J. Agric. Sci. Mansoura Univ., 30 (10): 5757 - 5764, 2005

STATISTICAL EVALUATION OF COTTON YIELD AND ITS COMPONENT OF SOME EGYPTION COTTON CULTIVARS GROWN IN DELTA REGION

Hassan. I. S. M[1] and Samia G. A. Mohamed[2]
1- Cotton Res. Institute, Agric. Res. Cent. Giza, Egypt.
2- Cent. Lab. For Design and stat. Analysis A.R.C.Giza Egypt

ABSTRACT

Two field experiments were carried out during 2003 and 2004 seasons at seven Governorates (El-Monfia, El-Gharbia, El-Dakahlia, El-Shrkia, El-Behira, Kafer-El-Sheikh and Damiatta) to investigate the relative importance of different lint cotton yield and seed cotton yield components in seven Egyptian cotton varieties (Giza45, Giza 70,Giza 85,Giza 86,Giza 87,Giza 88 and Giza 89). The recorded data were boll weight, lint percentage, seed index, seed cotton yield in kentar per faddan, lint yield in kentar per faddan and number of bolls per plant. Simple correlation coefficients and stepwise multiple linear regression were used, in addition to path coefficient analysis. The results showed positively and highly significant correlation coefficients between either seed cotton yield or lint yield and yield components.

Simple correlation coefficient was used for assessing the relationship between lint yield and characters studies. Lint yield was highly positive correlated with each of boll weight, lint percentage, seed index and number of bolls per plant. When the relative contribution from boll weight and number of bolls per plant were combined in linear regression equations, their contribution to seed cotton yield and lint yield were 97.80 % and 92.49 %, respectively.

Results of the path coefficient analysis, revealed that three yield components (boll weight, seed index and number of bolls per plant) contributing to seed cotton yield (k/f) and lint yield (k/f). The highest value for coefficient of determination (CD) were 0.0827 for boll weight and 0.779 for number of bolls per plant with relative importance equal to (RI) of 8.27% and 77.98 %, respectively in the first model (seed cotton yield). Boll weight and number of bolls per plant had the highest indirect effect being 10.57 %. The total relative contribution of the studied characters to the overall variation in seed cotton yield (k/f) was 97.80 %. While in the second model, results indicate that the highest values for coefficient of determination (CD) was 0.1146 for boll weight and 0.7069 for number of bolls per plant with, relative important (RI%) equal to 11.02 % and 68.56 %, respectively in lint yield. The total relative contribution of the studied characters to the overall variation in lint yield was 92.46 %.

In general obtained results indicated that number of bolls per plant and boll weight were the major and the most consistent sources accounting for variation in seed cotton yield and lint yield. Therefore, it is important for the breeder to consider these characters in formulating his breeding programs to obtain the best yield.

INTRODUCATION

Cotton *(Gossypium sp)* is the most important fiber crop all over the world. In Egypt, cotton is important for both export and local textile industry. Yield is a very complex character determined by several components. It is the final outcome of hereditary and environment factors. It is the experience of plant breeders that direct selection for yield on an individual plant basis is

mostly misleading. Hence the breeder attempts to improve yield indirectly selection characters associated with yield. Therefore it is important to study the relative important of characters contribution to seed cotton yield and lint yield in the early segregating generations.

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.

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. The objective of the cotton breeder is to enhance yielding potential of cotton varieties. Cognizance of yield components is very necessary to appreciate the yielding capacity of selected lines in any breeding program before their release as commercial cultivars *(Worley et al. 1976).*

Elyan (1982), found that cotton yield per plant was correlated significantly and positively with number of bolls per plant in Egyptian and upland cotton cultivars. Number of bolls gave clear association rather than boll weight, and correlation values between lint index and lint percentage was positive *Abd-El-Hakim (1993),* found that simple correlation coefficient was used for assessing the relationship between lint yield and the some characters under studied (number of bolls per plant, seed index and lint percentage) were highly positive correlated. Path coefficient analysis showed that number of bolls per plant revealed the most prominent direct effects on lint yield with the highest relative important contribution value of 63.39 % to the total variation of lint yield.

Path coefficient analysis was used to estimate the relative contribution of yield components to yield variation in cotton by several workers, i. e. *El-Bayoumi,(1978),El-Marakbyet.al.,(1980), El-Shaer et.al., (1984),Nasrallah (1987), Shasfshsk et al., (1987), Ghaly et. al., (1990) and El-Beily et. al. (1996).* They reported that bolls number contributed with the greatest part to cotton yield but they mentioned different arrangements with regard to characters following number of bolls. In path coefficient analysis, number of bolls per plant revealed the most prominent direct effects on lint yield with the highest relative important contribution value of 63.39 % to the total variation of lint yield.

Using stepwise analysis, *Worley et. al., (1974); Seyam et. al., (1984), Abou-Zahra et. al., (1992) and Abou-Tour et. al. (1996),* noticed the order of importance of the basic yield component. *Hayam (2004)* stated that there were positives and highly significant correlation between lint percentage and each of seed cotton yield, number of bolls per plant and lint index. Meanwhile, a highly significant negative correlation was found between lint yield and seed index. In the fifth model, the characters chosen for path coefficient analysis, as contributors to lint yield were seed cotton yield lint percentage and the joint effect between them. The direct and indirect effects between them were relatively high on yielding ability and the relative importance equal to 88.83% for seed cotton yield, 2.6% for lint percentage and 3.86% for the joint effects between them.

The objective of study was to use the stepwise multiple linear regression to determine a prediction model for yield. Variable acceptance and variables removal as well as the relative contribution for variables acceptance can also be calculated path coefficient analysis to determine the relative importance of characters to cotton. This parameter might be useful in planning appropriate selection procedure for improving cotton yield.

MATERIALS AND METHODS

Seven commercial cultivars (Giza45, Giza 70,Giza 85, Giza 86, Giza 87,Giza 88 and Giza 89) were grown in the two successive seasons .of 2003 and 2004 at seven Governorates of North Egypt (El-Monfia, El-Gharbia, El-Dakahlia, El-Shrkia, El-Behira, Kafer-El-Sheikh and Damiatta).The experimental design was randomized complete blocks with four replications at each location. Seeds were sown on March in both seasons. The plot area was 13 m^2, containing five ridges of 4 m^2 length and 65 cm width. Hills in ridges were spaced 25 cm apart. Plants were thinned to two plants per hill after six weeks from planting. The first irrigation was given three weeks after sowing and the second are was two weeks later. Plants in all experiments were irrigated every two weeks until the end of the season for a total of nine irrigations. Phosphorus as calcium super-phosphate was applied before sowing at a rate of 24-kg $P_2 O_5$/ feddan. Nitrogen as ammonium nitrate (33.5% N) was applied at the rate of 60 kg N/ feddan in two equal amounts, 6 and 8 weeks after sowing, each application was followed immediately by irrigation. The seed cotton yield was obtained from the three middle ridges of each plot. Data were collected for the following characteristics:

1-Boll weight (BW): the average weight in grams of 25 bolls, picked at random from the first and the fifth ridges of each plot.
2-Lint percentage (LP%): the amount of lint in seed cotton sample, expressed in percentage.
3-Seed index (SI): estimated as the weight of 100 seeds in grams.
4-Seed cotton yield (SCY): obtained from the three middle ridges of the plot and was converted to kentar per feddan.
5-Lint yield (LY): estimated weight of lint yield in kentar per feddan.
6-Number of bolls per plant (B/P): the average number of harvested bolls per ten plants.

Data analysis:

The statistical analysis was carried out as follows:

1- Simple correlation coefficients were computed among characters studied according to method described by *Snedecor and Cochran (1969).* The path coefficient analysis proposed by *Wright (1921)* and utilized by *Dewey and Lu (1959),* was used in this study for the analysis of yield components path coefficient analysis used to identify the different independent characters which affect the dependent 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.

Table 1: Description of the studied parental cotton genotypes.

Serial	Genotypes	Pedigree
1	Giza 45	Giza 28 X Giza 7
2	Giza 70	Giza 59 A X Giza 51 B
3	Giza 85	Giza 67 X S.B 58
4	Giza 86	Giza 75 X Giza 81
5	Giza 87	Giza 77 X Giza 45 A
5	Giza 88	Giza 77 X Giza 45 B
7	Giza 89	Giza 75 x Rou. 6022

2-The stepwise multiple linear regressions as applied by *Draper and Smith (1966),* was used to compute a sequence of multiple regression equation 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. Regression analysis of both multiple linear regression and stepwise were estimated to determine the most contributing factors to seed cotton yield and lint yield (Y). Multiple coefficient of determination (R^2) for full model variability due to all independent variables was estimated for all variables and was compared to R^2 of stepwise analysis. The importance of stepwise analysis lays on the fact that it removes multicolinearty between predictor factors. Furthermore, it reduces the number of factors used to predict to the number that have the highest partial correlation with the dependent variable *Draper and Smith, (1966).* To obtain accurately precise prediction, coefficient of determination value (R^2) should be close 1 and standard error of estimates value (SE%) should be near zero *Draper and Smith, (1966).*

A path coefficient is simply a standardized 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

Simple correlation

A matrix of simple correlation coefficient for characters under study is presented in Table 2. for combined data over both two seasons. The results showed that highly significant positive correlation was found between seed cotton yield (k/f) and each of characters, boll weight (r =0.481), lint percentage(r =0.378), Seed index (r = 0.350) and number of bolls of plant (r =0.908). Also, the results showed that highly significant positive correlation was found between lint yield (k/f) and each of characters, boll weight (r =0.499), lint percentage (r =0.519), seed index (r =0.342, and number of bolls per plant (r=0.908). These results in agreement with those reported *Elyan (1982), AbdEl-Hakim (1990) and Hayam (2004).*

Table 2: Matrixes of simple correlation coefficient between yield and yield components in Egyptian cotton.

Variables	BW	LP%	SI	SCY	LY	B/P
BW	1.000					
LP%	0.403**	1.000				
SI	0.667**	0.141**	1.000			
SCY	0.481**	0.378**	0.350**	1.000		
LY	0.499**	0.519**	0.342**	0.967**	1.000	
B/P	0.208**	0.299**	0.163**	0.945**	0.908**	1.000

*and ** significant at 0.05 and 0.01 levels of significance, respectively

Stepwise multiple linear regression

Stepwise multiple linear regression and corresponded predication equations are indicating in Table 3. Regarding to seed cotton yield (k/f) and lint yield (k/f) the most contributing factors were boll weight and number of bolls per plant for models (1 and 2).

The total contribution of these characters over all variation in seed cotton yield (mod.1) and lint yield (mod.2) were 97.8 % and 92.5 %, respectively, for the coefficient of determination (R^2), whereas it was 89.4 % and 97.8 % for the predication equation stepwise for seed cotton yield (k/f). Also, it was 82.4 % and 92.4 % for the predication equation stepwise for lint yield (k/f). SE % values were calculated by diving overall standard error of estimates by the mean of dependent variable (Y, the seed cotton yield or lint yield) and were between 6.69 – 13.49 % for full model, whereas, it was between 5.96 – 20.56 for stepwise model (Table 3). The contribution of number of bolls per plant (X6) in seed cotton yield was high (R^2=0.89), whereas it (R^2=0.92) for lint yield. Number of bolls per plant is very important in yield predications. These results are in agreement with those reported by *Abd El – Hakim (1990) and Abou – Tour et al. (1996).*

Table 3: Predication equation, coefficient of determination, R^2 and standard error of estimates for Egyptian cotton using full model regression equations and stepwise.

Predication equation (Full model)		R^2	SE%
Seed cotton yield.			
$\hat{Y}$= -8.9158+ 3.2324X1** + o.o495 X3 + 1.0878 X6**	Step (1)	0.978	6.69
$\hat{Y}$ = -0.1361+1.1644 X6**	Step (2)	0.894	12.62
$\hat{Y}$ = -8.7087+3.3391X1 **+1.0882X6**		0.978	5.96
Lint cotton yield.			
$\hat{Y}$= -12.3979 +4.8398X1**-0.0867X3+1.3237X6**	Step (1)	0.925	13.49
$\hat{Y}$= - 0.8142+1.4291X6**	Step (2)	0.824	20.56
$\hat{Y}$=-12.7601+4.6531X1**+1.3229X6**		0.924	13.50

* and ** significant at 0.05 and 0.01 levels of significance, respectively
Boll weight (x1) Seed index (x3) Number of bolls (x6)

1-Path coefficient analysis:

The path coefficient procedure was used in this study to assess the relative importance of characters contributing, both directly and indirectly for two models to seed cotton and lint cotton yields (k/f).

Simple correlation coefficient between seed cotton yield or lint yield and its components namely: boll weight, seed index and numbers of bolls per plant were individually partitioned into their components of direct and indirect effects. The results of direct and indirect of yield components and their relative importance to seed cotton yield are shown in Table 4. and illustrated in Figures 1 and 2. The first model results indicate that number of bolls per plant and boll weight showed maximum direct effects toward seed cotton yield (k/f) recording the highest relative contribution to total variation of seed cotton yield (k/f) being 77.98% and 8.27% respectively. The results also showed that the highest indirect effects between boll weight and number of bolls per plant being 10.57%. The total relative contribution of the studied characters overall variation in seed cotton yield (k/f) was 97.80%. The residual effect of the other yield components in this model was 2.19%. While, the second model results indicate that number of bolls per plant and boll weight showed maximum direct effects toward lint yield (k/f) recording the highest relative contribution to total variation of lint yield (k/f) being 68.58% and 11.02%, respectively.

Table 4: Components (Direct and joint effects) of two-model variation in Egyptian cotton.

Variable	First model		Second model	
	CD	RI%	CD	RI%
Boll weight (x1)		8.27		11.02
Seed index (x2)	0.0827	0.02	0.1146	0.04
Number of bolls (x3)	0.0002	77.98	0.0004	68.58
(X1) x (x2)	0.7798	0.55	0.7069	0.86
(X1) x (x3)	0.0055	10.57	-0.0088	11.44
(X2) x (x3)	0.1057	0.41	0.1180	0.52
Residual	0.0041	2.19	-0.0054	7.54
Total contribution	0.0219	97.80	0.0754	92.46

CD= Coefficient of determination. RI%= Relative importance.
Multiple coefficient of determination first model = 97.80%.
Multiple coefficient of determination second model = 92.46%.

The results also clear that the highest indirect effects between boll weight and number of bolls per plant being 11.44%. The total relative contribution of the studied characters overall variation in lint yield (k/) was 92.46%. The residual effect of the other yield components in this model was 7.54%. It is clear that this residual effect has slight importance and showed very small contribution to both seed cotton yield (k/f) and lint yield (k/f) variation and also to the other characters, which were probably not included into this model. This finding is agreement with *El – Shaer et al. (1984)* who reported that the direct effects of number of bolls per plant and boll weight as well as, their indirect effects were responsible for 91.8 % to the variation in plant yield, and *El – Bayoumy (1978)* who 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 overall variation in seed cotton yield and lint yield were 91.61 % and 90.63 %, respectively.

In general, the results obtained herein indicated that boll weight and number of bolls per plant were the major and the most constant sources accounting for variation as total contribution in seed cotton yield (k/f) and lint yield (k/f) variation under study with value of 97.80% and 92.46% respectively. Therefore, it is important for the breeder to consider these characters in formulating his breeding programs under study to obtain the best gain in selection.

REFERENCES

Abd-El-Hakim, A.A. (1993). Path coefficient analysis of some characters Contributing to yield variation of an Egyptian cotton cross Giza 45 x Giza 69.The Annual Conference, ISSR, Cairo University, Vol.(28), art(1)1993)

Abou-Tour, H. B., M. A. Awaad, I. M. Haikal and S.S. Bader. (1996). Stepwise regression analysis of the primary lint yield components of Egyptian cotton. Egypt. J. Appl. Sc., 11(3): 139-145.

Abou-Zahara, S. I. S., M. M. Awaad and Foraisa A. El-Enani. (1992). Determining characters contributing to seed-cotton yield in some intervarietal and interspecific lines using stepwise regression analysis. Annals of Agric Sci., Moshtohor, 30: 645-653

Dewey, D. R. and K. H. Lu (1959). A correlation and path coefficient analysis of components of crested wheat grass seed production. Agron. J., 51:515-518 Draper, N. R. and H. Smith (1966). Applied Regression Analysis. John Willey and Sons Jne. NY. 407pp.

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

El-Bayoumi, K.E.M. (1978). The relationship between some characters of cotton plants. Ph, D. Thesis, Ain Shams Univ., Egypt.

El-Beily, M. A., H. B. Abo-Tour and A. A. Okasha. (1996). The relative contributions of yield components to lint yield in three cultivars of Egyptian cotton. J. Agric. Res., Tanta Univ., 22(1): 61-68.

Elyan, S. E. D. (1982). Micro and macro yield components interrelationships in cotton. M. Sc. Thesis, Fac. Agric. Cario University, Egypt.

El-Marakby, A. M.; M. E. M. El-Mocha; A. M. Abou-Alam and S. M. Al-Khafajy (1980) Path coefficient analysis and response to selection for yield and its components in Egyptian cotton varieties. Agric. Res. Rev., Egypt. 58:417-435.

El-Shaer, M. H; Reda Shabana; A. H. El-Shieekh and Laia M. A. Abd El-Rahman. (1984) Path coefficient analysis of some characters contributing to yield and quality of Cotton. Agric. Res. Rev., Egypt, 62:23-31.

Ghaly, F. M.; Thana. M. El-Gamal; M. H. El-Banna and Samia. D. Antoun. (1990). Path coefficient analysis of some characters contributing to yield variation of Giza 77 cotton cultivar. Agric. Res. Rev., Egypt, 68:1101-1109.

Hayam, M. S.M.B (2004). Effect of some environmental factors on prediction of cotton pests and yield. M.Sc. Dep. Of Agric. Sc. Ins. Of Env.Stood. Res.Faculty of Agriculture, Ain Shams Univ.

Nasrallah, A.K. (1987). Evaluation of upland cotton varieties and interrelationships among studied traits.Com.In Sci.&Dev. Rev.,18:73-89

Seyam, S. M.; A.A.Abo El-Zahab; H. N. El-Rassas and F. M. El-Rayes. (1984). The use of stepwise regression analysis in determining characters for yield selection in Egyptian cotton. Agric. Res. Rev., Egypt, 62:41-47.

Shafshak, S .E.; A .A. Sallam; M. K. Khalifa and M. M. Awad. (1987). The relative contributions of yield components to lint yield of some cotton varieties. Agric. Res. Rev., Egypt, 65:589 – 613.

Snedecor, G. W. and W. G. Cochran (1969). Statistical Methods. 6th Ed. Iowa Stat. Univ. Press, Ames, Iowa, USA.

Worley, S.; Jr., H.H.Ramey; D.C.Harrel and T.W.Culp. (1976). Ontogenetic model of cotton yield. Crop Sci., 16:30 – 34.

Worley, S.; T. W. Clup and D. C. Harrell. (1974). The relative contributions of yield components to lint yield of upland cotton. *Gossyoium hirsutum L.* Euphytica. 23:399-403.

Wright, S. (1921). Correlation and causation. J. Agric. Res., 20:557-585.

التقييم الإحصائي للمحصول ومكوناته لبعض أصناف القطن المصري المنزرعة في منطقة الدلتا

إبراهيم سيد محمد حسن [١] و سامية جودة عطية محمد [٢]

١- معهد بحوث القطن – مركز البحوث الزراعية- الجيزة

٢- المعمل المركزي لبحوث التصميم والتحليل الإحصائي- الجيزة

يهدف هذا البحث إلى تحديد الأهمية النسبية لمساهمة كل صفة من صفات المحصول في كمية القطن الزهر والشعر حيث أجريت الدراسة خلال موسمي ٢٠٠٣ ، ٢٠٠٤ على سبعة أصناف تجارية منزرعة من القطن المصري هي جيزة ٤٥، جيزة ٧٠ ، جيزة ٨٥ ، جيزة ٨٦ ، جيزة ٨٧، جيزة ٨٨، وجيزة ٨٩ حيث تمت زراعة هذه الأصناف في سبعة محافظات مختلفة هي المنوفية ، الغربية، الدقهلية، الشرقية، البحيرة، كفر الشيخ ودمياط في كلا من السنتين محل الدراسة وكانت أهم الصفات تحت الدراسة هي وزن اللوزة ، معدل الحليج ، معامل البذرة ، محصول القطن الزهر، محصول القطن الشعر، وعدد اللوز على النبات. أجريت التحليلات الإحصائية التالية (الارتباط البسيط – الانحدار المتعدد الخطي وتحليل المرور) وقد أشارت النتائج إلى وجود ارتباط معنوي موجب بين محصول القطن الزهر ومحصول القطن الشعر وكل من وزن اللوزة ، معدل الحليج ، معامل البذرة ، وعدد اللوز/ نبات.

كذلك أوضحت نتائج تحليل الانحدار الكلي لمحصول القطن الزهر مع كل من وزن اللوزة ، معامل البذرة ، وعدد اللوز/ نبات أن معامل التحديد $ر^{٢}$ = ٩٧,٨% بينما كانت قيمة معامل التحديد $ر^{٢}$ - ٩٢,٤٦% لمحصول القطن الشعر مع نفس الصفات . وقد أتضح إن أهم العوامل المؤثرة على محصول القطن الزهر ومحصول القطن الشعر هي وزن اللوزة وعدد اللوز/ نبات وذلك باستخدام النموذج المرحلي للانحدار المتعدد.

أظهر تحليل معامل المرور أن صفة عدد اللوز/ نبات ووزن اللوزة كانت أكثر الصفات ذات التأثير المباشر في محصول القطن الزهر وكانت المساهمة الكلية لهذه الصفات في محصول القطن الزهر(٧٧,٩٨%)،(٨,٢٧%) على الترتيب في النموذج الأول بينما كان الارتباط بين وزن اللوزة وعدد اللوز اكثر الصفات ذات التأثير غير المباشر وكانت المساهمة الكلية لهذه الصفات هي (١٠,٧٥%). وكذلك أظهر تحليل معامل المرور أن صفة عدد اللوز/ نبات ووزن اللوزة كانت أكثر الصفات ذات التأثير المباشر في محصول القطن الشعر وكانت المساهمة الكلية لهذه الصفات في محصول القطن الشعر(٦٨,٥٨%) ،(١١,٠٢%) على الترتيب في النموذج الثاني بينما كان الارتباط بين وزن اللوزة وعدد اللوز/ نبات اكثر الصفات ذات التأثير غير المباشر وكانت المساهمة الكلية لهذه الصفات هي (١١,٤٤%).

تشير النتائج أن الصفات المدروسة كانت كافية حيث تفسر (٩٧,٨٠%) ، (٩٢,٤٦%) من التباين الكلي في النموذج الأول والثاني على الترتيب – لذلك ينصح مربى القطن بالأخذ في الاعتبار صفات عدد اللوز على النبات ووزن اللوزة عند وضع برامج التربية والانتخاب لمحصول القطن الزهر والشعر.