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LINE X TESTER ANALYSIS FOR EVALUATION OF NEW MAIZE INBRED LINES

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ABCTRACT

Ninety nine yellow inbred lines were divided into four sets where each set contained 25,25,25and24 lines, respectively. These lines were top crossed with two yellow inbred line testers in 2004 summer season at Sakha Agriculture Research Station. All hybrids were evaluated for days to 50% silking as well as grain yield at two locations in 2005season, The best single crosses from four sets along with two checks i.e.SC155 and SC pioneer 3084 were evaluated during 2007 season. The results indicated that the mean squares variances of locations, lines, testers and lines by testers were highly significant for all traits , except for testers for silking date of set-3 and set-4. Silking date and grain yield traits were affected by non additive gene action for all sets, except for grain yield in set-2.The non additive gene action was more affected by locations for silking date in set-1 and set-2 as well as grain yield in sets- 2, 3 and 4. The parental inbred lines, which revealed significance and desirable GCA effect for earliness were : ten, seven, five and seven from set-1, set-2, set-3 and set-4, respectively. While it was five, four, five, and eight inbred lines from set-1, set-2, set-3 and set-4 ,respectively, which had a desirable positive and significant values for general combining ability effects for grain yield potentiality in their top crosses. The best tester inbred line for general combining ability effects was inbred, Sk121 for grain yield of set-1, set-3 and set-4, inbred line Sk10 for silking date and grain yield of set-2 and inbred line Sk6241 for silking date of set-1. Results of set-1 showed that the inbred tester line Sk121 with the three new yellow inbred lines Sk-5001/2, Sk-5001/7 and 5003/15 gave three single crosses which were significantly earlier showing 57.25, 58.62 and 58.5 days to 50% silking, respectively. They also showed higher grain yield of 35.31, 35.24 and 35.69 ard/fed , respectively, relative to the commercial check hybrid 155 which showed (61.39days and 33.3 ard/fed). The two inbred lines Sk-5002/8 and Sk5002/9 with the same tester inbred line Sk-121 gave two new yellow promising single crosses produced significantly better grain yield with 37.33 and 43.46 ard/fed relative to the same check hybrid in set-1. On the other hand, results of set-2, showed that the line Sk-5026/114 was a good combiner with both testers inbred lines i.e. Sk-10 and Sk6241 which gave significantly higher grain yield of 33.09 and 33.60 ard/fed relative to the check single cross 155 which yielded 29.75 ard/ fed. Tested inbred lines number Sk6001/133, Sk6001/135, Sk6001/136 and Sk7026/146 with the tester line Sk-121 in set-3 gave four good yield single crosses, which were significantly higher yielding than the check hybrid 155 (28.6 ard/fed) by 3.39, 5.63, 3.59 and 3.27 ard/fed. ,respectively .Also results of set-4 showed that the tested line Sk5019/72 with the tester Sk121gave good single cross which was significantly higher for grain yield (31.18 ard/fed) relative to SC155(28.5 ard/fed). Evaluation trial of the best single crosses showed that four single crosses; SC Sk5019/72 x Sk121, SC Sk5026/114 x Sk10, SC Sk6001/133 x Sk121 and SC Sk6001/136 x Sk121 were significantly higher for grain yield of 34.06, 35.56, 35.86 and 34.4 ard/fed., respectively, compared to checks SC155 (30.96 ard/fed.) and SC pioneer (24.81 ard/fed.). Also, these crosses were earlier than the two checks. This study suggested utilization of the above four crosses in the national maize breeding program.

INTRODUCTION

Breeding for high yielding potentially and earliness has been one among the main national maize program activities . Combining ability estimates of the inbred lines are very important for maize improvement not only in choosing the parents and crosses but also in suggesting the relation between additive and non-additive portions of the genetic variances in the germoplasm materials. Evaluation of new inbred lines could be done through top cross test. However, the effectiveness of this test mainly depends upon the type of tester to be used in the evaluation program , Rawlings and Thompson (1962), Horner *et al.*(1973), Russell *et al.*(1973),Russell and Eberhart (1975),Walejko and Russell (1977), Liakat and Tepora (1986), Zambezi *et al.* (1986), Mahmoud (1996), Al-Naggar *et al.* (1997), Amer *et al.*(2002), Mosa *et al.* (2004) indicated the superiority of maize inbred lines as tester for the evaluation of both general (GCA) and specific (SCA) combining ability. Nawar and El-Hosary (1984), Sedhom (1992), El-Kielany (1999), Amer *et al.* (2002), Mosa (2004), El-Shenawy and Mosa (2005) reported that non-additive component of gene action would play a major role in the inheritance of silking date and grain yield.

This study aimed to gain information on the mode of inheritance of all studied traits and to estimate the general combining ability effects of testers and inbred lines and to identify superior hybrids for high yielding ability and earliness.

MATERIALS AND METHODS

New 99 inbred lines of yellow maize were developed at Sakha Agricultural Research Station (ARS) were divided into 4 sets. Each set contained 25 inbred lines except for set-4 which contained 24 lines. Inbred lines in each set were crossed with the two inbred lines testers as follows: Sk121 and Sk6241 for set-1, Sk10 and Sk6241 for set-2, Sk121 and Gm1004 for set-3 , Sk121 and Sk10 for set-4 in 2004 season at Sakha ARS . The obtained top crosses and The commercial cross SC155 were evaluated in 2005 season at two locations i.e. Sakha and Sids Agricultural Research Stations for set-1, set-3 and set-4 while set-2 was evaluated at Sakha and Nubaria Res. stations. Based on the results of the top-crosses trials, four single crosses were chosen which had significantly outyielded the check and made in 2006 season. Four single crosses along with two checks : SC155 and SC pioneer 3084were conducted at the two locations, Sakha and Mallawia in 2007 season. A randomized complete blocks design with 4 replications was used for all trails. The experimental unit was one row in top-cross trails and 4 rows in evaluation trail of the best single crosses. Plot was 6m long and 80cm apart. Planting was in hills at 25cm spaced. All cultural practices were applied as recommended. Data were taken on silking date (number of days from planting to 50% emergence of silking) and grain yield ardab/feddan (one ardab =140 kg of grain and one feddan =4200m^2) adjusted based on shelling percent at 15.5% moisture content. Before calculating the combined analysis, test of homogeneity of error mean squares between locations was done for each set, as outlined by Snedecor and

Cochran (1980). When differences among top crosses were found significant, line x tester analysis was done according to Kempthorne (1957) as explained by Singh and Chaudhary (1979).

RESULTS AND DISCUSSION

1- Top-cross experiments:

The combined analysis of variance of silking date and grain yield for 4 sets of top crosses are presented in Table 1. Mean squares of locations (Loc) were highly significant for silking date and grain yield for all sets, indicating the presence of differences between locations which could be due to environmental variation and soil conditions. Soliman and Sadek (1999), Amer *et al.* (2002), El-Shenawy (2003) and Mosa (2004) also found significant differences among locations for silking date and grain yield.

Table 1: Combined analysis of variances for silking date and grain yield for 4 sets of top crosses.

S.O.V	Set-1		Set-2		Set-3		Set-4	
	Silking date	Grain yield	Silking date	Grain yield	Silking date	Grain yield	Silking date	Grain yield
Locations(loc	691.69**	489.291**	1616.04**	11000.39**	156.25**	4462.74**	127.19**	3914.24**
Rep/Loc	6.53	15.72	7.60	38.14	8.78	24.42	10.739	34.311
Testers (T)	84.64**	699.128**	42.25**	840.87**	3.61	634.19**	0.065	609.88**
T x Loc	0.25	130.84**	53.29**	158.44**	11.56**	129.01**	11.003**	5.35
Lines (L)	27.84**	121.89**	12.81**	66.69**	14.89**	91.745**	17.25**	92.162**
L x Loc	1.69	21.99**	5.96**	31.45**	3.29**	28.100**	0.53	26.488**
L x T	6.99**	46.75**	16.96**	33.48**	5.23**	85.46**	4.34**	62.076**
L x T x Loc	1.76	8.124	6.661**	30.99**	2.018	18.02*	1.595	8.008
Error	1.24	10.413	1.42	7.15	1.424	10.98	1.446	7.34

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

Regarding to Table 1, The mean squares due to Testers (T), Lines (L) and (L x T) interactions were highly significant for all studied traits for all sets except (T) for silking date of set-3 and set-4, indicating that the testers were significantly different from each other in top crosses. Moreover, the inbred lines significantly differed in their behavior from top cross to anther. In addition, the interactions of lines x testers were significant for all traits, suggesting that the inbred lines may perform differently in silking date and yield. This would be depending on the type of used tester. These results are in agreement with those results obtained by El-Itriby (1979), Nawar and El-Hosary (1984), Ashish and Singh (2002), Dodiya and Joshi (2002), Duarte *et al.* (2003).

The mean squares due to (T x Loc) interactions were significant for all traits of all sets, except for silking date of set-1 and grain yield of set-4, indicating that the testers behaved somewhat differently in top crosses from one location to another. Also, mean squares for (L x Loc) interactions were significant of all traits for all sets, except for silking date of set-1 and set-4, this is meaning different ranks of inbred in their top crosses from one location to another. While mean squares for (L x T x Loc) interactions were significant for silking date and grain yield for set-2 and grain yield for set-3.

Estimates of variances due to general combining ability GCA, specific combining ability SCA and their interactions with locations are shown in Table 2. Results indicated that K^2 SCA was dominant and considered the important component for silking date and grain yield in all sets except for grain yield in set-2 .

Table 2: Estimates of the variance values due to general combining ability GCA and specific combining ability SCA and their interactions with locations for two traits in four sets.

Genetic components	Set-1		Set-2		Set-3		Set-4	
	Silking date	Grain yield	Silking date	Grain yield	Silking date	Grain yield	Silking date	Grain yield
K^2 GCA	0.46	2.73	-0.11	3.29	0.076	2.00	-0.013	2.69
K^2 SCA	0.653	4.828	1.28	0.31	0.40	8.37	0.343	6.75
σ^2 GCA x Loc	-0.014	0.79	0.42	1.18	0.099	1.12	0.08	0.151
σ^2 SCA x Loc	0.137	-0.572	1.31	5.96	-1.376	1.76	0.038	0.167

Consequently, non-additive type of gene action was important in controlling the behavior of these traits for all sets, except for grain yield in set-2. These results are in agreement with those obtained by El-Hosary (1985) and Mosa (2004) , Mosa (2001) and Abd El-Moula (2005) . The magnitude of the interactions for σ^2 SCA x Locations were markedly higher than those of σ^2 GCA x Locations for silking date of set-1 and set-2 and grain yield of set-2, set-3 and set-4. While it was vice versa for silking date of set-3 and set-4 and grain yield of set-1. This is meaning that the non-additive gene action was more sensitive to environmental differences than additive gene action for silking date in set-1 and set-2 and grain yield in set-2, set-3 and set-4 and it was the opposite for silking date in set-3 and set-4 and grain yield in set-1,where the additive gene action was more sensitive to environmental differences. Rojas and Sprague (1952), Lonnquist and Gardner (1961) and Shehata and Dhawn (1975) found that non-additive component of genetic variation interacted more with the environment than additive component. While the reverse was obtained by Silva and Hallauer (1975), El-Itriby *et al.* (1990) and Mostafa *et al.*(1995).

Mean performance of top crosses in the four sets for both traits over locations are presented in Table 3. In set-1, 47 top crosses were significantly earlier when compared with check hybrid SC155. The top crosses :SK5001/1 x Sk6241, SK5001/2 x Sk6241, SK5001/3 x Sk6241, SK5001/5 x Sk6241, SK5001/6 x Sk6241, SK5004/17 x Sk6241, SK5006/18 x Sk6241, SK5006/19 x Sk6241 and SK5006/20 x Sk6241 were the best for earliness, Meanwhile for grain yield, the results exhibited that 14 top crosses were not significantly yielder than SC155 and the two top crosses: SK5002/8 x Sk121 and SK5002/9 x Sk121 were significantly superior for grain yield (37.33 and 43.46 ard/fed) compared to the check SC155 (33.30 ard /fed).

Table 3: Mean performance of top crosses in four sets for two traits over locations

Set-1					Set-2				
Inbred	Silking date (days)		Grain yield (ard/fed)		Inbred	Silking date (days)		Grain yield (ard/fed)	
	Tester		Tester			Tester		Tester	
	Sk121	Sk6241	Sk121	Sk6241		Sk10	Sk6241	Sk10	Sk6241
Sk-5001/1	57.25	56.37	33.50	28.74	Sk5026/101	60.87	64.00	31.99	26.42
Sk-5001/2	57.25	56.25	35.31	30.12	Sk5026/102	62.50	64.25	29.12	28.00
Sk-5001/3	58.37	54.62	32.22	30.26	Sk5026/103	60.62	62.50	29.51	27.72
Sk-5001/4	58.62	57.25	25.28	28.98	Sk5026/104	62.5	65.00	27.48	28.20
Sk-5001/5	58.62	56.50	33.43	27.60	Sk5026/105	61.83	62.12	28.45	26.74
Sk-5001/6	58.62	54.62	32.46	28.86	Sk5026/106	59.00	61.37	26.91	25.59
Sk-5001/7	58.62	57.00	35.24	29.64	Sk5026/107	63.12	64.62	28.00	27.61
Sk-5002/8	59.75	59.50	37.33	31.95	Sk5026/108	62.37	65.37	27.90	27.53
Sk-5002/9	60.75	59.87	43.46	33.81	Sk5026/109	62.00	63.62	23.94	24.62
Sk-5003/10	59.75	60.12	31.71	31.09	Sk5026/110	62.62	64.25	28.42	30.39
Sk-5003/11	58.50	59.50	32.52	29.43	Sk5026/111	62.37	63.00	29.71	27.18
Sk-5003/12	59.37	59.25	31.62	29.89	Sk5026/112	61.12	63.00	28.06	25.14
Sk-5003/13	61.37	60.12	34.28	34.94	Sk5026/113	60.37	61.62	29.30	23.90
Sk-5003/14	60.12	58.25	34.25	31.51	Sk5026/114	62.62	64.75	33.09	33.60
Sk-5003/15	58.50	59.12	35.69	34.48	Sk5026/115	60.62	62.87	30.57	28.53
Sk-5004/16	59.37	58.37	29.38	30.51	Sk5026/116	61.00	62.62	29.09	26.00
Sk-5004/17	58.50	56.12	31.99	25.76	Sk5026/117	62.25	64.37	27.87	27.93
Sk-5006/18	57.37	56.87	28.13	24.24	Sk5026/118	60.87	63.37	26.47	23.19
Sk-5006/19	57.37	56.50	26.35	29.06	Sk5027/119	63.62	66.00	31.62	25.73
Sk-5006/20	57.87	56.62	32.38	29.46	Sk5027/120	59.50	63.375	27.43	22.61
Sk-5007/21	59.50	59.62	33.54	30.21	Sk5027/121	57.62	61.50	29.60	21.59
Sk-5007/22	59.25	61.00	24.56	30.19	Sk5027/122	59.37	62.75	26.49	20.86
Sk-5007/23	58.25	58.75	33.39	28.58	Sk5027/123	59.50	62.62	30.81	24.89
Sk-5007/24	60.25	59.87	35.06	32.15	Sk5027/124	61.37	64.75	28.61	22.42
Sk-5007/25	59.12	57.50	33.71	29.19	Sk5027/125	59.62	63.75	30.80	22.58
SC155	61.39		33.30		SC155	62.30			29.75
L S D 0.05	1.09		3.16		L S D 0.05	1.16			2.60

Table 3: Cont.

Set-3					Set-4				
Inbred	Silking date (days)		Grain yield (ard/fed)		Inbred	Silking date (days)		Grain yield (ard/fed)	
	Tester		Tester			Tester		Tester	
	Sk121	Gm1004	Sk121	Gm1004		Sk121	Sk10	Sk121	Sk10
Sk5027/126	62.75	63.62	31.28	23.60	Sk5013/51	56.75	56.12	30.48	25.97
Sk5027/127	62.62	62.25	27.53	17.79	Sk5014/52	55.87	56.12	26.44	22.03
Sk5027/128	61.75	62.50	30.96	20.63	Sk5014/53	55.75	56.37	27.39	19.54
Sk5027/129	61.87	63.37	27.98	19.97	Sk5015/54	56.87	57.62	28.26	21.09
Sk5027/130	61.25	62.50	25.11	23.24	Sk5015/55	56.37	56.37	28.57	21.63
Sk5027/131	61.00	61.50	29.97	25.70	Sk5015/56	56.87	57.62	27.35	23.84
Sk6001/132	60.75	59.12	22.13	22.76	Sk5015/57	56.75	57.5	27.39	18.10
Sk6001/133	61.50	61.50	31.99	27.39	Sk5015/58	57.62	57.12	29.19	19.48
Sk6001/134	61.75	61.37	27.46	21.66	Sk5016/59	55.75	58.87	26.07	25.52
Sk6001/135	62.87	62.25	34.23	29.87	Sk5016/60	55.00	60.0	26.99	27.61
Sk6001/136	61.37	61.75	32.19	28.54	Sk5016/62	55.25	56.37	27.62	24.95
Sk6001/137	61.50	64.00	27.08	29.41	Sk5016/63	56.37	55.25	22.95	19.89
Sk6001/138	62.12	61.12	28.59	26.78	Sk5018/64	56.75	55.12	27.09	29.50
Sk6002/139	60.75	60.50	28.80	24.30	Sk5018/65	59.25	56.25	29.44	27.22
Sk6002/140	61.12	61.75	26.53	29.06	Sk5018/66	57.62	58.62	25.6	25.96
Sk7015/141	64.25	63.00	19.86	28.35	Sk5018/67	57.37	56.87	25.48	28.60
Sk7015/142	62.12	61.25	25.51	29.72	Sk5019/68	56.87	57.5	28.14	26.66
Sk7015/143	63.75	62.50	26.10	26.60	Sk5019/69	57.50	57.75	29.57	29.14
Sk7015/144	62.00	61.25	23.96	28.47	Sk5019/70	55.75	57.0	30.50	30.33
Sk7022/145	62.75	62.87	27.77	28.43	Sk5019/71	55.75	56.75	29.17	28.45
Sk7026/146	62.00	62.12	31.87	27.77	Sk5019/72	57.37	56.75	31.18	28.51
Sd-4/147	60.00	60.25	29.32	24.28	Sk5019/73	55.87	55.37	30.86	27.82
Sd-10/148	61.37	64.12	30.55	25.34	Sk5020/74	57.50	56.25	28.54	25.01
Sd-15/149	60.62	60.25	30.32	25.83	Sk5020/75	60.50	56.62	20.36	27.20
Sk9215/150	61.75	63.62	29.89	28.45					
SC155	61.3		28.6		SC 155	58.9		28.50	
L S D 0.05	1.16		3.24		L S D 0.05	1.170		2.65	

In set-2, top crosses, SK5026/101 x Sk10, SK5026/103 x Sk10, SK5026/106 x Sk10, SK5026/112 x Sk10, SK5026/113 x Sk10, SK5026/115 x Sk10, SK5026/116 x Sk10, SK5026/118 x Sk10, SK5027/120 x Sk10, SK5027/121 x Sk10, SK5027/122 x Sk10, SK5027/123 x Sk10 and SK5027/125 x Sk10 were significantly earlier as compared with the check SC155. For grain yield, the six top crosses exhibited high grain yield, but insignificantly relative to SC155. However the two top crosses SK5026/114 x Sk10 (33.09 ard /fed) and SK5026/114 x Sk6241 (33.60 ard /fed) were significantly better than SC155 which gave 29.75 ard /fed.

In set-3, top crosses, Sd4/147 x Sk121 and SK6001/132 x Gm1004, were significantly earlier than the check SC155 for days to 50% silking . While for grain yield, the top crosses; SK6001/133 x Sk121 (31.99 ard/fed), SK6001/135 x Sk121 (34.23 ard/fed) and SK6001/136 x Sk121 (32.19 ard/fed) and SK7026/146 x SK121 (31.87 ard/fed) were significantly outyielded SC155 (28.60 ard/fed).

In set-4, for silking date, 43 top crosses showed significantly earlier than check SC155. The best top crosses among them were, SK5014/52 x Sk121, SK5014/53 x Sk121, SK5016/59 x Sk121, SK5016/60 x Sk121, SK5016/62 x Sk121, SK5016/63 x Sk10, Sk5018/64 x Sk10, SK5019/70 x Sk121, SK5019/71 x Sk121, SK5019/73 x Sk10 and SK5019/73 x Sk10. Grain yield, 14 top crosses outyielded the check SC155 (28.5 ard/fed) although the increase was not significant .On the other hand , the top cross SK5019/72 x Sk121 (31.18 ard/fed) was significantly outyielded than SC155. Generally, All of these good promising new yellow single crosses should be advanced to the second testing step for releasing as new yellow single crosses in maize breeding program .

Estimates of general combining ability effects for inbred lines and testers for four sets over locations are presented in Table 4. In set-1, the GCA effects, for silking date ranged from –1.95* for inbred Sk5001/3 to 2.3* for inbred Sk5003/13, with ten inbred lines, Sk5001/1, Sk5001/2,Sk5001/3,Sk5001/5,Sk5001/6,Sk5001/7,Sk5004/17,Sk5006/18, Sk5006/19 and Sk5006/20 had desirable negatively significant values towards earliness, while for grain yield GCA effects ranged from –5.22* for inbred Sk5006/18 to 7.21* for inbred Sk5002/9, with five inbred lines,Sk5002/8, Sk5002/9, Sk5003/13, Sk5003/15 and Sk5007/24 had desirable positively significant values (toward high yield potentially in this top crosses).

The tester inbred line Sk 6241 for set-1 showed the best combiner for silking date, while inbred line tester Sk121 for set-1 showed the best general combiner for grain yield.

In set-2, the significantly desirable general combining ability effects were obtained for inbred lines: Sk 5026/105, Sk 5026/106, Sk 5026/112, Sk 5026/113, Sk 5026/115, Sk 5026/116 and Sk 5027/121 for earliness, Sk 5026/101, Sk 5026/110, Sk 5026/114 and Sk5026/115 for grain yield.

The tester inbred line Sk10 in set-2 was the best general combiner for silking date and grain yield.

Table 4 : Estimates of general combining ability effects for inbred lines and testers for four sets over locations.

Set-1			Set-2		
Inbred	Silking date	Grain yield	Inbred	Silking date	Grain yield
Sk-5001/1	-1.63*	-0.22	Sk5026/101	0.135	1.73*
Sk-5001/2	-1.70*	1.40	Sk5026/102	0.447	1.11
Sk-5001/3	-1.95*	-0.100	Sk5026/103	-0.052	1.11
Sk-5001/4	-0.51	-4.35*	Sk5026/104	0.572	0.36
Sk-5001/5	-0.88*	-0.66	Sk5026/105	-1.177*	0.11
Sk-5001/6	-1.82*	-0.78	Sk5026/106	-1.36*	-0.95
Sk-5001/7	-0.63*	1.08	Sk5026/107	1.32*	0.48
Sk-5002/8	1.17*	3.40*	Sk5026/108	0.32	0.36
Sk-5002/9	1.86*	7.21*	Sk5026/109	0.13	-3.01*
Sk-5003/10	1.48*	0.08	Sk5026/110	0.82*	1.86*
Sk-5003/11	0.55*	-0.47	Sk5026/111	-0.1	1.05
Sk-5003/12	0.86*	-0.66	Sk5026/112	-0.61*	-0.82
Sk-5003/13	2.30*	3.33*	Sk5026/113	-1.30*	-0.82
Sk-5003/14	0.73*	1.46	Sk5026/114	0.76*	6.05*
Sk-5003/15	0.36	3.65*	Sk5026/115	-0.61*	2.30*
Sk-5004/16	0.42	-1.22	Sk5026/116	-0.61*	0.11
Sk-5004/17	-1.13*	-2.41*	Sk5026/117	0.63*	0.48
Sk-5006/18	-1.32*	-5.22*	Sk5026/118	-0.24	-2.63*
Sk-5006/19	-1.51*	-3.47*	Sk5027/119	2.63*	1.30
Sk-5006/20	-1.13*	-0.47	Sk5027/120	-0.36	-2.51*
Sk-5007/21	1.11*	0.52	Sk5027/121	-1.177*	-1.76*
Sk-5007/22	1.67*	-3.85*	Sk5027/122	-0.30	-3.63*
Sk-5007/23	0.23	-0.47	Sk5027/123	-0.42	0.42
Sk-5007/24	1.61*	2.21*	Sk5027/124	-0.05	-1.95*
Sk-5007/25	-0.13	0.02	Sk5027/125	0.51	-0.76
Tester : Sk121	0.46*	1.30*	**Tester:Sk-10**	-0.32*	1.44*
Tester :Sk6241	-0.46*	-1.30*	**Tester:Sk6241**	0.32*	-1.44*
$LSD(g_i)$ 0.05	0.545	1.58	$LSD(g_i)$ 0.05	0.58	1.31
$LSD(g_t)$ 0.05	0.154	0.447	$LSD(g_t)$ 0.05	0.16	0.37

Table 4: Cont.

Set-3			Set-4		
Inbred	Silking date	Grain yield	Inbred	Silking date	Grain yield
Sk5027/126	1.26*	0 43	Sk5013/51	-0.42	1.81*
Sk5027/127	0.51	-4.38*	Sk5014/52	-0.86*	-2.18*
Sk5027/128	0.20	-1 31	Sk5014/53	-0.80*	-2.87*
Sk5027/129	0.70*	-2.94*	Sk5015/54	0.38	-1.87*
Sk5027/130	-0.04	-2.94*	Sk5015/55	0.07	-1.30
Sk5027/131	-0.67*	0.87	Sk5015/56	0.13	-0.80
Sk6001/132	-1.98*	-4.44*	Sk5015/57	0.94*	-3.68*
Sk6001/133	-0.42	2.87*	Sk5015/58	1.94*	-1.99*
Sk6001/134	-0.35	-2.38*	Sk5016/59	-0.80*	-0.62
Sk6001/135	0.64*	4.99*	Sk5016/60	-1.74*	0.81
Sk6001/136	-0.35	3.37*	Sk5016/62	-1.67*	-0.18
Sk6001/137	0.83*	1.24	Sk5016/63	-0.55	-4.93*
Sk6001/138	-0.29	0.62	Sk5018/64	-0.17	1.94*
Sk6002/139	-1.29*	-0.56	Sk5018/65	0.007	1.81*
Sk6002/140	-0.48	0.80	Sk5018/66	1.50*	-0.80
Sk7015/141	1.70*	-2.94*	Sk5018/67	0.82*	0.62
Sk7015/142	-0.23	0.49	Sk5019/68	0.32	1.06
Sk7015/143	1.20*	-0.75	Sk5019/69	-0.054	2.94*
Sk7015/144	-0.29	-0.88	Sk5019/70	0.25	3.94*
Sk7022/145	0.89*	0.99	Sk5019/71	-1.30*	2.44*
Sk7026/146	0.14	2.87*	Sk5019/72	-0.054	3.37*
Sd -4/147	-1.79*	-0.19	Sk5019/73	-0.61*	2.87*
Sd -10/148	0.83*	0.99	Sk5020/74	0.19	0.31
Sd -15/149	-1.48*	0.99	Sk5020/75	2.50*	-2.68*
Sk9215/150	0.76*	2.18*	-	-	-
Tester: Sk121	-0.09	1.26*	**Tester:Sk121**	-0.013	1.25*
Tester: Gm1004	0.09	-1.26*	**Tester:Sk10**	0.013	-1.25*
$LSD(g_i)$ 0.05	0.58	1.62	$LSD(g_i)$0.05	0.59	1.327
$LSD(g_t)$ 0.05	0.16	0.45	$LSD(g_t)$0.05	0.17	0.38

*** significant at the 0.05 level of probability.**

In set-3, the significantly desirable GCA was obtained, for inbred lines: Sk 5027/131, Sk 6001/132, Sk 6002/139,Sd4/147 and Sd15/149 for silking date, Sk 6001/133, Sk6001/135,Sk6001/136, Sk7026/146 , Sk 9215/150 and the tester inbred line Sk121 for grain yield.

The results of set-4 indicated that the inbred lines : Sk 5014/52, Sk 5014/53, Sk 5016/59, Sk 5016/60, Sk 5016/62, Sk 5019/71and Sk5019/73 were significantly desirable for general combining effects for silking date, while the inbred lines: Sk5013/51, Sk5018/64, Sk5018/65, Sk5019/69, Sk5019/70, Sk5019/71, Sk5019/72 and Sk5019/73 had significantly desirable GCA effects for grain yield.

The tester inbred line Sk121 in set-4 had significantly desirable general combining ability for grain yield. These inbred lines which had desirable GCA effects for grain yield and silking date in the four sets could be used in national maize breeding program.

Estimates of specific combining ability effects for top crosses in the four sets over locations are shown in Table 5. In set-1 the desirable and significant SCA effects were obtained for top crosses: Sk5001/3 x Sk6241, Sk5001/6 x Sk6241, Sk 5003/11x Sk121, Sk5003/15 x Sk121 and Sk5007/22 x Sk121 for earliness and top crosses, Sk5001/4 x Sk6241, Sk5002/9 x Sk121, Sk5006/19 x Sk6241 and Sk5007/22 x Sk6241 for grain yield.

In set-2, top crosses: Sk5026/102 x Sk6241, Sk5026/105 x Sk6241, Sk5026/108 x Sk6241, Sk5026/111 x Sk6241, Sk5027/120 x Sk10, Sk5027/121 x Sk10, Sk5027/122 x Sk10, Sk5027/123 x Sk10, Sk5027/125 x Sk10 had desirable SCA effects for earliness, while top crosses Sk5026/110 x Sk6241, Sk5027/121 x Sk10 and Sk5027/125 x Sk10 were the best top crosses for SCA effects, for grain yield.

In set-3, the top crosses : Sk6001/132 x Gm1004, Sk6001/137 x Sk121, Sd10/148 x Sk121 and Sk9215/150 x Sk121 had desirable significant SCA effects for earliness, while the top crosses : Sk5027/126 x Sk121, Sk5027/127 x Sk121, Sk5027/128 x Sk121, Sk5027/129 x Sk121, Sk6001/137 x Gm1004, Sk6002/140 x Gm1004, Sk7015/141 x Gm1004, Sk7015/142 x Gm1004, Sk7015/144 x Gm1004 showed highly SCA effects for grain yield.

In set-4; the desirable and significant SCA effects were obtained for the top crosses: Sk5015/57 x Sk121, Sk5015/58 x Sk121, Sk5018/66 x Sk10 and Sk5020/75 x Sk10 for earliness and Sk5014/53 x Sk121, Sk5015/54 x Sk121, Sk5015/55 x Sk121, Sk5015/57 x Sk121, Sk5015/58 x Sk121, Sk5018/64 x Sk10, Sk5018/67 x Sk10 and Sk5020/75 x Sk10 for grain yield . These crosses would be utilized in maize breeding programs.

2- Evaluation experiment of the best top crosses:

The combined analysis of variance of the four single crosses and checks (SC155 and SC pioneer 3084) over two locations are presented in Table 6. Highly significant differences were detected for locations, crosses and crosses x locations interaction for all traits, except for crosses x locations interaction for silking date.

The means of four crosses and two checks (SC 155 and SC pioneer 3084)over two location are presented in Table 7.

Table 5: Estimates of specific combining ability effects for top crosses in four sets over locations.

Set-1					Set-2				
Inbred	Silking date Tester		Grain yield Tester		Inbred	Silking date Tester		Grain yield Tester	
	Sk121	Sk6241	Sk121	Sk6241		Sk10	Sk6241	Sk10	Sk6241
Sk-5001/1	-0.022	0.022	1.075	-1.075	Sk5026/101	-0.425	0.425	1.307	-1.307
Sk-5001/2	0.04	-0.04	1.2	-1.2	Sk5026/102	0.887*	-0.887*	-0.817	0.817
Sk-5001/3	1.415*	-1.415*	-0.3	0.3	Sk5026/103	-0.487	0.487	-0.317	0.317
Sk-5001/4	0.227	-0.227	-3.175*	3.175*	Sk5026/104	0.762	-0.762	-1.692	1.692
Sk-5001/5	0.602	-0.602	1.512	-1.512	Sk5026/105	1.637*	-1.637*	-0.692	0.692
Sk-5001/6	1.54*	-1.54*	0.512	-0.512	Sk5026/106	-0.8	0.8	-0.88	0.88
Sk-5001/7	0.352	-0.352	1.512	-1.512	Sk5026/107	0.637	-0.637	-1.317	1.317
Sk-5002/8	-0.335	0.335	1.325	-1.325	Sk5026/108	0.887*	-0.887*	-1.192	1.192
Sk-5002/9	-0.022	0.022	3.387*	-3.387*	Sk5026/109	0.7	-0.7	-1.817	1.817
Sk-5003/10	-0.647	0.647	-0.987	0.987	Sk5026/110	0.637	-0.637	-2.442*	2.442*
Sk-5003/11	-0.96*	0.96*	0.2	-0.2	Sk5026/111	1.2*	-1.2*	-0.13	0.13
Sk-5003/12	-0.397	0.397	-0.362	0.362	Sk5026/112	0.575	-0.575	-0.13	0.13
Sk-5003/13	0.165	-0.165	-1.612	1.612	Sk5026/113	0.512	-0.512	1.245	-1.245
Sk-5003/14	0.477	-0.477	0.137	-0.137	Sk5026/114	0.7	-0.7	-1.63	1.63
Sk-5003/15	-0.772*	0.772*	-0.675	0.675	Sk5026/115	0.075	-0.075	-0.505	0.505
Sk-5004/16	0.04	-0.04	-1.925	1.925	Sk5026/116	0.45	-0.45	0.057	-0.057
Sk-5004/17	0.727	-0.727	1.762	-1.762	Sk5026/117	0.45	-0.45	-1.567	1.567
Sk-5006/18	-0.21	0.21	0.575	-0.575	Sk5026/118	-0.05	0.05	0.057	-0.057
Sk-5006/19	-0.022	0.022	-2.675*	2.675*	Sk5027/119	-0.175	0.175	1.62	-1.62
Sk-5006/20	0.102	-0.102	0.075	-0.075	Sk5027/120	-1.3*	1.3*	1.057	-1.057
Sk-5007/21	-0.522	0.522	0.45	-0.45	Sk5027/121	-2.362*	2.362*	2.558*	-2.558*
Sk-5007/22	-1.335*	1.335*	-4.175*	4.175*	Sk5027/122	-1.487*	1.487*	1.432	-1.432
Sk-5007/23	-0.522	0.522	1.075	-1.075	Sk5027/123	-1.237*	1.237*	1.62	-1.62
Sk-5007/24	-0.272	0.272	0.137	-0.137	Sk5027/124	0.262	-0.262	1.62	-1.62
Sk-5007/25	0.352	-0.352	0.95	-0.95	Sk5027/125	-2.05*	2.05*	2.557*	-2.557*
LSD$_{n}$ 0.05	0.77		2.23		LSD$_{n}$ 0.05	0.82		1.85	

Table 5:Cont .

Set-3					Set-4				
Inbred	Silking date Tester		Grain yield Tester		Inbred	Silking date Tester		Grain yield Tester	
	Sk121	Gm1004	Sk121	Gm1004		Sk121	Sk10	Sk121	Sk10
Sk5027/126	-0.342	0.342	2.677*	-2.677*	Sk5013/51	0.325	-0.325	0.992	-0.992
Sk5027/127	0.282	-0.282	3.615*	-3.615*	Sk5014/52	-0.111	0.111	0.992	-0.992
Sk5027/128	-0.28	0.28	3.802*	-3.802*	Sk5014/53	-0.299	0.299	2.554*	-2.554*
Sk5027/129	-0.655	0.655	2.677*	-2.677*	Sk5015/54	-0.361	0.361	2.304*	-2.304*
Sk5027/130	-0.53	0.53	-0.322	0.322	Sk5015/55	-0.549	0.549	2.242*	2.242*
Sk5027/131	-0.155	0.155	0.865	-0.865	Sk5015/56	-0.111	0.111	0.617	-0.617
Sk6001/132	0.907*	-0.907*	-1.572	1.572	Sk5015/57	-1.049*	1.049*	3.367*	-3.367*
Sk6001/133	0.095	-0.095	0.99	-0.99	Sk5015/58	-1.174*	1.174*	3.554*	-3.554*
Sk6001/134	0.282	-0.282	1.615	-1.615	Sk5016/59	-0.299	0.299	-1.07	1.07
Sk6001/135	0.407	-0.407	0.99	-0.99	Sk5016/60	-0.111	0.111	-1.507	1.507
Sk6001/136	-0.092	0.092	0.365	-0.365	Sk5016/62	0.075	-0.075	0.117	-0.117
Sk6001/137	-1.155*	1.155*	-2.385*	2.385*	Sk5016/63	0.075	-0.075	0.367	-0.367
Sk6001/138	0.595	-0.595	-0.385	0.385	Sk5018/64	0.075	-0.075	-2.382*	2.382*
Sk6002/139	0.22	-0.22	1.052	-1.052	Sk5018/65	0.013	-0.013	-0.132	0.132
Sk6002/140	-0.217	0.217	-2.447*	2.447*	Sk5018/66	0.888*	-0.888*	-1.507	1.507
Sk7015/141	0.72	-0.72	-5.572*	5.572*	Sk5018/67	-0.049	0.049	-2.82*	2.82*
Sk7015/142	0.532	-0.532	-3.26*	3.26*	Sk5019/68	0.2	-0.2	-0.632	0.632
Sk7015/143	0.72	-0.72	-1.51	1.51	Sk5019/69	0.075	-0.075	-1.007	1.007
Sk7015/144	0.47	-0.47	-3.51*	3.51*	Sk5019/70	0.388	-0.388	-1.132	1.132
Sk7022/145	0.032	-0.032	-1.635	1.635	Sk5019/71	0.2	-0.2	-1.007	1.007
Sk7026/146	0.032	-0.032	0.865	-0.865	Sk5019/72	0.575	-0.575	0.054	-0.054
Sd-4/147	-0.03	0.03	1.302	-1.302	Sk5019/73	-0.361	0.361	0.179	-0.179
Sd-10/148	-1.28*	1.28*	1.365	-1.365	Sk5020/74	0.45	-0.45	0.492	-0.492
Sd-15/149	0.282	-0.282	0.99	-0.99	Sk5020/75	1.138*	-1.138*	-4.632*	4.632*
Sk9215/150	-0.842*	0.842*	-0.572	0.572					
LSD$_{n}$ 0.05	0.82		2.29		LSD$_{n}$ 0.05	0.83		1.87	

* significant at the 0.05 level of probability.

Table 6: Analysis of variance for four crosses and two checks for silking date and grain yield over two locations.

S.O.V.	Silking date	Grain yield
Locations	225.33**	641.33**
Rep/L	2.72	5.58
Crosses (C)	36.83**	140.96**
C × L	3.43	114.94**
Error	1.45	7.07
CV%	2.01	8.16

** Significant at 0.01 level of probability.

Table 7: Means of four crosses and two checks (SC155 and SC Pioneer 3084) for silking date and grain yield over two locations.

Cross	Silking date (days)	Grain yield (ard/fed)
SC Sk 5019/72 x Sk121	58.87	34.06
SC Sk 5026/114 x Sk10	59.00	35.56
SC Sk 6001/133 x Sk121	59.12	35.86
SC Sk 6001/136 x Sk121	60.5	34.40
SC 155	59.13	30.96
SC Pioneer 3084	64.37	24.81
LSD 0.05	1.21	2.68

The four crosses were significant for earliness as compared to the SC pioneer 3084, also all crosses except for SC Sk6001/136 x Sk121 were insignificantly earlier than SC155 .The four crosses : SC Sk5019/72 x Sk121, SC Sk5026/114 x Sk10, SC Sk6001/133 x Sk121 and Sc Sk6001/136 x Sk121 showed significant increase for grain yield of 34.06, 35.56, 35.86 and 34.40 ard/fed ,respectively, when compared to checks SC155 (30.96 ard/fed) and SC pioneer (24.81 ard/fed).Therefore, this study suggested the use of the four single crosses in national maize breeding program as crosses that had a high potentially for yielding and earliness.

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تحليل السلالة في الكشاف لأجل تقييم سلالات جديدة من الذرة الشامية

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مركز البحوث الزراعية – معهد المحاصيل الحقلية – محطة بحوث سخا – قسم بحوث الذرة الشامية

تم تقسيم ۹۹ سلالة صفراء جديدة من الذرة الشامية الي أربع مجاميع كل مجموعة تشتمل علي ٢٥ سلالة ما عدا المجموعة الرابعة ٢٤ سلالة . هجنت سلالات كل مجموعة مع اثنين من السلالات ككشافات وذلك خلال موسم نمو ٢٠٠٤ بمحطة بحوث سخا .قيمت الهجن القمية الناتجة من الأربع مجاميع في موقعين لصفات عدد الأيام لظهور حرائر ٥٠% من النورات المؤنثة ومحصول الحبوب (أردب/فدان) خلال موسم ٢٠٠٥،ثم قيمت أفضل الهجن المنتخبة من تجارب الهجن القمية مع اثنين من الهجن التجارية هـ.ف١٥٥ وهـ.ف بايونير ٣٠٨٤ في موقعين سخا وملوي خلال موسم ٢٠٠٧. أظهرت النتائج أن تباين كل من المواقع ، السلالات و الكشافات وتفاعل السلالات × الكشافات عالى المعنوية لكل الصفات لكل المجاميع ما عدا تباين الكشافات لصفة عدد الأيام لظهور حرائر ٥٠% من النورات المؤنثة في المجموعتين الثالثة والرابعة. تبين أن الفعل الوراثي الغير المضيف أكثر أهمية في وراثة صفات عدد الأيام لظهور حرائر ٥٠% من النوزات المؤنثة ومحصول الحبوب لكل المجاميع ما عدا محصول الحبوب للمجموعة الثانية. كذلك تبين أن الفعل الوراثي الغير مضيف أكثر تأثر بالبيئة لصفة عدد الأيام لظهور حرائر ٥٠% من النورات المؤنثة للمجموعة الأولي والثانية ولصفة المحصول للمجموعة الثانية والثالثة والرابعة .

تبين أن هناك عدد ١٠, ٧, ٥, ٧سلالات في المجاميع ١, ٢, ٣, ٤ علي التوالي تمتلك قيم مرغوبة (سالبة المعنوية) للقدرة العامة علي الائتلاف لصفة عدد الأيام لظهور حرائر ٥٠% من النورات المؤنثة (مدلول علي تبكير هذه السلالات في هجنها القمية) بينما هناك عدد ٥, ٤, ٥, ٨ سلالات فى المجاميع ١, ٢, ٣, ٤على التوالي تمتلك قيم مرغوبة (موجبة المعنوية) للقدرة العامة علي الائتلاف لصفة المحصول (هذا يشير الي المقدرة المحصولية لهذه السلالات في هجنها القمية). كانت السلالة الكشاف سخا ١٢١ الأفضل في القدرة العامة علي الائتلاف لصفة المحصول في المجموعة الأولي والثالثة والرابعة، بينما سلالة الكشاف سخا ١٠ كانت الأفضل في القدرة العامة علي الائتلاف لصفة عدد الأيام لظهور حرائر ٥٠% من النورات المؤنثة ومحصول الحبوب للمجموعة الثانية والسلالة الكشاف سخا٦٢٤١ كانت الأفضل للقدرة العامة علي الائتلاف لصفة عدد الأيام لظهور حرائر ٥٠% من النورات المؤنثة للمجموعة الأولي.

أظهرت نتائج المجموعة الأولي أن السلالة الكشاف سخا ١٢١ مع السلالات سخا٥٠٠١/٢ وسخا٥٠٠١/٧ وسخا٥٠٠٣/ ١٥ أعطت ثلاث هجن فردية معنوية التبكير(٥٧,٢٥ ،٥٨,٦٢و ٥٨,٥٠ يوم علي التوالي) وفي نفس الوقت تزيد في المحصول (٣٥,٣١ ، ٣٥,٢٤ ، ٣٥,٦٩ أردب /فدان على التوالى) بالمقارنة بالهجين التجاري هـ.ف١٥٥ (٦١,٣٩ يوم ٣٣,٣ أردب /فدان). ايضا أعطت كلا من السلالات سخا ٥٠٠٢/٨ وسخا ٥٠٠٢/٩ من المجموعة الاولى مع السلالة الكشاف سخا١٢١ اثنين من الهجن الفردية التى تزيد بمعنوية في المحصول(٣٧,٣٣ و ٤٣,٤٦ أردب/ فدان)بالمقارنة هـ.ف١٥٥ . أظهرت النتائج عن المجموعة الثانية أن السلالة سخا٥٠٢٦/١١٤ لها قدرة جيدة علي الائتلاف مع كلا من السلالة الكشاف سخا١٠ والسلالة الكشاف سخا ٦٢٤١ وأعطت هجن فردية عالية المحصول (٣٣,٠٩ و٣٣,٦ أردب /فدان) تزيد بمعنوية عن هجين المقارنة هـ.ف١٥٥ (٢٩,٧٥ أردب/فدان). كذلك أعطت السلالات سخا٦٠٠١/١٣٣ وسخا٦٠٠١/١٣٥ وسخا٦٠٠١/١٣٦ وسخا٥٠٢٦/١٤٦ من المجموعة الثالثة بالتهجين مع السلالة الكشاف١٢١ هجن تزيد في المحصول عن هجن المقارنة هـ.ف١٥٥ (٢٨,٦ أردب /فدان) بمقدار ٣,٣٩ ، ٥,٦٣ ، ٣,٥٩ ، ٣,٢٧ أردب /فدان علي التوالي. كذلك أعطت السلالة سخا٥٠١٩/٧٢ من المجموعة الرابعة بالتهجين مع السلالة الكشاف سخا ١٢١ هجين فردي يزيد بمعنوية في المحصول (٣١,١٨ أردب/فدان) بالمقارنة بالهجن هـ.ف١٥٥ (٢٨,٥ أردب /فدان). اظهرت تجربة التقييم لأفضل الهجن القمية المنتخبة من الأربع مجاميع ان الهجن الفردية , سخا٥٠١٩/٧٢ × سخا١٢١ (٣٤,٠٦ اردب/فدان) و سخا٥٠٢٦/١١٤ × سخا١٠ (٣٥,٥٦ اردب/فدان) وسخا٦٠٠١/١٣٣ × سخا١٢١ (٣٥,٨٦ اردب/فدان) وسخا٦٠٠١/١٣٦ × سخا١٢١ (٣٤,٤٠ اردب/فدان) تاكد تفوقها فى المحصول عن هجيني المقارنة هجين فردى ١٥٥ (٣٠,٩٦ اردب/فدان) وهجين فردى بايونير٣٠٨٤ (٢٤,٨١ اردب/فدان) كما انها مبكرة عن هجيني المقارنة ولذلك توصى هذه الدراسة باستخدام هذه الهجن في البرنامج القومي للذرة الشامية كهجن عالية المحصول ومبكرة.