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CORRELATION AND PATH COEFFICIENT ANALYSES IN SUGARCANE

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ABSTRACT

Correlation and path coefficient analysis was undertaken among agronomic and economic characters of importance in sugarcane (Saccharum spp.). Fourteen promising sugarcane genotypes (G99-103, G2003-44, G2003-47, G2003-49, G2004-27, G2010-8, G2007-61, G2010-7 G2010-26, G201182, G2011-84, G2014-233 and G84-47) in addition to the commercial cultivar GT 54-9 were evaluated in a replicated field experiment at Giza Research Station (Giza Governorate) in 2017/2018 and 2018/2019 seasons for six morphological characters. Analysis of variance revealed significant differences among genotypes for all the characters studied. Cane yield showed positive and highly significant correlation with single cane weight, stalk length and millable cane number. There was an also positive and significant correlation of cane diameter and number of internodes with cane yield. Length of internode had positive but insignificant correlation with cane yield. Single cane weight had the highest positive direct effect on cane yield followed by millable cane number. Stalk diameter and stalk length were positively and significantly correlated with cane yield, which was due to the indirect effect of single cane weight. Results indicate that the genotypes should be selected on the basis of single cane weight and millable cane number for getting higher sugarcane yield.

Key words: ***Sugarcane (Saccharum spp.), Cane yield, Correlation, Path coefficient***

INTRODUCTION

Sugarcane is a C_4 plant and is photo synthetically one of the most efficient converters of solar energy into dry matter. Yield is a complex character which cannot be improved to a greater extent on its own. Because, it is influenced by a set of other characters known as yield components which are related among themselves and with yield either favorably or unfavorably traits. In general, in most crops, the associations among yield components are reported to be undesirable thereby hindering the rapid progress that could be made. Correlation studies provide an opportunity to study the magnitude and direction of association of yield with its components and also among various components (Chaudhary and Joshi 2005). To accumulate optimum combination of yield contributing characters in a single genotype, it is essential to know the implication of the interrelationship of various characters along with standard partial correlation or regression (path coefficient).

Path coefficient is an excellent means of studying direct and indirect effects of interrelated components of a complex trait (Kang *et al* 1989). Path-coefficient analysis measures the direct influence of one variable on another. Each correlation coefficient between a predictor variable and the response variable is partitioned into its component parts: the direct effect or path coefficient (a standardized partial-regression coefficient) for the predictor variable and indirect effects, which involve the product of a correlation coefficient between two predictor variables with the appropriate

path coefficient in the path diagram (Dewey and Lu 1959). By determining the inter-relationships among yield components, a better understanding of both the direct and indirect effects of the specific components can be attained. Effects of stalk number, stalk diameter, stalk length and single cane weight on cane yield have been reported by Hogarth (1971) and Chaudhary and Singh (1994). In this connection, Patel *et al* (2006) performed correlations and path coefficient analysis in different sugarcane genotypes and found that cane yield was significantly and positively correlated with number of shoots/ha, single cane weight, stalk height, stalk diameter. Cane yield had a positive and significant correlation coefficient with stalk weight and number (Masri *et al* 2008). Esayas *et al* (2016) manifested that highest positive direct effect of millable cane number (0.812) on cane yield followed by single cane weight (0. 682) and pol percent (0.550). However, stalk diameter and brix percent considerable negative direct effects and indirect positive effects through single cane weight on cane yield. Therefore, in view of their significant positive association with cane yield, indirect effect of stalk diameter and brix percent *via* single cane weight should be considered during selection. They added that genotypes should be selected on the basis of millable cane number, single cane weight and pol percent for getting higher cane and sugar yield. Pandya and Patel (2017) showed that path coefficient analysis indicated that stalk weight had the highest positive direct effect but it had positive and highly significant correlation with cane yield, the while highest positive indirect effect on cane yield was treated by stalk weight via CCS% followed by tillers at 120 days, sucrose% juice and germination% at 45 days. (Gadallah and Mehareb 2020), they reported highly significant and positive correlation between cane yield, millable cane weight and number of millable canes, followed by cane yield and stalk height then cane yield and stalk diameter.

Plant breeders generally select for only a few traits and it is very important to know the effects of this on other important characters as well. Considering these points, the present study was conducted to understand interrelationships among economic traits in sugarcane.

MATERIALS AND METHODS

Two field experiments were carried out at Giza Research Station (Giza governorate) in the two successive seasons 2017/2018 and 2018/19 (two spring plant cane crops). The average values of soil analysis at GizaResearch Stationwere 57.5% clay, 28.9% silt and 13.6% sand, pH of 7.4, available nitrogen of 60.1ppm and $CaCO_3$ of 1,83%.

Fourteen promising sugarcane (*Saccharum spp.*) genotypes (G99-103, G2003-44, G2003-47, G2003-49, G2004-27, G2010-8, G2007-61, G2010-7 G2010-26, G201182, G2011-84, G2014-233 and G84-47) in addition to the commercial cultivar GT 54-9 included in this study were planted in three 7-m long and 1.0-m width rows in three replicate of a randomized complete block design during the first week of March. Data were recorded for some morphological traits, *i.e* millable canes number/m, stalk length, stalk diameter, single stalk weight, number and length of internodes and cane yield.

Pearson correlation coefficient was estimated among these variables as suggested by Steel and Torri (1980). The total correlation coefficients of various yield contributory characters with regard to cane yieldwere partitioned into components of direct and indirect effects following the method adopted by Dewey and Lu (1959).

RESULTS AND DISCUSSION

There were significant differences among the genotypes for all studied characters (Table 1). This can be attributed to the fact that these genotypes were derived from parents having different genetic and geographic backgrounds.

Table 1. Mean squares for stalk characters in sugarcane genotypes.

SOV	df	No of millable cane	Stalk length	No of internodes	Length of internode	Cane diameter	Single cane weight	Cane yield
Replication	**2**	**55.61**	**4,73**	**0.066**	**2.12**	**0.0003**	**0.0045**	**68.82**
Genotypes	**14**	**387.96****	**713.09****	**17.21****	**4.08***	**0.0411***	**0.031****	**222.21****
Error	**28**	**35,63**	**89.95**	**3.86**	**0.877**	**0.0052**	**0.0013**	**10.86**

*** and ** Significant at 0.05 and 0.01 probability levels, respectively.**

Correlation coefficient

The pair-wise simple correlation coefficient (r) among various characters is presented in Table 2. Cane yield showed a positively and highly significant correlated with single cane weight (r = 0.72**), stalk length (r = 0.64**) and millable canes number (r = 0.41**). There was also positive and significant correlation of cane yield with cane diameter (r = 0.29*) and number of internodes (r = 0.30*). A positive value of r shows that the changes of the two variables are in the same direction, *i.e.* a high value of one variable is associated with high values of the other and *vice versa*. A positive and highly significant correlation between cane yield and its components, *viz* single cane weight, stalk length and millable cane number was reported by Mehareb and El-Mansoub (2020), who stated that Plant height and stalk diameter were positively correlated with cane yield. Punia *et al* (1983) and Masri *et al* (2008) and Gadallah and Mehareb (2020). Also, Hooda *et al* (1997) observed that cane diameter having a significant and positive correlation with cane yield. Length of internode had a positive but insignificant correlation with cane yield. Millable cane number had negative and significant correlation with cane diameter (r = -0.41**) and single cane weight (r = -0.30*). Balasundarum and Bhagyalakshmi (1978) also reported similar results.

Table 2. Correlation coefficients among different characters of 15 sugarcane genotypes.

Character		1	2	3	4	5	6
1	Number of millable cane						
2	Stalk length	-0.0021					
3	Number of internode	0.1309	0.4104**				
4	Length of internode	0.0075	0.3448**	0.164			
5	Cane diameter	-0.412**	0.4767**	0.3533**	0.112		
6	Single cane weight	-0.304*	0.6173**	0.214	0.199	0.5983**	
7	Cane yield	0.413**	0.639*	0.301*	0.1866	0.292*	0.720**

***, ** Significant at 5% and 1% probability levels, respectively**

A Negative correlation between two traits indicated their inverse relationship with each other. Single cane weight reclected positively and

highly significant in correlated with stalk length and cane diameter. Stalk length showed positively and highly significant in correlated with a number of the internodes and length of internodes. Whereas, number of internodes had positive but non-significant correlation with length of internodes (r = 0.16) and single cane weight (r = 0.21). Length of internodes had also in significant correlation with cane diameter (r =0.11) and single cane weight. It is obvious that single cane weight, stalk length, millable cane number, stalk diameter and number of internodes can be considered together in a positive direction towards an aim of developing a high-yielding sugarcane clone.

Estimates of correlation between a pair of characters indicate the inherent relationship that exists between the characters. (Heinz 1987) If there is a high positive correlation between two characters, selection for one of the characters should result in selection for the other character.

Comstock and Robinson (1952) emphasized the importance of genotypic correlation. They pointed out that traits not under selection may deteriorate and those under selection may show little response due to negative genotypic correlation. Phenotypic correlations which are approximations of genotypic correlation has been reported by many authors including James (1971), and Reimers *et al* (1982) and Wu *et al* (1983).

In the present study, (Table 2) cane yield was more closely correlated with stalk height, weight per stalk, followed by number of millable stalks and stalk diameter. This has important implications for the selection of varieties to be used as parental material for crossing purposes. The above information indicates that cane yield is affected by the above characters but the degree to which each character affects yield is dependent upon the degree of association of that character to cane yield. In this case, selected for the character weight of a single stalk would produce maximum yield as compared with any of the other characters. Hogarth (1971) and Rao, *et al* (1983) explained that cane yield was more closely correlated with stalk weight than stalk population or stalk diameter. Hogarth (1971) found that the number of stalks per stool and weight per stalk were negatively correlated. However, both stalks per stool and weight per stalk were positively correlated with weight per stool.

Path coefficient analysis for cane yield

Path coefficient analysis unfolds whether the association of cane yield with its components is due to the direct effects of component characters on cane yield or is a consequence of its indirect effects *via* some other traits. The highest positive and direct effect on cane yield was exerted by single cane weight (0.728) followed by millable cane number (0.576) (Table 3). The direct effect of single cane weight on cane yield was also reported by Punia *et al* (1983), Reddy and Reddy (2002) and Patel *et al* (2006). A direct effect of a millable cane on cane yield was similar to the findings of Balasundarum and Bhagyalakshmi (1978), Kang *et al* (1989), Punia *et al* (1983) and Chaudhary and Singh (1994). It was observed that stalk length and stalk diameter had a positive and significant correlation with cane yield. Their direct effects on cane yield were positive but low and negligible. A Significant correlation was due to indirect effects of single cane weight. Internode number and internode length had negative but negligible direct effects on cane yield. This implied that the selection of sugarcane genotypes based on stalk weight and millable cane number would be beneficial for increasing sugarcane yield.

Table 3. Path coefficients showing direct (diagonal) and indirect effects of 6 components on cane yield.

	Characters	1	2	3	4	5	6
1	Number of millable cane	0.576**	-0.0003	-0.007	-0.0001	-0.007	-0.188
2	Stalk length	-0.001	0.176*	-0.021	-0.006	0.009	0.449
3	Number of internode	0.075	0.072	-0.052**	-0.003	0.006	0.170
4	Length of internode	0.005	0.061	-0.008	-0.017*	0.002	0.145
5	Cane diameter	-0.209	0.084	-0.018	-0.002	0.018*	0.435
6	Single cane weight	-0.149	0.109	-0.012	-0.003	0.011	0.728**

***, ** Significant at 5% and 1% probability levels, respectively. Residual = 0.43.**

CONCLUSION

A correlation study indicates that stalk length and single cane weight are most important for cane yield improvement. Selection based on a number of millable cane and single cane weight is directly increased cane yield. During selection, an indirect effect of stalk length *via* single cane weight should also be considered. Three characters, *viz* stalk length, millable cane number and single cane weight are very important that can be considered during the breeding program. For more reliable information, these correlation coefficients should be separated into environmental, genotypic and phenotypic parts.

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تحليل الارتباط ومعامل المرور فى قصب السكر

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أجريت هذه الدراسة لقياس مدى مساهمة بعض الصفات فى حاصل محصول قصب السكر. تم تقييم أربعة عشر تراكيب وراثيه هى جيزة ٩٩-١٠٣, جيزة ٢٠٠٣-٤٤, جيزة ٢٠٠٣-٤٧, جيزة ٢٠٠٣-٤٩, جيزة ٢٠٠٤-٢٧, جيزة ٢٠١٠-٨, جيزة ٢٠٠٧-٦١, جيزة ٢٠١٠-٧, جيزة ٢٠١٠-٢٦, جيزة ٢٠١١-٨٢, جيزة ٢٠١١-٨٤, جيزة ٢٠١٤-٢٣٣, جيزة ٨٤-٤٧ بالاضافه الى الصنف التجارى المنزرع جيزه تايوان ٥٤-٩ فى تجربه حقليه بتصميم قطاعات كاملة العشوائية فى ثلاث مكررات بمحطة بحوث الجيزة – مركز البحوث الزراعية – محافظة الجيزة فى موسمين زراعيين٢٠١٧/٢٠١٨, ٢٠١٨/٢٠١٩ لدراسة ستة صفات مورفولوجيه. وقد أوضح تحليل التباين وجود اختلافات معنويه بين التراكيب الوراثية لكل الصفات المدروسه، أظهرت النتائج وجود ارتباط موجب ومعنوى بين كل من حاصل قصب السكر وصفات وزن العود، طول العود وعدد العيدان القابله للعصر، وايضاً وضح ان هناك ارتباط موجب ومعنوى بين صفتى قطر الساق وعدد السلاميات وحاصل قصب السكر. فى حين وجد ارتباط موجب ولكن غير معنوى بين طول السلاميه وحاصل قصب السكر. كان لصفة متوسط وزن العود أكبر تأثير موجب ومباشر على صفة حاصل قصب السكر تلتها صفة عدد العيدان القابله للعصر. وبالنسبة لصفتى طول وقطر الساق كان ارتباطهما ايجابيا ومعنويا مع حاصل قصب السكر وذلك للتأثير غير المباشر لمتوسط وزن العود. من النتائج المتحصل عليها تحت هذه الدراسه يتضح أن انتخاب التراكيب الوراثيه لقصب السكر يكون على أساس متوسط وزن العود مع عدد العيدان القابله للعصر للحصول على أعلى غلة لمحصول قصب السكر.

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