EVALUATION OF NEW SINGLE AND THREE- WAY MAIZE CROSSES FOR RESISTANCE TO DOWNY MILDEW DISEASE AND GRAIN YIELD UNDER DIFFERENT ENVIRONMENTS

El-Shenawy, A.A. and H. E. Mosa

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ABCTRACT

New white 21 inbred lines of maize were mated to the two testers, inbred line Sd 63 and promising SC Sk17 at Sakha Agricultural Research. Station during 2002 season. The resulting 42 top crosses and the two checks, SC10 and TWC324, were evaluated in two trials: the first trial during 2003 season at two locations, Sakha and Mallawi, to estimate silking date, ear position, grain yield, ear length and number of rows/ ear. While, the second trial was performed in the disease nursery at Sakha Agricultural Research Station during 2003 and 2004 seasons under artificial infection by downy mildew disease to estimate the resistance for this disease. Combining ability analysis for all studied traits were computed via line x tester procedure, as proposed by Kempthorne (1957). The results of the present study were combined over the two locations in the first trial and over the two years in the second trial and could be summarized as follows:

Mean squares due to lines, testers and their interaction were highly significant for all studied traits, except for testers and lines x testers interaction for number of rows/ ear and resistance to downy mildew disease, and lines x testers interaction for ear position.

The estimates of the genetic variance indicated that the additive genetic variance was the more important component in the inheritance of silking date, ear position and resistance to downy mildew disease. While, the non-additive genetic variance played the major contribution in the inheritance of grain yield, ear length and number of rows/ ear. Whereas, the additive genetic variance was more interacted with environment than non-additive one for all studied traits, except for grain yield and resistance to downy mildew disease.

The parental inbred lines, that revealed the highest and desirable GCA effects, were Sk5170/6 for silking date, Sk5170/1 for ear position, Sk132/234 for ear length, Sd 1011 for number of rows/ ear and resistance to downy mildew disease and Sk8170/4 for grain yield. Promising SC Sk17 as a tester was the best general combiner for all studied traits. The highest and desirable SCA effects were obtained for the top crosses, Gm147 x SC Sk17 for silking date, ear length and grain yield, Sk8170/4 x Sd 63 for number of rows/ ear and Gm152 x SC Sk17 for resistance to downy mildew disease.

The three- way crosses, Sk8170/7 x SC Sk17 and Sd1031 x SC Sk17 were superior for grain yield (38.12 and 38.81 ard/fad, respectively), earliness and resistance to downy mildew disease, compared to SC10 and TWC 324 for which the grain yield was 37.15 and 36.46 ard/fad, respectively. While, Sk8170/4 x Sd 63 and Sd1011 x Sd 63 single crosses exhibited 100% resistance to downy mildew disease under artificial infection. These results suggest the use of these crosses in maize breeding programs to obtain high yielding ability and high resistance to downy mildew disease.

INTRODUCTION

One of the main objectives of the national maize program in Egypt is releasing high yielding hybrids and resistance to major pests. Downy mildew *(Peronosclerospora Sorghi)* of maize is one of the most destructive diseases of maize in Egypt, especially in Delta Region. Line x tester analysis provides information on the combining ability (GCA and SCA) variances and effects for selection of desirable parents for hybridization and selection breeding procedure for genetic improvement of various polygenic characters. Broad genetic base testers were used almost exclusively to improve GCA (Hallauer and Miranda, 1981). Zambezi *et al.* (1986) reported that inbred tester could successfully be used for improving GCA as well as SCA in maize. Akhter *et al.* (1985) concluded that a two-tester combination (a composite verity and another single cross hybrid) seemed to be the optimal number for determining the GCA effects of the line. Orangel and Borges (1987), El-Shenawy (1995), El-Shenawy *et al.* (2003) and Mosa *et al.* (2004) found that GCA variance component was more important than SCA one for downy mildew disease, caused by *peronosclerospora sorghi*, silking date and ear position. Nawar and El-Hosary (1984), Sedhom (1992), El-Kielany (1999), Amer *et al.* (2002) and Mosa (2004) reported that σ^2SCA was more important in the inheritance of grain yield, ear length and number of rows/ ear.

This study was planned 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 their specific combining ability and to identify superior hybrids for high yielding ability and resistance to downy mildew disease.

MATERIALS AND METHODS

New white 21 inbred lines of maize were mated to the two testers, Sd-63 inbred line and Sakha 17 (SC Sk17) promising single cross at Sakha Agricultural Research. Station in 2002 season. The resulting 42 top crosses and the two commercial crosses, SC10 and TWC 324 were evaluated in two trials. The first trial was performed during 2003 season at Sakha and Mallawi Agricultural Research Stations. A randomized complete block design (RCBD), with four replications, was used in both locations. The experimental unit was one row, 6m. long, 80cm. apart and 25cm. between hills and one plant was left per hill. All cultural

Maize Research Section, FCRI, Sakha ARS, ARC, Egypt

practices were applied as usual. The data were recorded on silking date (days), ear position (%), grain yield (ard/fad) adjusted on 15.5 % basis, grain moisture content, ear length (cm) and number of rows per ear. The second trial was performed in a disease nursery under artificial infection by downy mildew disease at Sakha Agricultural Research Station. Annually in the same place, the field was previously planted by sorghum as a source of infection .It was alternatively planted with maize rows in a ratio of 1:2, respectively. RCBD design, with four replications, was used. Plot size was one row, 5m. long, 80cm. apart and 50cm. between hills and three grains were sown per hill and left without thinning. The percentage of resistance was taken after 35 days from planting, according to El-Shenawy (1995). Statistical analysis of the combined data over the two locations in the first trial and over two years in the second trial were performed, according to Snedecor and Cochran (1980). Combining ability analysis was computed by the line x tester procedure, as suggested by Kempthorne (1957).

RESULTS AND DISCUSSION

Mean performance of inbreds in their top crosses for five traits over two locations and resistance to downy mildew disease over two years are presented in Table 1. Mean number of days to 50% silking was significantly lower than the two checks, SC10 and TWC324, for all inbred lines in their top crosses over the two testers, except for Gm105 inbred line. The top crosses between the inbred lines, Sk8170/7, Sk5170/1 and Sk5170/6, and each of the two testers were the best among the studied top crosses for earliness. These inbreds and their top crosses could be utilized in the breeding programs for developing early- maturing single and three- way crosses.

Mean of ear position was significantly lower than the two check hybrids for Gm109, Gm147, Sk8170/4, Sk8170/7,Sk7001/7, Sk7005/9, Sk5170/1, Sd1036 and Sk5170/6 inbreds in their top crosses over all testers. The best top crosses for ear position were SC Sk7005/9 x Sd63, TWC Sk7005/9 x SCSk17 and TWC Sk5170/1 x SCSk17 (Table 1). Such result indicated that these materials are prospecting in maize breeding programs towards the development of good stature for single and three way- crosses and resistance to stalk breakage.

Sk8162, Sd8 and Sk132/234 inbreds showed on the average over all testers the highest means for ear length and significantly differed than the check varieties. The best crosses for ear length among all top crosses were SC Sk132/234 x Sd63 and TWC Sk132/234 x SCSk17.

Mean number of rows/ear, six inbreds; namely, Gm105, Gm152, Sk7005/9, Sk7005/11and Sd1011, were significantly higher than the two check varieties, SC10 and TWC324, in their top crosses and overall testers. The highest top crosses for number of rows/ear were SC Sd1011 x Sd63 and TWC Sd1011 x SCSk17 (Table 1).

Based on the average over all testers, six inbred lines; namely, G152, Sk8170/4, Sk8170/7, Sk5170/1, Sd8 and Sk132/234, showed an average over 35 ard/fad in their top crosses for grain yield. SC Gm152 x Sd63 (37.16 ard/fad), TWC Sk8170/7 x SCSk17(38.12 ard/fad) and TWC Sd1031 x SCSk17(38.81 ard/fad) outyielded, but insignificantly, SC10 (37.15 ard/fad) and TWC324 (36.46 ard/fad). It could be concluded that these inbred lines and crosses could be immediately utilized by corn breeders to develop new hybrids with high yield potentiality.

For resistance to downy mildew disease under artificial infection in Table 1, it was shown that most of the top crosses were higher than the check varieties, SC10 and TWC324. The highest crosses among the 42 top crosses were SC Sk8170/4 x Sd63 and SC Sd1011 xSd63, which had 100% resistance to downy mildew disease under artificial infestation. However, the inbred lines, Sk8170/4, Sd1036, Sd1011 and Sk5170/6, gave the highest resistance to downy mildew disease in their top crosses over the two testers. It could be concluded that these inbreds and crosses might be good materials for resistance to downy mildew disease.

Generally, three- way crosses; namely, TWC Sk8170/7 x SCSk17 and TWC Sd1031 x SCSk17, showed high yielding ability, earliness, suitable ear position and resistance to downy mildew disease better than the two commercial crosses, SC10 and TWC324.This study suggests the use of these crosses in Egypt, especially the Delta Region, to obtain high yielding potentialty and resistance to downy mildew disease caused by late planting date (July) and planting sudangrass or sorghum beside maize.

Moreover, mean of all studied traits for each tester in its top crosses with inbred lines are presented in Table 1. Top crosses, involving the promising SCSk17 inbred lines as a common tester, showed the highest means for all traits, except for silking date and ear position. Cress (1966) reported that the choice of a tester to maximize grain yield from selection might be based on the average performance of the top crosses, therefore, a tester with the highest average top cross performance was chosen. This result indicates that SCSk17 could be used as a good tester and produced three -way crosses that had a high yielding ability, earliness and resistance to downy mildew disease.

The combined analysis of variance for five traits over two locations and resistance to downy mildew disease over two years are presented in Table 2. The mean squares, due to environments, were highly significant and significant for ear length, grain yield and resistance to downy mildew disease, respectively, but it was not significant for silking date, ear position and number of rows/ear. Mean squares due to lines (L) were highly significant for all traits.

This indicates that the inbred lines significantly behaved different from each other in their respective top crosses. Besides, mean squares due to testers (T) were highly significant for all traits, except for number of rows/ear and resistance to downy mildew disease. Such results indicate a wide range of variability among testers. Highly significant lines x testers (L x T) interaction mean squares were exhibited only for silking date, ear length and grain yield, suggesting that inbred lines might differently perform in top crosses, depending on the type of tester used for these traits. Also, mean squares due to (L x Env.), (T x Env.) and (L x T x Env.) interactions were not significant for all studied traits, except for L x Env. interaction for grain yield, T x Env. interaction for silking date and ear length and L x T x Env. interaction for grain yield and resistance to downy mildew disease. Such interactions were almost highly significant.

Table (1) Mean performance of inbreds in their top crosses for five traits over two locations and resistance to downy mildew disease over two years.

Inbred line	Silking date (days)			Ear position (%)			Ear length (cm)		
	Sd 63	SC Sk17	Mean	Sd 63	SC Sk17	Mean	Sd 63	SC Sk17	Mean
Gm40	63.12	60.37	61.74	60.26	57.98	59.12	20.02	20.52	20.27
Gm105	65.25	63.50	64.38	58.49	56.78	57.64	20.30	22.17	21.24
Gm109	62.62	62.25	62.43	55.59	55.01	55.30	20.35	22.35	21.35
Gm147	64.25	59.37	61.81	55.61	54.94	55.28	17.70	21.35	19.53
Gm152	63.00	60.50	61.75	61.33	59.55	60.44	22.72	21.90	22.31
Sk8170/4	59.50	59.62	59.56	58.20	54.38	56.29	22.07	22.20	22.14
Sk8170/7	59.62	58.75	59.18	58.20	54.30	56.25	21.15	20.85	20.86
Sk8162	60.50	59.62	60.06	59.92	56.47	58.19	23.60	24.30	23.95
Sk7001/7	59.87	60.12	59.99	56.83	54.04	55.44	20.62	21.77	21.19
Sk7001/8	62.12	60.50	61.31	58.17	56.04	57.10	21.52	22.47	21.99
Sk7005/9	60.50	59.50	60.00	53.13	53.99	53.56	21.00	22.35	21.67
Sk7005/11	61.00	60.12	60.56	60.77	55.80	58.28	21.35	22.77	22.06
Sk5170/1	59.50	58.62	59.06	54.80	51.82	53.31	21.52	23.00	22.26
Sd8	62.00	60.37	61.18	59.64	57.89	58.76	23.90	24.47	24.18
Sd69	60.50	59.57	60.13	60.05	58.79	59.42	22.90	22.12	22.51
Sd1036	60.75	60.60	60.67	56.11	55.93	56.02	21.15	21.47	21.31
Sd1031	62.00	61.00	61.50	61.27	57.87	59.57	21.32	22.50	21.78
Sd1011	61.37	60.00	60.68	58.59	57.05	57.82	20.37	20.27	20.32
Sd86	60.50	59.00	59.75	57.98	57.18	57.58	21.52	21.27	21.40
Sk132/234	62.87	60.25	61.56	60.39	56.83	58.61	26.57	25.02	25.80
Sk5170/6	59.25	58.50	58.88	58.98	55.03	57.00	21.52	21.35	21.44
Mean over all lines	61.45	60.10		58.28	56.09		21.58	22.19	
LSD 0.05	1.15			3.17			1.12		
LSD 0.01	1.52			4.18			1.47		
Checks SC10	64.12			60.28			22.80		
TWC324	64.87			60.29			23.85		

Table (1):Cont.

Inbred line	Number of rows/ear			Grain yield (ard/fad)			Downy mildew resistance (%)		
	Sd 63	SC Sk17	Mean	Sd 63	SC Sk17	Mean	Sd 63	SC Sk17	Mean
Gm40	14.02	13.95	13.99	28.42	32.87	30.65	84.97	93.57	89.27
Gm105	14.10	15.05	14.58	31.63	35.72	33.67	98.96	94.58	96.77
Gm109	14.15	13.95	14.05	33.42	34.13	33.78	97.38	96.32	96.85
Gm147	13.10	13.85	13.48	16.07	32.63	24.35	95.44	94.62	95.03
Gm152	14.45	14.45	14.45	37.16	34.17	35.67	64.93	77.93	71.43
Sk8170/4	13.35	12.70	13.02	35.69	36.44	36.06	100.0 0	98.65	99.32
Sk8170/7	13.45	13.67	13.60	32.62	38.12	35.37	97.93	92.99	95.46
Sk8162	14.05	14.02	14.03	32.43	34.44	33.43	98.38	97.13	97.75
Sk7001/7	13.30	14.12	13.71	34.75	30.55	32.65	90.00	95.45	92.72
Sk7001/8	13.27	13.85	13.56	31.59	36.06	33.83	95.34	97.17	96.25
Sk7005/9	14.35	14.80	14.58	29.38	35.81	32.60	79.28	74.06	76.67
Sk7005/11	14.22	14.35	14.28	35.19	33.55	34.37	90.66	89.29	89.98
Sk5170/1	14.20	13.92	14.06	36.61	34.35	35.48	98.85	95.87	97.36
Sd8	13.30	13.55	13.43	36.66	34.16	35.41	97.21	96.32	96.76
Sd69	14.10	13.72	13.91	30.94	29.68	30.31	96.30	77.90	77.10
Sd1036	13.70	13.75	13.73	32.62	33.19	32.90	98.36	98.88	98.62
Sd1031	13.85	13.50	13.68	30.11	38.81	34.46	98.54	97.87	98.21
Sd1011	15.07	15.17	15.12	33.43	32.85	33.14	100.0 0	99.51	99.76
Sd86	13.80	14.05	13.93	35.32	31.58	33.45	72.67	81.66	77.17
Sk132/234	13.67	13.70	13.68	35.96	34.90	35.43	87.44	84.44	85.94
Sk5170/6	13.92	13.35	13.64	33.89	33.53	33.71	98.51	97.74	98.13
Mean over all lines	13.88	13.98		32.57	34.17		91.48	92.00	
LSD 0.05	0.77			3.68			8.42		
0.01	1.02			4.78			11.08		
Checks SC10	12.50			37.15			90.86		
TWC324	13.30			36.46			83.03		

Table (2): Combined analysis of variance for five traits over two locations and resistance to downy mildew disease over two years.

S.O.V.	Silking date (days)	Ear position (%)	Ear length (cm)	Number of rows/ear	Grain yield (ard/fad)	Downy mildew resistance (%)
Environments (Env.)	1.07	8.31	88.86**	1.65	2227.86**	496.83*
Error	8.74	48.26	7.77	0.325	116.47	79.92
Lines (L)	27.38**	60.11**	31.19**	3.38**	103.51**	1235.81**
Testers (T)	153.36**	394.33**	28.00**	0.58	220.19**	21.50
L x T	5.11**	9.08	5.44**	0.86	98.81**	89.36
L x Env.	1.40	13.90	1.52	1.05	31.81**	89.49
T x Env.	83.00**	29.76	12.57**	2.33	44.29	259
L x T X Env.	1.44	9.265	1.47	0.64	38.32**	116.24*
Error	1.393	10.51	1.30	0.63	13.78	73.88
CV %	1.94	5.67	5.24	5.70	11.13	9.37

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

Table (3): Estimates of genetic variance components for five traits over two locations and resistance to downy mildew disease over two years.

Genetic components	Silking date (days)	Ear position (%)	Ear length (cm)	Number of rows/ear	Grain yield (ard/fad)	Downy mildew resistance (%)
σ^2 GCA	1.160	2.230	0.201	0.001	0.479	4.599
σ^2 SCA	0.450	-0.023	0.496	0.020	7.561	-3.360
σ^2 GCA x Env.	0.440	0.136	0.060	0.011	-0.002	0.630
σ^2 SCA x Env.	0.006	-0.156	0.020	0.001	3.060	5.295

The estimates of the genetic variance components for five traits over two locations and resistance to downy mildew disease over two years are shown in Table 3.The σ^2gca (or additive genetic variance) value was the most important component controlling the inheritance of silking date, ear position and resistance to downy mildew disease. This result supports the findings of El-Shenawy (1995), Mahmoud (1996), El-Kielany (1999), Amer *et al.* (2002) and Mosa *et al.* (2004). On the other side, the results indicated that the σ^2sca value (or non-additive genetic variance) was a more important component controlling the inheritance of ear length, number of rows/ear and grain yield. Similar results were reported by El-Itriby *et al.* (1981), Nawar and El-Hosary (1984), El-Kielany (1999) and Mosa (2004). Moreover, the magnitude of the σ^2GCA x environment interactions were larger than σ^2SCA x environment one for all traits, except for grain yield and resistance to downy mildew disease, indicating that the additive gene action interacted more with environmental than the non- additive gene action for all studied traits, except for grain yield and resistance to downy mildew disease. Silva and Hallauer (1975), El-Itriby *et al.* (1990) and El-Shenawy *et al.* (2003) found that GCA x environment interaction was larger than SCA x environment. While, Lonnquist and Gardner (1961), Shehata and Dhawan (1975) and Mosa (2004) found that the non-additive genetic variation interaction was more with the environment than the additive component.

Estimates of general combining ability effects for 21 maize inbred lines and two testers of five traits over two locations and resistance to downy mildew disease over two years are presented in Table 4. The desirable general combining ability effects of inbred lines were obtained for Gm105 and Sd1011 for number of rows/ear and resistance to downy mildew disease, Gm109 and Sk5170/6 for ear position and resistance to downy mildew disease, Gm147 for ear position, Gm152 for number of rows/ear and grain yield, Sk8170/4 and Sk5170/1 for silking date, ear position, grain yield and resistance to downy mildew disease, Sk8170/7 for silking date and grain yield, Sk8162 for silking date, ear length and resistance to downy mildew disease, Sk7001/7 for silking date and ear position, Sk7001/8, Sd1036 and Sd1031 for grain yield, Sk7005/9 for silking date, ear position and number of rows/ear, Sd8 for ear length, grain yield and resistance to downy mildew disease, Sd69 for silking date and ear length, Sd86 for silking date and Sk132/234 for ear length and grain yield. These inbreds could be utilized in making hybrids that had high yielding ability, earliness, suitable ear position and high resistance to downy mildew disease. Regarding Table 4, the promising SCSk17, as a tester, was the best general combiner for all studied traits. The superiority of the heterozygous crosses, as desirable testers, were noticed by Sokolov and Kostyuchence (1978), Selim *et al.* (1981), Al-Naggar *et al.* (1997) and Mosa (2004).

Table (4): Estimates of general combining ability effects for 21 maize inbred lines and two testers of five traits over two locations and resistance to downy mildew disease over two years.

Inbred line	Silking date (days)	Ear position(%)	Ear length(cm)	Number of rows/ear	Grain yield (ard/fad)	Downy mildew resistance (%)
Gm40	0.991**	1.946*	-1.651**	0.077	-2.699**	-2.491
Gm105	3.616**	0.508	-0.589*	0.764**	0.30	5.008*
Gm109	1.678**	-1.928*	-0.526	0.077	0.425	5.071*
Gm147	1.053**	-1.991*	-2.339**	-0.485*	-8.824**	3.258
Gm152	0.991**	3.321**	0.348	0.577**	2.363*	-20.241**
Sk8170/4	-1.196**	-0.991	0.223	-0.922**	2.675**	7.633**
Sk8170/7	-1.571**	-0.866	-0.839*	-0.360	2.05*	3.758
Sk8162	-0.696*	0.946	2.035**	0.139	0.05	6.008**
Sk7001/7	-0.758*	-1.803*	-0.714*	-0.235	-0.699	0.946
Sk7001/8	0.553	0.071	0.098	-0.422*	0.425	4.446*
Sk7005/9	-0.758*	-3.74**	-0.214	0.452*	-0.761	-15.053**
Sk7005/11	-0.196	1.008	0.160	0.327	1.05	-1.741
Sk5170/1	-1.696**	-3.803**	0.348	0.139	2.175*	5.571**
Sd8	0.428	1.571	2.348**	-0.36	1.988*	4.946*
Sd69	-0.633*	2.258**	0.660*	-0.110	-3.136**	-14.616**
Sd1036	-0.383	-1.053	-0.589*	-0.172	-0.511	6.946**
Sd1031	0.741*	2.383**	-0.151	-0.110	1.113	6.446**
Sd1011	-0.071	0.696	-1.526**	1.077**	-0.324	8.008**
Sd86	-1.008**	0.196	-0.526	0.077	-0.011	-14.553**
Sk132/234	0.803**	1.446	3.910**	-0.297	2.113*	-5.741**
Sk5170/6	-1.883**	-0.178	-0.464	-0.235	0.238	6.383**
Testers Sd63	0.675**	1.083**	-0.288**	-0.041	-0.809**	-0.253
SC Sk17	-0.675**	-1.083**	0.288**	0.041	0.809**	0.253
L.S.D $_L$ 0.05	0.57	1.58	0.560	0.38	1.810	4.21
0.01	0.76	2.09	0.738	0.51	2.39	5.54
L.S.D $_T$ 0.05	0.178	0.49	0.17	0.12	0.561	1.29
0.01	0.23	0.64	0.22	0.15	0.73	1.71

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

Estimates of specific combining ability effects for 42 top crosses of five traits over two locations and resistance to downy mildew disease over two years are shown in Table 5. The desirable and significant SCA effects were obtained for Gm147 x SCSk17 for silking date, ear length and grain yield; Gm152 x Sd63 for ear length, Gm152 x SCSk17 for resistance to downy mildew disease, Sk8170/4 x Sd63 for number of rows/ear, Sk7001/7 x Sd63, Sd86 x Sd63, Sk7005/9 x SCSk17 and Sd1031 x SCSk17 for grain yield. Such crosses might be utilized in maize breeding programs for different purposes as earliness with high yielding ability and resistance to downy mildew disease.

Table (5): Estimates of specific combining ability effects for 42 top crosses of five traits over two locations and resistance to downy mildew disease over two years.

Inbred line	Silking date (days)		Ear position(%)		Ear length (cm)	
	Sd 63	SC Sk17	Sd 63	SC Sk17	Sd 63	SC Sk17
Gm40	0.699	-0.699	0.041	-0.041	0.038	-0.038
Gm105	0.199	-0.199	-0.270	0.270	-0.523	0.523
Gm109	-0.488	0.488	-0.833	0.833	-0.586	0.586
Gm147	1.761**	-1.761**	-0.770	0.770	-1.648**	1.648**
Gm152	0.574	-0.574	-0.208	0.208	0.790*	-0.790*
Sk8170/4	-0.738	0.738	0.854	-0.854	0.288	-0.288
Sk8170/7	-0.238	0.238	0.729	-0.729	0.476	-0.476
Sk8162	-0.238	0.238	0.666	-0.666	-0.023	0.023
Sk7001/7	-0.800*	0.800*	0.291	-0.291	-0.273	0.273
Sk7001/8	0.136	-0.136	0.041	-0.041	-0.211	0.211
Sk7005/9	-0.175	0.175	-1.520	1.520	-0.398	0.398
Sk7005/11	-0.238	0.238	1.354	-1.354	-0.273	0.273
Sk5170/1	0.238	-0.238	0.416	-0.416	-0.461	0.461
Sd8	0.136	-0.136	-0.208	0.208	0.038	-0.038
Sd69	-0.30	0.30	-0.645	0.645	0.601	-0.601
Sd1036	-0.30	0.30	-0.958	0.958	0.101	-0.101
Sd1031	-0.175	0.175	0.604	-0.604	-0.086	0.086
Sd1011	0.011	-0.011	-0.333	0.333	0.288	-0.288
Sd86	0.074	-0.074	-0.833	0.833	0.413	-0.413
Sk132/234	0.636	-0.636	0.666	-0.666	1.101	-1.101
Sk5170/6	-0.30	0.30	0.916	-0.916	0.351	-0.351
LSD S_{LT} 0.05	0.80		2.24		0.79	
0.01	1.07		2.95		1.04	

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

Table (5): Cont.

Inbred line	Number of rows/ear		Grain yield (ard/fad)		Downy mildew resistance (%)	
	Sd 63	SC Sk17	Sd 63	SC Sk17	Sd 63	SC Sk17
Gm40	0.041	-0.041	-1.377	1.377	-3.997	3.997
Gm105	-0.395	0.395	-1.377	1.377	2.377	-2.377
Gm109	0.291	-0.291	0.497	-0.497	0.815	-0.815
Gm147	-0.270	0.270	-7.502**	7.502**	0.752	-0.752
Gm152	-0.083	0.083	2.309	-2.309	-6.247*	6.247*
Sk8170/4	0.55*	-0.55*	0.497	-0.497	0.877	-0.877
Sk8170/7	-0.020	0.020	-1.877	1.877	2.627	-2.627
Sk8162	0.104	-0.104	-0.252	0.252	0.877	-0.877
Sk7001/7	-0.395	0.395	2.997*	-2.997*	-2.434	2.434
Sk7001/8	-0.208	0.208	-1.502	1.502	-0.809	0.809
Sk7005/9	-0.208	0.208	-2.540*	2.540*	2.940	-2.940
Sk7005/11	-0.083	0.083	1.747	-1.747	1.002	-1.002
Sk5170/1	0.104	-0.104	1.872	-1.872	1.690	-1.690
Sd8	-0.145	0.145	2.059	-2.059	0.690	-0.690
Sd69	0.229	-0.229	1.434	-1.434	-0.497	0.497
Sd1036	0.041	-0.041	0.434	-0.434	0.065	-0.065
Sd1031	0.229	-0.229	-3.565**	3.565**	0.565	-0.565
Sd1011	0.041	-0.041	1.122	-1.122	0.502	-0.502
Sd86	-0.083	0.083	2.684*	-2.684*	-4.184	4.184
Sk132/234	0.041	-0.041	1.309	-1.309	1.752	-1.752
Sk5170/6	0.229	-0.229	0.934	-0.934	0.627	-0.627
LSD S_{LT} 0.05	0.55		2.50		5.95	
0.01	0.72		3.38		7.84	

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

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الملخص العربي

تقويم هجن فردية و ثلاثية جديدة من الذرة الشامية لمقاومة مرض البياض الزغبي ومحصول الحبوب تحت ظروف بيئية مختلفة

عباس عبد الحي الشناوي - حاتم الحمادى موسى
مركز البحوث الزراعية- معهد المحاصيل الحقلية - قسم بحوث الذرة الشامية بسخا

تم إجراء التهجينات بين ٢١ سلالة بيضاء جديدة من الذرة الشامية واثنين من الكشافات (سلالة سدس ٦٣ وجبين فردى مبشر سخا ١٧) وذلك بمحطة بحوث سخا موسم ٢٠٠٢و قد قومت الهجن القمية (٤٢) الناتجة مع اثنين من الأصناف التجارية" هف ١٠، هث ٣٢٤ " وذلك في تجربتين مستقلتين. الأولي في موقعين موسم٢٠٠٢ بمحطتي بحوث سخا وملوي وقدر من التحليل المشترك كل من صفات تاريخ ظهور ٥٠% من النورات المؤنثة و موقع الكوز و محصول الحبوب و طول الكوز وعدد الصفوف بالكوز وزرعت التجربة الثانية في موسمي" ٢٠٠٣و٢٠٠٤" في حقل العدوى الصناعية بالبياض الزغبي بسخا و قدر من التحليل المشترك صفة نسبة المقاومة (١٠٠%) لمرض البياض الزغبي. وقد تم التحليل الوراثي للقدرة علي الائتلاف للصفات المدروسة باستخدام تصميم (السلالة ×الكشاف) طبقا ل Kempthorne (1957). ويمكن تلخيص أهم النتائج فيما يلي:-

- كانت تباينات كل من السلالات والكشافات والتفاعل بينهما عالية المعنوية لجميع الصفات تحت الدراسة ما عدا تباينات الكشافات وتفاعل السلالات × الكشافات لكل من صفات عدد الصفوف بالكوز و المقاومة لمرض البياض الزغبي، وتباين تفاعل السلالات × الكشافات لصفة موقع الكوز.
- كان التباين الوراثي المضيف اكثر أهمية من التباين الوراثي غير المضيف في وراثة صفات ؛ تاريخ ظهور ٥٠% من النورات المؤنثة و موقع الكوز والمقاومة لمرض البياض الزغبي، بينما كان التباين الوراثي غير المضيف هو الأكثر أهمية في وراثة محصول الحبوب و طول الكوز وعدد الصفوف بالكوز.كذلك كان التباين الوراثي المضيف اكثر تأثرا بالبيئة بالنسبة للتباين الوراثي الغير المضيف لجميع الصفات المدروسة ما عدا كل من صفتي محصول الحبوب والمقاومة لمرض البياض الزغبي.
- كانت أفضل السلالات في القدرة العامة علي الائتلاف السلالة" سخا ٥١٧٠/ ٦ " لصفة تاريخ ظهور ٥٠% من النورات المؤنثة،و السلالة" سخا ٥١٧٠/١ " لموقع الكوز، والسلالة" سخا١٣٢/٢٣٤ " لصفة طول الكوز، والسلالة " سدس ١٠١١ " لصفة عدد صفوف الكوز و المقاومة لمرض البياض الزغبي ، و السلالة" سخا ٨١٤٠/٤ " لصفة محصول الحبوب. بينما اظهر الكشاف "هف مبشر سخا ١٧ " افضل قدرة علمة علي الائتلاف لجميع الصفات.و كانت افضل الهجن التي اظهرت قدرة خاصة مرغوبة علي الائتلاف جميزة ١٤٧ × هف سخا١٧ لصفة تاريخ ظهور ٥٠% من النورات المؤنثة ولطول الكوز ومحصول الحبوب، سخا ٨١٧٠/٤ × سدس ٦٣ لصفة عدد الصفوف بالكوز وجميزة ١٥٢ × هف سخا١٧ لصفة المقاومة لمرض البياض الزغبي.
- اظهرت الهجن الثلاثية " سخا٨١٧٠/٧ × هف سخا١٧ و سدس١٠٣١ × هف سخا١٧ " تفوقاً في محصول الحبوب والتبكير والمقاومة لمرض البياض الزغبي مقارنة بهجيني المقارنة" هف١٠ و هث٣٢٤ ". كذلك أظهرت الهجن الفردية "سخا٨١٧٠/٤ × سدس٦٣ وسدس ١٠١١ × سدس٦٣ "١٠٠% مقاومة لمرض البياض الزغبي تحت ظروف العدوى الصناعية. ومن محصلة نتائج هذه الدراسة يمكن استخدام هذه الهجن في برنامج التربية للمحصول العالي والمقاومة لمرض البياض الزغبي.