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STUDY OF HYBRID VIGOR, COMBINING ABILITY AND SOME GENETIC PARAMETERS IN OKRA.

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ABSTRACT

This study was aimed ot investigate, hybrid vigor and combining ability in some traits of okra. to during 2021 and 2022 seasons, at private field located in the Mahmoudiya district of Baghdad, using the 7-line × 3 tester method. In the second season, the genotypes (parents and hybrids) were compared in varietal trait using Randomized Complete Block Design (RCBD) with three replications. The results revealed significant differences among the parents and crosses for most of studied traits. Hybrids O4×O2 and O10×O3 emerged as standouts, achieving the highest yield in the plastic house, with yields 927.80 kg and 892.60 kg, respectively. Hybrids O5×O1, O6×O2, and O8×O3 produced the highest numbers of pods. Hybrid O4×O2 exhibited the most significant positive values for hybrid vigor, reaching 54%, in plastic house yield. Certain parents exhibited a positive and significant general combining ability in the desired direction for the measured traits. Furthermore, hybrids O4×O2 and O10×O3 demonstrated a positive and significant specific combining ability in plastic house yield.

Key words: **average degree of dominance, gene action, heritability, hybridization.**

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INTRODUCTION

Hybrid vigor has garined substantial attention from scholars to its economically immense significance. Studies have demonstrated that this phenomenon results from the hybridization of genetically distinct breeds, often yielding hybrids of significant commercial value (Laxman et al.,2013). Interestingly, hybrid vigor could be emerge when inbreed line with high genetic similarity within the breed , which used in hybridization. Beyond genetic distance, there is a critical need for a strong ability to combine traits between parent inbreed line. Ashwani et al. (Amaranatha et al., 2013) delved into combining ability and hybrid vigor, specifically focusing on yield characteristics in okra, using the 5-line x 3 tester method. Their findings revealed significant positive values for combining ability effects, emphasizing the prevalence of non-additive gene actions across various measured traits. Understanding the genetic interactions and combining ability between parents plays a pivotal role in selecting the right candidates for hybridization programs. This knowledge could be lead to the development of exceptional hybrids, capitalizing on the phenomenon of hybrid vigor, and the creation of genotypes suitable for future breeding eavors (Ashwani et al. 2013Kishor et al. (2013) conducted a study using a taxation approach (5-line x 3 tester) in okra, uncovering positive hybrid vigor in yield-related traits and other characteristics. They observed significant hybrid vigor in yield, flowering time, branches numbers, pods numbers, pod weight, pod length, and pod diameter. Furthermore, they identified positive values for both general and specific combining abilities, alongside high heritability broad

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sense for most of the measured traits. Amaranatha et al. (2013) investigated hybrid vigor and its components in okra, finding positive and significant hybrid vigor, with the highest vigor that observed in traits of pods number, pod weight, and total yield. In a study involving reciprocal crosses of seven okra cultivars, Saeed et al. (2014) identified significant hybrid vigor for numerous traits, showcasing the substantial genetic variation within the host population. They noted high heritability in both broad and narrow senses for traits like flowers number, pods number, early yield, and total yield. The degree of dominance exceeded one for most studied traits, except for pod length and diameter. Singh and Singh (2012) explored hybrid vigor and combining ability in a 51-line x 3 tester method across ten characteristics. Their investigation unveiled significant hybrid vigor in vegetative and flowering growth traits, as well as yield components. They also observed significant positive effects for private general combining ability, coupled with high heritability for most traits.This study aimed to develop unique local hybrids using the line x tester breeding approach, focusing on general and specific combining abilities, and explore various genetic parameters while identifying promising hybrids.

MATERIALS AND METHODS

This experiment was conducted during 2021 and 2022 seasons. First season, ten okra cultivars were cultivated (Table 1), Their various traits were meticulously recorded, subsequently, certain cultivars were chosen as maternal lines (line), while others were designated as paternal lines (tester). This selection was based on specific phenotypic characteristics that distinguished these cultivars. Hybridization was carried out among the selected parents using the 7lines×3testers method during the flowering stage. After successful hybridization, once the pods had fully matured and begun to show signs of pod cover cracking, the pods from each parent were individually harvested. In addition, the seeds were carefully extracted and preserved for planting in the next season. In the 2022 season, a comprehensive experiment was conducted to evaluate the performance of the genotype (hybrids + their parents) alongside a commercially available hybrid, Abeer, at the Debbana Agricultural Company station in the Mahmoudiya District of Baghdad. The experiment encompassed a total of 32 genotypes, consisting of 21 hybrids, their ten parental lines, and the commercial hybrid Abeer. The evaluation experiment carried out using randomized complete block design (RCBD) with three replicates. The hybrids and parental seeds were initially sown in trays on December 15, 2021, and the seedlings were subsequently transplanted in January 15, 2022, into a plastic house covering an area of 450 (9 m × 50 m). In total, 1200 plants were planted within the plastic house. All the agricultural operations were conducted in accordance with the specific requirements of the plants. Data collected for various vegetative and flowering growth traits, as well as yield-related traits such as plant height, leaves area, total flowers) No, pods No, pod length, pod diameter, and greenhouse yield), were collected from all plants within the experimental units. Statistical analysis was carried out using the Genstat program, and mean values were compared using the least significant difference (L.S.D) test at a 0.05 significance level. Hybrid vigor was calculated relative to the highest performing parents for traits such as leaves area, flower No, pod No and plastic house ;yield, Based on the following equation
calculations were based on comparisons with the lowest performing parents and standard hybrid vigor for traits (plant height, pod length and pod diameter). In order to conduct genetic analysis, According to the following equation

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Low paraent ;
High parent ;
main of the first generation hybrid ;
Data pertaining to the commercial hybrid Abeer were excluded from the analysis. Subsequently, statistical analysis was performed on the remaining genotypes,using the Line × Tester method. were calculated following the methodology outlined by (Singh .(and Chaudhary. 1985

Table 1: Genotypes und.r study1rigins and Symbols Name of genotypes

Cultivars		
Name of genotypes	Source	Symbol
Petra	Local	O1
Strain 7	Local	O2
Betira mously	Local	O3
Petra	Egypt	O4
Betira	Local	O5
spineless Clemson	American	O6
940	Turkey	O7
Hussainawiya	Local	O8
Green Okra	Egypt	O9
Betira	Turkey	O10

RESULTS AND DISCUSSION

Analysis of growth traits

The results in Table 2 reveals significant differences among the various genotypes, indicating variations among the parental lines and their higher combinations. Some parents exhibited superiority over others in specific measured traits. For instance, parent O9 producal the shortest plant height (61 cm) and the largest leaves area (2.77). Parents O3, O5, O7, O9, and O10 outperformed others by producing the highest number of flowers (200 flowers each). Parents O7 and O9 stood out by yielding the greatest number of pods (185 pods). Conversely, parent O10 had the shortest pods (2.83 cm), and parent O4 had the smallest pod diameter (7.67 mm). Notably, parent O8 achieved the highest yield in the 450 plastic house (939.68 kg). On the other hand, parent O4 displayed the tallest plants (144 cm), while parent O2 had the smallest leaves area (0.95). Parent O6 produced the lowest number of flowers and pods (120 flowers and 105 pods, respectively). Parent O3 had the longest pods (4.5 cm), and parent O7 had the largest pod diameter (12.67 mm). Parent O2 yielded the lowest plastic house yield (552 kg). It's worth mentioning that the pods from parents O9 and O10 exhibited desirable qualities for consumers, characterized by their small diameter (8.33 mm and 12.33 mm, respectively) and short length (2.97 cm and 2.83 cm, respectively). Similar findings were reported by (Al-Zobaie. 2004,Saeed. et al. 2014) in their studies on okra. These variations among parents were subsequently reflected in the resulting hybrids. Certain hybrids outperformed the overall average of their parents. For instance, the hybrid O9×O3 exhibited the shortest plant height (76.33 cm), while the hybrid O6×O1 displayed the largest leaves area (3.47). Hybrids O5×O1, O6×O2, and O8×O3 produced the highest number of flowers (200 flowers each), while hybrids O5×O1 and O6×O2 yielded the greatest number of pods (190 pods each). In contrast, the hybrid O9×O2 had the shortest pods (2.83 cm). The smallest pod diameter (12.33 mm) was observed in hybrids O5×O1, O6×O2, O9×O2, and O4×O3. Notably, the hybrid O4×O2 had the highest plastic house yield (927.8 kg), and it did not significantly differ from the hybrid O10×O3. Both of these hybrids significantly outperformed the commercial hybrid OE in plastic house yield (756 kg). The hybrids O9×O2, O4×O3, and O6×O2 were distinguished by the quality of their pods, which are desirable for consumers due to their short length and small diameter.

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Table 2. Vegetative, flowering growth and yield of parents and their hybrids of okra and commercial hybrids

Genotypes	Plant height(cm)	Leave area(m2)	No.of. Flowers	No.of pods	Pod length(cm)	Pod diameter(mm)	Plastic house yield (kg)
O1	107.33	1.01	196.67	181.67	3.17	11.33	579.40
O2	126.67	0.95	186.67	165.00	4.33	8.67	552.00
O3	96.33	1.49	200.00	171.67	4.50	11.33	562.80
O4	144.00	1.03	173.33	151.67	4.33	7.67	602.48
O5	111.00	2.08	200.00	182.33	3.43	11.67	604.90
O6	89.33	1.16	120.00	105.00	3.83	11.33	566.16
O7	123.33	1.04	200.00	185.00	3.83	12.67	683.02
O8	133.67	1.74	186.67	151.67	4.30	10.00	939.68
O9	61.00	2.77	200.00	185.00	2.97	8.33	814.00
O10	115.33	1.00	200.00	178.33	2.83	12.33	929.90
O4*O1	120.67	1.04	173.33	163.33	3.83	13.33	606.40
O5*O1	121.00	2.13	200.00	190.00	3.07	12.33	744.76
O6*O1	121.33	3.47	173.33	163.33	4.27	13.67	627.60
O7*O1	135.33	2.05	186.67	170.00	3.67	13.00	763.60
O8*O1	112.33	3.15	186.67	176.67	4.47	13.67	529.40
O9*O1	99.67	1.23	160.00	150.00	3.33	12.67	539.40
O10*O1	115.33	1.23	186.67	176.67	4.17	12.67	614.64
O4*O2	153.67	1.84	160.00	150.00	4.17	13.67	927.80
O5*O2	166.67	2.09	196.67	182.00	4.03	13.33	565.36
O6*O2	123.33	2.20	200.00	190.00	3.03	12.33	736.44
O7*O2	120.67	2.32	186.67	176.67	3.77	13.00	608.44
O8*O2	104.67	0.98	160.00	150.00	3.83	13.33	565.00
O9*O2	112.33	1.68	196.67	176.67	2.83	12.33	498.56
O10*O2	131.33	1.09	193.33	183.33	4.50	14.00	597.80
O4*O3	102.00	1.29	183.33	173.33	3.00	12.33	587.40
O5*O3	135.67	1.77	173.33	163.33	3.33	12.67	549.40
O6*O3	133.67	0.84	186.67	156.67	3.17	12.67	565.20
O7*O3	146.33	3.21	173.33	163.33	3.77	13.00	655.60
O8*O3	124.67	2.92	200.00	186.67	4.17	13.67	480.88
O9*O3	76.33	1.06	186.67	156.67	3.83	13.33	494.80
O10*O3	123.67	0.99	173.33	156.67	3.17	12.67	892.60
OE	77.00	2.68	193.33	181.67	2.83	12.33	756.00
L.S.D	4.81	0.20	29.14	26.10	1.03	1.29	83.98
Grand mean	117.68	1.74	184.17	168.57	3.68	12.23	648.17

Differences between the average performances of parents and their hybrids have resulted in the manifestation of hybrid vigor across various vegetative and flowering growth traits as well as yield, as illustrates in Table 3. The hybrid O8×O2 stood out by exhibiting a noticeable negative hybrid vigor in the desired direction, particularly in plant height. Additionally, nine hybrids displayed positive and significant values for leaves area, while the hybrid O6×O2 showcased the highest hybrid vigor with a significant positive impact on both the number of flowers (7.14%) and the number of pods (15.15%).Conversely, the hybrid O3×O4 demonstrated a significant negative value for hybrid vigor, particularly in relation to pod length (-30.67%). Another noteworthy observation was that the hybrid O5×O1 displayed the lowest, significant, positive value for hybrid vigor relative to the lowest parental performance, particularly in the diameter of the pod (8.82%). Moreover, five hybrids exhibited significant positive values for hybrid vigor in the plastic house yield, which covered an area of 450 . The hybrid O4×O2 excelled by yielding the highest

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hybrid vigor value (54%). These findings with previous research, including the work of) Singh. and . Chaudhary. 1985 Singh and Singh.2012. Amaranatha et al. 2013 ,Elias andAl-Jubouri, 2022).

Table 3. Hybrid vigor (%) of okra single hybrids developed by line×tester method in vegetative and flowering growth traits and yield

Hybrids	Plant height	Leave Area	Flowers no	Pods no	Pod length	Pod diameter	Yield of the plastic house
O4×O1	12.428	1.294	-11.864	-10.092	21.029	73.901	0.651
O5×O1	12.736	2.404	0.000	4.205	-3.157	8.823	23.121
O6×O1	35.822	199.138	-11.864	-10.092	34.733	20.594	8.319
O7×O1	26.087	98.071	-6.667	-8.108	15.787	14.709	11.798
O8×O1	4.658	80.688	-5.085	-2.752	41.048	36.670	-43.662
O9×O1	63.393	-55.596	-20.000	-18.919	12.335	52.010	-33.735
O10×O1	7.453	21.053	-6.667	-2.752	47.087	11.771	-33.903
O4×O2	21.315	78.641	-14.286	-9.091	-3.831	78.257	53.997
O5×O2	50.153	0.481	-1.667	-0.183	17.477	53.836	-6.537
O6×O2	38.061	89.943	7.143	15.152	-20.871	42.298	30.076
O7×O2	-2.156	123.473	-6.667	-4.505	-1.722	49.994	-10.919
O8×O2	-17.363	-43.977	-14.286	-9.091	-10.860	53.836	-39.873
O9×O2	84.147	-39.350	-1.667	-4.505	-4.516	48.001	-38.752
O10×O2	13.873	8.638	-3.333	2.804	58.842	61.532	-35.714
O4×O3	5.886	-13.423	-8.333	0.971	-30.763	60.858	-2.503
O5×O3	40.838	-14.904	-13.333	-10.420	-2.913	11.771	-9.175
O6×O3	49.636	-43.400	-6.667	-8.738	-17.375	11.765	-0.170
O7×O3	51.904	115.213	-13.333	-11.712	-1.722	14.709	-4.015
O8×O3	29.419	67.304	0.000	8.738	-3.093	36.670	-48.825
O9×O3	25.131	-61.733	-6.667	-15.315	29.188	60.002	-39.214
O10×O3	28.381	-33.781	-13.333	-12.150	11.790	11.771	-4.011
S.E	3.871	15.539	1.389	1.789	3.626	3.084	5.969

Genetic analysis using the line×tester method (Table 4) revealed significant differences in the mean squares for various traits across all sources of variation, including genotypes, parents, parents vs. hybrids, hybrids, lines, testers, and the interaction between lines and testers. Notably, the sources of variation significantly affected traits such as plant height, plastic house yield, and leaves area, indicating their importance in the study. However, for some traits like pod length and pod diameter, the overlap between Line×tester did not have a significant effect on the mean squares, which led to the exclusion of these traits from further analysis of general and specific combining ability susceptibility, following (Singh and Singh.2012).

Table 4. Sources of difference, degrees of freedom, and mean squares of studied traits

S.o.d	D.f	Plant height	Leave area	Flowers no	Pods no	Pod length	Pod diameter	Plastic house yield
Rep	2	2.510	0.001	51.042	0.760	0.133	0.792	2354.658
Genotybe	30	1510.505**	1.8041**	896.7742**	900.3061**	0.9215**	7.3212**	52879.9329 **
Parent	9	1738.904**	1.097**	1870**	1850.207**	1.151**	9.274**	70860.005 **
P.vs. C	1	2969.967**	3.397**	268.515 NS	258.756 NS	0.093 NS	126.855**	66473.856 **
Crosses	20	1154.078**	1.996**	522.063 NS	523.397 *	0.795*	0.830NS	44952.822 **
Line	6	1909.889**	2.816**	277.249 NS	320.36 NS	0.745 NS	0.656NS	57845.611**
Testers	2	913.825**	0.673**	77.778 NS	297.397 NS	0.643 NS	0.302 NS	8585.583**
Line xTesters	12	816.214**	1.806 NS	718.519**	662.582**	0.845 NS	2.065 NS	44567.635 **
Error	60	8.667	0.015	318.423	255.503	0.401	0.622	2644.867

Table 5 shares significant general combining ability, indicating their strong combining ability for specific traits. For instance, O5 displayed strong combining ability for the number of flowers and pods. Parents O1, O3, O4, O7, and O10 exhibited significant positive values for plastic house yield. Conversely, parents O2, O8, and O9 displayed significant negative values in the desired direction for plant height. Other parents showed non-

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significant positive or negative values, indicating medium combining ability or low combining ability for the measured traits. The parents with good combining ability contribute positively to the trait improvement in their hybrid offspring. Hybrid performance often aligns with the behavior of the parents, whether in enhancing or reducing specific traits. These findings are consistent with the results reported by (Mukhlif et al .2021,Shreim .2022) Regarding the specific combining ability of hybrids, significant variations were observed with both positive and negative values across most traits, The hybrid O7×O2 exhibited the highest significant negative specific combining ability value for plant height (-22.19). Conversely, the hybrid O8×O3 displayed the highest positive and significant specific combining ability values for the flowers number (18.15) and the pods number (20.30). The hybrids O10×O3 and O4×O2 demonstrated the highest positive and significant specific combining ability values for plastic house yield (217.22 and 201.32, respectively). These results indicate that specific combining ability, is significant and in the desired direction, contributes to an increase in the trait beyond the average of the parent values. However, non-significant or negative values suggest a reduction in the average trait performance in hybrids compared to their parents' average. These findings with previous research, including the work of (Abdul Rasoul et al . 2005, Kishor et al. 2013)

Table 5. Effect of gca for parents and sca for okra single hybrids developed by line×tester for vegetative, flowering and yield growth traits

Genotypes	plant height(cm)	Flowers .no	pods no	plastic house yield
GCA Tester				
O1	0.556	1.746	2.921	75.438
O2	-4.937	-1.746	0.698	6.015
O3	7.492	2.063	3.365	16.53
S.E Tester	0.642	3.894	3.488	11.223
O4	2.556	-10.476	-7.079	80.958
O5	18.222	7.302	9.143	-6.402
O6	3.222	3.968	0.698	16.838
O7	11.222	-0.476	0.698	49.638
O8	-9	-0.476	1.81	-101.149
O9	-26.778	-1.587	-8.19	-115.322
O10	0.556	1.746	2.921	75.438
S.E LINER	0.981	5.948	5.328	17.143
SCA Hybrid				
O4*O1	0.981	3.148	0.296	-107.818
O5*O1	-14.352	12.037	10.741	117.902
O6*O1	0.981	-11.296	-7.481	-22.498
O7*O1	6.981	6.481	-0.815	80.702
O8*O1	4.204	6.481	4.741	-2.711
O9*O1	9.315	-19.074	-11.926	21.462
O10*O1	-2.352	4.259	3.63	-94.058
O4*O2	19.481	-14.63	-16.148	201.316
O5*O2	16.815	4.259	-0.37	-73.764
O6*O2	-11.519	10.926	16.074	74.076
O7*O2	-22.185	2.037	2.741	-86.724
O8*O2	-17.963	-24.63	-25.037	20.622
O9*O2	7.481	13.148	11.63	-31.644
O10*O2	-0.852	6.481	7.185	-123.164
O4*O3	-20.463	11.481	15.852	-93.498
O5*O3	-2.463	-16.296	-10.37	-44.138
O6*O3	10.537	0.37	-8.593	-51.578
O7*O3	15.204	-8.519	-1.926	6.022
O8*O3	13.759	18.148	20.296	-17.911
O9*O3	-16.796	5.926	0.296	10.182
O10*O3	3.204	-10.741	-10.815	217.222
S.E	1.7	10.302	9.229	29.692

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The genetic analysis results shows in Table 6 reveal several insights. Firstly, it's evident that the variance of specific combining ability (SCA) surpasses the variance of general combining ability (GCA) for traits such as plant height and plastic house yield. This observation is reflected in the degree of dominance (ā), which is greater than one, indicating the prevalence of over-dominant genes. This suggests that non-additive gene effects, including dominance and epistasis, play a significant role in determining the trait heritability in hybrids. Conversely, for traits like the number of flowers and the number of pods, negative values for the variation of general combining ability and the additive variation were observed. These negative values could be attributed to experimental error rather than genetic factors. Furthermore, the genetic variation (A + D) constitutes the largest portion of the phenotypic variation for traits like plant height and plastic house yield. This is reflected in the high heritability broad sense, which reaches 97.07% for plant height and 84.11% for plastic house yield. However, the heritability in the narrow sense is relatively low for plant height and plastic house yield. These findings are consistent with previous research by (Al-Mufarji.2006, ,Al-Jubouri and AL-Mashhadani. 2018). They collectively emphasize the significance of non-additive genetic effects in shaping hybrid traits and highlight the heritability of specific traits like plant height and plastic house yield, which are influenced by a combination of genetic factors.

Table 6. Values of genetic parameters of parents and okra single hybrids derived by the method of line×tester in vegetative, flowering and yield traits

Genetic marker	Plant height	plastic house	plastic house	plastic house Yield
gca	8.799	-5.116	-3.625	10.031
sca	269.182	133.365	135.693	13974.256
A	17.597	-10.232	-7.249	20.062
D	269.182	133.365	135.693	13974.256
G	286.779	123.133	128.444	13994.318
E	8.667	318.423	255.503	2644.867
P	295.447	441.556	383.946	16639.185
bs	97.066	27.886	33.454	84.105
ns	5.956	-2.317	-1.888	0.121
a-	5.531	—	—	37.324

CONCLUSION

the analysis of the genotypes under study has revealed a substantial degree of variation. This variability can be leveraged within breeding programs to introduce distinct genotypes, particularly those represented by O1, O3, O4, O7, and O10. These genotypes exhibit characteristics conducive to high production. Additionally, the promising hybrids, specifically O4×O2 and O10×O3, can be further developed to create new cultivars known for their high-yield potential. This highlights the importance of utilizing genetic diversity to enhance crop breeding efforts and ultimately contribute to improved agricultural productivity

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CONFLICT OF INTEREST

The authors declare that they have no conflicts of interest.

DECLARATION OF FUND

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AUTHOR/S DECLARATION

We confirm that all Figures and Tables in the manuscript are original to us. Additionally,

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AUTHOR'S CONTRIBUTION STATEMENT

REFERENCES

- Abdul Rasoul. I. J. , F. H. Al-Sahaf and F. Y. Bektash. 2005. Hybrid vigor and estimation of genetic marker of vegetative and flowering growth traits in tomatoes. Technical Journal. 18 (3) :152-144.
- AL-Juboori, A.W.A. 2021. Evaluation yield of okra with associated traits using analysis correlation path .IOP Conference Earth and Environmental Science .761.012036. DOI 10.1088/1755-1315/761/1/012036DownloadArticle
- Al-Jubouri. K. D. H. 2001. Study Of The Ability Of The Combining In The Breeding Summer Squash Hybrids And The Response Of Some Of Their Genotype To Potassium .P.h.D Disertation. College of Agriculture . University of Baghdad .p.p 216 .
- Al-Jubouri, K. D, and M. B . AL-Mashhadani. 2018. Hybrid vigor cucumber hybrids developed locally which suitable for open field , Journal of Agriculture and Veterinary Science . 11(1). 26-33. DOI: 10.9790/2380-1101022633.
- Al-Karghouli A. A. S, W. T. Rumman, R. H.t Al-Shawk and L. J. Lafta. 2015. Individual hybrid derivation from summer squash estimation of genetic parameters of full dialil cross. Iraqi Journal of Agriculture (research). 02 (0). 18-39.
- Al-Mufarji. O. K. A. 2006. Analysis of Combining Capacity And Estimation Of Hybrid Vigor And Genetic Marker In Okra. .P.h.D Disertation. College of Agriculture . University of Baghdad.205 pages.
- Altamari. A. M, M. Kasrawi, M. Akash, and T. M. AlAntary. 2019. Performance of single, triple and double cross hybrids in Beit Alpha cucumber (*Cucumis sativus* L.). Fresenius Environmental Bulletin. 28(12A). 10068- 10075. DOI:10.35516/jjas.v18i1.103
- Al-Zobaie. H. A. A, 2004. Unionization and Genetic Action in Tomatoes, Faculty of Agriculture. P.h.D Disertation. College of Agriculture. University of Baghdad.pp:89.
- Amaranatha. R.O, P. M. Sridevi, H. L. Sahimath, M.S. Nadaf and R.M. Hosamani. 2013. Heterosis for yield and yield components in okra. International Journal of Advanced Research . 155(8) .287-302.
- Ashwani. K., D. K. Baranwal, A. Judy and K. Srivastara . 2013. Combining ability and Heterosis for yield and its contributing characters in okra (*Abelmoschus moschatus* L. moench).Madras Agric.J.100(13):30- 35. DOI:10.29321/maj.10.001232
- Elias. M. S., 2011. Assessment The Genetic Distance For Pure Lines Of Summer Squash By Using AFLP Markers And Produce Single Crosses. M.Sc. Thasis, University of Baghdad.
- Elias. M. S. and K. D. H. Al-Jubouri, 2022. Investigate genetic relation among watermelon cultivars using molecular dna markers, Iraqi Journal of Agricultural Sciences .53(3):712- 723. DOI: https://doi.org/10.36103/ijas.v53i3.1581.
- Hadi. B. H ,W. Abed Hassan Ahmad , and N.Abed-Alamir. 2019. Evaluation the performance of double, single hybrids and inbreds of maize under different plant population and estimation heterosis and hybrid vigor. International Journal for Environment & Global Climate Change. 6(2).76-93. DOI:10.1088/1755-1315/388/1/012041

Iraqi Journal of Agricultural Sciences –2026:57(1):81-91
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/bs4zbn94

- Hadi. B.H, K.M. Wuhaib , and W.A. Hassan. 2017. Estimation of genetic parameters and path coefficient for growth traits, yield and its components for parents and hybrid of Maize. Iraqi J. Agric. Res. (Special Issue).22(10).142-152.
- Hadi .B. H, W. Abed Hassan, F. ALogaidi, and Z. AL-Shugeariy. 2018. Estimation of some genetic parameters, correlation and path coefficient analysis for Faba bean varieties under two plant densities. Karbala Journal of Agricultural Sciences .5 (2). 8102.
- Kazem. K. A, and W. Abed Hassan. 2021. Some genetic parameter for maize under different planting dates and environments. Al-Muthanna J. For Agric Sci.2.(8). DOI 10.52113/mjas04/8.2/44.
- Kishor, D. S, D. A. KShrishail, M. Santoshkumer, N. R. Raghavendra, V. Challa. and S. R. peddi . 2013. Studies on heterosis for yield and yield contributing traits in okra (*Abelmoschus moschatus* L. moench). Molecular Plant Breeding. 4(35). DOI:10.5376/MPB.2013.04.0035.
- Kumar. M, V. R. Sharma, N. Kumar, U. Sirohi, R. K. Naresh and V. Chaudhary. 2017. Screening of microsatellite markers for genetic diversity assessment and conservation of germplasm in okra (*Abelmoschus esculentus* L. Moench). International Journal of Current Microbiology and Applied Sciences . 6 (6). 509-520 .
- Laxman. M, G. Shanthakumer, P. O. Thimmanna, K. K. Udaykumar, G.Prakash. and A. Sateesh, 2013. Nutritional enhancement For Iron content and combining ability studies in newly derived inbred lines of okra (*Abelmoschus* moschatus L.moench). Molecular plant Breeding.4 (3).24-30. DOI:10.5376/mpb.2013.04.0003
- Mohammed. M. M. 2009. Estimation Of Gene Action And Genetic Parameters For Some Characters In Summer Squash (*Cucurbita Pepo* L.) By Using Generation Mean Analysis .M.Sc.,Thesis. College of Agriculture Engineering Scinences .Baghdad University .pp 97.
- Mukhlif. F. H, A. Sh. Abdullah and D. T. Hammody, 2021. Study of Combining Ability and Hybrid Vigor in Many Maize lines *Zea mays* L. 3rd Scientific & 1st International Conference of Desert Studies. 904 . 012017. doi:10.1088/1755-1315/904/1/012017.
- Saeed. A. H, M. K. Al-Kamar and A. H. Al-Asi. 2014. Calculation of hybrid vigor, gene action and degree of heritability in okra (*Abelmoschus esculentus* L.). Tikrit University Journal of Agricultural Sciences. 14 (2): 188 -194.
- Shinde .S, D. Zate, F. Khan and P. Thombre. 2023. Studies on combining ability in okra through line x tester analysis. The Pharma Innovation Journal .12(1). 221-227. DOI:10.22271/tpi.2023.v12.i1c.17863
- Shreim. G. M. Ali. 2022. Estimation of Genetic Markers, Combining Ability and Hybrid Vigor In Some Genotypes in Okra .P.h.D Disertation.College of Agriculture Food and Environment .Sana'a University .
- Singh .A.K, and M.C. Singh. 2012. Studies of heterosis and identification of superior crosses in okra(*Abelmoschus esculentus* L. Moench). Agri.Sci. Digest.32 (1)55-57. Corpus ID: 87569589
- Singh. R. K. and B. D. Chaudhary. 1985. Biometrical methods in quantitative genetics analysis. International Biometric Society. 34(4). 723 . DOI:10.2307/2530404.
- Vani .V .M, Singh B K and S. R. A. K Singh. 2020. GCA and SCA for plant and pod parameters of okra [*Abelmoschus esculentus* (L.) Moench]. Journal of

Iraqi Journal of Agricultural Sciences –2026:57(1):81-91
P-ISSN: 0075- 0530/ E-ISSN: 2410-0862
DOI: https://doi.org/10.36103/bs4zbn94

Pharmacognosy and Photochemistry 6: 332–38. Corpus ID: 226410952

- Vekariya R D, A. I. Patel, K. G. Modha, C. V .Kapadia, S. C. Mali and A. A. Patel. 2020. Estimation of heterosis, gene action and combining ability over environments for improvement of pod yield and its related traits in okra [*Abelmoschus esculentus* (L.) Moench]. International Journal of Current Microbiology and Applied Sciences 9 (9): 866–881. DOI:10.20546/ijcmas.2020.909

Iraqi Journal of Agricultural Sciences –2026:57(1):81-91
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دراسة قوة الهجين و قابلية الائتلاف وبعض المعلمات الوراثية في الباميا

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المستخلص

اجريت الدراسة بهدف دراسة قوة الهجين وقابلية الائتلاف في بعض صفات الباميا، في الموسمين 2021 و 2022. نفذت التجربة باحد الحقول الخاصة التابعة لقضاء المحمودية /بغداد ، باستعمال طريقة line×3 tester 7. وفي الموسم الثاني تم اختبار التراكيب الوراثية (الآباء +الهجن الناتجة منها) مع الهجين التجاري ضمن تصميم RCBD وبثلاث مكررات ودرست مؤشرات النمو الخضري والزهري والحاصل فضلا عن الغزارة الهجينية و التحليل الوراثي. اظهرت نتائج التجربة اختلاف الآباء معنويا باغلب المؤشرات المقاسة و انعكس هذا التباين على الهجن الناتجة منها ،اذ تميز الهجينان O2×O4 وO3× O10 باعطائهما اعلى حاصل للبيت البلاستيكي بلغ 927.80 كغم و 892.60 كغم على التتابع ،و تميزت الهجن O1× O5 و O2×O6 و O3×O8 باعطائها اعلى عدد للازهار و اعلى عدد للقرنات، اظهرالهجين O2×O4 اعلى قيمة موجبة معنوية للغزارة الهجينية بلغت 54% في حاصل البيت البلاستيكي ،واظهرت بعض الآباء تأثيرا ائتلافيا عاما موجبا ومعنويا وبالاتجاه المرغوب في المؤشرات المقاسة (اذ تميزت الآباء O1 و O3 وO4 و O6 و O7 و O9 و O10 بتأثير ائتلاف خاص موجب ومعنوي في حاصل البيت البلاستيكي).

الكلمات المفتاحية: معدل درجة السيادة، الفعل الجيني، نسبة التوريث ، التهجين.