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GENETIC VARIANCE FOR SOME MAIN SPIKE CHARACTERS IN BREAD WHEAT (*Triticum aestivum*, L.)

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ABSTRACT

The genetic variance for main spike characters *i.e.* spike length (cm), extrusion length (cm), number of spikelets/spike, spike density and spike grain weight (gm) for eight Egyptian bread wheat genotypes, were studied using 8 x 8 diallel crosses excluding reciprocals. The studied genotypes were Sakha 92, Sakha 69, Sakha 8, Giza 160, Gemmeiza 7, Gemmeiza 3, Giza 163 and Giza 164. Combining ability (Griffing, 1956), genetic variance (Hayman, 1954 a and b) and Jones (1956) were computed for the studied materials (parents and cross combination). Results indicated that mean squares of general and specific combining ability were significant for all studied characters. Wheat cultivars Sakha 92 and Sakha 8 were good general combiners for spike length, number of spikelets/spike and grain weight/spike and some cultivars for remaining characters. Whereas, cross combinations Sakha 92 X Giza 160, Sakha 92 X Gemmiza 7, Sakha 92 X Gemmeiza 3 could be true promising crosses. The mean squares for type of gene action obtained by Jones method (1956) indicated significant mean squares of additive gene effects "a" and dominance gene effects "b" for all studied characters. Separation out of the genetic variance to its component showed that, the additive genetic components and dominance genetic components were significant for all studied characters, except spike density. The ratio of $(H_1/D)^{0.5}$ was more than one for all characters, except spike length. Heritability in narrow sense was, 0.738 for spike length, 0.260 for extrusion length, 0.370 for number of spikelets/spike, 0.291 for spike density and 0.596 for weight of grains/spike. Heritability in broad sense values were high for all studied sharacters

INTRODUCTION

The aim of plant breeding is to change the plant heredity in many ways that will improving plant performance. Improved plant performance may be manifested in many ways ; improving yield and its components, therefore, the main spike characters were studied by using diallel crosses. Many researcher used diallel technique to obtain genetical information about main spike characters, in this respect Eissa (1993 a and b) ; AL-Kaddousi *et al.* (1994) reported the importance of additive and non-additive gene effects controlling main spike characters. In this respect additive gene effects played great role in the inheritance of spike length (Hassaballa *et al.*, 1984 and AL-Kaddoussi *et al.*, 1994). Whereas, dominance gene effect was reported to be of great importance for number of spike grain weight (Dasgupta and Mondal, 1988). The additive gene effect was importance in the inheritance of main spike characters (Saad, 1999 ; Salama, 2000 a and b ; Abd EL-Aty, 2002 and Esmail, 2002). Salama and Samia, Muhamed (2002) indicated that the highest heritability in broad sense for main spike characters were obtained.

The present investigation was undertaken to obtain information about gene action, combining ability and heritability for main spike characters of eight Egyptian bread wheat genotypes excluding reciprocals [Model 1, method 2].

MATERIALS AND METHODS

Eight genetically diverse bread wheat genotypes of local origin given in Table 1 were crossed in 2001/2002 and evaluated in 2002/2003 growing seasons, using diallel cross, excluding reciprocals. The eight parents and their 28 F_1's crosses were sown in 5th November 2002 at Awlad Sakar district, Sharkia governorate using a randomized complete block design with three replicates. Each plot consisted of 6 rows (2 rows for each parent and F_1). Row length was 2 m, row to row spacing was 20 cm, plant spacing was 10 cm. All recommended agricultural practices for wheat production were applied at the proper time. Data were recorded on 10 individual plants for each of the parental genotypes and F_1's to study spike length (cm), extrusion length (cm), number of spikelets/spike, spike density and spike grain weight (gm). The obtained data were subjected, firstly, to two way analysis of variance (Steel and Torrie, 1980). The general and specific combining ability variances were estimated using model 1, method 2 of Griffing (1956). Assessment and quantifying the types of gene action were computed according to Hayman (1954 a and b), Jones (1956) and Mather and Jinks (1982).

Table 1: Pedigree of the studied parental genotypes.

Serial number	Genotypes	Pedigree	Origin
1	Sakha 92	Napo 63 / Inia 661 / Wern "5"	Egypt
2	Sakha 69	Inia / RL 4220 // 7C / Yr "5"	//
3	Sakha 8	Indus / Norteno "5"	//
4	Giza 160	Chenab 70 / Giza 155	//
5	Gemmeiza 7	CMH 74 A. 360 / SX // Seri 8213 / Agent	//
6	Gemmeiza 3	Bb / 7C * 2 // Y 50 E / Kal * 3 X Sakha 8 / 4 / PRV / WW 15 / 3 / Bj "5" // On * 3 / Bon	//
7	Giza 163	Vcm // C no 67 / 7C / 3 / Kal / Bb	//
8	Giza 164	Kvz / Buha "5" // Kal / Bb	//

RESULTS AND DISCUSSION

1- Analysis of variance of combining ability G.C.A. and S.C.A. for main spike:

Mean squares of general combining ability G.C.A and specific combining ability S.C.A. are given in Table 2. Variances due to GCA and SCA were significant for all studied characters, indicating presence of additive and non-additive gene action in the inheritance of these characters. The G.C.A. variance was more than S.C.A. for all characters, except spike density. Revealing the importance of additive gene action in the genetics of these characters, except spike density. These results indicated that these characters could be improved through phenotypic selection. These results supported the finding of Salama (2000 a).

2- General combining ability effects:

Data in Table 3 present GCA effects for 8 studied parents of wheat. Positive and significant GCA effects were observed for Sakha 92 and Sakha 8 for spike length, number of spikelets/spike and spike grain wheat. These results showed that these parents possessed additive gene action for these characters and could be involved in breeding program for improving these characters. Parent: Gemmeiza 7 and 3 crosses positive and significant GCA effects for extrusion length and spike density, showing that these parents would be included in breeding procedures for improving these characters in wheat breeding program. Also, Sakha 69 had two positive and significant GCA effects *i.e.*, spike length and spike grain weight.

3- General combining ability effects:

Data of SCA effects for 28 crosses resulted from half diallel of 8 parents are given in Table 4. cross combination Sakha 69 X Gemmeiza 3 had 4 positive and significant SCA effects for spike length, extrusion length, number of spikelets/spike and spike grain weight, followed by cross combination Sakha 69 X Gemmeiza 7 which possessed dominance gene action for all characters, except spike grain weight. These crosses could be involved in wheat breeding program to improve these characters. These results are in agreement with those obtained by Eissa 1989 and Salama (2000 a).

Nine crosses combinations showed positive and significant SCA effects for two different characters which varied from cross to another. Eleven crosses combinations gave positive and significant SCA effects for single character which differed from cross to cross.

4- Separation out the genetic variance to its components for main spike characters:

Analysis of variance of half diallel for main spike characters (Table 5) indicated that both additive gene effects "a" and non-additive gene effects "b" were significant for all main spike characters, revealed, the importance of additive gene effects for controlling these traits. The b_1 component was significant for grain weight/spike indicating the presence of heterotic effects for this character. Significant of b_2 indicated that dominance gene controlling for all main spike characters were not equally distributed among parental genotypes. The b_3 which refer to specific combining ability (Griffing, 1956) indicated presence of considerable heterotic effects specific to some crosses combinations for all characters, except grain weight/spike. Similar results were obtained by Eissa (1989) and Esmail (2002).

5- Hayman's method:

Components of genetic variation are present in Table 6, showed significant of additive gene effects (D) and non-additive gene effects H_1 for all characters, except spike density. Significant of D and H_1 were significant indicated the importance of additive and non-additive gene effects for controlling these characters. The F value was positive and significant for extrusion length.

The h^2 parameter was significant for all characters, except number of spikelets/spike, significant h^2 indicated that dominance is mainly attributed to heterozygosity of loci.

Average degree of dominance $(H_1/D)^{0.5}$ ratio was less than unity for spike length, while it was more than one for the remaining characters indicating the presence of heterotic effects in the inheritance for these traits. These results similar by AL-Kaddoussi and Abd EL-Aty (2002).

The $H_2/4H_1$ value was deviated from its theoretical value for all characters, suggesting unequal showing frequency distribution among parental genotypes. The KD/KR was more than one for extrusion length and spike density indicating that, dominant alleles in the parental genotypes were more than recessive ones.

Narrow sense heritability was 0.738 for spike length, 0.260 for extrusion length, 0.370 for number of spikelets/spike, 0.291 for spike density and 0.596 for grain weight/spike, thus selection in nearly generation would be effective to improve grain weight/spike and spike length. Broad sense heritability values were high and exceeded 50 % for all studied characters.

Table 2: Mean squares of general (GCA) and specific combining ability (SCA) for main spike characters in half diallel of 8 X 8 in bread wheat.

S.O.V.	d.f	Spike length	Extrusion length	Number of spikelets/ spike	Spike density	Grains weight/ spike (g)
G.C.A.	7	6.675**	4.739**	1.780**	0.068**	1.065**
S.C.A.	28	2.114**	1.243**	0.632**	0.282**	0.625**
Error	70	0.159	0.457	0.131	0.023	0.035
δ^2G.C.A. /δ^2 S.C.A		3.157	3.812	2.812	0.241	1.704

Table 3: General combining ability (GCA) effects for main spike characters in half diallel of 8 X 8 in bread wheat.

	Spike length	Extrusion length	Number of spikelets/ spike	Spike density	Weight of grains/spike (g)
Sakha 92 X	1.480** 10.53	- 1.597** 26.33	0.264 25.37	- 0.130** 2.409	0.355** 3.04
Sakha 69 X	0.436** 12.03	0.21820.58	0.13124.90	- 0.0752.069	0.203** 3.20
Sakha 8 X	0.409** 11.23	0.23920.12	0.331** 23.8	- 0.0582.119	0.263** 2.21
Giza 160 X	- 0.44913.93	- 0.11720.22	0.259 24.10	0.0581.730	- 0.0593.45
Gemmiza 7 X	- 1.351 15.0	0.567** 20.98	- 0.971 26.40	0.097 1.759	- 0.678** 4.21
Gemmiza 3 X	- 0.22512.92	0.502 19.83	- 0.00924.97	0.102 1.933	- 0.143** 3.73
Giza 163 X	- 0.18512.97	- 0.02819.47	- 0.14425.0	- 0.0011.943	0.139 3.13
Giza 164 X	- 0.11612.70	0.500 20.85	0.13924.30	0.0091.914	- 0.0823.36
S. Egi	0.118	0.197	0.107	0.044	0.055

Table 4: Specific combining ability effects (SCA) for main spike characters in half diallel of 8 X 8 in bread wheat.

	Spike length	Extrusion length	Number of spikelets/ spike	Spike density	Weight of grains/ spike (g)
Sakha 92 X Sakha 69	0.483	- 3.328**	- 1.040**	- 0.062	- 0.0432
Sakha 92 X Sakha 8	0.320	- 2.721**	0.023	0.102	- 0.786
Sakha 92 X Giza 160	- 1.362**	1.462**	- 0.080	0.337**	0.372
Sakha 92 X Gemmiza 7	1.111**	2.536**	- 0.362**	0.062	2.562**
Sakha 92 X Gemmiza 3	0.502	- 0.231	0.821**	- 1.251**	1.311**
Sakha 92 X Giza 163	- 0.653*	0.622	0.322**	- 0.002	1.071**
Sakha 92 X Giza 164	- 0.531	5.631**	0.541**	- 0.011	0.652
Sakha 69 X Sakha 8	0.423	- 0.383	0.632**	0.421**	- 0.311
Sakha 69 X Giza 160	1.352**	- 0.302	- 0.117	0.311**	- 0.243
Sakha 69 X Gemmiza 7	1.261**	- 0.246	- 0.381**	- 0.402**	- 0.362
Sakha 69 X Gemmiza 3	0.625*	2.051**	0.852**	- 0.653**	1.411**
Sakha 69 X Giza 163	- 0.231	1.632**	0.036	0.143	0.202
Sakha 69 X Giza 164	- 0.554	- 2.730**	0.814**	- 0.232*	0.314
Sakha 8 X Giza 160	2.582**	- 0.022	- 0.621**	0.424**	0.251
Sakha 8 X Gemmiza 7	1.511**	- 0.361	- 0.936**	- 0.683**	0.632
Sakha 8 X Gemmiza 3	- 0.262	0.521	0.854**	- 0.489**	0.341
Sakha 8 X Giza 163	- 0.212	0.482	0.046	0.583**	- 0.258
Sakha 8 X Giza 164	- 0.311	0.522	- 0.006	- 0.321 **	- 0.738
Giza 160 X Gemmiza 7	1.002*	- 0.621	- 1.763**	0.113	- 0.381
Giza 160 X Gemmiza 3	0.514	0.542	- 0.033	- 0.499**	1.728**
Giza 160 X Giza 163	0.231	1.043	0.065	- 0.201	0.213
Giza 160 X Giza 164	1.206**	- 0..652	- 1.822**	- 0.142	0.969*
Gemmiza 7 X Gemmiza 3	1.243**	- 0.881	0.042	- 0.031	0.582
Gemmiza 7 X Giza 163	- 0.253	0.543	0.063	- 0.402**	- 0.361
Gemmiza 7 X Giza 164	- 0.117	1.721	- 0.482**	- 0.102	0.427
Gemmiza 3 X Giza 163	- 0.814**	2.220**	- 0.001	- 0.003	- 0.341
Gemmiza 3 X Giza 164	- 0.621	1.752**	0.285**	- 0.150	- 0.320
Giza 163 X Giza 164	0.703*	- 0.238	0.315**	- 0.101	- 0.468
S. Egi	0.314	0.533	0.081	0.123	0.466

Table 5: Mean squares of the half diallel analysis of variance for main spike characters (Jones, 1956).

S.O.V.	d.f	Spike length	Extrusion length	Number of spikelets/ spike	Spike density	Grains weight/ spike (g)
a	7	6.675**	4.739**	1.780**	0.068**	1.065**
b	28	0.370*	1.850**	0.278*	0.047*	0.127**
b_1	1	0.264	0.387	0.025	0.040	1.713**
b_2	7	0.333*	1.237**	0.352**	0.018*	0.203**
b_3	20	0.388**	2.138**	0.266*	0.057*	0.022
Error	70	0.159	0.457	0.131	0.023	0.035

Table 6: Additive [D], dominance (H_1 and H_2) and environmental [E] genetic components together with drived parameters for main spike characters in half diallel of 8 X 8 in bread wheat.

Characters / Parameters	Spike length	Extrusion length	Number of spikelets/ spike	Spike density	Weight of grains/ spike (g
D	0.239 ± 0.016	0.529 0.105	0.051 ± 0.008	0.0055±0.0046	0.035 ± 0.008
H_1	0.134 ± 0.037	0.612 ± 0.242	0.206 ± 0.021	0.0178 ± 0.010	0.067 ± 0.018
H_2	0.054 ± 0.032	0.460 ± 0.210	0.168 ± 0.018	0.0152 ± 0.010	0.036 ± 0.016
F	-0.057 ± 0.039	0.489 ± 0.248	-0.012 ± 0.021	0.0044±0.0197	0.004 ± 0.019
h^2	0.096 ± 0.022	0.026 ± 0.141	-0.007 ± 0.012	0.0149 ± 0.00	0.826 ± 0.010
E	0.053 ± 0.005	0.158 ± 0.035	0.044 ± 0.003	0.0012±0.0014	0.012 ± 0.003
Drived parameters					
$(H_1 / D)^{0.5}$	0.748	1.075	2.009	1.798	1.383
$(H_2 / 4H)$	0.101	0.188	0.204	0.213	0.135
KD / KR	0.725	2.509	0.898	1.571	0.376
T_n	0.738	0.260	0.370	0.291	0.596
T_b	0.792	0.572	0.678	0.829	0.769

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التباين الوراثى لبعض صفات السنبلة الرئيسية فى قمح الخبز المصرى

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أجريت هذه الدراسة فى الموسم الشتوى لأعوام ٢٠٠١/٢٠٠٢ و٢٠٠٢/٢٠٠٣ وذلك بغرض تقدير التباين الوراثى لبعض صفات السنبلة الرئيسية وهى طول السنبلة ، طول حامل السنبلة ، عدد السنيبلات ، كثافة السنبلة ومحصول حبوب السنبلة الرئيسية مستخدماً ثمانية أصناف من قمح الخبز المصرى والجيل الأول الناتج عن هجن الدياليل مستبعداً الهجن العكسية وهذه الأصناف هى: سخا ٩٢ ، سخا ٦٩ ، سخا ٨ ، جيزة ١٦٠ ، جميزة ٧ ، جميزة ٣ ، جيزة ١٦٣ وجيزة ١٦٤. وتم تحليل البيانات إحصائياً ووراثياً بإستخدام ثلاث نماذج من تحليل الدياليل وهى جرفنج ١٩٥٦ وجونز ١٩٥٦ وهايمان ١٩٥٤ أ ، ب وتلخصت النتائج فى الآتى:

١- أوضحت النتائج أن التباين الراجع للقدرة العامة والخاصة على التآلف كان معنوياً لجميع الصفات المدروسة.

٢- أظهرت النتائج أن الصنف سخا ٩٢ وسخا ٨ كانا أفضل الأصناف فى القدرة العامة على التآلف وكذلك أظهرت بعض الأصناف الأخرى قدرة معنوية وموجبة لبعض الصفات.

٣- كانت الهجن سخا ٩٢ × جميزة ٧ وسخا ٩٢ × جميزة ٣ أفضل الهجن بالنسبة للقدرة الخاصة على التآلف.

٤- أظهر تحليل التباين بإستخدام طريقة جونز ١٩٥٦ أن التباين الراجع للفعل الجينى المضيف "a" والفعل الجينى السيادى "b" كان معنوياً لجميع الصفات المدروسة.

٥- أظهر التحليل بطريقة هايمان ١٩٥٤ أهمية كل من الفعل الجينى المضيف والسيادى فى وراثة الصفات المدروسة. وكان التباين الراجع للفعل الجينى السيادى أعلى من نظيره المضيف لجميع الصفات ما عدا صفة طول السنبلة وكانت النسبة $(H_1/D)^{0.5}$ أقل من الوحدة (طول السنبلة).

٧- أعطت كفاءة التوريث بالمعنى الضيق ٠,٧٣٨ لصفة طول السنبلة ، ٠,٢٦٠ لصفة طول حامل السنبلة ، ٠,٣٧٠ لصفة عدد السنيبلات للسنبلة ، ٠,٢٩١ لصفة كثافة السنبلة و٠,٥٩٦ لصفة وزن حبوب السنبلة.