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GENETIC VARIABILITY FOR YIELD COMPONENTS IN SUGARCANE, *Saccharum officinarum* L.

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Investigations on the genetic variability for yield components in sugarcane were conducted. Number of tillers per plant, internode length, cane thickness plant height and sucrose contents were the five major characters studied. All the five traits observed had fairly broad spectrum of genetic variability. Maximum variation was however, recorded in number of tillers per plant where coefficient of variability value was 38.16 while the range was 4 to 13.3 tillers per plant. Sucrose followed with a coefficient of variability value of 34.59. These characters, therefore, indicate fairly high chances of improvement through appropriate selection techniques. Least amount of variability was recorded in internode length and plant height. Coefficient of variability values were 15.60 and 17.61 respectively.

INTRODUCTION

Absence of sexual reproduction is perhaps the most formidable constraint to genetic improvement of sugarcane in Pakistan. Planned and precise genetic recombinations for redesigning the sugarcane plant are not ordinarily possible under normal agro-climatic conditions. This has caused a serious depletion in genetic variability for different morpho-economic characters ultimately retarding the pace of development of this important sugar crop.

Heritable variation has always engaged the attention of the breeders to synthesise better clones. High degree of genetic variation and polygenic expression of tillering in sugarcane hybrids was observed by Babu and Ethirajan (1962) variation for sucrose contents was however, less. Saccharum spontaneum serving as the male parent was thought to be the cause of enhanced shooting and depressed tillering. A large number of morphologically diverse clones were studied by LO and Sun (1968) and a sizeable genetic variation for plant height was found to be the result of interaction of polygenes with environments. Baren (1974) also concluded that genetic variability for internode length and

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thickness is due to the large number of chromosomes and the genes in the species and sub species of Saccharum. These findings were later supported by Nena and Ramirez (1977) almost similar observations were reported by Roach (1977). A large heritable variation for sucrose, cane thickness and plant height based on (2n + n) and (n + n) type of chromosomal transmission was recorded.

The research under report was also planned to determine the available range of genetic variability for major yield components in clonal progenies developed from the open pollinated fuzz obtained from a large number af canes with diverse origin and attributes.

MATERIALS AND METHODS

The studies were carried out in the Department of Plant Breeding and Genetics, University of Agriculture, Faisalabad in the year 1977-78. The genetic material for these studies comprised 27 open pollinated progenies (clones) of Sugarcane AUS 1 to AC 27 raised from the following parents grown at Murree Hills Sub-station, Charrapani (elevation 4000 ft).

1. COL-8	6. L-4	11. COL-72
2. BL-4	7. COL-80	12. COL-7
3. AU 16	8. COL-8	13. L-3
4. S-2770	9. COL-285	14. BL-19
5. CO-207	10. COL-29	15. COL-61

Three commercial varieties viz. Col 54, L-118, L-116 were also included in the studies. The sowing was done in the field during the Ist week of March 1977, using randomized complete block design of layout with 10 replications. All thirty clones were represented in each replication having three guarded plants raised from single eyed setts. The plant to plant and row to row distance was 3 ft. Experimental population received the normal agronomic and plant protection care. Data on the following five characters were recorded on a single guarded plant for each clonal line in all the ten replications.

1. Tillers/plant.
2. Internode length
3. Cane thickness
4. Plant height
5. Sucrose contents (Pol per cent).

Analysis of variance was done to determine significance of mean differences. Duncan's new multiple range test was applied where the means were significant. The standard deviation and coefficient of variability for each character were computed as suggested by Steel and Torrie (1960).

RESULTS AND DISCUSSIONS

Tillering in crops like sugarcane is an important yield component. A reference to table III indicates that of all the five characters studied largest amount of variability was recorded for this character. Coefficient of variability value being 38.16 while the range of actual tiller production was 4-13.3 stalks per plant produced respectively by AUS 9 and AUS 17 (Table 1). The differences in number of tillers are obviously genetic and the wide range of variation indicates that several independent genes are possibly involved in the development of this character. Since the cane hybrids involved in this study were the open pollinated progenies of heterozygous parents, the variation in tiller production may have been caused by recombination of various genetic factors controlling tiller production. Saccharum species are complex polyploids known for meiotic instability, therefore, this differential tillering can also be ascribed to uneven distribution of chromosomes during gametogenesis. Reports earlier published by Coleman *et al.* (1962) and Price (1963) regarding polygenic control of tillering also support these findings. Least magnitude of variability was however, observed for internode length where the coefficient of variability was 15.60 and the range rested between 13.64 to 19.39 cm (Table III). The clone AUS 22 had the longest internodes (19.39) while the shortest (13.64) were obtained in clone AUS 24 (Table 1), both however, were not significantly different than several other clones in the test. This lower amount of variation obviously suggests that relatively lesser genetic factors were available in the population for recombination and if this be taken as the generalized picture, there is comparatively lesser scope for the improvement of this character. Existence of many genes controlling internode length has been reported by Baren (1974). Although their incorporation is certainly conditioned by unequal gametic distribution of chromosomes yet inclusion of more clones carrying such genes in a hybridization programme may augment this variability.

The results pertaining to cane thickness summarized in Table 2 and 3 indicate a fairly wide range of variation for this character. Coefficient of vari-

TABLE 1. *Mean values for number of tillers and internode length their standard error and statistical significance.*

Sr. No.	Clone	No. of tillers per plant		Internode length (cms)	
		Mean	St. Sig.	Mean	St. Sig.
1	AUS 1	9 8	bcdefgh	16 78	bcde
2	AUS 2	7.9	fghij	18.10	ab
3	AUS 3	9.5	cdefghi	15.42	efghi
4	AUS 4	12.8	ab	15 73	cdefgh
5	AUS 5	12 1	abc	15 80	cdefg
6	AUS 6	11.8	abcd	16.56	bcdefg
7	AUS—7	10.1	abcdefgh	16.56	bcdef
8	AUS 8	7.6	ghij	15.41	efghi
9	AUS—9	4 0	k	15.16	efghi
10	AUS -10	10.7	abcdefg	14 75	efghi
11	AUS - 11	8.7	defghij	15.49	efghi
12	AUS -12	10 5	abcdefg	16.01	cdefg
13	AUS 13	7.5	ghijk	14.60	fghi
14	AUS 14	7.8	ghij	16 80	bcde
15	AUS 15	9.4	cdefghi	17.72	abcd
16	AUS—16	10.06	abcdefg	15.66	defghi
17	AUS 17	13 3	a	15.67	cdefghi
18	AUS 18	6.8	hijk	13.69	ghi
19	AUS 19	11.1	abcdef	13.64	hi
20	AUS 20	11.6	abcde	17.80	abc
21	AUS 21	8.3	efghij	15.01	efghi
22	AUS 22	12.8	ab	19.39	a
23	AUS 23	11 1	abcdef	16.08	bcdefg
24	AUS 24	6.5	ijk	13 64	hi
25	AUS 25	10.3	abcdefgh	14.63	efghi
26	AUS 26	10 1	abddefgh	15.54	defghi
27	AUS 27	9 4	cdefghij	15 53	efghi
28	L-116	6.4	ijk	15.99	cdefg
29	L 118	6 0	jk	16 51	bcdefg
30	Col 54	8.6	defghij	14.66	efghi
	S E.	0.975		0 628	

Clones having the same letters do not differ significantly at 5 percent level of significance by Duncan's New Multiple range test.

TABLE 2. *Mean values for cane thickness, plant height and sucrose contents, their standard error and statistical significance.*

Sr. No.	Clone	Cane thickness		Plant height (dm)		Sucrose contents	
		Mean	St. Sig.	Mean	St. Sig.	Mean	St. Sig.
1	AUS—1	2.59	bcde	23 22	efgh	15.14	bcde
2	AUS—2	2.09	ghi	21.09	gh	13.20	ijk
3	AUS 3	1.73	klm	25.70	cdef	16.32	a
4	AUS 4	2.37	cde	23 05	fgh	13 32	hijk
6	AUS 5	1.97	hij	30.28	b	14.90	abcdefg
6	AUS—6	1.91	ijkl	23.29	efgh	12.19	kl
7	AUS—7	1.73	jkl	28.48	bc	13 63	efghijk
8	AUS—8	2.10	ghi	23 32	efgh	13.42	ghijk
9	AUS—9	3.17	a	23.13	efgh	13 54	fghijk
10	AUS—10	1.68	lm	24.60	defg	15.03	abcdefg
11	AUS—11	1.62	n	24.24	efgh	14.66	bcdefghi
12	AUS—12	2.69	bcd	26.29	cde	13.71	efghijk
13	AUS—13	2 06	ghi	23.77	efgh	14.80	abcdef
14	AUS—14	1.94	ij	22.25	fgh	13.03	jkl
15	AUS—15	1.63	m	28.30	bcd	15.06	abcdef
16	AUS—16	2.21	efg	26.60	cde	14 93	abcdefg
17	AUS—17	1.68	lm	24.49	efgh	16.05	ab
18	AUS—18	2.02	hij	24.18	efgh	15.40	abcd
19	AUS—19	2 29	def	22 07	fgh	13.92	defghij
20	AUS—20	2.03	ghij	26.91	bcd	15.01	abcdefgh
21	AUS 21	1.38	n	24 05	efgh	11.60	l
22	AUS 22	2.82	b	32.41	a	13.13	ijkl
23	AUS 23	1 84	ijkl	25.59	cdef	14.44	defghij
24	AUS 24	2 03	hij	25 91	cdef	13.23	hijk
25	AUS 25	2.13	fghi	26 81	cd	13.91	efghij
26	AUS—26	2.67	bc	23.96	efgh	15.86	abc
27	AUS 27	1.91	ijk	24.54	efg	15.47	abcd
28	L—116	2.43	cde	20.86	l	16.08	ab
29	L—118	2.66	bc	24.45	efgh	14.55	cdefghij
30	Col—54	2.16	efgh	24.80	cdef	15.00	abcdefg
	S. E.	0.0775		1.124		0 469	

Clones having the same letters do not differ significantly at 5 per cent level of significance by Duncan's New Multiple range test.

TABLE 3. *The range of variability, mean and coefficient of variability of five plant characters.*

	Characters	Unit	Range	Mean	S.D.	Cv %
1	No. of tillers per plant		4-13.3	9.44	3.60	38.16
2	Internode length	cm	13.64-19.39	15.81	2.38	15.60
3	Cane thickness	cm	1.38-3 17	2.13	0.44	21.05
4	Plant height	dm	20.86-32.41	24.99	4.40	17.61
5	Sucrose contents (Pol %)		11.69-16.32	14.35	3.81	34.59

ability value being 21.05 while the range was 1.38 to 3.17 cm. A new clone AUS 9 scoring maximum thickness of 3.17 cm. excelled the other entries by a significant margin. The least value of 1.38 was recorded in variety AUS 21 which was however, not significantly different than AUS 11. Pattern of variation thus suggests that a number of genes are also involved in the development of this character and the differences in thickness may have been produced through recombination of these genetic factors. The changes in cane thickness can also be caused through irregular meiotic behaviour of some clones during sexual reproduction. Almost identical findings have been reported by Parthasarthy (1951) Coleman *et al.* (1962) Price (1963) and Nena and Ramirez (1977). Most of the parental lines of the clones under study had fairly tall stature and there were not very sharp differences for height. Relatively larger variation for height was however, observed in the seedling clones. The coefficient of variability value was 17.61 and range of height was 20.86 to 32.41 dm (Table 3). The clone AUS 22 was the tallest (Table 2) and significantly better than all others while J.-116 happened to be the shortest (20.86 dm) and was significantly smaller than all other lines included in test. The trend obviously suggests that there were different height genes in the parental population and new combinations caused increased height in clonal lines. Meiotic irregularity once again may also be the cause of differential heights exhibited by the population. Similar observations were earlier reported by Roach (1977) ascribing differences in major morphological characters to uneven distribution of chromosomes.

The sucrose contents deserve prime consideration in all can breeding programmes. In the present studies an appreciable variability for sugar contents was recorded and the sucrose ranged from 11.69 to 16.32 per cent with coefficient of variability value of 34.59 (Table 3). Top scorer was AUS 3 which was however, closely followed by several other clones (Tables 2). Although the top value recorded is not very high yet it points to the possibility of improvement in this important trait. The genes boosting sucrose are present mostly in noble types and hybridization with wild canes usually manifests depressing effects. The quantum of noble blood therefore, directly influences the sucrose yield. Most of the parental lines had spontaneum blood and this factor may have reflected in the progency. But an appreciable coefficient of variability points to the possibility of improving sucrose through an appropriate breeding procedure. Studying the present findings one tends to believe that diminished variability for certain important economic characters is perhaps not the only issue. Absence of an opportunity for attempting well conceived genetic recombinations is the real obstinate problem in the process of producing better clones for various production situations.

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