COMBINING ABILITY OF EIGHT YELLOW MAIZE (*Zea mays* L.)INBRED LINES FOR DIFFERENT CHARACTERS IN DIALLEL CROSSES

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ABSTRACT

Eight diverse inbreds were crossed in a half diallel at Sakha Research Station in 2003 summer season. The 28 F_1s and the two checks were planted at Sakha and Sids Agric. Res. Stations in a randomized complete block design, with four replications, in 2004 summer season. Combined analysis for the two locations was performed for grain yield, ear length, number of rows/ear, number of ears/100 plant, resistance to late wilt disease, plant height and silking date. Estimates of combining ability effects according to Griffing (1956) Method 4 Model 1 were determined. Both additive and non-additive gene actions were found to be important in controlling of grain yield, ear length, resistance to late wilt disease, plant height and silking date; and only additive gene action in controlling of number of rows/ear and number of ears/100 plant. However, additive gene action seemed to be more an important than non-additive effect in the expression of all characters except resistance to late wilt disease. Also additive gene action was more interacted with the environment than non-additive action for all characters, except for number of ears/100 plant. The highest desirable values of GCA effects were obtained from Sk121 inbred for grain yield, ear length and number of ears/100 plant, while Sk N14 inbred for number of rows/ear and plant height, Sk8117 inbred for resistance to late wilt disease and Sk U10 inbred for silking date. The cross Sk N14 x Sk121 exhibited significant superiority over SC155 and SC Pioneer 3080 commercial hybrids for grain yield, ear length, number of rows/ear and number of ears/100 plant. This new cross will the recommended for further tests.

INTRODUCTION

In recent years, a major objective of maize breeding program in Egypt is to developing high yielding yellow maize hybrids and encouraging their cultivation to fulfill the need for feed industry. The concept of combining ability, as a measure of gene action was proposed by Sprague and Tatum (1942). Knowledge of gene action is useful to a plant breeder in selection of suitable parents for hybridization and in the choice of appropriate breeding procedure for the genetic improvement of various quantitative characters. Piovarci (1973) found that the ratio of variance due to general and specific combining abilities was 2:1 for grain yield, 5:1 for ear length and 45:1 for number of rows/ear, indicating the predominant role of additive gene action in the expression of these characters. Baktash *et al.* (1985) estimated GCA and SCA for grain yield per plant and ear characters in maize inbred lines, using diallel analysis. They found that GCA effects were more important than SCA effects for these traits, while Mahmoud (1989) showed that GCA was more important than SCA in the inheritance of number of days to 50% silking and resistance to late wilt disease. Mokbel (1988) reported that the magnitude of the ratio of general to specific combining ability variance was high for plant height and number of ears/plant, suggesting the importance of additive gene action in the inheritance of these characters. El-Rouby *et al.* (1973), El-Shenawy *et al.* (2002) and Mosa (2003) reported that the magnitude of the interactions for GCA x locations was higher than for SCA x locations of number of ears/100 plant, resistance to late wilt, plant height, number of rows/ear and grain yield characters. This study reported estimates of general and specific combining abilities and their interaction with locations and to identify superior single crosses over the best commercial varieties.

MATERIALS AND METHODS

Eight yellow inbred lines; i.e., Sk U10, Sk U14, Sk U15, Sk U16, Sk N14, Sk121, Sk6241 and Sk8117 were obtained by the maize research program .It were crossed in all possible combinations without reciprocals at Sakha Agricultural Research Station in2003 summer season. The 28 F_1s and the two yellow commercial hybrids; i.e., SC155 and SC Pioneer 3080, were grown in four replications of a randomized complete block design at Sakha and Sids Research Stations in 2004 summer season. Each plot was a single row, 6m long, 80cm apart and 25 cm hill spacing. After 21 days from planting date, plants were thinned to one plant per hill. Recommended cultural practices were followed. Data were recorded on grain yield ard/fad (1ardab = 140 kg, 1 faddan = 4200 m^2), adjusted on 15.5% basis grain content and shelling percent, ear length (cm), number of rows/ear, number of ears/100 plant, resistance to late wilt disease (%), plant height (cm) and number of days from planting date to 50%silking emergence. An ordinary analysis of variance for the data was performed for each location then combined over two locations according to Steel and Torrei, (1980). The hybrid effect was assumed to be fixed while the location effect was considered random. Variation among 28 hybrids was partitioned to GCA and SCA and their interactions with location according to Griffing (1956) for Method-4 Model-1.

RESULTS AND DISCUSSION

Mean squares of diallel analysis of 8 x 8 inbred lines combined over two locations for seven characters are presented in Table (1). Locations (L) mean squares were highly significant for grain yield, ear length and plant height and significant for number of rows/ear, indicating overall differences between the two locations for these traits, while insignificant locations MS were detected for number of ears/100 plant, resistance to late wilt disease and silking date.

Table (1): Mean squares of diallel analysis of 8 x 8 inbred lines combined over two locations for seven characters.

S.O.V.	d.f.	Grain yield (ard/fad)	Ear length (cm)	No. of rows/ ear	No.of ears/ 100 plant	Late wilt resistance (%)	Plant height (cm)	Silking date (days)
Locations (L)	1	1135.4**	314.6**	12.51*	115.41	827.10	74025.9**	8.43
Rep/ L	6	25.49	0.92	1.61	39.60	598.39	672.91	25.48
GCA	7	423.52**	44.1**	49.06**	177.96**	2064.79*	3710.4*	33.12**
SCA	20	67.23**	4.48**	1.34	50.99	511.26**	384.90**	3.16**
GCA × L	7	26.96**	3.50**	2.17*	41.4	402.77**	717.96**	1.66
SCA × L	20	7.83	0.69	0.94	46.37	144.45	106.18	0.86
Error	+174	9.01	0.57	0.97	46.36	141.5	88.32	1.05

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

Mean performance of 28 F_1s and the two check cultivars for seven characters over the two locations are presented in Table 2. Only the cross, Sk N14 x Sk121, exhibited significant superiority

Table (2): Mean performance of 28 F_1s and two check cultivars for seven characters over two locations.

Cross	Grain yield (ard/fad)	Ear length (cm)	No. of rows/ ear	No. of ears/100 plant	Late wilt resistance (%)	Plant height (cm)	Silking date (days)
Sk U10 × Sk U14	27.83	20.15	16.05	106.65	90.45	252.87	61.62
Sk U10 × Sk U15	26.99	19.10	17.00	99.41	85.01	233.62	61.75
Sk U10 × Sk U16	26.18	20.17	16.15	100.72	82.93	238.12	61.87
Sk U10 × Sk N14	29.07	19.27	17.70	100.02	81.93	229.37	61.25
Sk U10 × Sk 121	29.37	20.9	14.75	105.62	97.64	261.12	61.50
Sk U10 × Sk 6241	30.49	19.67	14.70	106.41	95.11	240.62	59.50
Sk U10 × Sk 8117	29.03	20.05	14.80	104.87	100.0	236.75	61.0
Sk U14 × Sk U15	18.53	16.25	17.15	99.39	70.38	233.12	62.87
Sk U14 × Sk U16	21.18	17.62	17.10	97.56	80.05	241.00	64.12
Sk U14× Sk N14	26.19	18.52	18.60	103.78	56.85	225.50	62.12
Sk U14 × Sk 121	29.45	20.27	15.35	105.83	99.50	260.87	64.37
Sk U14 × Sk 6241	27.16	19.37	15.25	105.34	96.01	226.75	61.37
Sk U14 × Sk 8117	28.29	18.67	16.2	104.71	99.47	247.62	62.62
Sk U15 × Sk U16	10.68	15.25	17.9	95.29	77.66	209.25	65.12
Sk U15 × Sk N14	24.20	17.90	19.35	99.56	90.20	210.87	62.75
Sk U15 × Sk 121	26.64	19.07	17.30	104.80	99.50	236.75	62.50
Sk U15 × Sk 6241	23.83	17.12	16.45	102.54	88.02	232.37	61.87
Sk U15 × Sk 8117	26.52	17.80	16.25	104.75	99.47	234.12	62.0
Sk U16 × Sk N14	24.88	18.52	18.4	99.94	95.28	221.75	64.0
Sk U16 × Sk 121	30.10	19.07	17.00	103.06	96.97	229.87	63.87
Sk U16 × Sk 6241	25.06	18.47	15.95	101.32	97.15	229.12	62.50
Sk U16 × Sk 8117	22.19	17.40	15.75	100.69	100.0	238.25	62.12
Sk N14× Sk 121	35.59	20.55	17.55	110.11	99.43	246.62	62.62
Sk N14 × Sk 6241	29.63	20.72	16.90	101.58	94.78	227.62	61.12
Sk N14 x Sk 8117	26.64	17.65	17.90	104.37	99.50	225.25	62.37
Sk 121 × Sk 6241	27.51	19.60	15.00	103.26	100.0	245.0	62.75
Sk 121 × Sk 8117	28.45	19.25	15.75	103.26	100.0	249.87	62.25
Sk 6241 × Sk 8117	25.20	18.45	14.20	99.37	100.0	233.0	61.87
Check SC 155	28.87	18.90	14.95	102.56	100.0	264.75	63.12
Check SC 3080	30.87	18.95	15.45	100.05	99.50	255.0	62.75
LSD 0.05	2.940	0.739	0.965	6.986	11.657	9.209	1.004
0.01	2.87	0.973	1.270	9.197	15.345	12.123	1.321

over the two commercial hybrids, SC155 and SC Pioneer 3080, for grain yield, ear length, number of rows/ear and number of ears/100 plant.

Figure (1) cleared that the, SC Sk N 14 x Sk121, was higher for grain yield (ard/fad) compared to SC155 and SC Pioneer 3080 under Sakha and Sids locations. Hence, it could be concluded that the new single cross SC Sk N14 x Sk121, will the recommended for further tests.

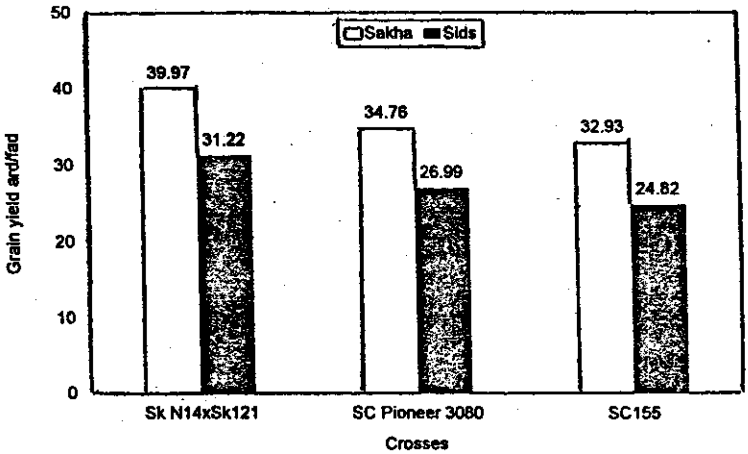

Fig 1:Means of grain yield (ard/fad) for the highest single cross Sk N14 x Sk121and two commercial crosses SC Pioneer 3080 and SC155 under Sakha and Sids locations.

The partition of the variation among hybrids to GCA, SCA and their interaction with locations for the seven characters under study is given in Table (1). All the mean squares of GCA and SCA were either significant or highly significant for all studied characters, except for the SCA mean square of number of rows/ear and number of ears/100 plant. Thus, both additive and non-additive gene actions were found to be important in controlling of grain yield, ear length, resistance to late wilt disease, plant height and silking date, but only additive gene action in controlling number of rows/ear and number of ears/100 plant. However, the additive genetic effects (K^2GCA) seemed to have played an important role than non-additive genetic effects (K^2SCA) in the expression of all studied characters except resistance to late wilt disease Table-3. This result supports the findings of Singh *et al.* (2002), for plant height; El-Hosary *et al.* (1999) and Ogunbodede *et al.* (2000), for silking date and number of rows / ear; Nawar *et al.* (1988), Baktash *et al.* (1985) and Rameeh *et al.* (2000), for grain yield and ear length; Piovarci (1973), for number of rows/ear; Motawei (2005), for number of ears/100 plant and disagreement with El-Shenawy (1995) and Amer *et al.* (1998), for resistance to late wilt disease.

Table (3) : Estimates of genetic, genetic x environment and environment parameters for seven characters under study.

Character	Statistical estimates				
	σ^2e	K^2GCA	K^2SCA	$\sigma^2 GCA \times L$	$\sigma^2 SCA \times L$
Grain yield (ard/fad)	9.01	8.26	7.43	0.74	0.00
Ear length (cm)	0.57	0.85	0.47	0.12	0.03
No. of rows/ear	0.97	0.98	0.05	0.05	0.00
No. of ears/ 100 plant	50.83	2.84	0.57	0.00	0.002
Late wilt resistance (%)	141.50	34.63	45.85	10.88	0.73
Plant height (cm)	88.32	62.34	34.84	26.23	4.46
Silking date (days)	1.05	0.66	0.29	0.02	0.00

Regarding to Table 1, the mean squares of interaction between GCA and locations were either significant or highly significant for all studied characters except number of ears/100 plant and silking date. None of the estimates of SCA x Loc was significant for all studied characters. The magnitude of σ^2 GCA x locations was larger than σ^2SCA x locations for all studied characters except number of ears/100 plant (Table 3), indicating that the additive component of genetic variation is highly affected by environment than the non-additive component. Matzinger *et al.* (1959), Debnath and Sarkar (1987), Mahmoud (1996), El-Shenawy *et al.* (2002) and Mosa (2003) suggested that the additive effects were more biased by interaction with environments than the non-additive effects.

The estimates of general combining effects of the eight inbred lines for seven characters over two locations are presented in Table 4. The results indicated that the desirable values of GCA effects were obtained from the parents, Sk U10, Sk N14 and Sk121, for grain yield, and ear length, however Sk121 was the best for grain yield; from parents Sk U15, Sk U16 and Sk N14, for number of rows/ear; from parent Sk121, for number of ears/100 plant; from parents, Sk121, Sk6241 and Sk8117, for resistance to late wilt disease; from parents, Sk U15, Sk U16 and Sk N14, for plant height towards short plants and from parents, Sk U10, Sk6241 and Sk 8117, for silking date towards earliness, suggesting the possibility of utilizing the above inbreds in maize breeding programs to improve these characters.

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

Inbred lines	Grain yield (ard/fad)	Ear length (cm)	No. of rows/ear	No. of ears/ 100 plant	Late wilt resistance (%)	Plant height (cm)	Silking date (days)
Sk U10	2.442*	1.203*	-0.713*	0.843	-1.739	7.203*	-1.322*
Sk U14	-0.932*	-0.088	-0.026	0.760	-8.406*	6.411*	0.447*
Sk U15	-4.432*	-1.526*	0.953*	-2.135*	-5.489*	-9.859*	0.406*
Sk U16	-4.036*	-0.901*	0.349*	-3.322*	-2.239	-6.984*	1.197*
Sk N 14	1.984*	0.286*	1.849*	0.135	-4.218*	-10.380*	-0.031
Sk 121	3.776*	1.224*	-0.484*	2.947*	8.281*	13.474*	0.572*
Sk 6241	0.796*	0.244*	-1.192*	0.218	4.614*	-2.463	-0.906*
Sk 8117	0.401	-0.442*	-0.734*	0.552	9.197*	2.599*	-0.364*
LSD g_i 0.05	0.794	0.199	0.260	1.886	3.147	2.486	0.271

* Significant from zero at the 0.05 level of probability.

The estimates of specific combining ability effects of 28 crosses for the seven characters over two locations are given in Table 5. The most desirable specific combining ability effects were obtained for grain yield in the crosses, Sk U10 x Sk U15, Sk U14 x Sk8117, Sk U15 x Sk8117, Sk U16 x Sk121, Sk U16 x Sk6241 and Sk N14 x Sk121, for ear length; in the crosses, Sk U10 x Sk U15, Sk U10 x Sk U16, Sk U15 x Sk121, Sk U15 x Sk8117 and Sk N14 x Sk6241, for number of rows/ear; in the cross, Sk U14 x Sk8117, for number of ears/100 plant; in the cross, Sk N14 x Sk121, for resistance to late wilt disease; in the crosses, Sk U10 x Sk U14, Sk U14 x Sk121, Sk U14 x Sk6241, Sk U15 x Sk N14 and Sk U16 x Sk N14, for plant height; in the crosses, Sk U10 x Sk8117, Sk U14 x Sk N14, Sk U14 x Sk6241,Sk U15 x Sk U16 and Sk U16 x Sk121 and for silking date; in the crosses, Sk U10 x Sk6241, Sk U14 x Sk N14, Sk U15 x Sk121 and Sk U16 x Sk8117. Those significant effects would contribute to the superiority of their hybrids .The highest yielding hybrid, Sk N14 x Sk 121 was due to the GCA of both parents in addition to significant positive SCA effects.

Table (5): Estimates of specific combining ability of 28 crosses for seven characters over two locations.

Cross	Grain yield (ard/fad)	Ear length (cm)	No. of rows /ear	No. of ears/100 plant	Late wilt resistance (%)	Plant height (cm)	Silking date (days)
Sk U10 × Sk U14	0.173	0.077	0.128	2.351	8.74*	3.65	0.152
Sk U10 × Sk U15	2.673*	0.640*	0.273	-2.003	0.33	0.67	0.318
Sk U10 × Sk U16	1.402	0.890*	-0.122	0.560	-5.05	2.29	-0.348
Sk U10 × Sk N14	-1.744	-1.048*	0.253	-3.649	-4.07	-3.06	0.256
Sk U10 × Sk 121	-3.161*	-0.235	-0.538	-0.836	-0.82	4.84	-0.098
Sk U10 × Sk 6241	0.943	-0.631*	0.294	2.768	0.22	0.27	-0.619*
Sk U10 × Sk 8117	-0.286	0.307	-0.288	0.810	0.64	-8.66*	0.339
Sk U14 × Sk U15	-2.452*	-0.818*	-0.413	-1.92	-7.51*	0.96	-0.327
Sk U14 × Sk U16	-0.098	-0.193	0.190	-2.482	-1.26	5.96*	0.131
Sk U14× Sk N14	-1.244	-0.381	0.190	0.185	-22.4*	-6.14*	-0.64*
Sk U14 × Sk 121	0.214	0.432	-0.72*	-0.503	7.72*	5.38	1.006*
Sk U14 × Sk 6241	0.818	0.536	-0.017	1.726	7.89*	-12.81*	-0.515
Sk U14 × Sk 8117	2.589*	0.348	0.648*	0.643	6.81	3.00	0.193
Sk U15 × Sk U16	-7.223*	-1.256*	-0.038	-1.836	-6.55	-9.52*	1.173*
Sk U15 × Sk N14	0.381	0.432	0.086	-1.045	8.06*	-4.5	0.027
Sk U15 × Sk 121	1.089	0.619*	0.419	1.393	4.81	-2.48	-0.827*
Sk U15 × Sk 6241	1.193	-0.527*	0.128	1.747	-3.03	9.09*	0.027
Sk U15 × Sk 8117	4.339*	0.911*	-0.455	3.664	3.89	5.77*	-0.390
Sk U16 × Sk N14	0.485	0.432	-0.309	0.393	9.81*	3.5	0.485
Sk U16 × Sk 121	3.943*	-0.006	0.523	0.830	-0.94	-12.23*	-0.244
Sk U16 × Sk 6241	1.923*	0.223	0.107	1.810	2.85	2.96	-0.140
Sk U16 × Sk 8117	-0.432	-0.089	-0.351	0.726	1.14	7.02*	-1.057*
Sk N14× Sk 121	3.423*	0.057	-0.226	4.497*	3.41	7.92*	-0.265
Sk N14 × Sk 6241	0.652	1.411*	-0.392	-1.399	2.58	4.86	-0.286
Sk N14 x Sk 8117	-1.952*	-0.902*	0.398	1.018	2.62	-2.58	0.423
Sk 121 × Sk 6241	-3.390*	-0.652*	0.190	-2.586	-4.8	-1.62	0.735*
Sk 121 × Sk 8117	-2.119*	-0.214	0.357	-2.795	-9.38*	-1.81	-0.307
Sk 6241 × Sk 8117	-2.140*	-0.360	-0.309	-4.865	-5.71	-2.75	0.798*
$LSDS_{ij}$ 0.05	1.75	0.44	0.57	4.17	6.96	5.50	0.60

* Significant from zero at the 0.05 level of probability.

REFERENCES

Amer, E. A., A. A. El-Shenawy and F. A. El-Zeir. (1998). Diallel analysis for ten inbred lines of maize (*Zea mays* L.). Egypt J. Appl. Sci. 13: 79-91.

Baktash, F.Y.; M.A. Younis; A.H.AL-Younis and B.A.AL-Ithawi. (1985).Diallel crosses of corn inbred lines for grain yield and ear characters.Iraqi J. Agric. Sci. "ZANCO" 3:29-45.

Dabanth,S.C. and K.R. Sarkar.(1987).Genetic analysis of grain yield and other characters in maize (*Zea mays* L.). J.Genet.Cytol.17:49-61.

El-Hosary, A.A.; A.A. Abdel-Sattar and M.H. Motawea. (1999). Heterosis and combining ability of seven inbred lines of maize in diallel crosses over two years . J. Agric. Res. 24: 65-84. Minufiya Univ., Egypt.

El-Rouby,M.M.; Y.S.Koraiem and A.A.Nawar. (1973).Estimation of genetic variance and its components in maize under stress and non-stress environment. I. Planting date .Egypt J. of Genet. and Cytol. 2:10-19.

EL-Shenawy, A.A.(1995).Breeding for disease resistance in maize. Ph.D. Thesis, Fac. Agric., Minufiya Univ., Egypt.

EL-Shenawy, A.A.; H.E. Mosa and R.S.H. Aly.(2002). Genetic analysis of grain yield per plant and other traits on maize early inbred lines. J. Agric. Sci. 27: 2019-2026. Mansoura Univ., Egypt.

Griffing, B.(1956) Concept of general and specific combining ability in relation to diallel crossing systems. Aust. J. Biological Sci. 9:463-493.

Mahmoud, A.A.(1989).Genetic studies through diallel cross of maize inbred lines. M.Sc Thesis, Fac. Agric., Cairo Univ., Egypt.

Mahmoud,A.A.(1996).Evaluation of combining ability of newly developed inbred lines of maize. Ph.D. Thesis, Fac. Agric., Cairo Univ., Egypt.

Matzinger,D.F.;G.F.Spraque and C.C.Cockerham.(1959).Diallel crosses of experiments repeated over locations and years .Agron. J.51: 346-349.

Mokbel, H.A.A. (1988).Genetical studies in maize .Estimation of the genetic variation components for nine maize quantitative characters by diallel analysis. M. Sc. Thesis, Fac. Agric. Alex., Univ., Egypt.

Mosa, H.E.(2003).Heterosis and combining ability in maize (*Zea mays* L.). J. Agric. Res. 28: 1375-1386. Minufiya Univ., Egypt.

Motawei, A.A.(2005).Combining ability and heterotic effect of nine maize inbred lines via diallel cross analysis. J.Agric.Res. 30:197-214. Minufiya, Univ., Egypt.

Nawar, A.A.; M.M.EL-Sayed; H.A.Dawwan and M.A.Shehata.(1988).Nitrogen fertilizer level effects on heterosis and combining ability in maize. J.Agric. Res. 13:919-935. Minufiya Univ.,Egypt.

Ogunbodede,B.A.;S.R.Ajibade and S.A.Olakojo. (2000). Heterosis and combining ability for yield and yield related characters in some Nigerian local varieties of maize (*Zea mays* L).Moor J.of Agric. Res. 1: 37-43.

Piovarci,A. (1973).Diallel analysis of the combining ability of inbred lines in breeding maize (*Zea mays* L.). Genetika a Slechteni 9: 97-106, Czechoslovakia) (C.F.PL.Br.Abst.44:589).

Rameeh, V.; A. Rezai and A. Arzani. (2000).Estimates of genetic parameters for yield and yield components in corn inbred lines using diallel crosses. J Sci. and Tech.of Agric. and Natural Res. 4: 95-104.

Singh, P.K.; L.B. Chaudhary and S.A.Akhtar. (2002). Heterosis in relation to combining ability in maize. J. of Res., Birsa Agric.Univ. 14: 37-43.

Sprague,G.F.and L.A.Tatum. (1942).General vs. specific combining ability in single crosses of corn J.Amer .Soc.Agron.34:923-932.

Steel, R.G.D. and J.H. Torrie. (1980). Principles and Procedures of Statistics. A Biometrical Approach. 2 *nd*. Ed.Me Graw Hill, N. Y. USA.

القدرة علي الأئتلاف لثماني سلالات صفراء من الذرة الشامية
لصفات مختلفة في تهجينات تزاوجية دائرية (*Zea mays* L.)

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الملخص العربى

أجرى التهجين بين ثماني سلالات مختلفة من الذرة الشامية الصفراء بنظام التزاوج الدائري غير الكامل في محطة البحوث الزراعية بسخا موسم صيفي ٢٠٠٣ قيمت الهجن ال٢٨ الناتجة بالإضافة إلى هجينين تجاريين في تجربتين بمحطتي سخا وسدس للبحوث .التصميم المستخدم هو القطاعات الكاملة العشوائية في أربعة تكرارات وذلك في موسم صيفي ٢٠٠٤. تم عمل التحليل المشترك للموقعين للصفات التالية : محصول الحبوب و طول الكوز و عدد الصفوف للكوز و عدد الكيزان لكل ١٠٠ نبات و مقاومة مرض الذبول المتأخر و ارتفاع النبات وتاريخ ظهور ٥٠% من النورات المؤنثة.و تم تقدير القدرة علي الائتلاف طبقا للطريقة الرابعة النموذج الأول عن جرفنج١٩٥٦.

أظهرت النتائج أن كل من الفعل الوراثي المضيف وغير مضيف للجين له دورا مهم في وراثة صفات المحصول و طول الكوز و مقاومة الذبول المتأخر وارتفاع النبات وتاريخ ظهور ٥٠% من النورات المؤنثة ، بينما الفعل الوراثي المضيف هو فقط الذي يتحكم في وراثة عدد الصفوف بالكوز وعدد الكيزان لكل ١٠٠ نبات. وبصفة عامة فان الفعل الوراثي المضيف للجين اكثر أهمية من الفعل الوراثي غير المضيف للجين في وراثة جميع الصفات تحت الدراسة ما عد صفة مقاومة مرض الذبول المتأخر . كذلك كان الفعل المضيف للجين اكثر تأثرا بالبيئة من الفعل غير المضيف لكل الصفات المدروسة ما عدا صفة عدد الكيزان لكل ١٠٠ نبات. وكانت السلالات التي أظهرت أعلي قيم مرغوبة لتأثيرات القدرة العامة علي الائتلاف هي : السلالة سخا ١٢١ لصفات محصول الحبوب و طول الكوز و عدد الكيزان لكل ١٠٠ نبات و السلالة سخا ن ١٤ لصفتي عدد الصفوف بالكوز وارتفاع النبات و السلالة سخا ٨١١٧ لمقاومة الذبول المتأخر والسلالة سخا ى ١٠ للتبكير. كما أظهر الهجين الفردي سخا ١٢١× سخا ن ١٤ تفوقا معنويا عن هجيني المقارنة هـ.ف ١٥٥ و هـ.ف بيونير ٣٠٨٠ لصفات محصول الحبوب وطول الكوز وعدد الصفوف بالكوز و عدد الكيزان لكل مائة نبات. هذا الهجين يمكن أن يستخدم فى مراحل أخرى متقدمة من التقييم فى برنامج الذرة الشامية.