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Variability and Heritability Studies in Sugarcane (*Saccharum officinarum* L.)

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ABSTRACT

An experiment was conducted at Sugarcane Research Station, Vuyyuru, Andhra Pradesh during 2015-16 season, with an objective to study the variability, heritability and genetic advance of eleven sugarcane genotypes (eight clones and three standards) for fourteen characters. The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the masking effect of the environment. Estimates of phenotypic and genotypic coefficients of variation were found to be moderate for single cane weight at harvest, per cent fibre at 10th month, CCS yield and cane yield indicating the presence of moderate variability for these traits in the genotypes studied. High heritability values coupled with high genetic advance as per cent of mean recorded for single cane weight at harvest, CCS yield and cane yield and high heritability and moderate genetic advance as per cent of mean values recorded for per cent juice sucrose at 10th month, per cent CCS at 10th month and per cent fibre at 10th month indicate the predominance of additive gene action in the inheritance of these characters. Non additive gene action was found to be predominant for shoot population at 120 DAP, stalk population at 240 DAP, length of millable cane at harvest, diameter of millable cane at harvest, per cent brix at 10th month and per cent purity at 10th month. Predominance of both additive and non additive gene actions were observed in the inheritance of number of germinants at 35 DAP and number of millable canes at harvest.

Key words: *Genetic advance, Heritability, Sugarcane, Variability.*

Sugarcane varieties in commercial cultivation are complex polyploids and the heterozygous and polyploid nature of this crop has resulted in generation of sufficient genetic variability. Evolution of superior genotypes with most of the desirable attributes is the need of the hour as it is necessary to have more varieties under cultivation so that epidemics are under check for a long time. A clear understanding of genetic parameters is of paramount importance to develop a breeding strategy. The present study was conducted to know the variability parameters for yield, yield components and juice quality parameters in sugarcane.

MATERIAL AND METHODS

The present investigation was carried out at Sugarcane Research Station, Vuyyuru, Andhra Pradesh during 2015-16 season with eight early maturing sugarcane clones *viz.,* 2010 V 50, 2011 V 100, 2011 V 126, 2011 V 127, 2011 V 137, 2011 V 140, 2011 V 164 and 2011 V 226 along with three standards Co 6907, 87 A 298 and 2003 V 46 following Randomized Block Design with three replications. Each genotype was planted in eight rows of eight metres length spaced at distance of 80 cm between the rows with four three budded setts per meter as seed rate. Standard agronomic practices were followed to maintain optimum plant population. Data were recorded on fourteen characters *viz.,* number of germinants at 35 DAP, shoot population at 120 DAP, stalk population at 240 DAP, number of millable canes at harvest, length of millable cane at harvest, diameter of millable cane at harvest, single cane weight at harvest, per cent brix at 10th month, per cent juice sucrose at 10th month, per cent CCS at 10th month, per cent purity at 10th month, per cent fibre at 10th month, CCS yield and cane yield and the data was subjected to statistical analysis on genetic parameters such as phenotypic coefficient of variation (PCV), genotypic coefficient of variation (GCV) using the formulae given by Burton (1952), heritability in broad sense calculated using the formula given by Hanson *et al.,* (1956) and genetic advance as per cent of mean estimated by formula suggested by Johnson *et al*., (1955).

RESULTS AND DISCUSSION

The analysis of variance indicated significant differences among eleven genotypes for all the characters studied (Table 1). The genetic variability studies indicated that material used in the present investigation possessed considerable variability which provides sufficient basis for selection by the breeder. The genotypic coefficients of variation for all the characters studied were lesser than the phenotypic coefficients of variation indicating the masking effect of the environment (Table 2).

Estimates of phenotypic and genotypic coefficients of variation were found to be moderate for single cane weight at harvest (17.01 and 15.36 respectively), per cent fibre at 10th month (11.92 & 10.64), CCS yield (17.0 & 14.79) and cane yield (14.74 & 12.35) indicating the presence of moderate variability for these traits in the genotypes studied. Hence improvement can be anticipated through simple selection. Sanghera *et al.* (2014) and Tyagi *et al.* (2011) reported similar results for single cane weight at harvest, CCS yield and cane yield. Moderate PCV coupled with low GCV were observed for number of germinants at 35 DAP, shoot population at 120 DAP and stalk population at 240 DAP which were in accordance with results reported by Pawar *et al.* (2011). Further, moderate PCV and low GCV were also recorded for number of millable canes at harvest (13.04 & 8.19) and length of millable cane at harvest (10.21 & 6.10). These results were supported by Kumar and Ram (2014) and Tadesse *et al.* (2014). Low PCV and GCV observed for diameter of millable cane at harvest , per cent brix at 10th month, per cent juice sucrose at 10th month, per cent CCS at 10th month and per cent purity at 10th month were also reported by Anbanandan and Saravanan (2010).

High heritability values coupled with high genetic advance as per cent of mean were recorded for single cane weight at harvest (81.6 & 28.59 respectively, CCS yield and cane yield (93.30 & 21.30). Similar results were reported by Anbanandan and Saravanan (2010). High

Table 1. Analysis of variance for yield, yield components and juice quality parameters in 11 genotypes of sugarcane (*Saccharum officinarum* L.).

		Mean sum of squares						
Source of variations	d.f	Number of germinants at 35 DAP plot^{-1}	Shoot population at 120 DAP plot^{-1}	Stalk population at 240 DAP plot^{-1}	Number of millable-canes plot^{-1} at harvest	Length of millable cane(cm) at harvest	Diameter of millable cane(cm) at harvest	Single cane weight(kg) at harvest
Replications	2	1885.85	5508.39*	2496.48*	4140.82	551.77	0.02	0.03
Treatments	10	2699.82**	3899.47*	2222.73*	2768.99*	1164.47*	0.08**	0.17**
Error	20	659.98	1495.09	682.35	530.65	437.43	0.01	0.01
Total	32	1374.05	2497.29	1277.10	1455.77	671.78	0.04	0.06

		Mean sum of squares						
Source of variations	d.f	Per cent brixat 10th month	Per cent juice sucrose at 10th month	Per cent CCS at 10th month	Per cent purityat 10th month	Per cent fibreat 10th month	CCS yield (kg plot^{-1})	Cane yield (kg plot^{-1})
Replications	2	0.61	0.51	0.03	0.28	0.02	29.40	2297.48
Treatments	10	3.37**	5.66**	23.08**	3.91**	6.01**	238.09**	10018.16**
Error	20	0.36	0.24	1.59	0.13	0.47	23.04	1245.02
Total	32	1.32	1.95	8.21	1.32	2.18	90.64	4052.41

* Significant at 5% level of probability ** Significant at 1% level of probability

Table 2. Mean, variability, heritability, genetic advance and genetic advance as percent of mean for yield, yield components and Juice quality parameters in sugarcane (*Saccharum officinarum* L.).

S. No.	Character	Mean	Range		GCV (%)	PCV (%)	Heri tability (%)	Genetic advance	GA (as % mean)
			Min	Max					
1.	Number of germinants at 35 DAP plot^{-1}	309.79	265.67	356.00	‘8.42	11.82	50.70	38.26	12.35
2.	Shoot population at 120 DAP plot^{-1}	403.67	343.00	446.67	7.01	11.87	34.90	34.45	8.53
3.	Stalk population at 240 DAP plot^{-1}	319.67	275.00	357.00	7.09	10.82	42.90	30.59	9.57
4.	Number of millable canes plot^{-1} at harvest	302.27	252.33	341.00	8.19	13.00	39.70	32.15	10.64
5.	Length of millable cane (cm) at harvest	255.40	210.60	287.27	6.10	10.21	35.70	19.15	7.50
6.	Diameter of millable cane (cm) at harvest	2.77	2.42	2.99	5.50	7.01	61.60	0.25	8.89
7.	Single cane weight (kg) at harvest	1.49	1.10	1.84	15.36	17.01	81.60	0.43	28.59
8.	Per cent brix at 10th month	19.58	16.89	20.26	5.11	5.96	73.40	1.77	9.02
9.	Per cent juice sucrose at 10th month	18.00	14.41	19.18	7.44	7.92	88.30	2.60	14.41
10.	Per cent CCS at 10th month	13.09	10.06	14.09	8.58	9.01	90.70	2.20	16.82
11.	Per cent purity at 10th month	92.17	85.69	95.25	2.90	3.21	81.90	4.99	5.41
12.	Per cent fibre at 10th month	12.77	11.23	15.67	10.64	11.92	79.70	2.50	19.57
13.	CCS yield (kg plot^{-1})	57.23	40.61	69.54	14.79	17.00	75.70	15.17	26.51
14.	Cane yield (kg plot^{-1})	437.97	315.33	499.00	12.35	14.74	70.10	93.30	21.30

heritability and moderate genetic advance as per cent of mean values were recorded for per cent juice sucrose at 10th month, per cent CCS at 10th month, supported by Kumar and Ram (2014) and per cent fibre at 10th month, supported by Doule and Balasundaram (2004). The results indicate the predominance of additive gene action in the inheritance of these characters and improvement of these traits will be possible through simple selection.

High heritability and low genetic advance as per cent of mean values were also recorded for diameter of millable cane at harvest, per cent brix at 10th month, supported by Tyagi *et al.,* (2011) and per cent purity at 10th month, supported by Bora *et al.,* (2014). Moderate heritability values coupled with low genetic advance as per cent of mean were recorded for shoot population at 120 DAP, stalk population at 240 DAP and length of millable cane at harvest. The results indicate the predominance of non additive gene action in the inheritance of these characters and the desired results may not be obtained by simple selection. Moderate heritability values coupled with moderate genetic advance as per cent of mean were recorded for number of germinants at 35 DAP (50.7 & 12.35 respectively) and number of millable canes at harvest (39.7 & 10.64) indicating the predominance of both additive and non additive gene actions in the inheritance of these characters.

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