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STATISTICAL STUDIES ON DESIGNED AND UNIFORMITY TRIALS TO DETECT THE INTERRELATION AMONG YIELD AND ITS COMPONENTS IN MAIZE.

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ABSTRACT

Two experiments in each season were conducted at Sids Agricultural Research Station, Beini Suef Governorate, during 2004 and 2005 seasons to detect the interrelations among yield and its components under designed and uniformity (homogeneity) trials in maize (Zea mays) using SC10 variety. The statistical procedures were simple correlation, multiple regression, stepwise regression analysis and Path analysis. The designed experiments included a- 5 nitrogen levels (0.0, 40, 80, 120 and 160 kg N/fed) b- three plant populations (20000, 24000 and 30000 plant/fed). The experiments were designed in split plot with four replications. Data of designed and uniformity trials were collected for the two seasons and analyzed for each character. Results indicated that uniformity trials excluded two variables (ear height (x_2) and plant height (x_6)) from the significant relation with seed yield (g)/plant compared with designed experiments which excluded only ear height (x_2) according to simple correlation. Multiple regression results showed that all characters contributed by 81.6 and 94.4% from the total variation of seed yield/plant for designed and uniformity trials, respectively. Also, results for standard deviation (S.D) and standard error (S.E.) obtained from homogeneity experiments were less than that obtained from designed experiments indicating that homogeneity trials are more efficient and accurate.

Stepwise analysis develops a sequence of multiple regression equation by accepting 4 variables (ear length (x_3), ear rows (x_4), kernels/row (x_5) and weight of 100 kernels (x_7)) with relative contribution R^2 being (79.69%) from designed experiments compared with 3 variables (ear rows (x_4), kernels/row (x_5) and weight of 100 kernels (x_7)) with relative contribution R^2 being (94.10%) from uniformity experiments.

Path analysis results cleared that weight of 100 kernels possessed the highest direct effect on yield/plant with values of 14.719% and 39.611% for designed and uniformity experiments, respectively. Also, results indicated that ear length cm (x_3) x weight of 100 kernels (x_7), weight of 100 kernels (x_7) x kernels/row (x_5) and ear length cm (x_3) x kernels/row (x_5) scored highest indirect effect on yield/plant for designed experiments with values being 13.736%, 12.833% and 12.643%, respectively. On the other hand, the weight of 100 kernels (x_7) x kernels/row (x_5) and ear rows (x_4) x kernels/row (x_5) scored indirect effect being 8.582% and 3.334%, respectively for uniformity experiments. Highest total *effect (direct and indirect) for designed experiments were obtained by ear length cm (x_3) and weight of 100 kernels (x_7) with values being 35.833% and 29.552%, respectively. On the other side, weight of 100 kernels (x_7) and ear rows (x_4) possessed the highest total effect with values equal 48.193% and 24.528% for uniformity experiments, respectively. Results also, indicated that 4 characters (ear length cm (x_3), ear rows (x_4), weight of 100 kernels (x_7) and kernels/row (x_5) were totally contributed by 80.107% in the total relation variation of yield/plant for designed experiments. On the other hand, three characters (ear rows (x_4), weight of 100 kernels (x_7) and kernels/row (x_5)) were totally contributed by 93.659% in yield/plant variation for uniformity experiments.*

Results of all statistical estimates indicated that uniformity trials were more efficient and accurate than designed experiments where they had low errors and high homogeneity. Hence, maize breeders should give more attention to use uniformity experiments to study the relationship between yield and its components.

Key words: ***Maize, Designed and uniformity trials, Statistical procedures.***

INTRODUCTION

Maize is one of the most important grain crops in the world as well as in Egypt. Determining the most contributing characters to the total variability of yield is of high important to achieve a successful breeding program to develop high yielding genotypes of a given crop. Multiple linear regression in both full model and stepwise as well as standard partial regression known as path coefficient are statistical procedures successfully applied to estimate the relative contribution of independent variables on a dependent variable.

Gautam *et.al.* (1999) showed that grain yield was positively correlated with ear length, grain rows, 100-grain weight, shelling percentage, plant height and ear height. Maximum direct effects towards grain yield were contributed by ear length followed by shelling percentage. The direct effects of plant height and ear height towards grain yield were small, as that of days to silking, indicating the possibility of developing high yielding plant types with short plant height, medium ear placement and early maturity. Arias *et.al.* (1999) found that the direct and indirect effects on ear weight of plant and ear height and its ratio varied according to the evaluated progeny type. Among the other traits, number of kernel rows showed only a small positive indirect effect via ear diameter for all progeny types and populations, and the number of kernels per row showed high positive direct effects. Ear diameter, whose direct contribution to ear weight was relatively high and positive and free of negative indirect effects via other traits. Kumar and Kumar (2000) indicated that the plant height, ear weight, number of seed rows per ear and number of seeds per ear was desirable for grain yield. Devi and Shaik-Mohammed (2001) reported that correlation coefficient and path analysis indicated significant correlation of ear length, 100-seed weight and number of seeds per ear. The path coefficient analysis indicated that the plant height, ear length, number of seed rows per ear, number of seeds per row and 100-seed weight positively influenced the yield directly and also indirectly through several yield components. Mohan *et.al* (2002) cleared that path coefficient analysis for all characters studied had positive and significant correlation with grain yield. Number of kernels/row, 100-kernel weight, kernel rows and ear length exhibited the highest positive direct effects on grain yield. However, ear height recorded the maximum negative direct effect on grain yield, followed by plant height. Singh *et.al* (2003) pointed that ear length had the maximum direct effect on grain yield followed by 500-kernel weight and ear leaf area. Viola *et.al* (2003) revealed that plant height, cob length, cob weight, cob height, and number of cobs per plant had greater directly contributed to increase cob yield. Ashmawy (2003) using stepwise and path analysis, cleared that the most contributing variables in grain yield/plant were ear length, ear diameter, and weight of 100 kernels. Ibrahim (2004) outlined that number of kernels/row and 100 kernel weight had high positive direct effects on grain yield/plant.

The aim of this study is to detect the real interrelations among yield and its components under designed and uniformity trials of maize. Also to investigate the contributing variables in the total variability of yield.

MATERIALS AND METHODS

Two experiments in each season were conducted at Sids Agricultural Research Station, Bein Suef, Governorate during 2004 and 2005 seasons to detect the interrelations among maize yield and its components under conditions of designed and uniformity trials.

The designed experiments included 5 nitrogen levels (0.0,40,80,120 and 160 kg N/fed) and three plant populations (20000, 24000 and 30000 plant/fed) where 30, 25 and 20 cm between hills, respectively. SC10 variety was used and the experiments were designed in split plot with four replications. The main plots contained plant populations and sub plots included nitrogen levels. The plot consisted of 12 ridges with 3 m long and 70 cm apart (12 x 3 x 0.7 = 25.2 m^2/plot) with total field area of 1512 m^2 =0.36 feddan (5 N levels x 3 plant populations x 4 replications x 25.2 plot size). Sowing was done on June 10^{th} and plants were harvested on October 10^{th} for all experiments.

Uniformity trails are conducted by planting the experimental site with a single crop variety and applying all cultural and management practices as uniformly as possible. Sources of variation are kept constant except that due to soil heterogeneity. Hence, uniformity trails were conducted in the same location, same area, same variety and same seasons. The area of the uniformity trial (24 X 63 m (1512 m^2 =0.36 feddan)) was divided into 8 strips. Each strip consisted of 90 ridges with 3 m long and 70 cm apart (2.1 m^2) considering the ridge as a basic unit with total ridges equal to 720. Basic units (ridges) were harvested separately after discarding two plants from each end to eliminate the border effect, each basic unit considering a sample (8 strips x 90 rows = 720 samples/character). All recommended practices were done as usual in maize fields. The data of designed and uniformity trials were collected for the two seasons to study the following characters:

1- Ear diameter in cm (X_1)	5- Number of kernels/row (X_5)
2- Ear height in cm (X_2)	6- Plant height in cm (X_6)
3- Ear length in cm (X_3)	7- Weight of 100 kernels (X_7)
4- Number of rows/ear (X_4)	8- Grain yield (g)/plant in gm (Y)

Statistical analysis

Relationships among dependent variable (y) and independent variables (x, s) were studied using the following multivariate procedures:

1- Simple correlation coefficient was computed for various characters as outlined by Snedecor and Cochran (1989).

2- Multiple regression analysis was performed as outlined by Draper and Smith (1987) to get the prediction equations to estimate the relative contribution of independent variables (R^2) in the total variation of the dependent variable.

3- Stepwise multiple regression analysis that aims to determine the variables accounting for the majority of the total variability in dependent character. This procedure develops a sequence of multiple regression equation in a stepwise manner. One variable is added to the regression equation at each step. The added variable is the variable that has the greatest contribution in the error sum of squares. Also, this variable has the highest partial correlation with the dependent variable for fixed values of those variables already added, and it is the variable that has the highest F value. Stepwise regression analysis was performed as described by Draper and Smith (1987).

4- Path coefficient analysis as applied by Dewey and Lu (1959). A path coefficient is simply a standardized partial regression coefficient as it measures the direct effect of one variable upon another and permits the separation of the correlation coefficient into components of direct and indirect effects.

RESULTS AND DISCUSSION

Firstly, statistical estimates were obtained for each character of yield and its components to compare the designed and uniformity trials. Results in Table (1) cleared the values of (S.D) and (S.E.) that obtained from homogeneity experiments were less than the obtained from designed experiments. On the other hand, the averages of all characters of homogeneity experiments were greater than the obtained from designed experiments. These results mean that homogeneity experiments (uniformity trials) were more efficient and more accurate compared with designed experiments. Also, these results gives maize breeders a chance to detect the true relations between yield and its components.

Table 1. Mean values, standard deviation (S.D.) and standard error (S.E.) for grain yield/plant of maize and related characters of designed and uniformity experiments.

Characters	Designed experiments			Uniformity experiments		
	Mean	S.D	S.E	Mean	S.D	S.E
Grain yield/plant in g (Y)	251.613	74.58	18.619	284.414	31.738	7.481
Ear diameter in cm (X_1)	4.897	3.388	0.357	5.077	0.239	0.056
Ear height in cm (X_2)	142.863	33.342	3.515	148.194	13.362	3.149
Ear length in cm (X_3)	19.533	2.640	0.278	20.633	1.163	0.274
Number of rows/ear (X_4)	12.907	55.943	5.897	12.833	0.857	0.2021
Number of kernels/row (X_5)	44.794	5.7049	0.601	47.250	2.002	0.471
Plant height in cm (X_6)	281.279	41.2937	4.353	290.417	32.969	2.771
Weight of 100 kernels (X_7)	38.430	43.581	4.594	41.778	3.059	0.721

Secondly, the relationships among ear diameter cm (x_1), ear height (x_2), ear length (x_3), and rows/ear (x_4), kernels/row (x_5), plant height (x_6), weight of 100 kernels (x_7) and grain yield (g)/plant (y) of designed and uniformity trials in maize were studied using the following multivariate procedures:

1- Simple correlation

a- Designed experiments

The obtained results in Table (2) cleared highly significant and positive correlation among grain yield (g)/plant and each of ear diameter in cm ($r=0.779^{**}$), length ($r=0.878^{**}$), and rows/ear ($r=0.480^{**}$), kernels/row ($r=0.837^{**}$), plant height ($r=0.412^{**}$) and weight of 100 kernels ($r=0.765^{**}$). Results clearly indicated that ear length, kernels/row, and 100-kernels weight had the greatest influence on the grain yield/plant.

Table 2. Correlation coefficients among grain yield/plant of maize and related characters in designed experiments.

Characters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	Y
Ear diameter in cm (X_1)	1.00							
Ear height in cm (X_2)	.083	1.00						
Ear length in cm (X_3)	.766	.080	1.00					
Number of rows/ear (X_4)	.350	-.069	.235	1.00				
Number of kernels/row (X_5)	.693	-.010	.920**	.090	1.00			
Plant height in cm (X_6)	.383**	.608**	.407**	-.011	.431**	1.00		
Weight of 100 kernels (X_7)	.709**	.267**	.792**	-.010	.718**	.639**	1.00	
Grain yield/plant in g (Y)	.779**	.085	.878**	.480**	.837**	.412**	.765**	1.00

Also, highly significant and positive correlation estimates were found between ear length and each of kernels/row ($r=0.920^{**}$), plant height ($r=0.407^{**}$), and weight of 100 kernels ($r=0.792^{**}$). Highly significant and positive correlation estimates were also found between ear diameter in cm and each of plant height ($r=0.393^{**}$) and weight of 100 kernels ($r=0.709^{**}$). Similar results were also obtained between kernels/row and each of plant height ($r=0.431^{**}$) and weight of 100 kernels ($r=0.718^{**}$). On The other hand, the relation between grain yield/plant and ear height was not significant. Similar results for designed experiments were reported by Devi and Shaik-Mohammed (2001) and Ashmawy (2003) for grain yield/plant (g) and its components.

b- Uniformity (homogeneity) experiments

Results in Table (3) showed highly significant and positive correlation among yield (g)/plant and each of ear diameter cm ($r=0.772^{**}$), length ($r=0.839^{**}$), and rows/ear ($r=0.438^{**}$), kernels/row ($r=0.734^{**}$) and weight of 100 kernels ($r=0.533^{**}$). Ear length (x2) and plant height (x6) which were not significant. Results also cleared that ear diameter (x1), ear length (x3) and kernels/row (x5) had the greatest influence on the grain yield/plant. Highly significant and positive correlation were also found between ear diameter (x1) and each of ear length ($r=0.655^{**}$) and weight of 100 kernels (r=0.661), ear height (x2) and plant height ($r=0.558^{**}$), ear length (x3) and kernels/row (r=0.753) and plant height (x6) and weight of 100 kernels (r=0.726).

Generally, results in Tables 1 and 2 indicated that uniformity trials excluded two variables (ear height (x2) and plant height (x6)) from the significant relation with seed yield (g)/plant compared with designed experiments which excluded only ear height (x2). This result meaning that homogeneity experiments (uniformity trials) should be used by researchers to obtain the true relations between yield and its components because its more efficient and more accurate.

Table 3. Correlation coefficients among grain yield/plant of maize and related characters in uniformity experiments.

Characters	X_1	X_2	X_3	X_4	X_5	X_6	X_7	Y
Ear diameter in cm (X_1)	1.00							
Ear height in cm (X_2)	.350	1.00						
Ear length in cm (X_3)	.655**	-.056	1.00					
Number of rows/ear (X_4)	.239	.344	.153	1.00				
Number of kernels/row (X_5)	.479*	-.128	.753**	.056	1.00			
Plant height in cm (X_6)	.361	.558**	.095	.138	-.290	1.00		
Weight of 100 kernels (X_7)	.661**	.367	.525*	-.082	.149	.726**	1.00	
Grain yield/plant in g (Y)	.772**	.237	.839**	.438	.734**	.182	.533**	1.00

2-Multiple regression analysis

Regression coefficients (b) and relative contributions (R^2) for grain yield/plant and all characters studied are shown in Table (4). Results showed that all characters contributed by 81.6 and 94.4% in the total variation of grain yield/plant for designed and uniformity experiments, respectively.

These results cleared that uniformity trials scored more relative contribution and had less residual compared with designed experiments and this means that uniformity trials could detect the true relation between yield and its components compared with design experiments. Also, these results may be due to that the relation between yield and its components could be affected by applied treatments in the designed experiments. Similar results were obtained by Devi and Shaik-Mohammed (2001) and Ashmawy (2003)) for designed experiments.

Table 4. Regression coefficients (b), standard deviation (SD) and standard error (SE) for maize characters according to multiple regression analysis for designed and uniformity experiments.

Characters	Designed experiments			Uniformity experiments		
	b	S.D	S.E	b	S.D	S.E
Ear diameter in cm (X_1)	21.74	0.348	0.257	12.552	0.239	0.201
Ear height in cm (X_2)	0.0324	17.632	4.854	0.0727	13.362	3.578
Ear length in cm (X_3)	7.560	2.339	3.845	3.439	1.163	2.727
Number of rows/ear (X_4)	9.683	1.273	2.383	15.77	0.858	1.216
Number of kernels/row (X_5)	2.720	5.796	0.149	7.706	2.002	0.136
Plant height in cm (X_6)	-0.065	32.622	2.002	-0.116	32.968	1.143
Weight of 100 kernels (X_7)	3.221	5.612	9.776	4.605	3.059	4.703

	Designed experiments	Uniformity experiments
Constant	-356.742	-586.123
Relative contribution (R^2)	81.6%	94.4%
Residuals	18.4%	5.6%

3-Stepwise multiple regression analysis

a- Designed experiments

Results of stepwise multiple regression analysis were arranged in Table (5) to determine the significant variables contributing to the variation of grain yield and their relative contributions.

Table 5. Accepted and removed variables of maize according to stepwise analysis in designed experiments.

Characters	b	SE	R^2 %	Probability of significance
Accepted variables				
Ear length (X_3)	8.726	3.842	74.1	0.000
Ear rows (x_4)	11.527	2.267	3.8	0.000
Kernels/row (x_5)	2.782	1.185	1.7	0.000
Weight of 100 kernels (x_7)	3.551	0.832	0.09	0.017
R^2% for accepted variables		*79.69*		
Residuals		20.31		
Total contributions (R^2) %		*100.000*		
Removed variables				
Characters		T	R^2 %	probability of significance
Ear diameter cm (x_1)		1.532	0.048	0.129
Ear height cm (x_2)		-.263	0.000	0.793
Plant height cm (x_6)		-.670	0.001	0.505
Total R^2 for removed variables		0.049		

Constant (a) = **-328.696**

Prediction equation $\hat{Y} = -328.696 + 8.726x_3 + 11.527x_4 + 2.782x_5 + 3.551x_7$

The results cleared that the most contributing variables in grain yield/plant of maize were ear length (R^2=74.1%), rows/ear (R^2=3.8%), kernels/row (R^2=1.7%) and weight of 100 kernels (R^2=0.09%) with total variation equal to 79.69%. Table (5) also, revealed that the best prediction equation was

$$\hat{Y} = -328.696 + 8.726x_3 + 11.527x_4 + 2.782x_5 + 3.551x_7$$

These results indicated that stepwise analysis develops a sequence of multiple regression equation by removing 3 variables from the full model equation (7 variables). Hence, maize breeders should give more importance to ear length (x_3), rows/ear (x_4), kernels/row (x_5) and weight of 100 kernels (x_7) as selection criteria for yield improvement. On the other hand, ear diameter (x_1), ear height cm (x_2) and plant height (x_6) were eliminated due to their low relative contribution (0.049%). These results are similar to those reported by Ashmawy (2003) for designed experiments.

b- Uniformity experiments

Significant and accepted variables and their contributions to the variation of grain yield are arranged in Table (6) according to stepwise multiple regression analysis. The results cleared that ear rows (x_4), kernels/row (x_5) and weight of 100 kernels (x_7) were the most contributing variables for grain yield/plant of maize. Those variables were contributed by 94.10% for grain yield variation. It is observed from the results that ear rows (x_4) was the most important variable followed by kernels/row (x_5) and weight of 100 kernels (x_7). The relative contributions in the total variation of grain yield/plant of maize were 71.4%, 12.5% and 10.2% for the above mentioned characters, respectively. Best prediction equation, revealed in Table (6) and was $\hat{Y} = -628.064+17.032x_4+10.339x_5+4.917x_7$

Table 6. Accepted and removed variables of maize according to stepwise analysis in uniformity experiments.

Accepted variables				
Characters	**B**	**SE**	**R^2 %**	**Probability of significance**
Ear rows (x_4)	17.032	2.568	71.4	0.000
Kernels/row (x_5)	10.339	1.109	12.5	0.000
Weight of 100 kernels (x_7)	4.913	0.728	10.2	0.000
R^2% for accepted variables		*94.100*		
Residuals		5.900		
Total contributions (R^2) %		*100.000*		
Removed variables				
Characters		**T**	**R^2 %**	**probability of significance**
Ear diameter cm (x_1)		0.901	0.001	0.384
Ear height cm (x_2)		-.209	0.000	0.838
Ear length (x_3)		0.857	0.000	0.407
Plant height cm (x_6)		-1.015	0.000	0.328
Total R^2 for removed variables		0.001		

Constant (a) = -628.064

Prediction equation $\hat{Y} = -628.064+17.032x_4+10.339x_5+4.917x_7$

These results revealed that stepwise analysis develops a sequence of multiple regression equation by accepting 3 variables from the full model equation (7 variables) for uniformity experiments compared with designed experiments which accepted 4 variables. Hence, maize breeders should give more importance to ear rows (x_4), kernels/row (x_5) and weight of 100 kernels (x_7) as selection criteria for yield improvement. Also, this result showed that uniformity trials are more efficient and more accurate because it scored low standard error (SE) and accepted variables. On the other side, results for uniformity trials eliminated ear diameter cm (x_1), ear height cm (x_2), plant height cm (x_6) and ear length (x_3) due to their low relative contributions (0.001%).

4- Path analysis

a-Designed experiments

Path analysis partitions simple correlation coefficients into their components direct and indirect effects. The results of yield components and their relative importance to the variability of grain yield/plant for designed experiments are presented in Table (7). The results cleared that weight of 100 kernels (x_7) followed by ear length (x_3) had the highest direct effect of relative importance (R^2) in yield/plant with values being 14.719 and 7.548%, respectively. Kernels/row (x_5) and ear rows (x_4) were contributed by 7.248 and 6.325% from the direct relative importance (R^2) of yield/plant, respectively. Highest indirect effect of relative importance (R^2) in yield/plant were 13.736, 12.833 and 12.643 recorded by ear length (x_3) x weight of 100 kernels (x_7), weight of 100 kernels (x_7) x kernels/row (x_5) and ear length cm (x_3) x kernels/row (x_5), respectively. Results also, indicated that ear rows (x_4) x weight of 100 kernels (x_7), ear length (x_3) x ear rows (x_4) and ear rows (x_4) x kernels/row (x_5) scored indirect effect of relative importance (R^2) in yield/plant equal 1.930, 1.870 and 1.219%, respectively. Generally, Table 7 cleared that ear length cm (x_3) possessed the highest total effect (direct and indirect) in yield/plant followed by weight of 100 kernels (x_7) with relative importance (R^2) being 35.833 and 29.552%, respectively. Ear rows (x_4) and kernels/row (x_5) possessed total effect (direct and indirect) of relative importance (R^2) in yield/plant being 9.474 and 7.248%, respectively.

The previous results for designed experiments agreed with those obtained by Mohan *et.al* (2002),Singh *et al* (2003), Viola *et al* (2003), Ashmawy (2003) and Ibrahim (2004).

Table 7. Direct and indirect effects of yield components and relative contributions in grain yield/plant of maize in designed trials.

Characters	Symbols	Relative contribution (R^2) %
Direct effect for ear length cm	*(x_3)*	*7.584*
Indirect effect for ear length cm	(x_3) X (x_4)	1.870
Indirect effect for ear length cm	(x_3) X (x_7)	13.736
Indirect effect for ear length cm	(x_3) X (x_5)	12.643
Total effect for ear length cm	*(x_3)*	*35.833*
Direct effect for ear rows	*(x_4)*	*6.325*
Indirect effect for ear rows	(x_4) X (x_7)	1.930
Indirect effect for ear rows	(x_4) X (x_5)	1.219
Total effect for ear rows	*(x_4)*	*9.474*
Direct effect for weight of 100 kernels	*(x_7)*	*14.719*
Indirect effect for weight of 100 kernels	(x_7) X (x_5)	12.833
Total effect for weight of 100 kernels	*(x_7)*	*29.552*
Direct effect for Kernels/row	*(x_5)*	*7.248*
Total effect for all characters (Direct and indirect)		*80.107*

b- Uniformity experiments

Simple correlation coefficients were also partitioned by path analysis into their components direct and indirect effects. Results in Table (8) showed that weight of 100 kernels (x_7) scored the highest direct effect of relative importance (R^2) in yield/plant followed by kernels/row (x_5).

Table 8. Direct and indirect effects for ear rows (x_4), weight of 100 seeds (x_7) and kernels/row (x_5) for uniformity trials of maize in yield/plant (g).

Characters	Symbols	Relative contribution (R^2) %
Direct effect for ear rows	*(x4)*	*19.740*
Indirect effect for ear rows	(x_4) X (x_7)	1.454
Indirect effect for ear rows	(x_4) X (x_5)	3.334
Total effect for ear rows	*(x_4)*	*24.528*
Direct effect for weight of 100 kernels	*(x_7)*	*39.611*
Indirect effect for weight of 100 kernels	(x_7) X (x_5)	8.582
Total effect for weight of 100 kernels	*(x_7)*	*48.193*
Direct effect for Kernels/row	*(x_5)*	*20.938*
Total effect for all characters (Direct and indirect)		*93.659*

These two variables possessed relative importance (R^2) being 39.611and 20.938% in yield/plant. Ear rows (x_4) scored direct effect of relative importance (R^2) in yield/plant being 19.740%.

Highest indirect effect of relative importance (R^2) in yield/plant were 8.582 and 3.334%. These values were obtained by weight of 100 kernels (x_7) x kernels/row (x_5) and ear rows (x_4) x kernels/row (x_5), respectively. Results also, cleared that ear rows (x_4) x weight of 100 kernels (x_7) scored relative importance (R^2) in yield/plant equal 1.454%. In general, Table 8 indicated that weight of 100 kernels (x_7) possessed the highest total effect (direct and indirect) in yield/plant and followed by ear rows with relative importance (R^2) equal 48.193 and 24.528%, respectively. kernels/row (x_5) possessed total effect (direct and indirect) of relative importance (R^2) in yield/plant being 20.938%.

Comparing results of path analysis, we showed that weight of 100 kernels possessed the highest direct effect of relative importance (R^2) in yield/plant with values 14.719% and 39.611% for designed and uniformity experiments, respectively. Ear length cm (x_3) x weight of 100 seeds (x_7), weight of 100 kernels (x_7) x kernels/row (x_5) and ear length cm (x_3) x kernels/row (x_5) scored highest indirect effect of relative importance (R^2) in yield/plant for designed experiments with values being 13.736, 12.833 and 12.643%, respectively. On the other hand, the highest indirect effect of relative importance (R^2) in yield/plant for uniformity experiments were 8.582 and 3.334% for weight of 100 kernels (x_7) x kernels/row (x_5) and ear rows (x_4) x kernels/row (x_5), respectively. Highest total effect (direct and indirect) for designed experiments in yield/plant were obtained by ear length cm (x_3) and weight of 100 kernels (x_7) with relative importance (R^2) being 35.833 and 29.552%, respectively. On the other side, weight of 100 kernels (x_7) and ear rows (x_4) possessed the highest total effect in yield/plant with relative importance (R^2) being 48.193 and 24.528 for uniformity experiments, respectively. Path analysis also, indicated that 4 characters (ear length cm (x_3), ear rows (x_4), weight of 100 kernels (x_7) and kernels/row (x_5)) were totally contributed by 80.107% from (R^2) in yield/plant for designed experiments. On the other hand, 3 characters (ear rows (x_4), weight of 100 kernels (x_7) and kernels/row (x_5)) were totally contributed by 93.659% from (R^2) in yield/plant for uniformity experiments.

The pervious results indicated that uniformity trials were more efficient and accurate than designed experiments where they had low errors and high homogeneity. Hence, maize breeders should give more attention to use uniformity experiments to study the relationship between yield and its components.

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دراسات إحصائية على التجارب المصممة وتجارب التجانس لكشف العلاقة الحقيقية بين المحصول ومكوناته في الذرة الشامية

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أقيمت تجربتان حقليتان في محطة بحوث سدس بمحافظة بنى سويف في موسمي ٢٠٠٤ ، ٢٠٠٥ لاكتشاف العلاقة المتداخلة بين المحصول ومكوناته تحت ظروف التجارب المصممة (تجارب المعاملات) وتجارب التجانس وذلك على محصول الذرة الشامية. ولكشف حقيقة تلك العلاقة تم استخدام عدة تحليلات إحصائية هي، الارتباط البسيط (Linear correlation) والارتباط والانحدار المتعدد (Multiple regression and correlation) والانحدار المتعدد المرحلي (Stepwise regression analysis) وتحليل معامل المرور (Path analysis) وذلك على هجين الذرة فردى ١٠ وقد احتوت كل تجربة مصممة (تجربة معاملات) على ٥ مستويات للنيتروجين هي صفر ، ٤٠ ، ٨٠ ، ١٢٠ ، ١٦٠ وحدة نيتروجين للفدان في القطع الرئيسية كما احتوت القطع الشقية على ٣ كثافات نباتية هي ٢٠٠٠٠ ، ٢٤٠٠٠ ، ٣٠٠٠٠ نبات/الفدان وذلك في تصميم قطع منشقة مرة واحدة في اربعة مكررات وقد احتوت القطعة التجريبية على ١٢ خط بطول ٣ امتار وعرض ٠,٧ م للخط بحيث كانت مساحة القطعة التجريبية ٢٥,٢ مترا مربعا وبالنسبة لتجربة التجانس فقد نفذت في نفس الجهة وبنفس المساحة وعلى نفس الصنف وفى نفس المواسم حيث اشتملت على ٨ شرائح احتوت كل شريحة على ٩٠ خط بعدد خطوط كلى ٧٢٠ خط للتجربة وقد طبقت كل التوصيات الموصى بها والمتبعة في حقول الذرة عل نفس الصنف، وقد تم جمع البيانات لكل من التجارب المصممة (تجارب المعاملات) وتجارب التجانس خلال الموسمين وقد استخدمت الطرق الإحصائية سابقة الذكر.

وقد أشارت النتائج إلى أن صفتي ارتفاع الكوز وطول النبات قد استبعدتا من الارتباط المعنوي مع محصول النبات عند استخدام تجارب التجانس مقارنة بالتجارب المصممة التي استبعدت فقط طول النبات وذلك بالنسبة للارتباط البسيط. أما بالنسبة للانحدار المتعدد أشارت النتائج إلى أن كل الصفات

قد ساهمت في التباين الكلي لمحصول النبات بحوالي ٨١,٦ % بالنسبة للتجارب المصممة مقارنة بنسبة ٩٤,٤ % عند استخدام تجارب التجانس، وقد أشارت النتائج أيضا إلى أن قيم الانحراف المعياري والخطا المعياري كانت قيمها اقل في تجارب التجانس مما يدل على دقتها مقارنة بتجارب المعاملات.واما بالنسبة لتحليل الانحدار المتعدد المرحلي أشارت النتائج إلى أن هذا التحليل قد اختزل معادلة الانحدار المتعدد (النموذج الكامل) لتجارب المعاملات من ٧ متغيرات إلى ٤ فقط هي الأعلى مساهمة في محصول النبات وهذه الصفات هي طول الكوز ، عدد الصفوف بالكوز ، عدد الحبوب في الصف ووزن المائة حبة بنسبة إسهام ٧٩,٦٩ % مقارنة بنسبة إسهام ٩٤,١٠ % لعدد ٣ متغيرات من ٧ هي عدد صفوف الكوز ، عدد الحبوب في الصف ووزن المائة حبة في تجارب التجانس. وبالنسبة لتحليل لمعامل المرور أوضحت النتائج إلى أن وزن المائة حبة حقق أعلى نسبة إسهام مباشرة في محصول النبات قدرها ٣٩,٦١١ % بالنسبة لتجارب التجانس مقارنة بنسبة ١٤,٧١٩ % لتجارب المعاملات، وقد أشارت النتائج أيضا إلى أن التأثير الغير مباشر لصفة (وزن المائة حبة x طول الكوز) ، (وزن المائة حبة x عدد الصفوف)، (طول الكوز x عدد الصفوف) كان الأعلى إسهاما في محصول النبات بقيم ١٣,٧٣٦ % ، ١٢,٨٣٣% ، ١٢,٦٤٣ % بالنسبة للتجارب المصممة على الترتيب. وفى الجهة المقابلة كان التأثير الغير مباشر لصفات (وزن المائة حبة x عدد حبوب الصف) ، (عدد الصفوف x عدد حبوب الصف) هو الأعلى إسهاما في محصول النبات بقيم ٨,٥٨٢ % ، ٣,٣٣٤% بالنسبة لتجارب التجانس على الترتيب.

وقد أوضحت نتائج تحليل معامل المرور أيضا بالنسبة لتجارب التجانس إلى أن صفتي طول الكوز ووزن المائة حبة كانت الأعلى إسهاما في محصول النبات بنسب ٣٥,٨٣٣% ، ٢٩,٥٥٢% على الترتيب وفى الجهة المقابلة بالنسبة لتجارب التجانس كانت صفتي وزن المائة حبة وعدد حبوب الصف الأعلى إسهاما في محصول النبات بنسب ٤٨,١٩٣% ، ٢٤,٥٢٨% على الترتيب. وقد أوضحت النتائج أيضا أن الأربع صفات السابقة (طول الكوز ، عدد صفوف الكوز ، ووزن المائة حبة ، عدد حبوب الصف) مجتمعة هي الأعلى في المساهمة الكلية بمجموع إسهام ٨٠,١٠٧ % في تباين المحصول بالنسبة للتجارب المصممة (تجارب المعاملات). وفى الجهة المقابلة كانت ٣ صفات هي (عدد صفوف الكوز ، وزن المائة حبة ، وعدد حبوب الصف) مجتمعة هي الأعلى في المساهمة الكلية بمجموع إسهام ٩٣,٦٥٩ % في تباين المحصول بالنسبة لتجارب التجانس.

ويتضح من النتائج السابقة ان دراسة العلاقة بين المحصول ومكوناته تحت ظروف تجارب التجانس كانت افضل من التجارب المصممة (المعاملات) نظرا لانخفاض قيمة كل من الخطا القياسي و الانحراف المعيارى فيها عن التجارب المصممة.