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METROGLYPH ANALYSIS OF GEOGRAPHICAL COMPLEXES IN SUGARCANE

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ABSTRACT

Metroglyph analysis of 78 genotypes sugarcane, viz., 3 *Saccharum officinarum*, 22 *Saccharum barberi* and *Saccharum sinense*, 8 exotic, and 45 Indian commercial hybrids, were evaluated for seven characters. Sixty seven genotypes formed nine complexes and 11 genotypes did not fall in any complex. Almost all *Saccharum barberi* and *Saccharum sinense* genotypes fall in complexes I, II and III near the point of origin while the genotypes of *Saccharum officinarum* fall far away from the point of origin due to high brix. The Indian and exotic commercial hybrids formed the compact mixed complexes and their ray patterns for different morphological characters resembled each other. On the basis of index score value and ray patterns of different morphological characters following genotypes of different complexes may be utilized for heterosis breeding programme: Co 7220, Co 6612 (VI), Co 8018, Co 6429 and Co 62146 (VII), Co 6402 (IX); and for brix purpose: Co 951, Uba White and Mangeri Red. The genetic diversity is more important than geographical diversity.

Key words: Index score, ray patterns, variation, frequency index, cluster, hardness.

The morphological characters offer valuable criteria for the systematic cataloguing of the available germplasm. Anita and Ioan [1] presented a detailed morphological description of different varieties of flue cured of tobacco to have a clear understanding of characters such as habit, shape and position of leaves, shape of the wing, leaf tip and margin. Anderson [2] proposed that the best way to analyse such complex variation is to reduce to measurements of different characters to a pattern or score and then compare the latter. The present paper reports the use of metroglyph analysis suggested by him in analysing the morphological variation in a set of 78 introductions of sugarcane varieties from the collection of the genetic stock.

MATERIALS AND METHODS

Total 78 entries (*Saccharum officinarum* 3, *Saccharum barberi* and *Saccharum sinense* 22, exotic 8, and Indian commercial hybrids 45) were planted in augmented design during the year 1983–1984 at Shahjahanpur. Ten competitive stalks (mother shoots) were selected from each entry for observations. The data on number of green leaves/stalk, number of internodes/stalk, stalk girth (cm), stalk height (cm), and length of internodes (cm) were recorded according to the standards suggested by Dutt et al. [3]. The rind hardness (in terms of wight in lb) was determined by presometer, an instrument designed by Khanna [4]. While brix was recorded by putting a few drops of juice, extracted from middle portion of cane stalk, on hand refrectometer.

The metroglyph analysis was done as suggested by Anderson [2]. The range of variability and class intervals of various morphological traits are given in Table 1. The range in each character is presented by different length of rays and the different characters by positions of the rays on the glyph. Index scores were obtained by alloting numerical value of the three grades of expression recognised in respect of each character and summing up the scores received by each genotype for variable attributes. The range and average index scores of different complexes along with the genotypes falling therein are presented in Table 2. All characters except stalk height and brix have been presented as rays at different positions on the glyph. A scatter diagram has been presented taking stalk height as ordinate and brix as abscissa (Fig. 1). The *Saccharum officinarum, Saccharum barberi* and *Saccharum sinense* genotypes are presented by solid and others by hollow glyphs.

RESULTS AND DISCUSSION

The scatter diagram (Fig. 1) shows that the genotypes (3 *S. officinarum,* 22 *S. barberi* and *S. sinense,* 45 Indian, and 8 exotic commercial hybrids) of sugarcane germplasm are constellating into nine complexes.

Table 1. Range of variability and class intervals of morphological characters in sugarcane

Character	Range of variability	Score 1		Score 2		Score 3	
		range	sign	range	sign	range	sign
No. of green leaves	4–15	4–7	0	7–10	0	10–15	0
No. of internodes	11–36	11–19	0	19–25	0	25–36	0
Hardness	4–13	4–7	0	7–10	0	10–13	0
Stalk girth	1.0–2.68	1.0–2.68	0	1.6–2.10	0	2.1–2.7	0
Brix	7.0–23.0	7.02–15.0	—	1.15–9.0	—	19.0–23.0	—
Stalk height	46.5–343.5	46.5–15.0	—	150.0–200.0	—	200.0–343.5	—
Length of internode	1.15–19.9	1.15–19.9	0	9.0–14.0	0	14.0–19.9	0

Complex I: ***Dwarf cane and poor brix type.*** Five genotypes of *S. barberi* and *S. sinense* including one Indian commercial hybrid formed this complex. The short-ray pattern was prevailing for different morphological characters except stalk girth and hardness. The range and average index scores were also lowest, indicating that all these genotypes fall near the point of origin and the stalk height and brix had less pronounced effect in this complex.

Complex II: ***Dwarf cane and good brix type.*** Eight genotypes, (except one, belong to *S. barberi* and *S. sinense*) formed the complex. The wide range of index scores (9–14) and low average index score (11.3) were evaluated for the scattered complex. It was noticed that as the value of brix increases, the ray pattern of hardness becomes shorter, while the ray pattern for numebr of leaves and stalk

girth becomes longer. This complex falls in the low to medium height range of 40–80 cm and in the range of brix 18.0–19.5, although the complex falls far the point of origin due to higher brix value.

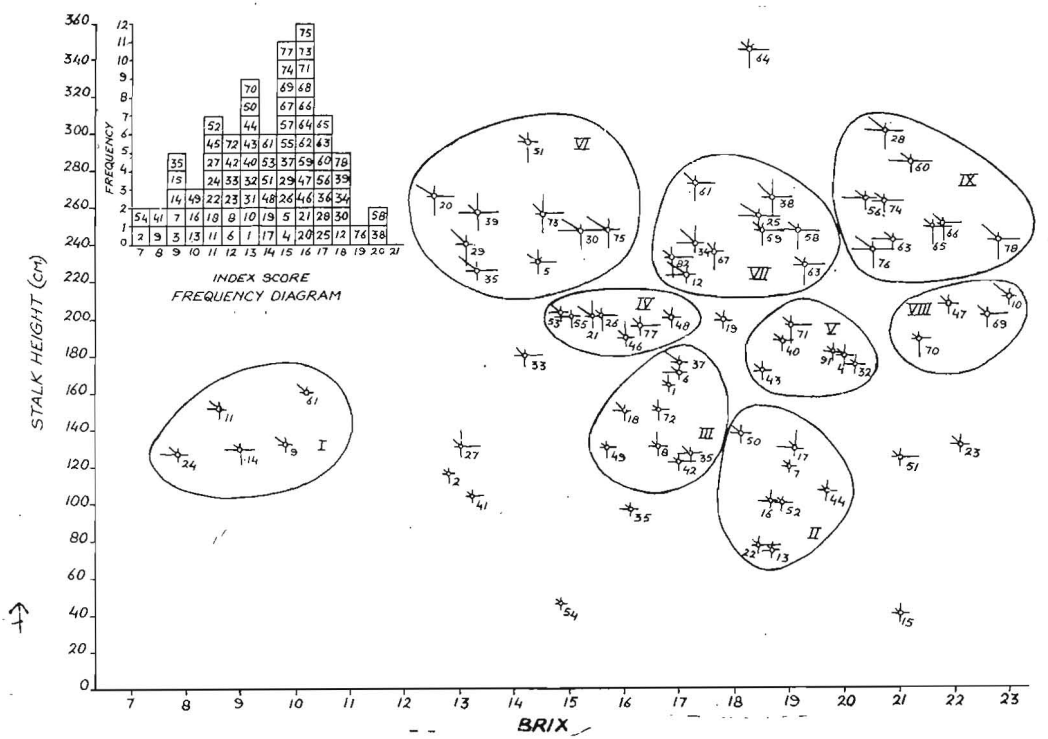

Fig. 1. Scatter diagram of metroglyphs representing different varieties of sugarcane.

Complex III: *Dwarf cane and medium brix type.* Nine genotypes formed the cluster. The wide range of index scores (10–15) and low average index score (12.00) resulted in the scattered cluster and short–ray pattern for different morphological traits. The long–ray pattern was showed by four *S. species* genotypes. The average index value of 12.00 indicates that most genotypes fall near the lower limit of the scores. Therefore, most of the genotypes had short to medium–ray pattern for different morphological traits.

Complex IV: *Medium cane and brix type.* Seven genotypes, including two genotypes of *S. barberi* and *S. sinense*, formed the complex. The narrow range of index scores (14–16) and higher average index score (15.00) show that the cluster must be compact and the rays should be medium to long for morphological attributes as shown by the complex itself. It was also found that the height and brix increased with simultaneous reduction in the number of *S. barberi* and *S. sinense* genotypes.

Table 2. Index score values and genotypes in different complexes in sugarcane

Score	Values in different complexes and their constituent genotypes								
	I	II	III	IV	V	VI	VII	VIII	IX
Range of scores	8–11	9–14	10–15	14–16	13–16	15–18	15–20	13–16	15–19
Average index scores	9.8	11.3	12.0	15.0	14.2	16.2	16.19	14.2	16.0
(genotypes)	3 (Matna Shaj)	7 (Pararia Shaj.)	1 (Pathari)	21 (Kewali)	4 (Uba Seedling)	5 (Khatuiya)	12 (Kansar)	10 (Khakai)	28 (B.39246)
	9 (Pararia)	13 (Khadya)	6 (Agoul)	26 (Keong)	31 (B. 39274)	20 (Kheli)	25 (57NG78 (Str.)	47 (Co 6602)	56 (Co 6614)
	11 (Pararia N Ganj)	16 (Nargori)	8 (Lal Khadi)	46 (Co 6708)	32 (B 49119)	29 (B 36246)	34 (Co 6425)	69 (Co 7220)	60 (Co 8117)
	14 (Putli Khajee)	17 (Mangwa)	18 (Pansahi)	48 (Co 8016)	40 (Co 6414)	30 (B 40105)	38 (Co 8018)	70 (Co 8103)	65 (Co 8121)
	24 (C 4772)	22 (Pararia-257)	37 (Co 6505)	53 (Co 6609)	43 (Co 7207)	36 (Co 6612)	58 (Co 62146)		66 (Co 8101)
		44 (Co 6514)	42 (Co 7704)	55 (Co 8149)	71 (Co 8003)	39 (Co 7220)	59 (Co 8114)		68 (Co 8010)
		50 (Co 6510)	45 (Co 6311)	77 (Co 8124)		57 (Co 6802)	61 (C0 1307)		74 (Co 6607)
		52 (Co 8023)	49 (Co 7218)			73 (Co 6609)	62 (Co 8145)		76 (Co 6402)
			72 (Co 8004)			75 (Co 6517)	63 (Co 8023) 67 (Co 8104)		78 (Co 6405)

Complex V: ***Medium cane height and better brix type:*** Six genotypes, including one of *S. officinarum*, formed the complex. The narrow range of index scores (13–16) and high average index score (15.00) were noted in this complex, therefore, the narrowness of the range of scores is an indication of compactness of the complex, while the higher average index score is a sign of wide-ray pattern. In this complex genotype Co 8003 had long-ray pattern. This complex resembles more complex IV, may be due to the fact that the range and average of index scores were somewhat similar.

Complex VI: ***Tall cane and medium brix type:*** Nine genotypes, including two of *S. officinarum*, formed the complex. The wide range scores (15–18) and highest average index score (16.2) show that it is a compact cluster with long-ray patterns for different morphological characters except stalk girth and hardness. The highest score was recorded in the genotypes Co 7220 (18) and Co 6612 (17).

Complex VII: ***Tall cane and medium brix type:*** Ten genotypes, including *S. barberi* and *S. sinense* formed the cluster. The wide range (15–20) and the highest average of index score (16.9) featured in this complex. In general long-ray pattern was shown by different morphological character, particularly long-ray pattern was observed for the number of internodes. The wide-ray pattern was shown by genotypes like, Co 8018 (20), Co 6424 and Co 62146 (18). It was interesting to note that the genotype Co 8018 showed long-ray pattern for all the morphological characters. Complex has more resemblance with complex VI.

Complex VIII: ***Medium cane and better brix type:*** Four genotypes fall in this complex. Narrow range (13–16) and high average index score (14.2) were found in this complex. Long-ray pattern was shown by number of internodes and stalk girth, while for other characters the ray pattern was low to medium.

Complex IX: ***Tall cane and better brix type:*** It consists of nine genotypes belonging to Indian and exotic commercial hybrids. The wide range (15–19) and high average index score (16.00) characterize this complex. All nine genotypes belong to tall and better brix types as depicted by the glyph position. Long-ray patterns were shown by number of internodes, hardness and length of internodes, while medium to long-ray patterns were noticed for stalk girth and number of green leaves. Genotypes Co 6402 and Co 6405 had the highest index scores (19 and 18, respectively) and long-ray pattern for all the traits except number of green leaves.

Eleven genotypes did not belong to any group, as they were widely scattered in relation to each other. The high-sugar genotype Uba White (*S. officinarum*) showed short-ray pattern for all the characters which indicated that only for better brix, the short internodes, thin cane, and less number of green leaves are the sugar promoting attributes. The position of the glyph of genotype Co 951 shows that it has tall cane and medium brix. The index score 17 indicates long-ray pattern for number of internodes and length of internode and medium-ray pattern for stalk girth and hardness.

The maxium mumber of genotypes recorded index scores 15 (11 genotypes) and 16 (12), but they are distributed in five complexes. This is due to the glyph position in the complexes and variation in height and brix of the cane. The lowest number of genotypes (2) had index scores 19 and 20, although these genotypes (Co 6402 (19) in complex IX and Co 8018 and Co 62146 in complex VIII showed highest index score along with long-ray patterns. The maximum number of genotypes formed complexes with 140 to 270 cm cane height and 15 to 22 brix.

It may be concluded that the genotypes of *S. barberi* and *S. sinense* fall in complexes I, II and III near the point of origin. It was also noticed that the ray patterns of these genotypes were somewhat similar, which indicates that these genotypes have poor height and brix. This was also confirmed by their ray patterns. The genotypes of *S. officinarum, S. barberi* and *S. sinense* were more diversified than the Indian and exotic commercial hybrids. Although a wide ray pattern was shown by these commercial hybrids, their ray patterns resembled each other. As the number of commercial hybrids increased the complexes became more compact, indicating less morphological differences between them.

In the present material, there were no significant differences among differed species and commercial varieties at geographic level. The maximum number of genotypes fall in the range of 140–270 cm height and 15–22 brix. The maximum number of genotypes fall within the range of index score values 15–17.

On the basis of range and average index score values the following genotypes had wide ray pattern for different morphological characters and fall in different complexes: Co 7220, Co 6612 (VI), Co 8018, Co 6425 and Co 62146 (VII); and genotypes CoS 951, Uba White, and Manageri Red were found better for brix.

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