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Estimation of Heterosis and Heterobeltiosis of F_1 Generation of Bread Wheat Genotypes.

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Abstract

This study included 10 genotypes of bread wheat, namely M45, Yakora, Giza168, Sids 12, SK95, Misr2, Giemiza 9, Sahel 1, Sids14, and Silano. The genotypes (parents and their single crosses) were cultivated at the research station of the Department of Field Crops of the College of Agriculture University of Kirkuk. During the winter agricultural season (2021-2022) using a Randomized Complete Block Design (R.C.B.D) and with three replications. The performance and hybrid vigour of the genetic compositions were studied based on the average and best parents . The most important results can be summarized as follows: The best performance of the parent (Sids12) was for the traits of the No. of grains. spike^{-1} (111.409) grains, the weight 1000 grains (42.991)(g), and the single grains yield (60.250) (g) . The hybrid (Sids 12x Sahel 1) showed the highest hybrid vigour for the traits of spike length (22.041) cm, No. of grains. spike^{-1} (147.835) grains, and single grains yield (96.991) (g). The hybrids (Yakora * Sids 12), (Yakora * Sids14), (Giza168* Sahel 1), (Sids 12* Sahel 1), and (Sids 12* Sids14) also showed significant hybrid vigour, calculated on the basis of deviation from the mean of parents for all the studied traits Days 75 % flowering , No. of tillers plant^{-1}, spike length (cm) , No. of grains spike^{-1} , weight1000 grains (g) , single grains yield (g) and Biological yield plant^{-1} (g) , The hybrid (Giemiza 9* Sids14) showed significant hybrid vigour, calculated on the basis of deviation of the first generation from the best parents for all the studied traits Days 75 % flowering, No. of tillers plant^{-1}, spike length (cm), No. of grains spike^{-1}, weight1000grains(g),singlegrainsyield (g) and Biological yield plant^{-1} (g).

Key words: Bread Wheat, Half Diallel Cross, Heterosis.
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Introduction

The wheat crop *Triticum aestivum L.* is one of the most important strategic crops grown globally and locally. Its importance comes from the fact that it is the staple food for many peoples of the world[1]. Bread wheat is a major source of energy for humans, and one of the most important factors that made it important in human nutrition is the good balance between proteins and carbohydrates in its grains , It is used as a raw material in many food industries such as: bread and pastries, as well as its use in industrial fields such as the starch industry and others, in addition to its use as animal feed [2], that Iraq is one of the original places for the origin of wheat and there are factors for the success of cultivating this crop, but the rate of wheat production in Iraq amounted to (4234) thousand tons, while in the world the rate of production reached about 722 million tons, and the cultivated area was estimated at (946.4) thousand hectares for the year [3]. The crossbreeding program provides new unions that enable plant breeders to produce hybrids and select in subsequent isolated generations for genotypes that possess the desired traits. (Half Diallel Cross) and the most common is the second method of in the field of plant breeding and its improvement because it provides plant breeders with important information that helps them choose the appropriate breeding method, in addition to the possibility of obtaining important genetic information about first-generation hybrids and the consequent screening of hybrids and selection of the best ones[3]. It follows its isolated generations to elect pure strains with characteristics sought by plant breeders. The importance of estimating the components of their genetic variation and then obtaining new unions and benefiting from the phenomenon of hybrid strength and knowing the action of the genes that control the growth characteristics of the individual plant yield and its components to determine the appropriate breeding method for it. The research aims to estimate the strength of the cross on the yield of grain and its main components by cross-crossing between ten genotypes of wheat.

Materials and methods

Included Study 10 genotypes of bread wheat, namely M45, Yakora, Giza168, Sids 12, SK95, Misr2, Giemiza 9, Sahel 1, Sids14, and Silano. The genotypes (parents and their single crosses) were cultivated at the research station of the Department of Field Crops of the College of Agriculture at the University of Kirkuk. During the winter agricultural season (2021-2022) using a Randomized Complete Block Design (R.C.B.D) and with three replications , As the experimental land was prepared by plowing it with two or thogonal plows using the backhoe plow, then it was blessed and leveled, and triple superphosphate fertilizer was added to it in the form of P2O5 is a source of phosphorus with a concentration of 46% at a rate of 40 kg. Dunum in one go before planting [4]. And urea fertilizer is a source of nitrogen, its concentration is 46%, at a rate of kg. dunams in two batches, the first at planting and the second at the stage of expelling the spikes explained by [5].

Table (1) shows the names, their genotypes, lineage and origin.

N	genotypes	Lineage	origin
1	M45	A modern strain derived from crosses	Egypt
2	Yakora	Ciano 67/Sonora 6411 Klien Rendidor/3/1L815626Y-2M-1Y-0M-302M	Egypt
3	Giza168	MRL/BUE/SERI CM93046-8M-0Y-0M-2Y-0B	Egypt
4	Sids 12	BUC//7C/ALD/5/MAYA74/ON//1160.147/3/BB/GLL/4/CHAT"S"/6/MAYA/VUL//CMH74A.630/4 * SX SD7096-4SD-1SD-1SD -0SD	Egypt
5	SK95	PASTOR // SITE / MO /3/ CHEN / AEGILOPS SQUARROSA (TAUS) // BCN /4/ WBLL1. CMA01Y00158S-040POY-040M-030ZTM-040SY-26M-0Y-0SY-0S.	Egypt
6	Misr2	Class selectedMisr2 is a new bread wheat from the bread wheat strains presented to the Wheat Department of the Agricultural Research Center in Egypt	Egypt
7	Giemiza 9	Ald "s"/HUC,"s;;//CMH74A.630/SX	Egypt
8	Sahel 1	NS 732/PIMA//Very'S'	Egypt
9	Sids14	Bow"s"/Vee"s"//Bow's'/Tsi/3/BANI SUEF 1 SD293-1SD-2SD-4SD-0SD	Egypt
10	Silano	Newly developed class	Iraq

Statistical analysis

Statistical analysis was carried out on the for all the studied traits of the genotypes of(10) parents and their (45) Half- Diallel Crosses for each trait using the Randomized Complete Block Design (R.C.B.D) according to the following mathematical model. .

$$Y_{ij} = \mu + R + t_i + b_j + e_{ij} \begin{bmatrix} i = 1 & , & ... & 10 \\ i = 1 & , & ... & 10 \\ r = 1 & , & ... & 3 \end{bmatrix}$$ Randomized Complete Block Design (R.C.B.D)

Heterosis

The strength of the Heterosis was calculated on the basis of the mean of the first generation from the mean of parents according to the following equation [6]

$$H\% = \frac{\overline{F1} - \overline{p}}{\overline{p}} = x100$$

The significance of the hybrid strength was tested by calculating the value t For each hybrid, as follows

Since: $V(H) = (3/2)\frac{\sigma_e^2}{r}$ $t = \frac{H}{\sqrt{V(H)}}$

Environmental variance $\sigma_e^2 = mse$

Heterosis strength was calculated on the basis of Deviations of the mean of the first generation from the best parenting [7] and as follows: $H = \overline{F1} - \overline{Bp}$

The significance of the hybrid strength was chosen by calculating the valuet for each hybrid, as follows: $H\% = \frac{\overline{F1} - \overline{Bp}}{\overline{Bp}} = x100$

$$t = \frac{H}{\sqrt{V(H)}} \quad V(H) = 2\frac{\sigma_e^2}{r}$$

Studied Characte

1. Days 75 % flowering 2. No. of tillers $plant^{-1}$3. spike length (cm) 4. No. of grains. $spike^{-1}$ 5. weight1000 grains (g) 6. single grains yield (g) 7. Biological yield $plant^{-1}$ (g).

Results and discussion

Table (2) shows the results of the analysis of variance for the studied traits. Significant differences were found between the genetic compositions at the 1% probability level for all the studied traits ,that the differences between the genetic compositions are attributed to the differences in the genetic factors. This requires the continuation of the study of their genetic behavior to know the genetic action that controls the inheritance of the traits under study. The result is considered an important input indicator in the continuation of the genetic analysis of these traits, and the estimation of the components of genetic variation and the action of the genes that dominate these traits. Previous studies by [8], [9], [10] , [11] have also obtained significant differences between the genetic compositions included in their studies.

Table (2) Analysis of variance (for parents and first-generation crosses) for all studied traits

Source of variance	D.F	Days 75% flowering	No. of tillers plant-1	spike length (cm)	No. of grains. spike-1	weight 1000 grains (g)	single grains yield (g)	Biological yield/plant (g)
Block	2	1.16	0.20	1.27	184.45	1.02	68.00	3.07
Genotypes	54	9.79**	2.48**	9.97**	422.97**	20.68**	371.73**	435.26**
Parents	9	8.65**	2.16**	10.84**	325.22**	17.43**	214.72**	537.23**
Hybrid	44	9.45**	2.30**	8.93**	419.11**	16.08**	343.61**	276.52**
Error	108	0.32	0.20	0.41	4.76	1.98	10.47	10.55

(ns) ,(*) And (**) is not significant and significant at the level of 5% and 1% respectively.

The results of Table 3 show the average values of the parents and F1 hybrids for the studied traits. For the Days 75% flowering heading trait, the parent(2) had the shortest flowering time, at (115,000) days, while the parent 10 was the latest, at (123,500) days , while the hybrid (6×3) was the fastest flowering hybrid, taking (116,000) days to flower, while the hybrid (10×7) was the latest, taking (122,000) days to flower . The characteristic of the is No. of tillers plant-1 one of the components of the grain yield and is determined by the growth rate of effective tillers as well as the number of lateral branches, which may be affected by agricultural processes, environmental conditions and genetic factors at the stage of tillering production, and through the data of the table (4) For parents and first-generation crosses, it was found that the parent (5) had the largest number of spikes in the plant, with an arithmetic mean of (14,012)spike while register parent (2) the least number of spikes (10,705) spike, hybrid out performance (8×7) over the rest of the hybrid, with an average of14,953spike^{1-}while the hybrid log (2 × 1) the lowest average for this trait was (10,909)spike^{1-}The reason may be due to the effective stems that the plant can produce and the lack of ineffective stems . The varieties in wheat differ in terms of width, shape and spike length(cm) , and these variables are key indicators in identifying and classifying the different types, as the parent (8) on the rest of the parents by giving him the highest average(18,589)cm while log parent (2) The shortest length of the spike reached(12,301)cm, the hybrid amtaz (8×4) with the maximum length of the spike reached(22,041)cm and a significant difference from the rest of the hybrids, while the hybrid gave (10×2) the lowest arithmetic mean(13,826)cm, and the reason may be attributed to the genetics responsible for this trait as well as the differences between the parents, which may be reflected in the hybrids resulting from their crosses. No. of grains. spike-1 is one of the main components of grain yield in wheat crop, and plant breeders aim to produce ears that have the highest number of grains. While The parent (4) gave the highest average of (111,409) grains, while the parent (2) recorded the lowest average of 74,823 grains. The hybrid (8 × 4) achieved the highest No. of grains. spike-1 with an average of (147,835) grains, with a significant difference from the rest of the hybrids. The hybrid (2 × 1) recorded the lowest number of grains per ear with an average of (82,909) grains. This may be due to the variation in the genetic compositions of this trait, as well as the difference in the process of exploiting growth factors, especially in the flowering stage to produce the largest number of fertile florets. The weight 1000 grains (g) is one of the important traits, which is a biological indicator of the efficiency of transporting the food materials produced at the source to the destination, which is reflected in the storage sites represented by the grain. The parent (7) surpassed the rest of the parents by a significant difference with an average of (44.102 g), while the parents (1) and (2) gave the lowest average of (38.204 g , 36.736 g) , respectively. The hybrid (7 × 3) achieved the highest average of (47.790) grams, while the hybrid (3 × 2) recorded the lowest average of (37.457 g). This may be due to the ability of the destination to absorb as much as possible of the output of the source, which is stored in the grain, thereby increasing its weight. The single grains yield(g) is the final result of most of the physiological and morphological traits of the plant, and increasing this trait is in itself an achievement for plant breeders, especially in wheat crop. The parent (4) gave the highest average of (60.250 g), while the father (2) gave the lowest average of(29.447 g). The hybrid (8 × 4) had the highest average of (96.991 g), while the hybrid (2 × 1) gave the lowest average of (37.543 g). This may be due to the parent (4) superiority in the traits of number of grains per ear and weight 1000 grains(g), which in turn reflected in his hybrids. For the trait of Biological yield/plant (g) , the parent (7) gave the highest average of (122.007 g), while the parent (2) gave the lowest average of (81.171 g). The hybrid (9 × 7) had the highest average of (139.733 g), while the hybrid (6 × 4) gave the lowest average of (94.326 g).

.Table (3) Arithmetic averages of parents and the second generation of quantitative traits in bread wheat

Parents and crosses		Days 75% flowering	No. of tillers plant-1	spike length (cm)	No. of grains. spike-1	Weight 1000 grains(g)	single grains yield (g)	Biological yield plant-1 g)(
1x1	1	115.583rs	11.798 d	14.703 f	88.826 e	38.204 d	40.034 e	91.403 d
2x2	2	115.000 e	10.705 e	12.301 g	74.823 g	36.736 d	29.447 f	81.171e
3x3	3	119.167cd	12.093 bd	15.991 de	101.555 b	42.272 abc	51.908 b	117.823 ab
4x4	4	122.250b	12.588 b	17.531 bc	111.409 a	42.991 ab	60.250 a	115.343 ab
5x5	5	119.667c	14.012 a	16.815 cd	94.333 cd	38.105 d	50.360 bc	114.492 b
6x6	6	121.750b	12.665 b	17.823 ab	80.565 f	40.673 c	41.528 de	106.819 c
7x7	7	118.333d	12.436bd	17.789 ab	94.326 cd	44.102 a	51.721 b	122.007 a
8x8	8	121.750 b	11.835 d	18.589 a	92.675 d	42.059 abc	46.191 cd	118.981 ab
9x9	9	122.500 b	12.510 bd	17.983 ab	97.641 c	41.326 bc	50.471 bc	117.785 ab
10x10	10	123.500 a	11.819 d	15.956 e	86.576 e	42.241 abc	43.261 de	115.427 ab
1x2	1	116.167 hk	10.909 t	13.752 s	82.909 v	41.488 mp	37.543 Y	99.281 n
1x3	2	119.500 fi	12.874 hn	16.955 mn	102.572 hk	42.842 jo	56.574 kq	104.600 m
1x4	3	121.167 ac	13.186 fk	19.842 bd	105.055 fi	45.181 ci	62.583 ej	117.846 l
1x5	4	119.250 gj	14.438 Abc	17.020 ln	95.109 np	43.743 gm	60.113 hn	117.843 l
1x6	5	120.750 bcd	13.294 ek	18.826 di	84.605 uv	40.577 op	45.646 vw	117.661 l
1x7	6	119.250 gj	13.752 df	19.579 be	95.034 np	41.766 lp	54.594 or	132.695 cf
1x8	7	119.750 eh	12.796 io	20.067 bc	100.826 km	45.271 bi	58.393 jp	130.145 dh
1x9	8	119.750 eh	13.411 ei	18.698 ei	98.434 ln	47.301 abc	62.438 fj	126.340 gj
1x10	9	120.000 fi	12.248 mr	16.726 np	90.675 qs	44.346 fk	49.276 rv	122.008 jl
2x3	10	119.500 fi	11.701 rs	14.840 qr	88.126 su	37.457 q	38.580 xy	119.301 kl
2x4	11	117.250oq	12.640 jo	15.790 oq	108.741 de	44.111 fk	60.624 hm	123.324 ik
2x5	12	119.750 eh	14.017 be	17.785 in	88.308 rt	39.958 P	49.437 rv	119.575 kl
2x6	13	119.000hk	11.685 rs	14.750 qs	89.214 qs	41.727 lp	43.481 wx	122.137 jl
2x7	14	119.000hk	12.970 gm	16.790 no	91.779 pr	41.205 np	49.059 sv	121.843 jl
2x8	15	116.500qs	11.825 rq	15.672pq	105.935 eh	42.156 kp	52.814 qt	124.326 ik
2x9	16	117.500np	12.587 kp	17.117 ln	101.019 km	42.065 kp	53.459 ps	129.480 eh
2x10	17	119.250 gj	11.076 st	13.826 s	84.782 tv	41.774 lp	39.218 xy	124.324 ik
3x4	18	118.750 ls	12.083 or	19.404 bf	110.789 cd	45.826 ag	61.324 hl	125.345 hj
3x5	19	121.500ab	12.977 gm	18.546 ei	113.419 bc	45.607 ah	67.152 cf	119.910 kl
3x6	20	116.000s	12.802 io	18.875 di	84.259 v	43.260 in	46.677 uw	131.813 cf
3x7	21	118.500jm	13.475 di	20.405 b	113.516 bc	47.790 a	73.247 b	133.986 be
3x8	22	119.000hk	13.957 be	19.063 cg	104.086 fk	46.007 ag	66.910 dg	132.794 bf
3x9	23	117.750mp	13.984 be	19.033 cg	102.447 hk	44.308 fk	63.492 ej	132.281 cf
3x10	24	119.500fi	11.898 pr	18.693 ei	101.324 jm	43.829 gl	52.863 qt	131.254 dg
4x5	25	118.750 ls	13.638 dg	19.220 cf	114.582 b	45.826 ag	71.598 bc	133.185 be
4x6	26	120.500cde	13.219 fk	17.290 kn	97.826 mo	46.159 af	59.697 ho	94.326 o
4x7	27	120.750 bcd	13.401 aj	17.942 hm	107.136 ef	47.254 abc	67.812 Cde	135.148 ad
4x8	28	119.750 eh	13.794 cf	22.041 a	147.835 a	47.552 Ab	96.991 a	136.796 abc
4x9	29	120.250cf	13.342 ej	19.525 be	111.027 cd	47.260 abc	69.994 bcd	121.359 jl
4x10	30	117.250oq	12.454 lq	17.795 in	105.826 eh	45.781 ag	60.312 hn	136.796 abc
5x6	31	118.000lo	13.102 fl	16.890 mn	88.066 su	44.618 Ej	51.478 qu	127.860 fi
5x7	32	120.000 Dg	12.922 gn	20.386 b	116.231 b	42.140 kp	63.269 ej	121.810 jl
5x8	33	117.250oq	14.150 bcd	17.096 ln	102.530 hk	42.669 jo	61.890 fk	136.796 abc
5x9	34	117.750mp	12.870 in	17.451 jn	101.827 il	44.726 dj	58.699 ip	131.754 cf
5x10	35	118.250Kn	12.594 kp	18.081 gl	102.802 gk	43.364 hn	56.154 lq	136.713 abc
6x7	36	117.000pr	13.302 ek	18.358 fk	101.486 jl	46.972 ad	63.406 ej	137.793 ab
6x8	37	117.667mp	13.001 gl	17.286 kn	104.602 fj	45.296 bi	61.677 gk	132.843 bf
6x9	38	119.333fj	14.571 ab	18.672 ei	92.308 pq	46.781 ae	62.942 ej	131.290 dg
6x10	39	118.500jm	13.084 fl	17.904 hm	85.242 tv	42.670 jo	47.558 tw	125.822 hj
7x8	40	120.250cf	14.953 a	19.063 dg	94.826 op	45.820 ag	65.028 dh	129.400 eh
7x9	41	120.250cf	13.600 dh	19.784 bd	101.311 jm	46.326 af	63.859 ei	139.733 a
7x10	42	122.000a	12.225 nr	18.076 gl	83.243 v	41.633 lp	42.352 wy	134.816 ad
8x9	43	117.500np	12.126 or	18.517 ej	102.927 gk	44.326 fk	55.350 mq	132.907 bf
8x10	44	120.500cde	12.242 mn	16.988 hp	106.136 eg	42.480 jo	55.173 nq	125.459 hj
9x10	45	120.750 bcd	12.991 gl	17.309 kn	90.076 qs	44.326 fk	51.851 qu	125.338 hj
Parents average		119.950	12.246	16.547	92.272	40.870	46.517	110.125
hybrid average		119.035	12.981	17.949	100.017	44.079	57.613	126.401
general average		119.201	12.847	17.694	98.609	43.495	55.595	123.441

Table (4) shows the results of the hybrid strength of the studied traits, which were measured on the basis of the deviation of the first generation from the average of the parents in the Half Diallel Crosses, in which it is noted that the trait of the Days 75% flowering showed a significant negative hybrid strength at the level of probability (1%) and in the desired direction in hybrids (2x4), (2x8), (2x9), (3x4), (3x6), (3x8), (3x9), (3x10), (4x5), (4x6), (4x8), (4x9), (4x10), (5x6), (5x8), (5x9), (5x10), (6x7), (6x8), (6x9), (6x10), (8x9), (8x10), and (9x10).This means that the above-mentioned hybrids had a shorter heading date than the average of the parents. Plant breeders are always looking for ways to develop crops that flower earlier and have more viable pollen. This is important for pollination and fertilization, which are essential for crop production. The hybrid (4x10) had the shortest flowering time, at(-5.625) days. The hybrids (3x6) and (8x9) had the next shortest flowering times, at (-4.458 and -4.628) days, respectively. The hybrids that flowered the latest were (1x3), (1x4), (1x5), (1x6), (1x7), (1x8), (2x3), (2x5), (2x7), (3x5), and (7x10). The results of this study suggest that the hybrid (4x10) is a promising candidate for further development as a crop with earlier flowering. This could lead to increased crop yields and improved food security. And to traits the No. of tillers plant-1 , twenty-two hybrids were produced (1x3) and (1x4) and (1x5) and (1x6) and (1x7) and (1x8) and (1x9) and (2x4) and (2x5) and (2x7) and (2x9) and (3x7) and (3x8) (3 x9), (4x7), (4x8), (5x8), (6x9), (6x10), (7x8), (7x9) and (9x10) in the desired direction and high in morale. It gave three hybrids (4x9) , (6x7) and (6x8) were produced the strength of the Heterosis is positive and significant, and the highest increase was (2.817) for the hybrid (7x8). With regard to the characteristic of the spike length (g), the strength of the hybrid was desirable and significant at the probability level of 1% in hybrids ((1x3) and (1x4) ,(1x5) , (1x6) , (1x7) , (1x8) , (1x9) , (1x10) , (2x5) , (2x7) , (2x9) , (3x4) , (3x5) , (3x6) , (3x7) , (3x8) , (3x9) , (3x10) , (4x5) , (4x8) , (94x) a, (5x7) , (5x10) , (7x9) , (7x10) and (9x10) and gave four hybrids (2x4), (4x10), (6x10) and (7x8) at a probability level of 5%. There was a highly significant increase in twenty-nine hybrids (1x3) , (1x4) , (1x8) , (1x9) , (2x4) , (2x6) , (2x7) , (2x8) , (2x9) , (2x10) , (3x4) , (3x5) , (3x7) , (3x8) , (3x10) , (4x5) , (4x7) , (4x8) , (4x9) , (4x10) , (5x7) , (5x8) , (5x9) , (5x10) , (6x7) , (6x8), (9x7), (8x9) and (8x10) for the No. of grains. spike-1 and significant in five crosses (1x5), (1x7), (1x10), (2x5) and (6x9), and the highest value was (45.794) For a hybrid (4x8). As for the weight 1000 grains(g), twenty-nine crosses achieved positive and significant hybrid strength at a probability level of 1%, while the crosses were (1x10), (2x10), (3x9), (5x8) and (9x10) at a probability level of 5% , and the highest increase was (7.536) for the hybrid (1x9). In the trait single grains yield(g) , gave thirty-three hybrids achieved positive and significant hybrid strength at the level of probability of 1%, while it was in six hybrids (1x6), (3x4), (3x10), (5x6), (6x10) and (9x10) were significant at a probability level of 5%, and the highest increase for the hybrid (4x8) was (43.771). While for the characteristics of the biological yield, thirty-six hybrids gave positive and highly significant values, and one hybrid (4x9) gave a positive and significant hybrid strength and reached the highest value (30.002) for the hybrid (2x9).

The results of the study show that there is a significant hybrid vigor compared to the average of the parents in all the studied traits. The following hybrids showed desirable and significant hybrid vigor (4×2), (9×2), (8×3), (8×4), and (9×4) for all the studied traits.(8×1), (9×1), (4×3), (7×3), (9×3), (10×4), and (10×5) for six of the studied traits. (3×1), (4×1), (7×2), (8×2), (5×4), and (7×6) for five of the studied traits. [12], [13], [14], [15], [16], [17]. in their previous studies for obtaining a significant and desirable cross-breed strength compared to the average of the parents for the studied traits.

Table (4): Heterosis on the basis deviation of the first generation from the average of the parents.

Hybrids	Days 75% flowering	No. of tillers plant-1	spike length (cm)	No. of grains. Spike-1	weight1000 grains(g)	single grains yield (g)	Biological yield/plant (g)
1x2	0.875*	-0.342	0.250	1.085	4.018**	2.803	12.994**
1x3	2.125**	0.928**	1.608**	7.381**	2.604**	10.603**	-0.013
1x4	2.250**	0.993**	3.725**	4.938**	4.583**	12.441**	-14.473**
1x5	1.625**	1.533**	1.261**	3.530*	5.589**	14.916**	14.895**
1x6	2.083**	1.062**	2.563**	-0.090	1.139	4.865*	18.550**
1x7	2.292**	1.635**	3.333**	3.457*	0.613	8.716**	25.990**
1x8	1.083**	0.980**	3.421**	10.076**	5.139**	15.281**	24.953**
1x9	0.708	1.257**	2.355**	5.200**	7.536**	17.186**	21.746**
1x10	0.458	0.440	1.397**	2.974*	4.123*	7.628**	-18.592**
2x3	2.417**	0.302	0.694	-0.064	-2.047*	-2.097	19.804**
2x4	-1.375**	0.993**	0.874*	15.625**	4.248**	15.775**	25.067**
2x5	2.417**	1.658**	3.228**	3.730*	2.537*	9.533**	21.743**
2x6	0.625	-0.001	-0.312	11.520**	3.023**	7.993**	28.142**
2x7	2.333**	1.399**	1.745**	7.204**	0.786	8.474**	20.254**
2x8	-1.875**	0.555	0.227	22.186**	2.759**	14.995**	24.250**
2x9	-1.250**	0.979**	1.975**	14.786**	3.034**	13.500**	30.002**
2x10	0.0125	-0.187	-0.303	4.082**	2.286*	2.864	26.025**
3x4	-1.958**	-0.257	2.642**	4.307**	3.194**	5.245*	-8.762**
3x5	2.083**	-0.076	2.142**	15.475**	5.419**	16.018**	3.753
3x6	-4.458**	0.423	1.968**	-6.801**	1.787	-0.041	19.492**
3x7	-0.250	1.210**	3.515**	15.576**	4.602**	21.432**	14.071**
3x8	-1.458**	1.993**	1.772**	6.971**	3.842**	17.860**	14.392**
3x9	-3.083**	1.683**	2.046**	2.849	2.509*	12.303**	14.477**
3x10	-1.833**	-0.058	2.719**	7.258**	1.573	5.278*	14.629**
4x5	-2.208**	0.338	2.047**	11.711**	5.278**	16.293**	18.268**
4x6	-1.500**	0.593	-0.387	1.839	4.327**	8.808**	-16.755**
4x7	0.458	0.889**	0.282	4.268**	3.708**	11.826**	16.474**
4x8	-2.250**	1.582**	3.981**	45.794**	5.027**	43.771**	19.634**
4x9	-2.125**	0.794*	1.768**	6.502**	5.101**	14.634**	4.796*
4x10	-5.625**	0.251	1.052*	6.834**	3.165**	8.557**	21.411**
5x6	-2.708**	-0.237	-0.429	0.617	5.229**	5.534*	17.205**
5x7	1.000*	-0.302	3.084**	21.902**	1.036	12.228	3.560
5x8	-3.458**	1.227**	-0.606	9.026**	2.587*	13.614**	20.059**
5x9	-3.333**	-0.391	0.053	5.840**	5.010**	8.284**	15.616**
5x10	-3.333**	-0.321	1.696**	12.348**	3.191**	9.343**	21.753**
6x7	-3.042**	0.751*	0.552	14.040**	4.585**	16.781**	23.380**
6x8	-4.083**	0.751*	-0.919*	17.982**	3.930**	17.817**	19.943**
6x9	-2.792**	1.983**	0.769	3.205*	5.782**	16.943**	18.988**
6x10	-4.125**	0.842**	1.015*	1.672	1.213	5.163*	14.699**
7x8	0.208	2.817**	0.874*	1.326	2.740**	16.072**	-8.906**
7x9	-0.167	1.127**	1.898**	5.327**	3.611**	12.763**	19.837**
7x10	1.083**	0.097	1.204**	-7.208**	-1.538	-5.139*	16.099**
8x9	-4.625**	-0.047	0.231	7.769**	2.634**	7.019**	14.524**
8x10	-2.125**	0.415	-0.284	16.510**	0.330	10.447**	8.255**
9x10	-2.250**	0.827**	0.340**	-2.033	2.543*	4.985*	8.732**
SE(H)	0.400	0.315	0.455	1.542	0.996	2.288	2.297

(ns) ,(*) And (**) is not significant and significant at the level of 5% and 1% respectively.

Table (5) shows the results of the hybrid strength for the studied traits, which were measured on the basis of the deviation of the first generation fromThe best parentsAnd it is noted in the description of the duration until the Days 75% flowering that the hybrids showed (3x6) ,(3x9) , (4x6) , (4x8) , (4x9) , (4x10) , (5x6) , (5x8) , (5x9) , (5x10) , (6x7) , (6x8) , (6x9) , (6x10), (8x9), (8x10) and (9x10) the strength of the hybrid and in the desired direction at the level of probability of 1%, while it gave only one hybrid (6x7) at the level of probability of 5%. And for the description of the No. of tillers plant^{-1} the hybrids gave (1x7) , (1x8) (1x9) , (3x7) , (3x8) , (3x9) , (4x8) , (6x9) , (7x8) and (7x9) in the desired direction (1.039, 1.864, 1.474, 1.206, 1.905, 2.516, and 1.390), respectively, and showed desirable and significant values for two hybrids (1x3) and (4x7), which amounted to (0.781 , 0.814), respectively, as for the hybrids (2x6), (3x5) , (5x7), (5x9) and (5x10) were negative and highly significant and significant in three hybrids (1x2), (2x10) and (5x6) in the undesirable direction. As for the trait of spike length (g), the strength of the hybrid was desirable and highly significant at the probability level of 1% in hybrids (1x4), (1x7), (1x8), (2x4), (3x4), (3x5), (3x7) and (3x10). And (4x5), (4x8), (4x9), (5x7) and (7x9) and gave four hybrids (1x6), (3x6), (3x9) and (5x10) at a probability level of 5%. The trait No. of grains. spike^{-1} was significantly higher in the hybrids (1x8), (2x6), (2x8), (3x7), (4x8), (5x7), (5x8), (5x10), (6x7), (6x8), (8x9), (8x10), and (9x10). The hybrids (5x9) and (7x9) also had a significant positive hybrid vigor, with the highest increase being 4.185 for the hybrid (5x9) and 3.669 for the hybrid (7x9). . For the weight 1000 grains (g), the hybrids gave (1x2), (1x5), (1x8), (1x9), (3x5), (3x7), (3x8), (4x6), (4x7), (4x8), (4x9), (5x6), (5x9), (6x8) (6x9) positive and significant hybrid strength at a probability level of 1%, while hybrids (1x4), (3x4), (4x5), (4x10), (6x7), (7x9) and (8x9) gave positive and significant hybrid strength at The probability level was 5%, and the highest value was (5.975) for the hybrid (9x1). As for the single grains yield (g), twenty hybrids gave positive and highly significant values of hybrid strength at the probability level of 1% and in three hybrids (1 x 10) and (2 x 8) (5 x 10) were significant at the 5% probability level, and the highest increase for the hybrid (4 x 8) amounted to (36.741). As for the characteristic of the Biological yield/plant (g) , thirty-two hybrids gave a significant desired hybrid strength at the level of probability 1%, while four hybrids (1x10), (2x5), (2x8) and (8x10) gave a significant hybrid strength at the level of probability 5%.

We conclude from the above that there is significant hybrid vigor compared to the average of the best in all the studied traits. The following hybrids showed desirable and significant hybrid vigor:(8×4) and (9×7) for all the studied traits.(8×1) and (7×3) for six of the studied traits.(9×3), (9×4), (9×5), (7×6), (8×6), and (9×6) for five of the studied traits..[14], [15] ,[16] ,[17], [18] ,[19] ,[20] ,[21].obtained in their previous studies for obtaining a moral and desirable crossbreed strength in comparison to the best parents for the studied traits

Table (5): Heterosis on the basis deviation of the first generation from the best parents

Hybrids	Days 75% flowering	No.of tillers plant-1	spike length (cm)	No. of grains. Spike-1	Weight 1000 grains(g)	single grains yield (g)	Biological yield/plant g)(
1x2	1.167*	-0.888*	-0.951	-5.917**	3.284**	-2.490	7.878**
1x3	3.917**	0.781*	0.963	1.016	0.570	4.666	-13.223**
1x4	5.583**	0.598	2.311**	-6.354**	2.190*	2.333	2.503
1x5	3.667**	0.426	0.205	0.776	5.638**	9.752**	3.351
1x6	5.167**	0.628	1.003*	-4.221*	-0.095	4.118	10.842**
1x7	3.667**	1.316**	1.790**	0.707	-2.337*	2.872	10.688**
1x8	4.167**	0.961**	1.478**	8.151**	3.212**	12.203**	11.164**
1x9	4.167**	0.901**	0.715	0.792	5.975**	11.967**	8.555**
1x10	4.417**	0.429	0.770	1.849	2.105	6.015*	6.581*
2x3	4.500**	-0.392	-1.152*	-13.429**	-4.815**	-13.328**	1.478
2x4	2.250**	0.052	-1.741**	-2.667	1.120	0.373	7.981**
2x5	4.750**	0.005	0.971	-6.025**	1.853	-0.924	5.083*
2x6	4.000**	-0.981**	-3.073**	8.649**	1.055	1.953	15.318**
2x7	4.000**	0.534	-0.999*	-2.547	-2.897*	-2.663	-0.164
2x8	1.500**	-0.010	-2.918**	13.260**	0.097	6.624*	5.345*
2x9	2.500**	0.077	-0.866	3.377	0.739	2.988	11.695**
2x10	4.250**	-0.744*	-2.130**	-1.794	-0.467	-4.043	8.897**
3x4	-0.417	-0.505	1.873**	-0.620	2.835*	1.074	7.522**
3x5	2.333**	-1.035**	1.731**	11.864**	3.335**	15.244**	2.087
3x6	-3.167**	0.137	1.053*	-17.296**	0.987	-5.231*	13.990**
3x7	-0.667	1.039**	2.616**	11.961**	3.687**	21.339**	11.979**
3x8	-0.167	1.864**	0.474	2.530	3.735**	15.002**	13.813**
3x9	-1.417**	1.474**	1.050*	0.892	2.036	11.584**	14.458**
3x10	0.333	-0.195	2.737**	-0.231	1.557	0.955	13.431**
4x5	-0.917*	-0.374	1.689**	3.173	2.835*	11.348**	17.843**
4x6	-1.250**	0.554	-0.533	-13.583**	3.168**	-0.553	-12.493**
4x7	2.417**	0.814*	0.153	-4.273*	3.152**	7.561**	13.141**
4x8	-2.000**	1.206**	3.452**	36.427**	4.561**	36.741**	17.815**
4x9	-2.000**	0.755*	1.542**	-0.382	4.269**	9.744**	3.575
4x10	-5.000**	-0.133	0.264	-5.583**	2.790*	0.062	21.454**
5x6	-1.667**	-0.910*	-0.933	-6.267**	3.945**	1.118	13.368**
5x7	1.667**	-1.090**	2.597**	21.899**	-1.962	11.548**	-0.197
5x8	-2.417**	0.138	-1.493**	8.197**	0.610	11.529**	17.815**
5x9	-1.917**	-1.142**	-0.531	4.185*	3.399**	8.228**	13.969**
5x10	-1.417**	-1.418**	1.266*	8.470**	1.123	5.793*	21.286**
6x7	-1.333**	0.637	0.535	7.160**	2.870*	11.684**	15.786**
6x8	-4.083**	0.336	-1.303*	11.927**	3.237**	15.486**	13.862**
6x9	-2.417**	1.905**	0.689	-5.334**	5.455**	12.471**	13.505**
6x10	-3.250**	0.419	0.082	-1.334	0.429	4.297	10.395**
7x8	1.917**	2.516**	0.473	0.500	1.718	13.306**	7.393**
7x9	1.917**	1.090**	1.801**	3.669*	2.223*	12.137**	17.726**
7x10	3.667**	-0.211	0.287	-11.083**	-2.469*	-9.369**	12.809**
8x9	-4.250**	-0.384	-0.072	5.286**	2.267*	4.879	13.926**
8x10	-1.250**	0.407	-1.601**	13.461**	0.239	8.983**	6.478*
9x10	-1.750**	0.482	-0.674	-7.565**	2.086	1.380	7.553**
SE(H)	0.462	0.363	0.525	1.781	1.150	2.642	2.653

(ns) ,(*) And (**) is not significant and significant at the level of 5% and 1% respectively.

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مجلة جامعة كركوك للعلوم الزراعية

تقدير قوة الهجين عن متوسط الأبوين وافضلهما في جيل F_1 لتراكيب وراثية من حنطة الخبز.

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- تاريخ استلام البحث 2023/10/02 وتاريخ قبوله 2023/10/30.
- البحث مستل من أطروحة دكتوراه الباحث الاول .

الملخص

تضمنت هذه الدراسة 10 تراكيب وراثية من حنطة الخبز هي M45 ، Yakora ، Giza168 ، Sids 12 ، SK95 ، Misr2، Giemiza9 ،Sahel1، Sids14 ، Silano تم زراعة التراكيب الوراثية (الاباء وهجنها الفردية) في محطة بحوث قسم المحاصيل الحقلية التابعة لكلية الزراعة في جامعة كركوك خلال الموسم الزراعي الشتوي (2021−2022) بتصميم القطاعات العشوائية الكاملة (R.C.B.D.) و بثلاثة مكررات ، ودرست الأداء وقوة الهجين على أساس متوسط وافضل الأبوين لصفات: المدة إلى طرد 50% من السنابل وعدد السنابل في النبات وطول السنبلة وعدد الحبوب في السنبلة ووزن 1000 حبة وحاصل النبات الفردي والحاصل البيولوجي، ويمكن تلخيص أهم النتائج كما يلي : كان أفضل أداء للاب (Sids12) لصفات عدد الحبوب بالسنبلة (111.409)حبة ووزن 1000 حبة (42.991) غم وحاصل النبات الفردي (60.250) غم نبات$^{-1}$ ، والهجين (Sids 12* Sahel 1) لصفات طول السنبلة (22.041) سم وعدد الحبوب في السنبلة (147.835) حبة وحاصل النبات الفردي (96.991) غم نبات$^{-1}$، أظهر الهجن (Yakora*Sids12) و(Yakora*Sids14) و(Giza168*Sahel1) و(Sids12*Sahel1) و(Sids 12* Sids14) قوة هجين عالية المعنوية المحسوبة على أساس انحراف عن متوسط الأبوين لجميع الصفات المدروسة (المدة إلى طرد 50% من السنابل وعدد السنابل في النبات وطول السنبلة وعدد الحبوب في السنبلة ووزن 1000 حبة وحاصل النبات الفردي والحاصل البيولوجي) ، وأعطى الهجين (Giemiza 9* Sids14) قوة هجين معنوية محسوبة على أساس انحراف الجيل الأول عن أفضل الأبوين لجميع الصفات المدروسة .

الكلمات المفتاحية: حنطة الخبز، تهجين التبادلي النصفي، قوة الهجين. .