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ESTIMATION OF COMBINING ABILITY FOR YIELD AND ITS COMPONENTS IN BREAD WHEAT (*Triticum aestivum* L.) USING LINE × TESTER ANALYSIS.

A. M. Moussa and A.A. Morad
Wheat Research Department, Field Crops Research Institute, A.R.C. Egypt.
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ABSTRACT: *Twenty bread wheat genotypes were evaluated to estimate general and specific combining ability for some quantitative characters in bread wheat at El- Gemmeiza Agricultural Research Station during the two successive seasons 2006/2007 – 2007/2008. These genotypes were crossed with four local wheat cultivars Gemmeiza 9, Gemmeiza 10, Sakha 94 and Giza 168 as a testers (T1, T2, T3 and T4, respectively) produce eighty crosses using line × tester analysis. The characters studied were; number of days to heading, number of days to maturity, plant height, number of spikes /plant, number of kernels/spike, kernel weight and grain yield / plant. The genotypes (parents and crosses) exhibited highly significant variation for all characters studied indicating the presence of genotypic differences among these twenty four genotypes under investigation. The mean squares of parent vs. crosses was highly significant for all characters . Further, partitioning of crosses mean squares i.e., line × tester mean squares were highly significant for all characters studied. The G.C.A./S.C.A. ratio exceeded the unity for most characters studied except for heading date and kernel weight indicating that, additive genetic variance was predominantly controlling the inheritance of these traits. The parental lines 11, 12 and 16 and testers Gemmeiza 9 and Gemmeiza 10 (T1 and T2, respectively) might be selected as a parental materials for wheat breeding programs. Moreover, lines number 11 and 12 had the highest general combining ability for all traits except for , plant height and kernel weight. There lines and testers which showed combining ability for grain yield were also good combiners for at the least one of the yield components.*

Key Words: *Bread wheat, Combining ability, Line × tester analysis, additive, and non-additive*

INTRODUCTION

Bread wheat (*Triticum aestivum* L.) is one of the major crops which is widely grown not only in Egypt but also through out the world as a prime food cereal. Increasing wheat production to narrow the gap between production and consumption is considered one of the main goals of Egyptian wheat breeders as well as in most countries all over the world, Shehab El-Din (1993).

Combining ability analysis has been used extensively in cross pollinated crops to classify the parental lines in terms of their ability to combine hybrid combination. In self pollinated crops like wheat, combining ability analysis could be useful in giving a good idea about the relative magnitude of additive and non-additive types of gene action in the trait expression . Moreover, it seems of special interest that some commercial cultivars which have the best agronomic characters, yet they combine very poorly when used as parents. Therefore, this will be helpful in choosing parents in the hybridization program.

General and specific combining ability were estimated by several wheat workers (Brown *et al*, 1966; Mani and Roa, 1977; Singh *et al*, 1982; Bhuller *et al*, 1988 and Abd El- Rahman 1991). These studies, in general , indicated that the major part of the total genetic variation for yield was associated with general combing ability effects, which measure additive genetic variance when the parents are randomly chosen. On other hand, specific combing ability measures non- additive genetics variance.

The line x tester analysis was used to estimate both general and specific combining ability effects for yield and its components in wheat by several authors such as Hassan and Abd El-Moniem (1991); Salem and Hassan (1991); Singh *et al* (1994); Gupta and Ahmed (1995); Hamada *et al* (2002); Moussa (2005) ; Seleem and El-Sawi (2006) and Koumber (2007). Most studies on wheat revealed that, general combining ability (G.C.A.) was more important than specific combining ability (S.C.A.) for, number of spikes/plant (Al- Koddossi and Hassan 1991) and Eissa (1993). However, (G.C.A.) and non-additive (S.C.A.), effects were observed for, grain yield / plant , number of kernels / spike, kernel weight and number of tillers/ plant, (Saadalla and Hamada 1994 and Chowdhry *et al* (1996). On the other hand, El- Beially and El- Sayed (2002) concluded that, mean square associated with (G.C.A.) and (S.C.A.) were significant for; heading date, plant height, number of spikes /plant, number of kernels / spike, kernel weight and grain yield /plant. So line x tester is used here in order to evaluate twenty parents along with four testers for general and specific combining ability.

MATERIALS AND METHODS

The present investigation was carried out at El- Gemmeiza Agricultural Research Station during the two successive seasons, 2006/2007 and 2007/2008, to estimate some breeding parameters in bread wheat for grain yield and its contributing traits using line × tester analysis . In 2006/2007 season , twenty bread wheat genotypes (L) were crossed with four local wheat cultivars, Gemmeiza 9, Gemmeiza 10, Sakha 94 and Giza 168 as testers (T) to produce 80 crosses. The pedigree of the parental genotypes are presented in Table (1).

In 2007/2008 season, the 80 F1 crosses and their parental genotypes were evaluated for grain yield and its contributing characters using a randomized complete block design with three replications. Each plot included three rows, 3m. long and 30cm. apart and plants were spaced at 10cm. within row for each genotype studied. The recommended agricultural practices were applied at the proper time. Data were recorded on ten individual guarded plants from each parental genotypes and their resultant F1's for the following characters: number of days to heading, number of days to maturity, plant height, number of spikes /plant, number of kernels /spike, 1000-kernel weight and grain yield /plant.

The obtained data were subjected to study combining analysis using the procedure of line × tester analysis as outlined by Kempthorne (1957). General and specific combining ability variances were estimated as described by Mather and jinks (1982).

Table (1): Name and pedigree of wheat parental genotypes.

Genotypes	Pedigree
Lines	
1	MILAN
2	Kauz*2/TRAP//KAUZ
3	Cham4//Vee's'/Snb's'
4	IRENA
5	PBW343
6	CHAM-6/MAYON"s"
7	PRL "s"/Toni//Attila
8	ATTILA*2/PBW65
9	W W 33/Vee"s"/AU/UP301/Bow"s"/4/Jup/Bjy"s"//URES/3/Vee"s"//Top-Sannine/Ald"s"
10	SAKHA 12/5 /KVZ//CNO 67 /PJ 62/3/YD"S"/BLOS"s"/4/K 134 (60)/ VEE
11	TOTA/JAR(2F5/2F2**)IN*TGLR**CNO"S" PJ62JAR"S")2F1/7/BL1133/3/CMH79A.995*/CNO79//CMH79A.955/BOW"S"
12	MILAN /MUNIA
13	MILAN / DUCULA
14	SW89.5193/KAUZ
15	WEAVER/4/NAC/TH.AC//3*PVN/3/MIRLO/BUC
16	OTUS/TOB97
17	MAI "s" / PJ / ENU "s" /3/ KITO /POTO19//MO/GUP/4/K134(60) / VEE
18	KVZ /4/ CC / INIA /3/ CNO // ELGAU / SON 64 /5/ SPARROW / " s" / BROCHIS "s" /6/ BAYA "s" / IMU
19	Buc//7C/Ald/s/MAYA 74/On//1160.147/3/Bb/GLL/4/Chat"S"/6/MAYA/VUL//CMII74A.630/4*SX.
20	KVZ/CMH 82-493//COMPACT*4/3/GEM# 7
Testers	
1	Gemmeiza # 9
2	Gemmeiza # 10
3	Sakha # 94
4	Giza # 168

RESULTS AND DISCUSSION

Analysis of variance

The mean performance of lines, testers and crosses for all traits studied are presented in Table (2).The analysis of variance for all traits studied are presented in Table (3).Genotypes i.e. Parents and crosses were found to be highly significant for all traits studied , indicating the presence of genetic differences among these twenty four genotypes under investigation. Data in Table (3) showed that, mean squares of parents vs. crosses were highly significant for all characters illustrating the wide range of heterosis values among the hybrids for all studied traits. Further more, partitioning of crosses mean squares i.e., line × tester analysis indicated that, the difference due to both lines and testers were highly significant for all characters studied. The contribution of lines × testers interaction was highly significant for all traits studied. Also, the results in Table (3) revealed that GCA/SCA ratio exceeded the unity for all traits except for heading date and 1000-kernel weight , indicating that GCA variance was more important than SCA variance and that the additive variance was the predominant variance component controlling the inheritance of all studied traits, except heading date and 1000- kernel weight. It is evident that the presence of large amount of additive effects suggests the potentiality for obtaining high yield and yield components and for improving these components. Also, selection procedures based on the accumulation of additive gene effect would be successful in improving all characters studied. The obtained results are in harmony with those previously reported by Bhullar *et al* (1981), Srivastava *et al* (1982), Qualser *et al* (1985), Al- Kaddoussi *et al* (1994), El- Adle *et al* (1996), Hamada *et al* (2002) and Koumber (2007).

The concept of combining ability has become increasingly important in plant breeding. It is especially useful to study and compare between the performance of lines in hybrid combination. Combining ability has been proved by many workers to be an inherited character. Moreover, it looks to be of special interest in a way that some commercial cultivars, deposit of being the best in their agronomic characters, yet they are low combiners when used as a parent. Meanwhile, because of difficulties caused by correlation of genes in the parents, genetic interpretation of statistics may be attempted only to show that the information is useful in measuring hybrid performance or in assessing potentialities of hybrid breeding program Baker (1978). It is worth to mention that , the proportional contribution of the lines, testers and their interaction to the studied characters varied from 22.20% of the total variation of the studied crosses for plant height to 69.75% for number of spikes /plant. However, the highest contribution value for the studied testers was 6.10% for plant height. The proportional contribution of line ×tester to the total variation ranged from 12.33% for number of days to maturity to 71.69% for plant height.

Table (2): Mean performance of lines, testers and crosses for all traits studied.

Genotypes	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
L1 X T1	106.0	152.3	107.1	15.1	69.9	47.3	34.0
T2	109.0	154.3	97.2	18.8	73.5	44.3	34.6
T3	107.0	152.7	104.8	16.9	80.0	42.7	35.3
T4	103.7	154.0	102.0	16.3	72.3	41.2	35.0
L2 X T1	101.3	150.7	106.1	16.9	70.2	48.0	43.8
T2	102.7	151.3	98.8	15.2	71.4	47.5	37.7
T3	97.0	150.7	103.3	16.7	82.4	47.8	48.1
T4	99.0	146.3	103.7	14.8	69.9	46.8	34.5
L3 X T1	106.0	153.0	109.9	15.5	88.1	44.5	35.0
T2	104.7	154.0	103.3	25.3	85.3	44.7	46.5
T3	104.7	151.7	105.9	26.6	80.3	40.7	51.3
T4	102.0	153.7	105.8	14.1	78.7	39.8	41.5
L4X T1	100.7	152.7	111.7	13.1	89.9	49.1	39.1
T2	103.0	153.3	98.8	13.5	82.4	46.7	32.2
T3	100.3	149.0	108.5	16.5	84.0	49.2	47.3
T4	99.7	152.7	103.1	12.4	82.5	45.9	31.7
L5 X T1	101.7	150.0	109.3	14.3	69.3	51.5	35.7
T2	101.7	149.3	104.1	17.3	69.3	48.6	33.9
T3	97.7	146.0	109.6	13.3	73.9	51.6	31.1
T4	95.0	149.3	106.1	18.6	69.7	50.4	50.5
L6 X T1	109.7	155.7	101.4	21.2	74.4	43.9	35.4
T2	106.3	155.7	98.0	17.9	73.9	40.0	29.6
T3	106.7	153.3	105.2	18.6	71.7	46.8	39.4
T4	101.7	154.3	102.2	18.0	72.3	42.0	34.7
L7 X T1	100.7	149.7	115.3	14.9	72.1	53.0	34.9
T2	102.0	151.0	111.8	16.0	67.0	50.9	36.2
T3	96.7	148.7	118.1	24.8	89.9	50.4	65.4
T4	95.3	150.3	114.2	16.1	84.5	50.3	44.0
L8 X T1	104.3	153.0	108.0	16.2	63.9	51.0	30.3
T2	104.0	151.3	104.5	18.7	79.3	45.7	43.1
T3	101.0	149.3	108.4	17.1	69.9	46.7	37.7
T4	100.7	151.0	107.6	13.5	73.7	45.9	28.5
L9 X T1	96.3	147.3	112.5	11.9	77.5	51.1	32.6
T2	94.7	146.7	107.5	13.0	67.6	50.2	33.9
T3	95.7	146.3	112.3	13.3	81.8	52.0	37.7
T4	94.7	147.7	108.5	12.5	78.1	50.2	37.6
L10X T1	94.3	148.0	106.9	14.3	60.7	46.6	32.7
T2	92.0	148.7	101.8	14.5	71.9	52.9	40.8
T3	91.0	148.3	101.1	16.3	81.4	48.4	45.5
T4	90.7	149.0	101.6	13.8	73.5	49.2	35.4
L11 X T1	95.0	150.3	107.9	16.7	73.3	46.5	38.8
T2	94.7	150.7	103.7	26.1	72.9	49.6	60.3

Table (2) : Cont.

Genotypes	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
T3	95.3	152.7	107.1	27.6	81.9	48.8	84.2
T4	94.3	154.3	105.7	32.0	91.0	48.1	68.3
L12 X T1	103.7	155.0	98.9	35.0	91.0	44.9	70.8
T2	105.3	154.0	105.6	34.6	77.4	43.5	77.2
T3	105.0	154.3	106.4	28.6	76.9	44.1	69.6
T4	99.3	153.3	105.3	21.8	89.8	43.4	54.3
L13 X T1	105.7	154.3	106.4	18.9	70.7	51.4	42.0
T2	105.0	152.3	97.3	13.9	63.3	45.8	24.1
T3	103.3	149.3	105.1	15.5	68.9	51.7	40.3
T4	100.0	150.7	106.7	16.9	72.5	44.1	35.5
L14 X T1	101.7	148.3	109.5	13.1	85.5	49.4	35.2
T2	102.3	150.3	99.3	15.3	77.7	45.1	41.0
T3	98.3	147.0	110.6	8.8	77.7	49.4	26.9
T4	96.3	147.0	109.8	13.3	76.8	46.3	36.2
L15 X T1	100.0	152.0	110.5	16.5	76.2	42.5	30.3
T2	102.0	153.3	102.0	20.1	80.8	42.0	38.9
T3	101.7	149.3	109.3	15.9	78.8	47.9	38.7
T4	98.3	152.3	105.1	13.3	72.7	41.7	27.3
L16X T1	98.0	148.3	112.8	14.8	75.8	49.3	39.8
T2	96.0	149.7	105.7	19.7	84.5	43.4	48.1
T3	100.0	149.0	107.3	17.7	78.5	46.9	45.1
T4	96.3	148.0	109.5	16.3	77.3	44.2	45.3
L17 X T1	94.3	146.3	111.2	16.0	69.1	55.7	41.8
T2	91.0	146.3	107.5	17.3	73.6	52.8	51.1
T3	93.0	145.0	109.1	16.1	74.4	53.5	44.0
T4	89.0	144.3	106.5	15.4	63.9	47.4	37.5
L18 X T1	91.7	146.0	110.9	13.2	69.0	45.1	39.7
T2	91.7	145.0	108.2	13.9	65.4	48.2	39.1
T3	91.7	142.3	109.5	14.3	68.6	45.0	34.4
T4	90.3	143.0	106.1	13.9	73.4	51.2	42.3
L19 X T1	95.3	148.0	106.9	13.9	88.5	49.8	47.9
T2	103.3	151.0	102.2	13.4	105.2	48.4	55.5
T3	99.3	150.0	104.4	15.5	95.7	47.5	46.0
T4	96.3	149.7	105.2	13.3	99.3	49.9	43.7
L20 XT1	98.3	150.7	104.3	13.0	70.2	48.7	42.5
T2	99.0	151.0	102.3	16.9	77.3	52.4	50.6
T3	99.3	150.3	106.2	15.9	84.5	54.4	43.7
T4	96.0	152.0	106.3	17.2	81.7	49.4	68.7
L1	106.0	152.0	103.2	18.0	60.1	44.4	33.6
L2	99.3	147.3	96.2	14.0	76.1	46.9	29.1
L3	108.3	152.7	108.1	13.4	78.9	39.9	22.6
L4	95.7	148.0	102.7	11.7	86.7	46.9	38.1
L5	99.7	147.7	102.8	18.6	76.7	48.8	38.9

Table (2) : Cont.

Genotypes	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
L6	110.0	158.7	99.8	16.5	59.1	36.8	25.0
L7	98.3	146.3	114.7	13.0	77.6	50.6	32.1
L8	99.7	147.3	107.8	14.7	72.6	41.7	32.0
L9	90.0	141.0	114.5	12.0	61.7	51.9	36.8
L10	84.3	142.0	105.1	9.9	60.1	44.9	23.8
L11	82.3	139.0	105.3	12.1	56.5	47.4	25.4
L12	96.3	145.7	108.2	17.3	66.7	46.3	39.6
L13	103.3	148.7	103.9	20.1	69.3	50.6	38.9
L14	97.3	144.0	103.5	16.1	97.5	50.3	54.5
L15	102.7	152.7	100.3	14.4	84.7	44.7	30.5
L16	100.7	146.0	102.6	15.2	88.7	45.3	39.1
L17	84.3	138.0	102.3	12.4	56.3	44.5	33.5
L18	85.3	138.7	103.6	13.1	54.4	46.7	34.4
L19	94.7	143.7	104.4	8.9	97.0	44.0	38.7
L20	89.7	141.7	94.5	6.5	78.0	51.8	25.7
T1	105.7	154.0	107.4	19.3	106.5	48.2	50.1
T2	107.3	153.7	90.9	21.4	79.8	41.7	36.2
T3	101.3	146.7	106.9	15.9	83.9	49.0	46.7
T4	95.7	150.3	102.1	17.5	86.3	38.3	39.0
L.S.D5%	8.5	2.0	n.s	7.4	n.s	6.1	19.0
L.S.D1%	11.4	2.6	n.s	10.0	n.s	8.2	25.5

Table (3): Mean squares for number of days to heading and maturity as well as yield and its components, and their contribution to the total variation.

Source of variation	df	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
Rep.	2	68.000**	2.750	2672.875**	201.656**	2726.875**	219.344**	1044.859**
Genotypes	103	123.811**	46.044**	4693.280**	68.099**	1883.269**	41.638**	381.907**
Parents	23	191.283**	86.277**	86.516**	39.270**	7544.400**	50.176**	194.038**
Crosses	79	104.206**	27.146**	6032.741**	73.341**	210.081**	37.748**	406.283**
Lines	19	283.987**	93.868**	5569.448**	212.701**	555.632**	104.852**	1060.850**
Testers	3	116.500**	32.167**	9692.417**	60.109**	174.583**	58.271**	430.771**
LinesxTesters	57	43.632**	4.640**	5994.557**	27.584**	96.765**	14.299**	186.805**
P vs crosses	1	120.750**	613.625**	4831.375**	317.069**	3859.188**	152.641**	2777.219**
Error	206	27.382	1.456	5007.094	21.136	1636.938	14.406	137.493
GCA		5.330	1.980	3.360	4.030	9.970	2.060	19.320
SCA		5.416	1.061	2.916	2.149	5.138	3.553	16.437
GCA/SCA		0.984	1.866	1.152	1.875	1.940	0.580	1.175
Proportional contribution to the total variation								
Contribution of lines	-	65.544	83.166	22.204	69.751	63.610	66.806	62.799
Contribution of testers	-	4.245	4.500	6.101	3.112	3.156	5.862	4.026
Contribution of line x testers	-	30.210	12.334	71.695	27.136	33.234	27.332	33.175

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

General combining ability effects

Estimates of the general combining ability effects (GCA) for the four testers and twenty lines for the seven traits studied are presented in Table (4). High positive values of general combining ability effects would be of interest in most traits, while, for heading date, maturity date and plant height , high negative values would be useful from the plant breeder point of view. The results revealed that lines number 9, 10, 11, 16, 17 and 18 are considered as good donors for earliness, while, 5, 9, 10, 14, 16, 17 and 18 are good for early maturing and 2, 3, 4, 5, 8, 9, 10, 11, 12, 13, 15, 19 and 20 for the shortness. On the other hand, wheat lines number 3, 11 and 12 showed desirable general combining ability effects for number of spikes/plant and lines number 3, 4, 11,12,14 and 19 for number of kernels /spike. Obviously, wheat lines number 5, 7, 9, 17 and 20 showed desirable general combining ability effects for kernel weight. Concerning grain yield /plant wheat lines number 11,12 and 20 were good donors . The tester cultivars Gemmeiza 9, Gemmeiza 10 and Sakha 94 (T1, T2 and T3, respectively) were good combiners for heading, maturity dates and plant height, While, the testers Sakha 94 and Giza 168 (T3 and T4, respectively) were good combiner for, number of kernels/ spike and grain yield /plant and T4 was good combiner for 1000-kernel weight.

Table (4): Estimation of General Combining Ability (G C A) effects for heading , maturity date, yield and yield components.

Genotypes	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
L1	7.525**	3.092**	25.550**	-0.299	-3.068**	-3.693**	-7.553*
L2	1.108	-0.492	-10.150	-1.169	-3.509**	-0.284	-1.236
L3	5.442**	2.842**	-6.908	3.317*	6.107**	-5.143**	1.324
L4	2.025	1.675**	-16.200	-3.183	7.715**	0.136	-4.691
L5	0.108	-1.575**	-5.867	-1.191	-6.451**	2.929**	-4.471
L6	7.192**	4.508**	38.567**	1.851	-3.926**	-4.383**	-7.501*
L7	-0.225	-0.325	1.750	0.876	1.390	3.606**	2.855
L8	3.608*	0.925**	-5.983	-0.708	-5.318**	-0.226	-7.377*
L9	-3.558*	-3.242**	-2.917	-4.383	-0.759	3.328**	-6.800*
L10	-6.892**	-1.742**	-10.267	-2.358	-5.134**	1.711	-3.652
L11	-4.058**	1.758**	-7.033	8.842**	2.790*	0.683	20.645**
L12	4.442**	3.925**	-9.083	12.942**	6.765**	-3.595**	25.707**
L13	4.608**	1.425**	-9.233	-0.799	-8.151**	0.707	-6.784*
L14	0.775	-2.075**	-5.817	-4.433	2.449*	-0.467	-7.457*
L15	1.608	1.508**	-6.383	-0.616	0.132	-4.015**	-8.461*
L16	-8.058**	-1.492**	-4.283	0.755	2.024	-1.606	2.324
L17	-7.058**	-4.742**	-4.542	-0.883	-6.743**	4.805**	1.343
L18	-7.558**	-6.158**	-4.433	-3.249	-7.901**	-0.180	-3.390
L19	-0.308	-0.575	-8.433	-3.016	20.174**	1.332	6.038
L20	-0.725	0.758*	-8.333	-1.316	1.415	3.680**	9.137**
T1	1.342*	0.342*	-6.470	-0.837	-1.723**	0.895	-3.140*
T2	0.275	0.725**	19.040**	0.997	-1.025*	-0.429	0.453
T3	0.342	-0.975**	-5.503	0.726	2.057**	0.719	3.326*
T4	-1.958**	-0.917**	-7.067	-0.886	0.690	-1.185*	-0.639
L.S.D5%line	2.961	0.683	20.37	2.601	2.289	2.147	6.634
L.S.D1%line	3.891	0.897	32.616	3.418	3.008	2.822	8.719
L.S.D5%tester	1.324	0.305	10.905	1.163	1.024	0.960	2.967
L.S.D1%tester	1.740	0.401	13.530	1.529	1.345	1.262	3.899

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

Specific combining ability effects

Data presented in Table (5) showed that, most hybrids exhibited significant and positive specific combining ability effects for yield and yield component traits, while, for heading date, maturity date and plant height, hybrids exhibited significant negative values. Two, six and nineteen out of eighty parental combinations exhibited significant negative effects for heading date, maturity date and plant height, respectively Earliness, if found, in wheat is a favorable for escaping from destructive injuries by stress conditions and for intensive production and for escaping from the stem rust. Four, twelve, one and four crosses had significant positive specific combining ability effects for number of spikes / plant, number of kernels /spike, kernel weight and grain yield / plant, respectively.

It could be concluded that, parents Gemmeiza 10 and Sakha 94 might be selected as parental materials for wheat breeding programs since they are considered as a good combiners for heading date, maturity date and plant height, while, Gemmeiza 9 and Giza 168 are considered as good combiners for number of kernels/ spike, as well as kernel weight and Sakha 94 was considered as a good combiner for grain yield. The line number 11 had highest general combining ability effects for number of days to heading , plant height, number of spikes/ plant, number of kernels / spike and grain yield / plant.

The results obtained herein concerning general and specific combining ability effects could be indicate that, excellent hybrid combinations were obtained from the three possible combinations between the parents of high and low general combining ability effects i. e. high×high, high ×low and low ×low. It could be concluded that, (GCA) effects were generally unrelated to the (SCA) of their respective crosses.

Therefore, from these results it may be concluded that, the selection of parents would be more profitable to select first on the basis of their general combining ability, and further selection might then be guided by evaluation of the specific combining ability effects. This conclusion was previously drawn by Hendawy (1994), Hewezi (1996), Koumber (2005), Hamada *et al* (2002), Koumber and El- Beially (2005), Moshref (2006) , Esmail (2007), Koumber (2007) and Hendawy (2008).

Table (5): Estimation of specific combining ability (S C A) effects for heading, maturity, yield and yield components.

Genotypes	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
L1 X T1	-1.758	-1.342	-6.513	-0.863	-2.277	2.522	2.409
T2	2.308	0.275	20.309**	1.069	0.591	0.862	-0.560
T3	0.242	0.308	-6.840	-0.625	4.009	-1.869	-2.747
T4	-0.792	0.758	-6.957	0.419	-2.324	-1.515	0.898
L2 X T1	-0.832	0.575	9.570	1.829	-1.535	-0.390	5.909
T2	2.392	0.858	-23.207**	-1.693	-1.067	-0.377	-3.824
T3	-3.342	1.892**	5.870	0.770	6.851	-0.464	3.796
T4	0.958	-3.325**	7.767	-0.211	-4.249	0.477	-5.882
L3 X T1	0.325	-0.425	10.128*	-4.013	6.748**	1.201	-5.398
T2	0.583	0.192	-21.982**	3.886	3.183	2.678	2.422
T3	-0.833	-0.442	5.195	5.491*	-4.832*	-2.470	4.425
T4	-0.375	0.675	6.658	-5.364*	-5.099*	-1.409	-1.449
L4X T1	-1.592	0.408	-13.247*	0.866	6.939	0.466	4.700
T2	1.808	0.692	-17.157**	-1.347	-1.292	-0.610	-5.856
T3	-0.925	-1.942**	17.120**	1.858	-2.774	0.794	6.424
T4	0.708	0.842	13.283*	-0.597	-2.874	0.651	-5.267
L5 X T1	1.325	0.992	8.487	-0.705	0.506	0.727	1.067
T2	2.392	-0.583	-22.223**	0.428	-0.192	-1.490	-4.346
T3	-1.675	-1.692*	7.853	-3.334	1.259	0.358	-10.036
T4	-2.042	0.758	5.883	3.611	-1.574	1.059	13.316*
L6 X T1	2.242	0.575	-6.385	3.087	3.081	-0.211	3.781
T2	-0.025	0.192	18.728**	-2.047	1.883	-2.768	-5.605
T3	0.242	-0.442	-6.098	-1.042	-3.465	2.940	1.268
T4	-2.458	-0.325	-6.245	2.796	-1.499	0387	0.557
L7 X T1	0.658	-0.592	6.937	-2.172	-4.535	0.923	-7.069
T2	3.058	0.358	-22.107**	-2.972	-10.40**	0.206	-9.389
T3	-2.342	-0.275	8.770	6.133*	9.484**	-1.498	16.931*
T4	-1.375	0.508	6.400	-0.989	5.451*	0.359	-0.473
L8 X T1	0.492	1.492*	7.337	0.678	-6.094**	2.771	-1.450
T2	1.225	-0.558	-21.640**	1.311	8.608**	-1.178	7.724
T3	-1.842	-0.858	6.770	0.161	-3.807	-1.370	-0.526
T4	0.125	-0.750	7.533	-2.006	1.292	-0.222	-0.575
L9 X T1	-0.342	-0.833	8.803	1.996	3.014	-0.693	0.249
T2	-0.942	-1.058	-21.773**	-0.680	-7.617**	-0.269	-2.007
T3	-0.833	0.308	7.570	-0.755	3.468	0.432	-1.050
T4	1.292	0.758	5.400	0.736	1.134	0.530	2.808
L10X T1	0.992	-0.842	10.520*	0.462	-9.477**	-3.612	-2.755
T2	-0.275	-0.558	-20.090**	-1.239	1.024	4.051	1.735
T3	-1.342	0.808	3.720	0.833	7.476**	-1.550	3.599
T4	0.625	0.592	5.850	-0.555	0.976	1.111	-2.579
L11 X T1	-1.175	-2.008**	8.253	-8.105**	-4.769*	-2.681	-20.91**
T2	-0.442	-2.058**	-21.423**	-0.472	-5.867*	1.782	-3.059

Table (5) : Cont.

Genotypes	No. of days to heading	No. of days to maturity	Plant height	No. of Spikes/ plant	No. of kernels/ spike	1000-kernel weight	Grain yield / plant
T3	0.158	1.642*	6.487	1.266	0.846	-0.116	17.948**
T4	1.458	2.425**	6.683	7.311**	10.551**	1.015	6.030
L12 X T1	-1.008	0.492	1.303	5.862*	8.956**	0.369	5.936
T2	1.725	-0.892	-17.507**	3.628	-5.342*	0.390	8.793
T3	1.325	1.142	7.903	-2.167	-8.957**	-0.614	-1.740
T4	-2.042	-0.742	8.300	-7.32**	5.343*	0.573	-12.988
L13 X T1	0.825	2.325**	8.987	3.437	3.606	2.278	9.663
T2	1.225	-0.583	-25.590**	-3.397	-4.559	-2.085	-11.826
T3	-0.508	-1.358	6.687	-1.525	-2.040	2.750	1.517
T4	-1.542	-0.908	9.917	1.486	-2.993	-2.942	0.646
L14 X T1	0.658	-0.175	8.703	1.337	7.806**	0.942	3.543
T2	2.392	1.442*	-27.073**	1.636	-0.692	-1.988	5.700
T3	-1.675	-0.192	8.803	-4.559	-3.774	1.124	-11.249
T4	-1.375	-1.075	9.567	1.586	-3.340	-0.781	2.006
L15 X T1	-1.842	-0.916	10.203*	0.920	0.789	-1.926	-0.313
T2	1.225	0.858	-23.773**	2.619	4.691*	-1.113	4.624
T3	0.825	-1.442	8.103	-1.309	-0.390	3.672	1.564
T4	-0.208	0.675	5.467	-2.231	-5.090*	-0.633	-5.874
L16X T1	5.825	-0.758	10.470*	-1.538	-1.469	2.461	-1.655
T2	-22.108**	0.192	-22.173**	1.594	6.466**	-2.172	3.082
T3	/.825**	1.225	4.003	-0.134	-2.615	0.250	-2.828
T4	7.458*	-0.658	7.700	0.778	-2.382	-0.539	1.401
L17 X T1	1.158	0.492	9.128	0.653	0.564	2.483	1.350
T2	-1.108	0.108	-20.148**	0.861	4.366	0.834	7.064
T3	0.825	0.475	5.995	-0.842	2.084	0.425	-2.916
T4	-0.875	-1.075	5.025	0.103	-7.015**	-3.743	-5.497
L18 X T1	-1.008	1.575*	8.720	0.220	1.622	-3.191	3.999
T2	5.833	0.192	-19.523**	-0.947	-2.675	1.295	-0.240
T3	-8.331**	-0.775	6.353	-0.209	-2.557	-3.099	-7.803
T4	0.958	-0.992	4.450	0.936	3.609	4.995*	4.045
L19 X T1	-4.592	-2.008**	8.653	0.720	-6.985**	-0.131	2.735
T2	4.475	0.608	-21.490**	-1.647	9.016**	-0.036	6.785
T3	0.408	1.308	5.253	0.758	-3.499	-2.138	-5.584
T4	-0.292	0.917	7.583	0.169	1.468	2.187	-3.936
L20 XT1	-1.175	-0.675	6.020	-1.913	-6.494**	-3.448	-5.781
T2	0.558	-0.725	-21.490**	0.186	-0.125	1.619	-1.217
T3	0.825	0.308	6.920	-0.609	3.993	2.444	-10.990
T4	-0.208	1.092	8.550	2.336	2.626	-0.615	17.988**
L . S. D. 5 %	5.921	1.366	10.073	5.202	4.578	4.295	13.269
L . S. D. 1%	7.782	1.795	15.231	6.837	6.017	5.644	17.438

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

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تقدير القدرة على الائتلاف للمحصول ومكوناته في قمح الخبز باستخدام تحليل السلالة × الكشاف

أحمد محمد موسى- عبد الفتاح عبد الرحمن مراد

قسم بحوث القمح- معهد بحوث المحاصيل الحقلية- مركز البحوث الزراعية- مصر

الملخص العربي

أجرى هذا البحث في محطة البحوث الزراعية بالجميزة – مركز البحوث الزراعية- في المواسم الزراعية ٢٠٠٦/٢٠٠٧- ٢٠٠٧/٢٠٠٨ وذلك بهدف دراسة القدرة على الائتلاف بمعناها العام والخاص للصفات الآتية :- عدد الأيام للتزهير – عدد الأيام للنضج- طول النبات- عدد السنابل للنبات – عدد حبوب السنبلة- وزن الألف حبة- محصول الحبوب للنبات. وقد استخدمت في هذه الدراسة عشرون سلالة تم تهجينها مع أربع كشافات محلية هي جميزة ٩- جميزة ١٠- سخا٩٤ – جيزة ١٦٨ بمجموع ثمانين هجينا وكانت أهم النتائج المتحصل عليها كما يلي :-

- كانت قيم التباين الراجعة إلى كل من التراكيب الوراثية والآباء والهجن عالية المعنوية لكل الصفات تحت الدراسة.
- أظهرت النتائج أن الفعل الجيني المضيف كان الأكثر أهمية في توارث معظم الصفات تحت الدراسة فيما عدا صفتي عدد الأيام للتزهير ووزن الحبوب حيث كان الفعل الجيني غير المضيف هو المتحكم في وراثة هاتين الصفتين .
- أظهرت النتائج أن السلالات رقم ١١ ، ١٢ ، ١٦ والصنفين جميزة ٩ ، سخا ٩٤ ذات قدرة تآلف عالية للمحصول ومكوناته ويمكن الاستفادة منها بإدخالها في برامج التربية كمواد وراثية.