ISSN 1110-0419

Annals Of Agric. Sc., Moshtohor,
Vol. 47(2): Ag. 141-151, (2009).

DETERMINATION OF THE RELATIVE CONTRIBUTION FOR YIELD FACTORS IN MAIZE BY USING SOME STATISTICAL PROCEDURES

BY

Shafshak, S.E.*; Sedhom S.A. *; Nasr, S. M. and Hayam S.A. Fateh ****

* Dep. of Agron., Fac . of Agric. Moshtohor, Banha Univ.

** Lab. for Design and Statistical Analysis, A.R.C.

ABSTRACT

Three field experiments were conducted at Sides Research Station, Benisuef Governorate, Agricultural Research Center, Egypt, during 2004,2005 and 2006 seasons to determine the relative contribution for yield factors in maize (*Zea mays L* .) by using some statistical procedures under some N fertilizer levels (zero, 30,60,90,120 and 150 kg N/feddan) for single cross (S.C.10, S.C. 122 and S.C. 123) and three way cross (T.W.C.310, T.W.C.311 and T.W.C.314). The experimental design was used a strip plot design with three replications. Four statistical procedures of relating yield components to yield namely, correlation, multiple linear regression, stepwise multiple linear regression and factor analysis were applied to 11 yield factors .The most important results obtained from this investigation over three seasons can be summarized as follows:

1- Simple correlation: Results indicate that the relationship between all possible pairs of the 11 traits was highly significant at 1% level of significance in all cases. Furthermore, the most important relationships to the maize breeder are between grain yield and number of kernels/ear (0.843), weight of 100-kernel (0.808), plant height (0.807), stem diameter (0.805), number of rows/ear (0.794), ear length (0.789) and number of kernels/row (0.780) which were highly significant positive correlation . This indicated that these characters had greatest influence on grain yield. When studying correlations it is important to recognize the nature of population under consideration. The magnitude of correlation coefficient can often be influenced by choice of individuals upon which the observations are made.

2- Multiple linear regression: Results indicate that the relative contribution for all yield factors explained 77.4% of the total variation in grain yield. Stem diameter, leaf area, plant height, number of leaves, ear length, ear diameter and weight of 100-kernel had the highest partial coefficient of determination; its values were 44.1, 42.4, 34.1, 21.5, 17.2, 17.2 and 12.1, respectively. On the other hand, number of rows/ear number of kernels/row and number of kernels/ ear gave the lowest values of partial coefficient. Hence, it can be noted that the variables had the highest variance inflation factor (VIF) gave the lowest values of partial R^2. Thus, evidence from the VIF calculation confirmed a part of the unstability of the regression coefficient due to there is interrelation among the explanatory variables.

3- Stepwise multiple linear regression: Results indicate that the accepted variables were number of leaves/ plant, stem diameter, plant height and leaf area. These variables were responsible for 41.3, 49.0, 42.2 and 28.8, respectively, of the yield variables. The other six characters (ear length, number. of rows/ear, number. of kernels/ row, number. of kernels/ear, weight of 100- kernel and ear diameter) are removed because of these variables had high multicollinearity. According to these results 78.5% of the total variation in yield could be attributed to the four accepted variables. Therefore, these four traits can not be ranked in any breeding program for improving grain yield. Whereas, removed variables consider characters of yield components.

4- Factor analysis: Results indicate that the two factors are loading. These factors explained 64.722 % of the total variability in the dependence structure. Factor 1 included six variables which accounted for 40.137 % of the total variance. The six variables were number of rows/ear, number of kernels/row, number of kernels/ear, ear length, weight of 100-kernel and ear diameter. The six variables were positively correlated with factor. These variables were of almost equal importance and highly communality with factor 1. Thus, this factor may be regarded as ear factor. Factor 2 was called a growth factor because it consisted of number of leaves, stem diameter, plant height and leaf area. It accounted only 24.585 % of the total variance in the dependence structure. All variables loading of factor 2 were positive. The sign of the loading indicates the direction of the relationship between the factor and variable. Factor analysis is one that can be used successfully for large amounts of multivariate data, and should be applied more frequently in field experiments. This study describes one application of factor analysis that further explains the multivariate structure .Use of factor analysis by plant breeders has the potential of increasing the comprehension of the causal relationships of variables and can help to determine the nature and sequence of traits to be selected in a breeding program.

INTRODUCTION

Multivariate statistics help the researcher to summarize data and reduce the number of variables necessary to describe it by using developing taxonomies or systems of classification, investigate useful ways to conceptualize or group items, generate hypotheses and test hypotheses. A big assumption of these methods is that the data itself is valid .In multiple regression, several variables are used. However one (a dependent variable) is generally predicted or explained by means of the others, independent variables and covariates. These are called dependent methods. This current investigation was carried out for the purpose of exploring evaluation of the most important statistical methods for estimating the relative contribution of yield factors to obtain maximum relative information and maximum coefficient of determination during investigation of each method depend on nature of empirical data .It can help plant breeders to determine the nature and sequence of characters to be selected to breeding programs. This will help in planning appropriate selection procedures (simple correlation, multiple linear regression, stepwise multiple linear regression and factor analysis) for improving crops. El-kalla and El-Rays (1984) concluded that varieties and leaf area were the most important variables determining yield either by using factor analysis or stepwise regression procedure. They also reported that 100-kernel weight was categorized with plant height in one factor with plant height having a negative effect on 100-kernel weight. In corn (*Zea mays L*). Shafshak *et al.* (1989) in a comparison between the full model regression and the stepwise regression procedure concluded that the coefficient of determination for full model regression and partial correlations were higher than stepwise regression. This latter had higher errors of estimates than the former. Nasr and Geweifel (1991) reported that stepwise coefficient of determination was tended to equal full model, and error of estimates was lower for stepwise analysis indicating that stepwise analysis was more efficient than full model regression .Mohamed and Sedhom (1993) found that the characters related were plant height ear length ear diameter, number of rows/ear, weight of grains/ear and grain yield/plot. Results of the path coefficient, the stepwise and multiple regression agreed upon the variables, viz, number of rows/ear, 100-kernel weight and number of grains/ear as major contributors to seed yield variations. The stepwise and the multiple regression procedure had the same adjusted R^2 (91%) denoting similar efficiency. Regression coefficient and standard error estimates were about the same in multiple and the stepwise regressions. The factor analysis grouped the seven variables in three major factors which altogether were responsible of 78.5% of the variability in the dependence structure. Nasr and Leilah (1993) pointed out that, the standard error decreased as number of sample units or replications increased. Number of plants required to detect 10% change markedly decreased as number of replications increased. Ashmawy (1994) indicated that 68.75% of the total variation in maize yield could be linearly related to the studied variables, 66.99% of the total yield variation could be attributed to the variables included into the model and 1.76% could be due to the eliminated variables. The variables included to the model could be arranged, according to their relative importance as measured by the partial R^2, in a descending order as follows years, first planting date (May 1st), second planting date (June 1st), shelling percentage, ear length, weight of 100- kernels, plant height, nitrogen fertilization and varieties. Nasr (1998) found that multiple linear regression and stepwise regression had the same adjusted R^2 (93%) denoting similar accuracy. The test of multicollinearity and linearity in the two procedures between variables indicated that, these models shows highly multiple coefficient of determination (R^2= 0.94) for prediction only and were not valid to interpret the partial correlation coefficient. Mohamed (2004) stated that the results indicate positive and highly significant correlation coefficients between grain yield/ plant and its components except the number of rows/ear. The principal component analysis grouped the studied variables in two major components, which altogether accountted for 95.6% of the total variation. The first component included ear diameter, ear length, the number of kernels/row, 100- kernel weight, shelling % and grain yield/ plant. The second component included plant and ear heights and the number of rows/ear. Atia and Mahmoud (2006) found that the characters most closely associated with yield were (x_1) days 50% polling, (x_2) days 50% silking, (x_3) plant height in cm,(x_4) ear height in cm,(x_5) ears number at harvest, (x6) ear length in cm, (x_7) ear diameter in cm .All these characters were positively correlated with yield, except characters x_1, x_2 and x_7 which were negatively correlated with yield. With regard to the r values between components of yield, all characters were positively correlated with each other without x_1, x_2 and x_7 that were negatively correlated with other characters. The results of multiple linear regression indicate that all variables were highly significantly contributing to variation in yield. In this analysis all variables were include in prediction equation. While some variables may contribute a little to the accuracy of the prediction equation. The stepwise multiple linear regression is useful in determining the best prediction equation for yield but it could not explain the inter relationship of the characters measured. At this point, factor analysis is a type of small number of main factors which would be better used to explain the inter-relationship of the variables. Factor analysis provided more information than previous methods due to groups of variables (factors) and percentage contribution of variables to each factor.

The present investigation was meant to evaluate four statistical methods for determining the relative contribution of yield factors in maize grain yield.

MATERIALS AND METHODS

Three field experiments were conducted at Sides Research Station, Benisuef Governorate, Agricultural Research Center, Egypt, during 2004, 2005and 2006 seasons to evaluate some statistical methods used for estimating the relative contribution of yield factors in maize (*Zea mays* L.)

Experimental treatments:

The researcher was used some agronomic treatments which aimed to measurement relationship between yield factors under different degrees of variation as follows:

a- Nitrogen fertilizer levels

N fertilizer levels applied were zero, 30, 60, 90,120 and 150 kg N /feddan. As urea (46.5%N). The fertilizer was splitted into two equal doses applied before the first and the second irrigations in the three seasons.

b- Cultivars

In three seasons, single crosses (S.C.10), (S.C.122) and (S.C. 123) and three way crosses (T.W.C.310), (T.W.C.311) and (T.W.C.314) were grown.

Experimental layout:

The experimental design used was a strip plot design with three replications. Cultivars were randomly assigned to the vertical strips and the nitrogen fertilizer levels to the horizontal strips. Plot area was 10.5 m2 (5ridges, 3m length). Planting date was 14/6, 23/5 and 23/6 in 2004, 2005and 2006 respectively. The three middle ridges were used for estimating grain yield after harvest. Ridges were 3 m long x 0.7m wide. As well as all other agronomic practices which were followed according to normal recommendations.

Data were collected on the following characters:

Plant height (cm) at harvest, ear height (cm), number of leaves/plant, stem diameter (cm), leaf area, ear diameter (cm),ear length (cm), number of rows/ear, number of kernels/row, weight of 100 kernels (gm) and grain yield/plant (gm).

Statistical procedures:

The obtained data were statistically analyzed according to the procedures of multivariate analysis outlined by Hair *et al.* (1992).

1-Correlation

Correlation is a measure of the degree to which variables vary together or a measure of the intensity of association. As such, it must be symmetric in the two variables. The sample linear correlation coefficient, also called the simple correlation, the total correlation and the product- moment correlation, is used for descriptive purposes and is defined by Equation.

$$r = \frac{\sum (x-\bar{x})(y-\bar{y})}{\sqrt{\sum (x-\bar{x})^2 (y-\bar{y})^2}}$$

Thus, mathematically the coefficient of correlation, R, between two variables is the ratio of their covariance or sum of products to the geometric mean of their sums of squares of deviations.

2-Multiple linear regression

Multiple regression analysis is a statistical technique that can be used to analyze the relationship between a single dependent variable and several independent variables. The objective of multiple regression analysis is to use the independent variables wishes to know. The result is a variate, a linear combination of the independent variables that best predicts the dependent variable. The variables are weighted in the process, the weights denoting their relative contribution to the overall prediction. In this way, regression analysis ensures that the analysis is provided the maximal prediction in a format that also facilitates interpretation as to the influence of each factor in making the prediction.

3- Stepwise multiple linear regression

In spite of its entirely different name, the procedure is, in fact, an improved version of the forward – selection procedure. The improvements involve the re-examination at every stage of the regression of the variables incorporated into the model in previous stages. A variable which may have been the best single variable to enter at an early stage may, at a later stage, be superfluous because of the relationships between it and other variables now in the regression. To check on this, the partial F criterion for each variable in the regression at any stage of calculation is evaluated and compared with a preselected percentage point of the appropriate F distribution. This provides a judgment on the contribution made by each variable as though it had been the most recent variable entered, irrespective of its actual point of entry into the model. Any variable which provides no significant contribution is removed from the model. This process is continued until no more variables will be admitted to the equation and no more are rejected. The complete stepwise solution is as follow:

Step 1:

The stepwise procedure starts with the simple correlation matrix and enters into regression the variable most highly correlated with the response is entered as in the forward-selection procedure.

Step 2:

Using the partial correlation coefficient as before, it now selects, as the next variable to inter regression that the variable whose partial correlation response is highest.

Step 3:

Given the regression equation, the method now examines the contribution variable would have mode if variable had been entered first and variable entered second. (The forward selection procedure does not do this). Since the value of the partial F is statistically significant at 5%, the variable entered second is retained. The stepwise method now selects as the next variable to enter, the one most highly partially correlated with the response (given that variables are already in regression).This is seen to be other variable.

Step 4.

A regression equation is now determined by least squares. The variable enters with significant a sequential F value which exceeds. At this point partial F-tests for the first and second variables are made to determine if they should remain in the regression equation. As a consequence, the second variable is rejected since its partial F value is less than F.

Step 5:

The only remaining variable is other variable. Since this variable is immediately rejected, the stepwise regression procedure terminates and chooses as its best regression equation (Draper and Smith (1966)).

4- Factor analysis:

Method according to Cattel (1965) this method basically reduces a large numbers of correlated variables to a small number of uncorrelated factors. When the contribution of a factor to the total percentage of the trace was less than 10%, the process stopped. After extraction, the matrix of factor was submitted to a varimax orthogonal rotation, as applied by Harman (1976). The effect of rotation is to accentuate the larger loading in each factor and to suppress the minor loading coefficient and in this way to improve the opportunity of achieving a meaningful biological interpretation of each factor. A communality (h2) is the amount of the variance of a variable accounted for the common factors together. Since the purpose was to determine the way in which yield components are related to each other, yield (y) was not included in this structure.

RESULTS AND DISCUSSION

Correlation analysis:

Data of simple correlation coefficients matrix for 11 characters of maize presented in Table 1. Results indicate that the relationship between all possible pairs of the 11 traits were highly significant at 1% level of significance in all cases. In addition a number of interesting relationships can be observed from Table (1). Furthermore, the most important relationships to the maize breeder are between grain yield and number of kernels/ear (0.843), weight of 100- kernel (0.808), plant height (0.807), stem diameter (0.805), number of rows/ear (0.794), ear length (0.789) and number of kernels/row (0.780) which were highly significant positive correlation. This indicated that these characters had greatest influence on grain yield. These results are in agreement with Mohamed and Sedhom (1993), Ashmawy (1994) and Mohamed (2004).

Multiple linear regression analysis:

As Table (2) the results indicate, the prediction model by using multiple linear regression for grain yield of maize and its attributes. The prediction equation was formulated as follows:

The relative contribution for all yield factor explained 77.4% of the total variation in grain yield. Stem diameter, leaf area, plant height, number of leaves, ear length, ear diameter and weight of 100-kernel had the highest coefficient of determination; its values were 44.1, 42.4, 34.1, 21.5, 17.2, 17.2 and 12.1, respectively. On the other hand, number of rows/ear, number of kernels/row and number of kernels/ear gave the lowest values of partial coefficient. Hence, it can be noted that the variables had the highest VIF which gave the lowest value of partial R^2. In this analysis all variables were included in prediction equation, while some variables may contribute a little to the accuracy of the prediction equation (Atia and Mahmoud (2006)). Number of rows/ ear, number of kernels /row and number of kernels/ ear had small value which was 7.4, 1.5 and 8.7, respectively. As well as, VIF value of all characters less than 10.0 (means that there is no collinearity or multicollinearity) except number of row/ ear, number of kernels /row and number of kernels/ear which had collinearity or multicollinearity. Thus, evidence from the VIF calculation confirmed a part of the unstable of the regression coefficient due to their interrelations among the explanatory variables

Table (1): A matrix of simple correlation coefficients for 11 characters as mean of three season.

Characters	1	2	3	4	5	6	7	8	9	10	11
1-G rain yield	1.000										
2- No .of Leaves	0.757	1.000									
3- Stem diameter	0.805	0.637	1.000								
4- Plant height (cm)	0.807	0.718	0.736	1.000							
5-No. of rows/ear	0.794	0.636	0.674	0.724	1.000						
6- No. kernels/row	0.780	0.673	0.635	0.662	0.735	1.000					
7- No. kernels/ ear	0.843	0.684	0.693	0.721	0.893	0.913	1.000				
8- Leaf area	0.777	0.596	0.699	0.720	0.646	0.636	0.692	1.000			
9 - Ear Length (cm)	0.789	0.670	0.673	0.743	0.707	0.601	0.699	0.696	1.000		
10– Weight of 100 kernel	0.808	0.712	0.600	0.743	0.664	0.689	0.707	0.600	0.727	1.000	
11- Ear diameter (cm)	0.771	0.703	0.636	0.686	0.692	0.620	0.695	0.568	0.627	0.710	1.000

Table (2): Multiple linear regression of 11 characters in predicting grain yield in maize as mean of three season.

Characters	Regression coefficient	Standard Error (SE)	R2%	Variance Inflation Factor (VIF)
1- No .of Leaves	5.105	3.713	21.5	3.782
2- Stem diameter	43.815	14.290	44.1	1.770
3- Plant height (cm)	0.527	0.233	34.1	2.582
4-No. of rows/ear	2.999	6.465	7.4	11.213
5- No. kernels/row	0.227	2.441	1.5	21.585
6- No. kernels/ ear	0.091	0.165	8.7	45.331
7- Leaf area	11.446	3.920	42.4	2.414
8 - Ear Length (cm)	0.534	1.184	17.2	2.065
9– Weight of 100 kernel	0.013	0.956	12.1	2.378
10- Ear diameter (cm)	19.086	17.510	17.2	3.175

Multiple R	0.880
R squared	0.774
Adjusted R squared	0.716
Standard error of est.	11.1500

$$Y = -278.366 + 5.105X_1 + 43.815\,X_2 + 0.527X_3 + 2.999X_4 + 0.227X_5 + 0.091X_6 + 11.446X_7 + 0.534X_8 + 0.013X_9 + 19.086X_{10}$$

These results indicated that using this model with the highly multiple R^2 ($R^2 = 77.4$) for prediction only (i.e. make no try to interpret the partial regression coefficients) and using a more sophisticated method of analysis such as, ridge regression, principle components or factor analysis to obtain a model that more clearly reflects the simple effects of the predictor (Joseph *et al.* (1992)). These results were in agreement with Ashmawy (1994), Nasr (1998) and Atia and Mahmoud (2006).

Stepwise multiple regression analysis:

Stepwise multiple linear regression analysis was used to determine the best variables that mostly reduced the variance of yield. This is done by introducing the variables in order of importance. Table 3shows the accepted and removed variables and reduction in yield variance caused by each variables. The accepted variables had the highest coefficient of multiple determination with the yield adjusted for variables already added. As it can be seen from Table (3), the accepted variables were number of leaves/ plant, stem diameter, plant height and leaf area.

Table (3): Accepted and removed variables according to stepwise multiple linear regression and relative contribution in grain yield in maize as mean of three seasons.

Characters	Regression coefficient	Standard Error (SE)	R2%	Variance Inflation Factor (VIF)
1- No .of Leaves	9.860	2.229	41.3	3.153
2- Stem diameter	8.964	3.136	49.0	2.042
3- Plant height (cm)	0.606	0.133	42.2	3.541
4-- Leaf area	7.605	2.591	28.8	2.607
Removed variables:				
1 - Ear Length (cm)	0.035			16.860
2--No. of rows/ear	0.068			13.306
3- No. kernels/row	0.030			33.426
4-- No. kernels/ ear	0.075			41.005
5- Weight of 100 kernel	0.060			19.786
6- - Ear diameter (cm)	0.097			2.330
Multiple R	0.862			
R squared	0.744			
Adjusted R squared	0.717			
Standard error of estimated.	11.908			

Those variables were responsible for 41.3, 49.0, 42.2 and 28.8, respectively; of yield variance .The prediction equation was formulated as follows:

$$Y = -193.153 + 9.860X_1 + 8.964X_2 + 0.606X_3 + 7.605X_4$$

The other six characters (ear length, number of rows/ear, number of kernels/row, number of kernels/ear, weight of 100-kernel and ear diameter) are removed because these variables had high multicollinearity. According to these results 74.4% of the total variation in yield could be attributed to the four accepted variables. Therefore, these four traits can not be ranked in any breeding program for improving grain yield. The stepwise multiple linear regression is useful in determining the best prediction equation for yield but it could not explain the inter relationship of the characters measured (Atia and Mahmod (2006)).To evaluate the results of stepwise analysis, assumptions must be tested. Meeting the assumptions of regression analysis is essential to ensure both that the results obtained were truly representative of the sample and that we have obtained the best possible results. The principal measure used to test the assumption is the residual difference between the actual dependent variable values and its predicted values (Joseph *et al.* (1992)).

On the other hand, removed variables were ear length, number of rows/ear, number of kernels/row, number of kernels/ear, weight of 100-kernel and ear diameter these variables consider characters of yield components. For comp arison purposes, we use the standardized partial regression plots. When using more than one predictor variables, that each predictor variables relationship is linear to ensure its best representation in the equation.

To do this, we use the partial regression plot for each predictor variable in the equation. In Figure (1- a, b,c,d).It can be seen that the relationships for number .of leaves, stem diameter and plant height are quite well defined, thus it has strong and significant effect in the regression equation. Leaf area is less well defined, both in slope and scatter of the points, thus, explaining their lesser effect in the equation. For all six components, non-linear pattern is shown. Therefore, this equation is not valid to interpret the partial correlation coefficients (Joseph, *et al.* (1992). These results were in agreement with El-Kalla and El- Rayes (1984), Ashmawy (1989) and Shafshak *et al.* (1989).

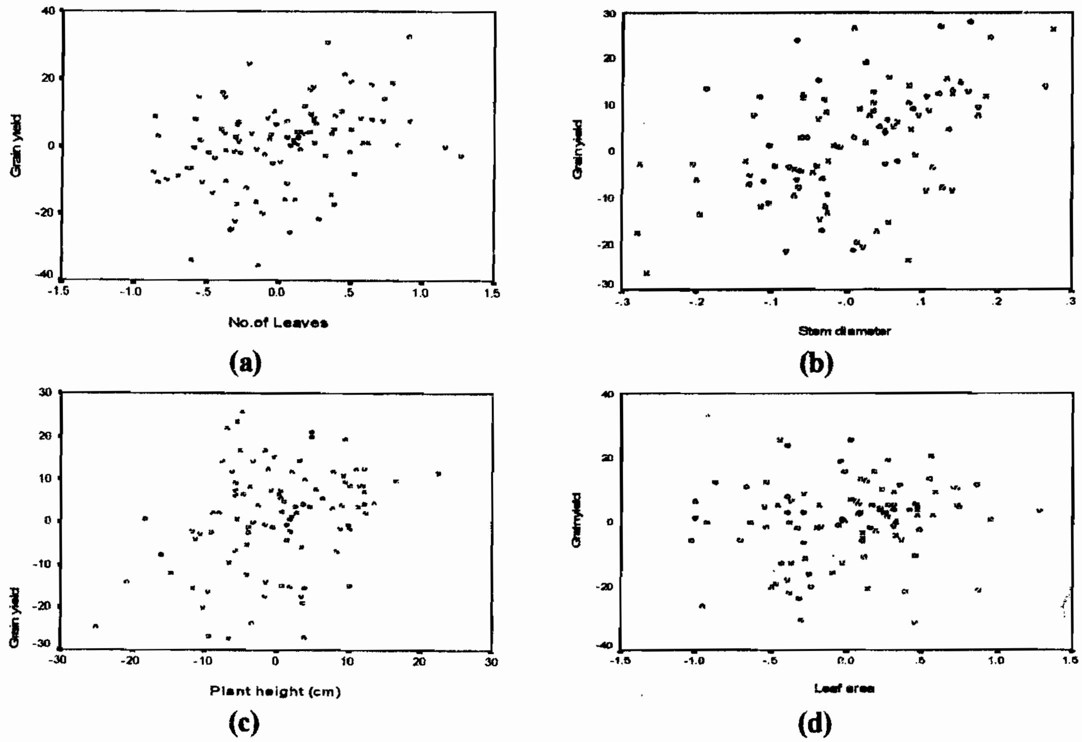

Fig. (1): Partial regression plot for Leaf area, Stem diameter, Plant height and number .of. Leaves with grain yield.

Factor analysis:

The results of factor analysis are presented in Table 4. Factors were constructed using the principal factor analysis technique to establish the dependent relationship between morphological characteristics and yield components. Factor analysis divided the ten variables into two main factors. For purposes of interpretation, only those factor loading greater than 0.5 were considered important. A summary of the composition of variables of the two factors with loadings are given in Table 4. The two factors explained 64.722 % of the total variability in the dependence structure.

Factor 1 included six variables which accounted for 40.137 % of the total variance. The six variables were number of rows/ear, number of kernels/row, number of kernels/ear, ear length, weight of 100-kernel and ear diameter. The six variables were positively correlated with factor. These variables were of almost equal importance and highly communality with factor 1. Thus, this factor may be regarded as ear factor.

Factor 2 was called a growth factor because it consisted of number of leaves, stem diameter, plant height and leaf area. It accounted only 24.585 % of the total variance in the dependence structure. All variables loading of factor 2 were positive. The sign of the loading indicates the direction of the relationship between the factor and variable.

The ear factor (Factor1) had high loadings for six variables. The correlation between these variables and factor 1 are given by the appropriate factor loading. Based on the investigated genotypes, selection for plant types with more (number of rows/ear, number of kernels/row, number of kernels/ear, ear length, weight of 100- kernel and ear diameter) will enable breeders to realize desired gains in grain yield of maize. Factor 2 (growth factor) contained four variable (number of leaves/plant, stem diameter, plant height and leaf area) usually associated with grain yield on a biological yield. Also, the high simple correlation between these four variables would indicate that selection for rather variable will be a determined to the other. Factor analysis is one that can be used successfully for large amounts of multivariate data, and should be applied more frequently in field experiments. This study describes one application of factor analysis that further explains the multivariate structure. Use of factor analysis by plant breeders has the potential of increasing the comprehension of the causal relationships of variables and can help to determine the nature and sequence of traits to be selected in a breeding program. This result is confirmed by the findings of El-Kalla and El- Rayes (1984), Ashmawy (1989), Mohamed and Sedhom (1993), Ashmawy (1994), Mohamed (2004) and Atia and Mahmoud (2006). So, it can be recommended from the previous results that it is essential to detect characters having the greatest influence on yield and their relative contribution to yield variation. This is useful in designing and evaluating breeding programs and agronomic systems. The important characters over all statistical procedures used were ear length, ear diameter and stem diameter. The results of statistical procedures indicated that, factor analysis would seem to be more suitable and efficient than other procedures. No difference was detected between the accuracy and precision of the full model regression and stepwise procedures had the same R square and standard error of estimate. Factor analysis is a type of multivariate analysis that can be used to reduce a large number of correlated variables to a small number of main factors which would be better used to explain the interrelationship of the variables. Factor analysis provided more information than previous methods due to groups of variables (factors) and percentage contribution of variables to each factor.

Table (4): Summary of factor loading for 10 characters of maize

Factors	Loading	% Total communality	Percentage of variance	Suggested factor name
Factor 1:			40.137	factor yield
1- No. of rows/ear	0.712	0.738		
2- No. kernels/row	0.903	0.631		
3-- No. kernels/ ear	0.950	0.515		
4- Ear Length (cm)	0.820	0.284		
5- Weight of 100 kernel	0.596	0.143		
6- Ear diameter (cm)	0.628	0.028		
Factor 2:			24.585	factor growth
7- No .of Leaves	0.542	5.283		
8- Stem diameter	0.842	1.189		
9- Plant height (cm)	0.786	0.834		
10- Leaf area	0.586	0.356		
Cumulative variance			64.722	

REFERENCES

Ashmawy, F. (1989): Evaluation of some experimental and statistical procedures used in estimating yield components in maize .M .Sc .Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Ashmawy, F. (1994): Multivariate and response curve analyses for important yield factors in maize. Ph. D .Thesis, Fac. Agric., Moshtohor, Zagazig Univ., Egypt.

Atia, A.A.M. and Mahmoud, A.A. (2006): Factor analysis and other statistical techniques for studying yield and yield components in maize (*Zea mays* L.). Minufiya J .Agric. Res., 31(1):61-73.

Cattel, R.B. (1965): Factor analysis on introduction to essentials. The pupose and underlying models. Biometrics.21:190-215.

Draper, N.R. and Smith, H. (1966): Applied Regression Analysis. John Wilay & Sons Jne. Ny.407 pp.

El- Kalla, S.E. and El-Rayes, F.M. (1984): Multivariate analysis of yield and the relative contribution of variables to its variations in maize (*Zea mays* L.). Agric. Res. Rev., 62 (7):1-13, Egypt.

Hair, J.F.; Anderson, Jr., R. E.; Tatham, R.L. and Black, W.C. (1992): Multivariate Data Analysis Macmillan Publishing Company, a division of Macmillan, Inc.

Harman, H.H. (1976). Modern Factor Analysis. 3rd Ed. Univ. of Chicago Press. Chicago.

Joseph, F.H.J.; Anderson, R.E. and Tatham, R.L. (1992): Multivariate Data Analysis Macmillan Publishing Company, New York.

Mohamed, N.A. (2004): Principal component and response curve analysis of some maize hybrids to different levels and plant density. Bull. Fac. Agric. Cairo Univ., 55:531-556.

Mohamed, M. K. and Sedhom, S. A. (1993): A comparison between four statistical procedures of relating yield components in a set of corn varieties. Ann. Agric. Sci., Moshtohor, 31(4):1856-1865.

Nasr, S.M. (1998). Evaluation of statistical methods for determining the relative contribution of yield factor in wheat. Egypt, J.Agric. Res., 76(4): 1733- 1749.

Nasr, S.M. and Geweifel, H.G.M. (1991): Evaluation of the relative contribution of peanut yield factors by using four statistical procedures. J. Agric. Sci. Mansoura Univ., 16 (7): 1483-1490.

Nasr, S.M. and Leilah, A.A. (1993): Integrated analysis of the relative contribution of some variables in sugar cane using some statistical techniques. Bull. Fac. Agric., Univ. Cairo, 44:253-266.

Shafshak, S.E.; Abd El-Halim, A.A.; Saad, A.M.M. and Ahmed, F.A. (1989): Integrated regression analysis of maize yield factor using minimum sample size. Egypt, J. Apple. Sci. 4:1855-1866.

تقدير المساهمة النسبية لعوامل المحصول فى الذرة الشامية باستخدام بعض الطرق الإحصائية

صلاح الدين عبد الرزاق شفشق*، سيدهم أسعد سيدهم*، سعيد محمد نصر، هيام سيد أحمد فاتح****

* قسم المحاصيل كلية الزراعة بمشتهر – جامعة بنها

** معمل بحوث التصميم والتحليل الإحصائى – مركز البحوث الزراعية

أقيمت ثلاثة تجارب حقلية بمحطة بحوث سدس بمحافظة بنى سويف خلال المواسم الزراعية ٢٠٠٤ و٢٠٠٥و٢٠٠٦ باستخدام بعض الطرق الإحصائية لتقدير المساهمة النسبية لعوامل محصول الذرة الشامية حيث زرع ستة من أصناف الذرة هجين فردى ١٠و١٢٢و١٢٣ وهجين ثلاثى ٣١٠و٣١١و٣١٤ تحت مستويات من السماد الآزوتى صفر و٣٠ و٦٠ و٩٠و١٢٠و١٥٠ كجم نيتروجين للفدان وكانت الصفات المدروسة عدد الصفوف بالكوز وعدد الحبوب بالكوز وطول الكوز وقطر الكوز ووزن المائة حبة وعدد الحبوب بالكوز وطول النبات وعدد أوراق النبات وقطر الساق ومساحة الورقة، وقد أوضحت النتائج مايلى:

١ – تحليل الارتباط:

أشارت النتائج حيث كانت علاقة الارتباط من الصفا ت تحت الدراسة عالية المعنوية على مستوى ١% فى كل الحالات .وأن أهم العلاقات كان الارتباط بين محصول الحبوب وعدد الحبوب بالكوز(٠,٨٤٣) ووزن المائة حبة (٠,٨٥٨) وطول النبات (٠,٨٠٧) وقطر الساق (٠,٨٠٥) وعدد الصفوف بالكوز (٠,٧٩٤) وطول الكوز (٠,٧٨٩) وعدد الحبوب بالصف (٠,٧٨٠) حيث كانت علاقة الارتباط موجبة وعالية المعنوية . حيث أشارت النتائج أن هذه الصفات لها تأثير قوى على محصول الحبوب.

٢- تحليل الانحدار المتعدد:

أوضحت الدراسة أن المساهمة النسبية لعوامل المحصول تحت الدراسة كانت ٧٧,٤ % من التباين الكلى للمحصول . كما أن قطر الساق ومساحة الورقة وارتفاع النبات وعدد الأوراق وطول الكوز وقطر الكوز ووزن المائة حبة أعطت أعلى قيمة لمعامل التقدير حيث كانت القيمة ٤٤,١ و٤٢,٤ و ٣٤,١ و ٢١,٥ و ١٧,٢ و ١٧,٢ و ١٢,١ على الترتيب . من ناحية أخرى فقد أشارت النتائج الى أن عدد الصفوف بالكوز وعدد الحبوب بالصف وعدد الحبوب بالكوز أعطت أقل قيمة لمعامل التقدير حيث نلاحظ أن هذة الصفات لها قيمة عالية لمعامل تضخم التباين حيث يشير ذلك الى وحود علاقة ارتباط ذاتى بين هذة المتغيرات مما يؤدى الى عدم ثبات معامل الانحدار وعدم الاعتماد على النتائج .

٣- تحليل الانحدار المتعدد المرحلى:

أوضحت النتائج أن العوامل المقبولة كانت عدد الاوراق بالنبات وقطر الساق وطول النبات ومساحة الورقة وكانت المساهمة النسبية لهذة المتغيرات هى ٤١,٣% و ٤٩,٠% و ٤٢,٢ % و ٢٨,٨% على الترتيب من تباين المحصول . كما أشارت النتائج الى أن المتغيرات المستبعدة هى طول الكوز وعدد الصفوف بالكوز وعدد الحبوب بالصف وعدد الحبوب بالكوز ووزن المائة حبة وقطر الكوز حيث أن هذة الصفات لها ارتباط ذاتى عالى فيما بينها . حيث ساهمت المتغيرات المقبولة بنسبة ٧٤,٤ % من التباين الكلى للمحصول علما بأن هذة المتغيرات المقبولة تعتبر من الصفات المورفولوجية لمحصول الذرة حيث لايعتمد عليها فى برامج التربية فى حين أن العوامل المستبعدة هى مكونات المحصول ويرجع ذلك الى وجود ارتباط ذاتى قوى بين المتغيرات التنبئية مما يجعل الباحث يتعامل مع تحليل العامل أو تحليل المكونات الرئيسية حيث أنهم أفضل من الانحدار المتعدد والانحدار المتعدد المرحلى .

٤-تحليل العامل:

أوضحت النتائج أن مكونات المحصول تواجدوا فى عاملين بمساهمة ٦٤,٧٢٢ من التباين الكلى . حيث شمل العامل الاول على ٦ متغيرات أعطوا ٤٠,١٣٧% من التباين الكلى حيث كانت هذه المتغيرات عدد الصفوف بالكوز وعدد الحبوب بالصف وعدد الحبوب بالكوز وطول الكوز ووزن المائة حبة وقطر الكوز . حيث كان ارتباطهم موجب فى هذا العامل وقد أعطت هذه المتغيرات أعلى قيمة للشيوع ويمكن تسمية هذا العامل بعامل المحصول أما العامل الثانى فيمكن تسميته بعامل النمو حيث أشتمل على متغيرات النمو مثل عدد الاوراق وقطر الساق وطول النبات ومساحة الورقة . كما ساهم هذا العامل بنسبة ٢٤,٥٨٥% من التباين الكلى كما ان المتغيرات فى هذا العامل كانت موجبة الارتباط وقد أعتبر أن تحليل العامل من أهم الطرق التى تستخدم بنجاح فى عدد المتغيرات الكثيرة كما أنة يمكن الاعتماد على النتائج المتحصل منة فى برامج التربية بنجاح لقدرته على تحديد طبيعة ونتائج المتغيرات فى برامج التربية.