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Relationship between Yield and Yield Contributing Traits in Sugarcane (*Saccharum officinarum, L.*)

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Abstract: An investigation was undertaken to assess the interrelationship of cane yield and its traits in sugarcane at National Sugar Crops Research Institute, farm Thatta, during 2000-2001. It was observed that cane girth, number of internodes per plant, cane height and millable canes m^{-2} were positively and highly significantly correlated with cane yield, the regression coefficients for these traits on cane yield were also positive. Multiple correlation and partial regression analysis indicated that cane girth, number of internodes per plant, cane height and millable canes m^{-2} should be considered in selecting high yielding strains.

Key Words: Sugarcane Genotypes, Cane Yield, Yield Components, Correlation, Multiple Correlations, Thatta, Pakistan

Introduction

In breeding of crop plants, an indirect approach to yield is frequently chosen, through selection of one or several components associated with it. Positive association among yield components hastens progress in breeding for yield. Negative associations among them make progress by selection difficult (Garcia, *et al.,* 1991). Varietal characteristics in crop plants are often correlated. Understanding these correlations helps the plant breeders to select appropriate breeding procedures for developing adapted genotypes. Thus, an understanding of the correlation between relevant characteristics determines the limits with in which any particular characteristic may be sacrificed in favour of the other characteristics (Sarwar, *et al.,* 1984). In recent years sugarcane breeding programmes in the country have been oriented to develop sugarcane varieties having high cane yield potential. The production per unit area depends on yield ability of the varieties or strains that are related to their genetic characteristics. Therefore, establishment of fundamental genetic pattern and relationship of these characteristics needed to improve the crop production. Ramdoyal, 1999 stated that the study of traits correlated with cane yield, which are better transmitted from one generation to the next, might offer alternatives in breeding for cane or sugar yield. Javed, *et al.,* 2001 stated that it is desirable to select the sugarcane genotypes directly for important characters but selection is often made on correlated characters on which selection is more economical. Legender, 1970 found that cane yield was positively associated with stalk number, stalk diameter, stalk length and stalk weight.

Knowing the genetic pattern of morphological characters is very important for the sugarcane breeder for its improvement. The main objective of this investigation was to study the functional relation between cane yield and yield components to know their relative importance in changing cane yield.

Materials and Methods

A field experiment was carried out to asses the inter relationship of cane yield and its traits. Fourteen different sugarcane genotypes were sown at NSCRI Farm, Thatta during October 2000-2001. The experiment was laid out in Randomized Complete Bock Design with 4 replications. Sowing was done in October 2000 by overlapping method using two budded sets. Three rows of each variety in 7 meters long furrows at one meter row spacing were sown. The fertilizer dose @ 1.43 Kg Urea, 0.51 Kg DAP and 0.79 Kg SOP /Plot (Plot Size 21 m^2) was applied. Uniform management and cultural operations, insect pest and disease control measures were adopted at appropriate stages. The data and observations pertaining to cane yield and its components were recorded. All the observations of each character were averaged for further statistical manipulation. Simple phenotypic correlation, coefficient of determination and multiple regression coefficients were computed by using MSTATC computer programmed (Michigan State University, 1992).

Results and Discussion

The correlation coefficient given in Table 1 showed that cane girth was positively interrelated with cane yield. The positive correlation coefficient was highly significant ($p< 0.01$). The regression coefficient (+6.390) is revealing positive tendency of cane yield with cane girth, meaning thereby increase in cane thickness corresponds to the increase in cane yield. These findings are agreed with those of early studies conducted by Draper and smith (1981), Faqeer (1986) and Mahmood, *et al.,* (1990).

The coefficient of determination (0.608) also revealed that selection for cane girth might be useful to improve the cane yield. A critical examination of the results in Table 1 further revealed positive relationship between number of internodes/ cane stalk and cane yield. The "r" value 0.730 was highly significant ($p < 0.01$) which revealed that number of internodes per stalk had significant impact to increase cane yield. The results obtained appeared to agree with those results as already had been recorded and reported by Afghan, *et al.*, (1993), Ramdoyal (1999) and Garcia, *et al.*, (1991). The "r^2" value 0.532 indicated that 53% variation in cane yield was due to this character that indicates positive tendency of cane yield with number of internodes per cane stalk.

Similar to number of internodes per acne stalk, cane height also showed positive correlation with cane yield and r = 0.838 was highly significant ($p < 0.01$). The correlation coefficient indicated that increase in plant height might have a positive effect upon cane yield. The regression coefficient (+4.582) is also revealing dependence of the character. Similar results regarding the relationship between the cane height and cane yield had already been reported by Jannisar (1988), Sharif *et al.*,1981 and Tai *et al.*,1982. The coefficient of determination revealed that 70% variability in cane yield was contributed by cane height. Therefore, to increase the yield, the selection for the larger cane size would need due care and attention.

The correlation coefficient given in Table 1 showed that millable canes were positively correlated with cane yield and the "r" value (0.827) was highly significant ($p < 0.01$). This suggested that increase in millable canes is directionally proportional to the effect in cane yield. The regression value of millable canes upon cane yield further indicated that dependence and relationship between two characters was correct. Similar suggestion had already been given by Afghan *et al.*, 1993, Mahmood *et al.*, 1990 and Milligan *et al.*, 1990. Who also reported positive and significant correlation between millable canes and cane yield. Coefficient of determination ($r^2 = 0.683$) also indicated larger portion of variability (68%) in cane yield was due to variation in number of millable canes. This situation suggested that this character might advantageneously be exploited to bring improvement
in cane yield by making section of genotypes bearing increased number of millable canes.

The detailed information on the effectiveness of different quantitative attributes and their contribution towards final yield was obtained by working out by multiple correlation and partial regression (Table 1). This was accomplished by assessing the cumulative effect of yield components on cane yield per hectare, taking cane yield per hectare as the dependent variable and the other traits as independent variables. The multiple correlation coefficients between cane yield per hectare and other characters was (r = 0.944) which meant that 89 percent of the variation in cane yield per hectare could be attributed to four independent variables. The calculated F- value 104.39 (Table 2) revealed that the multiple regressions were highly significant at 1 percent probability level. The "t" test for the significance of partial regression coefficients indicated that all the yield components i.e. cane girth, number of internodes per plant, cane height and millable canes m^{-2} contributed significantly towards cane yield per hectare (Table 1). These results were in accordance with the findings of Drapper and smith (1981), Faqeer (1986), Jannisar (1988) Afghan *et al.*, 1993 and Milligan *et al.*, 1990.

These observations lead to the conclusion that emphasis should be placed on cane girth, number of internodes, cane height and number of millable canes while selecting the sugarcane genotypes for higher cane yield.

Table 1: Estimates of Phenotypic Correlation, Regression Coefficient, Partial Regression and Multiple Correlation for Yield and Yield Components in Sugarcane

Characters	Phenotypic Correlation Coefficient	Coefficient of Determination	Regression Equation	Partial Regression Coefficient	"t" test
X_1, Cane girth (mm)	0.781**	0.608	Y= -81.954+7.189	2.5594	3.595**
X_2, Number. of Internodes/plant.	0.730**	0.532	Y=11.60+4.582	1.7399	2.754**
X_3, Cane height. (cm)	0.838**	0.702	Y=9.04+0.482	4.2257	3.492**
X_4, Millable Canes m^{-2}	0.827**	0.683	Y=-34.05+6.925	2.5407	3.233**
Y. Cane yield (t ha^{-1})	-	-	-	-	-

Multiple correlation coefficient = 0.944
Estimated error = 3.76
$Y = -61.688083 + 2.0930 X_1 + 1.0925 X_2 + 2.4330 X_3 + 2.1277 X_5$.

** Highly significant at 1% level of probability.

Table 2: Test of Significance for Multiple Regression Coefficient

Source of Variation	D.F	S.S	M.S	F. Value	Remarks
Regression on four variables	4	4213.094	1053.273	104.39	**
Residual	51	514.562	10.089		
Total	55	4727.656			

** Highly significant at 1% level of probability.

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