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MULTIVARIATE ANALYSIS OF YIELD AND RELATIVE CONTRIBUTION OF VARIABLES TO ITS VARIATION IN COTTON YIELD

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ABSTRACT

The stepwise multiple linear regression analysis was used to study the relationship between the variables using two models. While the first one seed cotton yield (ken./F.) is considered the dependent variable. In the second one lint yield (ken./F.) is considered the dependent variable. Three variables were significantly contributing to variation in seed cotton yield, these variables were number of bolls/plant, boll weight and seed index with relative contribution equal to (R^2%) 91.69% for all variables and contribution 91.63% for acceptance variables. Meanwhile two variables were significantly contributing to variation in lint yield, these variables were number of bolls/plant and boll weight with relative contribution 91.17% for all variables and 91.14% for acceptance variables. The path coefficient analysis indicated that number of bolls/plant and boll weight were the most prominent direct and indirect effects on seed cotton yield and lint yield. Total contribution of these characters over all variation in seed cotton yield (mod.1) and lint yield (mod.2) were 91.61% and 90.63%, respectively.

In general the results obtained herein indicated that number of bolls/plant and boll weight were the major and most consistent source accounting for variation as total contribution.

INTRODUCTION

In Egypt, cotton (*G. barbadense L.*) is considered to be one of the most important crops contributing to the national income for its unique characters.

Yield is a very complex character determined by several components. It is the final outcome of numerous factors, hereditary and environmental. It is the experience of plant breeders that direct selection for yield on an individual plant basis is mostly misleading. Hence the plant breeder attempt to improve yield indirectly through the improvement of characters associated with it. Therefore it is important to study the relative importance of characters contributing to seed cotton yield and lint yield in the early segregating generation.

The correlation studies give the amount of association between any pair of characters. The direct and indirect effect of each of the components on yield is, however not revealed by these correlation studies especially when more number of variables is included.

Correlation coefficients between yield components varying in magnitude and direction were reported in different types in cotton.

Path coefficient analysis developed by Wright (1921), followed by many workers in different crops facilitates the partitioning of the correlation coefficient into direct and indirect effects, there by providing the relative importance of each of the causal factors (Moursi *et al.* 1978).

MATERIALS AND METHODS

The materials used in this investigation consisted of the two newly promising strains, i.e. Giza 81 x Giza 83 and Giza 89 x Pima S6 and four commercial cultivars, Giza 80, Giza 83, Giza 85 and Giza 90. These were grown in the two successive seasons, i.e. 2002 and 2003 at five locations in Sohag, Assuit, El-Minia, Benisweef and El-Fayioum governorates of Upper Egypt. The experimental design was a randomized complete block design with four replications at each location. Seeds were grown on March in the two growing seasons. The plot area was 13 m^2 containing five rows of four meters long and 65 cm. wide. Hills in rows were spaced 25 cm. apart. Plants were thinned to two plants per hill after six weeks. The first irrigation was given three weeks after sowing, and the second was three weeks later. The experiments were irrigated every two weeks until the end of the seasons for a total of nine irrigations. Phosphorus was applied before sowing at a rate of 24 kg. Ph./feddan as calcium super-phosphate. Nitrogen was applied at the rate of 60 kg N./feddan as ammonium nitrate (33.5% n.) in two equal amounts, 6 and 8 weeks after sowing, each application was followed immediately by irrigation. The yield was obtained from the three middle rows of each plot. Data were collected for the following characters:

1- Number of opening bolls/plant (NB.): The average number of harvested bolls per ten plants.
2- Earliness% [Ear.%]: estimated as the portion of the total yield harvested in the first pick.
3- Lint yield k./f. (LY.): estimated as the weight of lint yield in kentar per feddan.
4- Seed cotton yield k./f. (SCY.): obtained from the three middle rows of the plot and was converted to kentar per feddan.
5- Seed index gm. (SI.): estimated as the weight of 100 seed in grams.
6- Lint percentage (LP. %): the amount of lint in seed cotton sample, expressed in percentage
7- Boll weight gm. (BW): the average weight in grams of 25 bolls, picked at random from the first and the fifth row.
8- Position of the first fruiting node (FB):node number at which the first fruiting branch is emerges on the main stem.

Stepwise multiple linear regression as applied by Draper and Smith (1966), was used to compute sequence of multiple regression equations in a stepwise manner. At each step one variable was added to the regression equation; it was the most one reduced the error sum of squares. Equivalently, it was the variable that had the highest partial correlation with the dependent variable adjusted for the variables already added. Similarly, it was the variable, which if added had the highest F value in the regression analysis of variance. Moreover, variables were forced into the regression equation and automatically removed when the values were low.

Simple correlation coefficient were computed among characters studies according to method described by Snedecor and Cochran (1981).

Path coefficient analysis used to identify the different characters., which affect the independent character directly as well as indirectly. It gives us the path in which an independent variable is affecting the dependent variable in a given set of independent variables. The path coefficient analysis proposed by Wright (1921) and utilized by Dewey and Lu (1959), was used in this study for analysis of yield components. A path coefficient is simply a standard partial regression coefficient as it measures the direct influence of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects.

RESULTS AND DISCUSSION

A matrix of simple correlation coefficient for characters under study is presented in table 1 for combined data over both seasons 2002 and 2003. Highly significant positive correlation was found between boll weight and seed index, Also there was found high significant positive correlation between seed cotton yield and each of the characters, lint yield and number of bolls/plant, also between number of bolls/plant and lint yield Abd El-Hakim (1993). Kamel and Omran,(1962), Abdel – Rahman (1983), stated that there were positive correlation between yield per plant and number of bolls per plant.

On the other hand there was a negative correlation coefficient between seed index and the two traits Earliness% and number of bolls/plant , also between boll weight and number of bolls/plant . This results is similar with obtained by Seyam *et al* (1984b) .

Table 1: A matrix of simple correlation coefficient of variables over two seasons 2002 and 2003.

Characters	BW	LP	SI	SCY	LY	Ear%	NB
BW	1.000						
LP	.084	1.000					
SI	.552**	-.353*	1.000				
SCY	.292*	.065	.205	1.000			
LY	.298*	.266	.129	.978**	1.000		
Ear%	-.154	.088	-.248	.202	.205	1.000	
NB	-.319*	.104	-.206	.766**	.764**	.318*	1.000
FB	.277	.057	.359*	.002	.016	-.321*	-.169

*** and ** denotes significant at 5% and 1% respectively.**

The stepwise multiple linear regression indicated that three and two variables were significantly contributing to variation in seed cotton yield and lint yield respectively. These variables were boll weight, number of bolls/plant and seed index for seed cotton yield (model.1), while the variables which contributing to variation in lint yield (model 2) were boll weight and number of bolls/plant . The total contribution of these characters over all variation in seed cotton yield (mod.1) and lint yield (mod.2) were 91.69% and 91.17% respectively. The prediction equation for model 1and model 2 was formulated as follows in Table 2 and Table 3.

Table 2: Accepted and removed variables according to stepwise analysis and their relative contribution (R^2%) in seed cotton yield variance in cotton.

Model 1 (seed yield)	
Prediction equation.	$\hat{Y}$= -12.2391+ 3.490 BW + 0.2704 SI + 0.9119 NB
R^2 for all variables	91.69%
Acceptance variables	BW, SI and NB
R^2 for acceptance variables.	91.63%
Removed variables	Ear..% and FB

Table 3: Accepted and removed variables according to stepwise analysis and their relative contribution (R^2%) in lint yield variance in cotton.

Model 2 (lint yield)	
Prediction equation	$\hat{Y}$ = -13.5579 + 4.8437 BW + 1.1292 NB
R^2 for all variables	91.17%
Acceptance variables	BW and NB
R^2 for acceptance variables	91.14%
Removed variables	SI, Ear% and FB

The path coefficient analysis Table 4 indicated that number of bolls/plant and boll weight were the most prominent direct and indirect effects in model 1 and model 2, with the highest relative importance values being 50.86% and 16.09% in model 1. Also the same characters were being 50.11% and 20.18% respectively in model 2.This finding is agreement with El-Shaer *et al* (1984). They reported that the direct effects of number of bolls and boll weight as well as, their indirect effects were responsible for 91.8% to the variation in plant yield. The results also cleared that boll weight and number of bolls/plant had the highest indirect effects, (18.26%) in the first model, contributing to seed cotton yield variation. While results indicated high indirect effects between number of bolls/plant and boll weight being 20.35% contributing to lint yield. El-Bayoumy (1978) reported that bolls number was the most important to seed cotton yield variation in nine Egyptian cotton varieties. The total contribution of the above mentioned characters over all variation in seed cotton yield and lint yield were 91.61% and 90.63% respectively. The residual effect of the other yield components in the present investigation was 8.39% in model 1 and 9.37% in model 2. it is clear that this residual effect has slight importance and showed very small contribution to seed cotton yield and lint yield variation and also to the other characters which were probably not included into these models. However the results of direct and indirect effects of seed cotton yield mod.1 and lint yield mod.2 were presented and illustrated diagrammatically in Figure1 and Figure2 respectively.

Table (4): Direct and indirect effects of yield components and their relative contribution in seed cotton yield (mod.1) and lint yield (mod.2)of cotton over both seasons 2002 and 2003.

Model 1			Model 2		
Variables	CD	RI%	Variables	CD	RI%
Boll weight (BW)	0.292	16.09	No. Of bolls/plant	0.909	50.11
Seed index (SI)	0.011	0.61	(NB)	0.366	20.18
No. of bolls/plant (NB)	0.923	50.86	Boll weight (BW)	-0.369	20.35
BW x SI	0.063	3.47	NB x BW	0.093	9.37
BW x NB	-0.332	18.26	Residual		
SI x NB	-0.042	2.31			
Residual	0.084	8.39			

Multiple coefficient of determination in model 1 =91.61%
Multiple coefficient of determination in model 2 =90.63%
CD=Coefficient of determination
RI =Relative importance

In general the results obtained herein indicated that number of bolls/plant and boll weights were the major and the most constant source accounting for variation as total contribution in seed yield and lint yield Variation. Therefore it is important for the breeder to consider these characters in formulating his breeding programs to obtain the best gain in selection.

RELATIVE CONTRIBUTION OF COTTON YIELD

FIRST MODEL (SEED COTTON YIELD)

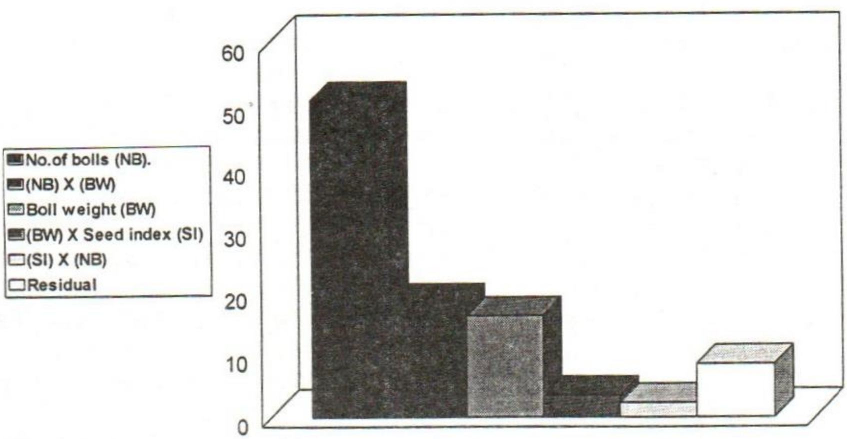

Fig.(1): Components (direct and joint effects) of seed cotton yield variation in cotton

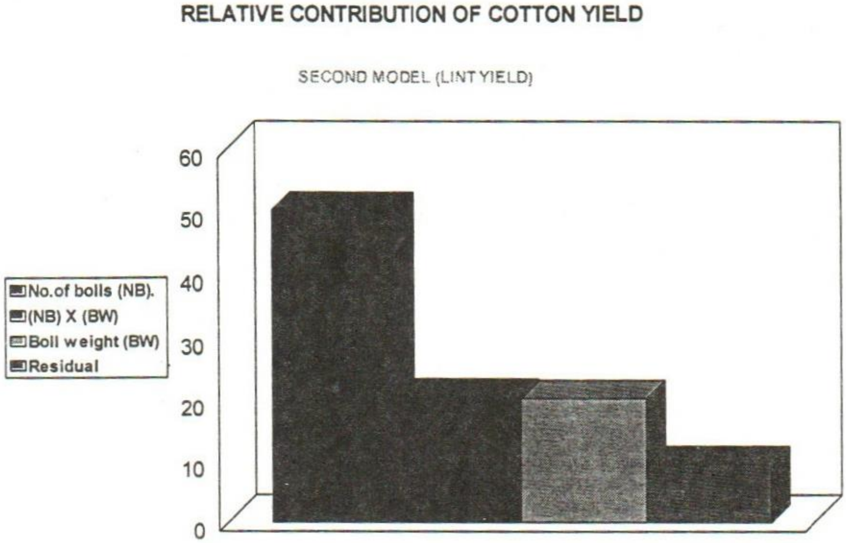

Fig.(2): Components (direct and joint effects) of lint yield variation in cotton

REFERENCES

Abd El-Hakim, A.M. (1993). Path coefficient analysis of characters contributing to yield variation of an Egyptian cotton cross Giza 45 x Giza 69. The annual conference, ISSR, Cairo University, Vol. (28), Part (1) 1993.

Abd El-Rahman, L.M.A. 1983. Studies on fibers and seed development of cotton with special reference to ginning and grading qualities Ph. D. Thesis, Fac. of Agric.,Univ. of Cairo, Egypt.

Dewey, D.R. and K.M.Lu 1959. A correlation and path coefficient analysis of components of crested wheat grass seed production. Agro. J1, 515-518.

Draper, N.R. and H. Smith,(1966). Applied regression analysis. John Willey and Sons Jne. ,N., 407pp.

El-Bayoumy, K.E.M. 1978.The relationship between some characters of cotton plants. Ph. D. Thesis, Fac. Of Agric., Ain Shams Univ., Egypt.

El-Shaer, M.H., Reda Shabana, A.H. El-Shiekh, and Laila M.A.Abd-El-Rahman. 1984. Path coefficient analysis of some characters contributing to yield and quality of cotton. Agric Res. Rev., Egypt, Vol. 62, No. 623-31.

Kamel, S.A. and A.O. Omran. 1962. Analysis studies of yield and it components in a cross of two varieties of Egyptian cotton 3rd Cotton Confr., Cairo. (In Arabic).

Moursi, M.A., A.M. El-Marakby, M.T. Fayed and M.G. Seif. 1978. Estimation of the relative importance of characters contributing to yarn strength in Egyptian cotton. Ann. Agric.Sci. Bull. 931, Ain Shams Univ.Egypt.

Seyam, S.M., A.A. Abo El-Dahab, H.N. El-Rassas, and F.M. El-Rayes.1984 b. The use of stepwise regression analysis in determining characters or yield selection in Egyptian cotton. Agric.Res.. Rev., Egypt, Vol. 62, No. 6:41-47.

Snedecor, G.W., and W.G.Cochran 1981. Statistical methods, 1$^{\underline{th}}$ Ed. Iowa State Univ. Press, Ames, Iowa. U.S.A.

Wright, S. 1921. Correlation and causation. J. Agric. Ress. 20: 557-585.

التحليل العاملى المتعدد والمساهمة النسبية لعوامل المحصول لبعض اصناف القطن المصرى

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تعتبر صفة المحصول صفة معقدة تعتمد على كثير من العوامل الوراثية والبيئية لذلك فان الانتخاب لصفة المحصول ومكوناته يؤدى الى التحسين المطلوب بطريق غير مباشر و من هذا المنطلق اجرى هذا البحث بهدف دراسة علاقة التلازم بين محصول القطن الزهر ومحصول الشعر ومكوناته فى نبات القطن و وكذلك دراسة المساهمة النسبية لكل من وزن اللوزة ومعدل الحليج ومعامل البذرة وصفة التبكير وعدد اللوز المتفتح واول فرع ثمرى على النبات على الاختلافات الكلية لمحصول القطن الزهر ومحصول الشعر لعدد من اصناف القطن المصرى وهى جبزة ٨٠ و جيزة٨٣ وجيزة ٨٥ وجيزة ٩٠ والهجن جيزة٨١ × جيزة٨٣ وجيزة ٨٩ × بياس.

اجرى تحليل الانحدار المتعدد المرحلى لدراسة العلاقة بين الصفات المختلفة باستخدام نموذجين فى التحليل، النموذج الاول تم اخذ صفة محصول القطن الزهر فيه كمتغير معتمد مع باقى المتغيرات المستقلة، اما فى النموذج الثانى فكانت صفة محصول الشعر هو المتغير المعتمد مع باقى المتغيرات المستقلة ، واظهرت النتائج المتحصل عليها فى النموذج الاول ان صفات عدد اللوز بالنبات ووزن اللوزة ودليل البذرة كانت اكثر الصفات مساهمة فى التباين الكلى لمحصول القطن الزهر بينما كانت صفات عدد اللوز بالنبات ووزن اللوزة اكثر الصفات مساهمة فى التباين الكلى لمحصول الشعر وذلك بمقدار ٩١,٦٩% و ٩١,١٧% على الترتيب .

لوحظ ان هناك ارتباطا موجبا عاليا بين محصول القطن الزهر وصفات محصول الشعر وعدد اللوز المتفتح ، وبين دليل البذرة ووزن اللوزة من ناحية اخرى، كذلك بين محصول الشعر وعدد اللوز المتفتح، كما ان هناك ارتباطا ت اخرى معنوية بين الصفات الاخرى وبعضها.

اوضحت نتائج تحليل معامل المرور ان عدد اللوز بالنبات ووزن اللوزة اكثر الصفات مساهمة بطريق مباشر وبطريق غير مباشر فى الاختلافات الكلية لمحصول الزهر بمقدار ٩١,٦١% من التباين الكلى، كما وجد ايضا ان نفس الصفات وهى عدد اللوز بالنبات ووزن اللوزة اكثر الصفات مساهمة بطريق مباشر وبطريق غير مباشر فى الاختلافات الكلية لمحصول الشعر بمقدار ٩٠,٦٣% من التباين الكلى.

لذلك ينصح المربى بالاخذ فى الاعتبار صفات عدد اللوز بالنبات ووزن اللوزة وهى اكثر الصفات اهمية عند وضع برامج التربية والانتخاب لمحصول القطن.