SINAI Journal of Applied Sciences 13 (4) 2024 455-464

Available online at www.sinjas.journals.ekb.eg

SCREENED BY SINAI Journal of Applied Sciences

iThenticate Professional Plagiarism Prevention

Print ISSN 2314-6079
Online ISSN 2682-3527

ARU-EGYPT SJAS Trust Science | It Creates

GENERAL AND SPECIFIC COMBINING ABILITY FOR WHITE MAIZE INBRED LINES FOR GRAIN YIELD AND ITS RELATED TRAITS

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ARTICLE INFO

Article history:
Received: 15/06/2024
Revised: 06/07/2024
Accepted: 01/08/2024

Keywords:
Maize,
General Combining Ability,
Specific Combining Ability.

ABSTRACT

Developing high-yielding and heterotic maize hybrids is essential for sustaining agricultural production, especially in the context of rapid climate change and a growing global population. By using line × tester design, fourteen white maize inbred lines derived from different sources were crossed by three inbred lines as testers; Sd43, Sk13 and Sk5 at Sakha Agricultural Research Station during 2022 growing season. The resulting 42 F_1 single crosses in addition to one commercial check hybrids (SC.10) were evaluated at three locations; Sakha, Nubaria and Sids Agricultural Research Stations in 2023 growing season. Mean squares due to Locations, lines, testers and lines × testers interactions were significant or highly significant for most of the studied traits. The desirable general combining ability (GCA) effects were assigned for inbred lines; Sk5004/21, Sk5007/32 and tester Sk5 for earliness, short plant heights and ear heights, inbred line Sk5004/23 and tester Sk 3 for grain yield and ear length, and SK 5007/33 for grain yield and ear diameter. The best hybrids for SCA effects were Sk 5004/22 × SK13 for earliness, SK5005/30 × Sd 43 for short plant height, SK 5004/20 x Sd43 for grain yield SK 5005/29 × SK 13 for ear length and SK 5004/26 × Sk 5 for ear diameter. Six hybrids (Sk5004/20 × Sd43), (Sk5005/26 × Sk13), (Sk5005/27 × Sk13), (Sk5005/31 × Sd43), (Sk5007/33 × Sd43) and (Sk5007/33 × Sk13) were significantly out-yielded the check SC10. These promising single hybrids are valuable and could be used in maize breeding programs for high yield.

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INTRODUCTION

Maize, (*Zea mays* L.), holds a dominant position as a staple crop worldwide, serving as a crucial source of food security for billions. Its significance extends beyond direct human consumption, as it plays a key role in animal feed production and various industrial applications (**Tanumihardjo *et al*, 2020**). However, in the face of a growing global population and the constant need for increased yields, maize breeders are continuously exploring innovative strategies to boost productivity. One such effective tool utilized in hybrid breeding programs is the concept of combining ability (**Fasahat *et al.*, 2016**). The concept of combining ability involves analyzing the performance of inbred maize lines, which serve as the foundation for hybrids, by breaking it down into two main components: general combining ability (GCA) and specific combining ability (SCA) (**Sprague and Tatum, 1942**). Line by tester mating design was developed by **Kempthorne (1957)**. which provided reliable information on the general combining ability effects of parents and their hybrids combinations. GCA represents the inherent capacity of an inbred line to positively contribute across different crosses. For instance, a line that consistently produces high-yielding offspring regardless

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https://doi.org/10.21608/sinjas.2025.304703.1279

of its partner demonstrates strong general combining ability. On the other hand, specific combining ability assesses the unique performance displayed by specific combinations of inbred lines. In these cases, certain pairings of lines synergistically unlock exceptional performance that is not observed when crossed with other lines (**Pavan *et al*, 2011**). By comprehending and leveraging these combining abilities, maize breeders are able to strategically select parental lines. Breeders can create superior maize hybrids optimized for yield, stress tolerance, and other desirable qualities by focusing on lines with strong GCA and selecting pairings with high SCA (**Habiba *et al*, 2022**). This focused strategy has significant potential for guaranteeing food security and building a more sustainable agricultural future.

Therefore, this study was undertaken with the following objectives: (1) to calculates the particular combining ability impacts of crosses and the general combining ability effects of lines and tests for grain yield and its constituent parts. (2) to identify the best crosses compared with the check.

MATERIALS AND METHODS

Plant Materials

Fourteen new white maize inbred lines derived from different genetic sources at Sakha Agricultural Research Station namely, Sk5004/19, Sk5004/20, Sk5004/21, Sk5004/22, Sk5004/23, Sk5005/25, Sk5005/26, Sk5005/27, Sk5005/28, Sk5005/29, Sk5005/30, Sk5007/31, Sk5007/32 and Sk5007/33.

Experimental locations and growing seasons

These inbred lines were crossed to three testers inbred lines; Sd-43, Sk-13and Sk-5 during 2022 summer growing season. In 2023, the 42 crosses and one check hybrid Sc.10 were evaluated at three locations; Sakha, Nubaria and Sids Agricultural Research Stations.

Experimental design and its management

Randomized Complete Block Design (RCBD) with three replications was used at each location. Plot size was one row, 6 m long and 0.8 m a part. Seeds were planted in hills evenly spaced at 0.25 m along the row at the rate of two kernels hill^{-1}, which thinned to one plant hill^{-1} after 21 days from planting date. All cultural practices for maize production were applied as recommended at the proper time.

Data Recorded

Data were recorded on, days to 50% silking date, plant height (cm), ear height (cm), ear length (cm), ear diameter (cm), and grain yield (GY ard fed^{-1}) adjusted to 15.5% grain moisture content, (one ard=140 kg and one feddan =4200 m^2).

Statistical Analysis

Analysis of variances was performed for the combined data across three locations according to **Sendecore and Cochran (1989)**. Calculation of variances analysis was carried out by using computer application of statical analysis system (**SAS, 2008**) when the differences between crosses were significant, hence line x tester analysis was done according to **Kempthorne (1957)** using the AGD-R statistical software version 5.0 (**Rodriguez *et al.*, 2015**).

RESULTS AND DISCUSSIONS

Analysis of Variances

The combined analysis of variance across three locations for six traits is presented in Table 1. Results showed highly significant differences among the three locations for all traits, indicating the presence of variation among the locations

Table 1. Analysis of variances for six traits of maize across three locations during 2023 season

SOV	d.f	Days to 50% silking	Plant height	Ear height	Grain yield	Ear length	Ear diameter
Location (Loc)	2	442.4**	110449.8**	19490.9**	1751.1**	760.7**	24.52**
Rep/Loc	6	4.9	941.5	542.9	23.1	5.8	0.06
Hybrids (H)	41	24.5**	1693.3**	607.1**	83.5**	8.7**	0.10**
Line (L)	13	46.2**	2590.9**	844.2**	118.0**	12.6**	0.19**
Tester (T)	2	109.6**	13952.7**	4914.9**	426.0**	54.9**	0.04
Line × tester(L x T)	26	7.0**	301.5**	157.1**	40.0**	3.2*	0.06**
Hybrids×Loc(HxL)	82	4.9**	189.9*	90.7	23.9**	3.2**	0.06**
Line× Loc (L x Loc)	26	8.1**	254.2**	140.5*	23.9**	3.8**	0.08**
Tester× Loc	4	8.4**	186.3	91.0	121.1**	13.5**	0.22**
(L x T x Loc)	52	3.0**	158.0	65.8	16.4**	2.1	0.04
Error	246	1.2	138.5	82.0	9.2	2.0	0.03

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

in both of climatic and soil conditions for these traits. Highly significant differences among hybrids (H) for all traits, indicating that hybrids had a wide genetic diversity among themselves for these traits providing opportunity for selection. Significant or highly significant mean squares were observed for lines (L), Testers (T) and their interaction (L×T) for all traits, except (T) for ear diameter meaning that great diversity exists among inbred lines and among testers; also indicating that the inbred lines performed differently in their crosses depending on the type of testers used for these traits. These results are in agreement with those reported by several authors such as; **Singh *et al.* (2017), Darshan and Marker (2019), Abebe *et al.* (2020), Mohamed (2020) Abd El-Azeem *et al.* (2021), Rajesh *et al.* (2018), Abu *et al.* (2021), Mousa *et al.* (2021), Abd El-Azeem *et al.* (2022), Aly *et al.* (2022) and Nigus (2022)**.The interaction of hybrids × locations and their partitions *i.e.,* L × Loc, T × loc and L × T × Loc were significant or highly significant for all studied traits except (H × Loc) for ear height, (T × Loc) for plant and ear heights and L×T×Loc for plant and ear heights, ear length and ear diameter, meaning that the hybrids and their partition (L,T and L x T) differed in their order from location to another, in most traits.

Mean Performance

Table 2 presented mean performance of the 42 hybrids and one check single cross (SC 10) for six traits combined across three locations. Mean values of hybrids; for days to 50% silking ranged from 62.0 days for Sk 5007/32×Sk5 to 68.6 for Sk5004/22×= Sd43, furthermore, 19 hybrids were significantly earlier than the check hybrid, for plant height, varied from 224.7 cm for×Sd43 (34.3 ard/fed), while the lowest one was (20.2 ard/fed) for Sk5004/22 × Sk5. six hybrids (Sk5004/20 ×Sd43, Sk5005/26× Sk13, Sk5005/27 × Sk13, Sk5005/31 × Sd43, Sk5007/33 ×Sd43, and Sk5007/33 × Sk13) were significantly outyielded check single cross 10. These results suggest that use of these six hybrids as good single crosses for maize breeding programs, for ear length ranged from 17.9 cm for Sk5004/21 × Sk5 to 22.8 cm for Sk5005/30

Table 2. Mean performances of 42 crosses and one check cross for six studied traits across three locations

Hybrid	Days to 50% silking	Plant height (cm)	Ear height (cm)	Grain yield (ard/fed)	Ear length (cm)	Ear diameter (cm)
Sk5004/19 × Sd43	68.3	273.3	140.0	31.9	20.4	4.73
Sk5004/19 × Sk13	66.7	259.4	138.7	29.9	20.6	4.76
Sk5004/19× Sk5	65.4	257.8	124.8	30.1	19.1	4.78
Sk5004/20 × Sd43	65.9	277.7	143.1	34.3	18.7	4.69
Sk5004/20 × Sk13	66.7	244.3	120.9	29.2	19.8	4.69
Sk5004/20 × Sk5	65.2	247.3	118.8	27.3	18.4	4.67
Sk5004/21 × Sd43	67.1	251.3	139.4	24.7	18.2	4.64
Sk5004/21 × Sk13	64.6	226.0	121.7	25.5	19.3	4.60
Sk5004/21 × Sk5	62.7	224.7	117.3	23.2	17.9	4.71
Sk5004/22 × Sd43	68.6	278.4	141.9	30.3	20.7	4.71
Sk5004/22 × Sk13	65.4	255.6	132.7	28.6	20.6	4.78
Sk5004/22 × Sk5	67.9	269.2	131.7	20.2	19.7	4.69
Sk5004/23 × Sd43	64.2	280.9	136.8	30.7	20.5	4.76
Sk5004/23 × Sk13	64.2	255.1	128.9	31.9	21.6	4.73
Sk5004/23 × Sk5	63.1	258.6	129.2	31.6	20.0	4.60
Sk5004/25 × Sd43	66.9	273.1	148.1	30.3	20.6	4.73
Sk5004/25 × Sk13	65.9	245.9	139.1	30.3	19.8	4.51
Sk5004/25 × Sk5	64.2	250.0	136.0	30.1	19.5	4.82
Sk5005/26 × Sd43	67.4	269.2	143.0	27.0	19.8	4.91
Sk5005/26 × Sk13	67.2	253.1	133.2	32.7	20.1	4.71
Sk5005/26 × Sk5	67.0	259.1	132.0	26.0	18.6	4.71
Sk5005/27 × Sd43	67.0	263.7	133.8	28.8	20.0	4.84
Sk5005/27 × Sk13	67.2	253.6	129.4	33.5	20.8	4.93
Sk5005/27 × Sk5	64.7	245.1	120.8	26.1	19.2	4.78
Sk5005/28 × Sd43	65.8	266.8	135.3	28.2	19.5	4.84
Sk5005/28 × Sk13	66.2	258.3	130.2	30.7	20.0	4.76
Sk5005/28 × Sk5	63.9	255.7	130.3	28.6	18.7	4.84
Sk5005/29 × Sd43	68.4	246.1	131.1	27.6	18.8	4.64
Sk5005/29 × Sk13	66.4	238.3	130.6	29.1	21.7	4.64
Sk5005/29 × Sk5	66.1	240.0	123.4	24.0	19.4	4.69
Sk5005/30 × Sd43	66.3	252.3	137.4	27.3	20.2	4.58
Sk5005/30× Sk13	66.9	246.4	135.1	31.8	22.8	4.49
Sk5005/30× Sk5	64.3	249.2	130.9	26.7	20.2	4.56
Sk5005/31 × Sd43	68.2	281.2	156.0	33.7	20.6	4.82
Sk5005/31 × Sk13	66.2	257.3	141.3	30.0	20.4	4.67
Sk5005/31 × Sk5	66.1	254.0	136.9	28.2	19.4	4.73
Sk5007/32 × Sd43	63.8	265.9	131.7	29.7	20.6	4.62
Sk5007/32 × Sk13	62.7	236.9	121.2	30.2	21.4	4.76
Sk5007/32 × Sk5	62.0	239.6	123.2	27.1	19.4	4.82
Sk5007/33 × Sd43	66.2	272.4	137.7	33.7	20.2	4.91
Sk5007/33 × Sk13	64.7	251.6	124.7	33.4	19.8	4.91
Sk5007/33 × Sk5	65.4	265.9	132.7	29.4	20.6	4.73
Check SC10	67.1	279.3	143.2	29.9	20.3	4.56
LSD 0.05	1.0	10.9	8.3	2.8	1.3	0.16
0.01	1.3	14.4	10.9	3.7	1.7	0.21

Sk5004/21 × Sk5 to 281.2 cm for Sk 5005/31 × Sd43.33 hybrid were significant short plant height than check SC 10 hybrid for ear height ranged from 117.3 cm for Sk 5004/21 x Sk 5 to 156 cm for Sk 5005/31 x Sd 43, 25 hybrids were significant for short ear height than check SC 10, for grain yield revealed that the highest hybrid Sk5004/20 × Sk13, three hybrids were significant increased than SC 10, for ear diameter, ranged from 4.51 cm for Sk5004/25 × Sk13 to 4.93 cm for Sk5005/27 × Sk13, with 22 hybrids were increased significantly than the check. From above results the best hybrid was SK 5007/32 x SK 5 for earliness, SK 5004/21 x SK 5 for plant and ear height, SK 5004/20 x Sd 43 for grain yield, SK 5005/30 x SK 13 for ear length, and SK 5005/27 x SK 13 for ear diameter.

General Combining Ability Effects (GCA)

Estimates of general combining ability effects of fourteen inbred lines and three testers for six traits across three locations are presented in Table 3. Results showed that for days to 50% silking four lines Sk5004/21, Sk 5004/23, Sk5005/28 and Sk5007/32 were desirable for earliness, meanwhile the desirable inbred lines Sk5004/21, Sk5005/29, Sk5005/29, Sk5005/30 and Sk5007/32 for short plant height, Sk5004/20, Sk5004/21, Sk5005/27, Sk5005/29 and 5007/32 for short ear height. Sk5004/19, Sk5004/23, Sk5005/31 and S 5007/33 for grain yield. Sk5004/23, Sk5005/30, for ear length, and Sk5005/27, Sk5005/28 and Sk5007/33 for ear diameter. The best tester for general combining ability (GCA) effects was Sk-5 for earliness, short plant and ear height, Sd 43 and Sk13 for grain yield and Sk 13 for ear length. These lines could be used in maize breeding program. Similar results of desirable GCA effects for inbred lines were reported for many researchers (**El-Shenawy *et al.*, 2009; Abraha *et al.*, 2013; Assefa *et al.*, 2017; Ejigu *et al.*, 2017; Mohamed 2020; Abd El-Azeem *et al.*, 2022)**.

Table 3. General combining ability effects for 14 inbred lines and three testers for six studied traits across three locations

Hybrid	Days to 50% silking	Plant height	Ear height	Grain yield	Ear length	Ear diameter
Sk5004/19	1.02**	7.56**	1.84	1.49*	0.06	0.029
Sk5004/20	0.13	0.48	-5.05**	1.13	-0.97**	-0.045
Sk5004/21	-1.02**	-21.96**	-6.49**	-4.70**	-1.48**	-0.075*
Sk5004/22	1.50**	11.78**	2.76	-2.77**	0.42	-0.001
Sk5004/23	-1.94**	8.89**	-1.01	2.31**	0.75**	-0.030
Sk5004/25	-0.13	0.37	8.43**	1.08	0.01	-0.038
Sk5005/26	1.43**	4.52*	3.43*	-0.55	-0.45	0.051
Sk5005/27	0.50*	-1.85	-4.64**	0.33	0.05	0.125**
Sk5005/28	-0.50*	4.30	-0.68	0.03	-0.55*	0.088**
Sk5005/29	1.21**	-14.48**	-4.27*	-2.23**	0.03	-0.067*
Sk5005/30	0.06	-6.63**	1.84	-0.51	1.12**	-0.186**
Sk5005/31	1.06**	8.22**	12.10**	1.48**	0.21	0.014
Sk5007/32	-2.98**	-8.52**	-7.27**	-0.15	0.55*	0.007
Sk5007/33	-0.35	7.33**	-0.98	3.04**	0.25	0.125**
Tester Sd43	0.94**	12.07**	7.02**	0.74**	-0.04	0.020
Tester Sk13	-0.01	-7.26**	-2.10**	1.35**	0.68**	-0.017
Tester Sk5	-0.93**	-4.81**	-4.93**	-2.09**	-0.64**	-0.003
LSD g_i L 0.05	0.41	4.44	3.42	1.14	0.53	0.065
0.01	0.54	5.84	4.50	1.51	0.70	0.086
LSD g_i T 0.05	0.19	2.05	1.58	0.53	0.25	0.030
0.01	0.25	2.70	2.08	0.70	0.33	0.040

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

Specific Combining Ability Effects (SCA)

Estimates of specific combining ability effects of 42 top crosses for six traits combined across three locations is presented in Table 4. Results revealed that the desirable crosses for SCA effects were Sk5004/20×Sd43, Sk5004/21×Sk-5, Sk 5004 /22 × Sk-13 and Sk5007/33×Sk-13for earliness, Sk5005/30×Sd43 for short plant height, Sk5004/20×Sd43, Sk5004/22× Sd43, Sk5004/23×Sk5, Sk5005/26×Sk13, Sk5005/27×Sk13 and Sk5005/31×Sd43 for high grain yield, Sk5005/29×Sk13, Sk5005/ 30 × Sk13 and Sk 5007/33 x Sk 5 for ear length , and Sk5004/25×Sk5 and Sk5005/26 × Sk13 for ear diameter.

Table 4. Specific combining ability effects of 42 crosses for six studied traits combined across three locations

Hybrid	Days to 50% silking	Plant height	Ear height	Grain yield	Ear length	Ear diameter
Sk5004/19 × Sd43	0.58	-2.25	-1.51	0.50	0.39	-0.042
Sk5004/19 × Sk13	-0.14	3.18	6.28*	-2.04*	-0.11	0.017
Sk5004/19× Sk5	-0.44	-0.93	-4.78	1.54	-0.28	0.025
Sk5004/20 × Sd43	-0.97**	9.15*	8.49**	3.27**	-0.25	-0.012
Sk5004/20 × Sk13	0.75*	-4.85	-4.61	-2.42*	0.16	0.024
Sk5004/20 × Sk5	0.22	-4.30	-3.89	-0.85	0.08	-0.012
Sk5004/21 × Sd43	1.40**	5.26	6.27*	-0.50	-0.26	-0.027
Sk5004/21 × Sk13	-0.21	-0.74	-2.39	-0.32	0.15	-0.035
Sk5004/21 × Sk5	-1.18**	-4.52	-3.89	0.82	0.11	0.062
Sk5004/22 × Sd43	0.32	-1.37	-0.54	3.20**	0.41	-0.034
Sk5004/22 × Sk13	-1.84**	-4.93	-0.65	0.89	-0.40	0.069
Sk5004/22 × Sk5	1.52**	6.29	1.19	-4.09**	-0.01	-0.034
Sk5004/23 × Sd43	-0.57	3.97	-1.88	-1.43	-0.12	0.040
Sk5004/23 × Sk13	0.38	-2.48	-0.65	-0.85	0.18	0.054
Sk5004/23 × Sk5	0.19	-1.48	2.52	2.28**	-0.06	-0.094
Sk5004/25 × Sd43	0.29	4.71	0.01	-0.64	0.70	0.025
Sk5004/25 × Sk13	0.23	-3.19	0.13	-1.31	-0.87	-0.161**
Sk5004/25 × Sk5	-0.52	-1.52	-0.15	1.95	0.18	0.136*
Sk5005/26 × Sd43	-0.71	-3.33	-0.10	-2.29*	0.31	0.114*
Sk5005/26 × Sk13	0.01	-0.11	-0.76	2.74**	-0.10	-0.050
Sk5005/26 × Sk5	0.71	3.44	0.85	-0.45	-0.21	-0.064
Sk5005/27 × Sd43	-0.23	-2.51	-1.25	-1.42	0.03	-0.027
Sk5005/27 × Sk13	0.93*	6.70	3.54	2.67**	0.10	0.098
Sk5005/27 × Sk5	-0.70	-4.19	-2.29	-1.25	-0.13	-0.071
Sk5005/28 × Sd43	-0.46	-5.55	-3.65	-1.71	0.12	0.010
Sk5005/28 × Sk13	0.93*	5.33	0.35	0.21	-0.10	-0.042
Sk5005/28 × Sk5	-0.48	0.22	3.30	1.50	-0.02	0.032
Sk5005/29 × Sd43	0.51	-7.44	-4.28	-0.04	-1.13*	-0.034
Sk5005/29 × Sk13	-0.55	4.11	4.28	0.85	1.08*	0.002
Sk5005/29 × Sk5	0.04	3.33	0.00	-0.81	0.06	0.032
Sk5005/30 × Sd43	-0.46	-9.07*	-4.06	-2.04*	-0.82	0.017
Sk5005/30× Sk13	1.04**	4.37	2.72	1.83	1.05*	-0.035
Sk5005/30× Sk5	-0.59	4.70	1.34	0.21	-0.23	0.017
Sk5005/31 × Sd43	0.43	4.97	4.24	2.36*	0.47	0.062
Sk5005/31 × Sk13	-0.62	0.40	-1.31	-2.00	-0.39	-0.057
Sk5005/31 × Sk5	0.19	-5.37	-2.92	-0.36	-0.07	-0.005
Sk5007/32 × Sd43	0.03	6.38	-0.73	-0.07	0.15	-0.131*
Sk5007/32 × Sk13	-0.14	-3.30	-2.05	-0.13	0.28	0.039
Sk5007/32 × Sk5	0.11	-3.08	2.78	0.20	-0.43	0.092
Sk5007/33 × Sd43	-0.16	-2.92	-1.02	0.80	0.01	0.040
Sk5007/33 × Sk13	-0.77*	-4.48	-4.90	-0.12	-1.03*	0.076
Sk5007/33 × Sk5	0.93*	7.40	5.93*	-0.69	1.02*	-0.116*
LSD S_{ij} 0.05	0.72	7.69	5.92	1.98	0.92	0.113
0.01	0.94	10.12	7.79	2.61	1.22	0.149

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

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الملخص العربي

القدرة الائتلافية العامة والخاصة لسلالات بيضاء من الذرة الشامية للمحصول وبعض الصفات المرتبطة بها

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تم في هذه الدراسة التهجين ما بين أربعة عشر سلالة بيضاء مع ثلاثة من الكشافات وهي سلالة سخا 13 وسخا 5 وسدس 43 وذلك بمحطة البحوث الزراعية بسخا خلال الموسم الصيفي 2022. تم تقييم ال 42 هجين الناتجة بالإضافة الى أحد الهجن التجارية وهو هجين فردى 10 وذلك في ثلاث محطات بحثية وهي سخا وسدس والنوبارية خلال الموسم الصيفي 2023. أظهرت النتائج وجود اختلافات عالية المعنوية ما بين المواقع الثلاثة لكل الصفات تحت الدراسة، كذلك التباينات الراجعة للهجن ومجزئاتها (السلالات والكشافات والسلالة في الكشاف) وكذلك تفاعلاتها مع المواقع كانت معنوية او عالية المعنوية لمعظم الصفات. أظهرت السلالات Sk5004/21 وSk5007/32و الكشاف Sk-5 قدرة عامة على التالف مرغوبة لكل من صفات التبكير والنباتات القصيرة وارتفاع الكوز وكذلك السلالة Sk5004/23 والكشاف Sk-13لكل من محصول الحبوب وطول الكوز والسلالة Sk5007/33 لكل من محصول الحبوب قطر الكوز. اظهرت الهجن Sk5004/22 × Sk13 قدرة خاصة مرغوبة للتبكير والهجين Sk5005/30 × Sd43 للنباتات القصيرة والهجين Sk5004/20 × Sd43 لمحصول الحبوب والهجين Sk5005/29 × Sk13 لطول الكوز و الهجين Sk5004/26 × Sk5 لقطر الكوز.كذلك أظهرت ستة هجن تفوق عن هجين المقارنة (هجين فردى 10)وهي (Sk5004/20 × Sd43)، (Sk5005/26 × Sk13)، (Sk5005/27 × Sk13)، (Sk5005/31 × Sd43)، and (Sk5007/33 × Sd43) (Sk5007/33 × Sk13). لذلك توصى هذه الدراسة باستخدام الهجن في مراحل التقييم المتقدمة في برنامج تربية الذرة الشامية.

الكلمات الاسترشادية: الذرة الشامية- القدرة العامة على الائتلاف – القدرة الخاصة على الائتلاف.

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