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ESTIMATING PREDICATION EQUATIONS OF YIELD AND ITS CHARACTERS IN MAIZE USING SOME MACRO CLIMATIC AND MICRO ENVIRONMENTAL FACTORS

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ABSTRACT

Two field experiments were conducted at Banha Experimental Station in El-Kaluobia Governorate during the two successive seasons 1999 and 2000 to study the effect of some macro climatic and micro environmental factors and to evaluate some parameters of three maize crosses, namely single cross 10 (S. C. 10.), single cross yellow 152 (S. C. Y. 152.) and three way cross 321 (T. W. C. 321). Nitrogen was added as urea (46% N) at three levels (60, 90, 120 kg N/ fed).The treatments were arranged in randomized complete blocks design with four replications. Analysis of variance, simple correlation coefficient, prediction equations of full model and stepwise multiple regression, path coefficient analysis, phenotypic, genotypic and environmental correlation coefficients were done.

Data showed that yield of single cross 10 was higher than single cross yellow 152 and three ways cross 310. Nitrogen fertilization has significant affected for all characters under study. The results revealed that maize plants fertilized with 120 kg N/ fed gave the highest values. Whereas single cross 10 (S.C. 10) +120 kg N/ fed produced highest grain yield/ plot in two seasons.

Highly significant and positive correlation coefficient were found between grain yield/ plot with all characters.

The full model regression including all factors ranged from 95% to 97% for all variables in two seasons 1999, 2000 respectively while stepwise regression ranged from 85% to 93% for two seasons 1999, 2000. It was found that the most important macro climatic factors and variables affecting grain yield of maize were day length in tassel initiation stage, growing degree day in silking initiation stage, relative humidity in six leaves exist on the plant, pollination and physiological maturity. In addition to variables ear length and number of kernels/ ear. Nitrogen fertilization crosses and years as micro environmental factors had significant effects on grain yield of maize.

Path coefficient analysis revealed that number of kernels/ ear and number of rows/ ear were the most prominent direct effect on grain yield/ plant in the first season with the highest relative importance value of 12.07% and 11.85%, respectively as estimates of their relative contribution to the total variation of grain yield/ plant. Both number of kernels/ ear, weight of 100 kernels have the most prominent direct effect on grain yield/ plant in the second season with the highest relative importance values of 40.96% and 4.53%, respectively as estimates of their relative contribution to the total variation of grain yield/ plant. In both seasons the total relative contribution of the studied characters overall variation in grain yield was 88.04% and 71.64% respectively.

Heritability values were estimate as a broad sense, it were relative high for the most of traits indicating that most variability among genotypes was due to causes.

All variables had high heritability estimates and ranged from 53.60% to 91.91% in both two seasons, except ear length and number of kernels/ ear. In general, heritability estimates were high and comparable for most of the studied characters.

Genotypic correlation coefficient between grain yield/ plot were positive and highly significant to ear diameter, number of kernels/ear and weight of 100 kernels in the first season whereas phenotypic and genotypic correlation coefficients were positive and highly significant to the number of kernels/ ear and grain yield/ plant in the second season.

All characters had positive and highly significant correlation coefficients with grain yield/ plant while number of rows/ ear was negative and highly significant in the first season. In the second season it was found to be positive and highly significant to number of kernels/ ear while ear length was negative and highly significant.

INTRODUCTION

Macro and micro environmental factors play an important role in securing a good crop yield. Light and temperature have their direct effect on physiological processes such as photosynthesis.(Weather controls the spread of fungal diseases sects pests and weeds which can restrict crop growth). It is importance to connect climatic and environmental conditions with fluctuations of yield which occur between and within seasons in all agricultural systems. Khalil (1956) mentioned that increase of light intensity suppressed stem elongation of wheat, whereas increased both tillers and leaf number per plant significantly. Abd El-Halim *et al.* (1990) and El-Shaer *et al.* (1990) studied the effect of macro climatic factors on three crops i.e. wheat, maize, and faba bean. It was found that the most important macro climatic factors over all the investigated field crops are potential sunshine hours, growing degree days, and total bright sunshine hours.

Corn (Zea *mays L*) is one of the most important cereal crops in Egypt and in the world. It ranks third, after wheat and rice.

Increasing N rate up to 120 kg N/ fed increased the average number of grains/ row, 100- grain weight and grain yield/ fed, while the average number of rows/ ear was not affected (Younis *et al.*, 1990; and Mohamed 1993). Growth and agronomic characters of maize such as number of plants and ear height, stem diameter and barren plants% and lodged and broked plants% were affected by application nitrogen fertilizer, Basha (1994), Ali *et al.* (1994), El-Gezawy (1996), Shams El- Din and El- Habbak (1996). and Badawi and Moursy (1997).

Also, most yield and yield component characters of maize, except shelling% in one season, were significantly and increased by increasing N fertilizer level up 130 or 150 kg N/ fed, while number of rows/ ear was not effected by adding N fertilizer, Salwau (1993), Moshtohory *et al.* (1995) and El-Gezawy (1996). On the other hand, Fox and Piekielek, (1983) and Ashmawy (1995) studied response of maize yield to nitrogen fertilizer. They found that the curve response of maize yield to nitrogen was quadratic.

The measurements of phenotypic, genotypic and environmental component of variance in maize yield and other characters have been a matter of great importance. Estimates of the genetic parameters in the population have impacts in methods of practing selection. The genetic advance from selection for a give trait is affected by the mean, the genetic variance and heritability of this trait. The overcome the low heritability of yield, plant breeder is trying to improve this complex trait indirectly by improving the traits known to be associated with yield. The aims of this study is to investigate the effect of some macro climatic and micro environmental factors on yield of maize via prediction equations of full model and stepwise multiple regression analysis. The results of this study would be helpful for plant breeder to planning programs for developing for high yielding of maize adapted to the environmental conditions.

MATERIALS AND METHODS

This research was carried out at Banha Experimental Station in El-Kaluobia governorate during the two successive seasons of 1999 and 2000 to study the effect of some macro climatic and micro environmental factors on grain yield of three maize crosses, namely single cross 10 (S. C. 10), single cross yellow 152 (S. C. Y. 152.) and three way cross 321 (T. W. C. 321). Three nitrogen fertilizer treatments (60, 90, 120 kg N/ fed urea 46%) were used and divided into two equal doses. The first, dose was applied at planting and the second dose after four weeks from planting dates. A randomized complete blocks design in four replications, was used each plot was 3 x 7 m and consisted of ten rows, 70 cm apart. Intra- hill spacing was 25 cm. The agricultural practices were done as recommended.

At harvest five plants selected randomly from the three guarded rows in each plot to collect data on the following characters:

1- Ear length (cm).
2- Ear diameter.
3- Number of rows/ ear.
4- Number of kernels/ ear.
5- Weight of 100 kernels.
6- Number of plant/ plot.
7- Grain yield/ plant (gm).
8- Grain yield/ plot (kg).

Climatic factors recorded:

We recorded maximum and minimum temperature during growing season to estimate GDD in the following growth stages (as defined by Jones and Kiniry 1986).

1- From germinations to end of vegetative growth (six leaves exist on the plant).
2- From end of vegetative growth to tassel initiation (four day after end vegetative growth).
3- Silking (silks are shown from the ear husk).
4- Pollination (black silk).
5- Physiological maturity.

Growing degree days GGD:

GDD were calculated as the average of daily mean temperature (maximum and minimum temperature) minus, threshold throughout growing season:

$$GDD = \frac{T\max + T\min}{2} - Tb$$

Where:

Tmax: maximum temperature.

T min: minimum temperature.

Tb : the base temperature below which no appreciable growth occurs i. e. 10 C (Jones and Kiniry 1986)

- Day length (DL) throughout growing seasons.
- Relative humidity (R H %)

Statistical procedures:

Data were statistically analyzed according to Snedecor and Cochran (1981) and treatment means were compared by using least significant difference test (L. S. D.) at 0.05% level of significance.

Simple correlation coefficients were done according to Steel and Torrie (1987). Regression analysis applied to obtain a suitable prediction equation according to Draper and Smith (1966).

Path coefficient analysis was used as applied by Dewey and Lu (1959). A path coefficient analysis 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 component of direct and indirect effects.

Analysis of variance for each variable and covariance for each pair of variables were performed for a randomized complete block design.

Broad sense heritability (H) was calculated as follows:-

H = (Genotypic variance/ Phenotypic variance) x 100

The expected genetic advance under selection (G_s) was calculated from the following formula as suggested by Johnson *et al.* (1955).

G_s = K. x phenotypic standard deviation x. H.

Where K is the selection differential in standard deviation units. In this investigation, the value used for K is 2.06, which corresponds to selecting the best 5% of the population.

Phenotypic, genotypic and environmental correlation coefficients between all possible combinations of characters were calculated from the phenotypic, genotypic and environmental variance and covariance components according to the procedure obtained by Johnson *et al.*, (1955) and Miller *et al.* (1958).

Selection for a given characters among the studying genotypes would seem very effective, but these high estimates of heritability may be due to both of the high genetic variability which occurred between these genotypes and to the confounded effects of the environmental conditions.

The equation for computing heritability is:

H = (Genotypic variance/{ Genotypic variance + Error mean square/ No. of replicates}). and since error mean square is low compared with genotypic variance and error mean square is further reduced by dividing it by number of replication, the results will be a small addition to genotypic variance and the denominator of the equation will be almost equal to the numerator.

Consequently, the rates or percent will approach 100%. Even estimating H from a series of experiments, the addition of the interaction variance to the denominator will not affect the estimate considerably, Since the interaction variance is low or negative.

RESULTS AND DISCUSSION

Analysis of variance

Effect of crosses.

Results in Table 1 show means yield and its attributed characters of the three maize crosses during the 1999 and 2000 seasons. Crosses differed significantly with respect of ear length, ear diameter, and number of rows / ears, number of kernels / ear, weight of 100 kernels, grain yield per plant and grain yield per plot, except number of plant / plot, number of ears / plant in the first season. Whereas in the second season, crosses was found to be significant for ear diameter, number of rows/ ear number of kernel/ears and weight of 100 kernel, grain yield per plant and grain yield per plot except ear length, number of plant/ plot and number of ears/ plant. Over the two seasons, it was found that the yield of single cross 10 (S. C. 10) was higher than single cross yellow 152 (S. C. Y. 152) and three way cross 321 (T. W. C. 321).

Table 1: Effect of mean crosses on yield and its related characters in zea maize during 1999 and 2000 seasons.

Characters	Mean Crosses							
	S. C. 10		S. C. Y. 152		T. W. C. 321		L. S. D. 0.05	
	1999	2000	1999	2000	1999	2000	1999	2000
Ear length (cm)	20.45	19.25	17.66	19.30	18.84	19.98	1.17	N.S
Ear diameter	15.00	15.85	15.55	17.13	16.63	15.65	1.31	1.09
No. of rows/ ear	13.50	12.98	13.54	13.75	13.97	13.46	0.56	0.52
No. of Kernels/ ear	681.6	664.5	608.1	645.4	634.4	660.0	21.6	24.8
No. of plants/ plot	91.25	95.75	91.41	95.58	93.33	90.75	N.S	N.S
No. of ears/ plant	182.5	191.5	182.8	191.1	186.6	181.5	N.S	N.S
weight of 100 kernels (g)	43.15	45.10	39.10	42.46	41.61	42.73	1.35	1.14
Grain yield/ plant(g)	318.0	278.7	247.9	268.8	285.0	284.5	23.1	28.9
Grain yield Kg/ plot	19.40	17.92	15.28	17.20	17.88	17.25	1.39	1.52

Effects of nitrogen fertilization:

Data of yield and its components as affected by nitrogen levels presented in Table 2 clearly indicate that the yield and its components were significantly affected by nitrogen fertilizer rates in both seasons of experimentation. The highest values of yield per plant and yield per plot were obtained when N was applied at the rate of 120 kg N/ fed. while the rate of 60 kg N/fed gave the lowest values for both yield per plant and per plot. these findings may be attributed to the favorable influence of nitrogen on the accumulation of metabolites.

These results are in agreement with those reported by Salwau (1993), Moshtohory *et al.* (1995) and El-Gezawy (1996).

Interaction effect:

A summary of the effects of the interaction between N- fertilizers and genetic on grain yield and its components are presented in Table 3. The results indicated that addition of 120 kg N/ fed to maize was enough to maximize grain yield and its components. Regarding the effect of increasing levels of nitrogen on yield per plant, the results indicated that this character increased in both seasons by increasing nitrogen fertilization.

The highest values of grain yield/plant were achieved with single cross 10 (S.C.10)+ 120 kg N/ fed in the first season and combination between two seasons whereas, it was the three way cross 321 (T.C.321) + 120 kg N/ fed in the second season. The highest grain yield/ plot resulted with single cross 10 (S.C.10) +120 kg N/ fed in both and combined season.

Table 2: Effect of nitrogen levels on some attributes and yield characters of maize during 1999 and 2000 seasons.

Characters	Nitrogen fertilizer							
	60 kg/ fed		90 kg/ fed		120 kg/ fed		L. S. D. 0.05	
	1999	2000	1999	2000	1999	2000	1999	2000
Ear length (cm)	16.23	17.03	18.86	19.48	21.87	22.04	1.17	1.01
Ear diameter	14.14	13.88	15.25	16.26	17.80	18.51	1.31	1.08
No. of rows/ ear	11.75	11.43	13.45	13.38	15.81	15.39	0.57	0.52
No. of Kernels/ ear	595.3	612.8	642.2	663.8	686.6	693.4	21.7	24.8
No. of plants/ plot	80.00	84.42	92.67	94.17	103.6	103.5	3.25	4.84
No. of ears/ plant	160.0	168.8	185.3	188.3	206.6	207.0	6.50	9.68
weight of 100 kernels (g)	35.25	37.54	40.92	43.84	47.70	48.94	1.35	1.14
Grain yield/ plant(g)	250.8	248.3	285.2	278.7	314.9	305.0	23.1	28.9
Grain yield Kg/ plot	13.32	13.96	17.59	17.42	21.66	20.99	1.39	1.52

Table 3: Highest value and combination of the interaction effects on yield and its components of maize in 1999 and 2000 seasons.

Variable	1999 season		2000 season		Combination	
	Treatments G X N Kg. /fed.	High value	Treatments G X N Kg./fed	High value	Treatments G X N Kg./fed	High value
Ear length (cm)	S.C.10+120	23.65	T. C.321+120	22.25	S.C.10+120	23.65
Ear diameter	T. C.321+120	18.95	T. C.321+120	18.95	T. C.321+120	18.95
No. of rows/ ear	S.C.10+120	16.48	T. C.321+120	12.55	S.C.10+120	16.48
No. of kernel/ ear	S.C.10+120	712.3	S.C.Y152+120	707.7	S.C.10+120	712.3
No. of plant plot	S.C.Y152+120	104.3	T.C.321+120	106.0	S.C.10 +120	106.0
No. ears/ plant	S.C.Y152+120	208.5	T. C.321+120	205.0	S.C.Y152+120	208.5
Weight of 100 kernels	S.C.10+120	49.6	S.C.Y152+120	49.55	S.C.10+120	49.60
Grain yield/ plant (g)	S.C.10+120	340.0	T.C.321+120	316.8	S.C.10+120	340.0
Grain yield/ plot (kg)	S.C.10+120	22.95	S.C.10+120	21.88	S.C.10+120	22.95

Simple correlation

Simple correlation coefficients between grain yield/ plot and its components are presented in Table 4. The results showed that all variables were positive and highly significant correlation coefficients between them except between number of plants per plots and each of ear diameter and number of rows per ear, and between weight of 100 kernels and number of plants per plot. Consequently, these results indicate that selection practiced for the improvement of any of a set of correlated characters, would automatically improve the other, even though direct selection for its improvement has not been made. These findings are in agreement with those obtained by Hassib (1997).

Table 4: Simple correlation coefficients between grain yield/plot of maize and its yield attributes over both 1999 and 2000 seasons.

Variable	X1	X2	X3	X4	X5	X6	Y
Ear length (cm) (x1)	1.00						
Ear diameter (x2)	0.77**	1.00					
No of rows/ ear (x3)	0.88**	0.92**	1.00				
No. of kernel/ ear (x4)	0.94**	0.65**	0.73**	1.00			
No. of plant/ plot (x5)	0.55**	0.31	0.39	0.63**	1.00		
Weight of 100 kernels (g) (x6)	0.87**	0.91**	0.92**	0.80**	0.39	1.00	
Grain yield /plot (kg) (Y)	0.96**	0.78**	0.87**	0.94**	0.89**	0.60**	1

** donate to 0.01 of significance

Multiple linear regressions

Prediction equations and additive components of multiple coefficient of determination, R^2, over the two seasons for both full model and stepwise analysis are given in Table 5. Selecting prediction equations were done according to coefficient of determination, and standard error of estimate, SE%. Five phonological stages were shown in Table 5.Regarding to full model and stepwise analysis, for all studied stage, R^2 was ranged between (0. 96 and 0.97), SE% ranged between (4.96 and 5.60) for grain yield per plot. Whereas R^2 was ranged between (0.95 and 0.97), SE% ranged between (3.1 and 3.75) for grain yield per plant. We notice that stepwise regression (0.92), SE% (6.03) for grain yield per plot whereas stepwise regression was ranged between (0.85 and 0.93), SE% ranged between (3.49 and 4.72) for grain yield per plant. We noticed that predication equation of stepwise multiple linear regression of the most important macro climatic factors and variables were day length in tassel initiation stage, growing degree days in silking initiation stage, relative humidity in six leaves exist on the plant stage, pollination and physiological maturity stage in addition to variables ear length and number of kernels per ears. On the other hand, the effective micro climatic factors of grain yield per plot were years, variety and nitrogen fertilization that used to predict yield through full model regression and stepwise. R^2 was found 0.86 and SE% 8.09.

Table 5: Predication equation, coefficient of determination, R^2 and standard error of stimates for maize grain yield/ plot using full model regression.

Predication equation (full model)	R^2	SE%	Predication equation stepwise	R^2	SE%
1- From germinations to the end of *Vegetative growth.*					
A - Grain yield/ plot Y=63.2996+0.7268X1+0.5331X2+ 0.8118X3+0.1291X4+0.1425X5+0.700X6 +0.0434 GDD1-0.0256 RH1	0.96	5.60	Step (1) Y=-28.9976+4.2058X1**	0.92	6.03
B-Grain yield/ plant. Y=1.2086-4.4437X1-0.1376X2+13. 0.348X3+0.9651X4-1.6308X5+0.4 201X6+0.8768GDD1-0.4786RH1	0.97	3.1	Step (1) Y=-175.5794+0.7027X4** Step (2) Y=-15.18674+0.7391 X4** -0.027RH1**	0.86 0.93	4.72 3.49
2- From end of vegetative growth to tassel initiation.					
A -Grain yield/ plot. Y= -71.4278+0.8979X1+0.5267X2 +0.5157X3+0.1205X4+0.1511X5 0.0687X6- 0.117E-10 DL + 3.4851E-10 RH	0.96	5.35	Step (1) y= -28.9976+4.2058X1**	0.92	6.03
B -Grain yield/ plant. Y=-153.9919-0.9854X1-0.2666X2+ 7.047X3-1.4563X4-1.4563X5-1.9188E-10 DI - 0.0957RH	0.95	3.57	Step (1) Y=-175.5794+0.70.7X4** Step (2) Y=-156.7207+0.7391X4* *-0.1086DI**	0.86 0.93	4.72 3.49
3- silking initiation					
A -Grain yield/ plot. Y= -3.3781-0.1054X1-0.0113X2+1. 9689X3+0.1705X4+0.2066X5-0. 0366X6+0.1505GDD2-0.0806 RH2	0.97	5.11	Step (1) Y= -28.9976+4.2058X1**	0.92	6.03
B -Grain yield/ plant. Y= 187.3897-2.5446X1-1.1028X2+ 9.3056X3+0.8681X4*-1.3699X5+0. 2298X6+0.2339GDD2-0.1986RH2	0.95	3.70	Step (1) Y=-175.5794+0.7027X4** Step (2) Y=131.3369+0.6947X4**-0.2398GDD2** Step (3) Y=135.362+0.6159X4**+0.7734X6** +0.2293GDD2**	0.85 0.91 0.93	3.50 3.88 3.63
4- Pollination.					
A -Grain yield/ plot. Y=-67.4517+0.4501X1-0.0581X2+1 .0118X3+0.1404X4+0.2389X5+0.00 93X6+0.0150GDD3-0.0090RH3	0.97	5.16	Step (1) Y=-28.9976+4.2058X1**	0.92	6.03
B -Grain yield/ plant. Y= -51.7919+0.1789X1+1.2538X2+ 5.7572X3+0.7386X4-1.6844X5+0.5 478X6-0.0390GDD3-0.0132RH3	0.95	3.60	Step (1) Y=-175.5794+0.7027X4** Step (2) Y=-41.3613+0.7391X4**-0.0370RH3**	0.86 0.93	4.72 3.49
5- Physiological maturity.					
A -Grain yield/ plot. Y= -104.1389-0.0300X1+0.0914X2 +1.3465X3+0.1607X4+0.1576X5+0.0151X6 +0.0240GDD4-0.0062RH4	0.97	4.96	Step (1) Y=-28.9976+4.2058X1**	0.92	6.03
B -Grain yield/ plant. Y=60.5745-0.3005X1+0.0547X2+6. 4338X3+0.7607X4*-1.4611X5+0. 4330X6-1.4611GDD4-0.0298RH4	0.95	3.75	Step (1) Y=-175.5794+0.7027X4** Step (2) Y= 85.7889+0.739X4**-0.0433RH4**	0.86 0.93	4.72 3.49
Grain yield/ plot (mean environmental factors): Y= 32.5061+0.7944Y-2.3900V + 11.5275F**	0.86	8.33	Step (1) Y=28.9178+11.5275F** Step (2) Y=33.6978-2.3900V+11.5275F**	0.83 0.86	8.79 8.09

* Significant at 0.05 level of significance.

** Significant at 0.01 level of significance.

Where:

Y = expected yield.

GDD1 = growing degree days in (from germination to the end of vegetative growth).

GDD2 = growing degree days in (from end of vegetative growth to tassel initiation).

GDD3 = growing degree days in pollination stage.

GDD4 = growing degree days in physiological maturity stage.

DL = day length in (from end of vegetative growth to tassel initiation).

RH = relative humidity in (from end of vegetative growth to tassel Initiation)

RH1 = relative humidity in (from germination to the end of vegetative growth).

RH2 = relative humidity in silking initiation stage.

RH3 = relative humidity in pollination stage.

RH4 = relative humidity in physiological maturity stage

Y = year.

V = variety.

F = fertilization.

X1 = ear length.

X2 = ear diameter.

X3 = number of rows/ ear.

X4 = number of kernels/ ear.

X5 = number of plant/ plot.

X6 = weight of 100 kernels/ g.

Path Coefficients

Simple correlation coefficient between grain yield per plant and its components namely ear length, ear diameter, number of rows per ear, number of kernels per ear and weight of 100- kernels were individually partitioned into their components of direct and indirect effects. Direct and indirect effects of yield components and their relative importance to the grain yield are shown in Table 6 and Figs 1, 2. The results indicated that number of kernels/ ear and number of rows/ ear showed maximum direct effects towards grain yield per plant recording the highest relative contribution to the total variation of grain yield being 12.07% and 11.85%, respectively in the first season. Whereas, it was the number of kernels/ ear and weight of 100 kernels in the most prominent direct effects on grain yield per plant with the highest relative importance value of 40.96% and 4.53%, respectively in the second season. The results also cleared that number of rows/ ear, number of kernels/ ear and weight of 100 kernel had the highest indirect effects being 19.61%, 9.76% and 9.16%, respectively, contributing to grain yield variation. Ear length accounted for 4.50% to total variation of grain yield per plant through number of rows/ear and 3.75% through number of kernels/ era whereas ear diameter accounted for 4.99% to total variation through number of kernels/ ear in the first season.

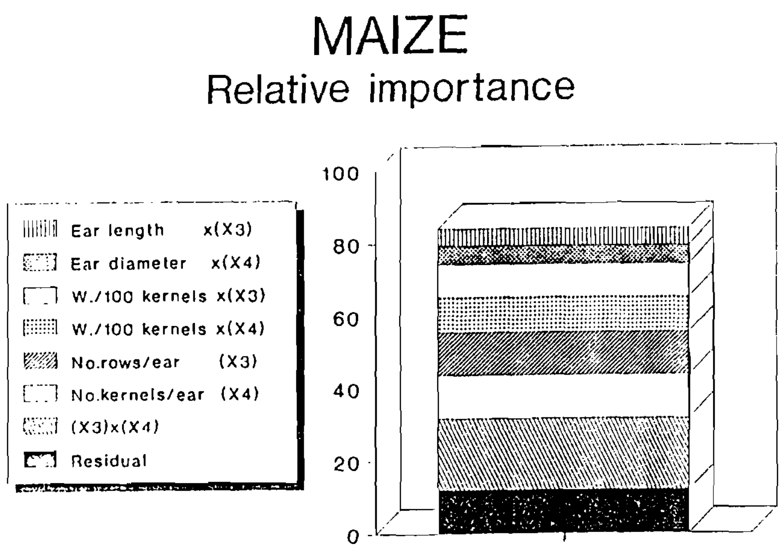

Fig.(1):Components (direct and indirect effects)in grain yield/plant variation of maize in the first season 1999

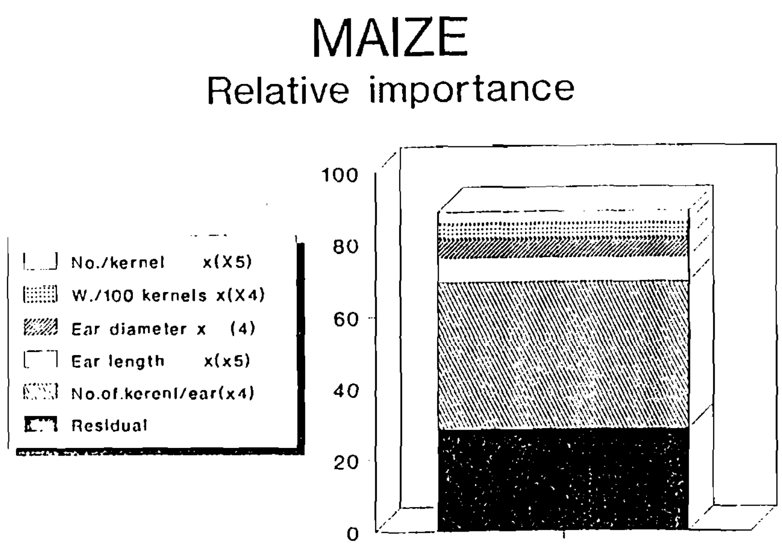

Fig.(2): components(direct and indirect effects) in grain yield/plantvariation of maize in the second season 2000

The analysis also demonstrated that ear length and number of kernels/ear had highest indirect effect through weight of 100 kernels 5.61% and 3.11%, respectively contributing to grain yield per plant. Ear diameter accounted for 5.25% to the total variation of grain yield through number of kernels/ ear in the second season. In 1999 and 2000 seasons the total relative contribution of the studied characters overall variation in grain yield was 88.04% and 71.64%, respectively. The residual effect of the other yield component in the present investigation was 11.96% and 28.36%, respectively, in both seasons. It is clear that this residual effect has slight importance and showed very small contribution to the grain yield variation and also to the other characters which were probably not included into this model. El- Rassas *et al.* (1990).

Table 6: Direct and joint effects of yield components and their relative contribution in grain yield/ plant of maize during seasons 1999 and 2000.

	1999 Season		2000 Season	
Source of variation	CD	R I%	CD	R I%
Ear length (cm) (x1)	0.0075	0.58	0.032	2.41
Ear diameter (x2)	0.016	1.22	0.017	1.26
No. of rows/ ear (x3)	0.155	11.85	0.001	0.07
No. of kernels/ ear (x4)	0.158	12.07	0.540	40.96
weight of 100 kernels (g) (x5)	0.033	2.49	0.060	4.53
(x1) X (x2)	-0.006	0.46	0.025	1.89
(x1) X (x3)	-0.059	4.50	-0.008	0.62
(x1) X (x4)	-0.049	3.75	0.036	2.74
(x1) X (x5)	-0.023	1.71	-0.074	5.61
(x2) X (x3)	0.041	3.10	-0.006	0.49
(x2) X (x4)	0.065	4.99	0.069	5.25
(x2) X (x5)	0.037	2.80	-0.018	1.34
(x3) X (x4)	0.257	19.61	-0.008	0.57
(x3) X (x5)	0.120	9.16	0.011	0.80
(x4) X (x5)	0.128	9.76	0.041	3.11
Total		88.04		71.64
Residual	0.1196	11.96	0.2836	28.36

CD = coefficient of determination.
RI % relative importance.

Heritability

Broad sense heritability estimates, presented in Table 7.It was calculated by using the genotypic and phenotypic variances obtained from the mean squares for each of the two seasons. All variables had high heritability estimates and ranged between 53.60% to 91.91% over two seasons, except for ear length and number of kernels/ ear. Meanwhile, genetic advance is ranged from 0.71 for the second seasons in ear length character to 5.51 in the first season in weight of 100 kernels characters. In general, heritability estimates were high and comparable for most of the studied characters.

The development of genotypes possessing high yielding capacity is a prime objective in zea maize. Grain yield is the result of many growth functions of the plant.

Phenotypic and genotypic correlation coefficients (Table 8) were determined in two seasons. This was done to provide a secure basis of confidence in the trends observed or inferred, and to gain the assurance of generality with respect to seasons and level of expression of yield trails.

Table 7: Phenotypic and genotypic variance (σ^2 ph and σ^2 g), heritability (H %) and genetic advance under selection (Gs) for some maize characters in two seasons 1999 and 2000.

Variables	Season	Genetic estimates			
		σ^2ph	σ^2g	H%	G_s
Ear length	1999	2.83	1.97	48.54	1.40
	2000	1.88	1.08	32.99	0.71
Ear diameter	1999	4.76	4.01	70.76	2.92
	2000	3.36	2.51	55.96	1.83
Number of rows	1999	5.16	4.40	72.63	3.14
	2000	6.44	6.17	91.91	4.70
Number of kernels/ ear	1999	4.35	3.04	48.60	1.75
	2000	1.52	0.95	39.21	0.79
Weight of 100 kernels	1999	10.68	9.86	85.21	5.51
	2000	7.12	5.71	64.16	4.19
Grain yield/ plant	1999	11.99	10.74	80.16	5.41
	2000	4.68	3.43	53.60	2.04

Correlated variation of two characters may be due to similar genetic causes or to similar response to environmental influence. The two components of correlated response may be separated statistically. If genetic correlation is high, attempts to obtain a response in one character by selecting for an associated trait may be worthwhile (Brim 1973). The practical utility of selecting for a given character as a means (indicator) of improving another depends on the extent to which improvement in the major characters is facilitated by selection for the indicators. Such improvement depends not only on the genotypic correlation but also on the phenotypic correlation and the magnitude of variances for both genotypic and phenotypic of all characters included in the selection scheme (Johnson, Robinson and Comstock 1955). Thus phenotypic variances and genotypic variances coupled with phenotypic and genotypic coefficients of variability as well as heritability were calculated and presented in Table 7.

The coefficient of phenotypic (r_P), genotypic (r_G) and environmental (r_E) correlation coefficients between combinations of pairs of the various characters are presented in Table 8. Genotypic correlation between grain yield per plot and ear diameter, number of kernels/ ear and weight of 100 kernels were highly positive significance in the first season while phonotypic and genotypic correlation coefficient were positive and highly significance to number of kernels/ ear and grain yield/ plant in the second season. Whereas in the first season grain yield per plant was found to be positive and highly significant for all characters except number of rows/ ear was negative and highly significant. In the second season it was found to be positive and highly significant to number of kernels/ ear while ear length was negative and highly significant. Other characters showed different degrees of significance for correlation between each pair of characters. Similar coefficients were obtained by Pathirana 1993.

The importance of the estimation of genotypic variance and error mean square is that the magnitude of variance will indicate the performance of the different genotypes in the given ecological conditions. This will allow maize breeder to produce and reproduce genotypes that represent somewhat near optimum combination of genes for a particular area. With these kinds of estimates, expected gain from various selection programs can be calculated.

In general there was a close agreement between phenotypic and genotypic correlation coefficients for any pair of traits in its sign and magnitude. Whereas genotypic association values are slightly higher indicating that such correlation was mostly due to genetic causes.

Table 8: Phenotypic (upper), genotypic (middle) and environmental (lower) correlation coefficient between studied characters of maize in two seasons 1999 lower and 2000 upper.

Variables	(x1)	(x2)	(x3)	(x4)	(x5)	(x6)	(x7)
Ear length	1.00	-0.542*	-0.756**	-0.138	0.849**	-0.119	-0.133
(x1)	1.00	-0.984**	-0.975**	-0.585*	0.972**	-0.649**	-0.264
	1.00	0.524	0.294	0.264	0.218	0.523	0.239
Ear diameter	0.274	1.00	0.819**	0.365	-0.281	0.400	0.216
(x2)	0.090	1.00	0.984**	0.923**	-0.951**	0.381	0.165
	0.569*	1.00	0.361	0.051	0.554*	0.430	0.461
Number of rows	-0.863**	-0.407	1.00	0.168	-0.705**	0.161	0.066
(x3)	-0.926**	-0.814**	1.00	0.290	-0.860**	0.218	0.064
	0.057	0.202	1.00	-0.027	-0.260	0.040	0.080
Number of kernels	0.711**	0.649**	-0.820**	1.00	0.114	0.829**	0.851**
(x4)	0.890**	0.741**	-0.660**	1.00	0.253	0.989**	0.989**
	0.489	0.562*	0.443	1.00	-0.027	0.579*	0.435
Weight of 100 kernels(g)	0.716**	0.801**	-0.843**	0.890**	1.00	0.152	0.082
(x5)	0.796**	0.901**	-0.932**	0.989**	1.00	0.137	0.041
	0.470	0.568*	-0.155	0.103	1.00	0.176	0.251
Grain yield/ plant (g)	0.700**	0.666**	-0.849**	0.902**	0.905**	1.00	0.962**
(x6)	0.746**	0.709**	-0.116	0.946**	0.975**	1.00	0.980**
	0.575*	0.699**	0.013	0.587*	0.430	1.00	0.827**
Grain yield / plot (kg)	0.313	0.412	-0.399	0.450	0.494	0.194	1.00
(x7)	0.340	0.609**	-0.484	0.672**	0.530*	0.189	1.00
	0.296	-0.026	0.045	-0.053	0.194	0.315	1.00

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تقدير معادلات التنبؤ لمحصول الذرة الشامية باستخدام بعض العوامل المناخية الكبرى والبيئية الصغرى

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أقيمت تجربتان حقليتان فى محطة بحوث التجارب الزراعية- ببنها - محافظة القليوبية فى موسمين متتالين١٩٩٩، ٢٠٠٠ لدراسة تأثير بعض العوامل المناخية الكبرى والبيئية الصغرى وكذلك دراسة التصنيفات المظهرية والوراثية والبيئية والعلاقات الارتباطية على المحصول ومكوناته لثلاث هجن من الذرة الشامية هجين فردى ١٠، وهجين فردى اصفر ١٥٢، وهجين ثلاثى٣٢١ تم تسميدها بمستويات التسميد الازوتى ٦٠، ٩٠ ١٢٠ كجم/فدان. استخدم تصميم القطاعات الكاملة العشوائية في أربعة مكررات. وتم التحليل الإحصائي لكل من تحليل التباين- الارتباط البسيط - استخدام معادلات التنبؤ بالمحصول لكل من النموذج الكامل والمرحلي للانحدار المتعدد - ومعامل المرور ودراسة الارتباط المظهري والوراثى والبيئي بين الصفات المدروسة.
أظهرت الدراسة النتائج التالية:-

١- أوضحت النتائج أن هجين فردى ١٠ أعطى أعلى كمية محصول عن كل هجين من فردى اصفر ١٥٢ وهجين ثلاثي ٣٢١.
٢- أدت زيادة مستويات التسميد النتروجين حتى ١٢٠ كجم/ فدان الي زيادة معنوية عالية لجميع الصفات المدروسة.
٣- حققت صفة المحصول بالقطعة استجابة معنوية مع هجين فردى ١٠ عند إضافة معدل تسميد نتروجين ١٢٠كجم/ فدان.
٤- دلت نتائج تحليل الارتباط البسيط على وجود ارتباط موجب وعالي المعنوية بين المحصول وجميع الصفات المدروسة.
٥- أوضحت نتائج تحليل الانحدار الكلى ان معامل التحديد ر٢ تقع ما بين ٩٥% - ٩٧% بينما تحليل الانحدار المرحلي تقع ما بين٨٥% - ٩٣%.
٦- وقد أتضح ان أهم العوامل المناخية الكبرى المؤثرة على المحصول ومكونات هي طول النهار في مرحلة تكوين النورة المذكرة - درجة الحرارة المتجمعة للنمو في مرحلة ظهور الحريرة -

الرطوبة النسبية في مرحلة نهاية النمو الخضري، وفى مرحلة ظهور الحريرة ومرحلة الحصاد، هذا بالإضافة إلى بعض الصفات مثل طول الكوز وعدد حبوب الكوز وذلك باستخدام النموذج المرحلي للانحدار المتعدد.

٧- أظهرت النتائج أن التسميد الازوتى و الهجن والسنوات كعوامل بيئية صغرى لها تأثيرا معنويا موجبا على المحصول.

٨- اظهر تحليل معامل المرور أن صفة عدد الحبوب بالكوز، وعدد الصفوف في الكوز كانت أكثر الصفات ذات التأثير المباشر في محصول نبات الذرة وكانت المساهمة الكلية لهذه الصفات في محصول النبات ٧٠و١٢%، ٨٥و١١%على الترتيب في الموسم الأول بينما كانت صفة عدد الحبوب بالكوز ووزن ١٠٠ حبة أكثر الصفات ذات التأثير المباشر وكانت الساهمة الكلية لهذه الصفات في محصول النبات ٩٦و٤٠%، ٥٣و٤٤% على الترتيب في الموسم الثاني.

٩- تشير النتائج ان الصفات المدروسة كانت كافية حيث تفسر ٤٠و٨٨% و ٦٤و٧١% من التباين الكلى في الموسم الأول والثانيعلى الترتيب.

١٠- وقد أظهرت التراكيب الو راثية عند تقدير درجة التوريث أن معظم الصفات ذات إسهاما عاليا وتقع مابين ٦و٥٣% - ٩١,٩١ % في كلا الموسمين ماعدا طول الكوز وعدد حبوب الكوز.

١١- وقد وجد أن هناك ارتباط وراثي موجب وعالي المعنوية بين المحصول وكل من قطر الكوز - عدد الحبوب بالكوز ووزن المائة حبة في الموسم الأول بينما كان الارتباط المظهري والوراثى لصفة عدد الحبوب بالكوز ومحصول النبات في الموسم الثاني.

١٢- أظهر معامل الارتباط المظهري والوراثى بين محصول النبات وكل الصفات معنوية موجبة عالية ماعدا صفة عدد الصفوف بالكوز التي كانت سالبة عالية المعنوية فى الموسم الأول بينما كان الارتباط في الموسم الثاني موجبا وعالي المعنوية لصفة عدد الحبوب بالكوز وذو معنوية سالبة لصفة طول الكوز.