SELECTION NEW SINGLE CROSSES OF MAIZE FOR GRAIN YIELD AND RESISTANCE TO DOWNY MILDEW DISEASE UNDER DIFFERENT LOCATIONS AND POTASSIUM FERTILIZATION

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

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

ABSTRACT

New yellow 22 inbred lines of maize were crossed with two yellow inbred testers at Sakha Agriculture Research Station in 2006 season. The resulting single crosses and two checks, SC155 and SC162 were evaluated in 2007 season in two experiments: the first experiment at two locations for silking date, plant height and grain yield. While the second experiment was performed in disease nursery at Sakha ARS under artificial infection by downy mildew disease under two potassium levels, to estimate the resistance for this disease. The results indicated that the mean squares of locations and potassium levels, were significant for all traits. The mean percentage of resistance to downy mildew disease was higher under high potassium level. The mean squares due to lines, testers and lines x testers interaction were highly significant for all traits. The non-additive type of gene action was important in controlling the behavior of plant height and resistance to downy mildew disease. While, the additive type of gene action played the major contribution in the inheritance of silking date and grain yield. The highest inbred lines which had significantly desirable GCA effects were L-3 for siking date, L-14 for plant height, L-21 for grain yield and L-10 for resistance to downy mildew disease. The tester inbred line Sk7070 was the best GCA effect for all traits except plant height. Single crosses: L-21 x Sk7070 and L-22 x Sk7070 showed high yielding ability, earliness, suitable plant height and resistance to downy mildew disease from two commercial crosses SC155 and SC162. This study suggest the use of these crosses in Egypt, especially in the delta region to obtain high yielding potentially and resistance to downy mildew disease caused by late planting date and planting Sudangrass and sorghum beside maize.

INTRODUCTION

Among the various pathogens affecting maize (*Zea mays L.*) production and productivity worldwide, the downy mildews are considered to be highly important in terms of their geographical distribution and potential ability to cause significant yield reduction. The symptoms of sorghum downy mildew (*Peronosclerospora Sorghi*) are characterized in that leaves of infected plants are narrower and more erect than those of healthy plants, and diseased plants may have phylloddied tassels (Frederiksen *et al.*1973 a, b). They added that, symptoms of sorghum downy mildew may occur either systemic or localized form. The systemic form of the disease is caused by infection of seedlings by oospores of the fungus borne in the soil or by conidia soon after seeding emergence from the soil. The localized form of the disease is caused from foliar infection by conidia. The disease is most prevalent in warm and humid regions. In Egypt, sorghum downy mildew (SDM) disease caused by *P. sorghi* became a serious problem to maize planting in Egypt especially in delta region. The best way of controlling this disease is through developing genetically resistance maize hybrids. However natural disease resistance mechanisms can be enhanced by plant nutrients .Potassium deficiency symptoms such as thin cell walls, weakened stalks and stems, smaller and shorter roots, sugars accumulation in the leaves and accumulation of unused nitrogen (N) encourage disease infection. Yamada and Aday (1977a) reported that only nitrogen independently of phosphorus and potassium was effective for seedling to cause infection of Philippine downy mildew and susceptibility of a resistance material was hardly affected by the application of three elements, in any amount and in any combination. Mochizuki *et al.*(1974), Yamada and Aday (1977b), Kaneko and Aday (1980) concluded that resistance to downy mildew disease was controlled by dominant gene and level of domanince was in the range of partial to over dominance. Jinahyon (1973) concluded that the resistance to sorghum downy mildew was a quantitative character, indicating polygenic inheritance. Singburaudom and Renfro (1982) found that both additive and non-additive effects were present of inheritance of resistance to SDM.

Odvady *et al.* (1984) found that environmental factors such as soil moisture, temperature and soil PH affected the level of disease incidence when susceptible host plants were exposed to *Peronosclerospora sorghi.* El-Sharawi (1985) found that a relationship was found between dates of planting and infection with SDM. The highest infection occurred in the late planting (July to August.) in Egypt. Orangel and Borges (1987) revealed that both additive and non- additive gene effects were present. However, additive gene effects was more important in determining disease reaction. Significant maternal or cytoplasmic inheritance was involved in the reaction to *P. sorghi.* Gowda *et al.* (1989) tested large number of maize genotypes against sorghum downy mildew disease under artificial inoculations and classified them as following : highly resistant (disease incidence ranged from (0.0 to 5.0%), resistant 5.1-10.0%), moderately resistance (10.1-20%), moderately susceptible (20.1-30%), susceptible (30.1-50%) and highly susceptible (50.1-100%). El-Zeir *et al.* (1998) reported that, maize fertilization by high level of phosphorus (200 kg/feddan) was quite suitable for low level of SDM disease. El-Shenawy (1995), Amer *et al.* (2002), Nair *et al.* (2004) and El-Shenawy and Mosa (2005) found that the additive genetic component played an important role in the inheritance of the resistance to downy mildew disease caused by *P sorghi.* Nawar and El-Hosary (1984), Sedhom (1992), Ashish and Singh (2002) reported that non-additive gene effects was more important in the inheritance of grain yield. While, Amer and El-Shenawy (2007) and Mosa *et al.* (2007) found that the additive genetic variance played an important role in the inheritance of grain yield. The use of an inbred as tester was suggested by Russell and Eberhart (1975) and it has been widely used by breeders (Walejko and Russell 1977, Darrah 1985, Horner *et al.*1989). The objective of the present investigation were to provide information on the nature of inheritance of resistance to SDM disease and identify the superior maize genotypes in disease resistance and yield traits.

MATERIALS AND METHODS

Twenty-two yellow inbred lines were derived from the S_5 segregating generation of (10) different genetic sources by selfpollination, visual selection for plant and ear traits and pest resistance of the lines *per se* among and within ear to row progenies in breeding nursery at Sakha Agric. Res. Sta. were used for the present study starting from 2001 season. In 2006 growing season, the 22 inbred lines were crossed with two different inbred lines testers; Gm 1004 and Sk7070. The resulting top crosses and two commercial cross SC 155 and SC 162 were evaluated under two types of experiments as follows: First, yield experiments, were planted in the normal season (may)of 2007 at Sakha and Sids Agric. Res. Sta. A randomized complete block design (RCBD), with four replications was used at all locations. The plot size was one row, 6m long, 80 cm apart and 25 cm between hills. Two kernels were planted per hill then thinned to one plant per hill. All cultural practices were applied as recommended at the proper time. Recorded data on grain yield ardab/feddan (one ardab = 140 kg of grain and feddan = 4200 m^2) adjusted to 15.5% moisture content, silking date (number of days from planting to 50% of silk emergence and plant height (cm). Second, disease experiments, were planted in late season (July) of 2007 season in disease nursery under artificial infection by downy mildew disease at Sakha . Annually the filed was previously planted by Sudangrass as a source of infection,30 days prior to planting of test entries. Spreader rows (sudangrass) were alternatively planted with maize rows in a ratio of 1:3 respectively. Top crosses and the two checks were evaluated in a disease nursery in two experiments under two potassium rates 12 and 24 kg k_2o/fed. the Potassium fertilizer was applied at planting. RCBD with four replications was used, plot size was one row, 4m long, 80cm apart, 25cm between hills. Two kernels were planted per hill and left without thinning. All cultural practices were applied as recommended. Resistance % was taken after 40 days from maize planting. Statistical analysis was done according to Steel and Torrie (1980). Combining ability was computed according to line x tester analysis procedure of Singh and Chaudhary (1979).

RESULTS AND DISCUSSION

The combined analysis of variance for three traits over two locations are presented in Table 1. The mean square of locations

(Loc) was significant for silking date and highly significant for plant height and grain yield, indicating over all differences between two locations. Results in Table 3, exhibited that the mean values of three traits at Sakha location (north Egypt) were higher than means of Sids location (middle Egypt). Mosa (2004) and Habliza and Khalifa (2005) found that significant differences among north and middle Egypt locations for growth and yield traits. Highly significant differences among potassium levels are shown in Table 2, this indicates that resistance to downy mildew disease was affected by potassium fertilization. Results in Table 4, showed that the mean percentage of resistance to downy mildew disease at 24 kg k_2o/fed. was higher than 12 kg k_2o/fed. This indicates that the higher of potassium level increased the resistance to downy mildew disease. Chang and Wu (1970) found that seedlings grown under higher levels of N and K were significantly less infected by downy mildew than those grown under lower levels of them.

Table 1: Mean squares of line x tester analysis for three traits over two locations.

S.O.V	d.f	Silking date	Plant height	Grain yield
Locations(Loc)	1	85.130*	259595.31**	14683.2**
Rep/Loc	6	12.340	2086.740	53.240
Lines (L)	21	21.954**	849.552**	42.074**
Testers(T)	1	985.57**	2801.276**	1515.749**
LxT	21	5.559**	192.097**	20.441**
LxLoc	21	1.67	169.741*	22.416**
TxLoc	1	61.389**	3234.344**	425.609**
LxTxLoc	21	2.234	152.963*	9.326
Error	270†	1.660	88.040	6.550

*,** significant at 0.05 and 0.01 levels of probability, respectively.
† included checks

Results in Table 1 and 2, showed that the mean squares due to lines (L), testers (T) and (L x T) interaction were highly significant for all traits. This indicates that the inbred lines behaved significantly different in their respective top crosses. Also, greater diversity among the two testers for evaluation the inbred lines. While, significant (L x T) interaction, suggesting that inbred line might differently perform in top crosses depending on the type of tester used for these traits. These results are in agreement with conclusions reached by Ashish and Singh (2002), Dodiya *et al.* (2002) and Duarte *et al.* (2003). The mean squares due to (L x Loc), (T x Loc) and (L x T x Loc)interactions were significant or highly significant for all traits except for (L x Loc) for silking date and (L x T x Loc) for silking date and grain yield. While (L x K), (T x K) and (L x T x K) mean squares were not significant.

Table 2: Mean squares of line x tester analysis for resistance to downy mildew disease over two potassium levels.

S.O.V	d.f	Downy mildew resistance
potassium levels (K)	1	2891.45**
Rep/P	6	185.860
Lines (L)	21	857.137**
Testers(T)	1	1727.966**
LxT	21	366.430**
LxK	21	115.97
TxK	1	3.133
LxTxK	21	143.254
Error	270†	131.890

*,** significant at 0.05 and 0.01 levels of probability, respectively.
† included checks

Table 3:Means of three traits at Sakha and Sids locations.

Location	Silking date (days)	Plant height (cm)	Grain yield (ard/fed)
Sakha	64.64	280.37	32.15
Sids	63.68	227.27	19.53
combined	64.16	253.82	25.84

Table 4: Means of resistance to downy mildew disease at two levels of potassium fertilizer.

potassium level	Downy mildew resistance (%)
12 Kg K_2o/fed.	87.03
24 Kg K_2o/fed.	92.63
Combined	89.83

The estimates of the genetic variance components for three traits over locations and resistance to downy mildew disease over potassium levels are shown in Table 5. Results indicated that K^2 SCA was dominant and the important component for plant height and resistance to downy mildew disease. Consequently, the non-additive type of gene action was important in controlling the behavior of these traits. These results are in agreement with those obtained by Nawar and El-Hosary (1984) for plant height, Mosa (2004) for grain yield and Kaneko and Aday (1980) for resistance to downy mildew disease. While the K^2 GCA or the additive type of gene action played the major contribution in the inheritance of silking date and grain yield. These results support the finding of Mosa *et al.* (2007) for silking date and Motawei (2006) for grain yield. The magnitude of the interaction for σ^2 GCA x locations were markedly higher than those of σ^2 SCA x locations for all traits except resistance to downy mildew disease.

Table 5: Estimates of genetic variance components for three traits over locations and resistance to downy mildew disease over potassium levels.

Genetic component	Silking date	Plant height	Grain yield	Genetic component	Downy mildew resistance
K^2GCA	4.91	3.54	5.58	K^2GCA	12.84
K^2SCA	0.41	4.89	1.38	K^2SCA	27.89
σ^2GCAxLoc	0.62	33.62	4.57	σ^2 GCAxK	0.0
σ^2SCAxLoc	0.14	16.23	0.69	σ^2 SCAx K	2.84

Mean performance of inbreds in their single crosses and two checks for three traits over locations and resistance to downy mildew over potassium levels are shown in Table 6. Results exhibited that 16 single crosses were earlier than the better check for earliness SC155 (62.77 days). The best single crosses for earliness: L-4 x Sk7070, L-7 x Sk7070 and L-8 x Sk7070 of 60.5, 60.87 and 61.37 days, respectively. Meanwhile, 15 single crosses were shorter than the best check for short plant height SC155 (251.37cm), the best single crosses among them were, L-14 x Gm1004, L-18 x Gm1004 and L-22 x Gm1004 of 234.5, 235.75 and 238.75cm, respectively. Two single crosses: L-21 x Sk7070 (30.30 ard/fed) and L-22 x Sk7070 (32.66 ard/fed) were higher compared to the best check for grain yield SC162 which gave (30.2

ard/fed). For resistance to downy mildew disease, 17 single crosses were higher than the best check for resistance SC162 (95.17%). The best crosses among them were L-6 x Gm1004, L-7 x Gm1004, L-16 x Gm1004, L-10 x Sk7070, L-11 x Sk7070 and L-22 x Sk7070 of 97.56, 98.38, 97.18, 98.95, 96.91 and 96.87%, respectively. Generally, two single crosses L-21 x Sk7070 and L-22 x Sk7070 showed high yielding ability, earliness, suitable plant height and resistance to downy mildew disease better than the two commercial crosses SC155 and SC162. This study suggests the use of these crosses in Egypt, especially the delta region to obtain high yielding potentially and resistance to downy mildew disease caused by late planting date (July) and planting sudangrass beside maize.

Table 6: Mean performance of inbreds in their single crosses and two checks for three traits over locations and resistance to downy mildew over two potassium levels.

Inbred line	Silking date (days)		Plant height (cm)		Grain yield (ard/fed)		Downy mildew resistance (%)	
	Gm1004	Sk7070	Gm1004	Sk7070	Gm1004	Sk7070	Gm1004	Sk7070
L-1	67.75	63.25	254.50	265.00	19.94	27.37	95.98	92.07
L-2	68.25	62.50	252.37	257.87	21.95	27.55	93.72	94.42
L-3	62.12	61.87	254.62	261.37	25.32	26.66	92.58	87.92
L-4	65.12	60.50	248.12	252.62	23.93	27.01	95.90	95.65
L-5	66.87	64.12	244.37	249.37	24.66	27.72	91.41	95.52
L-6	66.25	63.50	256.12	258.12	24.75	28.60	97.56	91.72
L-7	63.37	60.87	247.37	253.62	21.02	25.72	98.39	90.56
L-8	64.75	61.37	251.50	256.87	23.63	26.63	95.55	92.85
L-9	66.75	62.50	271.12	264.87	20.91	27.00	94.14	95.64
L-10	66.87	62.12	259.62	253.62	24.32	28.43	96.24	98.95
L-11	64.12	61.62	246.25	259.75	23.14	28.73	93.15	96.91
L-12	65.75	62.75	254.00	258.75	25.85	27.53	92.82	90.73
L-13	65.37	62.00	245.12	243.75	20.04	24.60	83.10	95.25
L-14	65.25	61.50	234.50	245.87	23.65	28.74	90.97	92.04
L-15	67.50	65.25	265.00	263.62	23.48	27.97	92.77	86.59
L-16	67.62	63.37	254.25	264.00	26.51	26.90	97.18	95.29
L-17	66.50	62.87	239.62	251.50	26.29	26.85	96.16	95.86
L-18	65.62	61.75	235.75	249.12	20.92	28.57	86.27	94.61
L-19	65.12	62.25	248.00	254.12	23.07	29.34	63.35	79.63
L-20	66.62	63.00	262.87	267.37	23.57	27.15	59.32	84.09
L-21	66.00	62.62	254.37	250.00	29.09	30.30	86.16	90.00
L-22	64.12	62.50	238.75	261.12	24.53	32.66	72.60	96.87
SC155	62.77		251.37		26.10		68.73	
SC162	67.0		263.50		30.20		95.17	
$LSD_{0.05}$	1.26		9.19		2.5		11.25	

Estimates of general combining ability effects for inbred lines for three traits over locations and resistance to downy mildew disease over potassium levels are presented in Table 7. The best inbred lines for general combining ability effects (GCA) were L-3, L-4, L-7, L-8, L-11, L-14 and L-22 for silking date, L-5, L-13, L-14, L-17 and L-18 for plant height, L-21 and L-22 for grain yield and L-4, L-10, L-16 and L-17 for resistance to downy mildew disease. These inbreds could be utilized in making hybrids that had high yielding ability, earliness, suitable plant height and resistance to downy mildew disease.

Table 7: Estimates of general combining ability effects for inbred lines for three traits over locations and resistance to downy mildew disease over potassium levels.

Inbred line	Silking date	Plant height	Grain yield	Downy mildew resistance
L-1	1.366*	6.099*	-2.086*	3.841
L-2	1.241*	1.474	-0.989	3.885
L-3	-2.133*	4.349	0.251	0.062
L-4	-1.321*	-3.275	-0.269	5.6*
L-5	1.366*	-6.775*	0.452	3.279
L-6	0.741*	3.474	0.933	4.452
L-7	-2.008*	-3.150	-2.364*	-10.709*
L-8	-1.071*	0.536	-0.611	4.017
L-9	0.491	14.349*	-1.783*	4.708
L-10	0.366	2.974	0.635	7.410*
L-11	-1.258*	-0.650	0.197	4.845
L-12	0.116	2.724	0.953	1.588
L-13	-0.446	-9.213*	-3.414*	-1.013
L-14	-0.758*	-13.463*	0.456	1.317
L-15	2.241*	10.661*	-0.009	-0.501
L-16	1.366*	5.474*	0.967	6.048*
L-17	0.554	-8.088*	0.835	5.825*
L-18	-0.446	-11.213*	-0.993	0.256
L-19	-0.446	-2.588	0.463	-18.696*
L-20	0.679*	11.474*	-0.377	-18.476*
L-21	0.179	-1.463	3.896*	-2.278
L-22	-0.821*	-3.713	2.870*	-5.449
-	-	-	-	-
LSDgi0.05	0.64	4.59	1.25	5.60

On the other hand, the results in Table 8, exhibited that the tester inbred line Sk7070 was the best general combiner for all traits except plant height. The inbred line as good tester was noticed by several investigator among them Russell and Eberhart (1975), Darrah (1985), Liakat and Teparo (1986) and Al-Naggar *et al.* (1997).

Table 8: Estimates of general combining ability effects for two testers for three traits over locations and resistance to downy mildew disease over potassium levels.

Tester	Silking date	Plant height	Grain yield	Downy mildew resistance
Gm1004	1.673*	-2.821*	-2.215*	-2.075*
Sk7070	-1.673*	2.821*	2.215*	2.075*
LSD $^{g}_{t}$ 0.05	0.19	1.38	0.37	1.69

Estimates of specific combining ability effects for top crosses for three traits over locations and resistance to downy mildew disease over potassium levels are presented in Table 9. The significantly desirable SCA effects were obtained for L-3 x Gm1004, L-22 x Gm1004 and L-2 x Sk7070 for silking date, L-22 x Gm1004 for plant height, L-16 x Gm1004, L-17 x Gm1004, L-18 x Sk7070 and L-22 x 7070 for grain yield and L-7 x Sk7070, L-20 x Sk7070 and L-22 x Sk7070 for resistance to downy mildew disease. Such crosses could be utilized in maize breeding programs for different purposes as earliness with high yielding ability and resistance to downy mildew disease.

Table 9: Estimates of specific combining ability effects for top crosses for three traits over locations and resistance to downy mildew disease over potassium levels.

Inbred line	Silking date		Plant height		Grain yield		Downy mildew resistance	
	Gm1004	Sk7070	Gm1004	Sk7070	Gm1004	Sk7070	Gm1004	Sk7070
L-1	0.576	-0.576	-2.428	2.428	-1.640	1.640	4.172	-4.172
L-2	1.201*	-1.201*	0.071	-0.071	-0.726	0.726	1.868	-1.868
L-3	-1.548*	1.548*	-0.553	0.553	1.408	-1.408	4.544	-4.544
L-4	0.639	-0.639	0.571	-0.571	0.537	-0.537	2.343	-2.343
L-5	-0.298	0.298	0.321	-0.321	0.545	-0.545	0.164	-0.164
L-6	-0.298	0.298	1.821	-1.821	0.152	-0.152	5.136	-5.136
L-7	-0.423	0.423	-0.303	0.303	-0.274	0.274	-8.868*	8.868*
L-8	0.014	-0.014	0.133	-0.133	0.575	-0.575	3.566	-3.566
L-9	0.451	-0.451	5.946	-5.946	-0.972	0.972	1.466	-1.466
L-10	0.701	-0.701	5.821	-5.821	0.022	-0.022	0.857	-0.857
L-11	-0.423	0.423	-3.928	3.928	-0.717	0.717	0.339	-0.339
L-12	-0.173	0.173	0.446	-0.446	1.236	-1.236	3.257	-3.257
L-13	0.014	-0.014	3.508	-3.508	-0.204	0.204	-3.860	3.860
L-14	0.201	-0.201	-2.866	2.866	-0.465	0.465	1.679	-1.679
L-15	-0.548	0.548	3.508	-3.508	-0.169	0.169	5.306	-5.306
L-16	0.451	-0.451	-2.053	2.053	1.878*	-1.878*	3.157	-3.157
L-17	0.139	-0.139	-3.116	3.116	1.793*	-1.793*	2.370	-2.370
L-18	0.264	-0.264	-3.866	3.866	-1.751*	1.751*	-1.956	1.956
L-19	-0.235	0.235	-0.241	0.241	-1.060	1.060	-5.927	5.927
L-20	0.139	-0.139	0.571	-0.571	0.283	-0.283	-10.170*	10.170*
L-21	0.014	-0.014	5.008	-5.008	1.535	-1.535	0.470	-0.470
L-22	-0.860*	0.860*	-8.366*	8.366*	-1.987*	1.987*	-9.920*	9.920*
LSD S_{it} 0.05	0.86		6.50		1.75		7.95	

REFERENCES

Al-Naggar, A.M.; H.Y. El-Sherbieny and A.A. Mahmoud (1997). Effectiveness of inbred, single crosses and population as tester for combining ability in maize. Egypt J. plant breed., 1:35-46.

Amer E. A. and A. A. El-Shenawy (2007). Combining ability for new twenty one yellow maize inbred lines. J. Agric. Sci. Mansoura Univ. 32:7053-7062.

Amer, E.A.; H.E. Mosa and A.A. Motawei (2002). Genetic analysis for grain yield, downy mildew, late wilt and kernel rot disease on maize. J. Agric. Sci. Mansoura Univ. 27: 1965-1974.

Ashish, S. and I.S. Singh (2002). Evaluation and classification of exotic inbreds over locations based on line x tester analysis in maize (*Zea mays L.*). Crop Improvement, 29:184-189.

Chang, S.C. and Y.Z. Wu (1970). The influence of fertilization and irrigation on the incidence of downy mildew (*Sclerospora sacchari*) of corn. Proc. VII. Inter-Asian corn Improv. Works, 95-100.

Darrah, L.L. (1985). Evaluation of population improvement in the Kenya maize breeding methods study. P. 160-175. In to feed ourselves. Proc. First Eastern, central and southern Africa regional workshop-lusaka, Zambia. CIMMYT, Mexico, D.F.

Dodiya, N.S. and V.N. Joshi (2002). Gene action for grain yield and its attributes in maize (*Zea mays L.*). Indian J. of genetic and plant breed. 62:253-254.

Duarte, I.A.; J.M. Ferreira and C.N. Nuss (2003). Screening potential of three maize top cross testers. Pesquisa Agropecuaria Brasileira, 38:365-372.

El-Sharawi, M.M. (1985). Studies on sorghum downy mildew on corn as a new disease in Egypt. Ph.D. Thesis, Fac. of Agric., Tanta Univ., Egypt.

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

El-Shenawy, A.A. and H.E. Mosa(2005). Evaluation of new single and three way maize crosses for resistance to downy mildew disease and grain yield under different envirnments. Alex. J. Agric. Res. 50:35-43.

El-Zeir, F.A.A.; S.A.E. Tolba and E.A. Amer (1998). Additional sources of maize resistant to downy mildew *Peronosclerospora sorghi* and effect of phosphorus fertilizer and disease severity. J. Agric. Res. Tanta Univ. 24:1-9.

Frederiksen, R.A.; A.J.Bockholt and A.J.Ullstrup (1973 a). Reaction of selected corn inbreds to *Peronosclerospora sorghi*. II-plant Dis. Reltr. 57:42-43.

Frederiksen, R.A.; A.J. Bockholt; L.E. Clark; J.W. Cosper; J. Craig; J.W. Johnson; B.L. Jones; P. Matocha; F.R. Miller; L. Reyes; D.T. Rosenow; O. Tuleen and H.J. Walker (1973b). Sorghum downy mildew a disease of maize and sorghum.

Thexas A&M Univ. Stn. Res. Monog. 2:32 P., Collage St., Texas, USA.

Gowda, K.T.P.; B.J. Gowda and S. Rajasekh (1989). Resistance to downy mildew in medium maturity maize genotypes. Current Res. Univ. of Agric. Sci. Bangalore 18:16-18.

Habliza, A.A. and K.I. Khalifa (2005). Selection among new yellow maize inbred lines using top cross and stability analysis. Alex. J. Agric. Res. 50:41-51.

Horner, E.S.; E. Magloire and J.A. Morera (1989). Comparison of selection for S_2 progeny Vs. testcross performance for population improvement in maize. Crop Sci. 29:868-874.

Jinahyon, S. (1973). The genetics of resistance and its implication to breeding for resistance in corn. Proc. Inter-Asian corn Improv. Works 9:30-39.

Kaneko, K. and B. A. Aday (1980). Inheritance of resistance to Philippine downy mildew of maize, *peronosclercspora philippinensis*. Crop. Sci. 20: 590-594.

Liakat, m.A. and N.M. Teparo (1986). Comparative performance of four types of testers for evaluating corn inbred lines from two populations. Philippine. J. Crop Sci. 4:175-179.

Mochizuki, N; V.R. Carangal and B.A. Aday (1974). Diallel analysis of host resistance to Philippine downy mildew of maize caused by *sclerospora philippinensis*. Japan Agric. Res. 8: 185 - 187.

Mosa, H.E. (2004). Comparison between two types of testers for evaluating new white inbred lines of maize. Annals of Agric. Sci. Moshtohor, 42:475-487.

Mosa, H.E. ; E.A. Amer and M.A. El-Ghonemy(2007). White maize inbred lines selection through line x tester analysis. J. Agric. Sci. Mansoura Univ. 32:7089-7097.

Motawei, A.A. (2006). Additive and non-additive genetics variances of important quantitive traits in new maize inbred lines via line x tester analysis. J. Agric. Sci. Mansoura Univ. 31:6855-6865.

Nair, S.K.; B.M. Prasanna; R.S. Rathore; T.A.S. Setty; R. Kumar and N.N. Singh (2004). Genetic analysis of resistance to sorghum downy mildew and rajasthan downy mildew in maize (*Zea mays L.*) Field Crops Res. 89:379-387.

Nawar, A.A. and A.A. El-Hosary (1984). Evaluation of eleven testers of different genetic sources of corn J. Genet. Cytol. 13:227-237.

Odvady, G.N.; R.N. Frederiksen and J. Graig (1984). The integrated control of downy mildew. Proc.38th Annu. Corn sorghum Res. Conf. 38:28-36.

Orangel, L. and F. Borges (1987). Diallel analysis of maize resistance to sorghum downy mildew. Crop Sci. 27:178-180.

Russell, W.A. and S. A. Eberhart (1975). Hybrid performance of selected maize lines from reciprocal recurrent selection and testcross selection programs. Crop Sci. 15:1-4.

Sedhom, S.A. (1992). Development and evaluation of some new inbred lines of maize. Proc. 5th Conf. Agron. Zagazig, 13-15 Sept (1):269-280.

Singburaudom, N. and B.L. Renfro (1982). Heritability of resistance in maize to sorghum downy mildew (*Peronosclerospora sorghi)* (Weston and Uppal) C.G. Show Crop Prot. 1:323-332.

Singh, R. K. and D. B. Chaudhary (1979). Biometrical methods in quantitative genetic analysis. Kalyani publisher, Baharate Ram Road, Daryagani, New Delhi, India..

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.

Walejko, R.N. and W.A. Russell (1977). Evaluation of recurrent selection for specific combining ability in two open-pollinated maize cultivars. Crop Sci. 17:647-651.

Yamada, M. and B.A. Aday (1977a). Fertilizer conditions affecting susceptibility to downy mildew disease, *Sclerospora philippinensis* Weston, in resistant and susceptible materials of maize. Ann. Phytopath. Soc. Japan 43:291-293.

Yamada, M. and B.A. Aday (1977b). Usefulness of local varieties for developing resistant varieties to Philippine downy mildew disease. Maize Gen. Coop. News Lett., 51: 68 - 70.

الملخص العربي

انتخاب هجن فردية جديدة من الذرة الشامية لأجل المحصول العالي والمقاومة لمرض البياض الزغبى تحت مواقع مختلفة والتسميد البوتاسى

حاتم الحمادى موسى - عاصم عبده مطاوع - عباس عبد الحى الشناوى

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

تم تهجين ٢٢ سلاله من الذرة الشامية الصفراء مع اثنين من السلالات ككشافات وذلك خلال موسم نمو ٢٠٠٦ بمحطة البحوث الزراعية بسخا. فـي موسم ٢٠٠٧ قيمت الهجن الناتجة مع اثنين من الهجن التجاريـة هـ.ف١٥٥ و هـ.ف ١٦٢ في تجربتين مستقلتين. الأولى في موقعين لـصفات عـدد الأيـام لظهور حرائر ٥٠% من النورات المؤنثة وارتفاع النبات ومحصول الحبـوب والثانية في حقل العدوى الصناعية بالبياض الزغبى بسخا تحت مـستويين مـن التسميد البوتاسى لتقدير نسبة المقاومة لمرض البياض الزغبى.

كانت الاختلافات بين المواقع وكذلك بين مستويات التسميد البوتاسـى معنوية لكل الصفات. وتبين ارتفاع نسبة المقاومة لمرض البياض الزغبى تحت مستوى التسميد البوتاسى العالي. كان تباين كـل مـن الـسلالات والكـشافات وتفاعلهما عالي المعنوية لكل الصفات . تبين ان الفعل الوراثي الغير مـضيف أكثر أهمية في التحكم في وراثة صفات ارتفـاع النبـات والمقاومـة لمـرض البياض الزغبى بينما الفعل الوراثى المضيف له الدور الرئيسي في وراثة صفة تاريخ ظهور حرائر ٥٠% من النورات المؤنثة وصفة محصول الحبوب. تبين ان أفضل سلالة في القدرة العامة على الائتلاف كانت سلالة ٣ لـصفة تـاريخ ظهور حرائر ٥٠% من النورات المؤنثة وسلالة ١٤ لـصفة ارتفـاع النبـات والسلالة٢١ لصفة محصول الحبوب والسلالة ١٠ لـصفة المقاومـة لمـرض البياض الزغبى. أظهرت السلالة الكشاف سخا٧٠٧٠ أفضل قدرة عامة علـى الائتلاف لجميع الصفات ماعدا صفة ارتفاع النبات كـذلك. أظهـرت الهجـن الفردية التالية: سلالة ٢١ × السلالة الكشاف سخا ٧٠٧٠ والسلالة٢٢ × السلالة الكشاف سخا٧٠٧٠ تفوقا في صفة المحصول والتبكير وارتفاع النبات المناسب والمقاومة لمرض البياض الزغبى بالمقارنة بـالهجن التجاريـة ١٥٥ و١٦٢. ولذلك توصى الدراسة باستخدام هذه الهجن في مصر خاصة في منطقة الـدلتا لقدرتها المحصولية العالية ومقاومتها لمرض البياض الزغبى عند الزراعة فـي العروات المتأخرة أو بجانب الذرة السكرية أو السورجم.