Diallel analysis of inheritance pattern of grain yield and yield componenets in bread wheat (*Triticum aestivum* L.)

Ahmed H. Al-Juboori Dawood S.M. Al-Obaidi Jassim.M. Al-Juboori
College of Agriculture / Tikrit University
E-mail:Ahmed75hawas@yahoo.com

Hisham S.Ali
State board of Agricultural research-Ministry of Agriculture-Baghdad,Iraq.

Abstract

The objective of this study is to estimate the nature of inheritance of grain yield and it's components in bread wheat. Half diallel crossing (6×6) performed in 2010 season including six parents (Line A-60 , Line3-7 , IPA99 , Abu-Ghraib3 , Bancal and Sham6) and grown in comparison experiment in 2010 season. Plant height(cm), flag leaf area (cm), no. of spikes per plant, no. of grains per spike,1000 grains weight (g) and grain yield per plant(g) were studied. Highly significant differences appear among genotypes in all traits studied reflected in high significant difference of GCA and SCA except grain yield. plant^{-1}(g). P<0.01 differences in IPA99 and Bancal parents had significant GCA effects toward desired direction in most grain yield components traits, were regarded as good combiners, while (Line3-7×IPA99) and (Line3-7×Abu-Ghraib3) crosses have significant positive SCA effects, also exhibiting high significant hybrid vigor in grain yield and many other of it's component traits followed by (Line A-60× Bancal) cross. δ^2GCA/δ^2SCA less than 1 for all traits.That refers to an important non additive type of gene action regarded as the major genetic variance component controlling inheritance traits, though regardless of environmental variances. Low Narrow sense heritability was seen in grain components traits, while heritability in broad sense were high and ranged from 85.5-94.3,therefore, gain from selection were low in all traits. Therefore, selection should be delayed on late generation and recurrent selection may be affective method of breeding the bread wheat genotypes.

Key words: Diallel analysis , wheat bread genotypes.

Introduction

Crossing among genotypes is an effective and efficient method of breeding besides producing new genotypes which may posses favorable traits in plant population (Farshadfar *et al*, 2012). A study of inheritance should concentrate on important traits of yield components that differ significantly among genotypes ability in transmittance their traits to the offspring. As a result of this, the study of inheritance of these traits would be valued for breeding program. Many genotypes gave higher value of grain yield and it's components (flag leaf area , and no.of spikes. plant^{-1}.) of their crosses, which are regarded as promising genotypes (Saleh,2011). Hybrid vigor in grain yield and it's component's is the main important object of crossing wheat genotypes (Kumar *et al*, 2011 and Mujahid *et al*, 2000). The highest heterosis was found in 1000kernel weight (12.86) and plant

Date of research received 28/9/2014 and accepted 24/6/2015

grain yield (37.6%) companied with significant differences among genotypes (Akinci, 2009). Hybrid vigor is more important if compared with commercial crosses which had a significant positive value (41%) in grain yield besides improvement in kernel weight and other yield components (Toklu *et al*, 2007). Genetic distance and significant differences among genotypes are very important for manifestation of hybrid vigor in F1's (Al-Taweel, 2009) that are significantly activated and rapidly enhanced growth of flag leaf area for F1's compared with best parent (Inamullah, 2004) which is highly affected and correlated with grain yield (Abdel-Moneam, 2009 ; Akram *et al*, 2008 ; Yildrim *et al*, 2009). Highly significant differences among genotypes led to significant genetic variance generated in the observed segregating populations for grain yield. plant^{-1}(Ojaghi *et al*, 2010 ; Subhashchandra *et al*, 2009). Also, GCA and SCA were significant for plant height, spike length, and 100grain weight and grain yield (Anwar *et al*, 2011). Although SCA variance proportion was greater than GCA except plant height which indicated preponderance of non-additive type of gene action of these traits (Kashif and Khan, 2008 ; Saifullah *et al*, 2004) with over dominance gene action (Akram *et al*, 2008 ; Rabbani, 2009 ; Singh *et al*, 2003). Non additive gene effects of 1000 grain weight, and grain yield.plant^{-1} delayed selection on progeny of segregating generations with recurrent selection which would be advisable for accumulating desirable genes for such traits (Hassan *et al*,2007). Otherwise non additive gene action was more obvious especially over dominance in flag leaf area and yield components (Akram *et al*, 2008 ; Rabbani, 2009 ; Saeed, 2010). Being significant GCA and SCA which need to directed breeding program depending on the additive and non additive gene action that are both significant for wheat grain yield components (Ahmad *et al*, 2011 ; Bhatti *et al*, 1984 ; Hassan *et al*, 2007 ; Masood and Kronstad, 2000) and flag leaf width (Dere and Yildirim, 2005) while over dominance type of gene action are not included neither for flag leaf area nor for spike length and grain yield.plant^{-1} (Inamullah, 2004). Preponderance of significant GCA effects on SCA in wheat grain yield and it's components : spike length and grain yield.plant^{-1}. (Ul-Allah *et al*, 2010) and plant height ,peduncle length and spike density (Bhatti *et al*, 1984 ; Saeed, 2010) which state a good combiner of wheat lines (Anwar *et al*, 2011). Most wheat grain yield components which exhibited significant GCA effects (Inamullah, 2004 ; Khan *et al*, 2007). Significant epistasis gene effects caused significant SCA effects as a result of intergenomic gene action for grain yield components (Masood and Kronstad, 2000). Significant GCA and SCA effects increase complexity of breeding program and reduces gain from selection and genetic advance as an out put of crossing program (Mehaian *et al*, 2000). However, no.grains. spike^{-1} reveald significant GCA effects than the other traits which were under SCA and dominance variance (Hassan *et al*, 2007). Additive gene effect operating plant height,no.grains.spike^{-1} and grain yield. plant^{-1}, while 1000 grain weight controlling by non additive type of gene action (Akram *et al*, 2008 ; Khan *et al*, 2007).

Gain from selection depends in large proportion on the heritability estimate, selection pressure and phenotypic standard devation.High heritable estimate of grain yield components led to increase of opportunity and enlarged genetic role of improving such traits , however , heritability in narrow sense was more important in wheat and superior crosses often showed high estimates in most agronomical and physiological traits. Consequently, of high expected genetic advanced occurred in crossing program. Many traits contributing largely and significantly of wheat grain yield, therefore, had a high percentage of heritability in narrow sense(88% in no.grains.spike^{-1}) (Farshadfar *et al*, 2012). High estimates of heritability in narrow sense in no.grains.spike^{-1} (Ojaghi et al, 2010) and growth characters:flag leaf area and plant height and grain yield (Virk *et al*, 1984) had exaggerating importance selection in early generation for gathering additive gene action and genotypic stability over generations which means gathering of favorable trans-mitted genes (Ojaghi *et al*, 2010). On the other hand, low estimates of strict heritability were recorded in spike length and grain yield.plant^{-1} (Ahmad *et al*, 2007). Other crosses may revealed medium estimates for no.spikes.plant^{-1}, 100 grain weight and perhaps low for plant height, flag leaf area, no.grains.spike^{-1} and grain yield which needed increasing genetic variance in descendent by using an appropriate breeding method(Al-Taweel, 2009). The aim of the study was to determine hybrid vigour, general combining ability, specific combining ability, heritability in narrow sense and expected genetic advanced in 6×6 half diallel by using griffing approach in wheat bred lines.

Materials and Methods

A Randomized completely block design with three replicates was used for evaluating 21 entries (15crosses) and their parents (Line A-60 , Line3-7, IPA99 , Abu-Ghraib3 , Bancal and Sham6) in the 2011 season obtained from 6×6 half diallel crossing in 2010 season. An experimental unit containing one row with 3m long and 0.25 m and 0.10 m inter and intra row spacing and fertilization with 200kg Nitrogen\ha splited into two times : first at the planting and seconed at the beginning of the tillering stage. Phosphorus was added with 200kg\ha with nitrogen fertilizer. Crop management was done as required. Random sample

(10plant) was taken to study the following traits:1-Plant height (cm) measured at the full bloom, 2-Flag leaf area (cm^2) measured at the full anthesis,3-No. spikes.plant^{-1} 4- spike length (cm), 5- No.grains.spike^{-1}, 6-1000 grains weight (gram), 7-Grain yield.plant^{-1} (gram). The collected data was statistically analysed according to the design used. The means were compared by using LSD at the 5% level of significance (Dawood and Abdulyas, 1990). The genetic parameters included : variance due to general combining ability (VGCA), variance due to specific combining ability (VSCA), environment variance (δ^2E), additive variance (δ^2A), dominance variance (δ^2D),genotypic variance(δ^2G), phenotypic variance (δ^2P), heritability in narrow sense($H^2_{n.s.}$),heritability in broad sense ($H^2_{b.s.}$), average degree of dominance($\bar{a}$), and genetic advance (Gi) were estimated according to Singh and Chaudhary, (1985) according to the following formulas in table 1.

Table (1): Parents and their pedigree

No	Parents	Pedigree
1	Line A-60	ACSAD875/3/TJB368.231/Buc//CUPE
2	Line 3-7	ACSAD875/TIA3
3	IPA99	Ures/Bows/3/Jup/Bl's//Ures
4	Abu-Ghraib3	Ageeba×Inia66× Maxico 24
5	Bancal	Espanish
6	Sham 6	ICARDA

Results and Discussion

The analysis of variance revealed highly significant differences among genotypes in all traits studied (Table 2) that refered to divergence of the studied genotypes which needed digging down for understanding and classifying such differences into environmental and genetical variances proportions clarifying architecture and the nature of inheritance in descendent (Ojaghi *et al*, 2010 ; Saleh, 2011 ; Subhashchandra et al, 2009). The ratio of δ^2GCA to δ^2SCA dividing variance GCA by SCA less than 1 for all traits studied as a result of reducing GCA variance components and that refered to important non additive type of gene action for inheritance of these traits. In such case, abreeding program will be effective through crossing and utilization of superior segregations, and these results are adequate with Saifullah *et al*, (2004). Furthermore, analysis of significant differences among genotypes revealed exceeded F's on their parents in most traits studied. Crossing led to an improvement of characteristics growth through increasing plant height in most crosses and flag leaf area in (1×5) cross only (41.87) (Table 3). Grain yield and it's components differ significantly among crosses and their parents. The highest values of no.spikes.plant^{-1} (8.5) and spike length (61.87) in 2×3 and 4×6 crosses respectively. The highest no.grains.spike^{-1}mean (55.64) in genotype (5)and 44.13 , 42.14 and 42.10 gram for 3×6 , 1×5 and 1×6 crosses respectively that didn't differ significantly among each other. While (5) and (1) parents gave the highest value of 1000 grains weight (44.82 and 43.2 respectivily) exceeded all the other genotypes. The cross 2×3 gave high grain yield(17.16 gram) and didn't difer significntly from 1×5 , 4×5 , 1×6 and 3×6 crosses. No. spikes.plant^{-1} and spike length may be regarded as the major effects and contribut largely to increas grain yield.plant^{-1} that stating of importance these components in wheat grain yield (Toklu and Yaqbasanlar, 2007). Significant differences among genotypes (parents and their crosses) in all traits insist the importance of studying genetic behavior of these traits through estimating GCA and SCA effects which were highly significant in all traits except GCA effects of grain yield (table 2 and 3). Data has shown the importance of both additive and non additive types of gene action controlling growth and grain yield components which means the presence of non additive type of gene action. Whole GCA effects were significant even positive or negative in plant height. The parents (3) and (5) gave significant effects of GCA (1.53 and 1.67 respectively). While significant negative GCA effects were in parent (4)(-2.75) for plant height which meant that this parents possessed genes decreasing plant height compared to (3) and (5) parents that have genes increasing plant height affected by additive type of gene action. Also, positive significant desired GCA effects in 1 and 5 genotype(1.29 and 2.93 respectively) for the flag leaf area and the other estimates were negative except parent(3). These results showed importance of additive gene action controlling inheritance flag leaf area in 1 and 5 parents. Genotype (6) , (3) and (4) have the highest positive significant GCA effects (0.22, 0.19 and 0.19 for (6) ,(4) and (3) parents respectively) in no.spikes.plant^{-1}, though parent (5) have the lowest value(-0.54). Fifth parent showed greatest significant GCA effects in Spike length (0.71), no.grains.spike^{-1}(2.55), 1000grain weight (2.21) and grain yield (0.25) which means the possessing parent (5) favorable genes (additively action) increasing grain yield as a result of improving yield components. Desired positive significant GCA effects for other yield components were in 1000 grains weight in parent(1) and spike length and no.grains.spike^{-1} in parent (3) and no.spikes.plant^{-1} in parent (6). That interpreted the additive type of gene action of the inheritance nature of these traits. These results are in a harmony with Anwar *et al,* (2011). Significant SCA effects toward the desired direction(affecting positively on plant height) were found in 1×5 and 2×4 crosses (7.71 and 7.69 respectively). Other crosses were low in these effects and possess genes negatively affecting plant height. This perhaps means that one parent should be negative and another should be affect on SCA effects. Flag leaf area showed positive significant SCA effects in

(1) and (5) parents (1.29 and 2.93 respectively), other significant effects were negative, which means that the genes increasing leaf area have additive action concentrate in (1) and (5) parents. Cross 2×3 gave the highest significant positive effects of SCA for each no.spikes.plant^{-1} (1.36) and grain yield (4.20) addicting of abundance genes of these parents increasing no.spikes.plant^{-1} and grain yield which regarded a good combiner for obtaining superior hybrids produces transgressive segregation (14). The no. of grains.spike^{-1} and 1000grains weight have positive significant SCA effects in 2×4 (10.63) and 3×6 (7.02). Remarkably medium×high and low×low gave the highest values of positive SCA effects as a result of parental gene combinations. The present results are in agreement with Hassan *et al*, (2007).

Hybrid vigor is the most important parameter in output of breeding program which was positive and significant in most traits of crosses under investigation (Table 4). Flag leaf area exhibited positive highly significant hybrid vigor estimates (11.61 and 9.52 for 1×5 and 2×4 crosses respectively, also superiority over better parent were obviously in no. spikes.plant^{-1} (1.93 and 2 fore 2×3 and 2×4 crosses respectively), besides no.grains.spike^{-1} (14.18 , 19.49 , 16.81 and 21.67 for1×6 , 2×4 , 2×6 and 4×6 crosses respectively). Only 2.23) in 1000grains weight and spike length respectively. 3×6 cross showed highly positive significant hybrid vigor (9.38 and Superiority of 2×3 and 2×4 crosses in grain components traits were reflected in positive significant hybrid vigor in grain yield for the two crosses respectively. F1's significantly differs from best parents in plant height of 1×5 , 2×3 and 2×4 crosses and in flag leaf area of 1×4 ,1×5 and 2×4 crosses. Many traits were better than their higher parent significantly in no. spikes.plant^{-1} (1×2 , 1×3 , 1×5 , 2×3 , 2×4 and 4×5 crosses) while no.grains.spike^{-1} exhibited significant positive differences of 1×4 , 1×6 , 2×3 , 2×4 , 2×6 and 4×6 crosses). Also, 2×3 , 2×4 and 3×4 exceeded their best parent significantly in spike length besides of 1×3 and 4×5 crosses in grain yield which were regarded the most complex and important traits of plant.

Table (2): Analysis of variance represented by M.S. for the traits studied

S.O.V.	d.f.	Traits						
		Plant height (cm)	Flag leaf area (cm^2)	No.spikes. plant^{-1}	Spike length (cm)	No.grains. spike^{-1}	1000grains weight (g)	Grain yield (g)
Blocks	2	3.27	21.25	8.82**	2.32	165.85*	11.48	31.94*
Genotypes	20	62.28**	69.31**	2.82**	3.07**	157.08**	33.25**	18.60**
GCA	5	73.16**	83.40**	2.04**	4.17**	55.89**	60.55**	3.00
SCA	15	58.65**	64.63**	3.08**	2.70**	190.75**	24.23**	23.82**
Error	40	10.76	6.14	0.31	0.39	13.61	2.21	2.67
C.V.		10.64	28.80	24.08	15.86	25.32	14.90	32.62
δ^2GCA/ δ^2SCA		0.16	0.16	0.07	0.20	0.03	0.33	0.002

	Traits

		Plant Height(cm)	Flag leaf Area(cm^2)	No.Spikes .Plant^{-1}	Spike length(cm)	No.grains. spike^{-1}	1000Grains weight(g)	Grain yield. plant^{-1}(gm)
1	Mean	70.23	24.82	5.966	10.07	41.67	43.20	10.83
	Gi	-0.77	1.29	-0.39	-0.32	-2.22	1.77	0.22
2	Mean	70.33	19.65	5.43	10.21	41.67	37.32	8.50
	Gi	1.10	-1.65	-0.03	0.10	0.06	-0.84	-0.50
3	Mean	74.10	25.36	6.56	10.08	48.44	34.74	11
	Gi	1.53	0.21	0.19	0.14	0.12	-1.07	0.24
4	Mean	67.57	19.04	6.33	8.94	37.83	35.64	8.33
	Gi	-2.75	-1.83	0.19	-0.21	-0.15	-1.56	-0.40
5	Mean	72.16	30.29	4.56	12.22	55.64	44.82	11.30
	Gi	1.67	2.93	-0.54	0.71	2.55	2.21	0.25
6	Mean	72.66	24.43	8.30	9.57	40.20	33.49	12.33
	Gi	-0.79	-0.96	0.22	-0.42	-0.37	-0.50	0.18
	SE(gi)	0.35	0.26	0.06	0.06	0.39	0.16	0.17
1×2	Mean	71.20	29.39	7.40	42.59	35.70	10.76	11.16
	Sij	-3.24	0.85	0.49	-0.06	-6.01	-3.91	-1.77
1×3	Mean	76.82	31.12	8.03	50.53	39.18	10.90	15.83
	Sij	1.95	0.71	0.9	0.03	1.86	-0.2	2.14
1×4	Mean	68.23	32.38	7.23	51.66	39.49	11	13.66
	Sij	-2.34	4.03	0.10	0.49	3.26	0.58	0.62
1×5	Mean	82.73	41.87	7.53	53.32	42.14	11.88	17
	Sij	7.71	8.74	1.13	0.44	2.51	-0.53	3.29
1×6	Mean	73.13	28.18	6.29	55.85	42.10	10.07	15
	Sij	0.59	-1.03	-0.76	-0.23	7.67	2.14	1.37
2×3	Mean	82.96	31.00	8.5	57.49	37.66	12.35	17.16
	Sij	6.20	3.54	1.36	1.06	6.52	0.89	4.20
2×4	Mean	80.15	29.18	8.33	61.31	37.36	11.82	16
	Sij	7.69	3.77	1.19	0.89	10.63	1.073	3.68
2×5	Mean	79.63	31.92	6.73	52.24	38.97	11.84	13.66
	Sij	2.73	1.74	0.33	-0.02	-1.14	-1.08	0.69
2×6	Mean	73.03	28.30	6.73	58.63	39.74	10.94	13.5
	Sij	-1.39	1.94	-0.43	0.21	8.16	2.40	0.60
3×4	Mean	69.26	27.93	7.43	45.64	34.25	11.60	12.5
	Sij	-3.63	0.65	0.06	0.63	-5.09	-1.79	-0.56
3×5	Mean	79.73	30.64	6.43	55.40	37.48	11.13	13.16
	Sij	2.40	-1.40	-0.19	-0.77	1.96	-2.34	-0.55
3×6	Mean	74.10	32.59	6.86	50.40	44.13	12.31	13.83
	Sij	-0.75	4.44	-0.53	1.54	-0.11	7.02	0.18
4×5	Mean	71.43	32.06	7.66	58.02	41.28	12.77	15.83
	Sij	-1.59	2.06	1.03	1.22	4.85	1.93	2.75
4×6	Mean	72.49	27.93	7.06	61.87	34.82	10.50	14.66
	Sij	1.93	1.84	-0.33	0.09	11.62	-1.80	1.66
5×6	Mean	74.33	28.75	7	45.26	39.02	10.99	12.33
	Sij	-0.66	-2.11	0.33	-0.35	-7.69	-1.37	-1.32
L.S.D.(0.05)		7.81	5.90	1.33	8.78	3.54	1.49	3.47
SE(ij)(0.05)		0.80	0.60	0.13	0.15	0.9	0.36	0.39

Table (3): General combining ability (GCA) and specific combining ability effects (SCA) with means of studied traits for parents and their crosses

Table (4): Hybrid vigor in growth , grain yield and it's components traits of bread wheat crosses

Crosses	Traits						
	Plant hight(cm)	Flag leaf area(cm^2)	No.spikes. $plant^{-1}$	No.grains. $spike^{-1}$	1000grains weight(g)	Spike length(cm)	Grain yield. $Plant^{-1}$ (g)
1×2	0.86	4.56	1.43*	0.77	-7.49**	0.54	0.33
1×3	2.72	5.75	1.46*	0.77	-4.01*	0.82	4.83*
1×4	-2	7.56*	0.90	9.99**	-3.70*	0.92	2.83
1×5	10.57*	11.61**	1.56*	-2.02	-2.68	-0.33	5.70**
1×6	0.46	3.36	-1.90*	14.18**	-1.09	0	2.67
2×3	8.86*	5.63	1.93**	9.05*	0.34	2.14*	6.16**
2×4	9.82*	9.52**	2**	19.49**	0.04	1.61*	7.50**
2×5	7.46	1.67	1.30	-3.40	-5.85**	-0.38	2.36
2×6	0.36	3.87	-1.56*	16.81**	2.42	0.72	1.16
3×4	-4.84	2.56	0.86	-2.80	-1.38	1.52*	1.50
3×5	5.63	0.39	-0.13	-0.23	-7.34**	-1.08	1.86
3×6	0	7.22	-1.43*	1.96	9.38**	2.23**	1.50
4×5	-0.73	1.81	1.33*	2.38	-3.54*	0.55	4.53*
4×6	-0.17	3.50	-1.23	21.67**	-0.81	0.93	2.33
5×6	1.66	-1.49	-1.30	-10.38*	-5.80**	-1.22	0

It was composed by other yield components, however significant positive hybrid vigor in the most important yield components trait(no.spikes.$plant^{-1}$) and frequently low negative values of hybrid vigor responsible for superiority than others (Kumar *et al*, 2011 ; Mujahid *et al*, 2000).

Comparing SCA variances in plant height of parent (3) (10.861) and parent (5) (14.34) (Table 5) clarify higher ability of parent (3) than (5) for transmitting this trait to offspring than parent (5), but the latter have large ability for transmitting their genes of leaf area to their F1's as a result of low SCA variance (19.91) comparison with parent (1) (21.12). GCA variances ranged from (0.17-7.17) for plant height and (-1.90)-(8.38) for flag leaf area. Parent (6) have higher value for GCA effect with low SCA variances in no.spikes.$plant^{-1}$ comparison to parent (4) which have less GCA effect and SCA variance, that stating of important parent (6) of transmitting their genes to offspring, while parent (4) have less ability for transmitting their genes to offspring. Both spike length and no.grains.$spike^{-1}$ have the same genetic behavior in parent(5) that have high positive significant GCA effects and low SCA variances (0.43) for spike length and no. grains.$spike^{-1}$ (17.72) comparison with parent (3) which have less SCA variance and non significant GCA effect for these traits respectively. Higher genetic ability for transmitting genes in parent (5) than other parents obtained from low SCA variances for the significant positive values of 1000 grain weight and grain yield.plant^{-1} , therefore , parent (5) is more important than parent (1) and (3) fore obtained significant hybrid vigor in these traits respectively (table4) which are in charge of increasing opportunity of appearance transgressive segregations in descendants.

Table (5): GCA and SCA variances of traits studied

Parents	Variance	Plant height (cm)	Flag leaf area (cm^2)	No.spikes. plant^{-1}	Spike length (cm)	No.grains. spike^{-1}	1000 Grains weight(g)	Grain yield.plant^{-1} (g)
1	δ^2GCA	0.17	1.43	-0.01	0.087	4.39	3.05	-0.05
	δ^2SCA	15.33	21.12	0.60	-0.04	23.05	4.19	4.07
2	δ^2GCA	0.80	2.49	-0.01	-0.005	-0.53	0.62	0.14
	δ^2SCA	24.80	5.95	0.82	0.96	59.09	5.11	7.67
3	δ^2GCA	1.93	-0.19	0.02	0.005	-0.52	1.07	-0.04
	δ^2SCA	10.86	6.15	0.61	0.96	13.12	13.77	4.59
4	δ^2GCA	7.17	3.11	0.02	0.03	-0.51	2.34	0.05
	δ^2SCA	16.43	7.01	0.52	0.57	71.22	1.98	5.02
5	δ^2GCA	2.33	8.38	0.28	0.49	5.99	4.81	-0.04
	δ^2SCA	14.34	19.91	0.52	0.43	17.72	2.20	4.11
6	δ^2GCA	0.20	0.68	0.03	0.16	-0.40	0.16	-0.07
	δ^2SCA	-2.85	5.47	0.18	0.48	74.15	15.25	0.55

Additive and dominance types of genes action were significant in most of yield components. It was computed depending on GCA and SCA variances components and, therefore, reflected the amount of their considerations. Additive types of genes action were highly significant in plant height, spike length and 1000 grain weight and significant in flag leaf area and no.spikes.plant^{-1} (Table 6). Most traits studied have dominance gene action greater than additive besides significant environmental and phenotypic variances. These results are in a harmony with Akram *et al,* (2008) , Rabbani, (2009) and Saeed, (2010) which that refered of importance dominance gene action in wheat traits.Heritability estimates in narrow sence were moderate (0.21 , 0.23 , 0.25 and 0.37) in plant hight, flag leaf area, spike length, and 1000 grain wieght respectivily. These results are in agreement with the findings of Ahmad *et al,* (2007) and Al-Taweel, (2009). Broad sense heritability was remarkably high in all traits and ranged from 0.94-0.85 because of upraising dominance genetic variances in comparison with environmental variances controlling inheritance of these traits, and that means 85-94% of differences caused by genetic effects on such traits. Average degree of dominance were more than 1 for all traits with assurance of controlling over dominance of inheritance such traits. Genetic gain from selection ranged from 0.01 for grain yield.plant^{-1} and 2.379 for 1000 grains weight and calculating percentage of genetic advance over all means for each trait revealed low values ranged from 0.12-7.41 as a result of low Narrow heritability and phenotypic variances.

Table (6): Variance components and genetic parameters of traits studied

Traits	Genetic Parameters											
	VGCA	VSCA	δ^2E	δ^2A	δ^2D	δ^2G	δ^2P	$H^2_{n.s.}$	$H^2_{b.s.}$	$\bar{a}$	Gi	Gi%
Plant height(cm)	2.6	15.96	3.57 ±2.34	5.20 ±1.83	15.96± 6.75	21.16± 0.58	24.75 ±0.96	0.21	0.85	2.47	1.84	2.48
Flag leaf area(cm^2)	3.21	19.49	2.04 ±1.34	6.43 ±2.07	19.49 ±7.40	25.93± 0.05	27.98 ±5.11	0.23	0.92	2.46	2.14	7.41
No.spikes. plant^{-1}	0.07	0.92	0.10 ±0.06	0.14 ±0.06	0.92 ±0.35	1.06 ±0.01	1.17 ±0.20	0.12	0.91	3.58	0.23	3.35
Spike length(cm)	0.158	0.77	0.13 ±0.08	0.31 ±0.10	0.77 ±0.31	1.08 ±0.01	1.21 ±0.23	0.25	0.89	2.21	0.50	4.55
No.grains. spike^{-1}	1.76	59.04	4.54 ±2.97	3.52 ±2.99	59.04± 21.83	62.56 ±0.60	67.10 ±11.21	0.05	0.93	5.78	0.75	1.49
1000Grains weight(gm)	2.43	7.33	0.73 ±0.48	4.86 ±1.39	7.33 ±2.77	12.20 ±0.18	12.94 ±2.29	0.37	0.94	1.73	2.37	6.14
Grain yield. plant^{-1}(gm)	0.01	7.05	0.89 ±0.58	0.02 ±0.34	7.05 ±2.73	7.07 ±0.07	7.97 ±1.03	0.003	0.88	22.75	0.01	0.12

References

1- Abdel-Moneam, M.A. (2009). heterosis in some crosses of bread wheat under irrigation and drought conditions. Pak. J. Biol. Sci. 12(6):486-491.

2- Ahmad, F.;F. Muhammad; M. Saifullah; and H.Khan. (2007). Inheritance of important traits bread in wheat over different planting dates using diallel analysis. Sarhad J. Agric. 23(4):955-964.

3- Ahmad, F.;S. Khan; S.Q. Ahmad; H.Khan; A.Khan; and F.Muhammad. (2011). Genetic analysis of some quantitative traits in bread wheat across environments. Afric. J.Agric. Res. 6(3):686-692.

4- Akinci, C. (2009). Heterosis and combining ability estimates in 6×6 half diallel crosses of durum wheat (*Triticum durum* L.). Bulgar. j. Agric. Sci. 15(3): 214-221.
5- Akram, Z.;S. Ajmal; G. Shabbir; M. Munir; and N.M. Cheema (2009). Inheritance mechanism of some yield components in bread wheat. Pak. j. Agric. Res. 22(1-2):1-8.
6- Akram, Z.;S. Ajmal; M.Munir and G.Shabir. (2008). Genetic determination of yield related attributes in bread wheat. Sarhad J.Agric., 24(3):431-438.
7- Alniami, A.T.H.A. (2006). Genetic analysis for grain yield and it's components in durum Desf. A thesis, Mosul Univ, Iraq. (in Arabic).
8- Al-Taweel, M.S.M. (2009). Study of genetic architecture for several genotypes of Durum wheat (*Triticum durum* Desf). Mosul Univ. Iraq. (in Arabic).
9- Anwar, J.; M.Akbar; M.Hussian; S.Asghar; J.Ahmad; and M.Owais (2011). Combining ability estimates for grain yield in wheat.Agric.Res. 49(4):437-445.
10- Bhatti, M.S.; M.A. Bajwa; N. Islam; and A.Asi (1984). combining ability analysis of five wheat varieties. Pakistan J.Agric. Res., 5(2):88-91.
11- Dawood, K.M. and Z.Abdulyas (1990). Statistical Methods of Agricultural Researches. Higher education printers, Mosul university, Iraq (in arabic).
12- Dere, S. and M.B. Yildirim (2005). Inheritance of grain yield plant, flag per leaf width, and length in a × 8 diallel cross population of bread wheat (*Triticum aestivum* L.) Turk. J. Agric. 30:339-345.
13- Farshadfar, E.;F. Rafiee and A. YGhotipoor (2012). Comparison of the efficiency along half diallel methods in the genetic analysis of bread wheat (*Triticum aestivum* L.) under drought stress conditions. Annals boil. Res. 3, (3):1607-1622.
14- Hassan, G.;F. Muhammad; S.S. Afridi; and I.Khalil (2007). Combining ability in the F1's generation of diallel cross for yield and yield components in wheat. Sarhad J.Agric. 23(4):937-942.
15- Inamullah,H.A.(2004).Inheritance of important traits in bread wheat using diallel analysis.Ph.D.thesis, WP Agricultural Univ.Peshawar-Pakistan.
16- Khan, M.A.; N.Ahmad; M.Akbar; A.Ur-Rahman; and M.M. Iqbal (2007). Combining ability analysis in wheat Pak. J. Agric. Sci. 44(1):1-5.
17- Khashif, M. and A.S. Khan (2008). Cobining ability studies for some yield contributing traits of bread wheat under normal and late sowing conditions. Pak. J. Agric. Sci. 45(1):44-49.
18- Kumar, A.; V.K.M. Mishra; R.P. Vyas; and V. Singh (2011). Heterosis and combining ability analysis in bread wheat (*Triticum aestivum* L.) J. Plant Breed. and Crop Sci. 3(10):209-217.

19- Masood, M.S. and W.E. Kronstad (2000). Combining ability analysis over various generations in a diallel cross of bread wheat. Pak. J. Agric. Res. 16 (1):1-4.
20- Mujahid, M.Y.; N.S. Kisana; Z.Ahmad; I.Ahmad; S.Z.Mustafa and A.Majid (2000). Estimation and utilization of heterosis and heterobeltiosis in some bread wheat crosses derived from divers germoplasm Pak. J. Biol. Sci., 3(7):1148-1151.
21- Mehaian,V;S. Nagaraian; M, Srivastav; V.Kumar and N.Rao (2000). Commercial heterosis in wheat an overview. Wheat research center. Karnal, Haryana, India.
22- Ojaghi, J.;S.Salayeva and R.Eshgi (2010). Inheritance pattern of important quantitative traits in bread wheat (*Triticum aestivum* L.). World appl. sci.J., 11(6):711-717.
23- Rabbani; G. (2009). Inheritance mechanizems of drought tolerance and yield attributes in wheat under irrigated and rainfed conditions. Ph.D. thesis, Arid Agric. Univ. Rawalpindi, Pakistan. reactions in a diallel cross of bread wheat. Pak. J.Agric. Res., 16(1):1-4.
24- Saeed, A. (2010). Genetic studies on yield and yield related traits in wheat under normal and stress conditions. Ph.D.thesis, Univ. Agric. Fasalabad-pakistan.
25- Saifullah, A.;M. Asif; and M.Munir (2004). Amplication of combining ability analysis of some characteristics of spring wheat. Quaterly Science Vision 9(1-2):1-5.
26- Saleh, S.H. (2011). Performance, correlation and path coefficient analysis for grain yield and it'srelated traits in diallel crosses of bread wheat under normal irrigation and drought conditions. World .J. Agric. Sci. 7(3):270-279.
27- Singh, R.K. and B.D. Chaudhary (1985). Biometrical Methods in Quantitative Genetic Analysis. Kalyani publishers, new Delhi – Ludhiana. pp:140-146.
28- Singh, H.;S.N. Sharma; R.S. Sain; and D.L. Singhania (2003). The inheritance of production traits in bread wheat by diallel analysis.SABRAO J. Breed. and Genet. 125-128.
29- Subhashchandra, B.;H.C. Lohithaswa; S.A. Desai; R.R. Hanchinal; I.K. Kala-pponavar; K.K.Math and P.M. Salimath (2009). Assesment of genetic variability and relationship between genetic diversity and transgressive segregation in tetraploid wheat. Karnataka J.Agric. Sci. 22(1):36-38.
30- Toklu, F. and T. Yaqbasanlar (2007). Genetic analysis of kernel size and kernel weight in bread wheat (*Triticum aestivum* L.) Asian J. Plant Sci., 6:844-848.

31- Ul-Allah, S.;AS. Khan; A.Reza; and S.Sadique. (2010). Gene action analysis of yield and yield related traits in spring wheat (*Triticum aestivum* L.). Intr. J. Agric. Biol.12(1):
32- Virk, D.S.; A.S.Khehra; S.Parminder; S.Virk; and B.S.Dhillon. (1984). Comparative genetic analysis of traits using diallel and factorial mating design in bread wheat.TAG 69(3):325-328.
33- Yildrim, M.; B. Bahar; M. Koc; and C. Barutcular (2009). Memberan thermal stability at different developmental stages of spring wheat genotypes and their diallel cross populations. Ankara Univ. Ziraat Facul. 15(4):293-300.

التحليل التبادلي لطبيعة توارث صفات النمووحاصل الحبوب ومكوناته في حنطة الخبز
(*Triticum aestivum* L.)

أحمد هواس الجبوري   داودسلمان مدب العبيدي   جاسم محمد الجبوري   هشام سرحان علي
كلية الزراعة / جامعة تكريت   الهيئة العامة للبحوث الزراعية / وزارة الزراعة - بغداد

الخلاصة

تهدف الدراسة الى فهم طبيعة توارث صفات النمو والحاصل الحبوبي ومكوناته من خلال التضريب التبادلي (6×6) في الموسم الزراعي لعام 2010 باستخدام الاباء (Line A-60 وLine 7-3 وIpa 99 وAbu-Graib 3 و Bancal وSham 6). اجريت تجربة مقارنة الاباء وهجنها في الموسم الزراعي لعام2011. درست صفات ارتفاع النبات(سم) ومساحة ورقة العلم(سم^{2}) وعددالسنابل.نبات$^{-1}$ وعددالحبوب .

سنبلة$^{-1}$ ووزن 1000حبة(غم) وحاصل الحبوب.نبات$^{-1}$(غم).

ظهرت اختلافات عالية المعنوية بين التراكيب الوراثية في جميع الصفات المدروسة والتي ادت الى التأثير على قابلية الأئتلاف العامة للاباء والتي كانت اختلافاتها في التأثير هي الاخرى عالية المعنوية في الصفات المدروسة عدا صفة عددالسنابل.نبات$^{-1}$، وكانت الاباء: اباء99 وشام6 ذات قابلية عالية على التوافق ويمكن اعتبارها متوافقات جيدة.بينما أمتلكت الهجن (Ipa99 × Line3-7) و (Abu-×Line3-7 Graib 3) أعلى قابلية خاصة على التوافق موجبة ومعنوية فضلا على اظهارها قوة هجين موجبة ومعنوية في حاصل الحبوب وبعض مكوناته الاخرى تلاها الهجين (Bancal × Line A-60). كانت نسبة تباين القابلية العامة الى الخاصة أقل من 1 ولجميع الصفات المدروسة مما يبين الاهمية الاكبر للفعل الجيني غير الاضافي في وراثة تلك الصفات وقد انعكس ذلك في انخفاض نسبة التوريث بالمعنى الضيق وزيادة نسبتها بالمعنى الواسع وقد تراوحت الاخيرة بين 85.5-94.3 رغم عدم أهمية التباينات البيئية ولذلك فالانتخاب يجب ان يؤخر الى الاجيال المتأخرة ويعد الانتخاب التكراري مهما في تمييز الانعزالات الجيدة أو الفائقة الحدود لتراكيب حنطة الخبز.

الكلمات المفتاحية: التحليل التبادلي و تراكيب حنطة الخبز.