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EVALUATION OF NEW YELLOW SINGLE AND THREE WAY CROSSES IN MAIZE

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ABSTRACT

In order to estimate the general combining ability effects for both inbred lines and testers . Fourteen new yellow inbred lines of maize were top crossed to two testers, inbred lines Gz 656 and SC 162 at Sakha in 2012 season. The 28 top crosses (14 single crosses and 14 three way crosses) and two checks (SC162 and TWC 353) were evaluated at Sakha and Mallawei Agricultural Research Stations in 2013 seasons. Number of days to 50% silking, plant height, ear height, ear length, ear diameter and grain yield/plant were estimated. Significant differences between the locations were detected for all the studied traits except for number of days to 50% silking. Mean squares due to lines (L) and testers (T) and their interaction L x T were significant for all the studied traits except for T for ear height and L x T interaction for days to 50% silking, ear length and ear diameter. The additive gene effects were the most important component controlling the inheritance of days to 50% silking, ear length and grain yield/plant. Meanwhile, the non-additive gene effects played the major contribution in the inheritance of plant height, ear height and ear diameter. The best inbred line for general combining ability (GCA) effects were Sk 6004/40, Sk 5001/37, Sk6021/42, Sk6021/43 and Sk6021/43 for days to 50% silking, short plant and ear height, ear length, ear diameter and grain yield/plant, respectively. The tester inbred line Gz 656 had desirable GCA effects for short plant height, ear length, , ear diameter and grain yield/plant. While, the tester SC 162 showed desirable GCA for earliness. The best cross for specific combining ability (SCA) effects was Sk6021/46 x Gz 656 for grain yield/plant. The best mean crosses for earliness, plant height and ear height were Sk 6004/40 x SC 162, Sk 6004/40 x Gz 656 and Sk 5001/35 x Gz 656, respectively. Single cross Sk 6021/46 x Gz 656 did not significantly outyield the check SC 162 .similarly, were the three way crosses Sk 5001/32 x SC 162, Sk 5001/33 x SC 162, Sk 5001/36 x SC 162, Sk 6006/41 x SC 162, Sk 6021/42 x SC 162 and Sk 6021/46 x SC 162 compared to check TWC 353. It could conduced that the new single crosses and three way crosses could be recommended for further testing in the hybrids development program .

INTRODUCTION

Line x tester analysis provides information on the combining ability (GCA and SCA) variances and its effects for selection of desirable parents for hybridization as well as selection breeding procedure for genetic improvement of various polygenetic characters for new inbred lines in maize breeding programs. Rawling and Thompson (1962) and Hallauer (1975) indicated that the suitable tester should include simplicity in use, provide information that correctly classifies the relative merit of lines and maximum genetic gain. Zambezi *et al*. (1986), Al-Naggar *et al*. (1997), Amer *et al* (2002) and Mosa (2004) and (2010) suggested that inbred tester can be effectively used for evaluation of both general (GCA) and specific (SCA) combining ability. Castellanos *et al* . (1998) studied 21 maize inbred lines and seven testers (five single crosses, one synthetic and inbred line to identify the best tester. They concluded that the single cross was the best tester. Abel and

Pollak (1991) suggested two divergent testers that contain an inherently high level of favorable alleles. Many researcher exhibited that the additive gene effects were controlling in the inheritance of days to 50% silking, ear length and grain yield (Faheem *et al.*, 1995; Kadlubiec *et al,* 2000; Motawei and Ibrahim, 2005; Iqbal *et al.* 2007 and Motawei , 2010). Meanwhile, the non-additive effects were the most important component controlling in the inheritance of plant height, ear height and ear diameter (Castellanos *et al.*, 1998 and Mosa, 2010)

The objectives of this study was aimed to estimate the general combing ability effects for inbred lines and testers and determine superior single and three way crosses compared to checks.

MATERIALS AND METHODS

Fourteen yellow inbred lines of maize; i.e. Sk 5001/31, Sk 5001/32, Sk 5001/33, Sk 5001/34, Sk 5001/35, Sk 5001/36, Sk 5001/37, Sk 5001/38, Sk 6004/39, Sk 6004/40, Sk 6006/41, Sk 6021/42, Sk 6021/43 and Sk 6021/46 were mated to two testers i.e. inbred line Giza 656 and single cross 162 in 2012 season at Sakha (Sk) Agricultural Research Station. In 2013 season, the resulting 28 crosses (14 single crosses and 14 three way crosses) and the two commercial checks single cross SC 162 and three way cross TWC 353 were evaluated in two locations i.e. Sakha and Mallawei Agric. Res. Stations. A randomized complete blocks design, with four replications was used at each location. The plot size was one row, 6 m long and 0.8 m width. Planting was done in hills spaced at 0.25 m along the row at the rate of two kernels/ hill which was thinned to one plant per hill befor the first irrigation. All cultural practices were applied as recommended at the proper time. Results were taken for number of days to 50% silking (days), plant height (cm), ear height (cm), ear length (cm), ear diameter (cm), grain yield/plant (g) adjusted to 15.5% moisture content.

Before calculating the combined analysis, test of homogeneity of error mean squares was done as outlined by Steel and Torrie (1980) for the two locations. The procedure of Singh and Chaudhary (1979) was used for calculating the general and specific combining ability effects and variances.

RESULTS AND DISCUSSION

Analysis of variance for six traits across locations are showed in Table 1. The results indicated that the differences between the two locations (Loc.) were highly significant for all the studied traits except for days to 50% silking. The results also indicated that the mean square of hybrids (H) and hybrids x locations interaction (H x Loc.) were highly significant for all the studied traits except for days to 50% silking and ear diameter for H x Loc. Interaction.

Table 1: Analysis of variance for six traits across locations.

SOV	D.f	Days to 50% silking (days)	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	Grain yield /plant (g)
Locations (Loc)	1	11.707	46092.81**	18480.15**	38.24**	6.733**	44665.54**
Rep/Loc	6	14.737	1006.37	1550.91	2.42	0.016	1305.65
Hybrids (H)	29	18.996**	948.95**	171.80**	9.625**	0.147**	4145.21**
H x Loc.	29	2.454	373.77**	113.93**	2.315**	0.064	2172.44**
Error	174	1.962	98.536	61.049	1.099	0.044	423.464

**** Significant at the 0.01 level of probability.**

Mean squares of line x tester analysis for six traits across locations are presented in Table 2. The source of variation for crosses was partitioned into, lines (L), testers (T) and L x T interaction. Significant to highly significant differences were detected among (L) and (T) for all the studied traits except for (T) for ear height. These results indicated that the inbred lines significantly differed in their behavior with respect for the crosses. Also, the two testers were different from each other in the top crosses. Meanwhile, the L x T interaction was significant for plant height and grain yield/plant. These results are in agreement with those reported by Mosa (2001), El-Shenawy *et al*., (2003), Mosa (2004), El Shenawy and Mousa (2005), Habliza and Khalifa (2005) and Abd El-Hadi *et al*. (2009). The interactions between L x Loc. was significant for plant height and grain yield/plant. Also, the interaction between T x Loc. was significant for all the studied traits except for days to 50% silking and plant height. The interactions between L x T x Loc. was not significant for all the studied traits except for grain yield/plant.

Table 2: Line x tester analysis for six traits across locations.

S.O.V	D.f	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield /plant
Lines(L)	13	17.788**	1252.882**	289.651**	10.265**	0.181**	5434.999**
Testers (T)	1	193.143**	1050.112**	111.446	75.446**	0.464**	14656.168**
L x T	13	3.297	304.179**	70.370	1.002	0.068	1084.681**
L x Loc.	13	3.168	572.38**	176.985	2.425	0.043	2094.561**
T x Loc.	1	1.786	67.54	340.072*	8.332**	0.429**	6081.33**
L x T x Loc.	13	2.131	173.080	36.36	1.415	0.056	1711.677**
Error	174	1.962	98.536	61.049	1.099	0.044	423.464

***, ** Significant at the 0.05 and 0.01 levels of probability, respectively.**

Mean performance of the 28 crosses and the two check hybrids for the six traits across locations are presented in Table 3. Thirteen single crosses were significantly earlier than check SC 162, the best cross among them was SK 5001/37 x GZ 656.While seven three way crosses were significantly earlier compared to the check TWC 353, the best crosses among them were SK 5001/36 x SC 162, Sk 6004/40 x SC 162 and SK 6006/41 x SC 162. All single crosses had significantly shorter plants than the check SC 162 . Mean while three crosses, Sk 5001/34 x SC 162, Sk 5001/37 x SC 162 and Sk 6004/40 x SC 162 had significantly shorter plants than the check TWC 353. Four crosses Sk 5001/34 x Gz 656, Sk 5001/35 x GZ 656, Sk 5001/37 x GZ 656 and SK 5004/40 x GZ 656 showed significantly shorter ear height than SC 162 . Also, the three

way cross Sk 5001/34 x SC 162 had shorter ear height than TWC 353. The ear length of the single crosses ranged from 19.32 cm for Sk 6004/40 x Gz 656 to 23.65 cm for check SC 162; Also, the ear length of the three way crosses ranged from 18.05 cm for SK 6004//40 x SC 162 to 21.27 cm for check TWC 353. Ear diameter of the single crosses ranged from 4.95 cm for Sk 5001/31 x GZ 656 to 5.4 cm for Sk 5001/34 x GZ 656 while that for three way crosses ranged from 4.72 cm for Sk 6004/40 x SC 162 to 5.4 cm for check TWC 353. Grain yield/plant single crosses ranged from 161.87g for Sk 6004/40 x GZ 656 to 254.81g for Sk 6021/46 x GZ 656.Yield of the Check SC162 was not significantly higher compared that of the new single crosses i.e Sk 6021/46 x GZ 656 and SK 6021/42 x GZ 656. Meanwhile, yield of the three way crosses ranged from 153.77g for Sk 6004/40 x SC 162 to 209.61g for Sk 5001/33 x SC 162.The three way crosses Sk 5001/32 x SC 162, Sk 5001/33 x SC 162, Sk 5001/36 x SC 162, Sk 6006/41 x SC 162, SK 6021/42 x SC 162 and Sk 6021/46 x SC 162 did not significantly outyield that of the check TWC 353.

Table 3: Mean performance of six traits of 14 single crosses, 14 three way crosses and two checks SC 162 and TWC 353 across locations.

Crosses	Days to 50% silking (days)	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	Grain yield /plant (g)
Sk 5001/31 x Gz 656	59.50	257.50	144.37	21.70	4.95	203.27
Sk 5001/32 x Gz 656	61.50	261.25	147.50	22.02	5.00	205.97
Sk 5001/33 x Gz 656	61.50	253.75	134.50	21.65	5.17	208.10
Sk 5001/34 x Gz 656	61.12	232.75	131.12	21.17	5.40	179.58
Sk 5001/35 x Gz 656	61.62	237.37	129.50	21.40	5.15	193.53
Sk 5001/36 x Gz 656	60.25	239.50	138.87	21.82	5.22	203.60
Sk 5001/37 x Gz 656	59.37	239.87	129.75	21.60	5.12	174.18
Sk 5001/38 x Gz 656	61.25	241.75	139.12	20.55	5.12	186.16
Sk 6004/39 x Gz 656	61.37	236.50	138.00	23.02	5.22	178.55
Sk 6004/40 x Gz 656	59.50	217.25	130.25	19.32	5.02	161.87
Sk 6006/41 x Gz 656	61.50	249.50	137.00	21.02	5.22	201.27
Sk 6021/42 x Gz 656	61.25	250.37	136.37	22.65	5.30	226.03
Sk 6021/43 x Gz 656	63.25	244.25	132.50	21.30	5.32	189.02
Sk 6021/46 x Gz 656	61.75	263.00	142.75	22.02	5.20	254.81
SC 162	63.37	274.75	139.87	23.65	5.15	241.36
Sk 5001/31 x Sc 162	58.37	253.12	138.12	20.79	5.07	177.50
Sk 5001/32 x Sc 162	59.50	261.87	143.62	21.05	5.07	200.50
Sk 5001/33 x Sc 162	59.50	253.25	134.37	20.62	5.07	209.61
Sk 5001/34 x Sc 162	59.12	237.87	130.00	19.87	5.05	159.47
Sk 5001/35 x Sc 162	58.75	247.62	132.12	19.90	5.02	173.01
Sk 5001/36 x Sc 162	57.75	250.50	135.00	20.80	5.17	192.56
Sk 5001/37 x Sc 162	58.25	242.62	131.37	19.97	5.10	167.57
Sk 5001/38 x Sc 162	59.87	245.50	135.87	20.10	5.10	171.61
Sk 6004/39 x Sc 162	60.25	244.25	133.12	20.85	5.07	168.42
Sk 6004/40 x Sc 162	57.37	241.75	139.12	18.05	4.72	153.77
Sk 6006/41 x Sc 162	57.87	258.25	137.12	20.60	5.05	193.60
Sk 6021/42 x Sc 162	59.75	248.87	132.50	20.85	5.17	195.23
Sk 6021/43 x Sc 162	60.62	250.25	133.62	20.52	5.25	185.87
Sk 6021/46 x Sc 162	61.75	249.50	135.87	20.85	5.22	190.75
TWC 353	60.75	252.62	138.87	21.27	5.40	190.16
L.S.D 0.05	1.372	9.727	7.657	1.027	0.205	20.166
L.S.D 0.01	1.806	12.805	10.07	1.352	0.270	26.545

Estimates of general combining ability effects for fourteen inbred lines across two locations are presented in Table 4. Desirable were obtained for the general combining ability effects inbred lines Sk 5001/31, Sk 5001/36, Sk 5001/37 and Sk 6004/40 for earliness, Sk 5001/34, Sk 5001/37, Sk 6004/39 and Sk 6004/40 for short plant height, Sk 5001/34, Sk 5001/35 and Sk 5001/37 for short ear height, Sk 5001/32, Sk 6004/39 and Sk 6021/42 for ear length, Sk 6021/42 and Sk 6021/34 for ear diameter and Sk 5001/32, Sk 5001/33, Sk 6021/42 and Sk 6021/46 for grain yield/plant.

Table 4: Estimates of general combining ability effects for fourteen inbred lines across two Locations.

Inbred line	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield /plant
Sk 5001/31	-1.187**	8.531**	5.410**	0.398	-0.117*	0.904
Sk 5001/32	0.375	14.781**	9.723**	0.598*	-0.092	13.754**
Sk 5001/33	0.375	6.718**	-1.401	0.198	-0.004	19.373**
Sk 5001/34	0.0001	-11.468**	-5.276**	-0.414	0.095	-19.951**
Sk 5001/35	0.062	-4.281	-5.026*	-0.289	-0.042	-6.207
Sk 5001/36	-1.125**	-1.781	1.098	0.373	0.070	8.598
Sk 5001/37	-1.312**	-5.531*	-5.276**	-0.151	-0.017	-18.601**
Sk 5001/38	0.437	-3.156	1.660	-.614*	-0.017	-10.595*
Sk 6004/39	0.687*	-6.406**	-0.276	0.998**	0.020	-15.995**
Sk 6004/40	-1.687**	-17.281**	-1.151	-2.251**	-0.254**	-31.657**
Sk 6006/41	-0.437	7.093**	1.223	-0.126	0.008	7.954
Sk 6021/42	0.375	2.843	-1.401	0.810**	0.108*	21.154**
Sk 6021/43	1.812**	0.468	-2.776	-0.026	0.158**	-2.032
Sk 6021/46	1.625**	9.468**	3.473	0.498	0.083	33.298**
$L.S.D_{giL}0.05$	0.686	4.863	3.828	0.513	0.102	10.082
$L.S.D_{giL}0.01$	0.903	6.402	5.039	0.676	0.135	13.272
$L.S.D_{gi-gj}0.05$	0.971	6.879	5.414	0.726	0.145	14.259
$L.S.D_{gi-gj}0.01$	1.278	9.05	7.126	0.955	0.190	18.769

***, ** Significant at 0.05 and 0.01 levels of probability, respectively.**

Estimates of general combining ability effects for two testers across locations are presented in Table 5. The inbred line tester GZ 656 was the best tester for short-plant type, ear length, ear diameter and grain yield/plant while the tester single cross 162 showed the desirable GCA for earliness. The superiority of single crosses as good testers was reported by Horner *et al.* (1973), El-Shenawy and Mosa (2005) and Abd El-Hadi *et al.* (2009). While, the best inbred lines as good tester was noticed by several investigators among them Darrah (1985), Al-Naggar *et al.* (1997) and Abd El-Hadi *et al.* (2009).

Table 5: Estimates of general combining ability effects for two testers across two locations.

Tester	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield /plant
Tester-Gz 656	0.928**	-2.162*	0.705	0.580**	0.045*	8.088**
Tester-Sc 162	-0.928**	2.165*	-0.705	-0.580**	-0.045*	-8.088**
$L.S.D_{gi_T}0.05$	0.259	1.838	1.447	0.194	0.038	3.811
$L.S.D_{gi_T}0.01$	0.341	2.419	1.904	0.255	0.051	5.016
$L.S.D_{gi-gj}0.05$	0.367	2.599	2.046	0.274	0.055	5.389
$L.S.D_{gi-gj}0.01$	0.483	3.421	2.693	0.360	0.072	7.093

***, ** Significant at 0.05 and 0.01 levels of probability, respectively.**

Estimates of specific combining ability effects of the 28 crosses across two locations are presented in Table 6. The desirable SCA effects were obtained from the crosses Sk 6021/46 x GZ 656 for days to 50% silking; Sk 6004/40/46 x GZ 656 and Sk 6021/46 x SC 162 for plant height and Sk 6004/40 x GZ 656 for ear height. Meanwhile, the desirable SCA effects was Sk 6021/46 x GZ 656 for grain yield/plant .

Table 6: Estimates of specific combining ability effects for 28 crosses cross two locations.

Cross	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield /plant
Sk 5001/31 x Gz 656	-0.366	4.352	2.419	-0.217	-0.108	4.798
Sk 5001/31 x SC 162	0.366	-4.352	-2.419	0.217	0.108	-4.798
Sk 5001/32 x Gz 656	0.071	1.852	1.232	-0.092	-0.083	-5.351
Sk 5001/32 x SC 162	-0.71	-1.852	-1.232	0.092	0.083	5.351
Sk 5001/33 x Gz 656	0.071	2.415	-0.642	-0.067	0.004	-8.845
Sk 5001/33 x SC 162	-0.071	-2.415	0.642	.067	-0.004	8.845
Sk 5001/34 x Gz 656	0.071	-0.397	-0.142	0.069	0.129	1.967
Sk 5001/34 x SC 162	-0.071	0.397	0.142	-0.069	-0.129	-1.967
Sk 5001/35 x Gz 656	0.508	-2.959	-2.017	0.169	0.016	2.173
Sk 5001/35 x SC 162	-0.508	2.959	2.017	-0.169	-0.016	-2.173
Sk 5001/36 x Gz 656	0.321	-3.334	1.232	-0.067	-0.020	-2.570
Sk 5001/36 x SC 162	-0.321	3.334	-1.232	0.067	0.020	2.570
Sk 5001/37 x Gz 656	-0.366	0.790	-1.517	0.232	-0.033	-4.782
Sk 5001/37 x SC 162	0.366	-0.790	1.517	-0.232	0.033	4.782
Sk 5001/38 x Gz 656	-0.241	0.290	0.919	-0.355	-0.033	-0.813
Sk 5001/38 x SC 162	0.241	-0.290	-0.919	0.355	0.033	0.813
Sk 6004/39 x Gz 656	-0.366	-1.709	1.732	0.507	0.029	-3.026
Sk 6004/39 x SC 162	0.366	1.709	-1.732	-0.507	-0.029	3.026
Sk 6004/40 x Gz 656	0.133	-10.084**	-5.642*	0.057	0.104	-4.038
Sk 6004/40 x SC 162	-0.133	10.084**	5.642*	-0.057	-0.104	4.038
Sk 6006/41 x Gz 656	0.883	-2.209	-0.767	-0.367	0.041	-4.251
Sk 6006/41 x SC 162	-0.883	2.209	0.767	0.367	-0.041	4.251
Sk 6021/42 x Gz 656	-0.178	2.915	1.232	0.319	0.016	7.311
Sk 6021/42 x SC 162	0.178	-2.915	-1.232	-0.319	-0.016	-7.311
Sk 6021/43 x Gz 656	0.383	-0.834	-1.267	-0.192	-0.008	-6.513
Sk 6021/43 x SC 162	-0.383	0.834	1.267	0.192	0.008	6.513
Sk 6021/46 x Gz 656	-0.978*	8.915*	2.732	0.007	-0.058	23.942**
Sk 6021/46 x SC 162	0.978*	-8.915*	-2.732	-0.007	0.058	-23.942**
$L.S.D_{(Sij)}$ 0.05	0.970	6.878	5.414	0.726	0.145	14.259
$L.S.D_{(Sij)}$ 0.01	1.277	9.054	7.127	0.956	0.191	18.770
$L.S.D_{(Sij - Skl)}$ 0.05	1.372	9.727	7.657	1.027	0.205	20.166
$L.S.D_{(Sij - Skl)}$ 0.01	1.806	12.805	10.079	1.352	0.27	26.545

***, ** Significant at 0.05 and 0.01 levels of probability, respectively.**

Estimates of gene effect components for six traits across two locations in Table 7. The additive genetic effects (K^2 GCA) seemed to have played an important role than non-additive gene effects (K^2 SCA) in the expression of days to 50% silking, ear length and grain yield /plant. These results support the finding of El-Zeir *et al.* (2000), Ibrahim and Motawei (2004), Parves and Rather (2006) and Aly and Khalil (2013). While, the non-additive gene effects (K^2 SCA) was important for plant height, ear height and ear diameter. These results are in agreement with Ibrahim and Motawei (2004).

Table 7: Estimates of gene effect components for six traits across two locations.

Genetic parameter	Days to 50% silking	Plant height	Ear height	Ear length	Ear diameter	Grain yield /plant
K^2 GCA	1.609	12.99	-0.90	0.585	0.0013	93.088
K^2 SCA	0.145	16.38	4.251	-0.05	0.0015	-78.37

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تقييم هجن فردية وثلاثية جديدة من الذرة الشامية الصفراء

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أجريت التهجينات القمية بين ١٤ سلالة من الذرة الشامية الصفراء واثنين من الكشافات سلاله جيزة ٦٥٦ وهجين فردى ١٦٢ بسخا في موسم ٢٠١٢. وتم تقيم الهجن القمية ال ٢٨ الناتجة (١٤هجين فردى و ١٤هجين ثلاثى) مع اثنين من هجن المقارنة (هـ .ف ١٦٢ و هـ . ث ٣٥٣) بمحطتي بحوث سخا وملوي موسم ٢٠١٣. وتم قياس صفات عدد الأيام حتى ظهور ٥٠% من النورات المؤنثة وارتفاع النبات و ارتفاع الكوز وطول الكوز وقطر الكوز و محصول الحبوب/نبات. وتم تنفيذ التجارب فى القطاعات الكاملة العشوائية ويمكن تلخيص أهم النتائج كما يلى :

١- أشارت النتائج لوجود الاختلافات بين كلا الموقعين معنوية لكل الصفات تحت الدراسة عدا صفة عدد الأيام حتى ظهور ٥٠% من النورات المؤنثة .

٢- أظهرت النتائج أن التباينات الراجعة إلى السلالات والكشافات والتفاعل بينهما معنوية لكل الصفات تحت الدراسة عدا صفة ارتفاع الكوز بالنسبة للكشافات و عدد الايام حتى ظهور ٥٠% من النورات المؤنثة وارتفاع النبات وطول وقطر الكوز لتفاعل السلالات x الكشافات .

٣- أشارت النتائج أن أفضل السلالات للقدرة العامة على الائتلاف سخا ٤٠/٦٠٠٤ وسخا٤٠/٦٠٠٤ وسخا ٣٧/٥٠٠١،سخا ٤٢/٦٠٢١، سخا٦٠٢١ /٤٣ و سخا٦٠٢١ /٤٣ لعدد الأيام حتى ظهور ٥٠% من النورات المؤنثة وارتفاع النبات وارتفاع الكوز و طول الكوز وقطر الكوز ومحصول الحبوب/النبات على التوالى.

٤- أوضحت النتائج أن السلالة الكشاف جيزة ٦٥٦ أفضل قدرة عامة على الائتلاف لصفات ارتفاع النبات وارتفاع الكوز وطول الكوز وقطر الكوز و محصول الحبوب/النبات بينما كان الهجين الفردي الكشاف ١٦٢ هو الأفضل في القدرة العامة على الائتلاف لصفة التبكير، وأظهر الهجين الفردى سخا ٤٦/٦٠٢١ xجيزة ٦٥٦ قدرة خاصة على الائتلاف لصفة المحصول /النبات.

٥- أظهرت النتائج أن الهجن سخا ٤٠/٦٠٠٤ × هـف ١٦٢ و سخا ٤٠/٦٠٠٤ × جيزة ٦٥٦ و سخا ٣٥/٥٠٠١ × جيزة ٦٥٦ الأفضل فى التبكير وارتفاع النبات وارتفاع الكوز على التوالي. أظهر الهجين الفردى سخا ٤٦/٦٠٢١ x جيزة ٦٥٦ زيادة غير معنوية فى المحصول عن هجن المقارنة ١٦٢ كذلك الهجن الثلاثية سخا ٣٢/٥٠٠١ × هـف ١٦٢، سخا ٣٣/٥٠٠١ × هـف ١٦٢، سخا ٣٦/٥٠٠١ × هـف ١٦٢، سخا ٤١/٦٠٠٦ × هـف ١٦٢، سخا ٤٢/٦٠٢١ × هـف ١٦٢، سخا ٤٦/٦٠٢١ × هـف ١٦٢ بالمقارنة بالهجين الثلاثي ٣٥٣ . توصى هذه الدراسة أن باستخدام الهجن الفردية والثلاثية الجديدة فى مراحل تقييم أخرى متقدمة وفى برنامج لانتاج الهجن .