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ESTIMATES OF THE GENETIC COMPONENTS CONTROLLING SOME MORPHOLOGICAL CHARACTERS OF BREAD WHEAT (*Triticum aestivum*, l.)

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ABSTRACT

In 2001/2002 and 2002/2003 growing seasons the genetic system controlling some morphological characters *i.e.*, heading date, plant height, flag leaf length, flag leaf width and flag leaf area for eight divers bread wheat genotypes, were studied using 8 x 8 diallel crosses excluding reciprocals. The studied genotypes of local origin were Sakha 92, Sakha 69, Sakha 8, Giza 160, Gemmeiza 7, Gemmeiza 3, Giza 163 and Giza 164. The obtained data were statistically and genetically analysed using, Griffing (1956), Hayman (1954 a and b) and Jones (1956) approaches. Results indicated that mean squares of general and specific combining were significant for morphological characters. Wheat cultivar Sakha 92 was good general combiner for all characters except heading date, Sakha 8 for flag leaf length and flag leaf area, Gemmiza 7 for heading date and plant height and Gemmeiza 3 for flag leaf width, flag leaf area and heading date. The wheat cross Sakha 92 X Gemmeiza 7 for all studied characters was good combiner in specific combining and some crosses *i.e.*, Sakha 92 X Giza 160 and Sakha 92 X Giza 164 for three characters. The mean squares for types of gene action obtained by Jones method (1956) indicated that additive genetic variance "a" and dominance genetic variance "b" were significant for all studied characters. When using second degree statistic Hayman (1954 a and b) results showed significant additive gene effects (D) for all characters and dominance gene effects (H_1) for all characters except plant height. The ratio of $(H_1/D)^{0.5}$ was more than one for all characters except flag leaf length. Heritability in narrow sense were, 0.388 for heading date, 0.818 for plant height, 0.386 for flag leaf length, 0.356 for flag leaf width and 0.542 for flag leaf area. These genetic information are of great intense for plant breeder to plan correct and effective breeding program to improve these characters in wheat.

INTRODUCTION

In the initial stages of breeding program breeders need general knowledge about gene action and genetic system controlling genetic variation of the studied characters. The diallel analysis provide detailed genetical information about specific genotypes before including in breeding programs. Many researches used diallel technique to obtain genetical information about morphological characters, in this respect, Mosaad *et al.* (1990) ; Eissa (1993) ; AL-Kaddoussi *et al.* (1994) ; Eissa *et al.* (1994) and Awaad (1996), these researches studied the gene action and genetic controlled morphological characters. The importance of dominance for heading date and plant height were studied by Shehab EL-Din (1997) and Ageez and EL-Sherbeny (1998). Morphological characters were studied using diallel crosses in wheat by Ali and Khan (1998) ; Chowdhry *et al.* (1999) ; Kraljevic (2000) ; Abd EL-Aty (2002) ; Esmail (2002) and Salama and Samia, Mouhamed (2002).

The present investigation was undertaken to obtain genetic information about gene action of genetic system, and heritability for morphological characters in eight bread wheat genotypes using half diallel of 8 X 8.

MATERIALS AND METHODS

In 2001/2002 and 2002/2003 growing seasons eight genetically diverse bread wheat genotypes given in Table 1 were crossed in 2001/2002 to obtain 28 F_1\`s 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 in private farm and evaluated using a randomized complete block design experiment with three replicates. Each plot consisted of 6 rows (2 rows for each parent and F_1). Row length was 2 m, rowlknjmt 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 guarded and competitive plants for each of the parental genotypes and F_1\`s to study plant height (cm), days to heading (day), flag leaf length (cm), flag leaf width (cm) and flag leaf area (cm^2). 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 mode 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- Combining ability analysis of variance:

Mean squares of general combining ability G.C.A and specific combining ability S.C.A. are given in Table 2. Value of GCA and SCA variables were highly significant indicating that additive and non additive gene action played a great role in the genetics of morphological characters. The

G.C.A. : S.C.A. ratio was more than one suggesting the importance of additive gene effects in the inheritance for these characters. Therefore, selection would be effective when improving these character in breeding program. Similar results were reported by AL-Kaddoussi *et al.* (1994) and Eissa *et al.* (1994). The G.C.A. effects for morphological characters (Table 3) showed that, the wheat cultivar Sakha 92 was the best general combiner for all characters except plant height, Sakha 8 for flag leaf length and flag leaf area and heading date, Giza 160 for heading date and plant height and Gemmeiza 3 for plant height and flag leaf width.

Data in Table 4 show that SCA effects for 28 F_1`s results from half diallel of 8 X 8 in Egyptian bread wheat. The obtained results indicated that cross combination Sakha 92 X Gemmeiza 7 showed that all SCA effects are desirable for plant breeder to improve these characters to heading date are negative and significant and at the same time flag leaf width, length and area had positive and significant SCA effects. So, this cross could be used in wheat breeding program to improve these characters. Cross combinations of Sakha 92 X Giza 160 and Sakha 92 X Giza 164 had desirable SCA effects for 3 characters out of studied characters. Nine crosses combinations possessed 2 characters that had desirable SCA effects. The same number of cross combination (9) had only one character. The test of cross combinations are of low value for the plant breeder. These results are in agreement with those obtained by Al-Kaddoussi (1994) and Eissa *et al.* (1994).

2- Separation out the genetic variance to its components for morphological characters:

Analysis of variance of half diallel table for morphological characters Table 5 indicated that additive and dominance gene effects were importance in the genetic control of all traits. Similar result were confirmed by AL-Kaddoussi *et al.* (1994) and Salama and Samia, Muhamed (2002). When the dominance component "b" was further partitioned to three components of b_1, b_2 and b_3. The results indicated that "b_1" was highly significant for, heading date, flag leaf length and flag leaf area, that the means of F_1`s and parents were significantly different. Thus, dominance deviation of genes are predominantly acting in on direction *i.e.* dominance is unidirectional. The "$b_2$" item which refer to the mean dominance deviation of $F_1$`s from their mid-parent value over arrays was significant for all morphological characters, except heading date. The "b_3" component which test part of dominance that is unique each F_1 was significant for heading date indicating that there were dominance effects specific to individual cross (Griffing, 1956), which could be considered adequate for isolating transgressive segregations which possibly for heading cultivars. Similar results were reported by Mossad *et al.* (1990).

Assessment and separation out the total genetic variance using second degree statistics (Table 6) revealed that additive genetic variance and dominance genetic variance (H_1) for all characters are significant. The "F" value estimates the covariance of additive and dominance gene effects was positive and significant for flag leaf length and flag leaf area ; indicating that the dominance alleles in the parent were more than recessive ones.

The ratio $(H_1/D)^{0.5}$ was more than one for all characters, except flag leaf length (0.892) indicating the importance of additive gene effects controlled this character (flag leaf length). Meanwhile, over dominance effects controlled the other characters.

Measured of the overall dominance effects of heterozygous loci by h^2 indicated positive and significant for heading date, flag leaf length and flag leaf area. The frequency among parental genotypes $H_2/4H_1$ were less than the theoretical value (0.25) for all characters, except plant height it was nearer to maximum value. Indicated distribution of positive and negative gene among parents unequal the frequency of gene distribution (dominant and recessive). Heritability in narrow sense was high for plant height (0.818) and flag leaf area (0.542). These results hold true since the additive components was significant. While, for remaining characters ranged from 0.356 for flag leaf width to 0.542 for flag leaf area.

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

S.O.V.	d.f	Heading date	Plant height	Flag leaf length	Flag leaf width	Flag leaf area
G.C.A.	7	12.681**	97.71**	5.583**	0.029**	53.175**
S.C.A.	28	7.226**	20.87**	2.410**	0.008**	24.017**
Error	70	2.012	2.556	0.534	0.003	4.327

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

	Heading date (day)	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Flag leaf area (cm^2)
Sakha 92	5.225**	- 4.299**	0.916**	0.112**	3.332**
X`	101.167	134.33	29.68	2.12	45.80
Sakha 69	0.436	0.306	0.398	- 0.081**	0.564
X`	99.567	118.10	29.48	2.15	46.15
Sakha 8	- 2.047**	- 0.382	0.793**	0.023	2.194**
X`	105.833	121.77	26.12	2.04	38.51
Giza 160	- 2.345**	- 2.040**	- 0.756**	- 0.036**	- 0.206
X`	105.633	126.37	33.22	2.19	54.32
Gemmiza 7	3.763**	6.691	- 1.286**	- 0.079**	- 3.490**
X`	98.6	127.10	32.63	2.25	93.31
Gemmiza 3	- 1.339**	1.473**	- 0.210	0.059**	- 1.549**
X`	103.40	120.43	30.87	2.27	51.13
Giza 163	- 1.704**	- 0.618	0.105	- 0.008	0.333
X`	104.9	118.57	31.13	2.23	50.56
Giza 164	- 2.439**	- 1.174**	0.033	- 0.008	0.969
X`	105.753	124.23	30.92	2.19	49.50
S. Egi	0.419	0.473	0.216	0.016	0.615

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

	Heading date (day)	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Flag leaf area (cm^2)
Sakha 92 X Sakha 69	4.528**	- 10.680**	- 0.350	0.055	0.170
Sakha 92 X Sakha 8	5.539**	- 2.227	- 0.755	- 0.023	2.392
Sakha 92 X Giza 160	4.407**	- 2.227	2.023**	0.213**	3.594*
Sakha 92 X Gemmiza 7	- 22.785**	- 14.680**	1.471**	0.233**	3.621*
Sakha 92 X Gemmiza 3	4.620**	- 6.681**	0.321	- 0.621**	0.232
Sakha 92 X Giza 163	4.988**	- 8.682**	- 0.652	0.212**	0.101
Sakha 92 X Giza 164	5.080**	- 5.368**	1.852**	0.101*	- 3.266*
Sakha 69 X Sakha 8	- 1.214	- 3.450**	1.420**	- 0.032	0.252
Sakha 69 X Giza 160	- 1.536	- 6.520**	- 0.230	0.143**	0.368
Sakha 69 X Gemmiza 7	12.196**	1.420	- 0.521	0.122**	0.261
Sakha 69 X Gemmiza 3	- 1.362	- 2.360	2.542**	0.043	- 0.011
Sakha 69 X Giza 163	2.346*	- 4.850**	1.432**	- 0.053	1.423
Sakha 69 X Giza 164	2.412*	- 8.530**	1.511**	- 0.170**	0.543
Sakha 8 X Giza 160	0.668	- 2.030	- 0.520	- 0.106*	3.641*
Sakha 8 X Gemmiza 7	0.917	2.440	- 0.204	- 0.117*	2.102
Sakha 8 X Gemmiza 3	- 1.572	4.670**	- 0.531	0.023	1.000
Sakha 8 X Giza 163	- 0.450	0.902	- 0.021	0.051	- 0.234
Sakha 8 X Giza 164	- 1.125	- 5.740**	0.364	- 0.111*	- 1.441
Giza 160 X Gemmiza 7	1.712	5.390**	1.242*	0.352**	0.302
Giza 160 X Gemmiza 3	1.309	6.440**	1.532**	0.210**	0.411
Giza 160 X Giza 163	1.002	3.810*	1.624**	0.010	- 0.238
Giza 160 X Giza 164	2.416*	1.220	- 0.502	- 0.009	- 0.246
Gemmiza 7 X Gemmiza 3	- 7.195**	11.900**	0.361	0.402**	0.143
Gemmiza 7 X Giza 163	- 6.507**	10.480**	0.420	0.201**	- 0.265
Gemmiza 7 X Giza 164	- 6.822**	30.650**	- 0.320	- 0.101*	0.211
Gemmiza 3 X Giza 163	- 1.456	22.540**	0.100	0.001	0.031
Gemmiza 3 X Giza 164	- 2.678*	- 2.110	- 0.856	0.003	- 0.926
Giza 163 X Giza 164	- 0.817	5.800**	- 0.888	- 0.068	- 0.385
S. Egi	1.118	1.260	0.576	0.043	1.640

Table 5: Mean squares of the half diallel analysis of variance for morphological characters (Jones, 1956) in half diallel 8 X 8 in bread wheat.

S.O.V.	d.f	Heading date (day)	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Flag leaf area (cm^2)
a	7	12.681**	97.710**	5.583**	0.029**	53.475**
b	28	6.533**	22.409**	1.181**	0.005	5.809
b_1	1	77.158**	2.003	4.896**	0.002	20.928**
b_2	7	3.371	83.550**	2.733**	0.014**	16.806**
b_3	20	4.109*	2.027	0.452	0.002	1.205
Error	70	2.012	2.556	0.534	0.003	4.327

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

	Heading date (day)	Plant height (cm)	Flag leaf length (cm)	Flag leaf width (cm)	Flag leaf area (cm^2)
D	1.052 ± 0.24	2.952 ± 1.162	0.522 ± 0.05	0.0007**± 0.0002	4.247 ± 0.416
H_1	14.151 ± 2.39	3.273 ± 2.67	0.416 ± 0.118	0.0087 ± 0.0004	5.891 ± 0.981
H_2	12.104 ± 2.10	3.270 ± 2.32	0.092 ± 0.102	0.0071 ± 0.0004	1.088 ± 0.833
F	-1.366 ± 1.91	0.180 ± 2.74	0.592 ± 0.124	0.00045 ± 0.0004	5.027 ± 0.984
h^2	6.181 ± 1.21	-0.015 ± 1.55	2.295 ± 0.067	-0.0014 ± 0.0002	9.598 ± 0.559
E	0.184 ± 0.012	1.240 ± 0.381	0.184 ± 0.017	0.0001 ± 0.0007	1.458 ± 0.138
Drived parameters					
$(H1 / D)^{0.5}$	3.667	1.052	0.892	3.525	1.178
$(H_2 / 4H)$	0.219	0.249	0.055	0.201	0.046
KD / KR	0.702	1.014	1.492	1.178	0.647
T_n	0.388	0.818	0.386	0.356	0.542
T_b	0.965	0.900	0.449	0.987	0.615

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حساب المكونات الوراثية لبعض الصفات المورفولوجية فى قمح الخبز

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أجريت هذه الدراسة فى الموسم الشتوى لأعوام ٢٠٠١/٢٠٠٢ و٢٠٠٢/٢٠٠٣ وذلك بغرض دراسة النظام الوراثى وتجزئته إلى مكوناته لبعض الصفات المورفولوجية فى قمح الخبز وهذه الصفات هى عدد الأيام حتى طرد السنابل (يوم) وإرتفاع النبات (سم) وطول ورقة العلم (سم) وعرض ورقة العلم (سم) ومساحة ورقة العلم (سم^{2}) وذلك بإستخدام 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 إحصائيا ووراثيا 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 الائتلاف كان معنوياً لجميع الصفات المدروسة.

٢- أظهرت النتائج أن الصنف سخا ٩٢ كان معنوياً بالنسبة للقدرة العامة على التآلف لجميع الصفات المدروسة ما عدا صفة عدد الأيام حتى طرد السنابل والصنف سخا ٨ لصفتى طول ومساحة ورقة العلم وعدد الأيام حتى طرد السنابل.

٣- كان الهجسين سخا ٩٢ × جميزة ٧ أفضل الهجن بالنسبة للقدرة الخاصة على التآلف لجميع الصفات المدروسة.

٤- أظهر تحليل جونز أن التباين الراجع للفعل المضيف "a" والسيادى "b" كان معنوياً لجميع الصفات المدروسة.

٥- أظهر تحليل هايمان ١٩٥٤ معنوية المكون الراجع للفعل الجينى المضيف والسيادى لجميع الصفات بينما كان المكون السيادى لصفة إرتفاع النبات غير معنوى.

٦- كانت النسبة $(H_1/D)^{0.5}$ > الوحدة لجميع الصفات ما عدا صفة طول ورقة العلم.

٧- كان معامل التوريث بالمعنى الضيق ٠,٣٨٨ لصفة ميعاد طرد السنابل و٠,٨١٨ لصفة إرتفاع النبات و ٠,٣٨٦ لصفة طول ورقة العلم و٠,٣٥٦ لصفة عرض ورقة العلم و٠,٥٤٢ لصفة مساحة ورقة العلم.

وهذه المعلومات ذات إهتمام كبير بالنسبة للمربى للتخطيط لبرامج تربية صحيحة وفعالة فى تحسين محصول القمح