COMBINING ABILITY, GENE ACTION AND HETEROSIS FOR NEW YELLOW MAIZE (*ZEA MAYS* L.) INBRED LINES VIA DIALLEL MATING DESIGN

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Abstract

A half diallel set of crosses among seven new yellow maize inbred lines were done at Sakha Agric. Res., Station in 2010 summer season to get 21 single crosses to determine combining ability, gene action and heterosis. In 2011 season, those 21 crosses along the check hybrid SC173 were evaluated in replicated trails conducted at sakha and Ismailia Agric. Res. stations. Data were recorded for No. of days to 50% silking, plant and ear heights, ear length and diameter, No. of rows ear-1, No. of kernels row-1 and grain yield. Data were analyzed according to Griffing (1956) Method-4, Model-1. The results indicated that mean squares of hybrids were significant for all of the studied traits. While, the hybrids by loc interaction was significant for 50% silking, No. of rows ear-1, No. of kernels row-1 and grain yield. Variances due to general and specific combining abilities were significant or highly significant for all traits, except plant height for specific combining ability. The ratio of GCA/SCA mean squares was high and exceeded the unity for all traits, revealing that the magnitude of additive was more important than that of non-additive gene action in the inheritance of these traits. For grain yield, the crosses Gz653 x Sk9215 (36.13), Gz653 x Sk5019 (36.50) and Sk9215 x Sk5030 (35.68 ard fed-1) were significantly better than the check hybrid SC173 (31.29 ard fed-1) and increasing the useful heterosis relative to the check by 15.47, 15.05 and 14.03% for these crosses, respectively. While the crosses Gz-653 x Sk-5026, Gz-653 x Sk-6001, Gz653 x Sk6023 and Sk5030 x Sk6001 did not differ significantly compared to the check hybrid. The parental line-Gz-653 possessed GCA effects for ear length, No. of kernels row-1 and grain yield. The desirable GCA effects were obtained in line Sk-5019 for silking date, plant height, ear height, ear diameter and No. of rows ear-1, indicated that this line was good combiner for these traits. The best crosses showed SCA effects were obtained from the crosses, Sk9215 x Sk5030 for ear diameter, No. of kernels row-1 and grain yield, Gz653 x Sk5030, Gz653 x Sk6023 and Sk9215 x Sk5026 for silking date toward earliness. These crosses had significant estimates of specific combining ability effects and could be used in maize breeding program to improve these traits for earliness and grain yield.

Key words: Zea mays L., diallel, GCA, SCA, gene action,

INTRODUCTION

Diallel crosses have been used in genetic research to determinate the inheritance of a trait among a set of genotypes to identify superior parents for hybrid or cultivar development (Yan and Kang, 2003). Conventional diallel analysis (Griffing,s 1956) was limited to partitioning total variation into GCA of parents. The combining ability analysis is an important method to know gene actions and is frequently used by crop breeders to identify parents with high GCA and hybrids with high SCA effects. Several researchers reported that the non-additive gene action controlling in the inheritance of grain yield and yield components. Piovarci (1975) for grain yield, Nawar *et al.* (1980), El-Shenawy *et al.* (2002) and Mosa (2003) for grain yield, ear length, ear diameter, No. of kernels row^{-1}, plant and ear heights and Aly and Mousa (2011) for ear length, No. of rows ear^{-1} and ear height. While, the additive gene action play the major role in the inheritance of grain yield and its attributes, Al-Naggar (1991) and Mosa (2001) for 50% silking and No. of rows ear^{-1}, Abd El-Azeem *et al.* (2009) for 50% silking, plant height, ear height, ear length and grain yield and Aly and Mousa (2011) for 50% silking, plant height and grain yield.

Many investigators reported high heterosis for grain yield of maize (Akhtar and Singh 1982, Mosa 2001 and 2003). Sharief *et al.* (2009) studied heterosis in yellow maize and found that the increased percentages of grain yield for seven crosses relative to three check hybrids, SC155, TWC352 and Gem.Y.Pop. to range from 16.96 to 43.45%, from 11.19 to 40.47% and from 22.02 to 54.15% , respectively. Aly and Mousa (2011) found that the useful heterosis in the three crosses and increasing percentage relative to the check SC10 for grain yield were 22.85, 20.44 and 25.50%, respectively. Also, found that heterosis percentages relative to the check ranged from 4.13 to 10.19% for ear diameter, from -6.76 to -3.98% for silking date toward earliness, from -11.49 to -5.83 for plant height toward shorter plant and from -13.70 to -7.23% for ear height toward lower ear placement.

The objectives of this investigation were: to estimate general and specific combining abilities of seven new yellow maize inbred lines, to determine the type of gene action controlling yield and other traits and their interaction with locations and to identify maize genotypes superior in yielding ability to be offered to maize breeding programs.

MATERIALS AND METHODS

Seven new yellow maize inbred lines, derived from different sources by maize breeding program (Table-1), were crossed in all possible combinations excluding reciprocals during the summer of 2010 at Sakha Agric. Res. Station. The resultant 21 single crosses and a check hybrid (SC173) were evaluated at two locations i.e. Sakha and Ismailia Agric. Res. Stns in 2011 season. A randomized complete block design, with four replications was used at each location. The experimental plot was one row, 6 m long, 0.8 m apart. Planting was made in hills spaced at 0.25 m along the row at the rate of two kernels $hill^{-1}$ planted and therefore thinned to one plant $hill^{-1}$. All agronomic operations were performed as recommended for maize cultivation.

Data were recoded for No. of days from planting to 50% silking, plant height (cm), ear height (cm), ear length (cm), ear diameter (cm), No. of rows ear^{-1}, No. of kernels row^{-1} and grain yield in ardab fed^{-1}(one ardab = 140 kg from grains at 15.5% moisture content and one feddan 4200 m^2). Analysis of variance for combined data was done according to Steel and Torrie (1980). General and specific combining (SCA and SCA) abilities effects were estimated according to Griffing's (1956) Method-4 Model-1. Useful (superiority) heterosis was measured as follow: Useful heterosis (superiority) = $((F_1-SH)*100)/(SH)$ where, F_1 mean of hybrid and SH mean value of the local commercial hybrid (Meredith and Bridge, 1972).

Table 1. Names and sources of inbred lines used in this study

Inbred lines	Name	Source
Line-1	Gz-653	Exp. 9281 Population
Line-2	Sk-9215	Pop. Downey Mildew 5703
Line-3	Sk-5019	Pop. F-21
Line-4	Sk-5026	Sk-121 x Sk-318
Line-5	Sk-5032	Pop. Sk-1
Line-6	Sk-6001	Pop. Comp.-21
Line-7	Sk-6023	TWC-352 x Sk-N-12

Pop. = Population, Sk = Sakha, Gz= Giza, TWC= Three Way Cross and Comp. = Composite

RESULTS AND DISCUSSION

Combined analyses of variance over two locations , Sakha and Ismailia Agric. Res. Station for eight traits i.e., No. of days to 50%silking, plant height, ear height, ear length, ear diameter, No. of rows ear^{-1}, No. of kernels row^{-1} and grain yield are presented in Table (2). Mean squares of locations were highly significant for all of the studied traits. Mean squares due to hybrids (H) and their interaction with locations (H x Loc) were highly significant for all of the studied traits, except hybrids for ear diameter and (H x Loc) for plant and ear heights, ear length and ear diameter, indicating that the hybrids were differ from one to other and from location to another. These results were agreement with these reported by Mosa (2003) and Abd El-Azeem *et al.* (2009) for silking date, plant height, ear height, ear length, ear diameter and grain yield, Aly and Mousa (2011) and Zare *et al.* (2011) obtained similar results.

Mean performance over two locations of the 21 new hybrids and the check hybrid SC173 for eight traits in 2011 season are shown in Table (3). Results revealed that the cross Sk5019 x Sk6001 (55.37 day) was the earliest and was significantly earlier than the check hybrid SC173 (56.50 day). For plant and ear heights, 12 and 7 crosses were significantly of shorter plants and lower ear placement compared to the check hybrid (285.62 and 150.37 cm, respectively). The values for plant height ranged from 234.25 cm for the shortest cross Sk-9215 x Sk-6001 to 300.00 cm for the tallest cross Gz653 x Sk9215. While, for ear placement, the values ranged from 129.62 cm for the cross lowest ear placement (Sk5019 x Sk5030) to 156.50 cm for the cross of highest ear placement (Gz653 x Sk6023). For ear length, the cross Gz653 x Sk5030 (21.36) did not differ significantly compared to the check SC173 (22.43). Regarding, ear diameter the crosses Gz-653 x Sk-5019 (4.78), Gz-653 x Sk-6001 (4.66), Sk-5019 x Sk-6001 (4.80) and Sk-5019 x Sk-6023 (4.78 cm) were superior significantly compared to the check SC173 (4.46 cm). For No. of rows ear^{-1}, results showed that 15 crosses were differed significantly from the check (13.80) and the values ranged from 13.30 in the cross Gz-653 x Sk-5030 to 17.80 in the cross Sk-5019 x Sk-6023. For No. of kernels row^{-1}, seven crosses did not differ significantly compared to the check hybrid SC173 (42.35) and the values ranged from 34.21 in the cross Sk-5019 x Sk-6023 to 43.96 in the cross Sk-9215 x Sk-5030. Results indicated that the crosses Gz653 x Sk9215 (36.13), Gz653 x Sk5019 (36.50) and Sk9215 x Sk5030 (35.68 ard fed^{-1}) significantly outyielded the commercial check hybrid SC173 (31.29 ard fed^{-1}). Moreover, the crosses Gz653 x Sk5030 (34.77), Gz653 x Sk6001 (35.54), Gz653 x Sk6023 (34.03) and Sk5030 x Sk6001 (33.44 ard fed^{-1}) exhibited similar yield performance to that of the check hybrid since no significant differences.

Estimates of the variance due to general (GCA) and specific (SCA) combining abilities, as well as their interactions with locations for eight traits are illustrated in Table

(4). Variances due to GCA were highly significant for all of the studied traits. On the other hand, the variances due to SCA gave were either significant or highly significant for all traits except for plant height, indicating that both additive and non-additive gene action were involved in inheritance of all traits except ear height where the additive gene action was the most important. However, the proportion of GCA variance was higher than that of SCA variance. This indicates that the additive gene action was playing the major role in the inheritance of all traits under study. Several investigators reported that both additive and non-additive gene action were controlling these traits, Vacaro *et al.* (2002) for plant height, Rezaei and Roohi (2004) for ear length, ear height, Aly and Mousa (2011) and Zare *et al.* (2011) for all of the studied traits. Also, they reported that the GCA variance played the major role in the inheritance of 50% silking, plant height and grain yield. General combining ability by location interaction was highly significant for all of the studied traits except for plant and ear heights. Meanwhile, the interaction between SCA x Loc was significant for silking date and grain yield, indicating that the magnitude of all types of gene action differ from location to another. The magnitude of the interaction for GCA x Loc was higher than SCA x Loc for all of the studied traits (Robinson and Moll 1959, Amer 2002 and Mosa 2003). The ratio of GCA/SCA was more than unity for all traits under studied conditions, revealing the importance of additive gene action in the genetic control of these traits. Similar result were obtained by Mousa (1997), Dawood *et al.* (1994) and Amer (2002) for silking date, plant height, ear height and No. of rows ear^{-1}, Bello and Olaoye (2009) for silking date, plant height and grain yield and Aly and Mousa (2011) for silking date, plant height, ear diameter and grain yield.

General combining ability (GCA) effects for the studied traits in the seven genetically diverse yellow maize inbred lines over two locations are shown in Table (5). Results revealed that line Sk5019 recorded negative (desirable) and significant GCA effects for 50% silking, plant and ear heights toward earliness, shorter plants and lower ear placement, respectively. The desirable GCA effects were obtained in the lines, Sk6001 for 50% silking and plant height, Sk9215 for plant height. Results indicating that these genotypes contained the highest concentrations of favorable genes of earliness, shorter plants and lower ear placement. Thus, it could be involved in breeding program for improving these traits. General combining ability effects desirable positive and significant were obtained in the line Gz653 for ear length, No. of kernels row^{-1} and grain yield as well as lines Sk5019, Sk6001 and Sk6023 for ear diameter and No. of rows ear^{-1}, revealing that these lines could be recommended in breeding program for improving and increasing grain yield and its components in maize.

Specific combining ability (SCA) effects for various single crosses of maize resulted for half diallel 7 x 7 over two locations are given in Table (6). Results showed that the best combinations crosses were Gz653 x Sk6023 and Sk9215 x Sk5026 for earliest trait and single cross Sk6215 x Sk6001 gave desirable and significant SCA effects for plant and ear heights toward shorter plant and lower ear placement, respectively. At the same time, cross Sk9215 x Sk5030 gave significant positive SCA effects for ear diameter, No. of kernels row^{-1} and grain yield. While, single cross Sk5030 x Sk6001 possessed positive and significant SCA effects for grain yield. These results suggesting that these crosses contained high level of heterotic effects for these traits and could be used as single crosses in commercial production after evaluated under more different environmental conditions.

Estimation of superiority (useful heterosis) percentage of the 21 crosses relative to the check hybrid SC173 for all of the studied traits over two locations are presented in Table (7). Results showed that the cross Sk5019 x Sk6001 exhibited significant and negative relative to the check for 50% silking toward earliness and percent of useful heterosis ranged from -2.00 to 12.60%. Results revealed that 12 and 7 out 21 crosses were possessed negative and significant superiority heterosis relative to check for plant and ear heights toward shorter plant and lower ear placement, respectively. Regarding, ear diameter and No. of rows ear^{-1}, 6 and 14 crosses had significant and superiority effects relative to the check hybrid and increasing percentage ranged from (4.48 to 7.62%5.43) and from (5.43 to 28.99%) for ear diameter and No. of rows ear^{-1}, respectively. From grain yield, the crosses Gz653 x Sk9215, Gz653 x Sk5019 and Sk9215 x Sk5030 exhibited significant superiority effects relative to the check SC173 and the increasing percentage were 15.47, 15.05 and 14.03% for the previous crosses, respectively. Many investigators reported high heterosis for grain yield and other traits in maize, Akhtar and Singh (1982), Mosa (2003), Ojo *et al.* (2007) and Aly and Mousa (2011).

Table 2. Combined analysis of variance of 22 hybrids over two locations for eight traits in season 2011.

S.O.V.	D.F.	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows ear^{-1}	No. of kernels row^{-1}	Grain yield (ard fed^{-1})
Locations (Loc)	1	27.0**	137388.0**	128443.5**	941.6**	12.3**	26.9**	1172.2**	6321.7**
Rep/Loc	6	3.00	446.90	317.93	1.87	0.04	1.51	9.03	7.45
Hybrids (H)	21	43.36**	1890.23**	613.38**	25.72**	0.19	11.77**	72.55**	54.92**
H x Loc	21	3.34**	299.93	96.29	4.32	0.06	1.20*	21.19**	84.44**
Error	126	1.04	207.52	91.17	3.05	0.04	0.53	9.47	19.46

*, ** indicate significance at 0.05 and 0.01 levels of probability, respectively.

Table 3. Mean performance of 21 new single crosses and the hybrid check for eight traits over two locations during 2011 season.

cross	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows ear^{-1}	No. of kernels row^{-1}	Grain yield (ard fed^{-1})
Gz653 x Sk9215	63.62	277.00	148.62	19.76	4.27	14.50	40.90	36.13
x Sk5019	61.75	287.37	152.50	20.25	4.78	15.80	43.67	36.50
x Sk5026	62.75	300.00	161.87	19.83	4.45	14.10	40.65	30.41
x Sk5030	63.12	290.12	148.87	21.36	4.41	13.30	43.17	34.77
x Sk6001	61.87	277.12	156.25	19.95	4.66	15.85	42.67	35.54
x Sk6023	60.87	291.62	156.50	19.70	4.57	15.42	40.10	34.03
Sk9215 x Sk5019	58.00	257.75	139.87	18.78	4.60	15.90	41.90	31.45
x Sk5026	57.75	262.00	144.87	17.07	4.22	14.55	38.70	27.23
x Sk5030	60.62	264.62	147.25	19.41	4.50	14.25	43.96	35.68
x Sk6001	58.12	234.25	133.00	16.88	4.33	15.80	38.37	30.90
x Sk6023	58.25	262.50	152.25	17.42	4.60	16.20	39.20	30.21
Sk5019 x Sk5026	58.00	261.87	138.00	18.10	4.46	15.10	40.01	31.37
x Sk5030	58.37	259.62	129.62	17.76	4.58	14.55	43.18	30.37
x Sk6001	55.37	255.75	136.75	17.20	4.80	17.30	39.02	30.32
x Sk6023	56.75	259.87	136.50	16.06	4.78	17.80	34.21	29.54
Sk5026 x Sk5030	59.87	275.00	148.25	19.33	4.37	13.75	43.47	31.59
x Sk6001	59.25	261.25	148.00	19.26	4.62	15.95	41.15	30.24
x Sk6023	59.12	282.50	154.62	18.46	4.55	15.80	38.20	32.04
Sk5030 x Sk6001	59.37	253.87	140.75	19.08	4.73	16.10	42.65	33.44
x Sk6023	61.00	274.00	147.75	17.62	4.60	15.45	38.90	32.06
Sk6001 x Sk6023	57.12	266.37	153.37	18.40	4.70	17.45	37.30	31.72
Check SC173	56.50	285.62	150.37	22.43	4.46	13.80	42.35	31.29
LSD 0.05	0.999	14.11	9.35	1.71	0.196	0.713	3.01	4.32

Table 4. Estimates of the variance due to general (GCA) and specific (SCA) combining abilities and their interaction with locations for eight traits over two locations in 2011 growing season.

S.O.V.	D.F.	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows ear^{-1}	No. of kernels row^{-1}	Grain yield (ard fed^{-1})
GCA	6	110.30**	5780.12**	1465.94**	33.38**	0.728**	32.70**	120.75**	95.89**
SCA	14	5.38**	246.42	197.60**	6.62**	0.144**	0.93*	20.32*	34.24*
GCA x Loc	6	8.30**	337.07	142.53	8.60*	0.236**	3.43**	49.07**	92.77**
SCA x Loc	14	1.88*	119.89	42.88	3.30	0.080	0.55	13.34	78.42**
GCA/SCA		20.48	7.42	7.42	5.41	5.06	3.72	5.95	3.23
GCAxL/SCAxL		4.41	2.81	3.23	2.61	2.95	6.21	3.68	1.18

*, ** indicate significance at 0.05 and 0.01 levels of probability, respectively.

Table 5. Estimates of general combining ability (GCA) effects of seven yellow maize inbred lines for eight traits over two locations during 2011 season.

lines	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows ear^{-1}	No. of kernels row^{-1}	Grain yield (ard fed^{-1})
Gz653	3.257**	21.54**	9.18**	1.79**	0.02	-0.73**	1.56*	2.85**
Sk9215	-0.267	-11.49**	-2.57	-0.51	-0.20**	-0.36*	-0.04	-0.33
Sk5019	-1.692**	-6.66*	-9.09**	-0.78*	0.15**	0.72**	-0.16	-0.65
Sk5026	-0.192	5.41	3.382	0.04	-0.13**	-0.66**	-0.16	-2.03*
Sk5030	0.932**	0.34	-3.24	0.49	-0.03	-1.06**	2.36**	1.05
Sk6001	-1.117**	-13.39**	-2.12	-0.26	0.08*	1.02**	-0.44	-0.2
Sk6023	-0.917**	4.26*	4.46**	-0.78*	0.15**	1.07**	-3.14**	-0.70
S.E. Gi	0.211	2.982	1.977	0.362	0.041	0.151	0.637	0.913
S.E. Gi - Gj	0.322	4.555	3.019	0.552	0.063	0.230	0.973	1.395

*, ** indicate significance at 0.05 and 0.01 levels of probability, respectively.

Table 6. Estimates of specific combining ability (SCA) effects of 21 single crosses for eight traits over two locations during 2011 season.

cross	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows ear^{-1}	No. of kernels row^{-1}	Grain yield (ard fed^{-1})
Gz653 x Sk9215	1.02*	2.31	4.44	0.13	0.26**	0.04	1.18	1.31
x Sk5019	0.57	3.24	5.96	0.65	0.14	0.58*	-2.82*	2.13
x Sk5026	0.07	3.79	2.59	-0.68	0.04	0.05	-1.18	-2.49
x Sk5030	-0.68	-1.01	-3.52	0.38	-0.03	-0.30	-1.58	-1.44
x Sk6001	0.12	-0.28	2.73	-0.25	0.09	0.05	0.97	0.81
x Sk6023	-1.08**	-3.43	-3.59	0.03	0.02	-0.30	1.17	-0.32
Sk9215 x Sk5019	0.34	6.64	5.08	1.45*	0.09	-0.08	1.54	0.18
x Sk5026	-1.41**	-1.18	-2.39	-1.35*	-0.13	0.18	-1.58	-3.69*
x Sk5030	0.34	6.52	7.68*	0.78	0.17**	0.20	2.82*	3.98*
x Sk6001	-0.11	-10.83*	-8.77*	-1.48*	-0.08	-0.21	1.56	-0.77
x Sk6023	-0.18	0.47	3.91	0.33	0.22**	-0.03	2.77*	-1.02
Sk5019 x Sk5026	0.27	-6.13	-2.74	0.28	0.02	-0.40	-0.21	2.01
x Sk5030	-0.48	-3.31	-4.49	-0.80	-0.06	-0.50*	0.52	-2.07
x Sk6001	-0.43	6.54	1.51	-0.55	-0.06	-0.08	-1.81	-0.94
x Sk6023	-0.26	-6.98	-5.32	-1.39*	-0.13	0.58*	-2.86*	-2.32
Sk5026 x Sk5030	-0.48	-0.01	1.66	0.13	-0.03	0.13	0.89	0.43
x Sk6001	0.94*	-0.03	0.28	0.88	0.09	0.05	1.19	0.06
x Sk6023	0.62	3.57	0.33	0.65	0.02	0.06	0.89	3.68*
Sk5030 x Sk6001	-0.06	-2.33	-0.34	0.30	0.02	0.45	0.17	0.48
x Sk6023	1.37**	0.14	0.08	-0.68	-0.06	0.03	-1.01	-0.39
Sk6001 x Sk6023	-0.46	6.24	4.58	0.70	-0.06	-0.12	0.04	0.36
S.E. Sij	0.416	5.881	3.898	0.713	0.082	0.297	1.256	1.801
S.E. Sij-Skl	0.559	7.890	5.230	0.957	0.110	0.399	1.686	2.416

*, ** indicate significance at 0.05 and 0.01 levels of probability, respectively.

Table 7. Estimates of Useful heterosis (Superiority) of 21 crosses relative to the check SC173 for all studied traits over two locations, 2011 season.

cross	Days to 50% silking	Plant height (cm)	Ear height (cm)	Ear length (cm)	Ear diameter (cm)	No. of rows ear^{-1}	No. of kernels row^{-1}	Grain yield (ard fed^{-1})
Gz653 x Sk9215	12.60**	-3.02	-1.16	-11.90**	-4.26*	5.07	-3.42	15.47*
x Sk5019	9.29**	0.61	1.42	-9.72**	7.17**	14.49**	3.12	15.05*
x Sk5026	11.06**	5.03*	7.65*	-11.59**	-0.22	2.17	-4.01	-2.81
x Sk5030	11.72**	1.58	-1.00	-4.77	-1.12	-3.62	1.94	11.12
x Sk6001	9.50**	-2.98	3.91	-11.06**	4.48*	14.86**	0.76	13.58
x Sk6023	7.73**	2.10	4.08	-12.17**	2.47	-89.71**	-5.31	8.72
Sk9215 x Sk5019	2.65**	-9.76**	-6.98*	-16.27**	3.14	15.22**	-1.06	0.51
x Sk5026	2.21*	-8.27**	-3.66	-23.90**	-5.38*	5.43*	-8.62*	-12.98
x Sk5030	7.29**	-7.35**	-2.11	-13.46**	0.90	3.26	3.80	14.03*
x Sk6001	2.87**	-17.99**	-11.55**	-24.74**	-2.91	14.49**	-9.40**	-1.25
x Sk6023	3.10**	-8.09**	1.25	-22.34**	3.14	17.39**	-7.44*	-3.45
Sk5019 x Sk5026	2.65**	-8.32**	-8.23**	-19.30**	0.00	9.42**	-5.53	0.26
x Sk5030	3.31**	-9.10**	-13.80**	-20.82**	2.69	5.43*	1.96	-2.94
x Sk6001	-2.00*	-10.46**	-9.06**	-23.32**	7.62**	25.36**	-7.86*	-3.10
x Sk6023	0.44	-9.02**	-9.22**	-28.40**	7.17**	28.99**	-19.22**	-5.59
Sk5026 x Sk5030	5.96**	-3.72	-1.41	-13.82**	-2.02	-0.72	2.64	0.96
x Sk6001	4.87**	-8.55**	-1.58	-14.13**	3.59	15.58**	-2.83	-3.36
x Sk6023	4.64**	-1.09	2.83	-17.70**	2.02	14.49**	-9.80	2.40
Sk5030 x Sk6001	5.08**	-11.12**	-6.40*	-14.94**	6.05**	16.67**	0.71	6.87
x Sk6023	7.96**	-4.07	-1.74	-21.44**	3.14	4.71	-8.15*	2.46
Sk6001 x Sk6023	1.10	-6.74**	2.00	-17.97**	5.38*	26.45**	-11.92**	1.37
LSD 0.05	0.999	14.11	9.35	1.71	0.196	0.713	3.01	4.32
0.01	1.312	18.54	12.28	2.24	0.257	0.937	3.95	5.67

*, ** indicate significance at 0.05 and 0.01 levels of probability, respectively.

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القدرة على التآلف , طبيعة الفعل الجينى وقوة الهجين لسلالات صفراء جديدة من الذرة الشامية (*Zea mays* L.) بإستخدام طريقة التزاوج الدورى

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تم تقدير القدرة على التآلف وطبيعة الفعل الجينى وقوة الهجين لعدد سبعة سلالات صفراء جديدة من الذرة الشامية من خلال التهجين النصف دورى بينهم للحصول على ٢١ هجين فردى بمحطة البحوث الزراعية بسخا موسم ٢٠١٠. وتم تقييم الهجن الناتجة مع هجين المقارنة الفردى الأصفر ١٧٣ بمحطتى البحوث الزراعية بسخا والإسماعيلية فى الموسم الزراعى ٢٠١١من خلال تجربة بإستخدام تصميم القطاعات الكاملة العشوائية ذات الأربع مكررات وتم أخذ بيانات صفات عدد الأيام حتى ظهور٥٠% من الحراير ، إرتفاعى النبات والكوز ، طول وقطر الكوز ، عدد السطور بالكوز ، عدد الحبوب فى السطر ومحصول النبات. تم تقدير كلاً من القدرة العامة والخاصة على التآلف بإستخدام الطريقة الرابعة والموديل الأول لجريفينج ١٩٥٦. أظهرت النتائج أن التباين الراجع للهجن وتفاعل الهجن مع المواقع كان معنوياً لكل الصفات المدروسة ما عدا صفات: التزهير ، محصول الحبوب ، عدد السطور بالكوز وعدد الحبوب بالسطر بالنسة لتفاعل الهجن مع المواقع. كان لكل من الفعل الجينى المضيف وغير المضيف دوراً هاماً فى وراثة كل الصفات المدروسة فيما عدا صفة إرتفاع النبات بالنسبة للفعل الجينى غير المضيف. كانت نسبة القدرة العامة للتآلف إلى القدرة الخاصة على التآلف تزيد على الوحدة لكل الصفات تحت الدراسة مشيراً إلى أن الفعل الجينى المضيف يلعب الدور الأكثر أهمية فى وراثة هذه الصفات أكثر من الفعل الجينى غير المضيف. أظهرت الهجن جيزة٦٥٣ x سخا٩٢١٥، جيزة٦٥٣ x سخا٥٠١٩ وسخا٩٢١٥ x سخا٥٠٣٠ معنوية فى المحصول عن هجين المقارنة هجين فردى١٧٣ (٣١,٢٩ أردب/فدان) والتى أعطت (٣٦,١٣) ، (٣٦,٥٠) و(٣٥,٦٨) أردب فدان-١ على الترتيب بنسب مئوية مقدارها ١٥,٤٧ ، ١٥,٠٥ و١٤,٠٣% للهجن على الترتيب. فى حين كانت الهجن جيزة٦٥٣ x سخا٥٠٢٦ ، جيزة٦٥٣ x سخا٦٠٠١ ، جيزة٦٥٣ x سخا٦٠٢٣ وسخا٥٠٣٠ x سخا ٦٠٠١ لا تختلف معنوياً عن هجين المقارنة لصفة محصول الحبوب. أشارت النتائج إلى أن السلالة جيزة٦٥٣ تمتلك قدرة عامة على التآلف موجبة ومعنوية لصفة محصول الحبوب ، طول الكوز وعدد الحبوب بالسطر وكذلك السلالة سخا٥٠١٩ لصفات التزهير تجاة التبكير ، إرتفاع النبات وإرتفاع الكوز تجاة قصر النبات وأفضلية لموقع الكوز على النبات ، قطر الكوز وعدد السطور بالكوز. أشارت النتائج إلى أن أفضل الهجن ذات قدرة خاصة على التآلف سخا ٩٢١٥ x سخا ٥٠٣٠ لصفات محصول الحبوب ، قطر الكوز وعدد الحبوب بالسطر وفى الهجن جيزة٦٥٣ x سخا ٥٠٣٠ وجيزة٦٥٣ x سخا ٦٠٢٣ و سخا ٩٢١٥ x سخا ٥٠٢٦ لصفة التزهير تجاة التبكير. ويوصى بإستخدام هذه الهجن فى برنامج التربية للتحسين لصفات التبكير ومحصول الحبوب وبعض مكونات المحصول فى الذرة الشامية.