Annals of Agric. Sci., Moshtohor **ISSN 1110-0419**
Vol. 60(4) (2022), 1009 – 1018 **https://assjm.journals.ekb.eg**

Evaluation of Combining Ability for Some New Yellow Maize Inbred Lines Using Line X Tester Model

Badr A. R., S. A. Sedhom, M.EL.M. EL-Badawy, and A.A.A. EL-Hosary
Department of Agronomy, Faculty of Agriculture, Benha University, Egypt.
Corresponding Author: S.A. Sedhom, Faculty of Agriculture, Benha University, Egypt.
E-mail: Sedhom.mansour@fagr.bu.edu.eg. **https://orcid.org/0000-0002-5394-1184**

Abstract

This investigation was carried out to study the combining ability effects of 13 parents of maize (10 inbred lines and 3 testers) crossed in line x tester scheme for earliness and yield characteristics. The trial included the 13 parents, 30 top crosses, along with the check hybrids SC 168. The experiment was conducted at two planting dates on 24 May and 14 June 2021 at the Agric. Res. and Experimental Station of the Fac. of Agric., Moshtohor Benha University. The experimental design was randomized complete blocks with three replications. Mean squares due to crosses (C) inbred lines (L), testers (T) and line x tester (LxT) were significant for most studied traits of both sowing dates as well as for the combined analysis. Significance of interaction variance for C, L, T and LxT with sowing dates for the most studied traits was detected. δ^2_{SCA} played the major role in determining the inheritance of all traits, revealing that the largest part of the total genetic variability associated with these traits was a result of non- additive gene action. The magnitude of the interaction of δ^2 SCA x sowing date (SD) was generally higher than for δ^2 GCA x SD. This finding indicates that non-additive type of gene action is more affected by SD than additive and additive x additive types of gene action. The cross L3xT10 was the earlier hybrid since it expressed the lowest values for days to 50% pollen shed (59.58), days to 50% silking (60.5) and days to maturity (91.33). The top crosses L4xT2, and L7xT1 in early sowing date, L1xT1, L2xT1, L3xT1, L2xT2, , L1xT3, , L2xT2, , L3xT1, , L3xT2, , L3xT3, , L5xT1, , L5xT2, , L6xT1, L6xT3, L7xT1, L8xT1, L9xT3 and L10xT2 in late sowing date and L3xT1, L4xT2, L7xT1, and L10xT2 in the combined across sowing date differed significantly from the check SC 168.
.

Key words: Combining ability, Inbred lines, GCA and SCA, Maize, Testers.

Introduction

The main goal of most maize breeding programs is to develop promising high yielding crosses for commercial use. Maize breeders are constantly searching for elite inbred lines with great general and specific combining ability effects to utilize as parents for new promising hybrids. Line x tester scheme is used to assess general (GCA) and specific (SCA) combining ability for inbred lines.

The problem of the type and quantity of testers to be utilized in the line x tester model for assessing inbred lines is still open. The most popular approach for conducting evaluations is the top cross (test cross) method, which employs broad and narrow base testers. The selection of an appropriate tester is crucial in this regard. Matzinger (1953) demonstrated that a heterogeneous genetic basis tester does not contribute as much to line x tester interaction as a limited genetic base tester. Early testing was proposed by Davis (1927), Jinkins (1935), Sprague (1939) and Sedhom et al (2021) and is strongly influenced by the type and quantity of testers required for an effective evaluation of inbred lines. The total combining ability effects of the lines were originally divided into general (GCA) and specific (SCA) combining ability by Sprague and Tatum (1942) and Sedhom et al (2021). The ideal tester should gather as much data as possible while assessing the combining potential of inbred lines. Creating breeding strategies requires careful consideration of the two key genetic characteristics, SCA and GCA. Additionally, the size of the genetic contributions to a particular characteristic will primarily depend on the environmental changes under which the breeding populations will be evaluated. Consequently, corn breeders have invested a lot of time and energy in estimating the interactions between genetic elements and environments. The main goal of this investigation is to determine GCA and SCA as well as the type of gene action involved in the manifestation of earliness, grain yield and its components traits.

Materials and Methods

The current experiment was conducted at the Experiment and Research Station of Moshtohor, Benha University, Kalubia Governorate, Egypt, throughout the course of two succeeding seasons of 2020 and 2021. Thirteen new inbred lines of yellow maize were classified into ten female lines i.e. M 201 (L1), M 402-2 (L2), M 251-b (L3), M 411 (L4), M 415-r (L5), M 261 (L6), M 237 (L7), M 455 (L8), M 230-w (L9), and M 481-r (L10) and three male testers i.e. M 204 (T1), M 440 (T2) and M 206-w (T3).

Top crosses were created from the crossing between lines and testers planted in several dates to get around the different flowering times and to ensure there were enough hybrid seeds. The aforementioned inbred lines were sown on June 1, 8, and 15. Then, the line x tester scheme was applied to produce 30 single crosses in the first summer season. Two neighboring trials were carried out in the second summer on the sowing dates of 24 May and 14 June 2021.Each experiment, included 13 inbred lines (10 inbred lines and 3 testers) and 30 top crosses, along with check hybrid SC168. Three replications of a randomized complete blocks design were used for the experiment. One ridge measuring 10 meters long and 70 cm wide made up each plot. Two kernels per hill were planted and eventually culled down to one plant per hill, with each hill being set 25 cm apart. The plots had their first irrigation shortly after being sown, and their second irrigation followed 21 days later. After then, the plants were watered at intervals of 10 to 15 days. The plots received informal fertilization prior to planting at a rate of 120 kg of nitrogen per feddan (1 feddan equals 4200 m2) before the first and second irrigations. The other cultural customs around maize cultivation were carried out properly.

Data for the following traits were recorded on 10 individual guarded plants chosen at random from each plot, except for days to 50% pollen-shed, silking and maturity where the plants within plot was used. Also, data included, No. of kernels row^{-1}, No. of rows ear^{-1}, 100-kernel weight (g) and grain yield plant^{-1} (g).

Analysis of variance was performed for each sowing date then the combined data across sowing dates was performed after test of mean of squares for errors homogeneity according to Steel and Torrie (1980). General and specific combining abilities of line x tester were analyzed according to Kempthorne (1957).

Results and Discussion

Table (1) shows mean squares (MS) for genotypes, parents, crosses and their subdivision into lines (L), testers (T) and line x tester (LxT). All mention mean squares were significant for all studied traits in both and across sowing dates except days to 50% pollen shed in the first sowing date and days to maturity in both and across sowing dates, revealing a great diversity among testers and inbred lines. At the same time, mean squares of testers x inbred lines interaction were significant at both planting dates and the combined analysis for all studied traits. Also, the significant effect of LxT is an indication to the predominance of dominance gene action in controlling most of the measured traits at both planting dates and the weak effects of additive gene action. Mean squares due to sowing date were significant for all studied traits, indicating a variation between two sowing dates.

Early sowing date was higher mean values than those of late one in all traits. These features may have increased at early planting dates as a result of the more favourable weather conditions, long of day, and increased vegetative growth of maize plants. These results are in agreement with those obtained by Hani et al (2006), Hefny and Aly (2008), Ngaboyisonga et al (2009), Tamilarasi and Vetriventhan (2009), EL-Badawy et al (2010) Abd El-Aal (2012), El-Hosary and El-Gammaal (2013), El-Hosary, (2014), Bayoumi et al. (2018), El Hosary et al. (2018), El Hosary (2020) and Sedhom et al (2021)

Table 1. Mean squares from ordinary analysis of variance and combining ability for the studied traits.

S.O.V	df	Days to 50% shed	Days to 50% silk	Days to 50% maturity	number of kernels/ row	number of rows/ ear	100-kernels weight	grain yield / plant
				first planting date				
Rep	2	0.16	3.62**	0.48	0.94	0.06	1.24	4.02
Genotype (G)	42	15.78**	12.71**	6.44**	121.35**	4.8**	71.05**	6748.52**
Parent (P)	12	12.63**	9.3**	11.52**	120.16**	6.06**	60.09**	4858.25**
Crosses (c)	29	0.79**	0.93**	4.36**	6.19**	1.63**	16.98**	470.08**
P vs C	1	488.21**	395.2**	5.99*	3475.2**	81.52**	1770.54**	211506.71**
Lines (L)	9	0.82*	0.9**	7.46**	6.66*	1.88**	22.4**	611.28**
Testers (T)	2	0.36	1.39*	0.7	5.08 *	10.62**	34.41**	126.53**
Line x Tester	18	0.82**	0.89**	3.21**	6.08*	0.5*	12.34**	437.65**
Error	84	0.31	0.34	1.42	3.15	0.25	1.05	9.43
δ2 gca		-0.001	0.001	0.021	0.002	0.021	0.087	0.606
δ2 sca		0.17	0.17	0.17	0.170	0.170	0.170	0.170

second planting date								
REP.	2	0.03	1.22	4.14*	2.06	0.71	0.13	29.09
Genotype (G)	42	19.4**	17.5**	4.72**	125.61**	4.69**	48.38**	4533.58**
Parent (P)	12	12.79**	10.89**	8.98**	111.11**	4.25**	28.32**	4068.08**
Crosses (c)	29	3.97**	3.21**	3.11**	8.61**	1.67**	25.46**	576.98**
P vs C	1	546.08**	511.23**	0.01	3692.81**	97.26**	953.89**	124860.73**
Lines (L)	9	3.19**	3.13**	2.17*	12.09**	2.57**	21.95**	577.82**
Testers (T)	2	2.87**	3.86**	0.09	4.89 *	6.84**	32.04**	1093.21**
Line x Tester	18	4.48**	3.18**	3.93**	7.28*	0.65	26.49**	519.21**
Error	84	0.46	0.61	1.2	3.54	0.43	2.07	12.26
δ2 gca		-0.01	0.001	-0.015	0.025	0.019	-0.019	1.080
δ2 sca		1.342	0.854	0.91	1.246	0.074	8.139	168.982
Combined across sowing dates								
Sowing dates (S)	1	1433.98474**	1343.51381**	1480.32558**	274.24806**	18.12335**	1090.81492**	36388.80031**
REPS with S	4	0.1	2.42**	2.31	1.5	0.39	0.69	16.56
Genotype (G)	42	33.6**	28.57**	7.7**	245.07**	8.95**	109.16**	10693.28**
Parent (P)	12	24.24**	19.13**	13.22**	227.87**	9.19**	83.42**	8785.97**
Crosses (c)	29	2.99**	2.33**	5.59**	13.52**	3.01**	31.79**	448.08**
P vs C	1	1033.48**	902.71**	2.81	7166.35**	178.43**	2661.79**	330691.82**
Lines (L)	9	3.07**	3.49**	6.04**	17.63**	4.09**	34.28**	198.89**
Testers (T)	2	1.93**	4.3**	0.6	9.86*	17.19**	58.51**	481.11**
Line x Tester	18	3.07**	1.53**	5.92**	11.87**	0.9**	27.57**	569.01**
S X G	42	1.58**	1.64**	3.46**	1.89	0.53*	10.28**	588.82**
S X C	29	1.77**	1.81**	1.88	1.28	0.29	10.66**	598.98**
S X L	9	0.93*	0.54	3.59**	1.12	0.36	10.07**	990.21**
S X T	2	1.3*	0.94	0.18	0.11	0.28	7.94**	738.63**
S X L x T	18	2.24**	2.54**	1.21	1.49	0.25	11.26**	387.84**
S X P	12	1.18**	1.06*	7.29**	3.39	1.12**	4.99**	140.36**
S X PvsC	1	0.81	3.73**	3.18	1.65	0.35	62.64**	5675.62**
Error	168	0.39	0.48	1.31	3.35	0.34	1.56	10.84
δ2 gca		-0.029	0.121	-0.134	0.096	0.499	0.966	-11.744
δ2 sca		0.447	0.176	0.77	1.420	0.094	4.334	93.027
δ2 gca xs		0.21	0.124	0.321	0.142	0.125	0.147	0.190
δ2 sca xs		2.105	3.081	2.151	1.553	3.213	1.254	4.582

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

The large interaction effect with sowing date (SD) suggests that lines and testers rank differently to sowing dates. The current findings support Kang's earlier theory from 1998 that the environment has a significant impact on the phenotypic manifestation of agronomic features. Bello and Olaoye (2009) hypothesized that climatic variation—including variations in rainfall, sunshine, relative humidity, and other variables—could play a significant role in breeding for desirable qualities like grain output. Early maturity in maize is advantageous for avoiding the damaging effects of Pyrausta nubilalis, Chilo simplex, and Sesamia cretica. Similar results were reported by El-Hosary and El-Badawy (2005), El-Hosary et al (2006), El-Hosary and El-Gammaal (2013), El-Hosary, (2014), Bayoumi et al. (2018), El Hosary et al. (2018), El Hosary (2020) and Sedhom et al (2021)

The estimates of variances resulting from GCA, SCA, and their interactions with sowing dates (Table 1) revealed that δ^2 SCA played the major part in determining the inheritance of all studied traits, revealing that the majority of the total genetic variability associated with these traits was the result of non-additive gene action. The findings of El-Hosary (1985), Sofi and Rather (2006), and Basbag et al. (2007), who stated that δ^2 SCA was crucial in the inheritance of grain yield plant^{-1} and other agronomic variables, are supported by these results for the majority of examined traits. In general, the interactions between δ^2SCA and sowing date (S) had larger magnitudes than those between δ^2GCA and S. This study suggests that the sowing date has a greater impact on non-additive types of gene activation. This is in agreement with the findings of several investigators who reported that δ^2_{SCA} is more sensitive to environmental changes than δ^2_{GCA} (Gilbert 1958, El-Badawy 2013 and Sedhom et al (2021).

Means of the parent inbred lines, testers and 30 top crosses, as well as SC 168 in the combined analysis for all studied traits are showed in Table 2.

Regarding, earliness traits, most studied top crosses showed significant lower values or insignificant differences comparing with SC168 for the three measured traits at the combined across sowing dates. Furthermore, the cross L3xT10 exhibited the earlier hybrid as this cross give the lowest values for days to 50% pollen shed (59.58), days to 50% silking (60.5) and days to maturity (91.33).

For No. of kernels row^{-1}, the tester 3 twelve crosses had significantly the highest mean value and differ significantly from SC 168. The top cross L9xT3 gave the highest number of kernels row^{-1}(36.14).

With regard to No of rows ear^{-1}, six crosses (L2xT3, L3xT3, L5xT2, L5xT3, L6xT2 and L6xT3) had higher values and superior over check hybrid SC 168.

For 100-kernel weight, the tester no 3 and the top crosses L2xT1, L3xT2, L3xT3, L5xT2, L7xT1, L8xT1, L9xT3 and L10xT2 showed significantly differ from the check hybrid SC 168.

For grain yield plant^{-1}, the top crosses L4xT2, and L7xT1 in early sowing date, L1xT1, L2xT1, L3xT1, L2xT2, , L1xT3, , L2xT2, , L3xT1, , L3xT2, , L3xT3, , L5xT1, , L5xT2, , L6xT1, L6xT3, L7xT1, L8xT1, L9xT3 and L10xT2 in late sowing date and L3xT1, L4xT2, L7xT1, and L10xT2 in the combined across sowing date had significantly differ from SC 168

General combining ability effects for parents across sowing dates are presented in Table (3). There is no specific line recorded a desirable ($\hat{g}_i$) effects for all traits. Significant and desirable negative ($\hat{g}_i$) effects were obtained by L1 days to 50% pollen shed, silking and maturity and L3 for days to 50% silking. Furthermore, positive and desirable ($\hat{g}_i$) effects were obtained by L3, L5 and L6 for no of kernels/ row, L1 and L2 for no of rows/ ear, L3 and L9 for 100-kernel weight and L3, L4, L5 and L10 for grain yield/ plant.

As expected, the tester no 1 (T1) gave highly significant desirable ($\hat{g}_i$) effects for 100-kernel weight and grain yield/ plant. This observation further confirms the previous findings and experience of many maize breeders. T3 were the best general combiners for days to 50% pollen shed, days to 50% silk, and no of kernels/ row.

It is worth noting that the inbred line which possess high ($\hat{g}_i$) effects for grain yield plant $^{-1}$ might also be so in one or more of the yield contributing traits.

The superiority of inbred lines as good testers was noticed by several investigators Al-Naggar et al (1997), Amer (2002) and Ibrahim and Ghonemy (2010). These results indicated that these parental inbred lines possess favorable genes and that improvement in yield may be attained if they are used in a hybridization program.

Specific combining ability effects of the top crosses combined across the two sowing dates are presented in Table (4).

Table 2. Mean performance of the testers and test crosses and check cultivars in combined two across sowing dates.

Genotype	Days to 50% pollen shed	Days to 50% silk	Days to 50% maturity	number of kernels/ row	number of rows/ ear	100-kernels weight	grain yield / plant		
							S1	S2	Comb.
L1	67.42	68.17	98.25	19.85	12.43	22.83	26.22	17.87	22.04
L2	64.00	66.33	95.67	17.97	11.22	21.58	21.87	17.47	19.67
L3	64.17	65.33	97.00	21.18	12.13	22.83	39.53	34.80	37.17
L4	64.58	65.58	98.08	19.08	13.32	23.58	31.77	31.30	31.53
L5	65.50	67.25	99.67	18.97	12.86	24.75	42.17	25.32	33.74
L6	64.33	66.08	95.50	19.40	12.98	21.58	49.30	21.67	35.48
L7	67.00	68.58	96.58	15.95	11.03	19.92	27.17	15.23	21.20
L8	67.83	68.67	99.58	19.83	11.06	22.92	38.60	34.27	36.43
L9	63.75	64.33	96.67	18.89	12.33	25.33	39.57	34.83	37.20
L10	64.75	66.00	97.75	23.85	11.84	22.67	39.07	30.17	34.62
T1	65.75	66.38	99.50	27.10	12.83	22.63	53.25	62.00	57.63
T2	61.50	61.63	95.75	34.16	14.03	35.25	163.70	144.00	153.85
T3	63.13	63.63	98.00	35.56	15.41	25.38	112.00	91.75	101.88
L1xT1	59.50	60.58	95.08	35.28	13.54	31.25	125.85	123.67	124.76
L2xT2	60.83	61.42	97.00	35.98	14.53	28.83	131.32	115.25	123.28
L3xT3	59.67	61.00	97.25	34.58	14.63	28.25	136.07	123.93	130.00
L1xT2	61.67	63.83	97.83	35.21	13.93	33.50	128.57	102.60	115.58
L2xT2	60.50	61.17	96.67	35.28	14.09	30.92	145.02	117.70	131.36
L3xT2	59.92	61.25	96.25	35.98	15.08	26.75	131.93	99.13	115.53
L1xT3	60.67	61.17	97.92	34.06	14.62	32.33	142.58	140.07	141.33
L2xT3	60.17	60.75	97.25	33.86	14.29	34.58	135.77	116.58	126.18
L3xT3	60.50	62.00	97.92	34.20	15.13	35.75	122.43	119.82	121.13
L1xT4	61.25	61.92	98.25	33.32	14.24	31.83	147.75	107.83	127.79
L2xT4	61.92	62.75	98.50	32.98	14.87	30.17	172.02	104.98	138.50
L3xT4	60.67	61.33	97.58	34.94	14.35	29.42	148.63	101.73	125.18
L1xT5	61.75	62.42	97.33	33.32	14.68	30.33	128.58	123.97	126.28
L2xT5	61.50	62.83	99.83	34.90	15.34	33.00	144.23	117.33	130.78
L3xT5	61.08	61.67	97.42	32.45	15.97	29.17	139.13	111.60	125.37
L1xT6	60.92	61.25	97.33	33.91	13.78	31.17	132.42	120.45	126.43
L2xT6	61.25	61.67	96.25	28.50	15.28	29.42	144.27	82.33	113.30
L3xT6	60.33	61.00	96.67	33.48	15.58	29.67	138.37	117.42	127.89
L1xT7	60.83	61.33	98.08	34.81	13.84	34.67	167.08	129.37	148.23
L2xT7	61.25	62.08	97.92	32.63	13.93	27.92	118.12	97.17	107.64
L3xT7	60.92	61.67	96.83	33.94	14.90	28.67	146.13	102.33	124.23
L1xT8	60.83	61.33	97.25	34.96	13.49	33.25	139.25	126.17	132.71
L2xT8	61.50	62.17	96.25	32.26	13.91	29.50	143.23	96.13	119.68
L3xT8	61.17	61.92	98.25	32.74	14.24	27.25	155.05	77.60	116.33
L1xT9	60.75	61.17	97.08	33.32	13.23	31.92	145.77	108.05	126.91
L2xT9	60.75	61.42	95.83	33.27	14.15	31.83	135.37	101.67	118.52
L3xT9	61.42	62.08	98.58	36.14	14.12	32.83	124.50	123.20	123.85
L1xT10	61.08	61.83	95.92	33.68	13.00	29.00	144.73	95.70	120.22
L2xT10	60.67	61.67	97.67	34.88	13.76	33.17	161.33	117.48	139.41
L3xT10	59.58	60.50	91.33	32.81	15.04	31.75	148.42	104.83	126.63
SC 168	61.09	61.33	99.67	32.44	14.43	31.34	158.53	105.63	132.08
LSD 0.05	0.75	0.78	1.31	1.96	0.62	1.43	4.99	5.69	3.74
LSD 0.01	1.00	1.03	1.74	2.60	0.82	1.90	6.61	7.53	4.96

S1, S2 and Comb. refer to early, late planting date and combined analysis across planting dates, respectively.

Table 3. Estimates of general combining ability effects of eight inbred lines for all the studied traits across two sowing date.

GCA effects	Days to 50% pollen shed	Days to 50% silk	Days to 50% maturity	number of kernels/ row	number of rows/ ear	100-kernels weight	grain yield /plant
lines							
L1	-0.64 **	-0.83 *	-0.87**	-0.15	1.36**	-1.49 **	0.18
L2	0.44**	-0.13	-0.39	-0.01	1.57**	-0.55	-5.01**
L3	-0.33	-0.38 *	0.38	0.29*	0.12	3.29**	3.71**
L4	0.36*	0.45**	0.80**	0.10	-0.18	-0.46	4.66**
L5	0.67**	0.62**	0.88**	0.94**	-0.37	-0.10	1.64*
L6	-0.33	0.01	-0.56 *	0.49**	-1.96**	-0.85 **	-3.29 **
L7	0.06	0.17	0.30	-0.16	-0.13	-0.52	0.87
L8	0.17	0.34*	-0.06	-0.50 **	-0.60	-0.94 **	-2.93 **
L9	-0.08	0.14	-0.14	-0.55 **	0.32	1.26**	-2.74 **
L10	-0.31	-0.38*	-0.34	-0.45**	-0.13	0.37	2.92**
LSD gi5%	0.32	0.31	0.54	0.25	0.80	0.59	1.53
LSD gi1%	0.42	0.41	0.71	0.34	1.06	0.78	2.03
LSD gi-gj 5%	0.45	0.44	0.76	0.36	1.13	0.83	2.16
LSD gi-gj 1%	0.60	0.58	1.01	0.47	1.50	1.10	2.87
Testers							
T1	0.04	0.10	-0.10	-0.55 **	0.26	0.99**	3.19**
T2	0.15	0.21*	0.01	0.03	-0.47*	0.00	-0.97*
T3	-0.20*	-0.30**	0.10	0.52**	0.20	-0.99**	-2.22 **
LSD gi5%	0.17	0.17	0.29	0.14	0.44	0.32	0.84
LSD gi1%	0.23	0.22	0.39	0.18	0.58	0.42	1.11
LSD gi-gj 5%	0.25	0.24	0.42	0.20	0.62	0.45	1.18
LSD gi-gj 1%	0.33	0.32	0.55	0.26	0.82	0.60	1.57

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

Table 4. Estimates of specific combining ability effects for all studied traits across two sowing date.

genotype	Days to 50% pollen shed	Days to 50% silk	Days to 50% maturity	number of kernels/ row	number of rows/ ear	100-kernels weight	grain yield /plant
T1xL1	-0.46	-0.60*	-1.26 **	-0.14	-0.27	0.82	-4.44**
T2xL2	0.26	0.63**	0.55	0.26	1.17	-0.61	-1.76
T3xL3	0.20	-0.03	0.71	-0.13	-0.91	-0.21	6.21**
T1xL2	1.71**	0.88**	1.02**	0.11	-0.54	2.12**	-8.43**
T2xL2	-1.07*	-0.40	-0.26	-0.31	0.26	0.53	11.50**
T3xL2	-0.64*	-0.48	-0.76	0.19	0.28	-2.65**	-3.07 *
T1xL3	-0.18	0.13	0.33	0.49**	-0.24	-2.88**	8.59**
T2xL3	-0.71 *	-0.48	-0.45	-0.42	0.29	0.36	-2.40
T3xL3	0.89**	0.36	0.13	-0.07	-0.04	2.51**	-6.20**
T1xL4	-0.13	-0.13	0.24	0.31	-0.69	0.37	-5.89 **
T2xL4	0.60**	0.43	0.38	0.35	-0.30	-0.30	8.98**
T3xL4	-0.47	-0.31	-0.63	-0.66**	0.99	-0.07	-3.09
T1xL5	0.07	0.21	-0.76	-0.10	-0.50	-1.49**	-4.39 **
T2xL5	0.38	-0.15	1.63**	-0.02	1.81**	2.17**	4.28**
T3xL5	-0.44	-0.06	-0.87	0.12	-1.31	-0.68	0.11
T1xL6	-0.10	-0.01	0.69	-0.55*	1.68**	0.09	0.70
T2xL6	0.21	0.21	-0.51	0.37	-2.99**	-0.66	-8.27**
T3xL6	-0.11	-0.20	-0.18	0.19	1.31	0.57	7.57**
T1xL7	-0.41	-0.26	0.58	0.17	0.75	3.26**	18.34**
T2xL7	0.24	0.04	0.30	-0.33	-0.69	-2.50**	-18.09**
T3xL7	0.17	0.22	-0.88	0.16	-0.06	-0.76	-0.25
T1xL8	-0.52	-0.43	0.10	0.16	1.38	2.26**	6.61**
T2xL8	0.21	0.13	-1.01*	0.00	-0.59	-0.50	-2.25
T3xL8	0.31	0.30	0.90	-0.16	-0.78	-1.76**	-4.36**
T1xL9	-0.43	-0.32	0.02	-0.06	-1.19	-1.27*	0.63
T2xL9	-0.29	-0.43	-1.34**	0.29	-0.51	-0.36	-3.61**
T3xL9	0.72**	0.75**	1.32**	-0.23	1.70**	1. 63**	2.98**
T1xL10	0.46	0.54**	-0.95 *	-0.38	-0.38	-3.29**	-11.72
T2xL10	0.18	0.02	0.69	-0.20	1.56**	1.86**	11.63**
T3xL10	-0.64	-0.56*	0.26	0.59**	-1.18	1.43**	0.10
LSD 5% Sij	0.55	0.53	0.93	0.44	1.39	1.01	2.65
LSD 1% Sij	0.73	0.71	1.23	0.58	1.84	1.34	3.51
LSD 5% Sij.skl	0.78	0.75	1.31	0.62	1.96	1.43	3.74
LSD 1% Sij.skl	1.03	1.00	1.74	0.82	2.60	1.90	4.96

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

The greatest inter- and intra-allelic interactions as deduced from $\hat{S}_{ij}$ effect were observed by top-crosses between T2 x L3 and T2xL3 for days to 50% pollen shed, T1xL1 and T3xL10 for days to 50% silking, T1xL1, T2xL8, T2xL9 and T1xL10 for days to maturity, T2xL10, and T3xT10 for no of kerenls/ row, T2xL5, T1xL6, T3xL9 and T2xL10 for No of rows ear^{-1}, T1xL2, T3xL3, T2xL5, T1xL7, T1xL8, T3xL9, T2x L10 and T3xL10 for 100-kernel weight and T3xL3, T2xL2, T1xL3, T2xL4, T3xL6,, T1xL7, T1xL8, T3xL9,and L2xT10 for grain yield plant^{-1}. These top-crosses might be of interest in breeding programs as most of them involved at least one good combiner for the traits in view. From the present study, it could be concluded that testers of broad genetic base are more efficient than those of narrow genetic base for evaluation of $\hat{g}_i$ effects for inbred lines of maize.

References

Abd El-Aal A.M.M. (2012). Utilization of line x tester model for evaluating the performance of some new yellow maize inbred lines. Bull. Fac., Agric., Cairo Univ. 63: 29-36.

AL-Naggar, A.M.; H.Y. El-Sherbieny and A.A. Mahmoud (1997): Effectiveness of inbreds, single crosses and populations as testers for combining ability in maize. Egypt. J. Plant Breed. 1: 35-46.

Amer, E.A. (2002). Combining ability on early maturing inbred lines of maize. Egypt. J. Appl. Sci. 42(2): 162:181.

Basbag, S., R. Ekinci and O. Gencer (2007). Combining ability and heterosis for earliness characters in line x tester population of Gossypium hirsutum L. Hereditas 144:185-190.

Bayoumi, Rehab. A., S.M. Shoker, G.Y. Hamam, A.A.A. EL-Hosary (2018) Determination of combining ability for some new yellow maize inbred lines using line x tester model. Annals of Agric. Sci., Moshtohor. 305-316.

Bello, O.B. and G. Olaoye (2009). Combining ability for maize grain yield and other agronomic characters in a typical southern guinea savanna ecology of Nigeria. Afr. J. Biotechnol. 8: 2518-2522.

Davis, R.L. (1927): Report of the plant breeder.Rep. Puerto Rico. Agric. Exp. Sta. P: 14-15.

El Hosary A.A.A. (2020) Estimation of genetic variability using linextester technic in yellow maize and stability analysis for superior hybrids using different stability procedures. J. of plant production, Mansoura Univ. 11 (9): 847-854.

El Hosary A.A.A., M. H. Motawea and A.A. Elgammaal (2018) Combining ability for yield and some of its attributes in maize across two locations. Egypt. J. Plant Breed. 22 (3):625 –640.

El-Badawy, M.EL.M. (2013). Heterosis and combining ability in maize using diallel crosses among seven new inbred lines. Asian J. Crop Sci. 5: 1-13.

El-Badawy, M.EL.M., S.A. Sedhom, A.M. Morsy and A.A.A. El-Hosary, (2010). Combining ability in maize (Zea mays L.) under two nitrogen rates and genetic distance determined by RAPD markers. Proceedings of the 12th International Conference of Agronomy, September 20-22, 2010, EL-Arish, Sinai, Egypt, pp: 48-66.

El-Hosary A.A. (1985). Study of combining ability in some top crosses in maize. Egypt. J. Agron. 10(1-2) 39-47.

El-Hosary A.A.A. and A.A. El-Gammaal (2013) Utilization of line x tester model for evaluating the combining ability of some new white maize inbred lines. Egypt. J. Plant Breed. 17 (1):79 – 92.

El-Hosary, A.A. and M.EL.M. El-Badawy, (2005). Heterosis and combining ability in yellow corn (Zea mays L.) under two nitrogen levels. Proceedings of the 11th Conference of Agronomy, November 15-16, 2005, Assiut University, Egypt, pp: 89-99.

El-Hosary, A.A., M.EL.M. El-Badawy and Y.M. Abdel-Tawab (2006). Genetic distance of inbred lines and prediction of maize single-cross performance using RAPD and SSR markers. Egypt. J. Genet. Cytol. 35: 209-224.

El-Hosary, A.A.A. (2014) Relative values of three different testers in evaluating combining ability of new maize inbred lines. Int. J. Plant Breed. Genet., 8(2): 57-65

Gilbert, N.E.G. (1958). Diallel cross in plant breeding. Heredity 12: 477-492.

Hani A. Eltelib, Muna A. Hamad and Eltom E. Ali (2006). The effect of nitrogen and phosphorus fertilization on growth, yield and quality of forage maize (Zea mays L.). Journal of Agronomy 5: 515-518.

Hefny, M.M. and A.A. Aly (2008). Yielding ability and nitrogen use efficiency in maize inbred lines and their crosses. International Journal of Agricultural Research 3: 27-39.

Ibrahim, M.H.A. and M.A. Ghonemy (2010). Evaluation of some new maize inbred lines for combining ability using top cross method. Egypt. J. Plant Breed. 14(1): 217:228.

Jenkins, M.T. (1935): The effect of inbreeding and selection within inbred lines of maize upon the hybrids made after successive generations of selfing. Lowa State J. Sci. 3: 429-450.

Kang, M.S. (1998). Using genotype by environment interaction for crop cultivar development. Adv. Agron., 62:199-252.

Kempthorne, O. (1957). An Introduction to Genetic Statistics. John Wiley and Sons Inc., Landon, New York.

Matzinger D.F. (1953). Comparison of three types of testers for the evaluation of inbred lines of corn. Agron. J. 45:493-495.

Ngaboyisonga, C., K. Njoroge, D. Kirubi and S.M. Githiri (2009). Effects of low nitrogen and drought on genetic parameters of grain yield and endosperm hardness of quality protein maize. Asian J. Agric. Res. 3: 1-10.

Sedhom AS, M.E.M. EL-Badawy, A.A.A.El Hosary, M.S. Abd El-Latif, A.M.S. Rady, M.M.A. Moustafa, S.A. Mohamed, O.A.M. Badr, S.A. Abo-Marzoka, K.A. Baiumy and M.M. El-Nahas(2021) Molecular markers and GGE biplot analysis for selecting higher-yield and drought-tolerant maize hybrids. Agronomy Journal, 2021;1–15. https://doi.org/10.1002/agj2.20778

Sofi, P. and A.G. Rather (2006). Genetic analysis of yield traits in local and CIMMYT inbred line crosses using line x tester analysis in maize (Zea mays L.) Asian J. Plant Sci., 5: 1039-1042.

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

Sprague, G.F. (1939). An estimation of the number of top crossed plants required for adequate representation of corn variety. J. Am. Soc. Agron. 38: 11-16.

Steel, R.G. and J.H. Torrie (1980). Principles and procedures of statistics. McGraw-Hill Book Company, New York, Toronto, London.

Tamilarasi, P.M. and M. Vetriventhan (2009). Exploitation of promising maize (Zea mays L.) hybrids for nitrogen (N) stress environment by studying the SCA, heterosis and nature of gene action at different N fertilizer doses. Int. J. Plant Sci. 4: 15-19.

تقيم القدرة على التالف لبعض الهجن الصفراء الجديدة من الذرة الشامية باستخدام نموذج السلالة x الكشاف

احمد رزق غنيم, سيدهم اسعد سيدهم , محمود الزعبلاوى البدوى و احمد على الحصرى
قسم المحاصيل – كلية الزراعة – جامعة بنها

تم تقييم 20 هجين قمى ناتجين من تهجين 10 سلالة x 3 كشافات مع الهجن التجاري للمقارنة (هجين فردى 168) فى تصميم القطاعات الكاملة العشوائية تحت ميعادى زراعة (24 مايو و 14 يونيه) موسم 2021 فى مزرعة كلية الزراعة – جامعة بنها لصفات عدد الايام حتى ظهور 50% من النورات المذكرة و الحراير و النضج, المحصول و مكوناته. و كانت اهم النتائج:

- التباين الراجع الى الكشافات و السلالات و التفاعل بين السلالات x الكشافات كان معنوى فى كلا الميعادين و التحليل المشترك لمعظم الصفات تحت الدراسة.
- كان التباين الراجع الى التفاعل بين الهجن القمية و السلالات و الكشافات و السلالات x الكشافات مع ميعادى الزراعة معنويا لمعظم الصفات تحت الدراسة.
- أظهر التباين الراجع للفعل الوراثى غير المضيف دورا اكثر اهمية فى وراثة الصفات محل الدراسة بالمقارنة بالتباين الراجع للفعل المضيف و مع ذلك كان التفاعل بين التأثير غير المضيف x ميعادى الزراعة اعلى من التفاعل بين التأثير المضيف x ميعادى الزراعة لجميع هذه الصفات.
- الهجين القمي الفردي سلالة 10 x كشاف 3 اظهر افضل الهجن فى صفات التبكير و حقق زيادة معنوية عن صنف المقارنة فردى 168.
- اظهرت الهجن L4xT2, and L7xT1 فى موعد الزراعة المبكر و الهجن L1xT1, L2xT1, L3xT1, L2xT2, , L1xT3, , L2xT2, , L3xT1, , L3xT2, , L3xT3, , L5xT1, , L5xT2, , L6xT1, L6xT3, L7xT1, L8xT1, L9xT3 and L10xT2 فى موعد الزراعة المتاخر و الهجن L3xT1, L4xT2, L7xT1, and L10xT2 فى التحليل التجميعى زيادة معنوية عن صنف المقارنة 168 و قدرة خاصة على التالف لصفة المحصول.