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STUDIES ON SOME EARLY ATTRIBUTES OF SUGARCANE (*SACCHARUM OFFICINARUM* L.) IN RELATION TO YIELD AND YIELD COMPONENTS

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ABSTRACT

Three early growth attributes, namely, germination, tillering and early vigour, were studied in relation to stalk and sugar yield and their components, in *Saccharum officinarum* population comprising 94 genotypes. Germination and tillering influenced final stalk population to a considerable extent. However, these two characters did not show any significant relationship with any other yield component. Early vigour was strongly correlated with stalk and sugar yield and all their components, and could be of use as an effective early selection criterion.

Key words: Early attributes, heritability, correlation, correlated responses.

In sugarcane, some of the early growth attributes influence the major yield components to discernible levels. Germination and tillering, for instance, have a definite positive role in deciding the final stalk population. Possibly, early vigour contributes to better stalk height and stalk weight. These three early attributes were studied in relation to yield and yield components in a *Saccharum officinarum* population.

MATERIALS AND METHODS

Ninety four *S. officinarum* clones, collected from various geographical sources and maintained in the world collection of sugarcane germplasm, were planted in randomised block design with three replications at the Sugarcane Breeding Institute–Research Centre, Cannanore. Plot size was a single row of 3 m length, having 15 healthy, three budded sets each. Normal cultural practices in vogue in the Kerala State were followed.

Number of germinants/row (NOG) was recorded 30 days after planting. Number of tillers (NOT) was recorded on per plot basis on 90th day. Early shoot height (ESH) was recorded from the base of the clump to the top most visible transverse mark, also on 90th day. The ESH was taken as a measure of early vigour. Yield and quality data, viz., No. of

millable stalks/plot (NMS), stalk diameter, stalk height, stalk weight, stalk yield/plot, sucrose% in juice, and commercial cane sugar per plot (sugar yield) were recorded 10 months after planting.

Data were analysed for variation following the standard statistical procedures. Genotypic coefficient of variation (GCV), heritability in broad sense (h^2), and genetic advance as percentage of mean (GA) were worked out as per [1–3], respectively. Genotypic correlations (r_g) were worked out following [4] and correlated responses as per [5].

RESULTS AND DISCUSSION

Genetic parameters like GCV, h^2 and GA are presented in Table 1. Tiller number (NOT) showed the highest GCV, followed by early shoot height (ESH) and number of germinants (NOG). The estimate of h^2 was also highest for NOT. Thus NOT is one character which showed relatively high levels of variability and heritability. Consequently, GA was also highest for this character, indicating that substantial improvement is possible for this character through selection.

Table 1. Variability (GCV), heritability (h^2) and genetic advance (GA) for early attributes

Parameter	NOG	NOT	ESH
Mean ± SE	33.1 ± 5.3	46.7 ± 7.1	35.1 ± 6.2
Range	6.0–48.7	15.3–83.3	12.7–61.0
GCV	21.7	29.0	21.8
h^2	55.1	70.7	50.6
GA	33.3	50.2	32.0

The genotypic correlations among the three characters are presented in Table 2. All the three characters showed significant positive correlations among themselves. But none of the correlations were of high order to suggest any strong inter-dependance among them.

These early attributes showed varying levels of association with the stalk yield components, viz., number of millable stalks (NMS), stalk diameter, stalk height and stalk weight (Table 3). All the characters had significant positive association with NMS. Number of tillers, in particular, had a very strong positive association ($r_g = 0.70$) with NMS, implying that the final stalk population is largely determined by the initial tillers produced by a genotype. However, the relationship was not absolute to suggest a total dependence of NMS on NOT. The rate of tiller survival during the subsequent stages of growth may also contribute towards the final stalk population. Neither NOG or NOT showed any significant relationship with the remaining yield components. This suggests that these two characters influence stalk yield only through NMS and not through any other components. Incidentally, these characters showed only a moderate level of association with stalk yield. In contrast, ESH showed

Table 2. Genotypic correlations (r_g) among early attributes

Character	NOT	ESH
NOG	0.40**	0.30**
NOT		0.25*

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

strong positive association with all the stalk yield components without exception and its association with stalk yield per se was even stronger (r_g = 0.75). Obviously, the initial advantage in terms of early vigour resulting from early production and elongation of internodes is maintained during the subsequent growth also and is reflected in the overall productivity of the plant.

NOG and NOT had no significant association with sucrose% of juice (Table 3). But ESH recorded a low but significant correlation with sucrose% also. NOG and NOT had low positive correlations of low order only, with sugar yield (CCS/plot) also, while ESH recorded a highly significant positive correlation (r_g = 0.61). Thus, it is evident that ESH has a positive contribution towards both sucrose% and sugar yield. Possibly, early production and elongation of internodes facilitates early accumulation and further build-up of sucrose, eventually resulting in higher sugar yield.

Table 3. Genotypic correlations (r_g) of early attributes with stalk and sugar yield and their components

Characters	NMS	Stalk diameter	Stalk height	Stalk weight	Sucrose %	Stalk yield	Sugar yield (CCS/plot)
NOG	0.57**	0.001	–0.11	–0.15	0.19	0.30**	0.19
NOT	0.70**	–0.11	0.09	–0.15	0.02	0.34**	0.21*
ESH	0.43**	0.30**	0.66**	0.57**	0.24*	0.75**	0.61**

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

Correlated responses in stalk and sugar yield by selecting for early attributes were worked out (Table 4). The ESH recorded the highest correlated responses of 6.80 and 0.68, respectively, for stalk and sugar yield. NOG and NOT gave substantially low responses for stalk as well as sugar yield. This reveals the relative importance of ESH as an early selection criterion.

In sugarcane, several studies have dealt with plant characters contributing to stalk and sugar yield. They have clearly established stalk weight and NMS as the major yield components [6–11]. However studies on early attributes in relation to yield and quality components were few. Shah et al. [12] studied two groups of

Table 4. Correlated response in stalk and sugar yield by early attribute selection

Character under selection	Stalk yield		Sugar yield	
	correlated response	gain over population mean, %	correlated response	gain over population mean, %
NOG	2.87	14.5	0.22	10.5
NOT	3.62	18.3	0.28	13.3
ESH	6.80	34.4	0.68	31.9

sugarcane populations and reported low GA for germination and high for tillering. Mariotti [7] reported high genotypic variability for both germination and tillering. These two characters showed a high positive association with stalk yield also, but their association with juice quality was weak. In the present study, ESH was the most important early attribute having positive contribution with both stalk and sugar yield. It showed a high positive association with sucrose%, stalk and sugar yield, and all their components. Some of these components were themselves negatively correlated; for instance, NMS and stalk diameter (r_g = –0.23), NMS and stalk weight (r_g = –0.22). But, not withstanding their inter se relationships, ESH showed positive association with each of them, be it yield components or quality traits. Obviously, ESH influences all the stalk and sugar yield components positively and is an early index as to the overall potential of a genotype in terms of its productive components. Such genotypes with early internode production and elongation could be utilized in cane breeding programmes as potential genetic stocks to impart higher productivity in terms of yield and quality.

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