	19.97	17.79	89.13	93.88	12.35	11.59
11.	CoSe 11451	101.89	16.34	14.01	85.80	20.10	17.51	87.47	78.42	12.02	9.48
12.	BO 130	100.59	17.43	15.01	86.07	21.13	18.38	87.00	76.14	12.61	9.59
13.	CoP 12436	122.60	18.53	16.26	87.73	20.40	18.10	88.73	98.94	12.54	12.41
14.	CoLk 12207	112.40	17.60	15.24	86.57	20.87	18.27	87.60	105.86	12.58	13.32
15.	CoSe 95422 (C)	100.01	18.07	15.76	87.23	20.37	17.88	87.80	71.83	12.40	8.91
16.	BO 153 (C)	102.17	16.63	14.74	88.67	20.90	18.34	87.65	86.02	12.64	10.87
	GM	108.96	18.13	15.79	87.12	20.79	18.21	87.64	93.17	12.55	11.70
	CD 5%	13.12	0.99	0.88	0.84	0.77	0.58	1.26	14.26	0.38	1.99
	CV	7.22	3.27	3.34	0.58	2.21	1.91	0.86	9.18	1.82	10.21
	SEm ±	4.5440	0.34	0.30	0.29	0.26	0.20	0.43	4.94	0.13	0.69

Table 5: Selection of clones on the basis of mean value of six productive traits

Clones	Cane Yield (t/ha)		Sugar Yield (t/ha)		Single Cane Weight (kg)		Cane Diameter(cm)		Germination % at 90 DAP		No. of Shoots at 120 days(000/ha)		Average Rank	Pooled Rank
	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank	Mean	Rank		
CoP 11437	95.42	6	12.36	6	0.88	6	2.57	8	62.88	3	112.31	5	5.6	3
CoSe 12451	87.98	11	11.06	11	0.74	14	2.38	12	75.11	1	95.30	13	10.30	10
CoP 12437	110.90	2	13.89	2	0.92	4	3.02	5	49.11	13	98.88	11	6.16	5
CoP 14436	104.37	4	13.30	4	0.89	5	3.06	4	62.11	5	118.67	4	4.33	2
CoP 14437	95.17	7	12.15	7	0.96	2	3.00	6	57.78	8	102.32	9	6.5	6
CoP 15437	119.68	1	15.12	1	1.19	1	3.08	3	69.99	2	124.33	1	1.5	1
CoP 15436	92.77	10	11.18	10	0.86	7	3.18	1	60.33	6	109.27	7	6.83	7
CoP 11436	80.01	13	9.92	13	0.76	12	2.40	11	48.89	14	104.48	8	11.83	13
CoP 11438	93.41	9	12.08	8	0.86	7	3.02	5	44.55	16	110.23	6	8.5	8
CoLk 12208	93.88	8	11.59	9	0.80	10	2.36	13	58.00	7	84.61	15	10.33	11
CoSe 11451	78.42	14	9.48	15	0.77	13	2.40	11	45.77	15	98.39	12	13.33	14
BO 130	76.14	15	9.59	14	0.76	11	2.50	9	50.22	12	101.27	10	11.83	13
CoP 12436	98.94	5	12.41	5	0.81	9	2.48	10	50.44	11	94.86	14	9	9
CoLk 12207	105.86	3	13.32	3	0.94	3	3.12	2	56.77	9	82.24	16	6	4
CoSe 95422(C)	71.83	16	8.91	16	0.72	15	2.23	14	62.44	4	119.59	3	11.33	12
BO 153 (C)	86.02	12	10.87	12	0.84	8	2.80	7	54.44	10	122.55	2	8.5	8

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