Website : www.asthafoundation.in
Progressive Research : An International Journal
Vol 17 (1) : 57-61 (January-2022), Print ISSN : 0973-6417, Online ISSN : 2454-6003
Society for Scientific Development in Agriculture and Technology, Meerut (U.P.) India

Studies on Genetic Parameters, Correlation and Path Analysis in Sugarcane

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Abstract

In the present study nineteen promising sugarcane clones were evaluated forseven yield components and five quality traits.Analysis of variance for nineteen clones revealed significant differences among sugarcane clones for all the twelve traits studied indicating the presence of considerable genetic variability among the clones studied.High PCV and GCV were recorded for CCS yield, cane yield, number of millable canes at harvest and single cane weight indicating sufficient variation among the genotypes for these traitsand selection may be effective for these characters.High heritability along with high genetic advance was observed for CCS yield (46.42 %), cane yield (44.26 %) followed by number of millable canes at harvest (42.74 %).Cane yield, CCS %, sucrose %, number of millable canes, purity %, brix % and cane length, number of millable canes, cane length, internode length, single cane weight and internode number showed positive and significant correlation with CCS yield. Path coefficients indicated that cane yield had largest direct contribution followed by purity percent, sucrose %, cane length and cane girth on CCS yield.

Key words : *Sugarcane, variability, correlation, path analysis, yield and quality traits.*

Introduction

Sugarcane is one of the most important cash crops in India. In India Sugarcaneis grown in an area of 51.59 lakh ha with the production of 383.89 million tons with an average productivity of 74.4 t/ha of cane yield and 32.82 million tons of sugar production during 2018-19. Sugarcane varieties tend to run out or decline after some years of cultivation in a specific area (1). To obtain high yield on a sustainable basis, it has been essential to substitute regularly with newly developed clones. Insugarcane breeding program, main objective is to develop high yielding clones with good quality traits which improve the profitability of the sugar industry. Many characters have been identified as indirect selection indices in sugarcane breeding programmes (2) and yield in sugarcane is dependent on a number of factors. Knowledge of relationship of yield and quality component traits for cane yield improvement is desirable to adopt the most appropriate selection criteria in breeding. Apart from number of multivariate techniques used to determine genetic divergence in a variety of crops. Cluster analysis is also one of the most commonly used technique to determine genetic divergence and clones/varieties belonging to these clusters can be used in breeding programme because of presence of maximum diversity (3). Information on genetic parameters and the interrelationships among cane yield, yield componentsand quality traits is considered as utmost importance in selection of promising clones in sugarcane (4, 5). In order to meet sugar requirement of the country varieties not only with high cane yield but also with high sucrose have to be developed. Breeding for higher CCS yield is imperative to achieve self sufficiency in sugar production.In the present study, an attempt was made to generate information on genetic parameters, correlation and direct and indirect causal effects among yield components and quality traits on final targeted CCS yield in sugarcane.

Materials and Methods

In the present study nineteen promising sugarcane clones were evaluated forseven yield components and five quality traits. The present study was conducted at Agricultural Research Station, Perumallapalle, Tirupati during 2009-10. The experimental material comprised of nineteen promising sugarcane clones which were developed from Agricultural Research Station, Perumallapalle (11 clones: 2003 T 114, 2003 T 121, 2003 T 123, 2003 T 129, 2004 T 67, 2005 T 16, 2003 T 112, 2004 T 68, 2005 T 50, 2005 T 52, 2005 T 89), Regional Agricultural Research Station, Anakapalle (3 clones: 2002 A 192, 2000 A 213, 2000 A 225), Agricultural Research Station, Vuyyuru (2 clones: 2002 V 2 and 2002 V 48) and checks (2003 V 46, Co 6907 and 83 V 15 representing early and mid-late maturing groups). Experiment was laid out in randomized complete block design with three replications, each clone planted in eight rows and each row having of six meter length. Early clones were harvested at 300 days and midlate clones at 360 days after planting. All the recommended package of practices wasadopted during the entire crop season to raise healthy crop. Observations were recorded on ten randomly selected canes for each entry at harvesting oncane length

Received : November-2021; Revised : November-2021; Accepted : November-2021

Table-1 : Genetic parameters for cane yield components and quality traits in sugarcane.

Character	Mean	Genotypic coefficient of variation (GCV) %	Phenotypic coefficient of variation (PCV) %	Heritability in broad sense %	Genetic advance (GA) %	Genetic advance as percent of mean (GAM)
Cane length (m)	2.532	15.149	17.189	77.671	0.696	27.503
Cane girth (cm)	3.175	13.609	14.626	86.571	0.828	26.084
Internode number	29.246	9.925	11.583	73.424	5.124	17.52
Internode length (cm)	9.675	16.672	18.555	80.737	2.986	30.86
Single cane weight (kg)	1.396	19.893	22.271	79.786	0.511	36.604
Number of millable canes (000/ha)	70.614	21.927	23.168	89.571	30.187	42.749
Brix %	17.912	8.598	9.776	77.347	2.79	15.577
Sucrose%	14.886	13.459	15.006	80.437	3.702	24.866
Commercial cane sugar (CCS) %	9.989	16.121	18.17	78.714	2.943	29.464
Purity%	82.804	5.896	7.33	64.695	8.089	9.768
Cane yield (t/ha)	96.419	23.294	25.253	85.087	42.678	44.263
Commercial cane sugar (CCS) yield (t/ha)	9.651	25.003	27.744	81.222	4.48	46.42

(m), cane diameter (cm), internode number, internode length, single cane weight (kg), number of millable canes (000/ha), brix per cent, sucrose per cent, commercial cane sugar (CCS) per cent, purity percent, cane yield (t/ha) and commercial cane sugar (CCS) yield (t/ha).The data were subjected to statistical analysis for genetic variability, phenotypic and genetic coefficient of variation, genetic advance as percent mean for all studied characters according to (6). The broad sense heritability was estimated according to the method suggested by (7). Correlation coefficients among the characters under study were estimated according to the statistical techniques outlined by (8). The total correlation coefficient of various yield contributory characters with regard to CCS yield was partitioned into direct and indirect effects following the methods adopted by (9).

Results and Discussion

Analysis of variance for nineteen clones revealed significant differences among sugarcane clones for all the twelve traits studied indicating the presence of considerable genetic variability among the clones studied. Phenotypic coefficient of variance (PCV) is slightly higher than genotypic coefficient of variance (GCV) for the traits studied indicating the less interaction of traits with environment (Table-1). High PCV and GCV were recorded for CCS yield, cane yield, number of millable canes at harvest and single cane weight indicating sufficient variation among the genotypes for these traitsand selection may be effective for these characters. Significant variation for CCS yield and cane yield was reported by (10). (11) had reported high values of genotypic and phenotypic coefficient of variation for millable cane number. Tadesse *et al.,* (2014) reported similar results for CCS yield and cane yield. Among the traits purity %, brix % and internode number had low GCV and PCV values indicating the presence of limited genetic variability for these characters. These findings are in agreement with (12). Genotypic coefficient of variation is not a correct measure to know the heritable variation present and should be considered together with heritability estimates. Heritability estimates for all the traits under study were high ranging from 64.69 to 89.57 %. Among all the characters the highest heritability was recorded for number of millable canes at harvest (89.57 %) followed by cane girth (86.57), cane yield (85.08 %), and CCS yield (81.22%). (13) mentioned that high heritability coupled with high GCV and PCV indicated that traits were controlled by additive gene action. Hence, phenotypic selection could be effective in improvement of such traits.The results clearly indicated the importance of CCS yield, cane yield and number of millable canes as they revealed high GCV and PCVcoupled with high heritability. (14) reported similar results for sugar yield and cane yield. (15) found high heritability for millable cane number. High heritability alone is not a sufficient criterion to exercise the selection unless the information is accompanied with substantial amount of genetic advance. Genetic advance is another important selection parameter which can be exploited along with heritability of the trait in varietal development. In the study high heritability along with high genetic advance was observed for CCS yield (46.42%), cane yield (44.26%) followed by number of millable canes at harvest (42.74%) indicating the importance of additive gene action in governing the inheritance of these traits. These results are in

Table-2 : Phenotypic correlations among cane yield components and quality traits in sugarcane.

Character	Cane length (m)	Cane girth (cm)	Inter node number	Inter node length (cm)	Single cane weight (kg)	Number of millable canes (000/ha)	Brix %	Sucrose%	Commercial cane sugar (CCS) %	Purity%	Cane yield (t/ha)
Cane girth (cm)	-0.085NS										
Internode number	0.412**	0.190NS									
Internode length (cm)	0.705**	-0.227NS	0.042NS								
Single cane weight (kg)	0.296*	0.291*	-0.016NS	0.098NS							
Number of millable canes (000/ha)	0.487**	-0.128NS	0.352**	0.538**	-0.124NS						
Brix %	-0.247NS	0.312*	-0.109NS	-0.222NS	-0.157NS	-0.046NS					
Sucrose %	-0.243NS	0.267*	-0.080NS	-0.193NS	-0.206NS	-0.048NS	0.928**				
Commercial cane sugar (CCS) %	-0.241NS	0.245NS	-0.075NS	-0.184NS	-0.215NS	-0.054NS	0.885**	0.994**			
Purity %	-0.187NS	0.117NS	-0.006NS	-0.109NS	-0.269*	-0.029NS	0.598**	0.851**	0.900**		
Cane yield (t/ha)	0.653**	0.045NS	0.340**	0.551**	0.514**	0.748**	-0.169NS	-0.156NS	-0.154NS	-0.113NS	
Commercial cane sugar yield (t/ha)	0.331*	0.192NS	0.191NS	0.290*	0.177NS	0.568**	0.485**	0.577**	0.582**	0.557**	0.653**

Table-3 : Path analysis for cane yield components and quality traits in sugarcane.

Character	Cane length (m)	Cane girth (cm)	Inter node number	Inter node length (cm)	Single cane weight (kg)	Number of millable canes (000/ha)	Brix %	Sucrose %	Commercial cane sugar (CCS) %	Purity %	Cane yield (t/ha)	Commercial cane sugar (CCS) yield (t/ha)
Cane length (m)	0.076	-0.003	-0.046	-0.061	-0.037	-0.027	0.003	-0.828	0.833	-0.158	0.579	0.331*
Cane girth (cm)	-0.006	0.032	-0.021	0.020	-0.037	0.007	-0.004	0.908	-0.846	0.099	0.040	0.192NS
Internode number	0.031	0.006	-0.112	-0.004	0.002	-0.020	0.001	-0.272	0.260	-0.005	0.301	0.191NS
Internode length (cm)	0.054	-0.007	-0.005	-0.086	-0.012	-0.030	0.003	-0.656	0.635	-0.092	0.488	0.290*
Single cane weight (kg)	0.023	0.009	0.002	-0.008	-0.126	0.007	0.002	-0.701	0.743	-0.227	0.455	0.177NS
Number of millable canes (000/ha)	0.037	-0.004	-0.039	-0.047	0.016	-0.056	0.001	-0.164	0.187	-0.025	0.663	0.568**
Brix %	-0.019	0.010	0.012	0.019	0.020	0.003	-0.011	3.156	-3.061	0.505	-0.149	0.485**
Sucrose%	-0.019	0.009	0.009	0.017	0.026	0.003	-0.011	3.400	-3.438	0.719	-0.138	0.577**
Commercial cane sugar (CCS) %	-0.018	0.008	0.008	0.016	0.027	0.003	-0.010	3.382	-3.458	0.760	-0.136	0.582**
Purity%	-0.014	0.004	0.001	0.009	0.034	0.002	-0.007	2.895	-3.111	0.845	-0.100	0.557**
Cane yield(t/ha)	0.050	0.001	-0.038	-0.048	-0.065	-0.042	0.002	-0.530	0.532	-0.095	0.886	0.653**

accordance with (16) for number of millable canes, cane yield and sucrose yield and (17) for cane yield and CCS yield.

The correlation coefficients among various characters are presented in Table-2. Cane yield, CCS %, sucrose %, number of millable canes, purity %, brix % and cane length, number of millable canes, cane length, internode length, single cane weight and internode number showed positive and significant correlation with CCS yield. This suggests selection for these traits would improve the CCS yield in Sugarcane. Cane yield showed positive and significant correlation with number of millable canes, cane length, internode length, single cane weight and internode number. Similar results were recorded for single cane weight, cane length and number of millable canes by (18). Results indicated that cane yield, single cane weight, number of millable canes, cane length, internode length and internode number could be considered together in a positive direction towards an ultimate aim of developing high yielding sugarcane clones. Thus strong correlation among these traits indicated that improvement in one attributes would certainly leads to the improvement in other traits in desired direction. These results are in conformity with the observation of (19). There was no significant correlation of cane yield observed with any of the quality characters. Quality parameters showed negative non significant correlation with cane yield. These results were also in conformity with the findings of (20). The quality characters also had strong positive significant association with each other (Table-2). CCS yield was positively and significantly correlated with all the quality traits along with cane yield, number of millable canes, cane length and internode length. The non significant correlations of quality parameters with cane yield are nullified when CCS yield was considered for selection due to the correlation of CCS yield with cane yield.Similar results were reported by (21). Thus, in order to determine the contribution of various characters towards CCS yield, it was necessary that the correlation between CCS yield and component characters be partitioned into direct and indirect effects. The result of path coefficient analysis for yield components and quality traits was presented in Table-3. Path coefficients indicated that cane yield had largest direct contribution followed by purity percent, sucrose %, cane length and cane girth on CCS yield. Cane yield was considered asthe most important CCS yield contributing trait along with purity and sucrose percentages. Hence selection for higher CCS yield should be aimed to satisfy the needs of both farmers and sugarindustry thus producing higher sugar in the country.

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