Studies on Simple and Multiple Correlation between Stalk Weight and Its Attributes in Sugarcane (*Saccharum* Spp. L.)

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ABSTRACT

Correlation studies were done to find out the relation between stalk weight and its attributes and also to find out the attributes mainly responsible for stalk weight in five sugarcane genotypes in a field trial conducted at the Research Farm of El-Sabahia Agricultural Research Station, Alexandria, Egypt as planted crop in the spring of each of 2005 - 2006 and 2006 - 2007 seasons. These five sugar cane genotypes are G.T.54-9, G95-19, G.95-21, G.98-28 and Ph.8013. The results showed that the stalk weight of genotypes G.T.54-9 and G.95-19 had positive significant correlation with stalk length, stalk diameter, number of internodes and number of tillers, except number of tillers in G.95-19 was found to be insignificant. In G.95-21 and Ph.8013, though all the characters positively correlated with stalk weight, stalk length in case of G.95-21 and number of tillers in Ph.8013 had positive significant correlation with stalk weight. In variety G.98-28 non of the components had significant correlation with stalk weight. Among stalk weight the component, stalk length was found to be positive significantly correlated with stalk diameter, number of internodes and number of tillers in case of G.T. 54-9. Also, among stalk weight components, stalk diameter was found to be significantly different with number of internodes and number of tillers of the cane in all the varieties except in G.95-19, where stalk diameter did not have significant correlation with number of internodes and tillers. This indicates that the stalk weight of cane is not an independent characters but it is dependent on number of internodes and number of tillers of the cane. Multiple correlation coefficient between stalk weight and stalk length and stalk diameter was significant in varieties G.T.54-9, G.95-19 and G.95-21 indicating that the stalk weight has significant correlation with its attributes. In the other two varieties (G.98-28 and Ph. 8013) the contribution of these two characters was insignificant. Among the stalk length which had maximum contribution of 38.1, 37.59 and 35.45 percent in stalk weight of G.95-21, G.T.54-9 and G.95-19, respectively. The contribution of stalk diameter was of the order of 29.18 and 27.1 percent in the weight of G.T. 54-9 and G.95-19, respectively. These two characters contributed almost negligible in the stalk weight of variety G.98-28. Number of internodes and number of tillers of cane had significant and positive contribution in stalk weight of all the varieties. However, number of tillers contributed more as compared to number of internodes of cane to the stalk weight of variety G.T. 54-9 and Ph.8013. The respective contribution of number of tillers of cane was 53.91 and 45.25 percent in both varieties. In case of varieties G.95-19 and G.95-21, the contribution of number of internodes of cane to the stalk weight was more as compared to number of tillers of cane (40.1% in G95-19 and 33.33% in G.95-21). Multiple correlation coefficients were signification in all the cases. It could be concluded that increasing stalk length, stalk diameter, number of internodes and number of tillers should be the major selection criteria for the breeders for increasing stalk weight in sugar cane plants or genotypes in their breeding program.

INTRODUCTION

Cane yield in sugarcane is the ultimate expression of its individual components (Number of millable canes, weight per cane, length of cane and girth of cane). Some components contribute more while others do less contribution in the yield. There are also some components which do not have any substantial direct contribution in yield but contribute in a component responsible for yield. The association of yield components with yield is ascertained by calculating correlation coefficients between two variables. As yield components vary independently among varieties, study of the relative importance of each component for different varieties is essential to pinpoint the yield building characters of each variety and to exploit the desirable component by suitable management practices, to increase the yield. Keeping this consideration in view, the present study was undertaken.

Several investigators have studied the relationships between characters contributing to stalk weight and sucrose content. *Gaber et al* (1990) found that various correlations between stalk weight and stalk length, number of internodes and stalk diameter, stalk length and internodes number, and stalk diameter were positive and highly significant in different varieties studied. *Milligan et al* (1990) examined the genetic correlation between certain stalk related traits (stalk number, stalk weight and stalk length). They found that the correlation between stalk weight and sucrose content or Brix and stalk diameter and sucrose content were negative while they obtained highly significant positive correlation between stalk length and sucrose content. Singh and *Singh* (1995) found that stalk diameter/ shoot and shoot/clump directly influenced cane yield. *Singh et al* (1995) studied the genetic correlation of 45 sugar cane genotypes and performed a path analysis. They found

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that all 5 characters, viz. number of millable stalks and stalk height, weight, diameter and internodes number, were positively correlated with cane yield. The Path analysis revealed that number of millable stalks had the greatest direct positive effect, followed by stalk weight, on cane yield. *Premachandran* (1995) obtained high positive correlation for cane diameter with cane yield and commercial cane sugar (C.C.S.). Sucrose percentage in the juice had either negative or no correlation with cane yield and C.C.S. clones with high single cane weight and moderate sucrose percentage in the juice can be selected for breeding programmes. *Chang* (1996), studied three sugar cane characters; Brix (percent of soluble solids), purity and sugar content for four sugar cane cultivars for three consecutne crop years. The coefficient for genetic and phenotypic correlation among Brix, purity and sugar content were in the range of 0.84 to 0.97 and 0.78 to 0.94, respectively. The greatest correlation coefficient was found between brix and sugar content (0.97 and 0.94), demonstrating that the brix reading is a reliable index for content. *Younan et al* (1997) found highly significant and positive genetic correlation were calculated between each pair of the four characters; stalk weight, stalk length, number of internodes and stalk diameter, except the correlation between number of internodes and stalk diameter which was positive, but insignificant. On the other hand, those four characters were weakly and negatively correlated with Brix and sucrose content. Both Brix and sucrose content were highly significant and positively correlated.

MATERIALS AND METHODS

A field experiment was conducted at the Research Farm of Agricultural Research Station, Sabahia, Alexandria, Egypt for the two successive crop years, 2005-2006, 2006 -2007. Five sugar cane varieties; G.T. 54-9, G.95-19, G.95-21, G.98-28 and Ph.8013, were used in this study. A complete randomized block design experiment with three replications was conducted. Cuttings of the five varieties were planted in the field in the beginning of April in both seasons. Each variety was sown on 7 ridges, 1.5 meter width and 5meters in length. The distance between cuttings was 30 cm, and each cutting contained 2 buds, plot area was 52.5m2 (10.5 x 5m). Fertilization with 20kg N/feddan was added as amonium nitrate (33.3% N) in two doses (at 60 and 90 days) from planting date. Other cultivable practices needed for growing sugar cane were done during the two seasons. Harvest was about 300 days after planting date. 12plants from each plot were taken at random to determine the following measurements for each season:

1- Stalk weight in kg, measured after striping the stalk leaves.

2- Stalk length in centimeters.

3- Stalk diameter in millimeter, measured by verniercaliper.

4- Number of internodes.

5- Number of tillers.

A study was designed to obtain information on the associations of the five mentioned characters of the sugar cane plant.The correlation studies between stalk weight and its attributes were made in different varieties by the methods given by Bernardo(2002).All possible correlations among the five characters were calculated from the variance and co-variance components.

RESULTS AND DISCUSSION

In order to study relationship of stalk weight with different stalk weight components and also between stalk weight components themselves, simple correlation coefficient(r)was calculated between them and the values are presented in Tables(1) to(5), for different varieties. G.T.54-9 and G. 95-19 showed positive and significant correlation between stalk weight and all other characters except number of tillers in G.95-19 was insignificant. In G.95-21 and Ph.8013, though all the characters were positively correlated to stalk weight, the stalk length in case of G.95-21 and the number of tillers in Ph.8013 was significantly correlated. In the variety G.98-28, none of the component had significant correlation. Among stalk weight components, stalk length was found to be correlated significantly with stalk diameter, number of internodes and number of tillers in case of G.T.54-9. Also, among stalk weight components, stalk diameter was found to be correlated signification with number of internodes and number of tillers of the cane in all the varieties except in G.95-19, whereas stalk diameter did not have significant correlation with number of internodes and tillers. This indicates that the stalk weight of cane is not an independent character but it is dependent on number of internodes and number tillers of the cane. The magnitude of the association found in this study between the different traits of sugar cane is in agreement with those obtained by James and Falgout (1969), Nour *et al* (1977), Kang *et al* (1983), Jackson (1994), Premachadvan (1995) and Younan *et al* (1997). On the other side this partially disagreed with Singh and Khan (1995).In a study, Younan et al (1997) observed significant positive correlation between stalk weight and each of stalk length, stalk diameter, number of internodes in two seasons except the correlation between number of internodes and stalk diameter which was positive, but insignificant. Stalk weight is mainly contributed by stalk length, stalk diameter and number of internodes. It was observed by simple correlation studies that number of internodes and number of tillers of stalk canes contributed in stalk weight per stalk cane.

Table1. Simple correlation coefficient (r), between stalk weight and its attributes of variety G.T. 54-9

Characters	Stalk weight	Stalk length	Stalk diameter	Number of internodes	Number of tillers
Stalk weight	1	0.945*	0.914*	0.665*	0.786*
Stalk length		1	0.584*	0.788*	0.586*
Stalk diameter			1	0.756*	0.612*
No. of internodes				1	0.188
No. of tillers					1

Table 2. Simple correlation coefficient(r), between stalk weight and its attributes of variety G.95-19

Characters	Stalk weight	Stalk length	Stalk diameter	No. of internodes	No. of tillers
Stalk weight	1	0.664*	0.584*	0.868*	0.506
Stalk length		1	0.258	0.506	0.197
Stalk diameter			1	0.199	0.289
No. of internodes				1	0.493
No. of tillers					1

Table 3. Simple correlation coefficient(R), between stalk weight and its attributes of variety G.95-21

Characters	Stalk weight	Stalk length	Stalk diameter	Number of internodes	Number of tillers
Stalk weight	1	0.672*	0.512	0.559	0.564
Stalk length		1	0.376	0.275	0.435
Stalk diameter			1	0.945*	0.914*
No. of internodes				1	0.855*
No. of tillers					1

Table 4. Simple correlation coefficient(r), between stalk weight and its attributes of variety G.98-28

Characters	Stalk weight	Stalk length	Stalk diameter	Number of internodes	Number of tillers
Stalk weight	1	0.515	-0.160	0.059	0.012
Stalk length		1	-0.116	0.195	0.010
Stalk diameter			1	0.828*	0.863*
No. of internodes				1	0.535
No. of tillers					1

Table 5. Simple correlation coefficient(R), between stalk weight and its attributes of variety Ph.8013

Characters	Stalk weight	Stalk length	Stalk diameter	Number of internodes	Number of tillers
Stalk weight	1	0.418	0.423	0.338	0.589*
Stalk length		1	0.158	0.356	0.237
Stalk diameter			1	0.818*	0.859*
No. of internodes				1	0.569
No. of tillers					1

Multiple correlation coefficient between stalk weight and stalk length and stalk diameter was significant in G.T.54-9, G.95-19 and G.95-21 indicating that the stalk weight has significant correlation with its attributes jointly Table(6). In other two varieties (G.98-28 and Ph. 8013) the contribution of these two characters was not significant. Among these stalk length had maximum contribution of 38.1, 37.59 and 35.45 percent in stalk weight of G.95-21, G.T.54-9 and G.95-19, respectively. The contribution of stalk diameter was of the order of 29.18 and 27.1 percent in the weight of G.T. 54-9 and G.95-19, respectively. These two characters contributed almost negligible in the stalk weight of variety G.98-28. Table(7) showed that the number of internodes and number of tillers of cane had significant and positive contribution in stalk weight of all the varieties. However, number of tillers contributed more as compared to number of internodes of cane to the stalk weight of variety G.T. 54-9 and Ph. 8013. The respective contribution of number of tillers of cane was 53.91 and 45.25 percent in both the varieties. In case of varieties G.95-19 and G.95-21, the contribution of number of internodes of cane to the stalk weight was more as compared to number of tillers of cane (40.1% in G.95-19 and 33.33% in G.95-21). Multiple correlation coefficients were proven to be significant in all the cases. Hence it can be inferred that cumulative contribution of number of internodes and number of tillers was significant in cane weight indicating thereby that they contribute in stalk weight indirectly by contributing in weight per cane. It could be concluded that increasing of stalk length, stalk diameter, number of internodes and number of tillers should be the major selection criterion for the breeders for increasing stalk weight in sugar cane plants or genotypes in their breeding program.

Table 6. Simple correlation coefficient (r), and multiple correlation coefficient (R) between stalk weight and its components (x_1 ,x_2) and percent contribution of different components in stalk weight

Variety	Stalk weight components	r	R	Percent contribution
	Stalk length (x_1)	0.945*	0.989*	37.59
G.T.54-9	Stalk diameter (x_2)	0.914*		29.18
	Stalk length (x_1)	0.664*	0.782*	35.45
G.95-19	Stalk diameter (x_2)	0.584*		27.1
	Stalk length (x_1)	0.672*	0.739*	38.1
G.95-21	Stalk diameter (x_2)	0.512		15.1
	Stalk length (x_1)	0.515	0.0429	0.193
G.98-28	Stalk diameter (x_2)	-0.160		0.103
	Stalk length (x_1)	0.418	0.546	15.31
Ph.8013	Stalk diameter (x_2)	0.423		15.51

* Significant at 5% level of probability.

Table7. Simple correlation coefficient(r), and multiple correlation coefficient(R)between stalk weight and its components(x_1,x_2) and percent contribution of different components in stalk weight.

Variety	Stalk weight components	r	R	Percent contribution
	No. of internodes (x_1)	0.665*	0.781*	35.55
G.T.54-9	No. of tillers (x_2)	0.786*		53.91
	No. of internodes (x_1)	0.868*	0.92*	40.1
G.95-19	No. of tillers (x_2)	0.506		15.13
	No. of internodes (x_1)	0.559	0.769*	33.33
G.95-21	No. of tillers (x_2)	0.564		26.91
	No. of internodes (x_1)	0.059	0.0521	0.191
G.98-28	No. of tillers (x_2)	0.012		0.0101
	No. of internodes (x_1)	0.338	0.908*	39.35
Ph.8013	No. of tillers (x_2)	0.589*		45.25

* Significant at 5% level of probability.

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الملخص العربي

دراسات الارتباط البسيط والمتعدد بين وزن العود ومكوناته في قصب السكر

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خمسة تراكيب وراثية من قصب السكر في تجربة بحثية اقيمت في محطة البحوث الزراعية بالصبحية بالاسكندرية .وهذه التراكيب الوراثية الخمسة هي: Ph.8013,G.98-28, G.95-21, G.95-19,Gt.54-9 واجريت التجربة فى موسمي غرس ربيعى (2006/2005) ،(2007/2006) .

اظهرت النتائج وجود علاقة موجبة بين كل من وزن العود وطول العود وسمك العود وعدد العقل في العود وعدد الخلف في الجورة ،هذه العلاقات الموجبة كانت معنوية كلها باستثناء العلاقة مع عدد الخلف في الجورة لم تكن معنوية في التركيب الوراثي G.95-19 اما فى التراكيب G.95-21, Ph. 8013 كان هناك ارتباط موجب بين وزن العود وجميع الصفات مع الوضع في الاعتبار ظهور معنوية في هذه العلاقة الموجبة بين وزن العود وطول العود فى التركيب الوراثى G.95-21 وبين وزن العود وعدد الخلف في الجورة في حالة Ph.8013، وفي التركيب الوراثى G. 98-28 لم توجد أي علاقات معنوية بين الصفات المدروسة ،وفي حالة الصنفG.T.54-9 وجدت علاقات موجبة ومعنوية بين بعض مكونات وزن العود وهي بين طول العود وسمك العود ، عدد العقل (السلاميات) وعدد الخلف في الجورة. وهذا يدل علي ان وزن العود يعتمد علي عدد السلاميات (عدد العقل في العود) وعدد الخلفات في الجورة.

وكان الارتباط المتعدد بين وزن العود وطول وسمك العود في التراكيب الوراثيةG.T.54-9, G.95-19,G.95-21 يدل على ان وزن العود متلازم معنويا مع مكوناته، بينما لم يكن ذلك معنويا فى الصنفين Ph.8013 , G.98-28. وبالنسبة لطول العود فقد سجل الحد الاقصى للمساهمة فى وزن العود بالنسب المئوية 38.1، 37.59، 35.45 فى الاصناف G.95-21, G.T.54-9, G.95-19 على التوالى ، وكانت مساهمة سمك العود فى وزن العود هى 29.18% ، 27.1% فى الاصناف G.T.54-9,G.95-19 وهاتان الصفتان طول العود وسمك العود غالبا لاتأثير لهما فى صفة وزن العود بالنسبة للصنف G.98-28.

وكان الارتباط المتعدد بين وزن العود وعدد السلاميات (العقل فى العود) وعدد الخلفات فى الجورة دلت على ان هاتين الصفتين لهما تأثير معنوى وموجب على وزن العود فى كل الاصناف تحت الدراسة، ورغم هذا فقد لوحظ ان عدد الخلفات فى الجورة ذات مساهمة اكثر فى وزن العود بالمقارنة بعدد السلاميات فى العود وذلك فى الصنفين G.T. 54-9 &Ph. 8013 حيث كانت مساهمة صفة عدد الخلف للعود فى الجورة فى وزن العود 45.25% ، 53.91% لكلا الصنفين، وفى حالة الصنفين&G.95-21 G.95-19 كانت مساهمة عدد العقل فى العود بالنسبة لوزن العود اكبر من مساهمة عدد الخلف فى الجورة حيث كانت 41.1% للصنف G.95-19 ، 33.33% للصنف G.95-21. وكان الارتباط المتعدد معنوى فى كل الحالات.

ويستنتج من هذا ان زيادة كل من طول العود، وسمك العود، عدد السلاميات فى العود وعدد الخلف للعود فى الجورة يمكن ان تكون دليل المربى فى برامج التربية والانتخاب لزيادة المحصول من خلال زيادة وزن العود فى الطرز الوراثية واصناف قصب السكر.

تم دراسة الارتباط البسيط والمتعدد لايجاد العلاقة بين وزن العود ومكوناته والتوصل لتأثير المكونات الرئيسية في وزن العود وذلك في