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VARIABILITY, CHARACTER ASSOCIATIONS AND SELECTION OF PARENTS IN GENETICALLY DIVERSE POPULATIONS OF SUGARCANE UNDER CONDITIONS OF NORTH WESTERN ZONE

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With an objective to identify new donors for different characters from genetically diverse material involving various *Saccharum* species, forty hybrids each during 1990-91 (set- I), 1991-92 (set-II) and 1992-93 (set-III) cropping seasons were evaluated. Correlations among stalk yield and its components showed that number of millable stalks (NMS) and stalk length were positively associated with stalk yield in all three sets whereas with sugar yield, stalk yield in all three sets and quality traits in set-II and set-III were positively associated. Path analysis revealed the importance of NMS in all three sets, stalk length in set-II and single stalk weight (SSW) in set-III for increasing stalk yield. For sugar yield, NMS in set-I, brix and CCS per cent in set-II, sucrose per cent and SSW in set-III would prove reliable. Twenty six elite clones combining stalk yield and juice quality attributes were identified. Apart from these, donors for seven individual traits of yield and quality and red rot resistance were also identified. Utilization of selected clones in combination with proven parents/commercial hybrids is suggested.

Key words : Variability, correlation and path analyses, selection, interspecific hybrids, *Saccharum* spp.

The use of interspecific hybridization in sugarcane breeding has enabled the successful incorporation of vigour and disease resistance from wild species into the high sucrose clones of *S. officinarum*. Despite the broad extent of successful interspecific and intergeneric hybridization with *Saccharum*, relatively few clones of wild species occur in the pedigree of modern sugarcane cultivars and the progress in improvement of commercially cultivated varieties has been achieved almost entirely with a germplasm base which is now five to seven decades old. However, there have been some awareness of limited genetic base of modern hybrids and a realisation that naturally occurring forms of *Saccharum* may have good chances to contribute much more. Consequently, the need for a new cycle of nobilization using diverse clones of *S. officinarum, S. spontaneum, S. sinense, S. barberi* and *S. robustum* has been suggested by many workers (Walker, 1972; Ethiraja, 1987; Heinz, 1987; Rao, 1987) in order to broaden the genetic base in sugarcane. Considering these observations a programme on utilization of *Saccharum* species clones was initiated at Sugarcane Breeding Institute, Coimbatore during early nineties. The selected material was sent to four locations, including Karnal, representing different zones of sugarcane for further evaluation under local conditions and identification of elite donors for different zones. The present investigation aims to estimate variability, correlation and direct and indirect relationships between various yield and quality attributes and their relative impact on stalk and sugar yield to identify important character associations for selecting donors suitable for North Western Zone for further use in breeding.

MATERIALS AND METHODS

The experimental materials comprised of hybrid progenies from crosses involving commercial hybrids, *S. officinarum*, *S. barberi*, *S. sinense*, *S. spontaneum* and *S. robustum*. Forty hybrids each during 1990-91 (set-I), 1991-92 (set-II) and 1992-93 (set-III) seasons (Table 1) were evaluated in randomised block designs with two replications. Each hybrid was grown in a three row plot, 6m long, spaced 85 cm apart. Twenty four three- buded setts were planted in a row at equal distance. The trials were harvested after 360 days and data on twelve quantitative characters were recorded. Statistical analyses were done following standard procedures. The significance of phenotypic correlation coefficients was tested as per Fisher and Yates (1967).

Table 1. Details of hybrids evaluated in 3 trials during 1990-93

Pedigree	No. of hybrids evaluated during		
	1990-91	1991-92	1992-93
OR	-	2	2
(OR)H	2	23	9
(HR)H	4	3	7
[(OR)H]H	3	4	1
(OR) (OR)	3	1	1
(HR) (HR)	1	-	-
HO	6	1	9
HS	13	5	-
OS	-	-	2
HB	8	1	2
OB	-	-	7
Total	**40**	**40**	**40**

O : *S. officinarum* R : *S. robustum*
H : Commercial hybrids S : *S. spontaneum*
B : *S. barberi/sinense*

RESULTS AND DISCUSSION

The analysis of variance showed significant differences among ISH clones for all the characters studied in three sets. The genotypic coefficient of variation (GCV) gives the plant breeder perspective of the variability to be potentially exploited for genetic gain. The GCV was higher for number of millable stalks (NMS), stalk and sugar yields and single stalk weight (SSW) in comparison with stalk diameter, stalk length and all quality traits (Table 2). This indicated the better chances of success in selection programme based on NMS, stalk and sugar yields and SSW. Among the quality traits, GCV was higher for CCS% and sucrose % thereby indicating the better chances of selection based on these traits to identify high quality clones. The effect of high GCV for NMS, stalk and sugar yields and SSW was reflected in higher expected genetic advance for these traits. The heritability values were the maximum for NMS followed by fiber %, stalk diameter, stalk yield, and quality traits.

Table 2. Mean, genotypic coefficient of variation (GCV), heritability (h^2) and expected genetic advance expressed as % of mean (GA) in three populations of sugarcane

Character	Set	Mean	GCV	h^2	GA
Number of millable stalks/ plot (NMS)	I	169.25	47.61	0.96	96.13
	II	73.95	40.65	0.85	77.11
	III	117.71	24.84	0.56	38.45
Stalk diameter (cm)	I	2.12	16.42	0.84	30.92
	II	2.22	11.84	0.68	20.15
	III	2.40	14.08	0.85	26.70
Stalk length (cm)	I	202.21	8.65	0.32	10.01
	II	207.89	8.64	0.41	14.41
	III	243.00	6.28	0.42	8.43
Single stalk weight (kg) (SSW)	I	0.96	24.96	0.58	39.23
	II	0.90	25.58	0.58	40.30
	III	1.22	26.81	0.81	49.71
Juice extraction %	I	48.82	10.09	0.58	15.79
	II	48.40	5.11	0.24	5.13
	II	51.73	6.46	0.48	9.22
Fibre %	I	14.63	21.29	0.88	41.10
	II	14.97	17.72	0.83	33.27
	III	12.81	11.74	0.93	23.31

Brix %	I	20.15	7.17	0.60	11.49
	II	21.35	6.38	0.67	10.80
	III	19.81	8.47	0.74	15.06
Sucrose %	I	16.56	12.37	0.74	21.86
	II	18.54	9.32	0.67	15.72
	III	17.22	12.14	0.79	22.17
Purity %	I	82.28	6.04	0.75	10.77
	II	86.63	3.48	0.60	5.57
	III	86.51	5.06	0.80	9.32
CCS %	I	11.08	15.21	0.75	27.18
	II	12.71	10.79	0.66	18.08
	III	11.82	14.06	0.79	25.77
Stalk yield/plot (kg)	I	42.68	38.10	0.80	70.41
	II	58.56	24.82	0.67	41.78
	III	84.41	28.91	0.75	51.65
Sugar yield/plot (kg)	I	4.58	30.09	0.63	49.30
	II	7.50	27.94	0.64	46.18
	III	10.04	32.99	0.75	58.98

The .interrelationships among stalk yield and its components (Table 3) showed that NMS and stalk length were positively associated with stalk yield in all three sets. Stalk diameter, SSW, juice extraction, sucrose, purity and CCS showed negative association with stalk yield whereas the correlation between fibre % and stalk yield was significant and positive only in set-I. In set-III, SSW was associated positively with stalk yield. Rest of associations of characters with stalk yield were non-significant.

Among the component characters of stalk yield NMS showed negative associations with SSW whereas the correlation between NMS and fibre % was positive in all the sets. Relationships of stalk diameter with SSW in all sets and juice extraction in sets I and III were positive whereas it was negatively associated with fibre%. Stalk length showed positive association with SSW in sets II and III and fibre in sets I and II but the association was negative with juice extraction only in set-I. Correlations between SSW and juice extraction were significant and positive in sets I and III whereas SSW was negatively associated with fibre in three sets. As expected, the association between juice extraction percent and fibre percent were negative but were significant in sets I and II. Thus, for improving stalk yield, genotypes with high NMS and SSW should be selected but stalk diameter has to be given due importance.

Table 3. Phenotypic (above diagonal) and genotypic (below diagonal) correlation coefficients among yield and quality traits in three sets of sugarcane

Character	Set	NMS	Stalk diam.	Stalk length	SSW	Juice extr.%	Fibre %	Brix %	Sucrose %	Purity %	CCS%	Stalk yield	Sugar yield
NMS	I	—	–0.77**	0.47**	–0.58**	–0.60**	–0.66**	–0.54**	–0.66**	–0.70**	–0.67**	0.84**	0.51**
	II	—	–0.75**	0.15	–0.58**	–0.25	0.66**	–0.43**	–0.50**	–0.60**	–0.52**	0.32*	0.09
	III	—	–0.47**	0.10	–0.37*	–0.35*	0.57**	–0.30	–0.34*	–0.35*	–0.35*	0.40**	0.20
Stalk	I	–0.86	—	–0.17	0.88**	0.70**	–0.67**	0.51**	0.60**	0.62**	0.61**	–0.57**	–0.25
diameter	II	–0.98	—	0.13	0.74**	0.23	–0.57**	0.55**	0.63**	0.70**	0.64**	0.04	0.25
	III	–0.69	—	0.14	0.89**	0.61**	–0.43**	0.42**	0.47**	0.50**	0.48**	0.25	0.40**
Stalk length	I	0.88	–0.64	—	0.24	–0.31*	0.38*	–0.40**	–0.45**	–0.45**	–0.45**	0.47**	0.23
	II	0.21	–0.08	—	0.39*	–0.12	0.31*	0.19	0.18	0.14	0.17	0.59**	0.55**
	III	–0.09	0.27	—	0.47**	0.01	0.06	–0.15	–0.12	–0.02	–0.11	0.40**	0.31*
SSW	I	–0.75	0.98	–0.49	—	0.52**	–0.48**	0.36*	0.42**	0.42**	0.42**	0.43**	–0.35*
	II	–0.85	0.97	0.01	—	0.23	–0.43**	0.52**	0.56**	0.57**	0.56**	0.24	0.41**
	III	–0.60	0.95	0.53	—	0.53**	–0.31*	0.35*	0.39*	0.41**	0.40**	0.42**	0.52**
Juice extr.%	I	–0.77	0.90	–0.77	0.85	—	–0.72**	0.42**	0.53**	0.57**	0.54**	–0.48**	–0.19
	II	–0.64	0.34	–1.06	0.26	—	–0.46**	0.14	0.18	0.23	0.19	–0.09	0.01
	III	–0.8	0.80	0.03	0.79	—	–0.20	0.46**	0.46**	0.33*	0.45**	0.16	0.31*

(*Contd. on next page*)

Character	Set	NMS	Stalk diam.	Stalk length	SSW	Juice extr.%	Fibre %	Brix %	Sucrose %	Purity %	CCS%	Stalk yield	Sugar yield
Fibre %	I	0.72	–0.77	0.64	–0.68	–0.87	—	–0.41**	–0.54**	–0.61**	–0.56**	0.56**	0.26
	II	0.79	–0.79	0.54	–0.58	–1.02	—	–0.25	–0.32*	–0.42**	–0.34*	0.22	0.06
	III	0.78	–0.45	0.05	–0.32	–0.29	—	–0.21	–0.21	–0.19	–0.20	0.18	0.07
Brix %	I	–0.71	0.72	–0.40	0.74	0.80	–0.63	—	0.93**	0.64**	0.89**	–0.28	0.19
	II	–0.55	0.73	0.08	0.71	–0.09	–0.31	—	0.97**	0.83**	0.96**	0.27	0.57**
	III	–0.48	0.43	–0.12	0.38	0.53	–0.19	—	0.97**	0.69**	0.94**	0.13	0.50**
Sucrose %	I	–0.79	0.80	–0.57	0.78	0.85	–0.69	0.96	—	0.87**	0.99**	–0.40**	0.11
	II	–0.64	0.83	0.03	0.76	–0.05	–0.41	0.98	—	0.92**	0.99**	0.23	0.56**
	III	–0.52	0.51	–0.03	0.45	0.54	–0.20	0.98	—	0.85**	0.99**	0.11	0.51**
Purity %	I	–0.83	–0.83	–0.78	0.74	0.84	–0.71	0.83	0.94	—	0.91**	–0.52**	–0.05
	II	–0.82	0.99	–0.05	0.81	0.05	–0.59	0.92	0.96	—	0.94**	0.15	0.47**
	III	–0.58	0.60	–0.09	0.50	0.47	–0.21	0.76	0.88	—	0.88**	0.05	0.40**
CCS%	I	–0.79	0.81	–0.61	0.77	0.85	–0.70	0.95	0.99	0.96	—	–0.42**	0.09
	II	–0.67	0.86	0.02	0.77	–0.04	–0.44	0.98	0.99	0.97	—	0.22	0.56**
	III	–0.52	0.53	–0.01	0.46	0.54	–0.20	0.96	0.99	0.91	—	0.11	0.50**

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Character	Set	NMS	Stalk diam.	Stalk length	SSW	Juice extr.%	Fibre %	Brix %	Sucrose %	Purity %	CCS%	Stalk yield	Sugar yield
Stalk yield	I	0.90	–0.65	0.93	–0.49	–0.67	0.67	–0.43	–0.57	–0.72	–0.59	—	0.85**
	II	0.31	0.06	0.79	0.21	–0.62	0.39	0.28	0.25	0.15	0.24	—	0.93**
	III	0.40	0.29	0.46	0.48	0.12	0.22	0.10	0.11	0.06	0.11	—	0.90**
Sugar yield	I	0.58	–0.26	0.69	–0.11	–0.27	0.36	0.09	–0.06	–0.28	–0.09	0.85	—
	II	0.02	0.34	0.65	0.45	–0.58	0.18	0.60	0.57	0.47	0.56	0.93	—
	III	0.14	0.44	0.44	0.60	0.30	0.09	0.51	0.52	0.42	0.51	0.90	—

*, ** Significant at p = 0.05 and 0.01, respectively.

The association between sugar yield and other traits also varied in three sets (Table 3). High positive correlation coefficients were observed between stalk yield and sugar yield in all sets. Quality traits showed significant positive relationship with sugar yield only in sets II and III. Among the component traits of stalk yield, NMS in set I, stalk diameter in set III, stalk length and SSW in sets II and III were positively correlated with sugar yield. Therefore, sugar yield could be improved by increasing stalk yield however, maintaining sucrose percent at economic threshold level.

The interrelationships between component characters of stalk yield and quality parameters varied among three sets. NMS (in three sets), fibre percent (sets I and III) showed negative associations with quality parameters. The inverse relationships between NMS and quality traits indicate that the photosynthetic assimilates are mainly utilised for production and growth of stalks rather than storage of sugars in the stalks in these genotypes with high NMS (see Table 2). Quality traits were positively correlated with stalk diameter, SSW (in three sets) and juice extraction (sets I and III) indicating their importance for better quality genotypes, however, maintaining NMS at moderate level. Similarly, Bakshi Ram and Hemaprabha (1991) also reported importance of stalk diameter and SSW for selecting high quality genotypes among commercial hybrids × *S. spontaneum* progenies. Association between stalk length and quality traits varied from low positive in set II to significant negative in set I.

On the basis of results obtained from path analysis (Table 4), NMS was found to have moderate to high direct effects on stalk yield thereby suggesting the importance of NMS for improving stalk yield in all sets. Similarly, stalk length in set II and SSW in set III were important traits of stalk yield. On the contrary negative correlation and direct effects were observed for sucrose and purity in set I. Fibre content with low direct effect in three sets was not an important character of stalk yield. Wide variations were observed between the two values for other character associations. Correlation coefficients were positive and much higher than direct effects for stalk length in set I and III and fibre content in set I. High correlation coefficient between stalk length and stalk yield was mainly due to its higher indirect effect through NMS in set I whereas due to its higher positive indirect effects through SSW, brix % and CCS % in set III.

Path analysis for sugar yield revealed wide variations between significant correlation coefficients and direct effects for most of character associations excepting SSW in set III and brix % in set II (Table 5). This indicated the importance of indirect effects. The role of indirect effects on correlation values were remarkable for NMS in set I, CCS content in set II and sucrose content in set III. In such situations, the indirect casual factors are to be considered simultaneously for selection to increase efficiency of selection. Even though

Table 4. Phenotypic path coefficient analysis of stalk yield and other traits in three sets of sugarcane

Character	Set	NMS	Stalk diam.	Stalk length	SSW	Juice extr%	Fibre %	Brix %	Sucr. %	Purity %	CCS %	Corr. with st. yield
NMS	I	1.07	0.16	–0.04	–0.23	0.00	0.05	–0.29	0.28	–0.19	0.03	0.84**
	II	0.71	–0.08	0.05	–0.12	0.02	–0.09	–0.44	1.45	–0.16	–1.03	0.32*
	III	0.66	0.10	0.00	–0.29	–0.01	–0.02	0.75	–1.68	0.23	0.66	0.40**
Stalk diameter	I	–0.83	–0.20	0.01	0.35	0.00	–0.05	0.27	–0.25	0.17	–0.03	–0.57**
	II	–0.53	0.11	0.05	0.15	–0.02	0.08	0.57	–1.82	0.17	1.27	0.04
	III	–0.31	–0.20	0.00	0.71	0.02	0.01	–1.06	0.69	–0.33	–.27	0.25
Stalk	I	0.51	0.04	–0.08	0.10	0.00	0.03	–0.21	0.19	–0.12	0.02	0.47**
	II	0.11	0.01	0.37	0.08	0.01	–0.04	0.19	–0.52	0.04	0.35	0.59**
	III	0.06	–0.03	0.01	0.38	0.00	–0.00	0.38	–0.91	0.01	0.50	0.40**
SSW	I	–0.62	–0.18	–0.02	0.40	–0.00	–0.03	0.19	–0.18	0.12	–0.02	–0.35*
	II	–0.41	0.08	0.14	0.21	–0.02	0.06	0.54	–.62	0.14	1.12	0.24
	III	–0.24	–0.18	0.00	0.79	0.01	0.01	–0.89	2.05	–.27	–0.86	0.42**
Juice extr.%	I	–0.64	–0.14	0.02	0.20	–0.00	–0.05	0.22	–0.22	0.16	–0.03	–0.48**
	II	–0.18	0.03	–0.05	0.05	–0.07	0.07	0.14	–0.52	0.06	0.38	–0.09
	III	–0.23	–0.12	0.00	0.42	0.03	0.01	–1.18	2.55	–0.21	–1.10	0.16
Fibre %	I	0.70	0.13	–0.03	–0.19	0.00	0.07	–0.22	0.23	–0.17	0.03	0.56**
	II	0.47	–0.06	0.12	–0.09	0.03	–0.14	–0.26	0.93	–0.10	–0.67	0.22
	III	0.37	0.09	0.00	–0.25	–0.01	–0.03	0.53	–1.61	0.13	0.95	0.18

(Contd. on next page)

Character	Set	NMS	Stalk diam.	Stalk length	SSW	Juice extr%	Fibre %	Brix %	Sucr. %	Purity %	CCS %	Corr. with st. yield
Brix %	I	–0.58	–0.10	0.03	0.14	–0.00	–0.03	0.53	–0.39	0.18	–0.06	–0.28
	II	–0.30	0.06	0.07	0.11	–0.01	0.04	1.03	–1.84	0.20	0.90	0.26
	III	–0.19	–0.08	–0.00	0.28	0.01	0.01	–0.55	2.53	–0.45	–1.43	0.13
Sucrose %	I	–0.70	–0.12	0.04	0.17	–0.00	–0.04	0.49	–0.42	0.24	–0.05	–0.40**
	II	–0.36	0.07	0.07	0.12	–0.01	0.05	1.00	–.91	0.23	0.98	0.23
	III	–0.23	–0.10	–0.00	0.31	0 .01	0.01	–0.46	1.80	–0.55	–0.68	0.11
Purity %	I	–0.75	–0.12	0.04	0.17	–0.00	–0.06	0.34	–0.37	0.28	–0.04	–0.52**
	II	–0.42	0.08	0.05	0.12	–0.02	0.06	0.85	–1.68	0.25	0.87	0.15
	III	–0.23	–0.10	–0.00	0.33	0.01	0.01	–0.77	2.61	–0.65	–0.15	0.05
CCS %	I	–0.72	–0.12	0.04	0.17	–0.00	–0.04	0.47	–0.42	0.25	–0.05	–0.42**
	II	–0.37	0.07	0.06	0.12	–.01	0.05	0.99	–.90	0.23	0.98	0.22
	III	–0.23	–0.10	–0.00	0.31	0.01	0.01	–1.40	2.77	–0.58	–0.69	0.11
Residual	I	0.22										
	II	0.45										
	III	0.43										

*, ** Significant at P = 0.05 and 0.01, respectively.

the direct effects of NMS in set I, CCS in set II and sucrose % in set III were brought down, higher direct effects of NMS in set I, CCS percent and brix content in set II, sucrose % and SSW in set III on sugar yield would prove reliable for commercialisation of these early interspecific hybrids through breeding and selection.

Table 5. Phenotypic path coefficient analysis of sugar yield and other traits in three sets of sugarcane

Character	Set	NMS	Stalk diam.	Stalk length	SSW	Juice extr.%	Fibre %	Brix %	Sucr. %	Purity %	CCS %	Corr. with sug. yield
NMS	I	1.21	0.26	–0.08	–0.34	–0.01	0.04	–0.86	0.92	–0.85	0.21	0.51**
	II	0.59	–0.03	0.04	–0.12	0.01	–0.08	–0.14	0.65	0.01	–0.84	0.09
	III	0.55	0.08	0.00	–0.24	–0.01	–0.02	0.75	–.81	0.21	0.68	0.20
Stalk diameter	I	–0.94	–0.34	0.03	0.51	0.01	–0.04	0.80	–0.84	0.75	–0.19	–0.25
	II	–0.44	0.04	0.04	0.16	–0.01	0.07	0.18	–0.81	–0.01	1.04	0.25
	III	–0.26	–0.18	0.01	0.58	0.01	0.01	–0.77	2.32	–0.30	–.03	0.40**
Stalk length	I	0.57	0.06	–0.16	0.14	–0.01	0.02	–0.62	0.63	–0.55	0.14	0.23
	II	0.09	0.00	0.29	0.09	0.00	–0.04	0.06	–0.23	–0.00	0.28	0.55**
	III	0.05	–0.02	0.04	0.31	0.00	–0.00	0.63	–1.80	0.01	1.09	0.31*
SSW	I	–0.70	–0.30	–0.04	0.59	0.01	–0.03	0.56	–0.59	0.51	–0.14	–0.12
	II	–0.34	0.03	0.11	0.21	–0.01	0.05	0.18	–0.72	–0.01	0.91	0.41**
	III	–0.20	–0.16	0.02	0.65	0.01	0.01	–0.47	2.02	–0.25	–.12	0.52**
Juice extr.%	I	–0.73	–0.24	0.05	0.30	0.02	–0.04	0.67	–0.73	0.69	–0.17	–0.19
	II	–0.15	0.01	–0.04	0.05	–0.03	0.05	0.05	0.04	–0.23	–0.00	0.31
	III	–0.19	–0.11	0.00	0.35	0.02	0.01	–0.97	2.04	–0.20	–0.65	0.31*
Fibre %	I	0.79	0.23	–0.06	–0.28	–0.01	0.06	–0.65	0.75	–0.75	0.18	0.26
	II	0.39	–0.02	0.09	–0.09	0.21	–0.12	–0.08	0.41	0.01	–0.54	0.06
	III	0.31	0.07	0.00	–0.20	–0.00	–0.03	0.88	–2.19	0.12	1.10	0.07
Brix %	I	–0.66	–0.17	0.06	0.21	0.01	–0.03	1.58	–1.30	0.77	–0.28	0.19
	II	–0.25	0.02	0.05	0.11	–0.01	0.03	0.33	–1.26	–0.01	1.55	0.57**
	III	–0.16	–0.07	–0.01	0.23	0.01	0.01	–1.24	2.95	–0.42	–0.80	0.50**

Sucrose %	I	–0.80	–0.20	0.07	0.25	0.01	–0.03	1.48	–1.39	1.03	–0.31	0.11
	II	–0.30	0.02	0.05	0.12	–0.01	0.04	0.33	–1.29	–0.01	1.61	0.56**
	III	–0.19	–0.08	–0.00	0.25	0.01	0.01	–1.09	3.47	–0.51	–1.36	0.51**
Purity %	I	–0.85	–0.21	0.07	0.24	0.01	–0.04	1.00	–1.20	1.21	–0.29	–0.05
	II	–0.35	0.03	0.03	0.12	–0.01	0.05	0.28	–1.19	–0.01	1.52	0.47**
	III	–0.19	–0.09	–0.00	0.27	0.01	0.01	–0.94	3.12	–0.60	–.18	0.40**
CCS %	I	–0.81	–0.21	0.07	0.25	0.01	–0.04	1.41	–1.39	1.11	–0.32	0.09
	II	–0.31	0.02	0.05	0.12	–0.01	0.04	0.32	–1.28	–0.01	1.61	0.56**
	III	–0.20	–0.08	–0.00	0.26	0.01	0.01	–1.00	3.43	–0.53	–1.39	0.50**
Residual	I	0.33										
	II	0.34										
	III	0.33										

*, ** Significant at p=0.05 and 0.01, respectively.

In their studies, Bakshi Ram and Hemaprabha (1991, 1992) also emphasised the importance of different traits in different mating groups involving various *Saccharum* species. In the present study, the experimental material in three sets was comprised of hybrids involving different species of *Saccharum* and hence may be the cause of variation in the effective component together with deviation in interrelationships between the component characters. Another reason may be the retention of the original species associations as reported by Brown *et al.* (1969). In this regard, the realistic relationship between the characters in these interspecific hybrids can act as a valuable aid in enhancing the efficiency of selection in sugarcane breeding aimed at maximising sugar productivity.

Fibre content with very low direct effects on stalk yield and sugar yield in three sets, was not an important character. Kang *et al.* (1989) also reported the negligible direct effect of fibre content on tons per hectare of cane and sugar. Fibre may be important only from standpoint of milling efficiency and not because of its effect on stalk and sugar yields. High heritability, moderate GCV and genetic advance and negligible direct effects of fibre on stalk and sugar yields suggested that selection for sugarcane clones with optimum fibre content should be relatively easy.

The overall results of correlation and path analysis indicated higher magnitude of contribution of NMS, SSW, stalk length, brix percent, sucrose percent towards stalk and sugar yields. Of these traits, NMS showed the maximum GCV and expected genetic advance, high heritability and direct effects on stalk and sugar yields. This indicated the importance of NMS as the most reliable selection criterion. However, indirect causal factors, particularly the stalk diameter, have to be taken into consideration while selecting in these early stage interspecific hybrids.

Based on the results, twenty-six clones viz. ISH-001, -002, -009, -023, -028, -031, -041, -043, -068, -112, -131, -137, -153, -165, -186, -246, -354, -360, -362, -370, -375, -385, -391, -409, -427, and ISH-428 which combined most of the traits on par/superior to standards were identified as elite clones. Further, genetic stocks for seven individual traits and red rot resistance were also identified (Table 6). Statistical significance to the general mean and/or standards for respective traits was used as the criterion to isolate these elite donors. Testing for red rot was done against mixture of three major races prevalent in North Western Zone by plug method of inoculation. A total of 27 ISH clones were identified as resistant (R) and moderately resistant (MR) types (Table 6). All these ISH clones are maintained at Sugarcane Breeding Institute, Coimbatore and hence can be utilized in future breeding programmes.

Table 6. Genetic stocks for some important characters

Character	No. of stocks	Name of genetic stocks
Stalk yield	26	ISH-001, –002, –009, –031, –043, –065, –068, –112, –134, –135, –137, –141, –168, –175, –176, –186, –246, –362, –391, –427.
Sugar yield	21	ISH- 001, –002, –009, –028, –031, –043, –068, –131, –135, –137, –143, –148, –153, –165, –175, –186, –246, –362, –391, –427.
NMS	21	ISH- 134, –135, –137, –141, –142, –143, –145, –146, –147, –148, –149, –150, –155, –168, –175, –176, –225, –274, –280, –290, –385.
St. diameter	35	ISH- 002, –006, –022, –023, –028, –029, –031, –036, –038, –044, –052, –054, –056, –058, –068, –103, –109, –112, –113, –114, –118, –139, –156, –157, –161, –165, –178, –246, –1364, –175, –380, –425, –428, –447, –486.
SSW	25	ISH- 001, –002, –009, –022, –028, –029, –031, –038, –044, –052, –054, –068, –112, –113, –114, –117, –139, –156, –161, –178, –246, –362, –375, –425, –486.
CCS %	21	ISH- 001, –002, –006, –023, –027, –041, –052, –107, –131, –139, –153, –164, –165, –360, –370, –375, –385, –391, –428, –434.
Sucrose %	12	ISH- 001, –002, –041, –052, –131, –139, –360, –370, –375, –391, –428, –434.
Red rot	27	ISH-007, –018, –050, –061, –062, –063, –110, –112, –115, –135, –146, –176, –177, –188, –192, –198, –203, –229, –243, –263, –267, –292, –314, –316, –319, –360, –450.

The use of these interspecific hybrid clones would hastens the gains in performance and steps up the variance among progenies, which at present, is diminishing to that of experimental error level in commonly adopted intervarietal crossing programme. The progenies studied subsequently, of these interspecific hybrid clones (F_1) crossed with commercial hybrids were better than the progenies of F_1 x noble clones (Bakshi Ram and Hemaprabha, 1995). These progenies (F_1 x commercial hybrids) were not only superior in mean performance for various traits but also resulted in isolation of more number of genotypes significantly outyielding the standards.

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