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GENETIC ANALYSIS OF GRAIN YIELD PER PLANT AND OTHER TRAITS ON MAIZE EARLY INBRED LINES

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ABSTRACT

A half-diallel set of crosses involving nine white early inbred lines of maize were evaluated at the two locations Sakha and Sids. The objectives were to estimates the type and relative amount of genetic variance components and their interaction with the environment for tasseling date, ear position, late wilt resistance, number of ears/100 plant, 100-kernels weight and grain yield/plant. Genetically analyzed by the procedures developed by Griffing (1956) method-2 model-1.

Mean squares of locations (L) were significant for all studied traits. The significance of genotypes and their partitions parents (P), crosses (C) and P vs C (heterosis) were detected for all studied traits except (P vs C) for ear position. The mean squares of interaction between genotypes and their partitions with locations were significant for all studied traits except C x L and P vs C x L for 100-kernel weight. Both additive and non-additive genetic effects were controlling the genetic system for all studied traits. The additive genetic effects played an important role in the expression of all studied traits except grain yield/plant. The interaction between GCA and SCA with location were significant for all studied traits except SCA x location for 100-kernel weight.

The parental inbred lines Sd-62E and Sk-6056 seemed to be the best combiner for grain yield/plant. Sk-6054 and Sk-4051 were the best for earliness. Sd-62E and SD-7E were the first comber for late wilt resistance.The highest desirable SCA effects were detected in the crosses; (Sd-7E x Sk-4051), (Sd-7E x Sd-34E), (Sk-34E x Sk-4054), (Sk-4051 x Sk-6056), (Sd-62E x Sk-4054) and (Sd-34E x Sk-6056) for grain yield/plant and most studied traits.

INTRODUCTION

The making of all possible single crosses among a set of inbred lines has been a popular mating scheme for 60 years (Sprague and Tatum, 1942). Statistical analysis of diallel crosses and genetic interpretations of such analysis have been the subject of many research papers. Through knowledge on the genetic behaviour of the parents and the nature of gene action for grain yield and other desirable traits were prerequisites for maize improvement programs. Kalsy and Shama (1970), Nawar *et al.*, (1981), Pajic (1986) and Sedhom (1992) reported the importance of non-additive genetic in the inheritance of grain yield/plant. On the other hand, El-Hosary *et al.*, (1990) stated that the additive and non-additive genetic were significant for tasseling date, although additive effects were predominated. El-zeir (1998) found that GCA was greater than those SCA for ear position. Galal *et al.*. (1985), El-Shenawy (1995), Amer *et al.*,(1998) and Mosa (2001) noticed support to the importance of additive gene effects in the expression of late wilt resistance (caused by *Cephalosperium maydis*). Lee mason and Marcus (1976) mentioned that the additive gene effects more important than those non-additive gene effects for number of ears/100 plant. The same result was obtained for 100-kernels weight by El-Shamarka (1995), Mosa (1996) and Abd El-Maksoud (1997). The purpose of this investigation was to the study the type of gene action and to choose the best inbred lines and crosses for use in breeding maize program.

MATERIALS AND METHODS

The nine white maize early inbred lines, i.e. Sd-7E, Sd-62E, Sd-34E,Sk-4051, Sk-4054, Sk-6050, Sk-6054, Sk-6055 and Sk-6056 were crossed in all possible combinations excluding reciprocals (half diallel) at Sakha Station in 2000 growing season. The F_1 crosses and the parents were grown in 2001 growing season at the two locations Sakha and Sids. The experimental design was a Randomized Complete Blocks Design with four replications. Each experimental plot included one row of 6.0 m. length, each with a row-to-row spacing of 80 cm. Hills within row were 25 cm. abart, cultural practices were used as a recommended. The harvesting after 100 days from planting. The data were recorded for grain yield/plant (adjusted for shelling percentage and 15.5% moisture), tasseling date, ear position, late wilt resistance%, number of ears/100 plant and 100-kernel weight. Analysis of variance was carried out according to the Griffing (1956), method-2, model-1.

RESULTS AND DISCUSSION

Analyses of variance for all studied traits in the combined data are presented in table (1). The results indicated that locations (L) mean squares were highly significant for all studied traits, with mean values for Sakha location being higher than Sids location for all studied traits except ear position.This finding suggested markedly differences between the two locations in their environmental specially temperature and soil conditions(calculations not shown).

Table (1): Combined analyses of variance for the six traits over Sakha and Sids locations.

S. o. v.	Tasseling date	Ear position	Number of ears/100 plant	Late wilt resistance %	Grain yield/plant	100 kernel weight
Locations (L)	864.90**	95.23**	45447.62**	8917.20**	242503.69**	1720.29**
Ea	5.79	30.21	262.81	112.79	2980.74	57.35
Genotypes (G)	84.03**	53.26**	1603.92**	483.29**	18695.68**	146.62**
Parents (P)	53.6**	110.90**	2206.73**	236.04**	1357.31**	32.81**
Crosses (C)	30.49**	41.16**	753.61**	547.05**	7376.15**	93.49**
P vs C	2201.47**	15.64	26542.29**	229.69*	553586.19**	2916.4**
G x L	2.59**	19.291**	945.31**	386.38**	2036.45**	15.47**
P x L	4.16**	25.38**	1056.21**	223.95**	1505.27**	23.21*
C x L	1.97**	15.54**	518.17**	362.70**	1516.83**	14.09
P vs C x L	12.12**	101.86**	15008.01**	2514.62**	24472.59**	1.85
Error (Eb)	1.09	7.58	149.71	51.51	493.53	10.48
C.V.%	1.76	5.51	12.39	7.89	18.75	10.48

The significance of genotypes and their partitions parents (P), crosses (C), and heterosis (P vs C) were detected for all studied traits except P vs C for ear position, revealed that the genotypes i.e. (parents, crosses and P vs C) varied from each other. The locations had significant effect on genotypes and their partitions parents, crosses and P vs C for all studied traits except crosses and (P vs C) for 100-kernel weight, indicating that the genotypes and their partitions behaved differently from location to another.The mean performances of the combined date for all studied traits of nine parental lines and 36 crosses are presented in table (2).

Table (2): Mean performances of parents and their F_1 crosses over Sakha and Sids locations for the six traits.

Genotypes	Tasseling date	Ear position	Number of ears/100 plant	Late wilt resistance %	Grain yield/plant	100 kernel weight
Sd-7E	67.875	53.687	89.216	100	44.325	24.193
Sd-34E	65.375	48.480	46.190	94.494	25.164	26.912
Sd-62E	64.375	51.319	93.845	99.375	51.375	27.920
Sk-4051	61.750	50.618	71.405	92.461	22.703	25.844
SK-4054	67.875	48.062	74.333	92.67	26.348	27.168
Sk-6050	62.00	46.083	105.099	94.602	36.767	21.973
Sk-6054	60.500	52.713	83.080	85.877	44.078	23.735
Sk-6055	64.625	57.149	86.830	84.167	59.016	23.198
Sk-6056	65.125	45.868	84.137	89.211	50.718	25.986
Sd-7ExSd-34E	59.625	50.894	102.991	98.316	191.343	37.907
Sd- 62E	59.125	49.444	101.917	100	153.643	35.224
Sk-4051	58.75	50.753	114.037	99.432	184.452	37.460
Sk- 4054	64.875	52.204	95.920	96.932	74.922	29.495
Sk- 6050	61.500	52.344	113.612	96.480	101.744	29.839
Sk- 6054	58.750	52.385	98.938	88.083	98.954	30.203
Sk- 6055	57.875	54.194	101.140	89.940	140.614	30.112
Sk- 6056	58.500	48.474	106.687	92.277	162.998	32.632
Sd-34-ExSd62E	58.625	47.741	98.40	100	150.983	38.203
Sk- 4051	60.625	49.817	68.598	91.80	48.510	29.901
Sk- 4054	59.750	48.263	101.028	97.892	177.305	38.580
Sk- 6050	58.00	45.997	95.634	95.952	137.253	34.937
Sk- 6054	55.750	47.873	105.125	84.033	145.162	31.438
Sk- 6055	58.125	51.667	86.315	93.116	138.431	36.475
Sk- 6056	58.125	47.741	98.342	95.348	180.070	35.515
Sd-62ExSk-051	58.125	51.435	99.998	99.50	157.314	37.577
Sk- 4054	59.125	50.651	106.303	97.682	169.222	36.267
Sk- 6050	57.500	46.676	102.071	95.125	159.298	34.000
Sk- 6054	55.375	51.492	110.719	92.691	141.385	34.097
Sk- 6055	58.000	51.438	94.848	94.525	131.942	32.756
Sk- 6056	58.000	49.051	92.351	97.738	110.923	31.418
Sk-4051xSk-054	59.000	50.666	104.790	99.50	137.581	33.518
Sk-6050	57.000	47.762	100.878	95.735	122.385	32.169
Sk-6054	55.000	51.013	116.014	73.053	138.006	31.888
Sk-6055	56.625	52.165	101.791	86.567	127.708	31.903
Sk-6056	56.750	50.204	109.578	94.635	147.519	32.707
Sk-4054xSk-050	61.625	48.048	112.512	86.234	105.065	27.953
Sk-6054	59.125	52.566	111.322	81.476	107.236	29.698
Sk-6055	58.500	50.954	108.499	83.724	132.414	31.386
Sk-6056	58.750	48.773	105.098	87.447	159.284	30.504
Sk-6050xSk-054	56.375	48.629	114.717	70.147	120.658	26.750
Sk-6055	57.125	49.325	103.255	84.076	148.665	29.386
Sk-6056	56.750	44.187	103.363	86.163	159.005	30.120
Sk-6054xSk-055	56.000	54.626	126.405	77.236	121.308	26.377
Sk-6056	55.500	47.584	98.039	73.161	130.455	27.766
Sk-6055xSk-056	56.875	50.093	98.087	83.507	130.482	27.676
Check S.C.10	65.250	57.37	100.29	100	188.47	35.10
LSD 0.05	1.023	2.69	11.99	7.03	21.77	3.17
0.01	1.34	3.55	18.10	9.25	28.65	4.17

The results indicated that the inbred line Sk-6055 was the best performing inbred lines for grain yield/plant, Sd-62E was the best performing for 100-kernel weight and ranked the second for grain yield/ plant , late wilt resistance and number of ears/100 plant. The results also indicated that the highest mean value was obtained for Sk-6050 inbred line of number of ears/100 plant as well as of Sd-7E for late wilt resistance, while inbred line Sk-6054 was the best for earliness and Sk-6056 for ear position. The crosses (Sd-7E x Sd-34E), (Sd-7E x Sk-4051), (Sd-34E x Sk-4054), (Sd-34E x Sk-6056) and (Sd-62E x Sk-4054) exhibited insignificant comparied with the best commercial single cross-10 for grain yield / plant, 100- kernel weight, number of ears/100 plant and late wilt resistance, but its exhibited significant than S.C.10 for earliness and ear position.These finding indicated that the five crosses could be usd as a new early,short and high yielding single crosses in breeding maize program.

Table (3): Mean squares for combining ability (GCA and SCA) from diallel cross analysis for the six traits in the combined analysis over the two locations.

S.O.V.	Tasseling date	Ear position	Number of ears/100 plant	Late wilt resistance %	Grain yield/plant	100 kerne weight
GCA	141.40**	235.98**	2660.85**	1924.85**	4054.88**	260.51**
SCA	71.28**	12.66**	1369.04**	162.94**	21949.20**	121.31**
GCA x L	7.27**	27.77**	1658.75**	1159.96**	1668.61**	37.35**
SCA x L	1.56*	17.40**	786.77**	214.47**	2118.19**	10.61
Error Eb	1.09	7.58	149.71	51.51	493.53	10.48
GCA / SCA	1.98	18.63	1.94	11.81	0.18	2.14
GCAxL/ SCA x L	4.66	1.59	2.10	5.40	0.78	3.52

The mean squares of the six studied traits from a diallel analysis for general combining ability (GCA) and specific combining ability (SCA) in the combined data are presented in table (3). The results cleared that all mean squares of GCA and SCA were significant for all studied traits.This finding cleared the importance of both additive and non additive gene effects in the inheritance of all studied traits. The relative magnitude of general to specific combining ability mean square (GCA/SCA) showed high ratios which largely exceeded the unity were obtained in all studied traits except grain yield/plant. This result revealed that the additive genetic effects seemed to have an important role in expression of all studied traits except grain yield / plant the non-additive genetic effects was more important component in the expression of this trait.These results supported the findings of Robinson and Comstock (1955), Sprague (1964), Pajic(1986) and Sedhom(1992) Abdel-sattar *et al.* (1999) for grain yield /plant.Eberhart *et al.*(1966) and El-Hosary *et al*(1990) for earliness, El-Zeir (1998) for ear position, El-Shenawy (1995) , Amer *et al.* (1998) and Mosa (2001) for late wilt disease, Galal (1970), Lee mason and Marcus S. Zuber (1976), Nawar *et al.* (1979) for number of ears/100 plant, El-Shamarka (1995), Mosa (1996) and Add El-Maksoud (1997) for 100-kernel weight.

On the other hand, the interaction between GCA and SCA with locations were significant for all studied traits except SCA x L for 100-kernel weight. This finding indicated that the magnitudes of all types of gene action varied from location to another. The magnitudes of the interaction for GCA by locations were higher than those SCA for all studied traits except grain yield/plant.

Matzinger *et al.* (1959), Debnath and Sarkar (1987). They suggested that the additive effects were more biased by interaction with environments than the non-additive effects. While, the reverse was obtained by Rojas and Sprague (1952), Lannquiest and Gardner (1961),Galal *et al.* (1989) and Mosa (1996) they reported greater important of SCA x environments than that GCA x environments.

The estimates of GCA effects for individual inbred lines over two locations are presented in table (4). The results cleared that the GCA effects estimates for grain yield /plant was greatest for inbred lines Sd-62E and Sk-6056. The highest significant negative values of GCA, i.e., contribution to earlier tasseling date were exhibited for inbred line Sk-6054 followed by inbred line Sk-4051. The inbred lines Sk-6050 and Sk-6056 exhibited good GCA effects for ear position. The first and the best combiner of GCA effect had SK 6050 for number of ears/100 plant, SD-62 for late wilt resistance and SD 34E for 100 kernel weight. Regarding to table (4) the correlation coefficient between mean performance with GCA effects of the inbred lines were positive and significant for all studied traits except grain yield/plant which showed insignificant positive correlation.

Table (4): Estimates of general combining ability effects for nine inbred lines over the two locations.

Inbred lines	Tasseling date	Ear position	Number of ears/100 plant	Late wilt resistance %	Grain yield/plant	100 kernels weight
Sd-7E	1.846**	1.620**	2.385	4.731**	1.136	0.199
S Sd-34E	0.482**	-1.209**	-12.602**	3.275**	3.141	2.524**
Sd-62E	-0.165	0.029	0.624	6.054**	8.421**	2.392**
Sk-4051	-0.824**	0.437	-2.631*	1.430*	-4.450*	0.886**
SK-4054	2.005**	-0.181	0.609	0.619	-6.282**	0.242
Sk-6050	-0.415**	-2.283**	6.255**	-0.936	-5.202*	-1.811**
Sk-6054	-1.961**	1.032**	5.455**	-8.889**	-8.501**	-2.126**
Sk-6055	-0.518**	2.592**	0.597	-4.399**	0.433	-1.510**
Sk-6056	-0.449**	-2.037**	-0.692	-1.884**	11.304**	-0.796*
LSD 0.05	0.20	0.54	2.41	1.41	4.376	0.63
0.01	0.27	0.71	3.17	1.86	5.76	0.83
R*	0.923**	0.967**	0.891**	0.903**	0.464	0827**

R = Correlation coefficient between mean performance and GCA effects of the inbred lines.

This indicated that selection with tested inbred lines for initiation any proposed breeding program could be practiced either mean performance or GCA effects basis with similar efficiency.These results are agreement with Abd EL-Sattar *et al.* (1999) and Mosa (2001), they noticed significant correlation between mean performance with GCA effects for inbred lines.

The estimates of specific combining ability effects for the 36 crosses are presented in table (5). The results indicated the 23 single crosses were positive and segnificant SCA effects for grain yield/plant. The best combinations were detected for (Sd-7E x Sk-4051), (Sd-7E x Sd-34E), (Sk-34E x Sk-4054), (Sk-4051 x Sk-6056), (Sd-62E x Sk-4054) and (Sd-34E x Sk-6056). These crosses also had high mean values. These finding indicated that the previous crosses seemed to be the best combination for grain yield/plant, where it had significant SCA effects for grain yield/plant. Also the six crosses exhibited desirable SCA effects in the most studied traits especially earliness, prolificacy and weight of 100 kernel.Twenty nine crosses had negative and significant SCA effects for tasseling date (earliness). Three crosses had desirable SCA effects for ear position.Such significant desirable SCA effects were detected for eleven crosses for number of ears/100 plant, two cross for late wilt resistant and fourteen crosses for 100 kernels weight. These crosses might be of interest inbreeding programs proupes obtained new single crosses, inbred lines and synthetic varieties through traditional breeding procedures.

Table (5): Estimates of specific combining ability effects for 36 crosses over the two locations.

Crosses	Tasseling date	Ear position	Number of ears/ 100 plant	Late wilt resistance%	Grain yield/plant	100 kernel weight
Sd-7ExSd-34E	-2.148**	0.458	14.464**	-0.632	68.583**	4.277**
Sd- 62E	-2.000**	-2.230*	0.164	-1.727	25.603**	1.726
Sk-4051	-1.716**	-1.329	15.540**	2.329	69.284**	5.469**
Sk-4054	1.580**	0.741	-5.818	0.640	-38.415**	-1.853
Sk-6050	0.625	2.983**	6.228	1.744	-12.672	0.544
Sk-6054	-0.580	-0.292	-7.646	1.3	-12.164	1.223
Sk-6055	-2.898**	-0.042	-0.585	-1.333	20.562**	0.515
Sk-6056	-2.341**	-1.134	6.251	-1.513	32.076**	2.322*
Sd34ExSd62E	-1.136**	-1.104	11.634**	-0.271	20.938**	2.380*
Sk-4051	1.523**	0.564	-14.913**	-3.847	-68.664**	-4.416**
Sk-4054	-2.182**	-0.372	14.277**	3.056	61.963**	4.907**
Sk-6050	-1.511**	-0.536	3.237	2.672	20.831**	3.368**
Sk-6054	-2.216**	-1.975*	13.529**	-1.294	32.038**	0.133
Sk-6055	-0.909**	0.259	-0.423	3.298	16.373*	4.554**
Sk-6056	-1.352**	0.961	12.893**	3.015	47.142**	2.881**
Sd-62ExSk-4051	-0.330	0.944	3.262	1.075	34.860**	3.392**
Sk-4054	-2.159**	0.779	6.326	0.067	48.601**	2.725**
Sk-6050	-1.364**	-1.094	-3.552	-0.934	37.596**	2.512*
Sk-6054	-1.943**	0.406	5.897	4.584*	22.982**	2.924**
Sk-6055	-0.761*	-1.207	-5.116	1.928	4.605	0.966
Sk-6056	-0.830*	1.034	-6.324	2.626	-27.285**	-1.085
Sk-4051xSk4054	-1.625**	0.386	8.068*	6.510**	29.830**	1.483
Sk-6050	-1.205**	-0.416	-1.489	4.300	13.554	2.188*
Sk-6054	-1.659**	-0.480	14.446**	-10.429**	32.474**	2.221*
Sk-6055	-1.477**	-0.889	5.082	-1.405	13.241	1.620
Sk-6056	-1.420**	1.779*	14.158**	4.147	49.182**	1.711
Sk-4054xSk-6050	0.591	0.488	6.904	-4.390	-1.934	-1.386
Sk-6054	-0.364	1.692	6.514	-1.195	3.536	0.674
Sk-6055	-2.432**	-1.481	8.549*	-3.437	19.780**	1.746
Sk-6056	-2.250**	0.967	6.437	-2.231	35.779**	-0.151
Sk-6050xSk-6054	-0.693*	-0.145	4.264	-10.968*	15.878*	-0.221
Sk-6055	-1.386**	-1.008	-2.340	-1.530	34.951**	1.799
Sk-6056	-1.830**	-1.518	-0.943	-1.958	34.420**	1.820
Sk-6054xSk-6055	-0.966**	0.977	21.610**	-0.417	10.892	-0.895
Sk-6056	-1.534**	-14.36**	-5.467	-7.008**	9.170	-0.219
Sk-6055xSk-6056	-1.602**	-1.436	-0.561	-1.151	0.262	-0.925
L.S.D Sij 0.05	0.66	1.74	7.73	4.54	14.07	2.05
0.01	0.87	2.29	10.18	5.98	18.53	2.70

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التحليل الوراثى لصفة محصول الحبوب للنبات وبعض الصفات الأخرى على سلالات مبكرة من الذرة الشامي

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تم التهجين بين تسعة سلالات ذرة بيضاء مبكرة بنظام الهجن النصف دورية وذلك فى عام ٢٠٠٠ وقيمت الأباء والنسل الناتج منها فى تجربتين فى محطتى بحوث سخا و سدس فى موسم ٢٠٠١ وذلك لتقديرمكونات التباين الوراثي وأهميتها وكذلك تفاعلتها مع البيئة للصفات التالية محصول الحبوب /للنبات ، تاريخ التزهير لـ٥٠% لقاح ، موقع الكوز، المقاومة لمرض الذبول المتأخر ، عدد الكيزان لكل ١٠٠نبات ووزن ١٠٠حبه ويمكن تلخيص اهم النتائج فى :

١ - كان التباين الراجع للمواقع معنويالجميع الصفات المدروسة كذلك الاختلافات بين جميع التراكيب الوراثية وتفاعلاتها مع البيئة معنوية فى معظم الصفات المدروسة .

٢ -كان لكلا من التباين الراجع للتاثير االأضافى والتباين الراجع للتأثير الغير إضافي للجين دور فى توريث الصفات المدروسة و تبين ان التباين الراجع للتاثير الإضافي للجين له الدور الرئيسى فى وراثة حميع الصفات المدروسة ما عدا صفة محصول الحبوب /للنبات .

٣ - تبين ان تفاعل كل من التاثير الراجع للفعل الاضافى والغير اضافى للجين مع المواقع معنوى فى جميع الصفات المدروسة ما عدا تاثير تباين الفعل الغير اضافى مع المواقع فى صفة وزن ١٠٠ حبه .

٤ - أظهرت السلالات التالية افضل قدرة عامه على التالف ، سدس ٦٢ م ، وسخا ٦٠٥٦ لصفة محصول الحبوب للنبات والسلالات سخا ٦٠٥٤ وسخا ٤٠٥١ فى التبكير والسلالات سدس ٧م ، سدس ٦٢م ، للمقاومة مرض الذبول المتأخر .

٥ - افضل الهجن فى القدرة الخاصة على التالف فى صفة المحصول ومعظم الصفات المدروسة كانت (سدس ٧م X سخا ٤٠٥١) ، (سدس ٧م X سدس ٣٤م) ، (سدس ٣٤ م X سخا ٤٠٥٤) ، (سخا ٤٠٥١ X سخا ٦٠٥٦)، (سدس ٦٢م X سخا ٤٠٥٤) ، (سدس ٣٤ م X لسخا ٦٠٥٦) . ويمكن الاستفادة من هذه الهجن فى برنامج الذرة اشامية.ي٣