DETERMINATION OF OPTIMUM SEEDING RATE FOR SOME BREAD WHEAT GENOTYPES

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Abstract

Two field experiments were conducted at Agricultural Research Station of Etay-El- Barod, El- Behera Governorate during the two successive seasons of 2014/ 2015 and 2015/ 2016. To determine the optimum seeding rate for six bread wheat genotypes, i.e. 300, 350 and 400 grains /m^2 on yield and yield components for six wheat genotypes, i.e. Sakha 94, Gemmiza 10, Gemmiza 7, Line 1, Line 8 and Line 6. Results indicated that Line 1 genotype exhibited shorter period to heading (96.89 and 98.56 days) and to maturity (146.23 and 145.11 days) in the first and second seasons, respectively. On the other hand, Gemmeiza 10 exhibited taller plants (123.50 and 121.06 cm) followed by Line 6 (119.83 and 117.72 cm) and Gemmeiza 7 (115.71 and 112.39 cm). While Line 1and Line 6 genotypes gave more number of spikes/m^2 (417.00 and 395.00) and (406.22 and 390.56) spikes/m^2 in the first and second seasons, respectively. The highest number of grains/spike was produced by Line 1and Line 6 (66.33 and 63.41) and (64.60 and 56.86) grains/spike, respectively. The highest values of 1000-grain weight were given by Line 1and Line 6 (62.32 and 60.39 g), (48.64 and 49.94 g). Line 1 and Line 6 recorded the highest grain yield fed being (29.53, 28.23 and 26.90, 25.62 ardab/fed) in the two seasons, respectively). Gemmeiza 7 gave the highest value of straw yield (7.62 and 7.45 ton /fed) for the first and second seasons, respectively. Increasing seeding rate caused a significant increase in the period to heading (98.67 and 99.50 days), to maturity (145.67 and 146.94 days) and number of spikes /m^2 (405.67 and 404.67) but caused a significant decrease in plant height (112.10 and 105.51 cm) number of grain s/spike (62.58 and 59.03), 1000-grain weight (49.34 and 49.60g), grain yield (27.51 and 25.02 ardab/fed), in the first and ascend seasons respectively. Seeding rate of 300 grains/m^2 caused a significant increase in plant height (110.01 and 103.41 cm), number of grains /spike (58.82 and 55.38 grains /spike), 1000-grain weight (49.34 and 49.60 g),grain yield (27.51and 25.02 ardab/fed) in the first and ascend seasons respectively. Simple correlation results indicate that the relationship between all possible pairs of the seven traits was highly significant at 1% level of significance in all cases. Significant and positive correlation was existed between grain yield and all studied characters. The results showed that the factor analysis under the study of the characteristics under the study to three factors under each of the rates of seedling, where these factors contributed to 78.11% of the total variation under the rate of 300 grains /m^2 and 77.19% below the rate of 350 grains /m^2 and

76.88% under the rate of 400 grains /m^2. The study recommends the use of 300 grains /m^2 of seedling when cultivating new genotypes and expanding the use of the most mature and most productive genotypes. 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.
Key words: Factor analysis, Optimum seeding rate, Bread wheat.

INTRODUCTION

Wheat (*Triticum aestivum* L.) is the most important cereal crop in the world. Because of the difficulties facing the horizontal expansion for production increase in Egypt, increasing the yield vertically is the mains possible means which could be achieved by developing high yielding varieties and *via* good cultural practices, such as optimum seeding rate.

Wheat is the most important cereal crop for Egyptians. Self sufficiency of wheat can be reached by both increasing land area of wheat and improving the productivity per unit area. The latter can be achieved by introducing high yielding genotypes along with their optimum agronomic practices. The newly released long spike wheat genotypes (Sids group) are known to be high yielding ones but their tillering capacities are not satisfactory. Therefore, the response of these genotypes to varying seeding rates is expected to be significant and the determination of an optimum seeding rate for each genotype is a must.

Productive tillers in wheat are considered the most important yield factors. Effecting tillering is many and number of plants per unit area is an important one. Crowdness of plants affects tillereing capacity of wheat so that optimum seeding rate of wheat to be used in sowing should be studied with more care especially for the new genotypes. The effect of different seeding rates on number of effective tillers was studied by many researchers, among them, Munir *et al*. (2001), Abdel-Aziz *et al*. (2002), Saleh (2002), Gaballah (2005), Seleem and Hendawy (2007), Mousa (2006), Swelam (2008), Abdel –Nour and Fateh (2011) and Khaled and Rawy (2012). They all reported that number of spikes per unit area was significantly affected by changing the rate of seeding but their results regarding the optimum seeding rate were different.

Determining the most important characters which affect the yield is useful in the breeding programs. Full model and stepwise regression as well as path coefficient are statistical techniques successfully used to estimate the relative importance of some independent variables on a dependent variable. Walton (1972) reported that information given by the abovementioned procedures may be misleading. He mentioned that the biologists must seek for right assistance from statistical methodology and recommended factor analysis as a kind of multivariate approach. Factor analysis reduces a large number of correlated characters to a much smaller number of clusters or patterns of variables called factor.

The present study this work aimed to study the effect of seeding on yield components of wheat grains of six wheat cultivars and optimum seeding rate for some wheat genotypes, and to use factor analysis approach to assist the dependent relationship between yield and its related characters in wheat which would be helpful in planning an appropriate selection program and the determination the relative contribution of yield factors in wheat grain yield, and percentage contribution of variables to each factor.

MATERIALS AND METHODS

The present study was carried out at the Agricultural Research Station, of Etay-El- Barod, El- Behera Governorate during the two successive seasons of 2014/2015 and 2015/ 2016. The experiment included two treatments the first one was six wheat genotypes namely: Sakha 94, Gemmeiza 10, Gemmeiza 7, Line 1, Line 8 and Line 6 and (Table 1) the second treatment was three seeding rates of 300, 350 and 400 grains /m^2.

The experiment layout was a split and plot design with four replications. Wheat genotypes were distributed at random in the main plots and the seeding rates were assigned to the sub- plots. Each sub plot consisted of six rows, 3.5 m long and 0.2 m apart with an area of 4.2 m^2. Sowing dates were 20 and 23 November in the two successive seasons, respectively. Irrigation and all other agronomic practices were applied as recommended. Data recorded in the two growing seasons were: days to heading and maturity, plant height (cm), spike length (cm), number of spikes/m^2, number of grains/spike (g), 1000-grain weight and grain yields in ton/fed. The relationship between yield and its related characters was studied using simple correlation and factor analysis procedures.

Statistical procedures:

1-Analysis of Variance:

Data obtained in each season were subjected to the proper analysis of variance of split plot design as outlined by Steel *et al*. (1997). Treatment means were compared using least significant difference test (L.S.D.) at 5% level of significance.

2- Correlation matrix:

The coefficients of correlation between all pairs of the studied traits were computed as suggested by Snedecor and Cochran (1989).

3. **Factor analysis**:

Factor analysis was performed according to Cattell (l965) to reduce a large number of correlated variables to a much smaller number of clusters of variables called factors. After loadings of the first factor were calculated, the process was repeated on the residual matrix to find further factors and the process was stopped when the contribution of a factor to the total percentage was less than l0%. After extraction, the matrix of factor loading was submitted to a varimax orthogonal rotation, as applied by Kaiser (l958). The effect of rotation was to accentuate the larger loadings in each factor and to suppress the minor loading coefficient so as to improve the opportunity of achieving meaningful biological interpretation of each factor. Thus, factor analysis indicates both grouping and contribution percentage to the total variation in the dependence structure. Since the object was to determine the way in which yield components are related to each other, grain yield was not included in this structure.

Table 1. The Name and pedigree of the studied bread wheat genotypes.

No	Genotypes	Pedigree
1	Sakha 94	OPATA/RAYON//KAUZ CMBW90 Y3180 -0TOPM -3Y-010M-010M-010Y-10M-015Y-0Y-0AP-0S
2	Gemmeiza 10	MAYA74"S" /ON//160-147/3/BB/GLL/4/CHAT "S" GM5820-3GM-1GM-2GM-0GM
3	Gemmeiza 7	CMH74A.630/SX//SERI82/3/AGENT. GM 4611-2GM-3GM-1GM-0GM.
4	Line 1	GIZA 157 //SX / CARDINAL
5	Line 8	INTA/ RL 4220// 7C /YR "S" /3/KVZ/BUHA"S" //KAL/BB
6	Line 6	MILAN/KAUZ//CHIL/CHUM18 CMSS 96 M0 3121 S – 6M -010 SY- 010M -010 SY -3M-0Y -0ET

RESULTS AND DISCUSSION

Results presented in Tables (2, 3 and 4) show the effect of seeding rate on yield of wheat grains of six wheat genotypes.

1- Effect of genotype

Results in Table (2) showed significant differences ($p \leq 0.05$) among the tested genotypes for all studied wheat traits. Line 1 recorded the lowest number of days to heading and maturity (96.89, 99.44 and146.00, 145.11 days in the first and the second seasons, respectively.

Plant height is an important morphological character directly linked with the productive potential of plant in terms of grain yield. Gemmeiza 10 surpassed the other genotypes in this respect and recorded the highest values of plant height and spike length (123.50, 121.06 cm and12.39, 13.00 cm) in the two seasons, respectively. These differences between genotypes may be due to the genetic variation among the six genotypes.

Results presented in Table (2) revealed highly significant differences among wheat genotypes. Line1 genotype gave the highest values for no. of spikes/m^2 (417.0 and 395.0), no. of grains/spike (66.33 and 63.41), 1000-grain weight (62.32 and 60.39) and grain yield/fed (29.53 and 28.23 ardab/fed), in the first and second seasons, respectively. These results are in agreement with those obtained by Sharaan and Abdel –Samie (1999), Mousa (2006) and Abdel –Nour and Fateh (2011).

Table 2. Effect of wheat genotypes on grain yield and its related characters in the two seasons of 2014/2015 and 2015/2016.

characters	Genotypes						
	Sakha 94	Gemmeiza 10	Gemmeiza 7	Line 1	Line 8	Line 6	LSD (5%)
2014/2015 season							
1- No. of days to heading	102.78	101.11	104.00	96.89	99.44	98.22	1.06
2- No. of days to maturity	149.89	148.00	150.22	146.23	147.78	146.78	0.75
3- Plant height (cm)	88.39	123.50	115.71	109.34	104.20	119.83	1.80
4- Spike length (cm)	10.07	12.39	9.40	10.18	10.27	11.57	0.63
5- Number of spikes/m^2	377.56	394.89	366.67	417.00	395.00	406.22	16.23
6- Number of grains/ spike	61.30	56.32	52.76	66.33	62.38	64.60	3.47
7- 1000 grains weight (gm)	45.48	47.18	38.17	62.32	46.16	48.64	0.81
8- Grain yield (ard. /Fed)	21.79	23.15	22.19	29.53	24.42	26.90	0.99
2015/2016season							
1- No. of days to heading	101.00	100.33	102.56	98.56	102.11	117.72	0.91
2- No. of days to maturity	149.60	149.22	152.78	145.11	146.33	11.16	0.72
3- Plant height (cm)	82.30	121.06	112.39	104.10	100.48	117.72	2.17
4- Spike length (cm)	9.22	13.00	9.31	10.09	10.97	11.16	0.58
5- Number of spikes/m2	365.00	376.67	353.22	395.00	385.00	390.56	15.06
6- Number of grains/ spike	54.30	57.39	51.90	63.41	58.34	56.86	2.03
7- 1000 grains weight (gm)	44.89	48.67	39.12	60.39	46.54	49.94	0.96
8- Grain yield (ard. /Fed)	21.29	24.23	21.92	28.23	23.41	25.62	0.92

- Interaction between seeding rate and wheat cvs was not significant for all traits in both seasons.

2. Effect of seeding rate

Data compiled in Table (3) showed significant differences ($p < 0.05$) among the tested seeding rates for all studied wheat traits. Seeding rate of 300 grains/m^2 led wheat plant to flower and mature earlier resulting from planting 350 and 400 grains/m^2 in the first and the second seasons, respectively. The lateness of heading and maturity date may be due to the increase in the vegetative growth with increasing seeding rate.

Seeding rate of 300 grains /m^2 gave the highest values for plant height, number of grains/spike, 1000-grain weight and grain yield (112.10and 105.51cm), (62.85 and 59.03),(49.34 and 49.60g) and (27.51 and 25.02 ard/fed) in the first and the second seasons, respectively.

Increasing seeding rate from 300 to 350 and 400 grains/m^2 caused significant increase in spike length (cm) and number of spikes/m^2 in the two seasons, respectively. These findings are in accordance with those of El- Karamity (1998), Sharaan and Abdel –Samie (1999), Munir *et al.,* (2001) and Mousa (2006).

Table 3. Effect of seeding rate on wheat yield and its related characters in the two seasons of 2014/2015 and 2015/2016.

characters	Seeding rate			LSD (5%)
	300 grain/m^2	350 grain/m^2	400 grain/m^2	
2014/2015 season				
1- No. of days to heading	98.67	100.06	102.06	0.90
2- No. of days to maturity	145.67	146.78	147.72	0.90
3- Plant height (cm)	112.10	111.55	110.01	1.53
4- Spike length (cm)	9.66	10.64	11.13	0.54
5- Number of spikes/m^2	377.94	395.06	405.67	26.96
6- Number of grains/ spike	62.58	60.44	58.82	2.94
7- 1000 grains weight (g)	49.34	47.81	46.82	0.69
8- Grain yield (ard /fed)	27.51	25.07	23.96	0.84
2015/2016 season				
1- No. of days to heading	99.50	100.94	102.56	1.08
2- No. of days to maturity	146.94	148.44	152.06	0.98
3- Plant height (cm)	105.51	104.43	103.41	0.58
4- Spike length (cm)	10.48	10.48	11.04	0.49
5- Number of spikes/m^2	356.44	371.61	404.67	25.70
6- Number of grains/ spike	59.03	56.69	55.38	1.72
7-1000 grains weight (g)	49.60	48.44	46.74	0.81
8- Grain yield (ard /fed)	25.02	23.22	21.57	1.60

- Interaction between seeding rate and wheat cv was not significant for all traits in both seasons.

3. Simple correlation analysis

Data of simple correlation coefficients matrix for 6 characters of wheat presented in Table 4 and Fig (1) Results indicate that the relationship between all possible pairs of the 6 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 wheat breeder are between grain yield and spike length (r= 0.682**, 0.666** and 0.675** under 300, 350, 400 grains/m^2, respectively) followed by number of grains/spike (r= 0.631**, 0.640** and 0.636** under 300, 350, 400 grains/m^2 respectively). This was highly significant positive correlation. This indicated that these characters had greatest influence on grain yield.

The highest direct relationship with grain yield was shown by spike length under 300, 350, 400 grains/m^2 and by number of grains/spike under 350 grains/m^2 only which had the lowest values for the direct effect under both 300 and 400 grains/m^2.These results indicate the importance of partitioning the correlation value to its components .Moreover, positive but no significant indirect relationships between these three components and grain yield were found through interactions of each component with the other two ones. The greatest indirect association to grain yield was due to the number of grains/ spike through spike length under 300 and 400 grains/m^2.

However, interactions for spike length and number of grains/ spike with 1000-grain weight had negligible relationships to grain yield. Some studies showed that these traits were the most correlated components with grain yield. These results are in agreement with Dogan (2009).

Table 4. Simple correlation coefficients between grain yield of wheat and its attributes (combined across 2014/2015 and 2015/2016 seasons).

A- At 300 grains/m^2

Characters	X1	X2	X3	X4	X5	X6	Y
Days to maturity X1	1						
Plant height (cm) X2	-0.263	1					
Spike length (cm) X3	-0.129	0.240	1				
Number of grains/ spike X4	-0.371	0.494	0.205	1			
Number of spikes/m^2 X5	-0.155	0.312	0.374	0.256	1		
Weight of 1000 grains(g) X6	-0.243	0.428	0.408	0.241	0.479	1	
Grain yield (ard /fed) Y	-0.363*	0.498**	0.682**	0.631**	0.435*	0.448*	1

B- At 350 grains/m^2

Characters	X1	X2	X3	X4	X5	X6	Y
Days to maturity X1	1						
Plant height (cm) X2	-0.442**	1					
Spike length (cm) X3	-0.266	0.256	1				
Number of grains/ spike X4	0.034	0.145	0.460**	1			
Number of spikes/m^2 X5	-0.134	0.335	0.799**	0.529**	1		
Weight of 1000 grains(g) X6	-0.061	0.457**	0.332*	0.041	0.439**	1	
Grain yield (ard /fed) Y	-0.411*	0.534**	0.666**	0.640**	0.621**	0.442**	1

C- At 400 grains/m²

Characters	X1	X2	X3	X4	X5	X6	Y
Days to maturity X1	1						
Plant height (cm) X2	-0.315	1					
Spike length (cm) X3	-0.155	0.203	1				
Number of grains/ spike X4	0.006	0.466**	0.456**	1			
Number of spikes/m² X5	-0.272	0.302	0.424*	0.009	1		
Weight of 1000 grains(g) X6	-0.125	0.230	0.455**	0.260	0.344*	1	
Grain yield (ard/fed) Y	-0.373*	0.580**	0.675**	0.636**	0.425**	0.412*	1

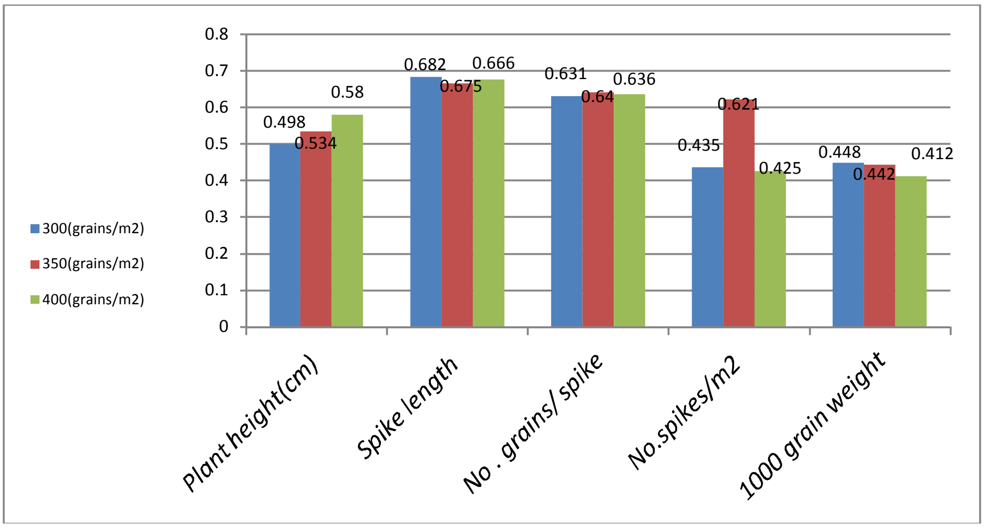

Fig 1. Simple correlation coefficients between grain yield and its components under seeding rate in wheat across the seasons 2014/15 and 2015/16.

2- Factor analysis

The results of factor analysis are presented in Table (5) and Fig (2). Factor was constructed using the principal factor analysis technique to establish the dependent relationship between yield components of wheat. The results indicated that factor analysis divided the seven characters of wheat into three main factors for interpretation, only factor loadings greater than 0.5 were considered important.

The results showed that the three factors of seeding rate 300 (grains/m²) explained 78.11% of the total variation in the dependent structure. Factor 1 accounted for 36.18% of the total variability. This factor contained three variables namely: spikes length, number of grains/plant and 1000 grains weight.

Factor 2 accounted for 21.11% of the total variance in the dependence structure. This factor contained two variables namely: days to maturity and plant height (cm). Factor III accounted for 20.81% of the total variance and included days to heading and number of spikes /m^2.

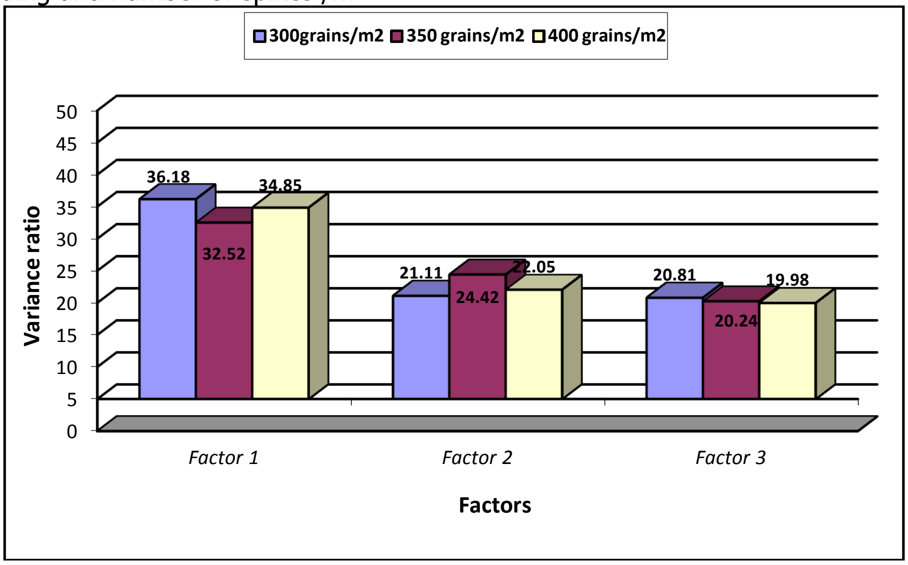

Fig2. Variance ratio for seeding rate of the three factors that were accepted according to factor analysis in wheat across the seasons 2014/2015and 2015/2016.

Table 5. Summary of factor loading for seven variables in wheat across the seasons 2014/2015 and 2015/2016 at seeding rate 300 grains/m^2.

Variables	Loading	Total Communality%	Percentage of variance	Latent root
Factor 1			36.18	2.53
spikes length	0.896	0.878		
Number of grains/plant	0.946	0.902		
1000 grain weight	0.887	0.865		
Factor 2			21.11	1.48
Days to maturity	0.749	0.815		
Plant height (cm)	-0.887	0.522		
Factor 3			20.81	1.46
Days to heading	0.885	0.794		
number of spikes /m^2	0.700	0.689		
Cumulative variance	**78.11**			

On the other hand, the three factors of seeding rate 350 (grains/m^2) were accounted for 77.19% of the total variation in the dependence structure (Table 6).

First factor included three variables, *i.e.*, spike length, number of grains /plant and 1000 grain weight, and accounted for 32.52% of the total variance in the dependence structure. The second factor was made up to days to heading and number of spikes/m^2 with total variance in the dependence structure of 24.42%. The third factor included plant height (cm) and days to maturity with total variance in the dependence structure being 20.24%.

Table 6. Summary of factor loading for seven variables in wheat across the seasons 2014/2015 and 2015/2016 at seeding rate 350 grains/m^2.

Variables	Loading	Total Communality%	Percentage of variance	Latent root
Factor 1			32.52	2.28
spikes length	.843	.799		
Number of grains /plant	.879	.767		
1000grain weight	.879	.786		
Factor 2			24.42	1.71
Days to heading	.869	.766		
number of spikes /m^2	.866	.809		
Factor 3			20.24	1.42
Plant height (cm)	-.892	.810		
Days to maturity	.729	.666		
Cumulative variance	77.19			

Table 7. Summary of factor loading for seven variables in wheat across the seasons 2014/2015 and 2015/2016 at seeding rate 400 grains/m^2.

Variables	Loading	Total Communality%	Percentage of variance	Latent root
Factor 1			34.85	2.44
spikes length	.897	.850		
Number of grains /plant	.925	.862		
1000grain weight	.868	.797		
Factor 2			22.05	1.54
plant height (cm)	.920	.858		
number of spikes /m^2	.532	.431		
Factor 3			19.98	1.41
Days to heading	.916	.855		
Days to maturity	.631	.729		
Cumulative variance	**76.88**			

The results in Table 7 showed that the three factors of seeding rate 400 grains/m^2 explained 76.88% of the total variation in the dependent structure. Factor 1 accounted for 34.85% of the total variability. This factor contained three variables namely: spikes length, number of grains/plant and 1000 grain weight. Factor 2 included plant height (cm) and number of spikes/m^2 with total variance in the dependence structure of 22.05%. The third factor included days to heading and days to maturity with total variance in the dependence structure of 19.98%.

Factor analysis is one that can be used successfully for large amounts of multivariate data, and should be applied more frequently in field experiments (Joseph *et al.*1992 and Hammed, 1993). 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. These results are in agreement with to those reported by Leilah and Al Khateeb (2005) and Mollasadeghi *et al*. (2011).

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تحديد معدل التقاوى الأمثل لبعض التراكيب الوراثية من قمح الخبز

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1. *المعمل المركزى لبحوث التصميم والتحليل الأحصائى– مركز البحوث الزراعية – الجيزة – مصر*
2. *قسم بحوث القمح – معهد بحوث المحاصيل الحقلية– مركز البحوث الزراعية– الجيزة – مصر*

أجريت تجربتان حقليتان فى محطة البحوث الزراعية بإيتاى البارود بمحافظة البحيرة خلال موسمي الزراعة 2015/2014, 2016/2015 وذلك بهدف دراسة تأثير ثلاث معدلات تقاوى هى (300،350،400 حبه/م2)على محصول الحبوب ومكوناته لستة تراكيب وراثية من قمح الخبز (سخا 94، جميزة 10 ، جميزة 7، سلالة1 ، سلالة 8، سلالة 6) وذلك بإستخدام تصميم القطع المنشقة فى أربع مكررات حيث وزعت التراكيب الوراثية فى القطع الرئيسية بينما وزعت معدلات تقاوى فى القطع الشقية . وقد تم إستخدام البيانات المتحصل عليها فى دراسة العلاقة بين المحصول ومكوناته بإستخدام معامل الارتباط البسيط وإستخدام تحليل العامل. ولقد أظهرت النتائج اختلافاً معنويا بين أصناف القمح تحت الدراسة بالنسبة لجميع الصفات المدروسة حيث سجلت السلالة1 فترات أقصر نسبيا سواء لبلوغ طور طرد السنابل أو طور النضج في كلا الموسمين. وأن نباتات الصنف جميزة 10 قد أعطت أعلي القيم لأرتفاع النباتات يليه السلالة 6 ثم الصنف جميزة 7 في كلا الموسمين.من ناحية أخرى أشارت النتائج ان السلالتان سلالة 1 و سلالة 6 أعطت أعلي القيم لصفة عدد السنابل/ م^2 ووزن 1000 حبة و محصول الحبوب في كلا الموسمين. ولقد أظهرت الدراسة إن زيادة معدل التقاوى حتى 400 حبة/م^2 أحدث زيادة معنوية فى عدد الايام لبلوغ طور طرد السنابل و طور النضج وفي طول السنبلة وعدد السنابل/ م^2 وقللت من إرتفاع النباتات وعدد الحبوب /سنبلة ووزن الـ 1000 حبة ومحصول الحبوب الناتج وأن أفضل معدل للتقاوى هو 300 حبة /م^2 . كما أشارت النتائج حيث كانت علاقة الارتباط من الصفات تحت الدراسة عالية المنوية علي مستوى 1% في كل الحالات. وأشارت النتائج إلى عدم تأثر جميع الصفات بالتفاعل بين معدلات التقاوى و التراكيب الوراثية مما يشير إلى تشابه سلوك أو إستجابه التراكيب الوراثية المختبرة. من ناحية أخرى فإن نتائج تحليل معامل الأرتباط البسيط قد أشارت إلى وجود أرتباط موجب عالى المعنوية بين صفة محصول الحبوب وجميع الصفات الأخرى عدا صفة عدد الأيام حتى النضج. وأوضحت النتائج أن تحليل العامل قسم الصفات تحت الدراسة إلى ثلاثة عوامل تحت كل من معدلات التقاوى حيث أسهمت هذة العوامل بحوالى 78.11 % من التباين الكلى تحت معدل 300 حبة/م^2 و 77.19% تحت معدل 350حبة/م^2 و76.88 % تحت معدل 400حبة/م^2. وتوصى الدراسة بضرورة إستخدام معدلات 300 حبة /م^2 من التقاوى عند زراعة التراكيب الوراثية الجديدة والتوسع فى إستخدام التراكيب الوراثية الأكثر تبكيرا فى النضج و الأكثر إنتاجية للحبوب.وقد أعتبر أن تحليل العامل من أهم الطرق التي تستخدم بنجاح فى عدد المتغيرات الكثيرة كما أنة يمكن الاعتماد علي النتائج المتحصل منة في برامج التربية بنجاح لقدرتة علي تحديد طبيعة ونتائج المتغيرات فى برامج التربية.