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COMBINING ABILITY AND TYPE OF GENE ACTION FOR GRAIN YIELD AND I T·S C OMPONENTS A ND R ESISTANCE TO DOWNY MILDEW DISEASE IN MAIZE

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ABSTRACT

Nine inbred lines of yellow maize were mated to three testers in 2001 growing season . Parents and their top-crosses were evaluated at Sakha, Sids and Nubaria locations in 2002 growing season. Combining ability analysis was calculated by the line x tester analysis according to Kempthorne (1957).

Mean squares due to location (Loc), genotypes (G), parents (P), crossess (C) and (P vs C) and their interactions with locations were significant for all studied traits except (G x Loc) , (P x Loc.) and (C x Loc) were not significant for all studied traits except grain yield (ard/fad). Also mean squares of crosses and their partitions (L), (T) and (L x T) were significant for all traits except (T) for ear diameter and (L x T) for plant and ear height and ear diameter.

The best inbred lines had desirable significant GCA effect for grain yield were SK-7070,SK-7078/2 and SK-7078/1.

Eight s ingle c rosses as top-crosses produced more grain yield than checks single cross 155 (23.8 ard/fad) , among them three crosses. i.e. SK-7070 x L 121 (31.3 ard/fad), SK-7078 x L 121 (27.1 ard/fad) and SK-7017/4 x L 121 (25.8 ard/fad) had significant by more yield than check SC155, Also, six three way crosses as top-crosses yielded more than the check TWC 352 (20.8 ard/fad) from these crosses two crosses , SC SK-22 x SK-7070 (26.1 ard/fad and SC SK-22 x SK-7078/30 (23.99 ard/fad) produced significantly by more than the check TWC352.

These materials can be used to improve yellow maize and are very useful in maize breeding program.

The i nbred l ines S K-7017/4, S K-7017/10 a nd 7 017/2-4 exhibited the highest positive significant GCA effects for resistance to downy mildew disease. These inbred lines could be used in breeding program. The top-crosses line 121 x SK-7078/1 and SC SK-21 x Gm-1004 had significantly positive SCA effects for resistance to downy mildew disease .

However GCA/SCA ratio was less than unity (0.21) for resistance to downy mildew disease, indicating that a non-additive effect was more important in inheritance of this trait.

INTRODUCATION

The best tester is one that is capable of giving higher maximum grain yield of its top cross hybrids Allison and Curnow (1966). Hallauer (1975) stated that the suitable tester should include simplicity in use, provide information that correctly classifies the relative merits of lines and maximize genetic gain EL-Itriby *et al* (1981), Shehata (1992), Mahmoud (1996) and Amer *et al* (2002) suggested that GCA effects were relatively more important than SCA effects in the inheritance of grain yield, while lonnquist and Gardner (1961), Shehata and Dhawan (1975), EL-Shenawy (1995), Mosa (2001) and EL-Shenawy *et al* (2003) found that the SCA were more important than GCA

effects in the inheritance of grain yield. EL-Shenawy (1995) was the first investigator who studied the genetic analysis for resistance to downy mildew in Egypt, Sakha A.R.C and suggested the technique of artificial infection by sorghum downy mildew disease fungi. He also reported that the general combining ability reflected in additive effect was the major portion conditioning the resistance to downy mildew. AL-Naggar *et al* (1997), EL-Zeir *et al* (2001) and Amer (2002) found that additive genetic effects were more important in the inheritance of downy mildew disease. Therefore the aim objective of this study is to evaluate nine new inbred lines and to estimate the combining ability effects, determine the importance of gene action, also type of tester and choosing the best lines resistant to downy mildew and top crosses that can be used in future breeding programs.

MATERIALS AND METHODS

Nine yellow inbred lines (8 new inbred lines developed at Sakha Research Station Isolated from a source resistant to downy mildew disease and one inbred line developed at Gemmeza Research Station) i.e, SK-7017/4, SK-7017/10, SK-7017/2-4, SK-7017/6, SK-7029, SK-7070, SK-7078/2, SK-7078/1 and Gm-1004 were used in this study. These nine inbred lines were crossed to three different testers, i.e. line 121 (narrow genetic base), promising single cross SK-22 and composite SK-21 (broad genetic base).The top-crosses were constituted during 2001 season at Sakha Agricuture Research Station. The parental (lines and testers), 39 top-cross and two commerical hybrids as checks (SC155 and TWC352) were evaluated in two experimental fields, first one was planted at May at three locations Sakha , Sids and Nubaria stations to evaluate grain yield and other traits, Second experimental field was at field disease nursery special for downy mildew disease planted at 20 Jully at Sakha Research Station to determined the genetic behavior of resistance to downy mildew disease. These experiments were carried out in 2002 growing season . A Randomize Complete Blocks Desing (R.C.B.D) with four replications was used in all locations. In each replication the genotypes were arranged in two groups as follows: 10 inbred lines (9 parental +1 tester line) and 43 genotypes (39 top-crosses +2 testers +2 checks), respectively, and randomly distributed in each group. The experimental unit was one row, 6m long, 80 cm apart and 25 cm between hills, one plant was left per hill after thening at 18 days from planting. In the second experiments each hill was planted 3 seeds and left without thining. The data were recorded on plant and ear height (cm), 50% silking (days), ear length (cm), ear diameter (cm) and grain yield (ard/fad) adjusted at 15.5% percentage grain moisture content. Data for downy mildew disease recorded in 35 days from planting according to EL-Shenawy (1995).

Plants of resistance (%) =

$$\frac{No.of.plants/plot - No.of.\text{infected } plants/plot}{No.of.plants/plot} x100$$

The homogeneity test of error mean -squares was done as outlined by Snedecor and Cochran (1967). The analysis of variance for every locations was carried out as discriber by Steel and Torrie (1980). Finally, combining ability analysis was computed according to Kempthorne (1957).This method of statistical analysis ;line x tester method ; had been extensively used for testing GCA and SCA of inbred lines .

RESULTS AND DISCUSSION

1- Grain yield , earliness and growth traits:

The combined analysis of variances over three locations for grain yield (ard/fed), e ar l ength, e ar d iameter, 5 0% s ilking (number of days from planting to 50% silking), plant height and ear height are shown in Table (1).

Table (1): combined analysis of variance for six t raits o ver t he t hree locations.

S.O.V	d.f	Silking Date (days)	Plant Height (cm)	Ear Height (cm)	Ear Length (cm)	Ear diamete r (cm)	Grain yield (ard/fad)
Location (Loc)	2	7104.95**	21004.85**	4655.12**	44.534**	9.872**	1175.138**
Rep/Loc	9	8.838	1383.46	943.56	1.351	0.116	21.531
Genotypes (G)	38	85.605**	15758.54**	7830.36**	47.72**	2.221**	672.498**
Parents (P)	11	53.545**	14989.88**	7697.08**	56.072**	2.848**	766.101**
Crosses (C)	26	11.162**	2390.55**	1482.70**	17.506**	0.363**	103.036**
P vs C	1	2373.75**	371781.38**	174335.61**	741.411**	43.634**	14448.887**
G x Loc.	76	4.854**	356.473**	141.477	2.439**	0.093**	17.015**
P x Loc.	22	8.248**	477.980**	148.298	5.038**	0.1618**	22.248**
C x Loc.	52	1.928	229.285	123.259	1.376	0.0577	15.127**
P vs C x Loc.	2	87.19**	2326.84**	540.097**	1.503	0.259**	19.515*
Line (L)	8	10.94**	4350.84**	3043.57**	34.23**	1.02**	178.59**
Tester (T)	2	47.46**	11312.28**	5604.84**	69.42**	0.06	408.9**
L x T	16	6.91**	295.11	186.97	2.81**	0.06	27.01**
L x Loc.	16	2.94	394.92	129.4	1.87	0.061	20.97**
T x Loc.	4	0.34	21.62	110.13	1.68	0.077	12.75
L x T x Loc.	32	1.62	172.45	121.83	1.006	0.058	12.49**
Error	342	2.014	227.994	112.15	1.279	0.055	6.385
X		60.79	212.5	119.84	17.56	4.48	19.899
C.V %		2.33	7.11	8.84	6.44	5.25	12.70

The mean squares of locations (Loc) were significant for all traits. The mean squares of combined analysis among genotypes (G), i.e., parents (P), crosses (C) and (P vs C), and their interactions with locations were significant for all traits expect (G x Loc) and (P x Loc) for ear height, (P vs C x Loc) and (C x Loc) were not significant for all traits expect for that of grain yield (ard/fad). The mean squares of crosses and their partitions i.e., lines (L), tester (T) and (L x T) were significant for all studied traits except for that of (T) for ear diameter and (L x T) for plant and ear height and ear diameter. These results indicated that both inbred lines and testers were significantly different from each other in top crosses, also the interaction of lines x testers was significant suggesting that inbred lines may perform differently in crosses depending on type of tester used. These results are in agreement with those

obtained by EL-Itribey *et al* (1990), Soliman and Sadek (1999), EL-Zeir (2000), Mosa (2001), Amer *et al* (2003) and EL-Shenawy (2003). The mean squares of (L x Loc), (T x Loc) and (L x T x Loc) were not significant for all traits except for that of (L x Loc) and (L x T x Loc) for grain yield. These findings indicated that there are different ranks of interaction of inbred lines in their top-crosses from one location to another appeared in grain yield.

Mean performance for studed traits over three locations are persented in Table (2).

Table (2): Mean performance for parents and top-crosses over the three locations.

Pedigree	Silking Date (days)	Plant Height (cm)	Ear Height (cm)	Ear Length (cm)	Ear diameter (cm)	Grain yield (ard/fad)
Sk-7017/4	64.08	185.00	105.67	16.60	3.96	8.48
Sk-7017/10	65.75	146.75	82.25	14.52	3.53	7.04
Sk-7017/2-4	63.92	128.83	72.83	13.63	3.56	7.55
Sk-7017/6	62.00	158.17	88.08	15.74	3.9	9.84
Sk-7029	64.92	121.58	56.83	14.30	3.47	6.11
Sk-7070	63.75	194.17	104.08	17.68	3.78	12.13
Sk-7078/2	65.33	144.17	62.67	14.72	3.93	7.62
Sk-7078/30	65.33	157.42	66.92	14.40	4.27	7.32
Gm 1004	66.92	166.92	89.67	13.22	4.37	7.61
L121	65.58	184.67	97.67	14.30	3.78	9.35
Sc Sk-22	58.83	210.92	119.83	19.33	5.050	32.21
Comp-21	63.58	244.08	144.17	19.58	4.70	23.52
Sk-7017/4 x L121	58.42	228.00	141.00	17.09	4.59	25.82
Sk-7017/4 x Sk-22	59.75	220.58	129.25	17.32	4.61	21.17
Sk-7017/4 x comp 21	61.75	234.75	143.33	18.62	4.64	20.76
Sk7017/10 x L121	59.25	235.67	136.83	17.14	4.58	24.16
Sk7017/10 x Sk-22	59.42	218.17	129.58	17.60	4.48	21.53
Sk7017/10 x comp-21	60.75	229.83	134.25	19.12	4.64	24.08
Sk-7017/2-4 x L121	59.50	216.58	127.92	16.74	4.62	22.55
Sk-7017/2-4 x Sk-22	59.25	203.17	120.83	16.94	4.61	20.93
Sk-7017/2-4 x comp-21	60.67	213.83	128.83	18.28	4.56	22.54
Sk-7017/6 x L121	58.33	236.08	144.83	17.50	4.62	24.03
Sk-7017/6 x Sk-22	58.42	223.67	136.75	17.53	4.53	20.21
Sk-7017/6 x comp-21	59.83	245.50	156.25	18.90	4.55	24.40
Sk-7029 x L121	59.68	240.08	138.08	18.78	4.43	24.39
Sk-7029 x Sk-22	59.17	213.42	119.25	18.48	4.58	19.14
Sk-7029 x comp-21	60.17	228.33	127.75	20.16	4.43	19.16
Sk-7070 x L121	59.58	261.08	147.33	20.52	4.65	31.28
Sk-7070 x Sk-22	58.75	238.08	133.50	19.91	4.58	26.13
Sk-7070 x comp-21	58.83	258.50	149.17	21.03	4.72	27.23
Sk-7078/2 x L121	58.00	241.08	131.25	19.13	4.98	27.06
Sk-7078/2 x Sk-22	57.58	223.92	117.33	18.15	4.87	22.71
Sk-7078/2 x comp-21	59.67	242.33	126.92	19.37	4.78	26.27
Sk-7078/30 x L121	58.58	229.42	120.50	17.92	4.98	25.25
Sk-7078/30 x Sk-22	57.75	219.00	111.00	17.89	4.93	23.99
Sk-7078/30 x comp-21	59.67	235.08	121.75	19.05	5.00	25.79
Gm 1004 x L-121	58.58	246.83	143.33	18.30	4.99	24.16
Gm 1004 x Sk-22	60.42	215.25	122.00	16.03	4.78	18.08
Gm 1004 x comp-21	59.00	246.58	144.25	19.183	4.78	24.47
SC155	59.167	245.17	136.75	17.03	4.82	23.84
TWC 352	60.58	248.67	147.50	18.52	4.89	20.81
L.S.D. 0.05	1.14	12.08	8.47	0.91	0.19	2.02
0.01	1.49	15.88	11.14	1.19	0.25	2.66

The results showed that the grain yield for the nine inbred lines ranged from 6.11ard/fad to 12.13 ard/fed for Sk-7029 and Sk-7070 respectively over the three locations. Also, the means of testrs over the three locations showed that SC SK-22 (32.21 ard/fad) as tester was the best promising for grain and all most traits compared with top-crosses and hybrid checks (SC 155 and TWC 352). In addition eight single crosses, SK-7070 x L 121 (31.3 ard/fad), SK-7078 x L 121 (27.1 ard/fad), SK-7017/4 x L 121 (25.8 ard/fad), SK-7078/30 x L 121 (25.3 ard/fad) SK-7029 x L 121 (24.4 ard/fad), SK-7017/10 x L 121 (24.2 ard/fad), Gm1004 x L 121 (24.2 ard/fad) and SK-7017/6 x L 121 (24.03 ard/fad) as top-crosses performed better than the check single cross (SC 155) (23.8 ard/fad). Also, six three way crosses as top-crosses SC SK-22 x SK-7070 (26.1 ard/fad), SC SK-22 x SK-7078/30 (23.99 ard/fad), SC SK-22 x SK-7078/2 (22.7 ard/fad), SC SK-22 x SK-7017/2-4 (22.6 ard/fad), SC SK-22 x SK-7017/4 (21.8 ard/fad) and SC SK-22 x SK-7017/10 (21.5 ard/fad) as top-crosses performed better than the check TWC 352 (20.8 ard/fad). Moreover, seven top-crosses derived from crossing the new inbred lines with the composite SK-21 produced more than checks SC155 and TWC 352. All these materials are very useful and can be used to improve yellow maize in maize breeding program.

Mean performance to new yellow inbred lines for silking date, plant height, ear height, ear length and ear diameter were ranged from 62 days (SK-7017/6) to 66.92 days (Gm-1004) with an average of 64 days, 121.6 cm (SK-7029) to 185 cm (SK-7017/4) with an average of 155.9 cm, 56 cm (SK-7029) to 105.7 (SK-7017/4) with an average of 81 cm, 13.22 cm (Gm 1004) to 17.68 (SK-7070) with an average of 13.51 cm and 3.47 cm (SK-7029) to (Gm 1004) with an average of 3.86 cm respectively. The results showed that the early top-crosses were SC SK-7078/2 x L-121 (58 days) and TWC SC Sk-22 x Sk-7070/30 (57.75 days). The shorter top-cross was SC SK-22 x SK 7017/2-4 (203.2 cm). The long ears appeared in all top-crosses produced using the composite SK-21. These results showed that choosing the testers was successful to discover the genetic ability in these new inbred lines and indicated the possibility to use the line 121 and the promising SC 22 to improve the yielding ability in yellow maize breeding programs.

General combining ability (GCA) effects for studied traits of the nine inbred lines are given in Table (3).The best inbred lines had disirable significant GCA effects were SK-7070, Sk-7078/2 and SK-7078/1 for grain yield, SK-7070 and 7078/2 for ear length, SK-7078 and SK-7078/2 for ear height, SK-7078/2, SK7078/1 and Gm 1004 for ear diameter and SK-7017/2-4 for the shortest plant and ear height. These inbred lines can be used as good conbiners in maize breeding program. The GCA effects of the testers for the studied traits are persented in Table (3). Desirable significant GCA effects were obtained by tester line 121 (narrow genetic base) for grain yield and ear length. Liakat and Teparo (1986) concluded that the lines are the most effective testers for evaluating inbred lines while, SC Sk-22 (broad genetic base) had the highest and desirable significant GCA effects for early silking date, plant height and ear height (earliness and shortings). However, composite 21 was significantly desirable for ear length. These results are in agreement with those obtained by Amer *et al* (2002).

Table (3): Estimates of general combining ability effects for nine lines and three testers over three locations.

GCA effects	Silking Date (days)	Plant Height (cm)	Ear Height (cm)	Ear Length (cm)	Ear diameter (cm)	Grain yield (ard/fed)
Lines						
Sk-7017/4	0.675**	-3.512	5.154**	-0.721**	-0.071*	-1.022*
Sk-7017/10	0.512*	-3.401	0.848	-0.444*	-0.118**	-0.345
Sk-7017/2-4	0.512*	-20.095**	-6.845**	-1.074**	-0.090*	-1.0596**
Sk-7017/6	-0.434	3.793	13.237**	-0.422*	-0.118**	-0.724
Sk-7029	0.378	-4.012	-4.345*	0.738**	-0.204**	-2.707**
Sk-7070	-0.241	21.265**	10.626**	2.110**	-0.037	4.609**
Sk-7078/2	-0.814**	4.487	-7.540**	0.483**	0.192**	1.742**
Sk-7078/1	-0.627**	-3.456	-14.956**	-0.110	0.284**	1.408**
Gm 1004	0.038	4.932*	3.821*	-0.558**	0.164**	-1.363**
Tester						
L 121	-0.416**	5.913**	4.080**	-0.273*	0.030	1.806**
Sc Sk-22	-0.347*	-11.817**	-8.317**	-0.629**	-0.024	-2.060**
Composite-21	0.764**	5.904**	4.237**	0.902**	-0.006	0.253
L.S.D g. 0.05	0.46	4.93	3.45	0.36	0.07	0.82
0.01	0.61	6.49	4.55	0.48	0.10	1.08
L.S.D g. 0.05	0.26	2.84	1.99	0.21	0.04	0.47
0.01	0.35	3.74	2.62	0.28	0.05	0.62

Specific combining ability (SCA)effects of the 27 top-crosses over three locations are shown in Table (4).

Table (4) : Estimates of specific combining ability effects for 39 top crosses over the three locations.

Crosses	Silking Date (days)	Plant Height (cm)	Ear Height (cm)	Ear Length (cm)	Ear diameter (cm)	Grain yield (ard/fad)
Sk-7017/4 x L 121	-1.1433**	-5.6912	-0.9412	-0.3095	-0.0526	1.4274*
Sk-7017/10 x L 121	-0.1400	1.8645	-0.8025	-0.5371	-0.0223	-0.9009
Sk-7017/2-4 x L 121	0.1100	-0.5249	-2.0242	-0.3065	-0.0080	-1.2669
Sk-7017/6 x L 121	-0.1133	-4.9139	-5.1915	-0.2011	0.0197	-0.6596
Sk-7029 x L 121	0.4133	6.8918	5.6418	-0.0871	-0.0780	1.6848*
Sk-7070 x L 121	0.9433*	2.6141	-0.0805	0.2835	-0.0280	1.2598
Sk-7078/2 x L 121	-0.0633	-0.6082	2.0031	0.5182	0.0747	-0.0909
Sk-7078/30 x L 121	0.3300	-4.3299	-1.3302	-0.0955	-0.0170	-1.5712*
Gm 1004 x L 121	-0.3367	4.6975	2.7251	0.7352*	0.1114	0.1174
Sk-7017/4 x Sc Sk-22	0.1278	4.6230	0.2931	0.2706	0.0181	0.6453
Sk-7017/10 x Sc Sk-22	-0.0389	2.0957	4.3456	0.2760	-0.0595	0.3300
Sk-7017/2-4 x Sc Sk-22	-0.2089	3.7904	3.2899	0.2488	0.0378	0.9880
Sk-7017/6 x Sc Sk-22	-0.0922	0.4014	-0.8764	0.1790	-0.0095	-0.6117
Sk-7029 x Sc Sk-22	-0.1456	-2.0430	-0.7931	-0.0320	0.1188	0.3007
Sk-7070 x Sc Sk-22	0.0444	-2.6546	-1.5154	0.1016	-0.0482	-0.0203
Sk-7078/2 x Sc Sk-22	-0.5522	-0.0430	0.4843	-0.1017	0.0135	-0.5780
Sk-7078/30 x Sc Sk-22	-0.5689	2.9844	1.5679	0.2346	-0.0202	1.0447
Gm 1004 x Sc Sk-22	1.4344**	-9.1543*	-6.2097*	-1.1767**	-0.0509	-2.0967**
Sk-7017/4 x comp Sk-21	1.0156*	1.0681	1.2343	0.0389	0.0345	-2.0728**
Sk-7017/10 x comp Sk-21	0.1789	-3.9602	-3.5431	0.2612	0.0818	0.5709
Sk-7017/2-4 x comp Sk-21	0.0989	-3.2655	-1.2657	0.0579	-0.0299	0.2809
Sk-7017/6 x comp Sk-21	0.2056	4.5125	6.0679*	0.0222	-0.0102	1.2712
Sk-7029 x comp Sk-21	-0.2678	-4.8489	-4.8487	0.1192	-0.0409	-1.9854**
Sk-7070 x comp Sk-21	-0.9878*	0.0405	1.5959	-0.3851	0.0761	-1.2394
Sk-7078/2 x comp Sk-21	0.6156	0.6511	-2.4874	-0.4165	-0.0882	0.6689
Sk-7078/30 x comp Sk-21	0.2389	1.3455	-0.2377	-0.1391	0.0371	0.5266
Gm 1004 x comp Sk-21	-1.0978*	4.4568	3.4846	0.4415	-0.0605	1.9792**
L.S.D sij 0.05	0.8	8.54	5.99	0.63	0.13	1.42
0.01	1.05	11.24	7.88	084	0.17	1.88

The results showed that the best SCA effects were obtained in top-crosses Sk-7017/4 x Line 121, Sk-7029 x Line 121 and Gm1004 x comp.sk-21 for grain yield, Gm 1004 x Line 121 for ear length. Also, Gm 1004 x Sk-22 for short plant and ear height. Morover, the top-crosses Sk-7017/4 x Line 121, Sk-7070 x composite 21 and Gm 1004 x composite 21 exhibited desirable SCA effectes for earliness. These results showed that the inbred line 121 was the best tester for evaluating combining ability of the new inbred lines for grain yield than other testers. Also, the tester composite Sk-21 was the best for evaluating specific combining ability of the new inbred lines for grain yield and earliness.

Estimates of GCA and SCA variances and their interaction with locations for all the studied traits are shown in Table (5). The GCA variance was more than SCA variance for all traits except silking date. These results indicated that the additive genetic variance played an important role in the inheritance of these traits. Mahmoud (1996), Soliman and Sadek (1999), EL-Zeir *et al* (2000) and Amer *et al* (2003), found that the additive genetic variance played an important role in the inheretance of grain yield. The interaction between σ^2 GCA x location was more than the interaction between σ^2 SCA x location for silking date, plant height and ear length. These results indicating that additive type of gene action was more influenced by environment than non-additive gene action, but the interaction between σ^2 GCA x Loc. was lower than σ^2SCA x Loc. For grain yield, ear height and ear diameter, indicating that the non-additive type of gene action was more influenced by environment than the additive gene action .

Table (5) : Estimates ratios of genetic components and their interaction with location for six traits.

Ratios	Silking Date (days)	Plant Height (cm)	Ear Height (cm)	Ear Length (cm)	Ear diameter (cm)	Grain yield (ard/fad)
GCA/SCA	0.309/0.440	104.17/10.22	57.49/5.42	0.66/0.12	0.006/0.0001	3.64/1.21
GCAxL/SCAx L	0.005/-0.09	17.88/-13.88	0.08/2.42	0.03/-0.06	0.0004/0.0007	0.307/1.526

2-Downy mildew resistance:-

In respect to downy mildew resistance, Table (6) represents the mean squares of studied resistance to downy mildew disease. The genotypes (G)mean squares and their partitions in parents (P), crosses and (P vs C) were significant. These results indicated that behaviours of genotypes and their partitions were different from one each other. These results in are agreement with Odvady *et al* (1984), EL-Shenawy (1995) and EL-Zeir *et al* (2001) . Mean squares due to lines and lines x tester were significant, but that of testers were not significant, these results reflected the effects of inbred lines in their top-crosses. The GCA/SCA ratio was less than unity (0.21) for resistance to downy mildew disease indicating that both additive and non-additive effects are important for inheritance of this trait.

The GCA effects for resistance to downy mildew disease in this study were larger in magnitude than SCA effects. These results were in agreement with Kaneko and Aday (1980), Orangel and Borges (1987), EL-Shenawy (1995) and Mohamed (2002). On the other hand EL-Shenawy and Tolba

(2001) found that SCA effects had the major portion of genetic variance in resistance to downy mildew disease

Table (6) : Analysis of variance for resistance to downy mildew disease in 2002 season

S.O.V	d.f	Resistance of downy mildew disease.
Reps.	3	33.569
Genotypes(G)	38	830.03**
Parents (P)	11	1630.34**
Crosses (c)	26	223.91**
P vs c	1	7785.65**
Lines (L)	8	452.71**
Testers (T)	2	22.7n.s
L x T	16	134.66
Error	114	56.237

X = 88.863
CV%= 8.44
GCA/SCA= 0.21

Mean performance for resistance to downy mildew disease is tabulated in Table (7) .The 21 top-crosses was highly resistance (over 90%). The mean *per se* of inbred lines ranged from 47.9% (Sk-7017/6) to 95.99% (Sk-7070). Also the mean *per se* of testers for resistance to downy mildew disease were, 47.2%, 42.9% and 85.8% for inbred line 121, SC Sk-22 and comp-Sk-21 respectively. The progenies of these new inbred lines in top-crosses were highly resistance . These results showed that the used system to improve the new inbred lines for resistance to downy mildew disease was very successful in nursery field for downy mildew at Sakha Research Station.

Table (7) : Mean performance for resistance to downy mildew in top-cross and mean per se of inbred lines and testers.

	L-121	S.c Sk-22	Comp-Sk-21	Mean per se of inbred lines
Sk-7017/4	98.843	99.061	97.917	83.704
Sk-7017/10	99.432	98.056	100.00	94.910
Sk-7017/2-4	99.576	98.319	97.492	92.585
Sk-7017/6	100.00	92.038	97.616	93.06
Sk-7029	97.934	95.336	97.399	47.903
Sk-7070	94.098	88.696	95.065	85.967
Sk-7078/2	92.049	72.311	86.298	95.990
Sk-7078/1	85.136	96.993	96.008	91.793
Gm 1004	74.991	94.251	81.567	77.369
Mean per se Of tester	47.16	42.92	85.82	

L.S.D 0.05 = 10.39
0.01 = 13.68

Estimated GCA effects for inbred lines are shown in Table (8). The inbred lines Sk-7017/4, Sk-7017/10 and 7017/2-4 exhibited the highest positive of significant GCA effects for resistance to downy mildew disease.

These inbred lines could be used in breeding program. Specific combining ability (SCA) effects for the 27 top-crosses are shown in Table (8). The top-crosses; line 121 x Sk-7078/1 and SC Sk-21 x Gm-1004 showed positively significant SCA effects for resistance to downy mildew disease. These top-crosses can be used in breeding program.

In conclusion, the new inbred lines selected from a source resistant to downy mildew disease. Can be used to breed downy mildew resistant yellow maize hybrid cultivars.

Table (8) :Estimates of GCA effects for nine lines three testers, and SCA effects for 27 top-crosses in 2002 season.

Tester Line	Line 121	Sc.Sk-21	Comp-Sk-21	GCA effects of inbred lines
Sk-7017/4	0.2471	1.2426	-1.4897	5.0338*
Sk-7017/10	0.2804	-0.3180	0.0376	5.5895**
Sk-7017/2-4	1.1247	0.6453	-1.7700	4.8891*
Sk-7017/6	3.4617	-3.7227	0.2610	2.9761
Sk-7029	1.0554	-0.7650	-0.2904	3.3165
Sk-7070	1.4894	-3.1350	1.6456	-0.9535
Sk-7078/2	8.5074*	-10.4530**	1.9456	-10.0205**
Sk-7078/1	7.5653*	5.0693	2.4960	-0.8809
Gm 1004	-8.6009*	11.4366**	-2.8357	-9.9702**
GCA effects of testers	-0.0111	-0.7886	0.7997	

L.S.D gl 0.05 = 4.24
0.01 =5.58
L.S.D gt 0.05= 2.44
0.01= 3.22
L.S.D sij 0.05= 7.34
0.01= 9.67

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القدرة على الائتلاف وطبيعة الفعل الجينى لمحصول الحبوب والمقاومة لمرض البياض الزغبى فى الذرة الشامية

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أجريت هذه الدراسة بمحطة البحوث الزراعية بسخا موسم ٢٠٠١ وموسم ٢٠٠٢ .تم التلقيح فى موسم ٢٠٠١ بين ٩ سلالات صفراء جديدة من الذرة الشامية مع ثلاثة كشافات وفى موسم ٢٠٠٢ تم تقيم الآباء والهجن القمية الناتجة فى ثلاث مناطق وهى سخا وسدس والنوبارية واظهرت النتائج ما يلى :-

١- المحصول وصفات التبكير و النمو :

كان تأثير المناطق والتراكيب الوراثية والاباء والهجن والاباء على الهجن معنويا مع جميع الصفات .

كان تاثيرا التفاعل بين التراكيب الوراثية x المناطق والآباء x المناطق والهجن x المناطق غير معنوية لجميع الصفات ما عدا صفة محصول الحبوب كان تأثير السلالات والكشاف وتفاعل السلالة xالكشاف معنوية لجميع الصفات ما عدا الكشاف لقطر الكوز والسلالة x الكشاف لصفات ارتفاع النبات والكوز وقطر الكوز .

كانت افضل السلالات للقدرة العامة للائتلاف معنويا لصفة المحصول للسلالة SK-7070 و SK-7078/2 و SK-7078/1 وكانت القدرة الخاصة للائتلاف معنوية مع الهجينين (SK-7017/4xL-121)و(SK-7029xL-121) وأوضحت المتوسطات ان ثمانية هجن فردية قمية كانت ذات قيمة اكبر من هجن المقارنة هجين فردى ١٥٥ (٢٣,٨اردب/فدان) ومنها ثلاثة هجن تزيد معنويا عن هجين المقارنة وهذه الهجن هى SK-7070 x L-121(٣١,٣اردب/فدان) و SK-7078 x L-121 (٢٧,١ إردب /فدان) و SK-7017/4 x L-121 (٢٥,٨اردب/فدان) .

كذلك يوجد ٦ هجن ثلاثية تزيد عن هجين المقارنة هجين ثلاثى ٣٥٢ (٢٠,٨اردب /فدان) ومنها هجينان تزيد معنويا عن هجين المقارنة وهى SK-22xSK7070 (٢٦,١ إردب/فدان) SK-22 x SK-7078/30 (٢٣,٩٩ إردب/فدان) وتعتبر الهجن السابقة مفيدة فى برنامج التربية للذرة الشامية الصفراء.

٢- المقاومة لمرض البياض الزغبى

أوضحت السلالة SK-7017/4 والسلالة SK-7017/10والسلالة SK-7017/4 قدرة عامة موجبة وعالية المعنوية لمقاومة مرض البياض الزغبي

أيضا أوضحت الهجن القمية L-121 x SK-7078/1 , L-121xGem1004 قدرة خاصة موجبة وعالية المعنوية بالنسبة للمقاومة لمرض البياض الزغبي .

ونظرا لان هذه السلالات الجديدة مستنبطة من مصادر مقاومة لمرض البياض الزغبى فكان ذلك واضحا فى متوسطات المقاومة للهجن القمية الناتجة واظهر معظمها اكثر من ٩٠% مقاومة لمرض البياض الزغبى

ولذلك فان هذه السلالات والهجن القمية يمكن الاستفادة منها فى برنامج التربية للمقاومة لمرض البياض الزغبى ببرنامج التربية للذرة الشامية .