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GENETIC VARIABILITY FOR CANE YIELD AND QUALITY TRAITS IN SUGARCANE

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ABSTRACT

The experiment was conducted at Sugarcane Research Institute, Pusa, Samastipur, Bihar, during 2009-10 cropping season in Randomized Block Design (RBD) with three replications. The experimental material comprised of 10 diverse genotypes of sugarcane. The data were recorded on fifteen yield and quality traits viz., germination%, number of shoots at 120 DAP and at 240 DAP, number of millable canes, single cane weight, cane diameter, cane height, brix %, sucrose %, purity % and CCS % at10 and 12 months stage, CCS (t/ha) and cane yield (t/ha). The analysis of variance revealed significant differences among the clones for all the traits studied. The magnitudes of phenotypic variances were higher than genotypic variances for all the traits. High heritability estimates were recorded for number of shoots at 120 DAP (79.32%), single cane weight (74.49%), sucrose at 10 months (70.22%), Brix at 12 months (66.34%) and germination at 45 DAP (63.00%). High heritability accompanied with high genetic advance as percent of mean was recorded by number of shoots at 120 DAP. High genetic advance (as percent of mean) was recorded for CCS (t/ha) and number of shoots at 120 DAP while moderate genetic advance as percent of mean were recorded by germination at 45 DAP, number of shoots at 240 DAP, cane height and single cane weight. High heritability accompanied with high genetic advance as percent of mean was recorded by number of shoots at 120 DAP. The mean performance of different clones for traits studied ranged, germination at 45 DAP (26.23-36.20), number of shoots at 120 DAP (118.70-144.00), number of shoots at 240 DAP (119.3 to 168.9), number of millable canes (92.3-117.4), single cane weight (0.52-0.65), cane diameter (1.94-2.22) and cane height (2.42 – 3.25). A good range of juice quality parameters was recorded viz. brix (18.2 – 20.2%), sucrose% (15.6-17.98%) and purity (86.6 – 89.63%) between clones at 10 month stage while,juice quality parameters at 12 months ranged for brix (18.13 – 21.33%), sucrose % (15.96 - 18.39%) and purity (83.4 – 88.87%). The characters with high heritability coupled with genetic advance and positive association with cane yield are advocated as selection criteria for yield improvement in sugarcane and identification of promising clones under sub-tropical conditions.

Key words : Sugarcane, genetic variability, heritability, genetic advance and cane yield.

Sugarcane (*Saccharum* spp. complex) is an important cash crop of India for sugar industry. It is generally grown in both tropics and sub-tropic regions, however its productivity depends on the varieties cultivated from different maturity groups, prevailing agro-climatic conditions of the region and other cultural practices to great extent. The subtropical region for sugarcane cultivation occupies more than 50 per cent of the national area.This species has C4 photosynthesis, resulting in a vigorous biomass accumulation under tropical conditions, but it is limited in temperate regions due low temperature during early growth period and at maturity. Sugarcane is responsible for ~70% raw table sugar production worldwide (Contreras et al., 2009). The subtropical region for sugarcane cultivation occupies more than 50 per cent of the national area (5.06 m ha) with a productivity of 66.9 t/ha, cane yield of 338.9 million tons and sugar 25.0 million tonnes. It is clonally propagated via stem cuttings, facilitating the preservation of cultivar genetic identity in this crop. Sugarcane varieties in commercial cultivation are complex polyploid. The heterozygous and polyploid nature of this crop has resulted in generation of greater genetic variability. The extent of genetic variability present in any crop is of paramount importance for its improvement. The information on the nature and the magnitude of variability present in the genetic material is of prime importance for a breeder to initiate any effective selection program. Genotypic and phenotypic coefficients of variation along with heritability as well as genetic advance are very essential to improve any trait of sugarcane because this would help in knowing whether or not the desired objective can be achieved from the material (Tyagi and Singh, 1998). Since, cane yield is a complex trait the association of different traits with it would be an important criterion for the development of high yielding, high sugared and early maturing varieties in sugarcane. So, present study was under taken to assess the extent of genetic variability, heritability and genetic advance of yield and yield and

Table-1 : Estimation of genetic variability parameters of variability in ten sugarcane genotypes for yield and quality traits.

Sl. No.	Characters	Mean	VG	VP	GCV	PCV	h^2(bs)%	GA	GAM
1.	Germination at 45 DAP	32.25	9.04	14.35	9.32	11.76	63.00	4.92	15.24
2.	No. of shoots 120 DAP	131.07	221.23	278.90	11.34	12.74	79.32	27.17	20.73
3.	No. of shoots 240 DAP	148.24	162.61	281.03	8.60	11.30	57.86	20.02	13.51
4.	No. of millable canes	109.00	37.69	80.55	5.63	8.23	46.78	8.68	7.97
5.	Single cane weight	0.58	0.0011	0.0015	5.71	6.67	74.49	0.06	10.17
6.	Cane diameter	2.10	0.0070	0.0144	3.10	5.71	48.45	0.12	5.65
7.	Cane height	2.70	0.05	0.09	8.28	11.11	54.50	0.33	12.36
8.	Brix % at 10 months	18.79	0.21	0.46	2.43	3.60	45.28	0.62	3.34
9.	Sucrose at 10 months	16.43	0.33	0.47	3.49	4.17	70.22	0.99	6.02
10.	Purity % at 10 months	87.87	0.68	1.67	0.94	1.47	40.54	1.09	1.24
11.	Brix at 12 months	19.97	0.97	1.46	4.93	6.05	66.35	1.64	8.22
12.	Sucrose at 12 months	17.27	0.25	1.08	2.90	6.02	23.27	0.49	2.85
13.	Purity % at 12 months	86.55	1.20	4.21	1.26	2.37	28.55	1.23	1.41
14.	CCS (t/ha)	7.51	12.61	34.26	47.28	77.93	36.81	4.46	59.40
15.	Cane Yield (t/ha)	63.45	0.26	0.47	0.80	1.08	54.67	0.78	1.22

Note: VG= Genotypic variance, VP= Phenotypic variance, GCV = Genotypic coefficient of variation, PCV = Phenotypic coefficient of variation, h^2= heritability in broad sense and GA as % of mean= Genetic Advance as percent of mean

quality attributing traits of elite sugarcane clones under subtropical condition of India.

MATERIALS AND METHODS

The experiment was conducted at Sugarcane Research Institute, Pusa, Samastipur, Bihar, during 2009-10 cropping season in Randomized Block Design (RBD) with three replications. The experimental material comprised of 10 diverse genotypes of sugarcane. The three eyed setts of each genotype were planted in 6?m × 5.4?m size plot with row to row distance as 0.90?m. Setts were placed in the furrow following end to end method at the rate of 12 buds/eyes per meter. The data were recorded on fifteen yield and quality traits viz., germination%,, number of shoots at 120 DAP and at 240 DAP, number of millable canes, single cane weight, cane diameter, cane height, brix %, sucrose % and purity %, CCS % at10 and 12 months stage, , CCS (t/ha) and cane yield (t/ha).The data were statistically analyzed and analysis of variance was used for calculating genotypic and phenotypic coefficients of variance for all characters. The broad sense heritability was estimated according to the method suggested by Johnson et al. (1955) and the expected genetic advance was calculated by the method given by Robinson et al. (1949).

RESULTS AND DISCUSSION

The analysis of variance revealed highly significant differences among the genotypes for all the characters studied. This indicates that there was significant amount of phenotypic variability present in the genotypes differ with regard to the characters that opened a way to proceed for further improvement through simple selection (Punia, 1982). Mean values for germination at 45 DAP varied from 26.23 - 36.20 and number of shoots at 120 DAP varied from 118.70-144.00 while number of shoots at 240 DAP ranged from 119.3 to 168.9 (Table 1). Likewise, number of millable canes ranged from 92.3-117.4 with an average of 109. Single cane weight varied from 0.52-0.65 kg and cane diameter ranged from 1.94-2.22 cm while cane height ranged from 2.42 -3.25 meters. A good range for juice quality parameters was recorded viz. brix (18.2 – 20.2%), sucrose % (15.6-17.98%) and purity (86.6 – 89.63%) between clones at 10 month stage while, juice quality parameters at 12 months ranged for brix (18.13 – 21.33%), sucrose % (15.96-18.39%) and purity (83.4 – 88.87%). Magnitudes of phenotypic variances were higher than genotypic variances for all the traits. The high phenotypic and genotypic coefficients of variation were observed CCS (t/ha) and number of shoots at 120 DAP. High genotypic and phenotypic coefficients of variation for CCS were reported earlier by Singh and Sangwan (1980).

After partitioning phenotypic variance, it was found that genotypic variance was higher than the environmental one for five characters studied. These results indicate that a negligible role was played by the environmental factors in the inheritance of these characters in sugarcane. The high genotypic variance for different traits in sugarcane has also been reported by other researchers (Balasundarum and Bhagyalakshmi, 1978; Nair *et al*., 1980). Genotypic coefficient of variation is not a correct measure to know the heritable variation present and should be

considered together with heritability estimates. In the present study, high heritability estimates were recorded for number of shoots at 120 DAP (79.32%), single cane weight (74.49%), sucrose at 10 months (70.22%), brix at 12 months (66.34%) and germination at 45 DAP (63.00%) (Table-1). This suggests that simple selection for these traits would be effective. Moderate heritability's were recorded for number of shoots at 240DAP (57.86%), cane yield (54.67%), cane height (54.50%), cane diameter (48.45%), Brix% at 10 months (45.28%), number of millable canes (46.78%), purity percent at 10 months (40.54%), and CCS (t/ha) (36.81%). Similar results were obtained by Sahi *et al.* (1977) for juice quality characters. Heritability estimates along with expected genetic gain is more useful than the heritability value alone in predicting the resultant effect for selecting the best genotypes (Johnson *et al*., 1955). Maximum genetic advance was observed for number of shoots at 120 DAP followed by number of shoots at 120 DAP indicating that there exists a scope to improve cane yield to a considerable extent by adopting suitable breeding procedures. High genetic advance (as percent of mean) was recorded for CCS (t/ha) and number of shoots at 120 DAP while moderate genetic advance as percent of mean were recorded by germination at 45 DAP, number of shoots at 240 DAP, cane height and single cane weight. High genetic advance (as percent of mean) for CCS (t/ha) was also reported by Tyagi and Singh (1998). Stalk diameter had low heritability with moderate genetic advance. Pandey (1989) had earlier reported the low genetic advance with moderate amount of heritability for stalk diameter suggesting a little scope in the improvement of this character. High heritability accompanied with high genetic advance as percent of mean was recorded by number of shoots at 120 DAP. This study revealed that characters with high heritability coupled with genetic advance and positive association with cane yield are advocated as selection criteria while selection to be made for higher sugar and cane yield and early maturing clones in sugarcane genotypes under subtropical conditions.

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