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GENETICAL AND GRAPHICAL ANALYSIS OF YIELD AND YIELD COMPONENTS UNDER TWO LOCATIONS IN DURUM WHEAT.

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ABSTRACT

Half diallel set of crosses involving six durum wheat parental lines were used to estimate the type and relative amount of genetic variance components for yield and its attributes under two locations. The results revealed that additive type of gene action was found to reach the level of significance in some cases at the two locations. Dominance gene effects were larger in magnitude than the additive ones and appeared to be the more prevailing for all the studied traits under both locations. “F” value coupled with Ko/Kr showed an excess of positive and negative alleles in parents at the two locations. Studies on the nature and degree of dominance revealed the existence of over-dominance for all studied traits at the two locations. The correlation between the parental performance and the parental order of dominance were found to be negative for all studied traits studied except plant height and number of grains per ear at the two locations and for ear length and number of spikelets per ear at the second location. High estimates of heritability in the broad sense were accompanied by moderate to low estimates for the narrow sense were detected for most traits.

INTRODUCTION

Wheat has bean considered the first strategic food crop for more than 7000 years in Egypt. Heritable improvement in yield and quality of grain has bean the main goal of wheat breeders. This could be attained by creation of heritable variability upon which selection could be practiced. Crossing of wheat genotypes possessing desired characteristics has, so far, been the most effective way to achieve progress. Diallel cross technique is a good tool for identification of hybrid combinations that have the potentiality of producing maximum improvement and identifying superior lines among the progenies in early segregating generations. The present investigation was undertaken to estimate the type and relative amount of genetic variance components for yield and its attributes of half diallel set of crosses involving six durum wheat parental genotypes under two environmental conditions of old and newly reclaimed lands.

MATERIALS AND METHODS

This work was conducted during the two growing season of 1998/1999 and 1999/2000 at the two locations, i.e. Sers EL-Laian and Nubaria Agricultural Research Station, Agricultural Research Center. Six parental genotypes of durum wheat represented a wide range of genetic diversity for several traits were selected for this study (Table 1).

In 1998/1999 season the six parents were crossed in all possible combinations, excluding reciprocals, to obtain a total of 15 F1 hybrids. The parental lines and their possible 15 Crosses were sown in the growing 1999/2000 at the two Locations, i.e. Sers EL-Laian (L1) and Nabaria (L2). The Two experiments were arranged in a Randomized Complete Blocks design with three replicates. Each replicate consisted of one row, three meters long with 30 cm between rows, and plants within rows were 10 cm apart allowing a total of 30 plants per plot. Random samples of ten guarded plants were chosen at harvesting for recording grain yield /plant and seven of its attributes.

The data obtained were subjected to genetical analysis of half-diallel table as described by Mather and Jinks (1982) and Hayman (1954b).

Table (1): The six parental durum wheat cultivars and lines used in the present study during 1998/99 and 1999/2000 seasons.

Varieties or Lines	Origin	Pedigree
Beni swif 1	Egypt	Jo"s"/AA//g "s"
Sohag 3	Egypt	Mexi "s"/Mgh/51792/Durum6
Line 1	Egypt	CMH79-1168/MEXI75//OFN /50/MO /3CHEN"S" RBC//HUL "S"/TUB "S" SDD 1422-135D-25D-15D
Line 2	Egypt	CMH77.774/MEX175//CMH77.774/3/0NRAB -OSD 1-5-SDD 1441 –1SD-1SD-1SD-OSD
Line 3	ICARDA	MOJ02CD84315-4YRC-040M-030YRL 2PAP-0Y.
Line 4	ICARDA	Gediflo//krf/te//76. ICD-89-0595-0AP-0SH-0SH-8SH-8SH

RESULTS AND DISCUSSION

The estimates of genetic parameters and their ratios for various traits are presented in Table 2. The additive genetic variance (D) was found to be significant for all studied traits studied at the first location while number of grains/ear was insignificant at both locations. The estimated values of the additive variance (D) were found to be larger in their magnitudes in the first location than in the second one for most studied traits i.e., plant height, number of ears /plant, number of spikelets /ear, number of grains/ear and grain yield / plant. This findings indicate that additive genetic components fluctuated from location to another.

The presence of dominance genetic variation H1 and H2 were found to be highly significant for all traits studied under the two Locations. Moreover, the estimated values of dominance components H1 and H2 were found to be greater in their magnitudes than the corresponding additive genetic variation (D) for all traits under investigation. Similar results were previously obtained by Amaya *et al*. (1972), EL-Haddad (1974), Jain and Singh (1976). Metkees and EL- Rassas (1986), AL-Kaddoussi (1989), Mosaad *et al.* (1990) Kheiralla *et al.* (1990), Hendawy (1998) and Seleem (2001).

Table 2 Table 2c

A positive F value indicates an excess of dominant genes while a negative value indicates an excess of recessive genes. In the present investigation, the positive values of F showed that there are more dominant alleles present in the parental lines than recessive alleles, irrespective of whether these dominant alleles are increasing or decreasing in their effects for all traits studied at the two locations, except plant height, number of ears/ plant, ear length and number of spikelets/ ear, the estimated F values were found to have different signs at first and second locations, respectively, suggesting that the non-additive gene action was susceptible to environment changes and the degree of dominance or recessiveness may be determined by the growing conditions.

The overall dominance effects of heterozygous loci symbolized as (h^2) were found to be significant for plant height and number of spikelets /ear at the two locations. However, ear yield/plant and grain yield/plant at the first location and number of grains/ear and 1000-grain weight at the second location showed insignificant estimates for h^2. Similar results previously obtained by Abul-Naas *et al.* (1991) and Seleem (2001).

The average degree of dominance $(H1/D)^{1/2}$ were found to be greater than unity for all traits under investigation, indicating the presence of over-dominance for these traits at the two locations. The estimated values of $(H1/D)^{1/2}$ were found to be changeable from location to location further confirming that the degree of dominance or recessiveness would be determined by the growing conditions of the two locations. Partial dominance was previously found for plant height by Afiah *et al.,* (1999), for ear length by Mosaad *et al.* (1999), for number of grains /ear by Jatasra and Paroda (1980), for grain yield/plant by EL-Haddad and Ali (1979). Over-dominance was obtained for plant height by Ketata *et al*. (1976), Rady *et al*. (1981), Mosaad *et al.* (1990) and Eissa (1994a).

For number of ears/plant by Abul- Naas *et al.*,(1991), AL-Kaddoussi *et al.* (1994). For number of spikelets /ear by Eissa (1994a). For number of grains /ear by Al-Kaddoussi *et al.* (1994) and Eissa (1994b). For ear yield by Jatasra and Paroda (1980) and Eissa (1994a). For 1000- grain weight by Rady *et al*. (1981) and Hendawy (1998). For grain yield /plant by Eissa (1994b) and Seleem (2001).

When positive and negative genes are equally distributed in the parental cultivars, the propotion H2/H1 is expected to be 0.25. Most of the values obtained herein were found to be close to this value (Table 2). However, for ear length, number of spikelets /ear and 1000-grain weight at the first location and number of grains/ear and grain yield /plant at the second location, the estimated values of H2/4H1 were found to be below 0.25,indicating that positive and negative alleles were not equally distributed among the parents and that gene action controlling these traits was different at the two locations. Same results previously obtained by Walton (1971), Bakheit, *et al*. (1989), Abul-Nass,*et al.* (1991) and Seleem (2001).

The ratio of dominant to recessive genes(KD/KR) was found to be more than unity for all traits studied at the two locations except ear length and number of spikelets /ear at the first location, number of ears/plant at the second location and plant height at the two locations, further confirming the existance of more dominant than recessive genes in the parental cultivars as previously discussed concerning the positive value of F parameter.

Correllation coefficient between Y and (Wr+Vr) for number of ears/plant at the second location only were found to be negative and significant, indicating that this trait was controlled by more dominant genes than recessive ones. The signs of the correlation coefficient values for some traits (Table 2) were found to be different in the two locations to study which would ascertain that the dominant genes could be increased or decreased according to the growth environmental conditions at the two locations. The estimated values of correlation coefficient were found to be low for plant height, ear length, number of grains/ear,1000-grain weight and grain yield/plant at the two locations which would indicate that the dominant genes of positive and negative effects in the parental lines could be in equal proportion.

The estimated values broad sense heritability were high for all studied traits at the two locations. On the other hand, Narrow sense heritability values were low in all traits except plant height at the two locations, for ear length and number of spikelets /ear at the first location, revealing that most of the genetic variance was due to non-additive genetic effects, therefor it could be concluded that from the two analysis selection procedures which are known to be effective in shiffing gene frequency when both additive and non-additive genetic variation are involved would be successful in improving most of the traits under examination. Similar results were obtained by Ketata *et al.* (1976), Jatasra and Paroda (1980), Mahdy (1988), Mosaad *et al.* (1990), Gouda *et al*. (1993), Hassan (1993), Al-Kaddoussi *et al.* (1994) , Hendawy (1998), Seleem (2001).

Graphical analysis :

The Vr and Wr graphics were utilized for assessing the genetic architecture of the parent and predicting the further performance of the resultant crosses for all studied traits.

1- Plant height:

The graphical analysis of plant height at the two different locations are presented in Figs (1a and 1b). Both partial dominance and over dominance apparently influenced plant height at the first and second locations, respectively, since the intersection of the respective regression line was found to be above and below the origin points at the two locations. This would indicate that the degree of recessiveness and dominance might be also be determined by the environmental conditions at the two locations. The regression coefficients were significantly deviated from zero but not from unity, indicating that the gene system controlling this character could detected to be additive without the complication of non-allelic interactions. The analysis of general and relative dominance has shown that parents 2 and 4 contain a substantial excess of dominant alleles and parent 3 has the most recessive ones at the two locations. Both partial and over dominance were previously found by Hendawy (1998). However, partial dominance was reviously found by Ali and El-Haddad (1978), El-Sayed (1997), Afiah *et al*., (1999) and Seleem (2001).

2- Number of ears per plant

The Wr on Vr regression line was found to be shifted to the right of the unit slope line and below the origin point at the two locations indicating that F1 arrays on the average express over dominance (Figs 2a and 2b). The regression coefficients at the first location (L1) was significantly deviated from the value of unity which would indicate the involvement of non-allelic interaction in the performance of this trait, that the genotype 2, 4, and 6 had more number of ears/ plant than the other genotype under investigation at the two locations with different excess of dominant and recessive genes. Over dominance was also obtained by Mahdy (1988), Hendawy (1998), in the L2, Afiah *et al*. (1999) in the S2, and Seleem (2001) in the L2. However, partial dominance was found by El-Sayed (1997).

2- Ear length:

The graphical analysis of ear length is given in Figs (3a and 3b) at the first and second locations. Both partial and over dominance apparently influenced ear length in the first (L1) and second (L2) respectively, since the intersection of the respective regression line was found to be above and below the origin points at the two locations. This would indicate that the degree of recessiveness and dominance might also be determined by the environmental conditions at the two locations. The regression coefficients were found to be significantly deviated from the value of unity at the two locations, indicating the presence of non-allelic interaction in the inheritance of this trait. Partial dominance also was obtained by Hendawy (1998) in the level 1 and Seleem (2001) in the L2. However, over dominance was obtained by El-Sayed (1997) and Afiah *et al*. (1999).

4- Number of spikelets per ear.

The regression coefficients at the second (L2) was found to be significantly deviated from zero but from unity , indicating that the gene system controlling this character could deduced to be additive without the complication of non-allelic interaction. The position of the actual regression line was found to be shifted to the left of the unit slope line and above the line of unit slope. Consequently, the partial dominance along with non-allelic interaction of the complementary gene are much involved in the inheritance of this trait at the (L1). Figure 4a, indicated that over dominance played an important role in the inheritance of this trait at the second location (L2) (Fig.4b). Partial dominance was found by Hendawy (1998) and Seleem (2001) in L1 and L2.

5-Number of grains per ear:

The graphical analysis of number of grains/ear is shown in Figs (5a and 5b). The regression line shifted to the left of the unit slop line and cut Wr axis above the origin point at the first location while shifted to the right of the unit slope line and cut Wr axis below the origin point at the second location, revealing the existence of both partial and high over dominance controlling this character, at both L1 and L2, respectively. The regression coefficients at the locations were significantly deviate from the value of unity which might indicate the involvement of non-allelic interaction in the performance of this character. The relative order of the points along the regression line, indicated that parents 4, 5 and 6 had the maximum number of recessive genes and parent 3 had the maximum number of dominant genes at the two locations. Partial dominance was found by Afiah *et al*., (1999) in the S2 and Seleem (2001) in the level L1.

6-Ear yield:

The Wr on Vr regression lines was found to be shifted to the right of the unit slope line and below the origin point at the two locations indicating that F1 arrays on the average express overdominance (Figs 6a and 6b). The regression coefficient was found to be significantly deviated from zero and unity which would indicate the presence of additive and non-allelic interactions at both locations. The analysis of general and relative dominance has shown that parents 1 and 3 contain substantial excess of dominant alleles while parent 5 has the most recessive at the two locations. Over dominance also was obtained by Hendawy (1998) in the L2 and seleem (2001)in the L1, L2.

7-1000-grain weight:

The observed regression lines showed the existance of over dominance at the first location and partial dominance at the second location (Figs 7a and 7b).The regression coefficients were found to deviated significantly from unity at both locations, indicating the presence of non-allelic interactions in the performance of this trait. Over dominance also was obtained by Mahdy (1988),Al-Kaddoussi *et al.* (1994)and Hendawy (1998), while partial dominance was obtained by Abul-Naas *et al*. (1991) and Kheiralla *et al.* (1993).

8-Grain yield per plant:

The actual regression line shifted above and to the left of the unit slope line. Consequently, the partial dominance along with non-allelic interaction of the complementary genes are much involved in the inheritance of this trait at the first (L1) (Fig.8a).The position of actual regression line with respect to the timing parabola for (L2),indicated that over dominance played an important role in the inheritance of this trait at the second (L2) (Fig-8b).The regression coefficients at the first location was found to be significant from the unity, indicating the existence of non-allelic interaction of this trait at this location. Partial dominance also was obtained by Ali and EL-Haddad (1978), Abul-Naas *et al*. (1991) and Kheiralla *et al*. (1993).

Finally, it could be concluded that the analysis of the observed data from the intervarietal F1 wheat hybrids and their parental varieties enable us to suggest the importance of overdominance as a major contribution in the inheritance of plant height at L2, number of ears/plant at both L1 and L2, ear length at L2, number of spikelets /ear at L2, number of grains / ear at L1, ear yield at both L1 and L2, and grain yield /plant at L2. The experiments also demonstrated the existence of dominant genes for plant height at L1, ear length at L1, number of spikletes / ear at L1, number of grain/ear at L2,1000-grain weight at both L1,and L2 and grain yield/plant at L1.At the same time, the two genetical analyses used in this respect draw together similar and accurate picture about the gene action controlling the inheritance of grain yield/plant and its related characters.

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التحليل الوراثى والبيانى لمحصول الحبوب ومكوناتة فى قمح الديورم تحت الظروف البيئية لموقعين مختلفين

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أجرى هذا البحث بمزرعة محطة البحوث الزراعية بسرس الليان وبمزرعة محطة البحوث الزراعية بالنوبارية بغرض دراسة السلوك الوراثى ودرجة التوريث للصفات تحت الدراسة. وقد أستخدم لهذا الغرض ستة أصناف من قمح المكرونة ذات أصول متباعدة خلال موسمين متتاليين حيث تم عمل جميع التهجينات الممكنة بين الاباء خلال موسم ١٩٩٨/١٩٩٩. و فى موسم ١٩٩٩/٢٠٠٠ تقييم السلالات الابوية والهجن الناتجة فى تصميم القطاعات الكاملة العشوائية فى ثلاث مكررات وقد تم تحليل البيانات باستخدام طريقة هيمان ١٩٥٤ ويمكن تلخيص النتائج المتحصل عليها كالأتي:

١-كان التباين الوراثى (D) معنوياً لمعظم الصفات فى الموقع الاول كما وجد أن التباين الراجع إلى السيادة معنوياً H1,H2 لكل الصفات ويزيد فى كميته عن الجزء المضيف فى كلا الموقعيين مما يدل على أن الجزء الاكبر من الاختلافات الوراثية المرتبطة بهذة الصفات كان راجع إلى فعل الجين من النوع السيادى.

٢-أظهرت قيمة F اختلافات كبيرة بين الاباء فى توزيع كل من الجينات السائدة والمتنحية والتي تتحكم فى توارث الصفات وبالنسبة لكلا الموقعين .

٣-أوضحت دراسة طبيعة ودرجة السيادة إلى وجود سيادة فائقة فى كلا الموقعين لكل الصفات تحت الدراسة وكان التكرار للجينات السائدة وتلك المتنحية غير متماثلا فى الآباء لكل الصفات تحت الدراسة فى كلا الموقعين .

٤-أظهرت قيم الإرتباط بين المتوسط المظهرى للآباء ودرجة السيادة أن الجينات التى تقلل أو تزيد من ظهور الصفة وقد أختلفت فى الأشارات الموجبة والسالبة لقيم معامل التلازم فى كلا الموقعين لصفات طول النبات وطول السنبلة وعدد السنيبلات فى السنبلة وعدد الحبوب فى السنبلة .

Table (2): Components of variation and other statistics for all traits studied at the two locations.

Source of variance	Plant height cm		Number of ears/plant		Ear / length		Number of spikletes/ear	
	L1	L2	L1	L2	L1	L2	L1	L2
^D	50.444**	23.293**	3.780**	0.238	0.921**	0.160	3.521**	0.163
	7.269	3.219	1.061	0.630	0.214	0.369	0.384	0.979
^F	-30.662	-2.198	4.536	-0.448	-1.110*	0.205	-0.830	0.030
	17.759	7.865	2.592	1.538	0.522	0.902	0.937	2.390
^H1	95.754**	27.579**	13.449**	6.663**	2.510**	3.102**	5.381**	12.267**
	18.454	8.173	2.693	1.599	0.523	0.937	0.974	2.484
^H2	78.012**	26.670**	12.007**	5.928**	1.856**	2.931**	4.021**	11.265**
	16.485	7.301	2.406	1.428	0.485	0.837	0.870	2.219
^h^{2}	24.082*	20.879**	0.929	-0.201	0.443	0.594	2.811**	3.921**
	11.096	4.914	1.619	0.961	0.326	0.564	0.585	1.494
^E	2.747	1.217	0.665	0.384	0.155	0.198	0.239	0.978**
	1.378	1.088	0.401	0.238	0.808	0.140	0.145	0.370
(^H1/^D)$^{1/2}$	0.204	0.242	1.886	5.288	1.651	4.405	1.238	8.682
(^H2/4^H1)	0.639	0.917	0.223	0.222	0.185	0.236	0.187	0.230
KD/KR	0.538	-0.631	1.933	0.698	0.465	1.341	0.826	1.021
r.(Wr+Vr)Yr			-0.589	-0.840	-0.001	0.049	-0.704	0.654
H b	97.2	91.81	83.41	85.10	92.12	80.11	94.17	77.58
n.	69.7	61.00	8.55	27.57	68.46	6.33	69.61	13.02

*** and ** Significant at 0.05 and 0.01 levels of probability respectively.**
L1= first location (Sers El-laian).
L2= second location (Nubaria).

Table (2): Cont.

S.O.V.	Number of grains/ear		Ear yield		1000- grain weight		Grain yield / plant	
	L1	L2	L1	L2	L1	L2	L1	L2
^D	19.769	3.416	0.092**	0.047	0.36*	0.041	9.660*	1.462
	36.981	4.798	0.017	0.040	0.172	0.285	3.955	3.636
^F	31.365	12.713	0.019	0.053	0.579	0.138	9.987	2.431
	90.344	11.721	0.043	0.097	0.421	0.696	9.662	8.822
^H1	385.664**	51.127**	0.430**	0.857**	2.184**	1.880**	57.972**	23.336*
	93.879	12.18	0.044	0.100	0.437	0.723	10.04	9.230
^H2	339.694**	39.349**	0.372**	0.723**	1.657**	1.659*	49.097**	14.964
	83.865	10.881	0.040	0.090	0.391	0.646	8.969	8.245
^h^{2}	16.162	14.555*	0.208**	0.019	0.414	0.883	27.433**	5.398
	56.446	7.324	0.027	0.06	0.263	0.435	6.037	5.550
^E	4.913	3.663*	0.014*	0.037	0.015	0.022	4.031	1.543
	13.977	1.814	0.007	0.149	0.65	0.108	1.495	1.374
(^H1/^D)$^{1/2}$	4.417	3.869	2.16	4.288	2.463	6.758	2.450	3.996
(^H2/4^H1)	0.22	0.192	0.216	0.211	0.190	0.221	0.212	0.16
KD/KR	1.438	2.854	1.101	1.305	1.969	1.657	1.535	1.526
r.(Wr+Vr)Yr	0.192	- 0.331	- 0.425	- 0.692	- 0.591	- 0.443	- 0.412	- 0.320
H b	95.41	75.15	92.02	86.92	97.46	95.65	80.41	82.83
n.	16.06	8.41	38.17	22.72	26.38	12.46	20.77	41.20