Agronomy Department

Evaluation of Combining Ability for some new inbred lines of Maize Using Line × Tester

BY

MOHAMMED SALAH IBRAHIM ALY SHALOF

B.Sc. Agric. Sci., (plant pathology) Fac. of Agric., Tanta Univ., 1999
Graduate Diploma in crops, Fac. of Agric., Al-Azhar Univ., 2006
M. Sc. Agronomy, Fac. Agric. Mansoura Univ., 2012

THESIS

Submitted in Partial Fulfillment of
The Requirements for the Degree of

PHILOSOPHY OF DOCTOR
In
Agricultural Sciences
(Agronomy)

SUPERVISORS

Prof. Dr. **Mahmoud S. A. Sultan**
Prof. of Agronomy,
Faculty of Agriculture,
Mansoura University

Prof. Dr. **Sadek E. Sadek**
Head Researches, N. M.B. Program,
Field Crops Research Institute(FCRI),
Agric. Res. Center (ARC), Egypt

Prof. Dr. **Maamoun A. Abdel-Moneam**
Prof. and Head of Agronomy Dept.,
Faculty of Agriculture, Mansoura University

2019

Arab Republic of Egypt, Mansoura University

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V- SUMMARY

Maize (*Zea mays* L.) is one of major cereal crops in Egypt and the world. Maize in the world ranks the third, surpassed only by wheat and rice.

The aim of the present investigation was to estimate, combining ability, Superiority percentages and heritability for some important characters in new yellow maize inbred lines and new white maize inbred lines by using methods of line × tester analysis **(Kempthorne, 1957)**. The crosses of line × tester were done by hand among nine yellow lines and three testers, 27 crosses were obtained and ten white line and two testers, 20 crosses were obtained. These lines seeds were obtained from Maize Research Dept., Field Crop Institute, ARC, Egypt.

In 2015 summer season, the parental inbred lines and testers were crossed by hand at Gemmeiza Agricultural Station. The nine lines and 27 single crosses along with two check (yellow SC 162 and yellow SC 168) and ten lines and 20 three way crosses along with two check (white TWC321 and TWC324) were evaluated in a randomized complete block design with three replications during 2016 summer season at two locations Gemmeiza Agricultural Station and Mallawy Agricultural Station summer season under two densities (24000 plant/fed. and 30000 plant/fed.) to study the combining ability in order to identify the most superior parental inbred lines that produce superior hybrids and develop high yielding new yellow single crosses and white three way crosses. Data were recorded on individual plant basis for all studied traits (Days to 50% tasseling and silking, plant height (cm), ear height (cm), ear position, resistance to late wilt disease, ear length, ear diameter, No. of rows/ ear, No. of kernels/ row, 100-kernel weight, and grain yield ard/fed. The data were analyzed of variance for mean of performance for each experiment and then combined over the two locations under density. The LSD

test at 5% and 1% according to **(Steel and Torrie, 1980)** was used for comparison the mean of performance of the different genotypes. Then; data were analyzed using **Agrobase 21 Statistically Software (2001).** The evaluating main genotype effects obtain GCA, SCA, effects and their interaction with environment.

The combined analysis over two locations under density was carried out when ever homogeneity of variance was detected. Means of genotypes were compared using LSD at 5% and 1% probability level.

Yellow Maize Experiment

Analysis of variance:

1- Mean squares were significant for all of the studied traits. Hybrids mean squares were highly significant for the twelve traits under both locations and combined analysis traits except resistance to late wilt disease and ear diameter. Indicating that the hybrids performance is differed from location to another.

Mean performance:

1- Generally most of F_1 single crosses were earlier, shorter and had lower ear placement than two checks hybrids; SC162 and SC168.

2- All the F_1 crosses were resistance to late wilt disease.

3- Two Single crosses (P_1×Gm174) and (P_6×Gm1021) were significantly better than both checks SC162 and SC168 for grain yield ,shorter for plant height and earlier in days to 50%silking and days to 50% tasseling.

4- Two yellow single crosses (P_7×Gm1021) and (P_8×Gm1021) which equal both checks SC162 and SC168 and significantly earliness, shortens and lower placement ear; in addition those crosses yielded better than both check hybrids significantly.

General combining ability (GCA):

1- Results indicating that parental inbred line P_8 and Gm 1021 could be considered as a good general combiners for earliness

2- Parental inbred line P_1 could be considered as a good general combiner for lateness for days to 50 % tasseling and Gm1002 for days to 50 % silking.

3- Parental inbred lines P_4, P_5, P_6, P_7, P_8, P_9, Gm1002 and Gm1021 are the best general combiners for low plant height, P_4 the best of them.

4- Parental inbred lines P_4, P_6, P_9, Gm1002 and Gm1021 are the best general combiners for low ear height, P_6 the best of them.

5- Parental inbred lines P_6 and Gm1002 are fine wide-ranging combiners for ear position.

6- Parental inbred lines P_7, P_2, P_8 and Gm174 are fine wide-ranging combiners for resistance to late wilt disease.

7- P_6 inbred could be measured as the best general combiner for thickness of ears.

8- Parental inbred lines P_1, P_4, P_6, P_7, P_9, Gm174 and Gm1021 are the best general combiners for ear length.

9- Inbred lines P_5, P_6, P_9, Gm1002 and Gm1021 could be considered as the best general combiner for increasing kernel number per ear.

10- Inbred line P_8 and Gm174 could be considered as the best general combiners for increasing rows number per ear.

11- Parental inbred lines P_2, P_5, P_6, P_8 and Gm1021 are the best general for 100-kernel weight; P_8 was the best of them.

12- The best general combiners for increasing grain yield were P_1, P_2, P_3, P_6, P_7, P_8, P_9, Gm174 and Gm1021. The best of them was P_8.

Specific combining ability(SCA):

1- For (SCA) effects ,out of 27 F_1 crosses most of them had positive and highly significant effects for grain yield but found two crosses

(P_1×Gm174) and (P_6×Gm1021) had highly significant effect (SCA) for grain yield over locations and combined under two densities.

2- Crosses (P_2×Gm1002),(P_3×Gm1002),(P_7×Gm1021) and (P_8×Gm1002) had highly significant effect (SCA) for grain yield and most of traits studied.

3- Crosses (P_1×Gm1002),(P_3×Gm1002) and (P_8×Gm1002) had highly significant effect (SCA) for most of traits studied.

4- Act in the same direction to reduce undesirable plant characteristic and maximize the character in view. Therefore, the previous crosses might be of prime importance in breeding program for traditional breeding procedures.

Superiority percentages:

1- For days to 50% tasseling and days to 50% silking all crosses had negative highly significant Superiority percentages over both checks SC 162 and 168**.**

2- The highest significant and negative Superiority effect was exhibited by most of crosses in location one and combined under two densities over both checks SC 162 and 168 for plant height.

3- All the crosses manifested highly significant and negative Superiority effect was exhibited by 27 cross over checks SC 162 and 168 for ear height and ear position.

4- Five crosses manifested highly significant and positive Superiority effect over checks SC 162 and 168 for ear length

5- The highest significant and positive Superiority effect for most of crosses but founded that eight crosses highly significant and positive Superiority effect over check varieties SC 162 and 168 value for ear diameter.

6- The significantly and positive Superiority showed highly significant and positive Superiority effect by most of crosses in combined data under density over checks SC 162 and 168 but founded that nine crosses had

highly significant and positive Superiority effect over checks SC 162 and 168 for Number of rows per ear.

7- Most of crosses had significantly and significant positive Superiority effect over check varieties for 100-kernel weight.

8- Highest positive significant Superiority effect were recorded most of crosses had highly positively significant Superiority effect over combined data for both locations under two densities over checks SC162 and 168 for grain yield (ard/fed). Seven crosses reported that crosses had positive and highly significant over check varieties SC 162 and 168 for grain yield (ard/fed).

Heritability and Genetic parameters:

1- Variance for general (δ^2gca) and specific (δ^2sca) combining ability and their interaction with density showed that (δ^2gca) was lower than (δ^2sca) for all studied traits in two locations and combined under density; this indicated that the non-additive gene action was dominance gene action of all studied traits.

2- The δ^2gca × location was lower than δ^2sca× location for all traits studied in two locations and combined under density**.**

3- For δ^2gca/ δ^2sca and genetic ratio shows the predictability based on GCA alone. Also the GCA/SCA ratio reveals that different traits show an additive or non-additive genetic effect.

4- A δ^2gca/ δ^2sca ratio with a value lower than one indicates non-additive genetic effect except 50% silking date and plant height in $L_1L_2D_2$ and ear diameter in L_1D_1.

5- Also a genetic ratio with a value lower than one indicates dominant genetic effect in two locations and combined under density. The predominance of SCA variance denotes that non-additive genetic effects were largely influencing the expression of these traits.

6- In tables' 67-72 data for studied traits showed that heritability estimates in broad sense were generally higher at locations and combined data under two densities. Percentages of heritability in the narrow sense for studied traits were ranged from 0% to 35%. In broad sense ranged from 0% to 76%.

7- On the other hand heritability in the narrow sense was the highest in LW disease, while heritability in the broad sense was the highest in ear height. Heritability estimates were low for tasseling date, plant and ear height, ear position, ear diameter and ear length in narrow sense and the same in broad sense in ear diameter.

White Maize Experiment

Analysis of variance:

1- Mean squares were significant for all of the studied traits. Hybrids mean squares were highly significant for the twelve traits under both locations and combined analysis except resistance to late wilt disease and ear diameter.

Mean performance:

1- Generally most of F_1 three way crosses were earlier, shorter and had lower ear placement than two checks hybrids; TWC321 and TWC324.

2- All the F_1 crosses were resistance to late wilt disease.

3- Three crosses (P_1×SC21), (P_6×SC24) and (P_7×SC24) were significantly better than both checks TWC321 and TWC324 for grain yield ,shorter for plant height and earlier in days to 50%silking and tasseling .

4- Three crosses (P_5 × SC24), (P_6 × SC21) and (P_3 × SC21) which statistically equal both checks TWC321 and TWC324 and significantly earlier, shorter and lower placement ear; in addition those crosses yielded better than both checks hybrid insignificantly.

General combining ability (GCA):

1- Results indicating that parental inbred lines P_6 , P_8 , P_9 and SC 21 could be careful as a good general combiners for earliness

2- Parental inbred line P_4 could be measured as a good general combiner for lateness for days to 50 % tasseling.

3- Parental inbred lines P_1, P_2 and P_8 are the best wide-ranging combiners for low plant height, P_8 the best of them.

4- Parental inbred lines P_6, P_7, P_8, P_9 and SC 21 are the best general combiners for low ear height, P_6 and P_7 the best of them.

5- Parental inbred lines P_5, P_6, P_7 and P_{10} are fine wide-ranging combiners for ear position.

6- P_6 and P_7 could be measured as the best general combiners for thickness of ears.

7- Parental inbred lines P_3, P_5, P_6, P_7, P_{10} and SC24 are the best general combiners for ear length, P_3 and P_6 are the most excellent of them.

8- Inbred lines P_5, P_6 and P_7 could be considered as the best general combiners for increasing kernel number per ear.

9- Inbred lines P_5 and P_7 could be considered as the best general combiners for increasing rows number per ear.

10- Parental inbred lines P_3, P_5, P_6 and SC24 are the best general combiners for 100-kernel weight; P_3 was the greatest of them.

11- The best general combiners for increasing grain yield were P_3, P_5, P_6, P_7, P_8, P_9, P_{10}, SC21 and SC24. The superlative of them was P_7.

Specific combining ability (SCA):

1- For (SCA) effects ,out of 20 F_1 three way crosses, some of them had positive and highly significant effects for grain yield , three crosses (P_4×SC21) , (P_5×SC24) and (P_7×SC24) had highly significant effect (SCA) for grain yield over locations and combined under two densities.

2- Crosses (P_3×SC21), (P_{10}×SC21) and (P_{10}×SC24) had significant and highly significant effect (SCA) for grain yield for a good number of traits studied.

3- Act in the same direction to reduce undesirable plant characteristic and maximize the character in view. Therefore, the previous crosses might be of main importance in breeding program for traditional breeding trial.

Superiority percentages:

1- For days to 50% tasseling and days to 50% silking all crosses had negative highly significant Superiority percentages over both checks TWC 321 and TWC324**.**

2- The highest significant and negative Superiority effect was exhibited by most of crosses in $L_1D_1D_2$ at combined under two densities over both checks TWC 321 and TWC324 for plant height.

3- All the crosses manifested highly significant and negative Superiority effect was exhibited by 20 cross over checks TWC 321 and TWC324 for ear height and ear position.

4- Three crosses manifested highly significant and positive Superiority effect over checks TWC 321 and TWC324for ear length

5- The highest significant and positive Superiority effect for most of crosses but founded that three crosses had highly significant and positive Superiority effect over check varieties TWC 321 and TWC324 and seven crosses had highly significant and positive Superiority effect over check variety TWC 324 for ear diameter.

6- The significantly and positive Superiority showed highly significant and positive effect by most of crosses in combined data under density over check TWC 321 and all crosses had highly significant and positive Superiority effect over check TWC 324 for Number of rows per ear.

7- Some of crosses had significantly and significant positive Superiority effect over check varsities for 100-kernel weight.

8- Highest positive significant Superiority effect were recorded, most of crosses had highly positively significant Superiority effect over combined data for both locations under two densities over TWC321 and TWC324 for grain yield (ard/fed). Five crosses reported that crosses had positive and highly significant over check varieties TWC321 and TWC324 for grain yield (ard/fed).

Heritability and Genetic parameters:

1- General (δ^2gca) and spaccific (δ^2sca) combining ability and their interaction with dates showed that (δ^2gca) was lower than (δ^2sca) for all studied traits in two locations and combined under densities except days to 50% tasseling and days to 50 % silking, this indicated that the non-additive gene action was dominance gene action of all studied traits.

2- δ^2gca × location was lower than δ^2sca× location for all traits studied in two locations and combined under density.

3- For δ^2gca/ δ^2sca and genetic ratio shows the predictability based on GCA alone. Also the GCA/SCA ratio reveals that different traits show an additive or non-additive genetic effect.

4- A δ^2gca/ δ^2sca ratio with a value lower than one indicates non-additive genetic effect except 50% tasseling date in L_1D_1 , $L_1L_2D_1$, L_1D_2 , L_2D_2 , $L_1L_2D_2$, silking date in $L_1L_2D_1$, L_1D_2 , $L_1L_2D_2$, ear position in $L_1L_2D_1$,100-KW in $L_1L_2D_2$ and GY in L_2D_1 and $L_1L_2D_2$.

5- Genetic ratio with a value lower than one it ranged from 0% to 94% indicates dominant genetic effect in two locations and combined under density.

6- For studied traits showed that heritability estimates in broad sense were generally higher at locations and combined data under two densities.

7- Percentages of heritability in the narrow sense for studied traits were ranged from 0 % to 40 %. In broad sense ranged from 0 % to 67%.

8- On the other hand heritability in the narrow sense was the highest in days to 50% tasseling and days to 50% silking, while heritability in the broad sense was the highest for all traits over locations under density.