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ESTIMATION OF VARIABILITY PARAMETERS FOR YIELD AND ITS CONTRIBUTING CHARACTERS AMONG EARLY GENERATION CLONES OF SUGARCANE (*SACCHARUM* SPECIES COMPLEX)

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Abstract

In the current set of an experiment thirty-three early generation clones (C_2) of sugarcane along with three checks (CoPant 97222, CoS 8436, CoJ 64) were planted in randomized block design with three replications. at Sugarcane Breeding Block, NEB Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar. Variability parameters were estimated for these clones based on ten morphological and juice quality trairs viz., Number of Millable Cane (NMC), cane height (m), cane diameter (cm), single cane weight (Kg), juice brix percent, juice sucrose percent, juice purity percent, Commercial cane sugar percent (CCS %), cane yield (t/ha), CCS yield (t/ha). Analysis of variance revealed significant differences among clones for all the traits under study. Highest GCV were found for single cane weight followed by cane yield and NMC. Single cane weight exhibited highest GCV followed by CCS yield, Cane yield and NMC. The lowest GCV was observed for juice purity%. PCV was recorded highest for Single cane weight (Kg) followed by NMC, CCS yield (t/ha), Cane yield (t/ha), Cane height (m) and Cane thickness (Kg). The lowest phenotypic coefficient of variation was observed for juice purity percent. The range for environmental coefficient of variation (ECV) was observed low for juice purity percent to highest for single cane weight. High estimates of heritability was observed in the present study for cane yield followed by cane quality characters like CCS yield, CCS % and Juice sucrose % while moderate heritability was observed for juice purity, cane height and cane thickness. High estimate of genetic advance was observed for cane yield and NMC while low genetic advance was observed for cane height, cane thickness, single cane weight and NMC. It is evident from the present finding that substantial genetic variability was envisaged for yield and its component traits among the clones under study. Therefore, these traits should be taken into account while selecting superior and desirable plants for further improvement of yield parameters in evolving high yielding genotype in cane.

INTRODUCTION

Sugarcane (*Saccharum* spp. complex) is an important cash crop and is cultivated in the tropical and subtropical regions of the world. Sugarcane has the distinct characteristic of high sugar concentration accumulated in the stalk. Sugarcane growing countries of the world are lying between the latitude 36.7°N and 31.0°S of the equator extending from tropical to sub-tropical zones. Sugarcane is grown in more than 110 countries in all over the world. In India, sugarcane is cultivated in all the parts of country from latitude 80°N to 33°N. The world's sugar production during 2015-2016 was 179.64 million tonnes whereas the sugar consumption during the period was 171.56 million tonnes (Indian Sugar, 2015). Brazil is the largest sugar producer with a production of about 39.65 million tonnes. India ranks second in sugar production with 25.81 million tonnes followed by china (10.50 million tonnes). In India, it is cultivated in nearly 5.06 million ha of area with the total production of 362.33 million tones and productivity of 71.80 tonnes/ha (Indian Sugar, 2015).

The amount of variability present in breeding material plays an important role in the progress of improvement of crop plants through selection. The knowledge of nature and extent of genetic variation available in the breeding material helps the breeder to identify the potential donors for crop improvement programmes. Therefore, the knowledge of variability is desirable for a breeder before making any selection program. All the breeding methods

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and strategies for crop improvement are fundamentally based on the availability of genetic variability in the populations. Genetic variability and heritability are useful parameters that can help the breeder during different stages of crop improvement. The success of breeding program will depend largely on the extent of genetic variability and heritability for important economic traits in early generation populations. Since the estimate of heritability alone gives no indication of the amount of progress expected from selection, the heritability estimate along with genetic advance is needed in predicting resultant effect from selecting the best individuals (Johnson *et al.*, 1955).

Keeping the above facts in view, 36 genotypes of Sugarcane were subjected to detailed investigation for the underlined objectives to estimate the variability, heritability and genetic advance for different morphological and juice quality characters among early generation clones of sugarcane.

Materials and Methods

Plant material

The present investigation was carried out to estimate the variability, heritability and genetic advance for different morphological and juice quality characters among early generation clones of sugarcane to identify donors from diverse groups for yield and quality parameters. The clones were selected from C_1 generation and were planted as C_2 generation at Sugarcane Breeding Block, NEB Crop Research Centre, G.B. Pant University of Agriculture and Technology, Pantnagar, Udham Singh Nagar with early generation clones of Sugarcane. Thirty-three early generation clones (C_2) of sugarcane along with three checks (CoPant 97222, CoS 8436, CoJ 64) were planted in randomized block design with three replications. Each experimental plot consisted of single row each of 3.50 metres with 90 cm row to row distance.

Data collection

The biometrical observations were recorded for the ten traits *viz.,* Number of Millable Canes (NMC), cane height (m), cane diameter (cm), single cane weight (Kg), juice brix %, juice sucrose %, juice purity %, Commercial Cane Sugar (CCS) %, cane yield (t/ha), Commercial Cane Sugar (CCS) yield (t/ha) for five randomly selected plants per genotype per replication and expressed in per plant basis.

Statistical Analysis

Variance analysis

The analysis of variance was performed following

Table 1: Analysis of variance for various yield contributing characters in sugarcane.

Source of variation	d.f.	Mean Square									
		NMC	Cane height(m)	Cane thickness(cm)	Single Cane weight(kg)	Juice Brix%	Juice sucrose %	Juice purity%	CCS% (t/ha)	Cane yield (t/ha)	CCS Yield
Replication	2	13.74	0.1385	0.00845	0.05918	1.283	0.748	1.712	0.317	16.562	0.1499
Treatment	35	309.039**	0.2099**	0.1872**	0.1944**	5.458**	4.473**	1.195**	2.199**	411.388**	5.248**
Error	70	41.086	0.0476	0.0374	0.0183	0.528	0.387	0.541	0.184	15.973	0.210
SE(Mean)		3.701	0.126	0.112	0.0779	0.419	0.359	0.424	0.248	2.308	0.264
CV%		11.028	9.124	8.548	11.097	4.254	4.136	0.836	4.139	5.728	6.344
CD at 5%		10.438	0.3552	0.3147	0.2199	1.184	1.012	1.197	0.699	6.509	0.746

**Significant at 1% level of probability the standard procedures given by Panse and Sukhatme (1969).

Coefficient of variability

The phenotypic and genotypic coefficient of variation (PCV and GCV) was computed as per method described by Burton and DeVane (1953). PCV and GCV values were categorized as low (0-10%), moderate (10-20%) and high (>20) values as indicated by Darvhankar *et al.*, 2016.

Heritability

Heritability (broad sense; hereafter denoted only heritability) estimate was computed by dividing the genotypic variance with phenotypic variance and then multiplying by 100 as suggested by Warner (1952). Heritability was classified as suggested by Robinson *et al.* (1949) into low (0-30%), moderate (30.1-60%) and high (>60%).

Genetic advance

Genetic advance was calculated by the formula as suggested by Lush (1949). Genetic advance as categorized into low (0- 10%), moderate (10.1-20%) and high (>20%) as suggested by Johnson *et al.* (1955).

Results and discussion

Analysis of variance

The analyses of variance indicating the mean sum of squares for all the ten characters studied are presented in the table 1. F-test revealed highly significant variation among the clones for all the characters studied such as NMC, cane height, cane thickness, single cane weight, juice brix%, juice sucrose%, juice purity, CCS%, Cane yield, CCS yield.

Coefficient of variability

The phenotypic and genotypic coefficient of variation were estimated for all the characters as shown in table 2. Comparative study of coefficient of variation on various characters revealed relatively high contribution of genotypic variation in determining the total phenotypic variation for most of the characters, except in case juice purity %, where environmental variation contributes a slightly high in total phenotypic variation. Highest GCV percent was exhibited by Single cane weight (Kg) (19.91%) followed by NMC (16.26%), cane thickness (cm) (9.89%) and Cane height (m) (9.74 %). Juice purity percent exhibited the lowest GCV percent (0.53%). PCV was recorded highest for single cane weight (Kg) (22.80%) followed by NMC (19.65%), cane height (m) (13.32%) and cane thickness (cm) (13.07 %). The lowest phenotypic coefficient of variation was observed for juice purity percent (0.99 %). The ECV percent was observed lowest for juice purity percent (0.836 %) while highest for single cane weight (Kg) (11.10 %).

The broad sense heritability value was estimated highest for juice sucrose percent (77.9 %), followed by single cane weight (kg) (76.3 %), Juice brix percent (75.7 %) and NMC (68.5 %). Heritability estimates in broad sense were moderate for the cane thickness (57.2%) and cane height (53.2 %) while the heritability estimated low for juice purity percent (28.8 %). The genetic advance as percent of mean for various characters ranged from lowest for juice purity percent (0.59 %) to highest for single cane weight (kg) (35.83 %). The genetic advance was estimated moderate for cane thickness (cm), cane height (m), juice brix percent and juice brix percent.

In may be concluded from the above results that high heritability coupled with high genetic advance as percent of means was observed for NMC/ha, Single cane weight (Kg), suggesting the preponderance of additive genetic effect in the determination of these characters. It also indicated that selection for these characters will be effective. However, high heritability with moderate genetic advance as percent of means was observed for

Table 2: Variability estimates for different characters in sugarcane

Characters	GM±SE	GCV	PCV	ECV	h^2(b)	GA	GA %
NMC	18.31±1.16	16.26	19.65	11.03	68.50	5.08	27.72
Cane height(m)	2.39±0.13	9.74	13.34	9.12	53.20	0.35	14.64
Cane thickness(cm)	2.26±0.11	9.89	13.07	8.55	57.20	0.35	15.39
Single cane weight (Kg)	1.22±0.08	19.91	22.80	11.10	76.30	0.44	35.83
Juice brix %	17.09±0.42	7.50	8.63	4.25	75.70	2.30	13.44
Juice sucrose%	15.05±0.36	7.77	8.80	4.14	77.90	2.12	14.12
Juice purity %	87.96±0.42	0.53	0.99	0.84	28.80	0.52	0.59
CCS %	10.37±0.25	7.90	8.92	4.14	78.50	1.50	14.42
Cane yield (t/ha)	21.97±0.73	16.46	17.43	5.73	89.20	7.04	32.02
CCS yield (t/ha)	2.28±0.08	17.92	19.01	6.35	88.80	0.79	34.78

juice brix percent, juice sucrose percent, cane height (m) and cane thickness (cm) indicating the role of dominant genetic effects in determination of these characters and it require careful selection for the desired improvements in the characters.

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