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ESTIMATION COMBINING ABILITY AND SOME GENETIC PARAMETERS FOR MAIZE (Zea mays l.) AND ITS COMPONENETS USING LINE X TESTER

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ABSTRAC

Experiment was carried out in were sowing in 2/3/2021 at field of College of Agriculture Engineering Science, Duhok using line x tester method to compare eight inbred line, MA-F-53,SY-F-54 and H-4, used as tester (female parent).IK58,HS,Un44052 and DK-17,used as line(male parents) to study yield and yield components and to determine the nature of gene action in parents and hybrids. The results show that the mean significant variation among divers the genotype for all studied traits, also the means square due to line, tester and interaction between them exhibited significant effect for all traits except number of ear per plant. The Tester H-4 and Lines HS and Un44052 were the best general combiner for the most traits, the cross SY-F-54*DK-17 recorded the highest value (208.699) for yield per plant and gave and recoded a significant specific combining ability effect for the most studied traits. The range of narrow sense heritability ranged from 34% for number of ears per plant and 98% for grain yield per plant, also the expected genetic advance in next generation as present was moderate 14.25% for grain per plant and low value for the other traits.

KEYWORDS: Combining ability, Line, Tester, Yield components

INTRODUCTION

Corn is one of the most summarists economic cereal crops of the world. Corn contributes highly present of poultry ration and also entered in more industrial products. The annual production of it about 854.6 million tons on an area of 168.4 million hectares with average seed yield of 5.07 tons per hectares (Anonyreous, 2015). The development of new maize hybrid required information about genetic structure of the parental lines and their hybrid. This information can be obtained by different mating design, one of them line x tester (kemphorne, 1957) and use these method to evaluate the off spring (Venkatesh *etal.,* 2001,) This method was used in different studies, for example, by (Wali *et al,*. 2010, Dar. *et al.,* 2017. Bayoumi *et al,.2018* and Mohammed *et al.,*2021) to estimation the effect of the general and specific combining abilities and their hybrids. One the most revealing procedures in this concern line is tester mating design, which wildly used for assessing the type of gene action and combining ability, since it provides reliable information on general and specific combining ability (Lime *et al*.,2021). Plant Breeders always have an objective to advance the yield and yield components of maize which continuous development and release hybrid of higher yielding and well adapted varieties having better advantage over the existing local hybrid (Assefa *etal*., 2020). Line x tester method helps in evaluation the genetic components and the kind of genetic effect, also the line x tester used by several breeders (Venkatesh *etal.*,2001, Al.Zubaidy and Al-Jubouri,2016 and Mohammed *etal,*.2021) and found significant differences between lines and tester, and the combinations between them indicates that the importance of both additive and dominance genetic variance in controlling grain yield and its components (mustafa,2005) used the line x tester of sixteen inbred line of maize in different locations and resulted that the hybrids were various in their specific combining ability and the cross (IPA4XATSH) gave significant desirable effect in the studied traits. Also (Gamea, 2019), used the line x tester to study the analysis of variance of hybrid and their components, this method showed highly significant difference for all studied traits except days to 50% silking and the general combining ability component was large than specific combining ability for all traits, indicating the dominance of additive gene action in the inheritance of these traits.

The aim of the current study is to estimate combining ability and some genetic parameters for maize yield and yield components, using line x tester mating.

MATERIALS AND METHODS

1- Eight of inbred line were used in this study which they are (MA-F-53, SY-F-54, H-4, IK58, HS, Un44o52 and DK-17) the first the Line used as female parents and the other used as lines (male parent), each inbred line were sowing in 2/3/2021 at field of College of Agriculture Engineering Science, Duhok University and cross were done by all possible according to Lin x tester (Al- Zubaidy and Al-Juboury,2016,to produce 15 hybrids (3-tester and 5 inbred line). In the same location the 15 hybrid and eight inbred were sown in 20/ 7/2021, using randomize complete block design with three replications. Each genotype was planting in one row (3m) length, the distance between them (0.75m) and distance between plants (0.25m). Compound fertilizer N.P.K. (27, 27 ,27) was added by 100kg/ha during preparation of the land, and urea by 200kg/ha were added in two period, the first after month of planting and the second before the flowering. All on the practices were done when the needed of plants. The data were recorded on ten plants randomly selected from each genotype on yield and yield components. Data of genotypes (parental and hybrids) were analyzed for each trait according to experimental design was used in this experiment and the sum of square was divided in to the components according to line x tester and follow parameters were estimated:

1-Analysis of variance

Line X tester analysis

a- S.S. due to lines

SS lines = (∑Yi.. 2 /tr)-(∑Yij.) 2/Itr

b- S.S. due to tester

SS testers=(∑Y.j. 2 /lr)-(∑Yij.)2/Itr

c- S.S. due to line x tester

SS lines x testers = SScrosses - SSlines – Sstesters

no. of crosses = Lxt = 5x3 =15

no. of parents = L+t = 5+3 = 8

no. of genotypes = no. of crosses + no. of parents = 10 + 15= 25

2- Estimation of general and specific combining ability effects

a- GCA for testers

b- GCA for lines

c- SCA for interaction (line x tester)

3- Estimation of component of variance and genetic interpretation. The Additive, Dominance and Environmental variances were estimated by using EMS from Griffing (?) analysis. and their significance from zero were tested in the manner explained by Kempthorne, (17).

$\sigma^2 A = 2\sigma^2 g$

$\sigma^2 D = \sigma^2 s$

$\sigma^2 E = \sigma^2 e$

$\sigma^2 G = \sigma^2 A + \sigma^2 D$

$\sigma^2 P = \sigma^2 G + \sigma^2 E$

where:

$\sigma^2 A$: additive genetic variance,

$\sigma^2 D$: non-additive (dominance and epistasis) genetic variance,

$\sigma^2 g$: the variance of general combining ability,

$\sigma^2 s$: the variance of specific combining ability

$\sigma^2 E$: the variance of experimental error, i.e. environmental variance,

$\sigma^2 G$: total genetic variance,

and $\sigma^2 P$: phenotypic variance (genetic and environmental variance).

4- Heritability:

Heritability was calculated in broad sense ($H_{b.s}$) and narrow sense ($H_{n.s}$) concept and average Degree of Dominance for each character were calculated as follows:

$$H.b.s = \frac{\sigma^2 G}{\sigma^2 p} \times 100$$

$$H.n.s = \frac{\sigma^2 A}{\sigma^2 p} \times 100$$

$$\bar{a} = \sqrt{\frac{2\sigma^2 D}{\sigma^2 A}}$$

where:

H b.s: heritability in broad sense,

H n.s: heritability in narrow sense,

If: $\bar{a}$ = zero denote no dominance,

$\bar{a} < 1$ denote partial dominance,

$\bar{a} = 1$ denote complete dominance,

$\bar{a} > 1$ denote over dominance.

5- Expected genetic advance

EGA = (i)(h_{ns})(σP)

EGA% = (EGA/$\bar{y}$) x 100

Where:

EGA: Expected genetic advanced
i: intensity of selection (which equals 1.76 when 10% of plants are selected
$h_{n.s}$: narrow sense heritability
σP: phenotypic deviation

6- Estimation of contribution for testers, lines and line x tester

a- Tester contribution = (Ms tester / Ms hybrids) x 100
b- lines contribution = (Ms lines / Ms hybrids) x 100
c- Interaction contribution = (Ms line x tester / Ms hybrids) x 100

RESULTE AND DISCUISION

The analysis of variance in Table (1) showed there were significant variations among divers the genotypes for all studied traits indicating wide range of genetic variability among the genotypes. Parents, cross and parents vs. Cross and Line x tester were also significant for all traits except number of ears per plant (number of ears plant-^{1}) and significant for ear length Line and Line x tester. These results indicate that their existence of genetic divergence between parents used in this study (tester and Line), which is turn was reflected in the presence of high significant differences between hybrids resulting from them. The parent results are corroboration with the finding of Lemi *et al.,* 2021. Mohamed *et al*, and Bayoumi *et al.,* 2018

Table (1): Analysis of variance for genotypes (line x tester) in maize trait

Source of variance	d. .f.	No. of ears per plant	Ear length (cm)	No .of grains per row	No .of rows per ear	300 grain weight(g)	Grain yield per plant
Rep.	2	0.22**	0.215	3.77	0.94	1.56*	6.90
genotype	22	0.09*	3.60**	113.48**	8.34**	159.19**	2475.37**
Parents	7	0.17*	0.99	7.43**	4.39**	195.33**	267.08**
P. v s crosses	1	0.40	12.85	1935.84	105.98	78.71	31588.21
Crosses	14	0.04	4.25**	36.33**	3.34**	146.88**	1500.02**
Tester	2	0.006	17.30**	105.23**	5.53**	452.27**	3993.56**
Line	4	0.048	2.45*	5.21**	2.27	53.22**	680.57**
Line x Tester	8	0.046	1.88*	34.66**	3.32**	117.36**	1286.36**
Error	44	0.06	0.66	2.75	0.33	8.009	26.001

Table 2 revaluated the means of the lines and testers for yield and yield components. It's noted that the T3 and T1 gave the highest values 14.60, 80:51 and 120.66 for number of rows per ear, 300 grain weight and grain yield per plant respectively, while the T1 recorded the largest values 18.80 for ear length and 25.0 for number of grains per row. Regarding to Lines parents the L7 recorded the highest values 14.66 for number of rows per plant, 84.01 g for 300 grain weight and 136.39 g for grain yield per plant, from the resulting above the L7 was superior in two important of yield components, also the L5 gave the highest value 1.33 for numbers of ear per plant and 18.23 cm for ear length. The parental T3 was characterized by a good mean performance for the most traits, and the same time, the parental L7 was characterized by most yield components similar findings were reported by Assefa *et al., 2020*, Arsode *et al*,.*2017 and* Dufara *et al*,.2017.

Table (2): Mean of parents (Line and tester) for maize traits.

parents	No. of ears per plant	Ear length (cm)	No. of grains per row	No. of rows per ear	300 grain weight(g)	Grain yield per plant (g)
			Tester			
1	1.60 ab	18.80 b-g	25,00 g	12.06 gh	68.51 g	110.00 l
2	1.73 a	17.73 fgh	24.86 g	11.46 k	76.76 fgh	118.33 kL
3	1.200 abc	17.06 h	24.46 g	14.60 fgh	80.51 ef	120.66 gk
			Lines			
4	1.200 abc	17.80 fgh	25.60gh	13.60 hi	92.06 a	110.00 l
5	1.33 abc	18.23 d-g	26.80 gh	12.86	78.17 fgh	132.32ghi

6	1.200 Abc	17.86 e-g	26.26 Gi	12.73 Ig	81.11 Def	120.66 Gk
7	1.100 C	17.80 Fgh	27.20 Gi	14.66 i-h	84.01 b-e	136.33 Gh
8	1.26 Abc	17.03 H	28.26 I	14.40 Gh	67.19 Gk	124.66 Igk

Values followed by the same letter for each trait are not significantly different.

The general combining ability of parental Lines and testers is parented in Table 3. The T3 exhibited positive genera combining ability for number of ears per plants, ear length, number of grains per row, number of rows per ear and grain yield per plant and the highest value was 3.1478g9 and 3.53114 for number of row per plant and grain yield per plant respectively so that, the T 3 for number of rows per plant and grain yield per plant respectively so that, the T3 exhibited a good combiner and desirable GCA effect, while the T1 dis play the negative GCA effect for the most studied traits, and this indicates that it is a poor combiner. Concerning for parental Lines the same Table indicated that, the L6 recorded positive GCA effect for yield and yield components and following by L7 produce positive GCA for ear length, number of rows per ear, 300 grains weight and grain yield per plant and negative for number of ears per plant and number of grain per row and the highest value of GCA (4.15189) for number of rows per ear, while the other line had positive and negative effect for different traits. The positive GCA effect of parental Lines Dis played the potential advantage of the parents for developing high yielding hybrids, also fan *etal*,. 2008 suggested that selecting parental Lines with positive GCA effect in most of yield components have a good chance to get hybrid with high yield. On the other hand, positive GCA effect for parental lines indicated that they are desirable parents for maize crosses development and involvement in maize program. In general many researchers have reported with the finding of Mohammed *etal*,. 2021 and Rawi, 2016.

Table (3): General combining ability for parents (line and tester) in maize traits.

parents	No. of ears per plant	Ear length (cm)	No. of grains per row	No. of rows per ear	300 grain weight(g)	Grain yield per plant(g)
			Tester			
1	-0.02223	-1.09778	-0.47552	-6.34011	-0.84533	-2.56226
2	0.017774	1.04892	-0.20892	3.19289	0.895367	-0.96886
3	0.004444	0.04892	0.68448	3.14789	-0.05003	3.53114
SE	0.0370	0.121	0.247	0.0859	0.421	0.760
			Lines			
4	-0.06666	0.39112	-0.76892	-1.57611	-0.14953	-0.65996
5	0.066644	0.08002	0.18668	-0.81711	-0.61063	3.82884
6	0.066644	0.34662	0.60888	0.04889	0.007067	0.89554
7	-0.08886	0.08002	-0.10222	4.15189	0.667067	0.06224
8	0.022244	-0.89778	0.07558	-1.80711	0.085967	-4.12666
SE	0.04788	0.156442	0.110 935	0.544654	0.054431	0.581875

The means of lines x tester hybrids and their specific combining ability effect for yield and yield components are presented in Table (4) and (5) and it seems that limited number of crosses showed a significant specific combining ability effects in the desired direction for yield traits, Table 5, as the number of cross with significant desired effect reached six hybrids for grain yield per plant, and 300 grain weight, seven hybrid for number of row per ear, nine for number of grains per row, eight for ear length and nine for number of ears per plant. From the Table 4 the highest value (208.69 g) recorded by cross 2x8, while the cross 2x6 gave the largest value 89.00 for 300 grain weight, for number of rows per plant, the cross 3x5 gave the highest value (17.46), while, the cross 2x4 recorded the largest value 43.06 for number of grains per row. For ear length and number of ear per plant the cross 2x5 had the maximum value 20.73 and 1.40 respectively. From the results in Table(4and 5) the value of any inbred line in hybrid breeding ultimately depend on its ability to combine very well with other line to produce superior hybrids. These results are generally analogous to the finding of Mohamed *etal*2021, Bayoumi *etal*, 2018 and Dar *etal,* 2017.

Table (4): Mean hybrid for yield and yield components in maize**.**

Line x tester

hybrids	No. of ears per plant	Ear length (cm)	No. of grain per row	No. of row per ear	300 grain weight(g)	Grain yield per plant(g)
1x4	1.o6 bc	18.20 c-g	32.86 h	15.53cde	63.26 k	137.90 g
1x5	1.200 abc	18.00 d-g	36.40 efg	16.26 bcd	69.77 ig	149.90 f
1x6	1.33 abc	17.93 d-g	35.00 e-h	16.53 abc	83.74 b-e	150.56 f
1x7	1.00 c	16.93 h	33.40 gh	14.46 fgh	80.41 ef	148.33 f
1x8	1.06 bc	16.93 h	33.60gh	14.33 gh	75.04 gh	167.22 de
2x4	1.06 bc	19.40 a-e	43.06 a	15.26 d-g	88.20 ab	179.31 c
2x5	1.400 abc	20.73 a	42.40 ab	14.53 fgh	86.43 bc	161.74 e
2x6	1.06 bc	19.73 abc	38.26 cde	16.13 bcd	89.00 efg	173.36 cd
2x7	1.06 bc	19.80 ab	36.46 efg	16.33 bcd	85.83 bcd	193.72 b
2x8	1.26 abc	19.06 b-f	34.86 fgh	16.20 bcd	80.43 ef	208.69 a
3x4	1.13 bc	19.66 abc	39.66 bcd	14.60 fgh	86.17 bcd	173.70 cd
3x5	1.06 bc	17.60fgh	33.73 gh	17.46 a	83.70 b-e	153.32 f

3x6	1.26 abc	19.46 abcd	37.53 def	16.86ab	79.76efg	176.38 c
3x7	1.13 bc	19.60 abc	40.96 abc	16.60 abc	86.56 ab	195.23 d
3x8	1.200 abc	17.40 hg	41.33 abc	17.40 a	81.46 ef	128.84 hij
X	1.23	18.39	33.56	15.03	79.74	152.78
C.V.%	23.05	4.36	3.33	3.88	3.47	3.31

Values followed by the same letter for each trait are not significantly different.

Table (5): Specific combining ability effect for hybrids for studied traits in maize.

Hybrid	No. of ears per plant	Ear length (cm)	No. of grain per row	No. of row per ear	300 grain weight(g)	Grain yield per plant(g)
1x4	2.6305	0.20888	0.87552	-9.61089	-0.51917	10.70666
1x5	2.6305	0.31998	0.65332	-3.85289	0.578633	-4.68214
1x6	0.133326	-0.01332	0.49772	9.24411	-0.04237	-2.21584
1x7	-0.04447	-0.74672	-0.85778	1.81811	-0.78907	2.98446
1x8	-0.08887	0.23108	-1.16898	2.40011	0.772033	-6.79364
2x4	-0.03997	-0.73782	0.60892	5.79611	-0.06317	-1.55374
2x5	0.160026	0.90658	-1.34668	3.27011	-0.53537	-1.54254
2x6	-0.17327	-0.36002	-0.16888	-5.02889	-0.53647	-0.40924
2x7	-0.01777	-0.02672	0.74222	-2.29889	-0.11977	4.62406
2x8	0.071126	0.21778	0.43112	-1.73989	1.254633	-1.12004
3x4	0.039956	0.52888	-1.21778	3.81411	0.582233	-9.15374
3x5	-0.15994	-1.22672	16.09362	0.58211	-0.04337	6.22446
3x6	0.040056	0.37338	-0.32888	-4.21689	0.578933	2.62476
3x7	0.062156	0.77328	0.11552	-73.7536	0.908933	-7.60894
3x8	0.017756	-0.44892	0.73772	-0.66089	-2.02657	7.91296
SE	0.082931	0.270966	0.192146	0.943369	0.094278	1.007837

Table 6. Show the estimation of genetic parameters for yield and yield components, and it's clear that the additive and dominance genetic variance were significant from zero for yield and yield components, an indication of their importance in controlling the inheritance of studied traits. It is noted that the variance of dominance were greater than these of the additive for all studied traits, indicating that the dominance genetic effects were more important in the inheritance of the yield and yield components in this study, so that the value of heritability in narrow sense was low than the heritability in broad sense of yield and yield

components and the value of heritability ranged between 0.06 for number of ears per plant and 0.64 for ear length, while the heritability in broad sense was high for all studied traits ranged between 0.34 for number of ears per plant and 0.98 for grain yield per plant. From the same Table, it is noted that the expected genetic advance in the next generation a percent was moderate for the grain yield per plant and low for other studied traits, as it ranged between 1.788y. For number of ears per plants and 14.257y. For grain yield per plant. These results were in conformity with the finding of Sub *etal.*, 2021, Mohamed *etal.*, 2019 and Tafa,2018

Table (6): Variance components and genetic parameters for yield and yield components in maize.

Genetic parameters	No. of ears per plant	Ear length (cm)	No. of grains per row	No. of rows per ear	300 grain weight(g)	Grain yield per plant(g)
V(A)	0.002	1.388	7.431	0.603	35.591	340.317
SE A	0.002	0.588	3.516	0.212	15.268	136.652
V(D)	0.009	0.555	11.250	1.072	38.231	425.900
SE D	0.007	0.281	5.169	0.496	17.496	191.761
V (E)	0.021	0.220	0.919	0.111	2.669	8.667
SE E	0.004	0.046	0.191712	0.023	0.557	1.807
V(G)	0.011	1.942	18.681	1.674	73.822	766.217
V(p)	0.0313	2.163	19.601	1.785	76.492	774.884
H(NS)	0.0695	0.6417	0.3791	0.3376	0.4653	0.4392
H(BS)	0.3417	0.8981	0.9531	0.9379	0.9651	0.9888
GA	0.0217	1.661	2.954	0.794	7.162	21.517
GA%	1.788	9.034	8.835	5.294	8.952	14.257

Proportional contribution of lines, Tester and line x tester for yield and yield components presented in Table 7. From the same table, the results show that the proportional contribution of Line and interaction to total variance was much higher than tester in number of ear per plant and number of grain per row, this suggested that Line female contributed maximum to total variance maize, while the tester and interaction gave the highest contribution for ear length, number of rows per ear, 300 grains weight and grain yield per plants, this main the tester, were most important to produce the hybrids in this study for these traits. Similar findings were reported by other researchers (Tesfaye *etal.*, 2019 and Lemi etal. 2021.

Table (7): Contribution as % of testers, lines and line x tester for studied traits in maize

No.	Traits	Testers%	Lines%	Line x tester%
1	No. of ears per plant	2.105	33.509	64.736
2	Ear length (cm	58.158	16.501	25.323
3	No. of grain per row	15.524	45.197	39.277
4	No. of row per ear	41.374	4.098	54.524
5	300 grain weight(g)	23.662	19.480	56.855
6	Grain yield per plant(g)	38.471	12.883	48.643

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