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ESTIMATION OF COMBINING ABILITY AND GENE ACTION IN THE F1 AND F2 GENERATIONS IN SOME BREAD WHEAT CROSSES

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ABSTRACT: ***A half diallel cross among seven common wheat varieties and lines were evaluated in both F1andF2 generations at El-Gemmeiza Agriculture Research Station during three successive seasons of 2007/2008,2008.2009 and2009/2010 to study some breeding parameters for yield and eats attributes. Highly significant difference was found among genotypes, parents and crosses for most traits in both generations. The significance of mean squares indicate the presence of true differences among these genotypes. Mean squares due to parents and crosses were highly significant for most traits studied. General and specific combining ability variances were highly significant for all traits studied indicating the importance of both additive and non .additive effects in the inheritance of these traits. The parental genotypes P2and P4 showed a highly significant negative effects for days to heading, plant height in F1 and F2 generation and parent P4 showed a highly significant and positive general combining ability effects for grain yield per plant ,and no. of kernels/spike in the F2 generation proving to be a good combiner for developing cultivars having a great no. of kernels/spike and the best specific combinations for grain yield in both generation were detected in the two crosses (P1xP5) and (P1xP6) .The GCA/SCA was found to be grater than unity for all traits studied except, plant height in both generations and no. of grains per spike and 1000-grain weight in F2 indicating that additive and additive x additive types of gene effects were of greater importance in the inheritance of these traits. The dominance gene effects were larger in magnitude than the additive ones, resulting in more values of (H/D) 1/2 which were more than unity in both generations. The positive and negative alleles (H2/4H1) were approximately equally distributed among the parental genotypes.***

Low heritability values in narrow sense were detected for all traits in both generations except for days to heading in the F1generation and no. of spikes per plant in the F2 generation which gave a high heritability values. Graphical analysis revealed that the partial dominance was found for days to heading and 1000-grain weight inF1 and plant height in F1 and F2. Over -dominance played an important role in the inheritance of no. of spikes per plant, no. of grains per spike and 1000-grain weight. However, complete dominance cases for grain yield per plant in both generations were obtained. The distribution of parental arrays along the regression line was widely scatterd for all traits studied indicating genetic diversity among the parents. The relative order of

the points of the seven parents along the regression line was different according to generation.

Key Words: *Combining ability, general, specific, additive, dominance.*

INTRODUCTION

Wheat is one of the most important cereal crops in Egypt, either as a staple food for human or as a major source of straw for animal feeding. Increasing wheat production per unit area could be possible rather than increasing the area devoted for wheat production due to the limitation of both arable land and irrigation water . The main goal of the Egyptian wheat national program is to develop high yielding cultivars and this can be achieved through, genetical studies on heterosis, combining ability and genetic components for wheat genotypes in order to select superior lines characterized by better performance.

In the hybridization program, plant breeder is often confronted with the difficulty of choosing the parental lines which when crossed will yield the highest proportion of desired segregates. The evaluation of a number of promising lines for their combining ability is quite helpful in selecting those parents. Diallel analysis in F1generation have been extensively used to determine the combining ability for yield and related traits in wheat by (Khan, 1991; Asad *et al.*, 1992;Khan *et al.*,1992; Chowdhry *et al.*, 1994; Rajara and Maheshwari, 1996).All those researchers reported variable estimates of general and specific combining ability and the magnitude of additive and non-additive genetic effects for various biometric traits. Therefore, the present study was undertaken to estimate general and specific combining ability for yield and its contributing traits in some wheat crosses. This information could be of great value for establishing successful wheat breeding programme aiming to develop high yielding wheat genotypes.

MATERIALS AND METHODS

The present investigation was carried out at El-Gemmeiza Agric. Res. Station during the three successive seasons of 2007/2008, 2008/2009, and 2009/2010. Seven common wheat genotypes (*Triticum aestivum* L-em Thell) were selected for this study representing a wide range of variability. The names, pedigree and code no. for these genotypes are presented in Table (1). The seven parental wheat genotypes were crossed in a half diallel fashion to produce 21 F1's hybrid grains during the winter season of 2007/2008. In 2008/2009 season, the obtained hybrid grains from each of the twenty one crosses were sown along with their 7 parents in a randomized complete block design with three replication to be evaluate in addition to produce F1 plants which have been selfed to produce F2 grains .Each plot consisted of 2 rows for each parent and F1 hybrids. Parents were crossed again to produce more F1grains. In the third season 2009 2010, the obtained grains of the 7 parental genotypes and their 21 F2 seeds were evaluated in a randomized complete block design with three replication, each plot consisted of 2 rows for each parent and 6 rows for F2 generation. In both two seasons, each row was two meters long and 30 cm apart and plants within row was 20 cm apart. Data were recorded on 10 individual guarded plants for parents and F1's and 60 plants for F2 's in each replicate for days to heading (day), plant height (cm) ,no. of spikes per plant, no. of grains per spike, 1000-grain weight (gm) and grain yield per plant (gm). All the recommended agricultural practices for wheat production were applied.

Table (1): The name and pedigree of the studied parental bread wheat varieties and lines.

No.	Name	Pedigree
P1	Gemmeiza9	Ald"s" /Huac // CMH74A.630/Sx .
P2	Line1	COMPACT-2//SAKHA93/SAKHA61.
P3	Line2	PRINIA/BAV92//HUTTES
P4	Line3	VOROBEY
P5	Line4	TEG/GAMFRENC11/6/CMH 79.955/4/AGA/3/4*SN64/CN067//INIA 66/5/NAC
P6	Line5	BOW/GEN//DERN/3/TNMU
P7	SIDS 12	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL/4/CHAT"S"/6/MAYA/VUL// CMH74A.630/4*SX.

Statistical and genetic analysis:

The obtained data were biometrically analyzed to estimate general (GCA) and specific (SCA) combining ability using method 2 model 1 of Griffing (1956). Heterosis (H) was computed according to the formula by Bhatt (1971) as follow: Heterosis (%) over better parent =(F1-BP/BP)x100.

Differences between the parental lines and their F1 hybrids were tested for significance using L.S.D. mean values at 0.05 and 0.01 level of probability.

The data were also subjected to estimate the components of genetic variance and graphical analysis following the procedures described by Hayman (1954a). Heritability in narrow sense was estimated according to Mather and Jinks (1971) for F1's data, and Verhalen and Murray (1969) for the F2's data.

RESULTS AND DISCUSSION

The mean performance of the seven parental wheat genotypes along with their 21 F1's and F2's crosses are presented in Table (2). The parental line (P4) was the earliest in heading whereas, the cultivar Gemmeiza 9 (P1) was the latest one and the resultant combination among them (P1xP4) tended towards the latest parent. The good level of earliness was pronounced in the cross (P2xP4) in F1 and the cross (P5xP6) in F2 .The parental wheat line (P6) was the shortest in height being 92.8cm. while, the tallest parent was (P3) being 102.2cm. Meanwhile, the cross (P1xP6) gave a higher value for plant height and (P1xP4) was the shortest in F1's while, the cross (P5xP6) in F2 generation was the tallest and (P2xP7) was the shortest. In continuous, as shown in Table (2), it is worthy to note that the wheat parental line (P3) produced the greatest no. of spikes / plant while, (P4) gave the lowest value and their F1 cross (P3xP4) gave also the greatest no. of spike followed by the cross (P1xP7) in both generations. The cultivar P1 gave the lowest no. of grains / spike while, the parental genotype P7 produced the highest no. of grains/ spike in both generation as well as the two combinations (P5xP7) in F1 and (P4xP7) in F2. The parental line P2 ranked the first for 1000-kernel weight in the 1st season and P7 in the 2nd season while, the combination (P3xP7) in F1 and (P2xP3) in F2 produced the heaviest 1000-grain weight. The parental genotype (P1) in the 1st season and P2 in the 2nd season gave the highest grain yield / plant as well as the two crosses (P3xP4) in F1 and (P2xP4) in F2.

Table (2): The genotypes mean performance for all traits studied in the F1 and F2 generations.

Genotypes	Days to heading "days"		Plant height "cm"		No .of spikes/plant	
	F1	F2	F1	F2	F1	F2
p1	100.00	95.50	97.00	107.57	12.67	9.70
p2	90.67	90.10	99.53	104.67	13.87	9.17
p3	92.33	92.00	102.07	100.17	14.00	8.75
p4	88.67	88.53	96.27	104.73	8.13	8.62
p5	90.00	89.83	98.73	100.86	9.47	8.60
p6	92.00	90.17	92.84	106.97	11.42	9.43
p7	91.33	90.83	94.73	105.30	9.10	10.26
p1xp2	89.33	91.53	105.18	112.12	13.64	12.12
p1xp3	100.33	90.07	102.13	115.53	15.47	12.45
xp4	93.00	83.67	101.95	114.18	14.12	13.33
xp5	97.00	79.23	101.07	116.44	12.13	14.78
x6	95.00	88.47	105.33	114.90	16.08	14.08
x7	97.00	84.77	98.00	116.82	17.00	15.74
p2xp3	94.00	84.07	100.22	116.97	15.60	12.42
xp4	87.67	80.13	93.33	116.95	6.07	12.82
xp5	88.33	81.33	96.47	107.67	6.40	9.94
xp6	89.67	81.50	100.83	116.52	14.05	11.63
p7	92.33	80.43	99.91	89.24	13.76	10.32
p3xp4	90.00	85.83	99.33	105.08	17.59	8.61
xp5	91.00	85.33	102.47	111.12	14.17	8.22
xp6	90.67	88.37	98.00	108.22	13.47	11.17
xp7	90.00	84.53	104.27	111.77	13.47	10.85
p4xp5	92.33	81.17	99.98	112.24	12.40	9.41
xp6	90.33	84.10	101.70	109.83	12.60	8.63
xp7	90.00	82.93	103.40	109.80	14.47	8.55
p5xp6	91.33	79.40	96.15	117.97	12.82	9.72
p7	91.33	90.47	97.16	114.17	15.50	9.64
p6xp7	91.00	89.33	98.27	105.18	16.83	9.48
L.S.D.5%	1.82	5.63	6.08	2.62	7.34	1.02
L.S.D.1%	2.42	7.49	8.09	3.49	9.76	1.36

Table (2) Cont.

Genotypes	No. of grains/spike		1000-grain weight "gm"		Grain yield/ plant "gm"	
	F1	F2	F1	F2	F1	F2
p1	75.20	75.67	53.02	50.02	51.40	16.97
p2	78.00	79.18	65.99	41.91	40.80	25.41
p3	78.87	66.51	47.71	48.18	49.99	17.39
p4	83.53	79.73	65.82	52.10	41.28	20.00
p5	79.10	73.33	52.95	39.17	30.45	18.38
p6	76.09	75.80	48.57	47.05	36.37	17.30
p7	116.03	116.13	58.52	53.43	48.36	24.54
p1xp2	80.10	54.68	44.83	46.40	43.27	22.51
p1xp3	57.67	39.58	49.33	44.57	37.05	22.39
xp4	57.83	63.02	58.10	49.17	30.23	32.61
xp5	46.63	54.79	53.37	52.04	23.11	25.60
x6	88.72	51.56	43.44	50.88	59.25	30.85
X7	67.27	46.72	54.19	40.70	51.49	27.25
p2xp3	70.53	45.97	56.50	53.90	49.05	24.06
xp4	95.02	64.69	59.02	42.59	27.12	33.17
xp5	79.43	56.72	57.79	45.07	25.30	23.12
xp6	64.03	54.33	56.26	47.49	50.59	21.42
P7	82.28	54.40	55.98	41.59	57.80	20.73
p3xp4	70.50	52.02	52.29	11.25	61.57	17.96
xp5	57.20	50.63	57.33	44.20	46.09	17.25
xp6	57.65	53.93	61.45	45.43	45.16	17.08
xp7	70.00	58.85	62.64	45.30	49.69	18.08
p4xp5	79.12	57.98	59.76	46.73	47.70	22.65
xp6	79.88	59.28	58.14	47.20	51.07	17.32
xp7	58.27	66.22	57.05	46.90	38.05	23.34
p5xp6	80.17	63.61	38.72	45.17	35.42	20.23
P7	119.17	53.95	44.66	40.93	48.41	20.93
p6xp7	82.15	45.68	49.18	42.76	44.97	19.26
L.S.D.5%	22.86	9.96	7.94	5.46	19.24	3.10
L.S.D.1%	30.41	13.25	10.57	7.26	25.60	4.13

The analysis of variance for all traits studied which are presented in Table (3), showed a highly significant difference among genotypes for all traits studied in F1 and F2 generations indicating the presence of a sufficient amount of genetic variability adequate for further biometrical assessments. Mean squares due to parents and crosses were highly significant for most traits in both generations. These findings indicate that the parental lines differed in their mean performance in all traits studied. Parents vs. crosses mean squares, as an indication to the average heterosis over all the hybrids, were found to be significant for most traits in both generations except for days to heading, 1000-grain weight and grain yield/plant in the F1 generation. The analysis of variance for both general combining ability (GCA) and specific combining ability (SCA) mean squares were found to be highly significant for most traits studied in both generations which indicating to the importance of both additive and non- additive gene effects in the inheritance of the traits studied .

Table (3): The observed mean squares from analysis of variance for all traits studied in F1 and F2 generations.

Source of variation	d.f.	Days to heading " days"		Plant height "cm"		No. of spikes/plant	
		F1	F2	F1	F2	F1	F2
Rep.	2	3.7	17.62	41.16	0.188	17.53	3.027
Genotypes	27	30.4**	70.0**	33.18**	128.8**	26.229**	12.790**
Parents "P"	6	41.0**	39.8**	28.68	24.0**	16.980**	1.169*
Cross "C"	20	28.7**	44.3**	29.32*	125.1**	25.551	14.099**
P v.s C	1	0.06	764.6**	137.3**	831.6**	95.30**	56.33**
GCA	6	31.7**	25.7**	9.65	25.6**	11.53	7.24**
SCA	21	3.94**	22.6**	11.37**	47.9**	7.94	3.41**
Error	54	1.3	11.9	13.83	2.58	20.187	0.392
GCA/SCA		8.1	1.1	0.85	0.53	1.45	2.123

Table (3) Cont.

Source of variation	d.f.	No. of grain/spike		1000-grain weight(gm)		Grain yield/plant(gm)	
		F1	F2	F1	F2	F1	F2
Rep.	2	536.16	9.79	2.98	3.11	540.27	0.65
Genotypes	27	785.04**	672.67**	134.27**	46.84**	307.33**	63.06**
Parents "P"	6	626.25**	781.71**	172.36**	82.46**	178.35	37.88**
Cross "C"	20	787.93**	139.05**	125.47**	36.49**	360.12**	67.94**
P v. s C	1	1679.7**	10690.77**	81.50	40.07**	25.44	116.53**
GCA	6	354.66**	181.1**	80.95**	14.13**	135.99*	33.41**
SCA	21	235.11**	238.25**	43.41**	16.03**	92.85*	18.16**
Error	54	195.982	37.85	23.66	11.13	138.95	3.99
GCA/SCA		1.518	0.76	2.35	0.88	1.46	1.84

In this direction , GCA/SCA variances were found to be greater than unity for all traits except for plant height in both generations and no. of grains per spike and 1000- grain weight in the F2 generation indicating that the additive and additive x additive types of gene action were more important in the inheritance of traits studied. The presence of both additive and non additive gene action would suggest that the breeding procedures which are known to be effective in shifting gene frequency when both additive and non-additive genetic variance were involved which will be successful in improving the traits under study. similar results were previously obtained by Awaad ,(2001), Esmail (2002), Seleem (2006) Ashoush (2006) El-Massry (2009) And Koumber (2011). General and combining ability effects (GCA):

Estimation of general combining (GCA) of the seven wheat genotypes for the studied characters are given in Table (4). The results revealed that the parental wheat genotypes P2, P4 and P5 were the best general combiners for decreasing no. of days to heading i.e.(towards earliness) in both F1 and F2 generations. Meanwhile, the two parental genotypes P1 and P3 in both generations showed a highly GCA effects towards lateness. Recently, the wheat breeders are concern about breeding for early mature cultivars which is very important for saving water needed for irrigation, escaping from unfavorable condition like terminal heat and rust diseases in addition to its importance in case of intensive agriculture. The cultivar Gemmeiza 9 (P1) showed a positive GCA effect for plant height in both generations whereas, the two parental genotypes P2 and P7 in both generations were considered as a good combiners for plant height in the negative direction i.e. (towards shortness) and this seems to be very important from wheat breeders point of view when they breeding for wheat cultivars having a reasonable plant height and hence can response to more N fertilizers without having any lodging problems.

Table (4): Estimates of general combining ability effects for 7 parent all genotypes for all traits studied.

Traits / Parents	Days to heading		Plant height "cm"		No. of spikes plant	
	F1	F2	F1	F2	F1	F2
p1	3.910**	2.88**	1.285*	2.99**	1.014	1.868**
p2	-1.42**	-1.29*	-0.121	-1.04**	-0.822	0.207
p3	0.466*	1.262*	1.604*	-1.02**	1.456	-0.431**
p4	-1.76**	-1.75**	-0.429	-0.07	-1.238	-0.781**
p5	-0.46*	-1.56*	-0.593	0.42	-1.367	-0.687**
p6	-0.497*	0.096	-1.125	0.93**	0.448	-0.168
p7	-0.238	0.366	-0.625	-2.22**	0.508	-0.008
L.S.D(gi)5%	0.397	1.23	1.328	0.572	1.601	0.223
L.S.D(gi)1%	0.528	1.635	1.766	0.761	2.129	0.297
L.S.D(gi-gi)5%	0.607	1.878	2.028	0.874	2.446	0.341
L.S.D(gi-gi)1%	0.807	2.498	2.697	1.162	3.253	0.453

Table (4) Cont.

Traits / Parents	No. of grains/spike F1	F2	1000-grain weight "gm" F1	F2	Grain yield plant "gm" F1	F2
p1	-6.676**	-3.146**	-2.859**	1.564**	-0.194	2.071**
p2	2.078	-0.093	3.038**	-1.026	-1.578	2.146**
p3	-7.49**	-6.221**	-0.009	0.437	4.436*	-2.769**
p4	-0.111	3.632**	4.554**	1.216*	-1.184	1.171**
p5	1.247	-0.627	-1.945*	-1.958**	-6.893**	-1.109**
p6	-0.435	-1.111	-3.412**	0.326	1.141	-1.75**
p7	11.388**	7.566**	0.633	-0.56	4.272*	0.24
L.S.D(gi)5%	4.989	2.173	1.734	1.191	4.201	0.677
L.S.D(gi)1%	6.635	2.891	2.306	1.585	5.587	0.901
L.S.D(gigi)5%	7.62	3.32	2.648	1.82	6.416	1.035
L.S.D(gigi)1%	10.135	4.416	3.522	2.42	8.534	1.376

The wheat genotype Sids 12 (P7) exhibited positive general combining ability in the F1and F2 generations for no. of grains /spike proving to be a good combiner for improving these character. Meanwhile, the two parental genotypes P1 and P3 showed a significant negative GCA effects for the same character. The general combining ability effects for the remaining parental genotypes were fluctuated either in the positive or in the negative direction according to the parental genotype or the generation. The parental wheat genotype P4 showed a highly significant GCA effects for 1000- kernel weight in the F1 and F2 generation followed by P2 in the F1 only proving to be a good combiners for improving these characters whereas, P5 showed a highly significant GCA effects for 1000- kernel weight and grain yield /plant in both generations. On the other hand, the two wheat genotypes P3 and P7 were considered as a good combiners for improving grain yield/plant in F1 generation while, the genotypes P1, P2 and P4 showed a highly significant positive GCA effects in F2 generation.

It could be concluded that the mean performance of the genotypes could be considered as a good indication for their general combining ability effects for most traits studied. These results are in harmony with those previously obtained by Eissa *et al* (1994), Al-Kaddoussi, (1996), Ashoush *et al.*,(2001), Esmail (2002), Salem Nagwa and Abd El Dayem. (2006) , Seleem(2006).

Specific combining ability effects (SCA):

Specific combining ability would not contribute in the improvement of self pollinated crops except for the exploitation of hybrid wheat where non-additive genetic variability could be utilized. The results of specific combining ability effects are presented in Table (5 a & b). The greatest SCA effects for days to heading in the negative direction (i.e. towards earliness) were detected in the crosses (p1xp5), and (p5xp6) in the F2 followed by (p1xp2) and (p3xp7) in the F1 generation. The remaining crosses had either negative or positive values for specific combining ability in both generations. It is of interest to mention that the parental genotypes P2,P4 and P5, were found to be excellent combiners for earliness in both generations .The most desirable SCA effects which had a negative values for plant height were detected in the cross (p2xp4) in the F1 generation and (p2xp7),(p3xp4) and (p6xp7), in the F2 generation. On the other hand, three crosses (p1xp2),(p1xp6) and (p4xp7) showed a positive SCA effects (i.e. towards tallness) . In the F1 generation as well as 13 out of 21 crosses in the F2 generation. These results agrees with those obtained by Esmail (2002) Seleem (2006) Ashoush (2006) ,EL-Massry (2009) and Koumber (2011).

Table (5a): Estimates of specific combining ability effects for crosses studied in F1 generation.

Crosses	Days to heading "days"	Plant height "cm"	No. of spikes /plant	No. of grains /spike	1000-grain weight "gm"	Grain yield /plant 'gm'
p1xp2	-5.213**	4.5*	0.37	8.61	-9.725**	1.42
xp3	3.898**	-0.27	-0.085	-4.254	-2.185	-10.81
xp4	-1.213*	1.582	1.259	-11.466	2.029	-12.013
xp5	1.491*	0.863	-0.595	-24.025**	3.794	13.424*
xp6	-0.472	5.661**	1.54	19.74**	-4.671	14.685*
xp7	1.268*	-2.172	2.397	-13.533	2.033	3.794
p2xp3	2.898**	-0.78	1.884	-0.141	-0.905	2.574
xp4	-1.213*	-5.629**	-4.955*	16.97*	-2.948	-13.734*
xp5	0.843	-2.331	-4.493	0.021	2.317	-9.847
xp6	-0.472	2.567	1.343	-13.697	2.254	7.412
xp7	1.935**	1.147	0.993	-7.277	-2.068	11.484
p3xp4	-0.769	-1.356	4.291	2.015	-6.634**	14.703*
xp5	-1.065	1.942	0.996	-12.643	4.904	4.928
xp6	-1.361*	-1.199	-1.518	-10.512	10.488	-4.031
xp7	-2.287**	3.773	-1.578	-9.985	7.636**	-2.265
p4xp5	2.491**	1.493	1.923	1.895	2.768	12.154
xp6	0.527	3.742	0.309	4.343	2.619	7.497
xp7	-0.065	4.941*	2.116	-29.097**	-2.251	-8.66
p5xp6	0.231	-1.644	0.654	3.268	-10.302**	-2.449
xp7	-0.028	-1.137	3.278	30.444**	-8.405**	7.403
p6xp7	-0.324	0.505	2.787	-4.89	-2.424	-4.061
L.S.D.5%sij	1.155	3.861	4.656	14.509	5.042	12.217
L.S.D.1%	1.536	5.136	6.193	19.296	6.705	16.248
L.S.D.5%(sij-sij)	1.761	5.736	6.917	21.553	7.49	18.149
L.S.D.1%	2.282	7.629	9.2	28.666	9.961	24.138

*and** significant at 0.05 and 0.01 levels of probability respectively.

Table (5 b): Estimates of specific combining ability effects for crosses studied in F2 generation.

Crosses	Days to heading "days"	Plant height "cm"	No. of spikes/plant	No. of grains/ spike	1000-grain weight 'gm"	Grain yield/plant "gm'
p1xp2	3.594*	0.393	-0.589	-3.333	-0.399	-3.77**
xp3	-0.427*	3.78**	0.375	-12.302**	-3.696*	1.021
xp4	-3.817*	1.487	1.609**	1.285	0.125	7.305**
xp5	-8.439**	3.253**	2.968**	-2.686	6.176**	2.574*
xp6	-0.861	1.203*	1.745**	-5.432	2.732	8.462**
xp7	-4.831**	6.272**	3.242**	-18.949**	-6.565**	2.872**
p2xp3	-2.257	9.26**	2.006**	-8.698**	8.231**	2.616**
xp4	-3.18	8.29**	2.217**	-0.094	-3.865*	7.787**
xp5	-2.169	-1.484	-0.214	-3.808	1.789	0.019
xp6	-3.657*	6.856**	0.956**	-5.711	1.925	-1.036
xp7	-4.994**	-17.271**	-0.604	-14.319**	-3.082	-3.719**
p3xp4	-0.035	-3.606**	-0.816*	-6.64*	-3.661*	-2.509*
xp5	-0.724	1.947*	-1.297**	-3.768	-0.541	-0.936
xp6	0.654	-1.467	1.131**	0.016	-1.591	-0.465
xp7	-3.45	5.233**	0.654*	-3.744	-0.838	-1.455
p4xp5	-1.88	2.113*	0.244	-6.27	1.207	0.521
xp6	-0.402	-0.8	-1.055**	-4.493	-0.604	-4.164**
xp7	-2.039	2.316**	-1.295**	-6.23	-0.017	-0.137
p5xp6	-5.491**	6.846**	-0.06	4.095	0.537	1.022
xp7	5.306**	6.839**	-0.306	-14.239**	-2.81	-0.268
p6xp7	2.517	-3.304**	-0.979**	-22.021**	-3.271	-1.293
L.S.D.5%sij	3.576	1.664	0.649	6.321	3.465	1.97
L.S.D.1%sij	4.756	2.213	0.863	8.407	4.608	2.62
L.S.D5%(sij-sij)	5.312	2.472	0.964	9.391	5.147	2.926
L.S.D1%sij-sij	7.065	3.287	1.282	12.489	6.846	3.892

*and**significant at 0.05 and 0.01 levels of probability respectively

Regarding no. of spikes/plant ,15 crosses in F1 generation revealed positive SCA effects but did not reach the significant level while, the cross (p2xp4)showed a significant SCA in the negative direction. On the other hand, nine crosses (p1xp4), (p1xp5), (p1xp6), (p1xp7), (p2xp3), (p2xp4), (p2xp6),(p3xp6) and (p3xp7) showed a significant positive SCA effects in the F2 generation whereas, the crosses (p3xp5), (p4xp6), (p4xp7) and (p6xp7) exhibited a negative values. These results agrees with Singh (1990) and Darwish (2003) in similar studies.

The two crosses (P3xP6) and (P3xP7) exhibited a highly significant SCA effects for 1000-kernel weight in the F1 generation obtained from two types of combinations, low x low and low x medium general combiners. Meanwhile, the two combinations (P1 x P5) and (P2 x P3) in the F2 generation showed a highly SCA effects coming through either high x low or low x medium general combiners, respectively . Therefore, these crosses could be used in wheat breeding program for improving this character. These results agrees with those reported by Ashoush *et al*; (2001), Ashoush (2006), Salem, Nagwa and Abd El Dayem (2006) and Koumber (2011) .

Concerning grain yield / plant , three crosses in the F1 generation (P1 x P5), (P1 x P6) and (P3 x P4) revealed a significant positive SCA effects derived from two types of combinations, low x low or low x high general combiners. It is evident from the data that the combination between the two best general combiners P3 and P7 for grain yield /plant gave a negative specific effect .Meanwhile, the six crosses (P1xP4), (P1xP5), (P1xP6), (P1xP7), (P2xP3) and (P2xP4) exhibited a significant positive effects for grain yield / plant in the F2 generation coming through two types of combinations high x high or high x low general combiners. In conclusion, the two combinations (P1 x P5) and (P1 x P6) are considered to be the most promising hybrids for varietals improvement purpose as they showed a high significant positive values for specific combining ability effects in both generations. These results agrees with the findings obtained by Hassan and Saad (1996), Hassan (1998), Ashoush *et al*., (2001), Esmail (2002), Salem, Nagwa and Abd El Dayem., (2006) Ashoush (2006), EL Massry (2009) and Koumber (2011).

The magnitude and direction of combining ability effects are known to be useful in selecting the best parental genotypes to start with in a crop improvement programs (Mather and Jinks, 1971). In this study, crosses displaying high specific combining ability effects for most traits were derived from parents with various types of general combining ability effects (high x high), (high x low) and (low x low). The occurrence of high specific combining ability effects in crosses involving (low x low) general combining ability indicates that, the parents in such cases lacked the additive gene effects compared with high general combining ability parents. It could be concluded that general combining ability effects were generally unrelated to the specific combining ability of their respective crosses and most of the previous crosses exhibited high positive SCA effects for some yield components and could be exploited in the wheat breeding programme for improving wheat yield and the selection might be focused on maximizing genetic gain for the traits under study. The conclusion was also reached by Esmail (2002), Ashoush (2006) and Koumber(2011).

Genetic components and heritability:

Data presented in Table (6) showed that, the additive variances component (D) was significant or highly significant for days to heading in the F1 generation and no .of grains per spike in F2 generation and 1000- grain weight in both F1 and F2 generations. These results indicate that the additive gene effects were predominant in the inheritance of these traits in both generations. Highly significant values for the dominance components (H1) were obtained for all traits studied in the F1 generation. which indicate that the dominance type of gene action was the most prevalent genetic component in the inheritance of these traits. The contradiction obtained herein between (D) and GCA estimate for most traits studied could be attribute to the greatest role of both allelic and non-allelic genetic types of the expression of the traits under study .These results are in agreement with those reported by Esmail (2002) and Ashoush (2006)

Highly significant values for the dominance components associated with gene distribution (H2) were obtained for all traits studied, except for no .of spikes per plant in F1 generation. In this study, (H2) values were smaller than the (H1) values for all traits studied indicating unequal allele frequency in the parents.

Table (6): Estimates of genetic components and various ratios from Hayman's analysis in F1 and F2 for the traits studied.

Components \ Traits	Days to heading		Plant height "cm"		No. of spikes/plant	
	F1	F2	F1	F2	F1	F2
D	13.10*	8.87	4.59	7.17	0	0.23
	±2.72	±6.33	±4.69	±27.94	±324	±0.81
H1	15.27*	64.6**	33.50**	176.91*	15.67*	14.15**
	±6.56	±15.25	±11.30	±67.27	±7.81	±1.94
H2	14.29*	59.5**	28.65**	159.15*	12.08	10.12**
	±5.78	±13.42	±9.96	±59.27	±6.88	±1.71
h2	-0.17	161.9**	23.24**	154.8**	14.50**	10.7**
	±3.88	±9.02	±6.69	±39.81	±4.62	±1.15
F	-0.33	3.13	6.31	8.78	-2.36	-0.58
	±6.56	±15.20	±11.26	±67.03	±7.78	±1.94
E	0.44	4.03	4.96**	0.83	6.69**	0.13
	±0.96	±2.24	±1.66	±9.87	±1.14	±0.29
(H1/D)1/2	1.08	2.69	2.71	4.96	1.30	7.74
(H2/4H1)	0.23	0.23	0.24	0.22	0.19	0.18
K D/K R	0.98	1.07	1.34	1.15	-1.00	0.83
h2/H2	1.24	2.72	0.81	0.97	1.2	1.06
Heritability n.s	0.64	0.22	0.11	0.16	0.23	0.48

* and ** significant at 0.05 and 0.01 levels for probability respectively.

Table (6): Cont.

Traits / Components	No. of grains/spike F1	No. of grains/spike F2	1000-grain weight "gm" F1	1000-grain weight "gm" F2	Grain yield/plant "gm" F1	Grain yield/plant "gm" F2
D	139.37	248.3**	49.80**	23.87**	8.35	11.335
	±99.41	±54.78	±12.78	±7.30	±37.66	±8.58
H1	769.3**	705.6**	129.16**	66.51**	258.4**	76.908**
	±239.33	±131.87	±30.79	±17.58	±90.67	±20.656
H2	705.7**	566.2**	108.59**	44.99**	247.4**	54.727**
	±210.89	±116.2	±27.13	±15.49	±79.89	±18.201
h2	279.39*	1988.75**	11.44	5.71	-20.28	21.115
	±141.65	±78.05	±18.22	±10.41	±53.66	±12.225
F	511.61	329.89*	36.91	40.78*	-37.32	13.677
	±238.49	±131.41	±30.68	±17.52	±90.35	±20.583
E	69.38*	12.28	7.64	3.61	51.09**	1.292
	±35.15	±19.37	±4.52	±2.58	±13.31	±3.034
(H1/D)1/2	2.35	1.68	1.61	1.67	5.56	2.607
(H2/4H1)	0.23	0.20	0.21	0.17	0.23	0.178
K D/K R	1.10	1.59	1.31	1.84	0.62	1.309
h2/H2	0.39	3.51	0.10	0.13	-0.08	0.386
Heritability n.s	0.23	0.16	0.32	0.13	0.20	0.398

* and ** significant at 0.05 and 0.01 levels for probability respectively.

These findings were obtained by (Hayman, 1954 b). (H1/D)1/2 were greater than unity for all traits studied which suggest the important role of non-additve gene effect in the genetic control for yield and its attributes. Similar findings were obtained by Ashoush (2006).

The overall dominance effects of heterozygous loci (h2) were significant or highly significant for all traits studied except, for days to heading in F1 generation and 1000-grain weight, and grain yield per plant in both generations indicating that the effect of dominance was due to heterozygosity and that dominance was unidirectional with appreciable hetrotic effect. The same trend was obtained by Seleem (2006) and Ashoush (2006).

The proportion of dominant to recessive genes in parents (KD/KR)were more than unity for most studied characters indicating that dominant alleles govern these traits in both generations. Meanwhile, (KD/KR) was less than unity for no .of spikes per plant in F2 generation and days to heading and grain yield in F1 generation indicating an excess of decreasing alleles among parental genotypes. The distribution of relative frequencies of dominant versus recessive genes (F) were not significant for most traits studied in both generations except, no. of grains per spike and 1000- grain weight in F_2 generation. Thus, it could be concluded that an equality of the relative frequencies of dominant and recessive alleles were present in the parents for all traits under study. These findings were in agreement with those reported by Ashoush (1996) , Ashoush (2006) and Koumber (2011).

The weighted measure of average degree of dominance (H1/D)1/2 was more unity for all studied traits in both generations, indicating presence of over dominance for these traits. Consequently, selection for any of these traits in the early segregating generations will be useless and to improve it, indirect selection correlated with the trait in question and with a ratio of zero may be profitable. Similar results were obtained by Ashoush (2006) and Koumber (2011).

The proportion of genes with positive and negative effects in the parents (H2/4H1) were slightly below the maximum value of 0.25, indicating that the positive and negative alleles were not equal distributed among the parents for all traits in both generations .The ratio h2/H2 gave an estimate for no. of gene groups controlling a trait and exhibit dominance to some degree. In general, an under estimate quantity when the gene effects are not equal. The results in Table (6) indicate that the environmental components of variance has variable magnitudes among different studied traits .It was significantly different from zero in F2 for most traits, indicating that yield and its components were affected by environmental conditions.

Heritability estimates in narrow sense for all traits studied are given in Table (6). Low heritability values in narrow sense were detected for all traits in both generations except, days to heading in the F1 generation which had a high value indicating that most of the genetic variances are due to non-additive genetic effects. These findings support the previous results regarding genetic components in which H1 estimates played a greater role in the inheritance of these character. Therefore, the bulk method program for improving such traits might be quite promising. Thess results are in harmony with those reported by Ashoush (1996), Ashoush(2006), EL-Massry (2009), EL-Shaarawy and Koumber (2010).

Graphical analysis:

The regression of coefficient Wr/Vr relationship for the six studied characters in F1 and F2 generations are given in figures (1- 6). The regression coefficient was significantly different from zero but not from unity for the F1 and F2, indicating that additive – dominance model was

satisfactory to explain the genetic system for these traits .The regression line cuts Wr axis above the origin point for days to heading, plant height and 1000-kernels weight in F1 generation and plant height, in F2 generation, suggesting a partial dominance cases .The same conclusions were obtained from (H1/D)1/2.On the other hand, the line regression cuts Wr axis under the origin point for no. of spikes per plant , no. of grains per spike and 1000-grain weight in the F1 and F2 generations suggesting presence of over-dominance. Meanwhile; days to heading, in the F2 generation showed a complete dominance case as well as grain yield/plant in both generations. The distribution of parental genotypes along the regression lines, indicate that genetic diversity between genotypes for most the traits studied.

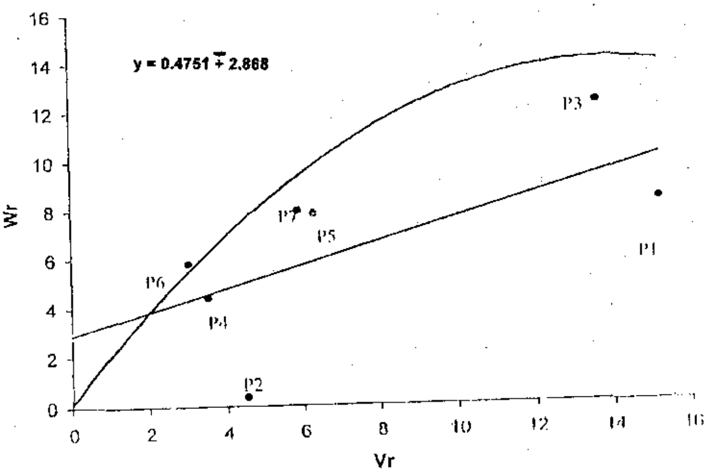

Fig. (1 a) : Vr – Wr graph for Heading date (F 1).

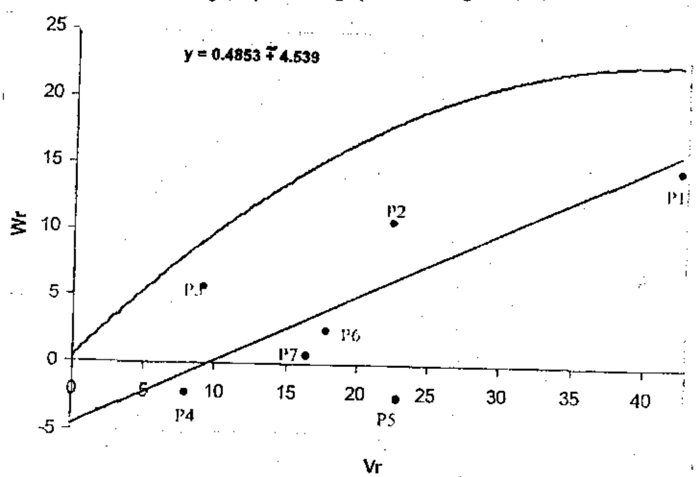

Fig. (1 b) : Vr – Wr graph for Heading date (F 2).

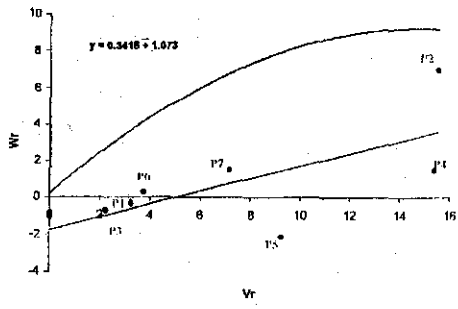

Fig. (2 a) : Vr – Wr graph for No. of spike/ plant (F 1).

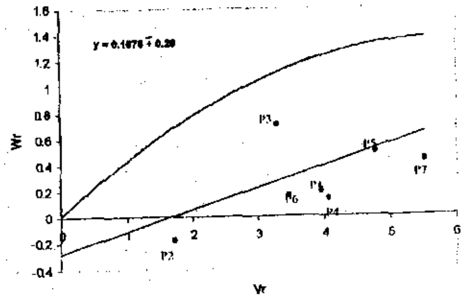

Fig. (2 b) : Vr – Wr graph for No. of spike/ plant (F 2).

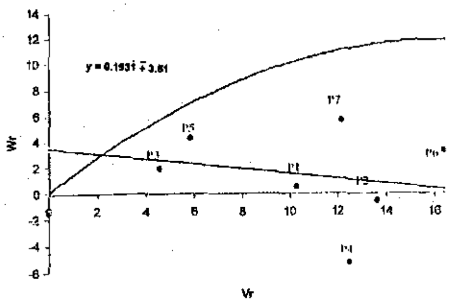

Fig. (3 a) : Vr – Wr graph for plant height (F 1).

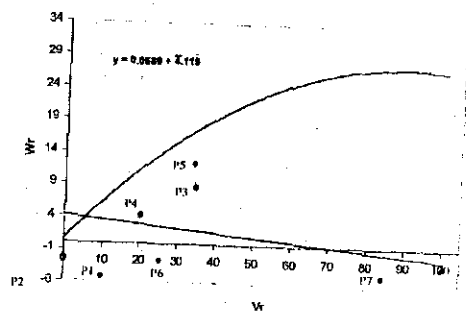

Fig. (3 b) : Vr – Wr graph for plant height (F 2).

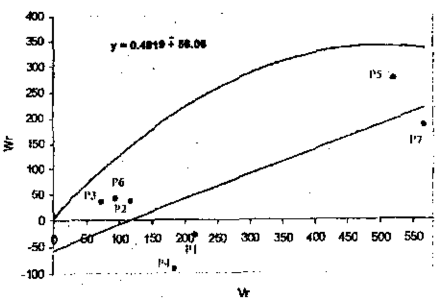

Fig. (4 a) : Vr – Wr graph for No. of grain/ spike (F 1).

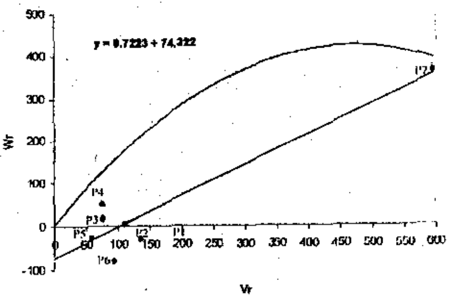

Fig. (4 b) : Vr – Wr graph for No. of grain/ spike (F 2).

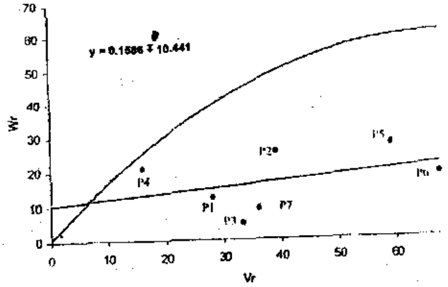

Fig. (5 a) : Vr – Wr graph for 1000 kernels weight (F 1).

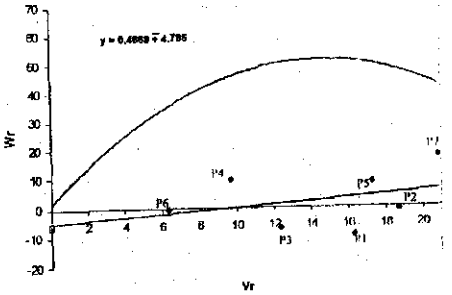

Fig. (5 b) : Vr – Wr graph for 1000 kernels weight (F 2).

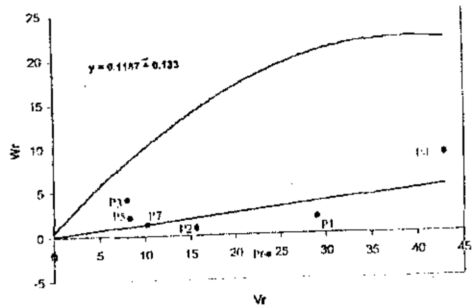

Fig. (6 a) : Vr – Wr graph for grain yield/ plnt (F 1).

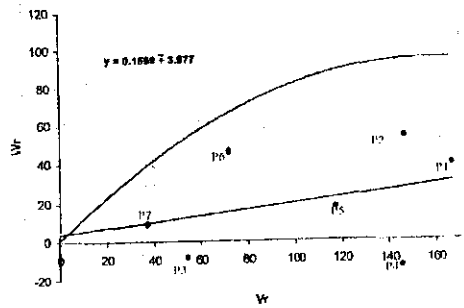

Fig. (6 b) : Vr – Wr graph for grain yield/ plnt (F 2).

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تقدير القدرة على الائتلاف والفعل الجيني للجيل الأول والثاني في بعض هجن قمح الخبز

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الملخص العربي

يهدف هذا البحث إلى دراسة القدرة على الائتلاف وتقدير الفعل الجيني للمحصول ومكوناته. ثم تقييم الهجن الناتجة من التهجين أحادي الاتجاه لسبعة أصناف وسلالات من قمح الخبز في الجيل الأول والثاني وذالك بمحطة البحوث الزراعية بالجميزة خلال ثلاث مواسم هي ٢٠٠٧ / ٢٠٠٨ , ٢٠٠٨ / ٢٠٠٩ , ٢٠٠٩ / ٢٠١٠ لدراسة بعض معايير التربية في تصميم قطاعات كاملة العشوائية ذات ثلاث مكررات لدراسة صفات عدد الأيام حتى طرد السنابل وطول النبات وعدد السنابل في النبات وعدد الحبوب في السنبلة ووزن ١٠٠٠ حبة ومحصول النبات الفردي

وكانت أهم النتائج المتحصل عليها كالتالي :

كان التباين الراجع إلي كل من التراكيب الوراثية والآباء والهجن في معظم الصفات معنويا في كل من الجيل الأول والثاني ويبين ذلك وجود اختلافات بين هذه التراكيب .

كان التباين الراجع للقدرة العامة و الخاصة علي التآلف معنويا لكل الصفات المدروسة في الجيل الأول والثاني مما يدل على أهمية كل من الفعل الجيني المضيف و السيادي في وراثة هذه الصفات.

كما كانت نسبة القدرة العامة علي القدرة الخاصة تزيد عن الوحدة في معظم الصفات مما يدل علي أهمية الفعل الجيني المضيف وكذا غير المضيف .

أظهرت الآباء رقم٢،٤تأثير سالب ومعنوي لصفات عدد الأيام حتى طرد السنابل وطول النبات في كل من الجيل الأول والثاني يستفاد بها في الحصول علي تراكيب وراثية مبكرة وذات

طول مناسب وكذا الأب رقم٤ ذات قدرة ائتلاف عالية لصفات محصول النبات وعدد الحبوب في السنبلة ويمكن الاستفادة به في تحسين هذه الصفات في برامج التربية. وكان الهجين(P1xP6) من أفضل الهجن لغرض تحسين محصول الحبوب حيث أنها أعطت قدرة ائتلاف خاصة عالية فى كل من الجيل الأول و الثاني.

كان التباين الراجع للتأثر السيادي معنويا لكل الصفات في كلا الجيلين أكثر من التأثير المضيف كما أوضحت الدراسة أن توزيع الجينات الموجبة والسالبة كانت غير منتظمة في الجيلين.

أوضحت النتائج أن درجة التوريث بمعناها الضيق كانت منخفضة في معظم الصفات في كلا الجيلين ماعدا صفة عدد الأيام حتى طرد السنابل في الجيل الأول وعدد السنابل فى النبات في الجيل الثاني كانت عالية .

أظهر تحليل التباين وجود سيادة جزئية لصفة عدد الأيام حتى طرد السنابل ووزن ١٠٠٠ حبة في الجيل الأول وطول النبات في الجيل الأول و الثاني أما السيادة الفائقة كان لها دور مهم في وراثة عدد السنابل علي النبات وعدد الحبوب في السنبلة بينما أظهر محصول الحبوب للنبات سيادة تامة في كل من الجيل الأول والثاني .