GENETIC ANALYSIS FOR SOME TOP CROSSES OF MAIZE (*Zea mays*, L.)

BY

Mohammed Reda Mahmoud Abd El- Naby Ismail

B.Sc. Agric. (Agronomy), Zagazig University- Benha Branch, 2004

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This thesis for M.Sc. degree
in Agriculture (Crop Breeding)

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CONTENTS

	Page
1. INTRODUCTION	1
2. REVIEW OF LITURATURE	3
2.1. Nature and number of testers	3
2.2. combining ability	7
2.3. Genotype x environment interaction	13
2.4. Heterosis	18
3. MATERIALS AND METHODS	23
4. RESULTS AND DISCUSSION	33
4.1. Analysis of variance	33
4.2. Mean performance	40
4.3. Analysis of variance for combining ability	52
4.3.1. General Combining ability effect	54
4.3.2. Specific combining ability effects	66
4.4. Heterosis	86
5. SUMMARY	91
6. LITERATURE CITED	99
7. ARABIC SUMMARY	-

INTRODUCTION

1. INTRODUCTION

Maize (*Zea mays* L.) is one of the most important cereals in Egypt due to its vast grown area, total production and cash value. It is essential for human consumption and livestock. Moreover, it is also used for industrial purposes such as manufacturing starch and cooking oils. Many efforts are devoted nowadays to increase its productivity through genetical improvement.

The ultimate goal of most breeding programs is the production of improved hybrids for commercial use through the evaluation of line genotypes for high yielding ability.

Evaluating inbred lines is of prime importance for hybrid production. Therefore, nature and number of tester parents to be used for evaluating inbred lines is still an important step. The top crosses test with abroad and narrow base testers is the most common procedure for the evaluating process. The top cross method of maize breeging has been used to evaluate inbred lines for general combining ability (GCA) and specific combining ability (SCA). **Davis (1927)**, **Jinkins (1935)** and **sqargue (1939)** suggested the method of early testing that greatly effected by the nature and number of testers needed for efficient evaluation of inbred lines. **Sprague and Tatum (1942)** was the first to partition the total combining ability effects of the lines into GCA and SCA. The choice of suitable tester is important to maximize information on evaluating inbred lines for combining ability

The main objectives of the present work were:

1) To evaluate some inbred lines of maize.
2) Provide information of suitable testers for testing of inbred lines.
3) To estimate general and specific combining ability for several traits of maize.
4) To estimate heterosis percentage for grain yield relative to S.C. G.155, Pioneer 3080 and T.W.C. G. 352 as checks.

REVIEW OF LITERATURE

2. REVIEW OF LITERATURE

The available literature concerning this study can be reviewed under the following headings:

2.1. Nature and number of testers.

2.2. Combining ability effects.

2.3. Genotypes x environmental interaction.

2.4. Heterosis.

2.1. Nature and number of testers.

The problem confronting breeders is the number of testers required for efficient evaluation of lines for GCA. Selecting suitable testers is the first and important step in evaluating inbred lines in maize breeding program. Review on the nature of testers is presented as follows:

Davis (1927) was the first to suggest the use of inbred, open pollinated varieties as a method for evaluating maize inbred lines.

Al-Naggar *et al.* (1997) studied effectiveness of different testers; narrow, medium and broad genetic base in evaluating combining ability of inbred lines of maize. They concluded that inbred tester sd.7 was the most powerful tester for the maximization of mean grain yield of the test crosses. The single cross tester S.C. 10 was the best based on the ability to reduce the magnitude of interaction variance of test cross x environment and provide of favorable SCA effects. They suggested that narrow or medium base testers are useful for evaluation of GCA of lines.

Abdel-Sattar (1998) top crossed twenty-four inbred lines were divided into two groups. First group (Consisted of 12 inbred lines) to each of Giza-2, T.W.C.310 and D.C 215 giving a total of 36 top crosses. Second group was top crossed to each of Giza-2, D.C. 204 and S.C. 10 giving a total 36 top crosses. They found that the testers D.C. 215 and T.W.C. 310 in the first set gave highest positive GCA effects for grain yield and number of kernels/ row. However the tester S.C.10 was the best general combiner for grain yield/ plant and its components in the second set.

Soliman and Sadek (1998) top crossed ten white maize inbred lines with three line testers and they found that the tester inbred line Gm.30 showed the highest significant GCA estimate for grain yield.

Sultan (1998) top crossed fourteen yellow maize inbred lines with two line testers, i.e. Gm-1002 and Gm-1004 and considered the two testers as best testers in classification inbred lines into high vrs low yielding ability.

Sadek *et al.* (2000) top crossed twenty white maize inbred lines to each of two line testers, i.e. Sd-7 and Sd-63 and they found that the tester line Sd-7 was the best combiner for grain yield while the tester inbred line Sd-63 showed desirable GCA effects for earliness and shortness.

Soliman *et al.* (2001) top crossed fourteen S_3 yellow maize inbred lines derived from the wide genetic base population Giza-45 (Ev-3) to each of three yellow maize inbred testers, i.e. Gz-638, Gm-1002 and Gm-1021. They found that inbred tester Gm-1021 manifested highest average performance of grain yield compared to test crosses of Gz-638 or Gm-1002.

Venkatesh *et al.* (2001) carried out line x tester analysis to determine the combining ability of modified single cross hybrids through their crosses and they inferred that among the sister line crosses used as female parents, (A_1 x A^-_1), (A_7 x A^-_7), (A_8 x A^-

$_8$), (A_{10} x A^{*}_{10}) and (A_{11} x A^{*}_{11}) are the best general combiners. Among the exotic testers that were used CML 290 had to be the best combiner. The indigenous tester CM111 widely used in the Indian maize program also showed its potential as a good tester.

Dodiya and Joshi (2002) mated twenty diverse advanced stage lines of maize with three inbred lines (testers) in Line x tester design and they found that T_1 had desired significant GCA effects for 100-grain weight and harvest index but best combiner for ear size and Stover yield. T_3 had desired significant GCA effects for grain yield and Stover yield.

Amer *et al.* (2003) crossed new seven yellow inbred lines of maize with four testers i.e. The inbred line L-121, two promising single crosses (Sk-21 and Sk-22) and one three way cross (T.W.C. 351) and they found that the inbred tester L-121 showed the best desirable GCA effect for grain yield and ear length. Moreover, the testers, S.C. Sk-21 and S.C. SK-22 were the best general combiners for ear height and ear diameter.

Abdel-Sattar (2004) crossed five inbred lines of maize in three levels of inbreeding (S_3, S_4 and S_5) to each of three different testers, i.e. S.C 122, T.W.C 310 and T.3057. He reported that the best parental tester for different traits were the broad genetic tester T.W.C.310.

Aly (2004) crossed thirty nine yellow and white inbred lines (S_8) of maize to each of the two testers, i.e. D.C. Dahab and synthetic variety Giza-2. He found that Dahab had desirable GCA effects for most of studied traits and this may be attributed to it had a narrower genetic base than Giza-2.

Amer (2004) top crossed eighteen new white inbred lines of maize to the three testers, i.e. Line Sk-7001/8, S.C. Sk-17 and Giza-2. He reported that the tester inbred line Sk-7001/8 had desirable significant GCA effects for short plant and ear position. While, the tester S.C. Sk-17 had desirable significant GCA effects for earliness, short plant, grain yield, ear length and ear diameter. Giza-2 as a tester had downer favorable genes for no. of rows/ ear and 100- kernel weight (g.).

Ibrahim and Motawei (2004) top crossed fourteen inbred lines of maize to the three testers, i.e. Sk-7001/8, S.C.Sk-17 and Gz-2. They found the inbred tester Sk-7001/8 showed the best desirable GCA effects for number of rows/ ear. Moreover, the tester S.C. SK-17 was the best combiner for grain yield and number of kernels/ row. While the tester Gz-2 was the best general combiner for earliness and short plants.

Mosa (2004) top crossed new white twenty seven inbred lines of maize to the two testers. i.e. homozygous inbred line GM-4 and heterozygous promising single cross sakha-1. the studied traits were silking date, plant and ear heights, grain yield, ear length, ear diameter, number of rows/ ear, number of kernels/ row and 100 kernel weight. He found that top crosses involving heterozygous S.C. Sk-1 as a common tester showed the heighest means for all traits and the widest range for all traits except plant height compared with top crosses involving homozygous inbred line Gm-4 as a common tester. Consequently, the heterozygous S.C. Sk-1 was the best tester for evaluating the inbred lines in top crosses. The heterozygous S.C. SK-1 as tester was the best general combiner for grain yield, ear length, number of rows/ ear, number of kernels/ row and 100-kernel weight. While the homozygous inbred line Gm-4 as tester was the best combiner for silking date, plant and ear heights and ear diameter.

Mosa *et al.* (2004) top crossed nine inbred lines of yellow maize to the three testers i.e. L-121, S.C. Sk-52 and composite - 21 and they found that the parental testers that exhibited better general combining ability were L-121 for grain yield/ plant. S.C. Sk-52 for number of rows/ ear and ear position and composite-21 for number of kernels/ row.

Abd El-Moula (2005) Top crossed twenty yellow maize inbred lines (S_4) to each of three testers, i.e. Gz-45 (base population) and two elite inbred lines (Gm-1001 and Gm-1004). He found that the tester lines Gm-1001 was the best combiner for grain yield and no. of ears/ 100 plants. While, the tester Gm-1004 showed desirable GCA for shortness and tester pop-45 for earliness and shortness.

Ibrahim and Osman (2005) top crossed new fifteen white inbred line of maize with the two tester lines, i.e. Sids-63 and Sakha-9195. They indicated that the tester line Sk-9195 had desirable significant GCA effects for earliness, ear length, number of rows/ ear, 100-kernel weight and grain yield (ard/fed). While, the second tester (Sd-63) had favorable genes for ear diameter.

Motawei *et al.* (2005) crossed twenty-nine inbred lines of yellow maize derived from S_5 generation with two genetically diverse inbred testers. The top-crosses were divided into two different sets: set-I included 28 top-crosses and set-II included 30 top crosses. They found that the tester Gm-1001 was a good general combiner for ear position, no. of rows/ear and ear diameter in the two sets of top crosses and for grain yield in set II. While tester line sk-6241 had favorable alleles for days to 50% silking, no. of ears/100 plants and no. of kernels/ row.

2.2 Combining ability:

Combining ability of inbred lines in the ultimate factor determining future usefulness of the lines for hybrids. combining ability initially was general concept considered collectively for classifying an inbred line relative to its cross performance.

Al-Naggar *et al.* (1997) found that the inbred testers Sd-7, Sd-86 and S.C. 10 gave the highest GCA effects for grain yield. The range between low and high estimates of SCA effects for grain yield was widest for Sd-7 followed by S.C.10.

Abdel-sattar (1998) top crossed twenty-four inbred lines were divided into two groups. First group, (consisted of 12 inbred lines) to each of Giza-2, T.W.C. 310 and D.C. 215. Second group was top crossed to each of Giza-2, D.C. 204 and S.C. 10. The studied traits were grain yield/ plant, plant height, ear height, ear length, ear diameter, number of rows/ ear and number of kernels/ row. He found that the variance associated with SCA was more important than σ^2 GCA for all traits in two sets revealed that the non-additive component of gene action had the major role in the inheritance of all traits.

Sultan (1998) top crossed fourteen yellow maize inbred lines with two line testers, i.e. Gm-1002 and Gm-1004 to estimate GCA and SCA for days to 50 % silking, plant height, ear position (%), number of ears/ 100 plants, ear length and diameter, number of rows/ ear, number of kernels/ row, 100-kernel weight and grain yield were calculated. He found that variance magnitude due to GCA was higher than that due to SCA. This indicated that additive genetic variance was the major source of variation responsible for the inheritance of grain yield and other agronomic traits.

El-Zeir (1999) mated ten maize inbred lines to four testers and found that additive genetic effects among lines were the major source of genetic variance responsible for all studied traits except ear height and ear length.

El-Zeir *et al.* (2000) top crossed seventeen inbred lines of maize to two testers. They found that non-additive genetic variance play an important role in the inheritance for grain yield, ear length, number of kernels/ row and weight of 100-kernel. While the additive genetic variance played an important role in the inheritance for silking date, plant height, ear height and number of rows/ ear.

Gado (2000) crossed seventeen yellow maize inbred lines with two testers, i.e. Gm-2 and Gm-9. He estimated GCA and SCA for days to 50 % silking, plant height, ear height, ear length, ear diameter, number of rows/ ear, number of grains/ row, 100-grain weight and grain yield (ard./fed.). He indicated that the additive genetic variance was the major source of variation responsible for the inheritance of these traits.

Sadek *et al.* (2000) top crossed twenty white maize inbred lines to each of two line testers, i.e. Sd-7 and Sd-63. They estimated GCA and SCA for grain yield, days to 50% silking, no. of ears/ 100 plant and plant and ear heights. They found that variance magnitude due to SCA was higher than that due to GCA. This indicated that non-additive genetic variance was the major source of genetic variation responsible for the inheritance of grain yield and other traits.

Soliman (2000) top crossed sixteen yellow maize inbred lines to each of three different testers. i.e. Gz-45 and two elite inbred lines, Gm-1001 and Gm-1021. He estimated GCA and SCA for grain yield, number of days to mid silking, plant height, ear position and number of ears/ 100 plants. He found that the magnitude of σ^2 SCA among lines for grain yield was larger than that of σ^2 GCA. On the contrary σ^2 GCA was greetar than σ^2 SCA for the other traits.

Barakat(2001) top crossed sixteen white maize inbred lines to each of the two line testers, i.e. Sd-7 and Sd-63 to estimate GCA and SCA for days to 50% silking, plant height, ear height, number of ears/ 100 plants, grain yield / plant and per feddan, ear length and diameter, number of rows/ ear and 100-kernel weight were calculated. He found that variance magnitude due to GCA was higher than that due to SCA. This indicated that additive genetic variance was the major source of variation responsible for the inheritance of grain yield and other agronomic traits.

Dubey *et al.* (2001) crossed fifteen diverse early maturing white seeded inbred lines of maize with three testers. The data were recorded on grain yield and maturity traits. They reported that the ratio of σ^2 SCA/σ^2 GCA was greater than one for all characters. This indicated the preponderance of non-additive variance in the expression of traits under study.

Mahmoud *et al.* (2001) crossed nineteen white maize lines to each of two elite inbred tester lines Sd-7 and Sd-34 to estimate combining ability effects for grain yield/fed., days to mid silking, plant height and ear placement (%). They reported that non-additive was more important than additive gene action in the inheritance of grain yield, whereas additive gene action was comprised most of the genetic variance of other studied traits.

Soliman *et al.* (2001) top crossed fourteen S_3 yellow maize inbred lines to each of three yellow maize inbred testers. The studied traits were grain yield, silking date, plant height and ear position. They found that the magnitude of the ratio of general to specific combining ability variance (σ^2GCA/σ^2SCA) revealed that the additive Component of gene action had the major role in the inheritance of all traits.

Soliman *et al.* (2001) top crossed eighteen yellow maize inbred lines to each of three broad genetic base testers namely pop.-59E, pop. 21 and pop.-Fat-3 to estimate the combining ability effects and determine the type of gene action for grain yield. They indicated that the magnitude of dominance (σ^2D) gene effects was more important than additive (σ^2A) genetic effects in controlling that trait.

Amer *et al.* (2002) reported that non additive genetic variances played an important role in the inheritance for grain yield and number of kernels/row. While the additive genetic variance played an important role in the inheritance for silking date, plant and ear height, ear length, ear diameter, number of rows/ ear and weight of 100-kernel.

Dodiya and Joshi (2002) mated twenty diverse advanced stage inbred lines of maize with three inbred lines (testers) in line x tester design. The studied traits were grain yield/plant,

plant height, days to 50% brown husk, ear size, 100 grain weight, stover yield and harvest index. They found that higher values of σ^2 SCA than σ^2 GCA (pooled) for all characters in all environments indicated the importance of non-additive variances in control of all the characters studied.

Joshi *et al.* (2002) crossed fifteen diverse early maturing white seed colour inbred lines of maize with three testers in line x tester design. The data were recorded on yield and yield contributing traits. They indicated that the expression of both GCA and SCA were influenced by the environmental fluctuation for these traits, A higher proportion of σ^2 SCA between σ^2 SCA and GCA also indicated that the additive x non-additive and non-additive interaction were significantly higher among the hybrids which would be important in the hybrids.

Amer *et al.* (2003) crossed seven new yellow inbred lines of maize with four testers and they found that additive was more important than non-additive genetic variance for all traits.

El-Shenawy *et al.* (2003) indicated that the σ^2 GCA played a greater portion in the inheritance of ear length, number of rows/ear, silking date, plant height and ear height. While, σ^2 SCA played the major role in the inheritance of grain yield and number of kernels/ row.

Abdel-sattar (2004) indicated that the ratios of GCA/SCA through all self generations showed the greatest role of dominance variance (σ^2_D) than of additive variance (σ^2_A). Lines contributed much more than the testers to the total genetic variation.

Aly (2004) crossed thirty nine yellow and white inbred lines of maize to each of two testers D.C. Dahab and synthetic variety Giza-2. He reported that the magnitude of σ^2 SCA was larger than that of σ^2 GCA for all studied traits at both locations and combined data indicated the non-additive was found to be more important than additive gene effect for all studied traits.

Amer (2004) top crossed eighteen new white inbred lines of maize to three testers, i.e. line, S.C. Sk-17 and Giza-2 to estimate combining ability for silking date, plant height, ear position, grain yield (ard./ fed.), ear length, ear diameter, number of rows/ear, number of kernels/row and 100-kernel weight. He mentioned that the additive type of gene action was more important than non-additive type of gene action in inheritance of all studied traits except ear position and ear diameter.

Ibrahim and Motawei (2004) mentioned that the additive genetic variance was more important for grain yield, weight of 100 grain, plant height and ear height. While, non-additive genetic variance was an important for number of kernels/row, ear diameter and silking date.

Mahmoud and Abd El-Azeem (2004) top crossed twenty three yellow inbred lines of maize to two testers, i.e. Gm-1004 and Gm-1021. GCA and SCA as well as genetic parameters estimated for days to 50% silking, plant height, ear height and grain yield traits were calculated. They found that the magnitude of σ^2 GCA (additive genetic variance) for all traits was larger than that of σ^2 SCA (non-additive genetic variance).

Mosa (2004) reported that the non-additive type of gene action were important in controlling the behavior of silking date, plant height, grain yield, ear length, number of kernels/row and 100 kernel weight. While the additive type of gene action played the major contribution in the inheritance of ear height, ear diameter and number of rows/ear.

Mosa *et al.* (2004) top crossed nine inbred lines of yellow maize to the three testers. The data were recorded for grain yield /plant, number of rows/ ear, number of kernels/row and ear position (%). They reported that additive genetic variance

(GCA) was predominating than non-additive genetic variance (SCA) in the inheritance of all traits.

Abd El-Moula (2005) top crossed twenty yellow maize inbred lines (S_4) to each of three testers, i.e. Gz-45 (base population) and two elite inbred lines, Gm-1001 and Gm-1004. The studied traits were grain yield, days to 50% silking, plant and ear heights and no. of ears/ 100 plants. He reported that variance magnitude due to SCA was higher than that due to GCA. This indicated that non-additive genetic variance was the major source of genetic variation for the inheritance of grain yield and other traits.

Ibrahim and Osman (2005) top crossed new fifteen white inbred lines of maize with two tester line. The data collected were days to 50% silking, plant height, ear height, ear length, ear diameter, number of rows/ ear, number of kernels/ row, 100-kernel weight and grain yield. They indicated that additive gene action was more important than non-additive one in the inheritance for all of the studied traits.

Motawei *et al.* (2005) reported that the additive genetic variance (σ^2 GCA) played an important role in the inheritance of ear position%, no. of rows/ ear and ear diameter in the two sets and days to 50% silking, no. of ears/ 100 plants and 100 kernel weight within set-I. Mean while, non-additive genetic variance was more important in the expression of grain yield, no. of kernels/ row and ear length in the two sets.

2.3. Genotype x environment interaction:

El-Hosary (1988) studied 20 new inbred lines by top cross method in maize. He found that the interaction between years and both types of combining ability were highly significant for all traits except plant height.

Sedhom (1992) studied thirty two inbred lines by top cross method. He found that the interaction between specific combining ability and environment was much higher than those of general combining ability for most studied traits.

Sedhom (1994) evaluated seven inbred lines using ten different testers and found that specific combining ability x years interaction was higher than that of general combining ability x years interaction for all traits except silking date, revealing that non additive gene effects seemed to be more affected by environment rather than additive ones.

Shehata *et al.* (1997) crossed five inbred maize lines with five narrow base elite inbred testers. They found that the interaction between entries (genotypes) by locations and its components, i.e. parent x location, crosses x location and parent vs. crosses x location were highly significant differences for all studied traits.

Sultan (1998) top crossed fourteen yellow maize inbred lines with two line testers. He found that both inbreds and testers significantly interacted with environments in case of grain yield and some other traits and indicated that the interaction of GCA by location was markedly higher and positive for grain yield and other traits.

El-Zeir (1999) mated ten maize inbred lines to four testers and found that the interaction between genotypes x locations for most attributes were significant.

El-Zeir *et al.* (2000) crossed seventeen inbred lines of maize with two testers. They found that additive type of gene action was found to be more affected by environment than non-additive type of gene action in most cases.

Gado (2000) evaluated seventeen yellow maize inbred lines using two testers and found that the interaction of inbreds with environment was significant in case of ear length and grain yield. Also significant interaction of testers with environment was also detected for number of days to 50% silking, plant height, ear height and ear diameter. The interaction of GCA by locations was higher and positive for grain yield and other traits except silking date, ear length and number of grain/ row.

Sadek ***et al.*** **(2000)** evaluated white maize inbred lines with two line tester. They found that both inbreds and testers significantly interacted with environments for most traits. Also, the interaction of SCA by location was higher than that of GCA ones for all studied traits.

Soliman (2000) crossed sixteen yellow maize inbred lines with three different testers. He found that the interaction of both lines and testers with locations were highly significant for grain yield, days to mid silking. Also, mean squares due to tester x location interaction was significant for plant height.

Barakat (2001) evaluated sixteen white maize inbred lines with two line testers. He found that both inbreds and testers significantly interacted with environments in all traits except plant height, ear height and number of ears / plant. However, the interaction of environments x lines x testers was significant for only grain yield/ plant and /feddan and ear length. Also, the interaction of GCA by locations was markedly higher and positive for grain yield and other traits.

Mahmoud ***et al.*** **(2001)** evaluated nineteen white maize lines with two elite inbred tester lines. They reported that non-additive gene action was affected more by environmental conditions than additive gene action for all studied traits.

Soliman ***et al.*** **(2001)** top crossed fourteen S_3 yellow maize inbred lines to each of three yellow maize inbred testers. They found that the magnitude of the interactions between σ^2 SCA x location was generally higher than σ^2 GCA x location for the studied traits except grain yield.

Amer ***et al.*** **(2002)** evaluated eight inbred lines of maize to four testers. They found that additive type of gene action was more affected by environment than non-additive type of gene action for all studied traits except ear length and ear diameter.

Dodiya and Joshi (2002) they found that environments played important role in the expression of GCA and SCA variance. The performance of the parents and their GCA effects varied in different environments which may be attributed to genotype x environment interaction.

Amer ***et al.*** **(2003)** evaluated seven new yellow inbred lines of maize to four testers. They found that additive more interacted by location than non-additive variance for grain yield, ear length, no. of rows/ear and no. of kernels/ row traits. While non-additive more influenced by location than additive variance for days to mid-silk, plant height, ear height and ear diameter traits.

EL-Shenawy ***et al.*** **(2003)** top crossed eight maize inbred lines to four testers. They found that the interactions were significant for most studied traits and the interaction between σ^2 GCA x location was greater than σ^2 SCA x location interaction for all studied traits except number of rows/ear.

Aly (2004) crossed thirty nine yellow and white inbred maize lines to two testers. They found that the variance interaction of σ^2 GCA x location were larger than those of σ^2 GCA_T x location for studied traits indicated that the σ^2 GCA for inbred lines was more affected by environments than for testers. Also, the combined data revealed that variance of σ^2 GCA x location interaction was either negative or smaller than variance of σ^2 SCA x Location interaction for all traits under study. these results indicated that non-additive type of gene action is more affected by environmental conditions than variance due to additive effects.

Ibrahim and Motawei (2004) top crossed fourteen inbred lines of maize to three testers. They reported that non- additive genetic variance was more affected interacted by locations than additive genetic variance for all studied traits except number of kernels/ row and ear diameter.

Mahmoud and Abdel-Azeem (2004) top crossed twenty three yellow inbred lines of maize to two testers. They found that the interaction of lines x location was highly significant for grain yield and significant for ear height. Tester x locations interaction was highly significant for ear height. Also, the interaction of lines x testers x locations was highly significant for grain yield.

Mosa (2004) crossed twenty seven inbred lines of maize to two testers. He found that a line x locations interaction was significant for all traits except number of rows/ear and 100-kernel weight. While testers x locations and line x testers x location interaction were not significant for most traits. The non-additive types of gene action were more sensitive to environmental differences than additive types of gene action for most traits.

Mosa *et al.* (2004) evaluated nine inbred lines of yellow maize to three testers. They reported that the non-additive genetic variance showed obvious interaction with locations for grain yield / plant, number of rows/ear and number of kernels/row.

Abd El-Moula (2005) top crossed twenty yellow maize inbred lines to each three testers. He found that the interaction of SCA with location was markedly higher than that of GCA ones for all studied traits.

Ibrahim and Osman (2005) evaluated new fifteen white inbred lines of maize to two tester lines. They reported that Genotypes x location interaction was significant for some traits i.e. grain yield, 100-kernel weight and ear height.

Motawei *et al.* (2005) crossed twenty-nine inbred lines of yellow maize with two genetically diverse inbred testers. They found that the magnitude of σ^2SCA was more affected by location in most studied traits and σ^2GCA was more sensitive to locations than σ^2SCA in the inheritance of days to 50% silking within two sets.

Seiam (2007) top crossed ten maize inbred lines to three inbred tester. He found that variation due to lines x locations interaction was highly significant for all studied traits. The variation due to tester x locations interaction was also significant for yield and plant height. The variation due to interaction of line x tester x location was highly significant for all studied traits.

2.4. Heterosis:

Shehata *et al.* (1997) crossed five maize inbred lines with five narrow base elite inbred testers. They found that one single cross (Gm-2 x Sd-35) gave the highest mean value and out yielded the recommended check single cross 10 by 4% while four hybrids (Gm-1 x Sd-7), (Gm-1 x Sd-35), (Gm-2 x Sd-34) and (Gm-5 x Sd-7) gave insignificant mean values grain yield/ plant or feddan relative to S.C. 10. The five single crosses surpassed and out yielded the two check hybrids S.C.9 and S.C. 103 by 15%. The highest value of heterotic effects relative to mid and better parent were obtained from the crosses, i.e. (Gm-1 x Sd-7), (Gm-1 x Sd-35), (Gm-2 x Sd-35), (Gm-3 x Sd-35), (Gm-3 x Sd-62), (Gm-3 x Sd-63), Gm-5 x Sd-7), (Gm-5 x Sd-35)and (Gm-5 x Sd-63) for grain yield and its components, significant negative heterotic effect for earliness were observed for the previous single crosses.

Soliman and Sadek (1998) top crossed ten white inbred maize lines with three inbred testers. They found that top cross (Gm-26 x Gm-30) out yielded the check hybrid Giza 10 by 7.9, 3.3 and 5.9 % at Sakha, Sids and their combined data , respectively.

El-Zeir (1999) mated ten maize inbred lines to four testers. He found that four single crosses (P4 x Sd-7), (P9 x Sd-62), (P10 x Sd-62) and (P7 x Sd-63) gave the highest mean values for yield and yield components in addition to earliness and shorter plants with low ear placement than the check hybrid S.C 10.

El-Zeir ***et al.*** **(2000)** top crossed seventeen inbred lines of maize to two testers. They found that top crosses Sk-7005/10 x Sd-7 and Sk-7005/11 x Sd-7 gave the higher mean values for yield and yield components. In addition to earliness, shorter plant and ear height than the check hybrid single cross-10.

Sadek ***et al.*** **(2000)** top crossed twenty white maize inbred lines to each of two line testers. They found that eleven out of 40 top crosses exhibited significantly positive SCA effects for grain yield. Further more, six out of those eleven top crosses, i.e. (Gm-4 x Sd-7), (Sd-1011 x Sd-7), (Gm-12A x Sd-7), (Sd-1006 x Sd-63), (Sd-1007 x Sd-63) and (Sd-98-9 x Sd-63) out yielded the commercial check S.C.10 (Best check) by 23.5, 19.8, 15.1, 11.7, 9.1 and 8.1 %.

Soliman (2000) top crossed sixteen yellow maize inbred lines to each of three different testers, i.e. Gz-45 and two elite inbred lines. He showed that 12 out of 48 top crosses surpassed significantly positive SCA effects. Five of them L-14, L-4, L-3 and L-7 crossed with inbred line Gm-1021 and (L-14 x Gm-1002) manifested highly significant over yielded the commercial hybrid S.C. 161 (30.27 ard./ fed.) by 28.9, 27.1, 19.3, 18.8 and 16.3%.

Mahmoud ***et al.*** **(2001)** crossed nineteen white maize inbred lines to each of two elite inbred tester lines. They indicated that the most superior cross (L-14 x Sd-34) possessed highly significant and positive SCA effects and manifested significantly out yielded (36.77 ard./ fed.) the best commercial hybrid S.C. 10 (34.51 ard./ fed.) by 6.5%. Also, this cross was insignificantly different from S.C. 10 for the other studied traits.

Soliman ***et al.*** **(2001)** top crossed fourteen yellow maize inbred lines to each of three yellow maize inbred testers. They found that Gm-1021 crossed to inbreds L-10, L-2 and L-7 produced the best single crosses which significantly out yielded the yellow commercial check hybrid S.C.161 (30.60 ard./fed.) by 22.9, 18.3 and 16.7 %.

Amer *et al.* (2002) mated eight inbred lines of maize to four testers, i.e. Sd-34, S.C.Sk-1, S.C.122 and T.W.C. 322. They reported that one top cross (Gm-4 x S.C. Sk1) produced yield of 31.51 ard./ fed. and surpassed these of commercial hybrids S.C.122 (27.69) and T.W.C. 322 (27.23) ard./ fed. Mean while nine top crosses (Sd-63 x Sd-34), (Sk-8202 x Sd-34), (Sk-8375 x Sd-34), (Sk-8375 x (T.W.C 322), (Gm-4 x S.C. 122), (Sd-63 x Sk-1), (Sk-8375 x S.C. Sk-1), (Sk-8375 x S.C. 122) and (Gm-4 x T.W.C 322) were not significant compared to S.C. 122 and T.W.C 322 for grain yield and most desirable traits.

Amer (2004) top crossed eighteen white inbred lines of maize to three testers, i.e. line Sk-7001/8, S.C. Sk-17 and Giza-2. He found that two single crosses i.e. Sk-7/15 x Sk-7001/8 (37.62 ard./ fed.) and Sk-7/28 x Sk-7001/8 (36.22 ard./ fed) were significantly superior than the commercial S.C. 10 (33.40 ard./fed.) for grain yield and most agronomic traits. Also, three T.W.C. ie. S.C. Sk-17 x Sk 712 (37.41 ard./ fed.), S.C. Sk-17 x Sk- 7/15 (37.07 ard./fed.) and S.C. Sk-17 x Sk-7/28 (35.26 ard./fed.) were significantly superior than the commercial T.W.C. 310 (32.30 ard./ fed.) for grain yield and most agronomic traits.

Ibrahim and Motawei (2004) top crossed fourteen inbred lines of maize to three testers i.e. Sk-7001/8, S.C. Sk-17 and Gz-2. They found that two top crosses Sk-63-32 x S.C. Sk-17 and Sk-63-32 x Sk-7001/8 did not differ significantly from the check variety S.C. 10. Moreover, fourteen top crosses exhibited significant differences than check variety T.W.C. 310.

Mosa (2004) top crossed white twenty-seven inbred lines of maize to two testers, i.e. inbred line Gm-4 and single cross Sk-1. He indicated that four single crosses i.e Sk-5015/7 x Gm-4 ard./fed)., Sk-5017/19 x Gm-4 (34.75 ard./ fed)., Sk-5015/4 x Gm-4 (32.98 ard./ fed) and Sk-5016/14 x Gm-4 (32.82 ard./ fed). Were superior for grain yield compared to S.C. 10 (32.68 ard./fed).

Mosa *et al.* (2004) top crossed nine inbred lines of yellow maize to three testers i.e. L-121, S.C. Sk-52 and composite-21. They found that the desirable heterotic effects for grain yield / plant relative to the check S.C. 155 were recorded for top cross Sk-7070 x L-121 (24.65%). Whereas, the highest heterosis values relative to the check T.W.C. 352 were detected for the top crosses Sk-7070 x L21 (28.82%) and Sk-7078/2 x L121 (17.73%).

Abd El-Moula (2005) top crossed twenty yellow maize inbred lines to each of three testers, i.e. Gz-45 and two elite inbred lines. He found that crosses L-2, L-10, L-11, L-13, L-15 and L-18 x Gm-1001 were the most superior and promising single crosses, since they outyielded the commercial check S.C. 155 by 40, 15.2, 26, 29.3, 30.8 and 20.7 %.

Ibrahim and Osman (2005) top crossed fifteen white inbred lines of maize with two tester line. They found that two single crosses i.e. Sk. 9195 x Sk-5027/6 (32.16 ard./ fed.) and Sk-9195 x 5037/15 (31.44 ard./ fed.) did not differ significantly than the commercial hybrid S.C. 10 (31.39 ard./ fed.) for grain yield and some agronomic traits.

Motawei *et al.* (2005) crossed twenty-nine inbred lines of yellow maize with two inbred testers. They found that one top cross (Sk-5001/11 x Sk6241) out yielded the best check S.C. 155. Meanwhile, in set-II one top cross (Sk-5001/26 x Gm-1001) was superior than the two checks and two crosses (Sk-5001/17 x Sk-6241) and (Sk-5001/18 x Gm-1001) were superior than the check Pioneer 3080 of grain yield.

Seiam (2007) top crossed ten white maize inbred lines to three inbred testers. He found that crosses of lines no. 1, 3, 6 and

8 across testers ranged from 27.98 to 31.35 ard./ fed. and significantly out yielded the highest yielding check S.C. 10 (26.77 ard./ fed.) by 5.7, 17.1, 6.35 and 4.5 % , respectively .

MATERIALS & METHODS

3. MATERIALS AND METHODS

The experimental work of this study was carried out at the Experiment Research Station of Moshtohor, Benha University, Qalyubiya Governorate, Egypt during the two successive seasons 2006 and 2007.

Plant materials

1- A total of twenty (*Zea mays* L.) yellow inbred lines were developed by Prof. Dr. Ali Abd El-Maksoud El-Hosary Prof. of Agronomy, Fac. of Agric., Moshtohor, Benha Univ. and were used to establish the experiment materials for several characters among inbred lines under study. These lines were selected on bases of yielding ability and other desirable plant aspects. The plant materials were selected with a wide range of diversity for several traits.

2- Three testers of yellow maize were used in this investigation to make all possible line x tester crosses. The three testers used in this study were chosen to represent wide difference in relation to the tested lines. i.e. (Gem. Pop.) representing broad genetic base, single cross (El-Hosary 101) representing approximately narrow genetic base and the inbred line 100 representing narrow genetic base. The code number, names and origin of these inbred lines and testers are present in (Table 1).

3- Three check varieties were used in this investigation their names are single cross Giza 155, S. C. Pioneer 3080 and three way cross Giza 352.

Table (1): The code number, name and origin of the studied twenty inbred lines and the three testers.

Code number	name	Origin
L1	M 319	Egypt
L2	M 103	Egypt
L3	M 202-A	Egypt
L4	M 210-B	Egypt
L5	M 202-D	Egypt
L6	M L-156	Egypt
L7	M 210-B-4	Egypt
L8	M 210-I	Egypt
L9	M 1012	Egypt
L10	M 106	Egypt
L11	M 101	Egypt
L12	M 1006	Egypt
L13	M 161	Egypt
L14	M 318-J	Egypt
L15	M 304-2	Egypt
L16	M 311-4	Egypt
L17	M 302-f	Egypt
L18	M 210-2	Egypt
L19	M 1006-B	Egypt
L20	M120-A	Egypt
T1	(Gem. Pop.)	Egypt
T2	S.C. (El-Hosary 101)	Egypt
T3	Inbred line (100)	Egypt

Field experiments

In the first summer season 2006 seeds of the twenty inbred lines and three testers were split sown on 25th May, 30th May and 8th June to avoid differences in flowering time and to secure enough hybrid seed. All possible top crosses combinations were made between the twenty inbred lines and three testers by hand method giving a total of 60 top crosses.

Each top cross was constituted by collecting pollen from 40-50 protected tassels, representing the tester, then top crossing into protected silks of 15 plants, representing the inbred lines by hand pollinating.

In the second summer, season 2007 two adjacent experiments were conducted on two sowing dates. i.e. 15th June and 4th July. In each experiment the twenty inbred lines, three testers and their 60 top crosses as well as the three check hybrids (S.C. G.155 and S.C. Pioneer 3080 and T.W.C. G.352) were grown in a randomized complete block design with three replications. Each plot consisted of two ridges of 5 m length and 70 cm width. Each hill was spaced 25 cm apart with two kernels planted per hill and later thinned to one plant per hill. The plots were irrigated after sowing. The second irrigation was given after 21 days from sowing. The plants were then irrigated at intervals of 10-15 days. The plots were informally fertilized at the rate of 120 kg of nitrogen per faddan given before the first and second irrigations. The other cultural practices of maize growing were properly practiced.

Characters studied

Data for the following traits were recorded on ten individual guarded plants chosen at random from each plot, except for days to 50% pollen shedding, days to 50% silking and maturity dates where the plot mean basis were used.

A. Agronomic characters

1- Days to 50% pollen shedding (tasseling date) was recorded as the number of days from sowing to the day when 50 percent of the plants tasseled.

2- Days to 50% silking (silking date) was recorded as the number of days from sowing to the day when 50 percent of the plants silked.

3- Plant height (cm) was measured from soil surface to the top of tassel.

4- Ear height (cm) was measured to the nearest centimeter from soil surface to the top ear node.

5- Leaf area of upper ear (cm^2) was computed according to the formula; farther ear leaf length x farther ear leaf width x 0.75.

6- Ear husk degree was measured before harvest by using 1-9 Scale; where scores of 1, 2, 3, and 4 was given when the kernels of top ear were appeared about 4, 3, 2 and 1cm, respectively. Score 5 was given when the kernels of top ear don't shown and the husk longer equal to zero. Scores 6, 7, 8 and 9 were given when the husk was longer than the top of the ear 1, 2, 3 and 4 cm, respectively.

7- Maturity date was recorded as the number of days from sowing to the day when all husks of ears turned brown.

B. Yield and yield components

1- Ear length (cm).

2- Ear diameter (cm).

3- Number of rows/ear.

4- Number of Kernel/ row.

5- Weight of 100-kernel (g).

6- Ear weight/plant.

7- Grain yield per plant (g) adjusted at 15.5 % moisture content.

8- Shelling percentage was computed as 100 x (grain weight /ear weight).

Analysis of data in the experiment

Statistical analysis.

An ordinary analysis of variance was firstly performed for all traits in each sowing date to test the significant of all genotypes. Homogeneity of error variance was tested for each trait. This test revealed the validity of combined analysis of both sowing date for all studied traits. When differences among top crosses were found significant, line x tester analysis according to **Kempthorne (1957)** was done for each sowing date and combined over them (Table 2 and 3).

Table (2): Source of variation and degree of freedom for top crosses to each three testers at each sowing date.

S. O. V.	**d.f**
Replications	r- 1
Crosses	fm- 1
Lines	f- 1
Testers	m- 1
Lines x testers	(f-1)(m-1)
Error	(r-1)(fm-1)
Total	rfm-1

Where: r = Number of replications, m = Number of testers and f = Number of lines

Table (3): Combined analysis of variance of the two sowing dates and the expectations of mean squares.

S. O. V.	d.f	E.M.S
sowing date (D)	D-1	
Reps / sowing date	D (r-1)	
Crosses	fm- 1	
i) inbred	f- 1	M_1 $\sigma^2 e + r\sigma^2 fmD + rm\sigma^2 fD + rD\sigma^2 fm + rm\sigma^2 f$
ii) Testers	m- 1	M_2 $\sigma^2 e + r\sigma^2 fmD + rf\sigma^2 mD + rD\sigma^2 fm + rfD\sigma^2 m$
iii) inbred x testers	(f-1)(m-1)	M_3 $\sigma^2 e + r\sigma^2 fmD + rD\sigma^2 fm$
Crosses x sowing date	(fm -1)(D-1)	
i) inbred x sowing date	(f -1)(D-1)	M_4 $\sigma^2 e + r\sigma^2 fmD + rm\sigma^2 fD$
ii) Testers x sowing date	(m -1)(D-1)	M_5 $\sigma^2 e + r\sigma^2 fmD + rf\sigma^2 mD$
iii) inbred x testers x D	(m -1)(f-1)(D-1)	M_6 $\sigma^2 e + r\sigma^2 fmD$
Error	D(r-1)(fm-1)	M_7 $\sigma^2 e$

Where:

D: sowing date.

$\sigma^2 fD$: variance due to inbred x sowing date interaction.

$\sigma^2 f$: variance due to inbreds.

$\sigma^2 mD$: variance due to tester x sowing date interaction.

$\sigma^2 m$: variance due to testers.

$\sigma^2 fmD$: varianve due to inbred x tester x sowing date interaction.

$\sigma^2 mD$: variance due to inbred x tester interaction.

Estimation of general and specific combining ability effects:

The model used to estimate general and specific combining ability effects of the ijk th observation was:

$X_{ijk} = \mu + \hat{g}_i + \hat{g}_j + \hat{s}_{ij} + e_{ijk}$

Where:

μ =overall population mean

$\hat{g}_i$ = GCA effect of the i th male parent (tester).

$\hat{g}_j$ = GCA effect of the j th female parent (inbred).

$\hat{s}_{ij}$ = SCA effect of ij th cross combination.

e_{ijk} = the error associated with the Xijk observation.

I = number of male parent (tester) = 1, 2, …m.

J = number of female parent (inbred) = 1, 2, …f

K = number or replication = 1, 2, … r

The individual effects were estimated as follows:

a) GCA for inbred lines:

$$\hat{g}_i = \frac{X_{i..}}{tr} - \frac{X_{...}}{Itr}$$

Where:

Xi… = total of all i th female (inbred) parent over all male parents (testers) and replications.

X… = total of all females (inbreds) over all males (testers) and replications.

b) GCA for testers:

$$\hat{g}_t = \frac{X_{t..}}{lr} - \frac{X_{...}}{ltr}$$

Where:

Xt… = total of the t th male (tester) parent over all females (inbreds) and replications.

I = number of Lines

t = number of testers, r = number of replication

c) Specific combining ability effects:

$$\hat{s}_{ij} = \frac{XIt}{r} - \frac{XI}{tr} - \frac{Xt}{Ir} + \frac{X...}{Itr}$$

Where:

Xit = total of the it th hybrid combination over all replications.

Stander error for combining ability effects:

S.E. (GCA for inbred lines)	=	$\sqrt{(Me/rtD)}$
S.E. (GCA for testers)	=	$\sqrt{(Me/rID)}$
S.E. (SCA effects)	=	$\sqrt{(Me/rD)}$
S.E. ($\hat{g}_i$-$\hat{g}_j$) inbred	=	$\sqrt{(2Me/rtD)}$
S.E. ($\hat{g}_i$-$\hat{g}_j$) tester	=	$\sqrt{(2Me/rID)}$
S.E. ($\hat{s}_{ij}$ –$\hat{s}_{kl}$)	=	$\sqrt{(2Me/rD)}$

Where:

D = number of sowing dates.

Me = error variance.

Estimation of variance components:

The following variance components were estimated based on the expectations of the mean squares of combined analysis (Table 3).

i) $\sigma^2 f = \dfrac{M1 - M3 - M4 + M6}{rmD}$

ii) $\sigma^2 m = \dfrac{M2 - M3 - M5 + M6}{rfD}$

iii) $\sigma^2 fm = \dfrac{M3 - M6}{rD}$

iv) $\sigma^2 fD = \dfrac{M4 - M6}{rm}$

v) $\sigma^2 mD = \dfrac{M5 - M6}{rf}$

vi) $\sigma^2 fmD = \dfrac{M6 - M7}{r}$

Where:

$\sigma^2 f$ = Variance due to inbreds.

$\sigma^2 m$ = Variance due to testers.

$\sigma^2 fm$ = Variance due to inbred x tester interaction.

$\sigma^2 fD$ = Variance due to inbred x Sowing date.

$\sigma^2 mD$ = Variance due to tester x Sowing date.

$\sigma^2 fmD$ = Variance due to inbred x tester x Sowing date.

The covariance of half-sibs (H.S.) and the covariance of full-sibs (F.S.) were estimated as follows:

Covariance H.S. = $\frac{m\sigma^2 f + f\sigma^2 m}{m + f}$

σ^2 fm =(Cov. F.S. – 2 Cov. H.S).

Covariance F.S. = σ^2 fm + 2 Cov. H.S.

σ^2 GCA = Cov. H.S. = $\frac{m\sigma^2 f + f\sigma^2 m}{m + f}$

σ^2 SCA = (Cov. F.S. – 2 Cov. H.S.) = σ^2 fm

σ^2 GCA x sowing date = $\frac{m\sigma^2 fD + f\sigma^2 mD}{m + f}$

σ^2 SCA x Sowing date = σ^2 fmD

Heterosis:

Heterosis for each trait was calculated for each individual top cross as the percent deviation of F_1 mean performance from either S.C. G. 155, Pioneer 3080 and T.W.C. G. 352 average values for each experiment as well as the combined data as follows:

The check variety heterosis (heterobeltosis) = $\frac{\text{F1 - Check variety}}{\text{Check variety}}$ X 100

Appropriate L.S.D values were computed according to the following formulae to test the significance of these heterotic effects.

L.S.D. for heterosis relative to check variety = t x $\sqrt{\frac{2MSe}{r}}$

Where:

t: is the tabulated t value at a stated level of probability for the experimental error degree of freedom and r: is the number of replications.

RESULTS & DISCUSSION

4. RESULTS AND DISCUSSION

4.1. Analysis of variance:

Analysis of variance for the studied traits in separate planting dates as well as the combined analysis is presented in (Table 4). Test of homogeneity revealed the validity of the combined analysis over both sowing dates. Sowing dates mean squares were significant for all traits except number of rows/ ear, number of kernels/ row and shelling percentage, indicating over all differences between the two sowing dates, with mean values in early sowing being higher than those in late sowing for all traits except ear husk (Table 5). The increase in these traits at early sowing date may be due to the prevailing of favorable temperature and day length leading to greater vegetative growth, yield and its components of corn plants. Therefore, the first sowing date seemed to be non-stress environments. These results are in harmony with those obtained by **Nawar *et al.* (1998), El-Hosary and El-Badawy (2005), El-Hosary *et al.* (2006) and Sedhom *et al.* (2007).**

Crosses mean squares were significant for all the studied traits at both sowing dates as well as the combined analysis except ear diameter at early sowing date, indicating the wide diversity between the parental materials used in the present study. Significant crosses x sowing date mean squares were obtained for all traits except ear height, ear husk, and ear diameter, revealing that the tested crosses varied from each other and ranked differently from sowing date to another.

Lines mean squares were significant for all traits at early and late sowing dates as well as the combined over them, indicating the wide diversity among those inbred lines. Significant lines x sowing date mean squares were detected for all traits except tasseling date, ear height, ear husk, ear diameter and shelling%.

These finding indicate that parental inbred lines differ in their mean performance in most traits.

Significant mean squares due to testers were obtained for all traits in both sowing date as well as the combined analysis except maturity dates at both sowing date as well as the combined analysis, tasseling date, silking date, leaf area, ear diameter, number of kernels/ row at early sowing, and ear length at early sowing date and the combined analysis. Such results indicated a wide range of variability among parental testers. In addition, lines mean squares were much higher than those of testers for most studied traits. Such results revealed that lines contributed much more to the total variation as compared to testers. Therefore, the total GCA variance was due to inbred lines for most traits. Also, the interaction between tester x sowing date mean squares were significant for silking date, leaf area, ear length, ear diameter, no. of kernels/ row, ear weight/ plant, 100-kernel weight and grain yield/ plant. This indicated that the testers behaved somewhat differently from one sowing date to another.

Significant line x tester mean squares were obtained for all traits except ear diameter at both sowing dates as well as the combined analysis, ear husk, number of rows/ ear and number of kernels/ row at late sowing date and shelling percentage at early sowing date. Significant interaction between line x tester x sowing date mean squares were obtained for tasseling and silking dates, plant height, leaf area, no. of rows/ ear, 100-kernel weight, shelling percentage, ear weight/ plant and grain yield/ plant.

Table (4): Observed mean squares from ordinary analysis and combining ability for the studied traits.

Traits / S.O.V.	d.f		Tasseling date (Dayes to 50% shed)			Silking date (Dayes to 50% silk)			Maturity date		
	S	com	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb
Sowing date (D)		1			2006.94 **			2064.01 **			1941.38 **
Rep	2		8.82 **	2.87		0.80	0.97		1.22	8.34 *	
Rep/D		4			5.84 **			0.89			4.78
Crosses	59	59	3.85 **	6.95 **	7.49 **	2.93 **	7.85 **	7.83 **	13.65 **	6.71 **	15.45 **
Lines	19	19	7.50 **	8.39 **	14.75 **	5.25 **	8.39 **	12.25 **	26.98 **	7.61 **	26.31 **
Testers	2	2	2.77	7.72 **	8.60 **	0.72	5.74 **	3.85 **	1.40	0.17	1.20
Lines x testers	38	38	2.08 **	6.19 **	3.80 **	1.89 **	7.69 **	5.83 **	7.62 **	6.60 **	10.77 **
Crosses x d		59			3.31 **			2.95 **			4.91 **
Line x D		19			1.14			1.40 *			8.29 **
Testers x D		2			1.89			2.60 *			0.37
Line x Testers x D		38			4.47 **			3.75 **			3.46
Error	118	236	1.14	1.43	1.29	0.65	0.98	0.82	3.32	2.50	2.91
GCA			0.02	0.01	0.16	0.01	0.00	0.06	0.06	0.00	0.03
SCA			0.31	1.59	-0.11	0.41	2.24	0.35	1.43	1.37	1.22
GCA xD					0.01			-0.04			0.02
SCA x D					1.06			0.98			0.18

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

cont.

Traits / S.O.V.	d.f S	d.f com	Plant height Early sowing	Plant height Late sowing	Plant height comb	Ear height Early sowing	Ear height Late sowing	Ear height comb	Leaf area of upper ear Early sowing	Leaf area of upper ear Late sowing	Leaf area of upper ear comb
Sowing date (D)		1			17222.50 * *			4214.12 * *			386188.00 * *
Rep	2		37.95	22.43		399.68 * *	174.90		564.37	291.69	
Rep/D		4			30.19			287.29 * *			428.03
Crosses	59	59	552.48 * *	607.96 * *	1025.96 * *	197.41 * *	168.10 * *	307.91 * *	10673.72 * *	10607.89 * *	16327.08 * *
Lines	19	19	711.11 * *	724.00 * *	1279.08 * *	275.44 * *	185.38 * *	388.74 * *	20706.98 * *	16475.69 * *	31410.80 * *
Testers	2	2	1162.39 * *	1785.78 * *	2906.01 * *	323.98 * *	398.93 * *	720.50 * *	483.97	22164.64 * *	14599.21 * *
Lines x testers	38	38	441.07 * *	487.94 * *	800.45 * *	151.74 * *	147.31 * *	245.78 * *	6193.38 * *	7065.74 * *	8876.16 * *
Crosses x d		59			134.48 * *			57.60			4954.53 * *
Line x D		19			156.04 * *			72.08			5771.88 * *
Testers x D		2			42.15			2.41			8049.40 * *
Line x Testers x D		38			128.56 * *			53.27			4382.97 * *
Error	118	236	53.99	37.46	45.72	37.48	67.35	52.41	1028.71	1106.29	1067.50
GCA			1.08	1.16	19.15	0.44	0.20	4.71	43.26	34.20	168.13
SCA			129.03	150.16	111.98	38.09	26.65	32.09	1721.56	1986.48	748.87
GCA xD					16.28			4.08			35.03
SCA x D					27.61			0.28			1105.15

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

cont.

Traits / S.O.V.	d.f		Ear husk			Ear length			Ear diameter		
	S	com	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb
Sowing date (D)		1			26.14 **			19.17 **			8.52 **
Rep	2		1.34	2.87 **		1.84	0.75		0.25 *	0.18	
Rep/D		4			2.10 **			1.30			0.22 *
Crosses	59	59	1.59 **	1.12 **	2.42 **	3.29 **	5.19 **	5.69 **	0.08	0.17 **	0.16 **
Lines	19	19	2.92 **	2.39 **	4.98 **	4.47 **	7.00 **	7.58 **	0.12 **	0.25 **	0.28 **
Testers	2	2	3.51 **	1.62 *	4.87 **	0.79	7.81 **	3.36	0.04	0.51 **	0.21 *
Lines x testers	38	38	0.82 *	0.45	1.01 **	2.83 **	4.16 **	4.86 **	0.06	0.11	0.10
Crosses x d		**59**			0.28			2.80 **			0.09
Line x D		19			0.33			3.88 **			0.10
Testers x D		2			0.25			5.24 *			0.34 **
Line x Testers x D		38			0.26			2.12			0.07
Error	118	236	0.48	0.44	0.46	1.43	1.56	1.50	0.06	0.08	0.07
GCA			0.01	0.01	0.06	0.004	0.01	-0.03	0.0002	0.001	-0.0001
SCA			0.11	0.01	0.13	0.47	0.86	0.46	-0.001	0.010	0.005
GCA xD					0.03			-0.01			-0.001
SCA x D					-0.07			0.21			0.0001

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

cont.

S.O.V. / Traits	d.f		Number of rows/ ear			Number of kernels/ row			100-kernel weight		
	S	com	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb
Sowing date (D)		1			1.21			8.04			1858.68 **
Rep	2		0.33	0.06		0.54	16.04		1.69	2.37	
Rep/D		4			0.19			8.29			2.03
Crosses	59	59	3.43 **	3.19 **	5.58 **	19.69 **	17.45 **	23.64 **	35.59 **	54.12 **	62.46 **
Lines	19	19	6.44 **	5.49 **	10.82 **	27.16 **	25.51 **	35.56 **	66.32 **	56.79 **	98.76 **
Testers	2	2	14.33 **	20.51 **	34.37 **	14.26	30.26 *	19.73	88.82 **	52.07 **	117.07 **
Lines x testers	38	38	1.35 **	1.12 **	1.45 **	16.24 **	12.74 *	17.88 **	17.42 **	52.90 **	41.44 **
Crosses x d		**59**			1.03 **			13.50 **			27.25 **
Line x D		19			1.11 **			17.11 **			24.35 **
Testers x D		2			0.47			24.79 *			23.82 **
Line x Testers x D		38			1.02 **			11.11			28.88 **
Error	118	236	0.62	0.44	0.53	8.37	7.22	7.79	2.12	2.99	2.56
GCA			0.02	0.02	0.31	0.03	0.05	0.00	0.18	0.01	1.03
SCA			0.24	0.23	0.07	2.63	1.84	1.13	5.10	16.63	2.09
GCA xD					0.24			0.001			0.52
SCA x D					0.16			1.11			8.77

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

cont.

Traits / S.O.V.	d.f		Ear weight /plant			Shelling %			Grain yield		
	S	com	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb	Early sowing	Late sowing	comb
Sowing date (D)		1			109641.84 **			0.15			75977.37 **
Rep	2		12.47	3.53		3.75	10.06		2.10	100.21	
Rep/D		4			8.00			6.91			51.15
Crosses	59	59	1476.25 **	1567.13 **	1330.21 **	17.17 **	46.75 **	40.78 **	1004.50 **	983.97 **	925.39 **
Lines	19	19	1787.49 **	1448.71 **	974.46 **	31.33 **	44.33 **	59.23 **	1194.66 **	899.72 **	733.38 **
Testers	2	2	357.51 **	5850.21 **	2300.22 **	5.72	107.14 **	79.79 **	329.61 **	2763.61 **	962.21 **
Lines x testers	38	38	1379.52 **	1400.92 **	1457.03 **	10.70	44.78 **	29.50 **	944.94 **	932.42 **	1019.46 **
Crosses x d		**59**			1713.18 **			23.14 **			1063.07 **
Line x D		19			2261.74 **			16.43			1361.00 **
Testers x D		2			3907.50 **			33.07			2131.00 **
Line x Testers x D		38			1323.41 **			25.97 **			857.90 **
Error	118	236	9.06	10.31	9.69	10.02	17.32	13.67	35.25	39.09	37.17
GCA			0.93	1.60	-22.91	0.06	0.02	0.60	0.58	0.50	-15.36
SCA			456.82	463.54	22.27	0.23	9.15	0.59	303.23	297.78	26.93
GCA xD					0.98			0.17			-2.35
SCA x D					437.91			4.10			273.58

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

4.2. Mean performance

Mean values of top crosses along with three hybrid checks (T.W. G 352, S.C. Pioneer 3080 and S.C. G 155) for all the studied traits in both sowing dates as well as their combined data are presented in (Table 5).

Results in (Table 5) showed that the mean performance of tasseling date was significantly lower than the best earlier check variety by one, twenty four and eighteen top crosses at early, late sowing dates as well as the combined analysis, respectively. The top cross T_1xL_1 at early sowing date had earlier than the best check variety S.C. Pioneer 3080. While, the top crosses T_3xL_{14}, T_1xL_1 and T_3xL_{16} gave the lowest mean values compared with other genotypes at late sowing date. The top crosses T_1xL_1, T_1xL_{13} and T_3xL_{14} gave the lowest mean values for tasseling date at the combined data.

For silking date, zero, twenty six and fifteen top crosses exhibited significantly earliness than the earlier check variety at early, late sowing dates as well as the combined, respectively. The top crosses T_1xL_1, T_1xL_{13}, T_2xL_{12} and T_3xL_{10} gave the lowest mean values for this trait at the combined data.

Regarding maturity date, fourty six, thirteen, fourty seven top crosses expressed significantly earliest than the earlier check variety. From breeder point of view, the previous mentioned top crosses seemed to be of prime importance since earliness in maize hybrids is a must avoid destructive pests. The top crosses T_1xL_1, T_1xL_6, T_2xL_7, T_2xL_9, T_2xL_{10}, T_2xL_{18}, T_3xL_6, T_3xL_{10} and L_3xL_{12} expressed the lowest significant values of maturity date and it were the earliest among the studied top crosses at the combined analysis.

Regarding plant height, twenty one, fiveteen and twenty top crosses expressed significant lowest values as compared with the best check variety T.W. G 352 at early, late sowing date as well as the combined analysis, respectively. The top crosses T_1xL_{10}, T_1xL_{12}, T_1xL_{18}, T_2xL_9 and T_2xL_{15} in the early sowing date, T_2xL_9, T_1xT_{13} and T_1xL_{15} at late sowing date and T_1xL_{10}, T_1xL_{15}, T_1xL_{18}, T_2xL_9, T_2xL_{15} and T_3xL_{14} at the combined analysis were the best among the studied crosses since they expressed the lowest significant values of this trait (Table 5).

As for ear height, eight, zero and nine top crosses showed significant lowest values as compared to best check variety (G155) from the three check hybrids at early, late sowing dates as well as the combined analysis, respectively (Table 5).

The three top crosses T_1xL_{10}, T_1xL_{18}, T_2xL_9 and T_2xL_{15} at the combined analysis which had the best values for plant height showed also the most desirable values for ear height. Therefore, these top crosses are prospective in maize breeding program.

For leaf area, fourteen, six and sixteen top crosses were significantly superior to the best check variety at early, late sowing dates and the combined analysis, respectively. Moreover, the seven top crosses T_1xL_6, T_1xL_1, T_2xL_2, T_2xL_{12}, T_3xL_1, T_3xL_9, T_3xL_{15} and T_3xL_{16} were the best among all studied crosses since they expressed the highest significant values of this trait in the combined analysis over both sowing dates (Table 5).

Regarding ear husk, none of the top crosses surpassed significant compared to the best check variety in both sowing dates and the combined data. However, the most top crosses exhibited insignificant values of ear husk compared with the best check variety (Table 5).

As for ear length one, ten and six top crosses exhibited significant higher than the best check variety at early, late sowing dates as well as the combined data, respectively. The top crosses T_1xL_{14}, T_2xL_3, T_2xL_{11}, T_3xL_{11} and T_3xL_{18} at the combined analysis exhibited significantly higher mean values as compared to the best check hybrid S.C. Pioneer 3080.

For ear diameter, none of the top crosses significantly surpassed the best check hybrid at early, late sowing date and the combined analysis. However, the check hybrid S.C. Pioneer 3080 gave the highest value for this trait but without superiority than most top crosses in both sowing dates as well as the combined data.

For number of rows/ ear, the top crosses T_2xL_5 at early sowing date; T_2xL_4, T_3xL_5 and T_3xL_6 at late sowing date; and T_1xL_{13}, T_2xL_5 ,T_3xL_5 and T_3xL_6 at the combined analysis, exhibited significant higher than the best check hybrid.

For number of kernels/row, with the exception of crossesT_1xL_3, T_2xL_{11},T_2xL_{20}, T_3xL_{16}, T_3xL_9 and T_3xL_{12} at late sowing date, none of top crosses surpassed the best check hybrids in early, late sowing date as well as the combined analysis. Also, the best check variety S.C. Pioneer 3080 recorded the highest no. of kernels/ row but without superiority over that recorded by most top crosses for this trait in both sowing dates as well as the combined over them.

Regarding 100-kernel weight, the top crosses T_1xL_1, T_1xL_3, T_1xL_{12}, T_3xL_3 and T_3xL_{10} at early sowing date; T_1xL_{12}, T_2xL_3, T_2xL_{15}, T_3xL_3, T_3xL_{13} and T_3xL_{19} at late sowing date and T_1xL_1, T_1xL_7, T_1xL_{12}, T_2xL_3, T_2xL_{15}, T_3xL_3 and T_3xL_{19} at the combined analysis exhibited significantly higher than the best check hybrid S.C. G 155.

For ear weight, one, thirty three and five top crosses out yielded the best check hybrid. Also, it is clear that the most desirable top crosses were obtained from the crossing between T_1 and each of inbred lines L_{13} and L_{17} and T_2 and each of inbred lines L_5, L_{10} and L_{12} at the combined data.

As for shelling percentage, none of the studied top crosses significantly exceeded that of the best of check hybrid. However, the most top crosses did not significantly from the best check hybrid.

Regarding grain yield/ plant, the highest mean values were recorded by S.C. Pioneer 3080 at early sowing date, but without significant superiority over those of hybrids T_1xL_{13}, T_1xL_{17}, T_2xL_5, T_2xL_{10}, T_2xL_{12} and T_2xL_{14}. While, twenty six and three top crosses exhibited significantly higher than the best check hybrid S.C. Pioneer 3080 at late sowing date and the combined analysis,respectively.

The best top crosses were T_1xL_{13}, T_1xL_{17} and T_2xL_{12} at the combined data. Also, eight top crosses at combined analysis did not differ significantly than the best check hybrid.

From such results it could be concluded that the previous top crosses could be efficient and prospective in maize breeding programs since they expressed significant desirable effects for grain yield and for one or more of yield components.

The fluctuations of hybrid performance from sowing date to another were detected for most traits. These results would be due to significance of the interaction between hybrids and sowing date.

Table (5): mean performance of the testers and line x tester and check varieties in both sowing dates as well as the combined over them.

Traits / Lines	Tasseling date (Dayes to 50% shed)									Silking date (Dayes to 50% silk)								
	Early sowing date			Late sowing date date			Combined			Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	60.00	62.67	62.00	56.00	57.00	57.00	58.00	59.83	59.50	62.00	63.33	64.33	57.33	58.00	57.00	59.67	60.67	60.67
2	64.00	63.67	64.33	60.67	59.33	57.33	62.33	61.50	60.83	64.67	65.00	65.33	61.33	60.00	59.00	63.00	62.50	62.17
3	65.33	63.33	63.00	59.33	57.67	61.00	62.33	60.50	62.00	66.00	63.67	65.00	60.00	58.67	63.00	63.00	61.17	64.00
4	63.33	65.00	64.00	59.00	59.67	60.67	61.17	62.33	62.33	63.67	65.67	64.33	59.67	60.67	61.00	61.67	63.17	62.67
5	64.33	65.67	64.33	61.33	59.33	59.00	62.83	62.50	61.67	65.00	66.33	65.00	62.33	60.00	59.33	63.67	63.17	62.17
6	64.00	63.67	64.00	58.33	59.33	58.67	61.17	61.50	61.33	64.33	64.00	64.33	58.67	60.00	59.00	61.50	62.00	61.67
7	62.67	63.00	62.33	56.67	57.67	60.00	59.67	60.33	61.17	63.67	63.67	63.33	57.00	58.00	60.33	60.33	60.83	61.83
8	64.67	64.00	64.00	59.00	60.67	61.00	61.83	62.33	62.50	65.00	64.67	64.67	59.33	61.00	61.33	62.17	62.83	63.00
9	64.33	64.00	63.33	58.33	60.00	58.33	61.33	62.00	60.83	64.67	64.33	63.67	58.67	60.33	59.00	61.67	62.33	61.33
10	64.33	62.00	62.00	58.33	59.67	56.33	61.33	60.83	59.17	64.67	62.67	63.00	59.33	60.00	56.67	62.00	61.33	59.83
11	63.67	64.00	63.00	58.33	59.67	56.67	61.00	61.83	59.83	64.33	64.33	64.67	58.67	60.00	58.00	61.50	62.17	61.33
12	62.00	62.67	62.00	60.00	56.33	56.00	61.00	59.50	59.00	66.00	63.00	63.33	63.33	56.67	57.33	64.67	59.83	60.33
13	62.00	62.33	61.00	56.00	57.33	57.00	59.00	59.83	59.00	62.33	63.00	62.67	56.33	57.67	57.33	59.33	60.33	60.00
14	63.67	62.33	62.33	59.00	60.67	55.67	61.33	61.50	59.00	64.33	63.67	63.00	60.00	61.00	57.00	62.17	62.33	60.00
15	63.00	61.00	63.33	58.33	60.00	57.67	60.67	60.50	60.50	63.67	63.00	63.67	58.67	62.00	58.67	61.17	62.50	61.17
16	63.00	62.67	62.67	58.33	59.33	56.00	60.67	61.00	59.33	63.33	63.00	63.33	58.67	59.67	57.33	61.00	61.33	60.33
17	63.67	65.67	63.33	60.33	58.67	58.00	62.00	62.17	60.67	64.00	66.67	64.33	60.67	60.00	58.67	62.33	63.33	61.50
18	62.67	63.00	61.67	57.00	58.33	58.00	59.83	60.67	59.83	63.33	63.67	62.67	57.67	59.33	59.00	60.50	61.50	60.83
19	63.33	61.00	63.00	57.00	58.00	61.00	60.17	59.50	62.00	63.67	62.67	63.67	57.67	58.33	62.00	60.67	60.50	62.83
20	63.33	63.33	63.33	58.33	57.67	56.67	60.83	60.50	60.00	64.33	64.00	64.33	59.00	60.00	58.00	61.67	62.00	61.17
Grand mean		63.19			58.47			60.83			64.03			59.24			61.64	
L (100)		67.33			63.67			65.5			68.00			64.00			66.00	
Elhosary 101		64			58.67			61.33			64.33			59.00			61.67	
Gem. pop		65			61.67			63.33			66.00			62.67			64.33	
T.W. 352		64.33			60.33			62.33			65.67			61.00			63.33	
S.C.3080		62.67			60.33			61.5			63.00			60.67			61.83	
G.155		63			60			61.5			63.33			60.33			61.83	
L. S. D 5%		1.73			1.93			1.28			1.31			1.60			1.02	
L. S. D 1%		2.29			2.56			1.69			1.73			2.12			1.35	

Cont

Traits / Lines	Maturity date									Plant height								
	Early sowing date			Late sowing date			Combined			Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	95.33	99.00	100.67	93.00	96.33	95.67	94.17	97.67	98.17	220.00	239.67	234.00	219.33	213.33	228.67	219.67	226.50	231.33
2	98.00	99.00	101.00	95.33	95.00	93.33	96.67	97.00	97.17	222.00	232.00	226.00	206.33	228.67	202.00	214.17	230.33	214.00
3	102.00	99.67	101.67	93.67	95.33	97.33	97.83	97.50	99.50	216.00	245.00	232.00	208.33	231.33	230.00	212.17	238.17	231.00
4	100.00	104.33	101.33	95.00	97.33	95.33	97.50	100.83	98.33	235.33	264.00	234.67	223.33	224.67	222.00	229.33	244.33	228.33
5	100.33	102.67	102.67	95.67	95.67	94.67	98.00	99.17	98.67	236.33	240.67	244.67	222.67	222.67	240.67	229.50	231.67	242.67
6	97.33	97.67	97.33	93.67	93.00	93.33	95.50	95.33	95.33	244.67	249.33	246.67	210.67	240.00	240.33	227.67	244.67	243.50
7	96.67	97.33	98.00	95.67	94.00	95.00	96.17	95.67	96.50	220.00	225.67	240.00	211.33	209.67	224.00	215.67	217.67	232.00
8	100.67	99.67	102.00	93.67	94.67	96.00	97.17	97.17	99.00	246.00	236.67	234.67	213.33	218.00	226.67	229.67	227.33	230.67
9	100.00	99.00	102.67	94.00	92.00	95.33	97.00	95.50	99.00	222.00	208.33	234.00	218.00	177.00	213.00	220.00	192.67	223.50
10	96.67	97.00	95.67	91.00	94.33	93.33	93.83	95.67	94.50	185.67	224.33	225.33	169.00	220.00	211.00	177.33	222.17	218.17
11	98.00	97.33	96.67	94.00	95.33	96.00	96.00	96.33	96.33	224.00	237.33	253.67	204.00	224.00	228.67	214.00	230.67	241.17
12	100.67	98.67	97.67	97.33	94.00	93.00	99.00	96.33	95.33	211.33	239.33	228.67	210.00	225.33	223.67	210.67	232.33	226.17
13	99.00	99.67	97.67	97.00	94.33	95.00	98.00	97.00	96.33	212.67	234.67	233.33	197.33	224.00	223.83	205.00	229.33	228.58
14	101.67	98.67	99.33	96.33	93.67	94.33	99.00	96.17	96.83	244.67	219.67	217.67	228.00	215.00	202.00	236.33	217.33	209.83
15	99.33	103.00	98.00	94.00	98.00	94.33	96.67	100.50	96.17	220.00	210.00	246.00	189.00	200.00	223.67	204.50	205.00	234.83
16	102.00	100.33	100.00	96.33	94.00	96.00	99.17	97.17	98.00	230.67	214.67	239.33	222.67	213.33	231.33	226.67	214.00	235.33
17	102.00	102.67	99.67	98.00	97.67	94.67	100.00	100.17	97.17	245.33	223.67	243.33	222.00	214.33	222.00	233.67	219.00	232.67
18	99.00	97.33	101.00	95.67	93.33	94.00	97.33	95.33	97.50	214.50	223.00	231.67	201.33	206.00	230.00	207.92	214.50	230.83
19	100.00	97.00	99.00	94.33	95.33	97.33	97.17	96.17	98.17	251.33	236.67	224.00	250.67	236.00	222.00	251.00	236.33	223.00
20	100.67	103.33	103.33	95.33	96.00	97.00	98.00	99.67	100.17	238.67	244.00	246.00	220.67	218.00	220.67	229.67	231.00	233.33
Grand mean		99.63			94.99			97.31			231.76			217.93			224.84	
L (100)		104.00			94.33			99.17			178.00			164.67			171.33	
Elhosary 101		98.00			93.00			95.50			252.00			244.00			248.00	
Gem. pop		102.33			94.67			98.50			222.67			200.00			211.33	
T.W. 352		104.33			97.67			101.00			237.33			222.33			229.83	
S.C.3080		104.33			97.00			100.67			247.33			245.00			246.17	
G.155		105.67			96.33			101.00			264.33			241.67			253.00	
L. S. D 5%		2.95			2.56			1.93			11.88			9.89			7.65	
L. S. D 1%		3.90			3.38			2.54			15.70			13.08			10.06	

Cont

Traits / Lines	Ear height									Leaf area of upper ear								
	Early sowing date			Late sowing date			Combined			Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	113.33	119.00	117.67	116.00	111.33	119.33	114.67	115.17	118.50	683.00	701.60	720.65	638.88	589.33	642.58	660.94	645.47	681.61
2	116.00	119.67	118.00	104.00	120.00	108.00	110.00	119.83	113.00	650.60	729.93	650.28	588.90	672.00	572.40	619.75	700.96	611.34
3	122.67	130.00	102.00	108.33	114.00	100.00	115.50	122.00	101.00	630.00	608.67	580.00	561.60	581.00	600.00	595.80	594.83	590.00
4	118.33	139.00	126.67	112.00	117.33	116.00	115.17	128.17	121.33	662.33	716.00	651.00	617.35	579.00	574.00	639.84	647.50	612.50
5	123.67	129.67	141.67	117.33	118.67	125.67	120.50	124.17	133.67	632.83	642.00	585.67	576.00	565.00	563.68	604.41	603.50	574.67
6	121.33	127.00	132.33	112.67	122.00	124.67	117.00	124.50	128.50	751.05	684.67	702.00	586.20	602.20	570.18	668.63	643.43	636.09
7	112.67	120.67	128.33	120.67	114.33	115.33	116.67	117.50	121.83	602.25	624.80	555.00	540.00	546.28	605.00	571.13	585.54	580.00
8	124.33	115.67	117.67	108.00	108.67	113.33	116.17	112.17	115.50	628.48	605.33	564.00	548.00	508.50	518.20	588.24	556.92	541.10
9	111.67	107.33	118.67	98.00	96.67	114.00	104.83	102.00	116.33	708.67	634.30	663.00	500.00	548.58	630.00	604.33	591.44	646.50
10	99.00	112.33	113.67	101.33	113.00	111.00	100.17	112.67	112.33	505.65	609.53	604.08	378.00	606.00	527.00	441.83	607.76	565.54
11	117.67	121.33	126.67	97.67	118.00	121.00	107.67	119.67	123.83	565.85	572.88	617.00	480.80	572.00	512.00	523.33	572.44	564.50
12	112.33	121.33	117.67	110.00	110.33	118.67	111.17	115.83	118.17	623.00	698.15	565.38	613.33	661.20	539.65	618.17	679.68	552.51
13	115.33	127.67	117.67	107.67	116.00	116.83	111.50	121.83	117.25	576.78	551.50	563.00	516.20	519.05	515.53	546.49	535.28	539.26
14	121.00	113.00	108.33	124.00	116.67	100.67	122.50	114.83	104.50	614.58	661.83	638.33	616.30	653.00	557.08	615.44	657.41	597.70
15	113.67	105.00	125.00	99.67	100.00	116.67	106.67	102.50	120.83	577.00	583.33	674.65	523.00	580.00	683.00	550.00	581.67	678.83
16	121.33	108.00	127.00	110.67	102.00	120.00	116.00	105.00	123.50	695.00	637.67	837.00	576.35	614.63	588.10	635.68	626.15	712.55
17	124.00	110.00	122.00	117.33	101.00	107.67	120.67	105.50	114.83	622.00	627.67	626.00	515.40	467.00	582.35	568.70	547.33	604.18
18	105.73	115.33	119.67	96.00	115.33	110.00	100.87	115.33	114.83	540.90	563.65	605.67	408.96	481.00	573.00	474.94	522.33	589.33
19	114.67	113.67	114.00	113.33	116.33	112.67	114.00	115.00	113.33	601.67	655.00	640.00	583.58	656.00	623.33	592.62	655.50	631.67
20	116.67	123.00	123.33	107.33	113.67	112.67	112.00	118.33	118.00	675.00	540.60	597.65	491.00	556.00	511.03	583.00	548.30	554.34
Grand mean	118.70			111.86			115.28			630.60			565.10			597.85		
L (100)	93.67			81.67			87.67			437.80			495.68			466.74		
Elhosary 101	131.00			116.00			123.50			714.15			555.83			634.99		
Gem. pop	114.67			105.33			110.00			561.08			576.73			568.90		
T.W. 352	126.33			109.67			118.00			620.15			462.20			541.18		
S.C.3080	122.67			113.67			118.17			581.40			575.48			578.44		
G.155	121.67			107.33			114.50			604.55			588.15			596.35		
L. S. D 5%	9.90			13.27			8.19			51.85			53.77			36.97		
L. S. D 1%	13.08			17.54			10.77			68.53			71.07			48.59		

Cont

Lines \ Traits	Ear husk: Early sowing date L (100)	Ear husk: Early sowing date Elhosary 101	Ear husk: Early sowing date Gem. pop	Ear husk: Late sowing date L (100)	Ear husk: Late sowing date Elhosary 101	Ear husk: Late sowing date Gem. pop	Ear husk: Combined L (100)	Ear husk: Combined Elhosary 101	Ear husk: Combined Gem. pop	Ear length: Early sowing date L (100)	Ear length: Early sowing date Elhosary 101	Ear length: Early sowing date Gem. pop	Ear length: Late sowing date L (100)	Ear length: Late sowing date Elhosary 101	Ear length: Late sowing date Gem. pop	Ear length: Combined L (100)	Ear length: Combined Elhosary 101	Ear length: Combined Gem. pop
1	4.33	4.00	5.00	5.33	5.00	5.00	4.83	4.50	5.00	17.23	16.53	17.00	17.27	16.67	16.50	17.25	16.60	16.75
2	5.33	6.00	6.33	6.33	7.00	6.67	5.83	6.50	6.50	16.67	17.00	16.63	14.23	15.53	15.77	15.45	16.27	16.20
3	4.67	4.00	5.00	5.33	5.00	5.67	5.00	4.50	5.33	16.57	18.73	15.00	17.73	19.10	14.37	17.15	18.92	14.68
4	4.33	6.00	5.33	5.67	6.00	6.00	5.00	6.00	5.67	15.33	17.20	16.73	14.80	16.40	16.53	15.07	16.80	16.63
5	5.33	5.67	5.33	5.67	6.33	6.00	5.50	6.00	5.67	15.07	16.87	14.67	18.13	16.13	15.03	16.60	16.50	14.85
6	4.00	5.67	5.67	4.67	5.67	6.00	4.33	5.67	5.83	17.67	16.67	17.50	17.37	15.63	17.57	17.52	16.15	17.53
7	4.67	5.33	5.33	5.67	6.00	6.00	5.17	5.67	5.67	17.07	16.73	17.97	16.33	15.00	15.27	16.70	15.87	16.62
8	5.00	5.33	5.67	5.33	5.67	6.00	5.17	5.50	5.83	16.43	17.80	17.73	17.00	16.03	15.37	16.72	16.92	16.55
9	7.00	6.00	5.67	7.00	7.00	7.00	7.00	6.50	6.33	15.93	15.13	16.27	18.20	14.63	16.00	17.07	14.88	16.13
10	4.67	5.33	4.67	5.33	6.00	5.33	5.00	5.67	5.00	15.00	16.80	18.53	15.00	16.23	16.23	15.00	16.52	17.38
11	4.33	5.67	5.33	4.67	5.67	5.67	4.50	5.67	5.50	17.80	17.97	17.53	17.03	18.20	19.33	17.42	18.08	18.43
12	5.00	6.00	5.33	5.67	6.00	6.33	5.33	6.00	5.83	18.00	16.37	17.60	17.80	17.60	16.37	17.90	16.99	16.98
13	4.67	5.00	4.67	5.67	6.00	5.00	5.17	5.50	4.83	16.80	16.40	17.23	17.10	14.80	16.67	16.95	15.60	16.95
14	4.67	5.33	4.33	5.33	6.33	6.00	5.00	5.83	5.17	19.73	18.00	17.43	16.63	14.40	15.70	18.18	16.20	16.57
15	5.00	6.00	5.67	5.67	6.33	5.33	5.33	6.17	5.50	16.20	17.47	17.70	15.60	17.00	16.43	15.90	17.23	17.07
16	6.00	6.67	6.33	6.33	6.33	6.33	6.17	6.50	6.33	16.13	15.43	15.83	16.03	13.67	14.50	16.08	14.55	15.17
17	6.00	7.00	6.00	6.33	7.33	7.00	6.17	7.17	6.50	17.20	15.13	16.47	17.50	16.43	15.80	17.35	15.78	16.13
18	6.00	5.67	5.00	6.00	5.33	6.00	6.00	5.50	5.50	15.67	17.07	17.83	18.57	15.17	18.33	17.12	16.12	18.08
19	6.33	6.67	5.00	6.67	6.67	5.67	6.50	6.67	5.33	18.47	17.07	16.67	17.47	15.97	16.60	17.97	16.52	16.63
20	5.67	5.33	6.33	6.33	5.67	6.67	6.00	5.50	6.50	17.90	16.47	18.50	17.40	19.27	17.40	17.65	17.87	17.95
Grand mean		5.39			5.93			5.66			16.91			16.45			16.68	
L (100)		6.00			6.00			6.00			14.87			13.73			14.30	
Elhosary 101		5.33			5.67			5.50			17.87			17.53			17.70	
Gem. pop		5.33			6.33			5.83			16.53			16.43			16.48	
T.W. 352		5.67			6.33			6.00			16.57			15.63			16.10	
S.C.3080		6.00			6.67			6.33			17.57			15.60			16.58	
G.155		6.00			7.00			6.50			17.33			15.50			16.42	
L. S. D 5%		1.12			1.07			0.77			1.94			2.02			1.38	
L. S. D 1%		1.48			1.41			1.01			2.56			2.67			1.82	

Cont

Lines \ Traits	Ear diameter									Number of rows/ ear								
	Early sowing date			Late sowing date			Combined			Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	4.70	4.50	4.60	4.50	4.27	4.47	4.60	4.38	4.53	13.83	15.17	14.40	14.00	14.50	15.87	13.92	14.83	15.13
2	4.67	4.43	4.77	4.00	4.00	3.93	4.34	4.22	4.35	13.60	14.27	14.13	13.93	14.33	15.67	13.77	14.30	14.90
3	4.37	4.27	4.43	4.13	4.03	4.20	4.25	4.15	4.32	12.80	12.57	14.50	12.70	12.40	14.20	12.75	12.48	14.35
4	4.20	4.60	4.47	4.27	4.27	4.20	4.23	4.43	4.33	14.53	14.27	14.27	14.40	16.57	14.67	14.47	15.42	14.47
5	4.47	4.73	4.47	4.37	4.20	4.47	4.42	4.47	4.47	15.33	16.93	16.27	15.23	15.73	16.67	15.28	16.33	16.47
6	4.53	4.87	4.73	4.03	4.13	4.47	4.28	4.50	4.60	14.27	16.40	15.70	12.97	15.57	16.77	13.62	15.98	16.23
7	4.53	4.40	4.23	4.33	4.00	3.77	4.43	4.20	4.00	13.60	13.20	14.53	13.07	14.33	14.87	13.33	13.77	14.70
8	4.43	4.53	4.60	4.40	3.90	3.80	4.42	4.22	4.20	12.67	12.80	13.87	13.30	13.57	13.43	12.98	13.18	13.65
9	4.53	4.47	4.67	4.50	4.30	4.60	4.52	4.38	4.63	13.00	13.93	13.20	13.33	14.77	14.90	13.17	14.35	14.05
10	4.33	4.43	4.07	4.03	4.20	4.27	4.18	4.32	4.17	12.13	13.50	15.13	12.57	13.53	14.70	12.35	13.52	14.92
11	4.47	4.43	4.23	3.93	3.73	4.00	4.20	4.08	4.12	13.47	14.90	14.20	12.87	13.53	14.03	13.17	14.22	14.12
12	4.33	4.67	4.53	4.20	4.30	3.80	4.27	4.48	4.17	14.00	13.47	15.70	14.20	14.30	14.83	14.10	13.88	15.27
13	4.67	4.73	4.53	4.60	4.23	4.37	4.63	4.48	4.45	16.53	16.00	15.70	16.43	16.20	16.10	16.48	16.10	15.90
14	4.50	4.63	4.40	4.07	4.07	4.00	4.28	4.35	4.20	14.37	13.80	13.50	13.67	14.83	14.97	14.02	14.32	14.23
15	4.60	4.47	4.50	4.37	4.30	4.27	4.48	4.38	4.38	14.40	14.50	15.70	13.73	14.20	15.23	14.07	14.35	15.47
16	4.67	4.50	4.33	4.57	4.10	4.23	4.62	4.30	4.28	13.73	14.10	14.73	14.13	15.03	15.13	13.93	14.57	14.93
17	4.80	4.40	4.60	4.43	4.07	4.60	4.62	4.23	4.60	14.53	13.73	15.37	14.17	14.43	14.83	14.35	14.08	15.10
18	4.53	4.70	4.63	4.57	3.73	4.57	4.55	4.22	4.60	13.87	14.73	16.17	14.13	14.53	13.50	14.00	14.63	14.83
19	4.67	4.73	4.73	4.47	4.33	4.50	4.57	4.53	4.62	12.93	13.87	14.17	13.63	14.03	14.20	13.28	13.95	14.18
20	4.57	4.47	4.37	4.30	4.23	4.00	4.43	4.35	4.18	13.33	14.00	15.23	13.97	14.00	15.10	13.65	14.00	15.17
Grand mean		4.52			4.22			4.37			14.33			14.44			14.38	
L (100)		3.70			3.23			3.47			12.53			12.50			12.52	
Elhosary 101		4.57			4.40			4.48			13.67			14.43			14.05	
Gem. pop		4.33			4.00			4.17			15.83			15.00			15.42	
T.W. 352		4.40			4.07			4.23			15.33			15.37			15.35	
S.C.3080		5.00			4.50			4.75			14.90			13.97			14.43	
G.155		4.33			3.87			4.10			15.27			14.00			14.63	
L. S. D 5%		0.39			0.45			0.29			1.27			1.07			0.82	
L. S. D 1%		0.52			0.59			0.39			1.68			1.41			1.08	

Cont

Lines \ Traits	Number of kernels/ row									100-kernel weight								
	Early sowing date			Late sowing date			Combined			Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	34.13	33.20	32.53	34.80	35.53	34.90	34.47	34.37	33.72	39.33	33.00	30.00	33.67	29.00	27.33	36.50	31.00	28.67
2	35.27	33.60	36.13	33.90	33.03	32.33	34.58	33.32	34.23	33.00	29.00	27.67	25.33	31.00	25.00	29.17	30.00	26.33
3	31.67	32.67	36.33	37.67	36.57	35.33	34.67	34.62	35.83	39.33	35.00	38.33	31.67	39.00	37.33	35.50	37.00	37.83
4	33.80	35.67	37.73	33.63	33.53	36.40	33.72	34.60	37.07	31.67	30.67	30.33	28.00	26.67	28.33	29.83	28.67	29.33
5	33.67	34.40	28.80	37.00	31.87	31.27	35.33	33.13	30.03	31.67	33.00	28.33	27.00	25.00	28.00	29.33	29.00	28.17
6	32.00	32.53	31.33	36.13	30.37	37.53	34.07	31.45	34.43	30.00	35.00	34.00	27.67	23.33	26.33	28.83	29.17	30.17
7	34.47	33.53	36.30	35.27	32.60	32.33	34.87	33.07	34.32	37.33	31.67	30.00	34.67	27.00	23.00	36.00	29.33	26.50
8	34.50	33.93	34.27	36.33	32.43	33.07	35.42	33.18	33.67	36.33	35.33	32.00	34.67	25.33	27.67	35.50	30.33	29.83
9	30.10	32.73	34.20	35.53	32.47	38.03	32.82	32.60	36.12	32.00	36.00	32.00	30.00	23.00	25.67	31.00	29.50	28.83
10	32.87	32.53	29.57	34.77	34.33	34.17	33.82	33.43	31.87	35.67	37.33	38.00	25.33	30.33	31.33	30.50	33.83	34.67
11	35.87	36.30	35.33	36.30	38.90	35.53	36.08	37.60	35.43	28.00	27.00	26.33	24.00	26.33	29.33	26.00	26.67	27.83
12	36.33	37.97	37.47	35.33	36.53	37.97	35.83	37.25	37.72	38.33	35.33	32.00	37.33	28.33	22.33	37.83	31.83	27.17
13	32.80	35.07	34.37	34.10	31.13	30.77	33.45	33.10	32.57	31.67	37.67	30.67	26.67	26.67	36.67	29.17	32.17	33.67
14	35.27	32.20	33.37	30.57	30.50	32.27	32.92	31.35	32.82	37.00	35.33	34.00	30.67	28.00	25.00	33.83	31.67	29.50
15	31.00	37.33	37.27	31.60	36.00	32.47	31.30	36.67	34.87	33.67	37.33	30.33	29.00	36.67	30.00	31.33	37.00	30.17
16	33.60	21.37	33.97	33.90	29.73	31.07	33.75	25.55	32.52	36.67	35.00	33.00	30.33	24.33	25.33	33.50	29.67	29.17
17	34.13	31.13	34.33	35.37	33.27	32.80	34.75	32.20	33.57	36.33	31.00	30.00	30.33	23.67	31.67	33.33	27.33	30.83
18	32.80	33.53	33.57	36.20	29.13	30.07	34.50	31.33	31.82	30.00	32.33	29.33	32.00	25.00	20.00	31.00	28.67	24.67
19	33.20	35.80	36.67	34.43	32.07	35.67	33.82	33.93	36.17	36.67	37.33	37.67	29.00	31.00	36.00	32.83	34.17	36.83
20	33.00	33.67	33.13	34.07	39.00	34.37	33.53	36.33	33.75	27.33	30.33	32.67	27.67	34.67	25.00	27.50	32.50	28.83
Grand mean		33.77			34.07			33.92			33.22			28.68			30.95	
L (100)		26.63			27.23			26.93			23.67			21.00			22.33	
Elhosary 101		31.30			35.37			33.33			38.00			32.00			35.00	
Gem. pop		32.77			36.53			34.65			28.67			22.33			25.50	
T.W. 352		34.20			31.57			32.88			32.33			27.67			30.00	
S.C.3080		40.77			33.00			36.88			34.00			28.67			31.33	
G.155		34.90			24.00			29.45			35.67			32.33			34.00	
L. S. D 5%		4.68			4.34			3.16			2.35			2.80			1.81	
L. S. D 1%		6.18			5.74			4.15			3.11			3.70			2.38	

Cont

Lines \ Traits	Ear weight /plant									Shelling %								
	Early sowing date			Late sowing date			Combined			Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	151.67	149.03	163.00	165.00	134.00	142.00	158.33	141.52	152.50	84.69	87.43	85.25	83.84	85.57	82.99	84.26	86.50	84.12
2	168.67	145.87	165.27	103.00	110.27	120.67	135.83	128.07	142.97	79.92	80.99	81.87	82.22	82.83	83.43	81.07	81.91	82.65
3	140.90	145.53	145.67	154.57	171.00	143.67	147.73	158.27	144.67	81.74	80.64	80.00	84.44	78.07	80.00	83.09	79.35	80.00
4	167.53	190.87	162.73	118.47	149.33	132.17	143.00	170.10	147.45	82.76	85.41	87.20	84.14	85.35	85.99	83.45	85.38	86.60
5	160.00	216.87	151.13	158.33	136.80	136.30	159.17	176.83	143.72	83.05	80.88	82.89	79.96	83.18	80.88	81.50	82.03	81.88
6	155.93	204.33	155.53	144.07	104.77	163.10	150.00	154.55	159.32	81.53	80.96	83.11	80.06	80.86	83.47	80.79	80.91	83.29
7	193.60	153.93	167.47	155.60	113.30	103.77	174.60	133.62	135.62	83.94	85.15	87.24	83.99	85.34	85.73	83.97	85.24	86.49
8	163.80	181.40	201.67	171.00	119.33	115.33	167.40	150.37	158.50	80.79	75.06	78.41	82.36	87.62	78.90	81.57	81.34	78.66
9	166.53	155.20	161.13	136.33	99.00	160.67	151.43	127.10	160.90	79.59	82.62	82.54	70.71	81.40	76.38	75.15	82.01	79.46
10	181.93	215.67	207.57	108.33	139.17	133.00	145.13	177.42	170.28	83.04	82.07	81.10	81.62	83.99	81.71	82.33	83.03	81.40
11	148.27	157.67	159.73	134.00	139.33	160.17	141.13	148.50	159.95	83.14	83.93	83.37	81.35	83.16	81.35	82.25	83.55	82.36
12	153.00	200.10	154.40	150.67	168.00	116.00	151.83	184.05	135.20	80.00	85.90	83.26	80.00	85.79	84.23	80.00	85.84	83.75
13	202.33	182.00	151.73	182.67	119.13	130.33	192.50	150.57	141.03	84.02	84.76	84.58	81.93	83.84	84.43	82.98	84.30	84.75
14	190.97	222.13	191.33	140.67	98.47	111.37	165.82	160.30	151.35	82.06	81.52	81.08	82.46	83.49	80.83	82.26	82.50	80.96
15	153.37	141.33	181.60	147.17	151.33	139.33	150.27	146.33	160.47	81.06	80.00	84.26	82.45	80.00	81.10	81.75	80.00	82.68
16	168.90	146.27	181.67	153.33	97.67	119.13	161.12	121.97	150.40	81.53	84.19	81.18	81.96	81.91	82.89	81.74	83.05	82.03
17	206.00	129.10	176.83	156.40	123.83	141.10	181.20	126.47	158.97	83.33	81.46	82.67	81.86	79.08	81.99	82.60	80.27	82.33
18	138.27	179.53	180.73	165.03	89.33	77.60	151.65	134.43	129.17	86.79	83.74	84.04	83.43	79.14	82.76	85.11	81.44	83.40
19	193.20	160.27	145.00	147.63	138.00	154.67	170.42	149.13	149.83	82.30	87.60	80.00	81.12	80.92	80.00	81.71	84.26	80.00
20	170.07	175.47	158.27	130.10	146.63	124.33	150.08	161.05	141.30	81.38	83.01	81.21	79.22	80.62	81.23	80.30	81.82	81.22
Grand mean	169.83			134.93			152.38			82.65			82.03			82.34		
L (100)	79.93			75.67			77.80			66.72			81.59			73.95		
Elhosary 101	220.00			182.50			201.25			84.32			84.93			84.60		
Gem. pop	143.00			113.87			128.43			78.32			80.65			79.35		
T.W. 352	194.30			114.67			154.48			79.36			78.95			79.21		
S.C.3080	213.87			129.07			171.47			83.48			81.84			82.86		
G.155	207.80			92.83			150.32			83.48			77.95			81.77		
L. S. D 5%	4.87			5.19			3.52			5.12			6.73			4.18		
L. S. D 1%	6.43			6.86			4.63			6.76			8.89			5.50		

Cont

Traits / Lines	Grain yield								
	Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	128.43	130.30	138.97	138.33	114.67	117.67	133.38	122.48	128.32
2	134.73	118.13	135.30	84.67	91.33	100.67	109.70	104.73	117.98
3	115.17	117.27	116.53	130.47	133.50	114.93	122.82	125.38	115.73
4	138.80	162.97	142.13	99.67	127.47	113.47	119.23	145.22	127.80
5	132.87	175.40	125.27	126.60	113.60	110.20	129.73	144.50	117.73
6	127.13	165.40	129.27	115.23	84.67	136.17	121.18	125.03	132.72
7	162.50	131.07	146.10	130.73	96.67	89.00	146.62	113.87	117.55
8	132.33	136.13	158.03	140.83	104.60	91.00	136.58	120.37	124.52
9	132.53	128.20	133.00	96.33	80.67	122.67	114.43	104.43	127.83
10	151.07	177.00	168.33	88.40	116.97	108.67	119.73	146.98	138.50
11	123.27	132.33	133.17	109.00	115.83	130.20	116.13	124.08	131.68
12	122.40	171.90	128.57	120.53	144.07	97.60	121.47	157.98	113.08
13	170.00	154.27	128.33	149.67	99.67	110.70	159.83	126.97	119.51
14	156.70	181.07	155.13	116.00	82.50	90.00	136.35	131.78	122.57
15	124.30	113.07	153.00	121.33	121.07	113.00	122.82	117.07	133.00
16	137.70	123.13	147.47	125.67	80.00	98.67	131.68	101.57	123.07
17	171.67	105.17	146.17	128.00	97.67	115.67	149.83	101.42	130.92
18	120.00	150.33	152.07	137.67	70.67	64.20	128.83	110.50	108.13
19	159.00	140.53	116.00	119.77	111.67	123.73	139.38	126.00	119.87
20	138.40	145.67	128.50	103.00	118.00	101.00	120.70	131.83	114.75
Grand mean	140.33			110.61			125.47		
L (100)	53.33			61.73			57.53		
Elhosary 101	185.50			155.00			170.25		
Gem. pop	112.00			91.83			101.92		
T.W. 352	154.20			90.53			122.37		
S.C.3080	178.53			105.63			142.08		
G.155	173.47			72.37			122.92		
L. S. D 5%	**9.60**			**10.11**			**6.90**		
L. S. D 1%	**12.69**			**13.36**			**9.07**		

4.3. Analysis of variance for combining ability:

The estimation of variance due to general combining ability (σ^2 GCA) and specific combining ability (σ^2 SCA) along with their interaction with sowing dates are presented in (Table 4) Results indicated that σ^2 SCA was more important than σ^2 GCA for all studied traits in both sowing dates as well as the combined analysis except tasseling date and number of rows/ ear in the combined analysis, ear diameter at early sowing date and ear husk at late sowing date σ^2 GCA= σ^2 SCA revealing that additive and non additive gene effects was similar for controling this trait . These results indicated that the largest part of the total genetic variability associated with those traits was the result of non – additive type of gene action. The importance of non-additive gene action in controlling such traits was reported by **El-Hosary (1989)** for ear length, ear diameter, number of rows/ ear, number of kernels/ row and grain yield/ plant, **Sedhom (1994)** for ear length and ear diameter; **Soliman (2000)** and **Mahmoud *et al.* (2001)** for grain yield ; **Amer *et al.* (2002)** for grain yield and number of kernels / row ; **El-Shenawy *et al.* (2003)** for grain yield and number of rows / ear; **Mosa (2004)** for silking date , plant height , grain yield , ear length , number of kernels / row and 100-kernel weight ; **Abd El-Moula (2005)** for grain yield , 50% silking , plant height and ear height ; **Motawei *et al.* (2005)** for grain yield , number of kernels / row and ear length.

The magnitude of the interaction between specific combining ability and sowing dates was much higher than that of general combining and sowing dates for all traits except ear height, ear husk and number of rows/ ear. These results led to the conclusion that non-additive gene action was more biased by the interaction with environments than the additive effects. Such results are in agreement with those reported by **El-Hosary (1985), Sedhom (1992 and 1994), Al-Naggar *et al.* (1997), Soliman (2000), Sadek *et al.*(2000); Mahmoud *et al.*(2001); Soliman *et al.*(2001);Amer *et al.*(2003); Aly (2004); Mosa**

(2004) ; Ibrahim and Motawei (2004) ; Mosa *et al.* (2004) ;Abd El-Moula (2005).

For the exceptional traits, the magnitude of σ^2 GCA x sowing date interaction was higher than that of σ^2 SCA x sowing date revealing that additive and additive x additive gene action interacted more with the environment than the non additive component. Similar results were reported by **El-Hosary (1989), Sedhom (1994), Sultan (1998), El-Zeir *et al.* (2000), Gado (2000), Barakat (2001), Amer *et al.* (2002), El-Shenawy et al (2003).**

4.3.1 General Combining ability effect:

The general combining ability effects ($\hat{g}_i$) of testers and parental inbred lines for all traits in both sowing dates as well as the combined analysis is presented in (Table 6).

From the breeder's point of view, high negative values for tasseling, silking and maturity dates as well as plant and ear heights along with high positive values for yield and its components would be useful for maize breeding program.

Testers:

Results in (Table 6) indicated that the tester T_1 (L_{100}) exhibited significant desirable ($\hat{g}_i$) effects for plant and ear heights and 100-Kernel weight at early, late sowing dates, as well as the combined data, ear diameter, ear weight / plant and grain yield / plant at late sowing date and the combined data; and ear length at late sowing date. Also, it gave significant undesirable or insignificant ($\hat{g}_i$) effects for other cases.

The parental tester S.C. (El-Hosary 101) expressed significant positive ($\hat{g}_i$) effects for leaf area and shelling percentage at late sowing date and the combined data and ear husk at early sowing date and the combined data; ear weight, grain yield/ plant and 100-Kernel weight at early sowing date. Also, it gave significant positive (undesirable) ($\hat{g}_i$) effects at late sowing date and the combined data for tasseling date and late sowing date for silking date. However, it gave insignificant ($\hat{g}_i$) effects for other cases.

Parental tester (Gem. Pop.) expressed significant desirable ($\hat{g}_i$) effects for number of rows/ ear in both sowing dates and the combined data; leaf area at late sowing date; tasseling date and silking date at late sowing date and the combined data. Also, it gave significant undesirable or insignificant ($\hat{g}_i$) effects for other cases.

Inbred lines:

six, four and four inbred lines expressed significant and negative ($\hat{g}_i$) effects for tasseling date at early, late sowing dates as well as the combined analysis, respectively.

For silking date seven, four and six inbred lines gave significant negative ($\hat{g}_i$) effects at early, late sowing dates and the combined over them, respectively. The parental inbred lines L_1 and L_{13} exhibited the highest ($\hat{g}_i$) effects for tasseling and silking dates in both sowing dates as well as the combined data. Moreover, both inbred lines L_1 and L_{13} were the best combiners for both traits together.

Consequently, they could be utilized in developing new hybrids characterized by earliness in flowering.

For maturity date, the parental inbred lines L_6 and L_{10} seemed to be the best combiners for earliness in both sowing dates as well as the combined analysis .Consequently, they could be utilized in developing new hybrids characterized by earliness in maturity.

Regarding plant height, seven, five and seven inbred lines gave significant negative ($\hat{g}_i$) effects at early, late sowing dates as well as the combined data, respectively. The best inbreds in general ($\hat{g}_i$) effects were L_2, L_9, L_{10}, L_{15} and L_{18} in both sowing dates and the combined analysis.

On the other hand, L_6, L_{19}, L_4 and L_5 gave significant positive ($\hat{g}_i$) effects for plant height in both sowing dates and the combined data. Therefore, they could be of great value in breeding programs for developing new hybrids with highest plant stature for forage crops..

For ear height, six, two and four inbred lines exhibited significant negative ($\hat{g}_i$) effects at early, late sowing dates as well as the combined data, respectively. The inbred lines L_9 and L_{15} were the best combiners for both traits (plant and ear heights). Therefore, they could be of great value in breeding programs for developing new hybrids with short plant stature.

For leaf area, six, eight and nine inbred lines exhibited significant positive ($\hat{g}_i$) effects at early, late sowing dates and the combined analysis, respectively. From these lines, the three inbred lines L_1, L_2, L_{11} and L_{16} were good combiners for this trait in both sowing dates and the combined analysis. Therefore, they could be of great value in breeding programs for developing hybrids with highest leaf area of upper ear increased forage crops and grain yield.

The inbred lines L_2, L_9 and L_{17} expressed significant positive ear husk in both sowing dates as well as the combined analysis.

Regarding ear length, the best general combiners which had significant positive ($\hat{g}_i$) effects was L_{11} in both sowing dates as well as the combined analysis. While, L_{19} exhibited significant positive ($\hat{g}_i$) effects in both sowing dates as well as the combined data for ear diameter.

Results in (Table 6) showed that the best general combiners which had significant and positive ($\hat{g}_i$) effects for number of rows/ ear was the inbred L_5, L_6 and L_{13} in both sowing dates as well as the combined data.

For no. of Kernels/ row, the best general combiners which had significant and positive ($\hat{g}_i$) effects were the parental inbred lines L_{11} and L_{12} in both sowing dates and the combined over them.

Regarding 100-kernel weight, seven , five and seven parental inbred lines exhibited significant positive ($\hat{g}_i$) effects at early, late sowing dates and the combined analysis, respectively .However , the most desirable ($\hat{g}_i$) effects for this trait were detected for the parental inbred lines L_3 followed by L_{19} in both sowing dates and the combined data.

For shelling percentage, four, two and five parental inbred lines exhibited significant and positive ($\hat{g}_i$) effects at early, late sowing dates as well as the combined analysis, respectively.

Moreover, the most desirable combiner for this trait was L_{18} in both sowing and the combined analysis.

Seven, ten and nine parental inbred lines for ear weight / plant; six, eight and seven parental inbred lines for grain yield/ plant exhibited significant positive ($\hat{g}_i$) effects at early, late sowing dates as well as the combined analysis, respectively. Moreover, the most desirable combiners for ear and grain yield/ plant were the inbred lines L_5 and L_{13} in both sowing dates and the combined analysis.

From the previous results it could be concluded that the parental inbred lines L_5 and L_{13} should be of great values in breeding programs for improving grain yield and its components and earliness (L_{13}). Also, it is clear that the parental inbred line which exhibited significant desirable ($\hat{g}_i$) effects for grain yield/ plant might express the same effects for one or more of traits contributing grain yield. For example, parental inbred line L_{13} expressed significant desirable ($\hat{g}_i$) effects for grain yield/ plant, ear weight/ plant, number of rows/ ear, plant height, tasseling and silking dates. While, L_5 gave significant positive ($\hat{g}_i$) effects for grain yield/ plant, ear weight/ plant, no. of rows/ ear and plant and ear heights (grain or fodder yield).

Table (6): General combining ability effects of testers and inbred lines for all the studied traits.

Parents \ Traits	Tasseling date (Dayes to 50% shed)			Silking date (Dayes to 50% silk)		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	0.18	0.02	0.10	0.12	-0.03	0.04
2	0.06	0.35 *	0.21 *	-0.02	0.32 *	0.15
3	-0.24	-0.37 *	-0.30 **	-0.10	-0.29 *	-0.20 *
L.S.D. (gi) 5%	0.27	0.30	0.20	0.20	0.25	0.16
1%	0.36	0.40	0.27	0.27	0.33	0.21
L.S.D. (gi-gj) 5%	0.38	0.43	0.29	0.29	0.35	0.23
1%	0.50	0.56	0.38	0.38	0.47	0.30
Lines						
1	-1.63 **	-1.80 **	-1.72 **	-0.81 **	-1.80 **	-1.31 **
2	0.81 *	0.64	0.73 **	0.97 **	0.87 **	0.92 **
3	0.70 *	0.87 *	0.78 **	0.86 **	1.31 **	1.08 **
4	0.92 **	1.31 **	1.12 **	0.52	1.20 **	0.86 **
5	1.59 **	1.42 **	1.51 **	1.41 **	1.31 **	1.36 **
6	0.70 *	0.31	0.51	0.19	-0.02	0.08
7	-0.52	-0.36	-0.44	-0.48	-0.80 *	-0.64 **
8	1.03 **	1.76 **	1.39 **	0.74 **	1.31 **	1.03 **
9	0.70 *	0.42	0.56 *	0.19	0.09	0.14
10	-0.41	-0.36	-0.38	-0.59 *	-0.58	-0.58 **
11	0.37	-0.24	0.06	0.41	-0.36	0.03
12	-0.97 **	-1.02 *	-0.99 **	0.08	-0.13	-0.03
13	-1.41 **	-1.69 **	-1.55 **	-1.37 **	-2.13 **	-1.75 **
14	-0.41	-0.02	-0.22	-0.37	0.09	-0.14
15	-0.74 *	0.20	-0.27	-0.59 *	0.53	-0.03
16	-0.41	-0.58	-0.49	-0.81 **	-0.69 *	-0.75 **
17	1.03 **	0.53	0.78 **	0.97 **	0.53	0.75 **
18	-0.74 *	-0.69	-0.72 **	-0.81 **	-0.58	-0.69 **
19	-0.74 *	0.20	-0.27	-0.70 **	0.09	-0.31
20	0.14	-0.91 *	-0.38	0.19	-0.24	-0.03
L.S.D. (gi) 5%	0.70	0.78	0.52	0.53	0.65	0.42
1%	0.92	1.03	0.69	0.69	0.85	0.55
L.S.D. (gi-gj) 5%	0.99	1.11	0.74	0.75	0.92	0.59
1%	1.30	1.45	0.97	0.98	1.20	0.78

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

Cont.

Parents \ Traits	Maturity date			Plant height		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	-0.17	-0.04	-0.10	-4.70 **	-5.53 **	-5.11 **
2	0.03	-0.02	0.01	0.68	0.14	0.41
3	0.13	0.06	0.10	4.03 **	5.38 **	4.70 **
L.S.D. (gi) 5%	0.46	0.40	0.31	1.86	1.55	1.21
1%	0.61	0.53	0.40	2.44	2.04	1.59
L.S.D. (gi-gj) 5%	0.65	0.57	0.43	2.63	2.19	1.71
1%	0.86	0.74	0.57	3.46	2.88	2.25
Lines						
1	-1.30 *	0.01	-0.64	-0.54	2.52	0.99
2	-0.30	-0.43	-0.37	-5.09 *	-5.59 **	-5.34 **
3	1.48 *	0.46	0.97 *	-0.76	5.30 **	2.27
4	2.26 **	0.90	1.58 **	12.91 **	5.41 **	9.16 **
5	2.26 **	0.34	1.30 **	8.80 **	10.74 **	9.77 **
6	-2.19 **	-1.66 **	-1.92 **	15.13 **	12.41 **	13.77 **
7	-2.30 **	-0.10	-1.20 **	-3.20	-2.93	-3.06
8	1.14	-0.21	0.47	7.35 **	1.41	4.38 **
9	0.92	-1.21 *	-0.14	-10.31 **	-15.26 **	-12.79 **
10	-3.19 **	-2.10 **	-2.64 **	-19.98 **	-17.93 **	-18.95 **
11	-2.30 **	0.12	-1.09 **	6.58 **	0.96	3.77 *
12	-0.63	-0.21	-0.42	-5.31 *	1.74	-1.79
13	-0.86	0.46	-0.20	-4.87 *	-2.87	-3.87 *
14	0.26	-0.21	0.02	-4.42	-2.93	-3.68 *
15	0.48	0.46	0.47	-6.42 **	-13.70 **	-10.06 **
16	1.14	0.46	0.80 *	-3.54	4.52 *	0.49
17	1.81 **	1.79 **	1.80 **	5.69 *	1.52	3.60 *
18	-0.52	-0.66	-0.59	-8.70 **	-5.48 **	-7.09 **
19	-0.97	0.68	-0.14	5.58 *	18.30 **	11.94 **
20	2.81 **	1.12 *	1.97 **	11.13 **	1.85	6.49 **
L.S.D. (gi) 5%	1.19	1.03	0.79	4.80	4.00	3.12
1%	1.57	1.36	1.04	6.31	5.26	4.11
L.S.D. (gi-gj) 5%	1.68	1.46	1.12	6.79	5.65	4.42
1%	2.21	1.92	1.47	8.92	7.43	5.81

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

Cont.

Traits / Parents	Ear height			Leaf area of upper ear		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	-2.43 **	-2.76 **	-2.59 **	-3.27	-22.10 **	-12.69 **
2	0.23	0.41	0.32	1.85	12.79 **	7.32 *
3	2.20 **	2.35 *	2.27 **	1.42	9.31 *	5.36
L.S.D. (gi) 5%	1.55	2.08	1.30	8.12	8.42	5.85
1%	2.04	2.73	1.70	10.67	11.06	7.68
L.S.D. (gi-gj) 5%	2.19	2.94	1.83	11.48	11.90	8.27
1%	2.88	3.86	2.41	15.08	15.64	10.87
Lines						
1	-2.03	3.70	0.83	71.15 **	58.50 **	64.82 **
2	-0.81	-1.19	-1.00	46.33 **	46.00 **	46.17 **
3	-0.48	-4.41	-2.45	-24.38 *	15.77	-4.30
4	9.30 **	3.25	6.28 **	45.84 **	25.02 *	35.43 **
5	12.97 **	8.70 **	10.83 **	-10.44	3.13	-3.65
6	8.19 **	7.92 **	8.05 **	81.97 **	21.10	51.53 **
7	1.85	4.92	3.39 *	-36.58 **	-1.34	-18.96 *
8	0.52	-1.86	-0.67	-31.33 **	-40.19 **	-35.76 **
9	-6.15 **	-8.97 **	-7.56 **	38.05 **	-5.57	16.24 *
10	-10.37 **	-3.41	-6.89 **	-57.52 **	-61.43 **	-59.47 **
11	3.19	0.36	1.78	-45.36 **	-43.50 **	-44.43 **
12	-1.59	1.14	-0.22	-1.76	39.63 **	18.94 *
13	1.52	1.64	1.58	-66.84 **	-48.17 **	-57.51 **
14	-4.59 *	1.92	-1.34	7.64	43.70 **	25.67 **
15	-4.15 *	-6.41 *	-5.28 **	-18.94	30.24 **	5.65
16	0.08	-0.97	-0.45	92.62 **	27.93 *	60.28 **
17	-0.03	-3.19	-1.61	-5.38	-43.51 **	-24.45 **
18	-5.12 *	-4.75	-4.94 **	-60.53 **	-77.44 **	-68.98 **
19	-4.59 *	2.25	-1.17	1.62	55.87 **	28.75 **
20	2.30	-0.64	0.83	-26.18 *	-45.75 **	-35.97 **
L.S.D (gi) 5%	4.00	5.36	3.34	20.95	21.73	15.09
1%	5.26	7.05	4.40	27.54	28.56	19.84
L.S.D. (gi-gj) 5%	5.66	7.58	4.73	29.63	30.73	21.35
1%	7.43	9.97	6.22	38.95	40.39	28.05

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

Cont.

Parents \ Traits	Ear husk			Ear length		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	-0.24 **	-0.18 **	-0.21 **	-0.07	0.41 **	0.17
2	0.24 **	0.13	0.19 **	-0.07	-0.25	-0.16
3	0.01	0.05	0.03	0.13	-0.16	-0.01
L.S.D. (gi) 5%	0.18	0.17	0.12	0.30	0.32	0.22
1%	0.23	0.22	0.16	0.40	0.42	0.29
L.S.D. (gi-gj) 5%	0.25	0.24	0.17	0.43	0.45	0.31
1%	0.33	0.31	0.23	0.56	0.59	0.41
Lines						
1	-0.95 **	-0.82 **	-0.89 **	0.01	0.37	0.19
2	0.49 *	0.73 **	0.61 **	-0.14	-1.27 **	-0.71 *
3	-0.84 **	-0.60 **	-0.72 **	-0.14	0.62	0.24
4	-0.17	-0.04	-0.11	-0.49	-0.54	-0.51
5	0.05	0.07	0.06	-1.38 **	-0.01	-0.69 *
6	-0.28	-0.49 *	-0.39 *	0.37	0.41	0.39
7	-0.28	-0.04	-0.16	0.35	-0.91 *	-0.28
8	-0.06	-0.27	-0.16	0.41	-0.31	0.05
9	0.83 **	1.07 **	0.95 **	-1.13 **	-0.17	-0.65 *
10	-0.51 *	-0.38	-0.44 **	-0.13	-0.63	-0.38
11	-0.28	-0.60 **	-0.44 **	0.86 *	1.74 **	1.30 **
12	0.05	0.07	0.06	0.41	0.81	0.61 *
13	-0.62 **	-0.38	-0.50 **	-0.10	-0.26	-0.18
14	-0.62 **	-0.04	-0.33 *	1.48 **	-0.87 *	0.30
15	0.16	-0.16	0.00	0.21	-0.10	0.06
16	0.94 **	0.40	0.67 **	-1.11 **	-1.71 **	-1.41 **
17	0.94 **	0.96 **	0.95 **	-0.64	0.13	-0.26
18	0.16	-0.16	0.00	-0.05	0.91 *	0.43
19	0.61 **	0.40	0.50 **	0.49	0.23	0.36
20	0.38	0.29	0.34 *	0.71	1.57 **	1.14 **
L.S.D. (gi) 5%	0.45	0.43	0.31	0.78	0.82	0.57
1%	0.59	0.57	0.41	1.03	1.07	0.74
L.S.D. (gi-gj) 5%	0.64	0.61	0.44	1.11	1.15	0.80
1%	0.84	0.80	0.58	1.45	1.52	1.05

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

Cont.

Traits / Parents	Ear diameter			Number of rows/ ear		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	0.00	0.09 **	0.05	-0.48 **	-0.62 **	-0.55 **
2	0.02	-0.10 **	-0.04	-0.02	0.08	0.03
3	-0.03	0.01	-0.01	0.50 **	0.54 **	0.52 **
L.S.D. (gi) 5%	0.06	0.07	0.05	0.20	0.17	0.13
1%	0.08	0.09	0.06	0.26	0.22	0.17
L.S.D. (gi-gj) 5%	0.09	0.10	0.07	0.28	0.24	0.18
1%	0.11	0.13	0.09	0.37	0.31	0.24
Lines						
1	0.08	0.20 *	0.14 *	0.14	0.35	0.24
2	0.10	-0.24 **	-0.07	-0.33	0.20	-0.06
3	-0.17 *	-0.09	-0.13 *	-1.04 **	-1.34 **	-1.19 **
4	-0.10	0.03	-0.04	0.03	0.77 **	0.40 *
5	0.03	0.13	0.08	1.85 **	1.44 **	1.64 **
6	0.19 *	0.00	0.09	1.13 **	0.66 **	0.89 **
7	-0.13	-0.18 *	-0.16 **	-0.55 *	-0.35	-0.45 **
8	0.00	-0.18 *	-0.09	-1.21 **	-1.01 **	-1.11 **
9	0.03	0.25 **	0.14 *	-0.95 **	-0.11	-0.53 **
10	-0.25 **	-0.05	-0.15 *	-0.74 **	-0.84 **	-0.79 **
11	-0.15	-0.33 **	-0.24 **	-0.14	-0.96 **	-0.55 **
12	-0.01	-0.12	-0.06	0.06	0.00	0.03
13	0.12	0.18 *	0.15 *	1.75 **	1.80 **	1.78 **
14	-0.01	-0.17	-0.09	-0.44	0.05	-0.19
15	0.00	0.09	0.05	0.54 *	-0.05	0.24
16	-0.02	0.08	0.03	-0.14	0.33	0.09
17	0.08	0.15	0.11	0.22	0.04	0.13
18	0.10	0.07	0.09	0.60 *	-0.39	0.11
19	0.19 *	0.22 *	0.20 **	-0.67 *	-0.49 *	-0.58 **
20	-0.06	-0.04	-0.05	-0.14	-0.09	-0.11
L.S.D. (gi) 5%	0.16	0.18	0.12	0.51	0.43	0.34
1%	0.21	0.24	0.16	0.68	0.57	0.44
L.S.D. (gi-gj) 5%	0.22	0.25	0.17	0.73	0.61	0.48
1%	0.29	0.33	0.22	0.96	0.80	0.62

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

Cont.

Traits / Parents	Number of kernels/ row			100-kernel weight		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	-0.25	0.77 **	0.26	0.88 **	1.07 **	0.98 **
2	-0.31	-0.62	-0.47	0.51 **	-0.46 *	0.03
3	0.56	-0.15	0.20	-1.39 **	-0.61 **	-1.00 **
L.S.D. (gi) 5%	0.73	0.68	0.50	0.37	0.44	0.29
1%	0.96	0.89	0.66	0.48	0.58	0.38
L.S.D. (gi-gj) 5%	1.04	0.96	0.71	0.52	0.62	0.40
1%	1.36	1.26	0.93	0.68	0.81	0.53
Lines						
1	-0.48	1.01	0.26	0.89	1.32 *	1.11 **
2	1.23	-0.98	0.12	-3.33 **	-1.57 **	-2.45 **
3	-0.22	2.45 **	1.12	4.33 **	7.32 **	5.83 **
4	1.96 *	0.45	1.21	-2.33 **	-1.01	-1.67 **
5	-1.48	-0.69	-1.09	-2.22 **	-2.01 **	-2.12 **
6	-1.82	0.61	-0.60	-0.22	-2.90 **	-1.56 **
7	1.00	-0.67	0.16	-0.22	-0.46	-0.34
8	0.46	-0.13	0.17	1.33 **	0.54	0.94 *
9	-1.43	1.27	-0.08	0.11	-2.46 **	-1.17 **
10	-2.12 *	0.35	-0.88	3.78 **	0.32	2.05 **
11	2.06 *	2.84 **	2.45 **	-6.11 **	-2.12 **	-4.12 **
12	3.48 **	2.54 **	3.01 **	2.00 **	0.66	1.33 **
13	0.31	-2.07 *	-0.88	0.11	1.32 *	0.72
14	-0.16	-2.96 **	-1.56 *	2.22 **	-0.79	0.72
15	1.43	-0.71	0.36	0.56	3.21 **	1.88 **
16	-4.13 **	-2.50 **	-3.32 **	1.67 **	-2.01 **	-0.17
17	-0.57	-0.26	-0.42	-0.78	-0.12	-0.45
18	-0.47	-2.27 *	-1.37 *	-2.67 **	-3.01 **	-2.84 **
19	1.45	-0.02	0.72	4.00 **	3.32 **	3.66 **
20	-0.50	1.74	0.62	-3.11 **	0.43	-1.34 **
L.S.D. (gi) 5%	1.89	1.76	1.29	0.95	1.13	0.74
1%	2.48	2.31	1.69	1.25	1.49	0.97
L.S.D. (gi-gj) 5%	2.67	2.48	1.82	1.34	1.60	1.04
1%	3.51	3.26	2.40	1.77	2.10	1.37

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

Cont.

Parents \ Traits	Ear weight /plant			Shelling %		
	Early sowing	Late sowing	Comb.	Early sowing	Late sowing	Comb.
Testers						
1	-1.09 **	11.19 **	5.05 **	-0.34	-1.26 **	-0.80 **
2	2.80 **	-7.49 **	-2.35 **	0.26	1.40 **	0.83 *
3	-1.71 **	-3.69 **	-2.70 **	0.09	-0.14	-0.03
L.S.D. (gi) 5%	0.76	0.81	0.56	0.80	1.05	0.66
1%	1.00	1.07	0.73	1.05	1.38	0.87
L.S.D. (gi-gj) 5%	1.08	1.15	0.79	1.13	1.49	0.94
1%	1.42	1.51	1.04	1.49	1.96	1.23
Lines						
1	-15.27 **	12.07 **	-1.60 *	3.11 **	1.42	2.26 **
2	-9.90 **	-23.62 **	-16.76 **	-1.75	0.11	-0.82
3	-25.80 **	21.48 **	-2.16 **	-1.88	-1.88	-1.88 *
4	3.88 **	-1.61	1.14	2.45 *	2.44	2.44 **
5	6.17 **	8.88 **	7.52 **	-0.40	-1.38	-0.89
6	2.10 *	2.38 *	2.24 **	-0.81	-1.25	-1.03
7	1.83	-10.71 **	-4.44 **	2.77 **	2.31	2.54 **
8	12.46 **	0.29	6.37 **	-4.59 **	0.24	-2.17 *
9	-8.88 **	-2.93 **	-5.90 **	-1.09	-2.82 *	-1.96 *
10	31.89 **	-8.10 **	11.90 **	-0.61	-0.28	-0.44
11	-14.61 **	9.57 **	-2.52 **	0.81	-0.76	0.02
12	-0.67	9.96 **	4.65 **	0.38	0.62	0.50
13	8.86 **	9.12 **	8.99 **	1.78	4.43 **	3.11 **
14	31.65 **	-18.10 **	6.77 **	-1.12	-0.46	-0.79
15	-11.07 **	11.02 **	-0.03	-0.90	-1.53	-1.22
16	-4.22 **	-11.55 **	-7.89 **	-0.38	-0.46	-0.42
17	0.81	5.52 **	3.16 **	-0.19	-1.74	-0.96
18	-3.65 **	-24.27 **	-13.96 **	2.18 *	5.39 **	3.78 **
19	-3.68 **	11.84 **	4.08 **	1.07	-2.04	-0.49
20	-1.90	-1.24	-1.57 *	-0.81	-2.36	-1.58
L.S.D. (gi) 5%	1.97	2.10	1.44	2.07	2.72	1.71
1%	2.58	2.76	1.89	2.72	3.57	2.24
L.S.D. (gi-gj) 5%	2.78	2.97	2.03	2.92	3.85	2.42
1%	3.66	3.90	2.67	3.84	5.05	3.17

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

Cont.

Traits / Parents	Grain yield		
	Early sowing	Late sowing	Comb.
Testers			
1	-1.41	7.79 **	3.19 **
2	2.71 **	-4.64 **	-0.97
3	-1.29	-3.15 **	-2.22 **
L.S.D. (gi) 5%	1.50	1.58	1.09
1%	1.97	2.08	1.43
L.S.D. (gi-gj) 5%	2.12	2.24	1.54
1%	2.79	2.94	2.03
Lines			
1	-7.79 **	12.25 **	2.23
2	-10.97 **	-19.08 **	-15.03 **
3	-24.04 **	14.99 **	-4.52 **
4	7.61 **	2.23	4.92 **
5	4.15 *	5.49 **	4.82 **
6	0.24	0.72	0.48
7	6.19 **	-5.84 **	0.18
8	1.81	0.84	1.32
9	-9.12 **	-7.75 **	-8.43 **
10	25.11 **	-6.63 **	9.24 **
11	-10.77 **	7.04 **	-1.87
12	0.59	9.43 **	5.01 **
13	10.51 **	13.37 **	11.94 **
14	23.94 **	-15.14 **	4.40 **
15	-10.24 **	7.16 **	-1.54
16	-4.26 *	-9.86 **	-7.06 **
17	0.64	2.47	1.56
18	0.44	-14.80 **	-7.18 **
19	-1.18	7.08 **	2.95 *
20	-2.84	-3.97	-3.41 *
L.S.D. (gi) 5%	3.88	4.08	2.82
1%	5.10	5.37	3.70
L.S.D. (gi-gj) 5%	5.49	5.78	3.98
1%	7.21	7.59	5.23

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

4.3.2 Specific combining ability effects:

Specific combining ability effects of the top crosses for all traits in both sowing dates as well as the combined analysis are presented in (Table 7).

Significant and negative SCA effects for tasseling date in top crosses; T_1xL_1, $T_2x\ L_{15}$ and T_2xL_{19} at early sowing date; T_1xL_7, T_1xL_{19}, T_2xL_3, T_2xL_{12}, T_3xL_2, T_3xL_{10}, T_3xL_{14} and T_3xL_{16} at late sowing date , and T_1xL_1, T_2xL_3, T_2xL_{19}, T_3xL_{10} and T_3xL_{14} at The combined analysis. The most desirable SCA effects for this trait were detected for the top cross T_2xL_3 followed by the crosses T_3xL_{14} and T_2xL_{19}. This means that the immediate use of line 3 and 19 as aparent of three way cross with S.C (S.C El-Hosary 101) could be recommended.

Also, in (Table 7) showed that the tester (Gem. Pop). expressed the highest number of significantly negative SCA effects especially at late sowing date and the combined analysis in their crosses and showed the highest negative SCA effects for tasseling date at late sowing and the combined analysis. Also, exhibited the widest range of SCA effects –2.41 to 2.70 at late sowing date and –1.31 to 1.75 in the combined analysis.

Regarding to silking date, three, two and zero top crosses exhibited significant and negative SCA effects were obtained for the tester T_1 (L_{100}), T_2 (S.C El-Hosary 101) and T_3 (Gem.pop.), respectively at early sowing date ;Three, three and three top crosses at late sowing gave significant negative SCA effects in the same order. While, one, three and three top crosses gave significant negative SCA effects in the same order at the combined analysis. Moreover, the most desirable SCA effects for this trait were obtained for the top cosses T_1xL_1 at early sowing date; T_2xL_3 and T_2xL_{12} at late sowing date and the combined analysis. Meanwhile, the tester T_2 (S.C El-Hosary 101) gave the best SCA effects for this trait. While, T_3 (Gem. pop.) had the widest range of SCA effects for this trait at late sowing and the combined analysis. However, T_1 (L_{100}) expressed the widest range of SCA effects for this trait at early sowing date. It could be concluded that the tester T_2 (S.C El-Hosary 101) was the best among all tester for silking date since it exhibited the largest number of significantly negative SCA effects over both sowing dates and the combined analysis. Also, the tester T_3 (Gem. pop.) expressed the widest range of SCA effects at late sowing date and the combined analysis.

Regarding to maturity date, one, zero and one at early sowing date; two, zero and two at late sowing date and one, two and three top crosses at the combined analysis exhibited significant negative SCA effects for tester T_1,T_2 and T_3, respectively. Also, the cross T_1xL_1 at early ,late sowing date and the combined analysis, T_3xL_{15} at early sowing date and the top cross T_3xL_{17} at late sowing date and the combined analysis had the most desirable $\hat{S}_{ij}$ effects for this trait.

For plant height, five, five and four top crosses at early sowing date; six, three and three top crosses at late sowing date and five, four and four top crosses at the combined analysis expressed significant negative $\hat{S}_{ij}$ effects for the tester T_1 (L_{100}), T_2 (S.C El-Hosary 101) and T_3(Gem. pop.), respectively. The highest desirable $\hat{S}_{ij}$ effects to short plants were detected by cross $T_{1}xL_3$ and $T_{1}xL_{10}$ in both sowing dates as well as the combined analysis. In addition this tester expressed the largest number of significantly negative $\hat{S}_{ij}$ effects and had the widest range of $\hat{S}_{ij}$ effects for this trait. In this respect, **Zambezi *et al.* (1986)** pointed out that inbred testers are preferred over broad base testers and mentioned two practical reasons for preferring inbred line (narrow base) testers to broad – base testers. First, sampling errors are likely to occur with heterogeneous testers. Second, use of an inbred line or (single cross) tester may permit quicker utilization of new lines in commercial hybrids, especially if the tester is already in commercial use.

For ear height, the top crosses T_1xL_4, T_2xL_{15} ,$T_2x\ L_{16}$, T_2xL_{17}, T_3xL_3, T_3xL_{14} and T_3xL_{15} at early sowing date; T_1xL_{11}, T_2xL_{16}, T_3xL_3, T_3xL_{14} at late sowing date and T_1xL_{11}, T_1XL_{18}, T_2xL_9, T_2xL_{15}, T_2xL_{16}, T_2xL_{17}, T_3xL3 and T_3xL_{14} at the combined analysis, expressed significant negative $\hat{S}_{ij}$ effects. However, the most desirable $\hat{S}_{ij}$ effects were detected for the top crosses T_2xL_{16}, T_3xL_3 and T_3xL_{14} at early, late sowing dates as well as the combined analysis, respectively. The T_2 (S.C El-Hosary 101) exhibited the largest number of desirable $\hat{S}_{ij}$ effects (4 crosses). While, the T_3 (Gem. pop.) expressed the widest range between $\hat{S}_{ij}$ effects at both sowing dates as well as the combined analysis. This may suggest the immediate use of T_2 (S.C El-Hosary 101) as parents in the development or three way crosses to improve ear height.

Leaf area of upper ear, the cross T_1xL_6, T_1xL_9, T_1xL_{20}, T_2xL_2, T_2xL_4.T_2xL_{12}, T_3xL_{15} and T_3xL_{16} at early sowing date; T_1 and each of L_4 and L_8; T_2 with each of L_2, L_{10} and L_{12}; and T_3 with each of L_9, L_{15}, L_{17} and L_{18} at late sowing date and T_1 with each of L_6, L_8 and L_{20}; T_2 and each of L_2, L_{10}, L_{12} and L_{14}; T_3 and each of L_9, L_{15}, L_{16} and L_{18}, gave significant positive $\hat{S}_{ij}$ effects. However, the other top crosses exhibited either significant negative or insignificant $\hat{S}_{ij}$ effects.

The top cross T_1xL_9 at early sowing date and the combined analysis and T_1xL_{18} and T_1xL_{19} at the combined analysis gave significantly positive $\hat{S}_{ij}$ effects for ear husk. However, the other top crosses gave either significant negative or insignificant $\hat{S}_{ij}$ effects for this trait.

For ear length, the top crosses T_1xL_{14}, T_2xL_3, T_2xL_5 and T_3xL_{10} at early sowing date; T_1xL_9, T_2xL_3 and T_2xL_{20} at late sowing date; T_1xL_{14}, T_2xL_3, T_3xL_{10} and T_3xL_{18} at the combined analysis expressed significant positive $\hat{S}_{ij}$ effects. However, the most desirable $\hat{S}_{ij}$ effects were detected for the top cross T_2xL_3 at both sowing dates as well as the combined analysis.

For ear diameter, the top cross T_2xL_{12} at the combined analysis gave significant positive $\hat{S}_{ij}$ effects. However, the other top crosses gave either significant negative or insignificant $\hat{S}_{ij}$ effects for this trait.

For number of rows/ ear, the top crosses T_1xL_{13}, T_1xL_{14}, T_2xL_6 and T_3xL_{10} at early sowing date; T_1xL_{13}, T_2x L_4 and T_3xL_6

at late sowing date and T_1xL_{13}, T_2xL_4, T_2xL_6, T_3xL_3 and T_3xL_{10} at the combined analysis, exhibited significantly positive $\hat{S}_{ij}$ effects. While, the other top crosses gave either significant negative or insignificant $\hat{S}_{ij}$ effects. The most desirable $\hat{S}_{ij}$ effects were obtained from top cross $T_3x\ L_{10}$, T_2xL_4 and T_1xL_{13} at early, late sowing dates as well as the combined analysis, respectively.

Regarding number of kernels/ row, the top crosses T_1xL_{16} and T_3xL_{16} at early sowing; T_1xL_{18}, T_2xL_{15} and T_2xL_{20} at late sowing date; and T_1xL_5, T_1xL_{16}, T_2xL_{15} and T_2xL_{20} at the combined analysis exhibited significantly positive $\hat{S}_{ij}$ effects for this trait. The rest top crosses showed either significant negative or insignificant $\hat{S}_{ij}$ effects.

Five, three and five top crosses at early sowing date; seven, four and five at late sowing date; seven, three and seven at the combined analysis expressed significant positive $\hat{S}_{ij}$ effects for 100-kernel weight for the T_1, T_2 and T_3, respectively. Moreover, the most desirable $\hat{S}_{ij}$ effects for this trait were obtained for the top crosses T_1xL_1, T_1xL_{12} and T_1xL_{12} at early, late sowing dates as well as the combined analysis, respectively.

It could be concluded that the tester L_{100} was the best among all testers for this trait since it exhibited the largest number of significant positive $\hat{S}_{ij}$ effects, in addition this tester T_1 expressed the best $\hat{S}_{ij}$ effect over all crosses and had the widest range of $\hat{S}_{ij}$ effect. In this respect, **Zambezi *et al.* (1986)** pointed out that inbred testers are preferred over broad base testers and mentioned two practical reasons for preferring inbred line (narrow base) testers to broad-base testers. First, sampling errors are likely to occur with heterogeneous testers. Second, use of an inbred line or (single cross) tester may permit quicker utilization of new lines in commercial hybrids especially if the tester is already in commercial use.

Concerning ear weight, seven, eight and nine top crosses at early sowing date; eight, seven and seven at late sowing date; eight, seven and nine top crosses at the combined analysis expressed significant positive $\hat{S}_{ij}$ effects for T_1, T_2 and T_3, respectively. The most desirable $\hat{S}_{ij}$ effects were recorded for the top crosses T_1xL_{17} and T_2xL_5 at early sowing date; T_1xL_{18}, T_2xL_{12} and T_3xL_9 at late sowing date; and T_1xL_{13} and T_2xL_{12} at the combined analysis.

Regarding shelling percentage, the top crosses T_2xL_{19} at early sowing; T_1xL_3, T_2xL_9, T_2xL_{18} and T_3xL_{13} at late sowing date; T_1xL_{13}, T_2xL_9, T_2xL_{18}, and T_3xL_{13} at the combined analysis exhibited significant positive $\hat{S}_{ij}$ effects. The other top crosses exhibited either significant negative or insignificant $\hat{S}_{ij}$ effects for this trait.

For grain yield/ plant, five, seven and six top crosses at early sowing date; six, six and six top crosses at late sowing date; seven, six and eight top crosses at the combined analysis for testers T_1, T_2 and T_3, respectively. The best $\hat{S}_{ij}$ effects were obtained from top crosses T_1xL_{17}, T_2xL_5, T_2xL_{12} and T_3xL_{15} at early sowing date;T_1xL_{18},T_2xL_{12} and T_3xL_6 at late sowing date; T_2xL_{12} and T_1xL_{17} at the combined analysis. Furthermore, the tester T_2 (S.C El-Hosary 101) exhibited the widest range between $\hat{S}_{ij}$ effects for this trait at the combined analysis. Therefore, the immediate use of lines L_4, L_5, L_{10} and L_{12} as parents in the development of three way crosses with T_2 (S.C El-Hosary 101). Also, the immediate use of lines L_7, L_{13} and L_{17} as parents in development of single crosses with T_1 (L_{100}).

Table (7): Specific combining ability effects for all top crosses at separate sowing dates as well as the combined analysis.

Lines \ Traits	Tasseling date (Dayes to 50% shed)								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	-1.73 **	1.05	0.68	-0.68	-0.02	0.70	-1.21 **	0.52	0.69
2	-0.18	-0.39	0.57	1.54 *	-0.13	-1.41 *	0.68	-0.26	-0.42
3	1.27 *	-0.62	-0.65	-0.02	-2.02 **	2.03 **	0.63	-1.32 **	0.69
4	-0.96	0.83	0.13	-0.79	-0.46	1.26	-0.88	0.18	0.69
5	-0.62	0.83	-0.21	1.43 *	-0.91	-0.52	0.40	-0.04	-0.36
6	-0.07	-0.28	0.35	-0.46	0.21	0.26	-0.26	-0.04	0.30
7	-0.18	0.27	-0.09	-1.46 *	-0.79	2.26 **	-0.82	-0.26	1.08 *
8	0.27	-0.28	0.02	-1.24	0.09	1.14	-0.49	-0.09	0.58
9	0.27	0.05	-0.32	-0.57	0.76	-0.19	-0.15	0.41	-0.25
10	1.38 *	-0.84	-0.54	0.21	1.21	-1.41 *	0.79	0.18	-0.98 *
11	-0.07	0.38	-0.32	0.09	1.09	-1.19	0.01	0.74	-0.75
12	-0.40	0.38	0.02	2.54 **	-1.46 *	-1.08	1.07 *	-0.54	-0.53
13	0.04	0.49	-0.54	-0.79	0.21	0.59	-0.38	0.35	0.02
14	0.71	-0.51	-0.21	0.54	1.87 **	-2.41 **	0.63	0.68	-1.31 **
15	0.38	-1.51 *	1.13	-0.35	0.98	-0.63	0.01	-0.26	0.25
16	0.04	-0.17	0.13	0.43	1.09	-1.52 *	0.24	0.46	-0.70
17	-0.73	1.38 *	-0.65	1.32	-0.68	-0.63	0.29	0.35	-0.64
18	0.04	0.49	-0.54	-0.79	0.21	0.59	-0.38	0.35	0.02
19	0.71	-1.51 *	0.79	-1.68 *	-1.02	2.70 **	-0.49	-1.26 **	1.75 **
20	-0.18	-0.06	0.24	0.76	-0.24	-0.52	0.29	-0.15	-0.14
L.S.D. (gi) 5%	1.21			1.35			0.91		
1%	1.59			1.78			1.19		
L.S.D. (gi-gj) 5%	1.71			1.91			1.28		
1%	2.25			2.52			1.69		

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

Cont.

Lines \ Traits	Silking date (Dayes to 50% silk)								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	-1.34 **	0.13	1.21 **	-0.08	0.23	-0.15	-0.71	0.18	0.53
2	-0.45	0.02	0.43	1.25 *	-0.43	-0.82	0.40	-0.21	-0.19
3	0.99 *	-1.21 **	0.21	-0.53	-2.21 **	2.74 **	0.23	-1.71 **	1.48 **
4	-1.01 *	1.13 *	-0.12	-0.75	-0.10	0.85	-0.88 *	0.51	0.36
5	-0.56	0.91	-0.34	1.81 **	-0.88	-0.93	0.62	0.01	-0.64
6	-0.01	-0.21	0.21	-0.53	0.46	0.07	-0.27	0.12	0.14
7	-0.01	0.13	-0.12	-1.42 *	-0.77	2.18 **	-0.71	-0.32	1.03 **
8	0.11	-0.09	-0.01	-1.19 *	0.12	1.07	-0.54	0.01	0.53
9	0.33	0.13	-0.46	-0.64	0.68	-0.04	-0.16	0.40	-0.25
10	1.11 *	-0.76	-0.34	0.69	1.01	-1.71 **	0.90 *	0.12	-1.03 **
11	-0.23	-0.09	0.32	-0.19	0.79	-0.59	-0.21	0.35	-0.14
12	1.77 **	-1.09 *	-0.68	4.25 **	-2.77 **	-1.48 **	3.01 **	-1.93 **	-1.08 **
13	-0.45	0.35	0.10	-0.75	0.23	0.52	-0.60	0.29	0.31
14	0.55	0.02	-0.57	0.69	1.34 *	-2.04 **	0.62	0.68	-1.30 **
15	0.11	-0.43	0.32	-1.08	1.90 **	-0.82	-0.49	0.74 *	-0.25
16	-0.01	-0.21	0.21	0.14	0.79	-0.93	0.07	0.29	-0.36
17	-1.12 *	1.68 **	-0.57	0.92	-0.10	-0.82	-0.10	0.79 *	-0.69
18	-0.01	0.46	-0.46	-0.97	0.34	0.63	-0.49	0.40	0.09
19	0.22	-0.65	0.43	-1.64 **	-1.32 *	2.96 **	-0.71	-0.99 **	1.70 **
20	-0.01	-0.21	0.21	0.03	0.68	-0.71	0.01	0.24	-0.25
L.S.D. (gi) 5%	0.91			1.12			0.72		
1%	1.20			1.47			0.95		
L.S.D. (gi-gj) 5%	1.29			1.59			1.02		
1%	1.70			2.09			1.35		

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

Cont.

Traits / Lines	Maturity date								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	-2.83 **	0.63	2.20 *	-1.96 *	1.36	0.61	-2.40 **	0.99	1.40 *
2	-1.17	-0.37	1.53	0.82	0.47	-1.28	-0.17	0.05	0.13
3	1.06	-1.48	0.42	-1.74	-0.09	1.83 *	-0.34	-0.78	1.13
4	-1.72	2.41 *	-0.69	-0.85	1.47	-0.62	-1.29	1.94 **	-0.65
5	-1.39	0.74	0.64	0.37	0.36	-0.73	-0.51	0.55	-0.04
6	0.06	0.19	-0.24	0.37	-0.31	-0.06	0.21	-0.06	-0.15
7	-0.50	-0.03	0.53	0.82	-0.87	0.05	0.16	-0.45	0.29
8	0.06	-1.14	1.09	-1.07	-0.09	1.16	-0.51	-0.62	1.13
9	-0.39	-1.59	1.98	0.26	-1.76	1.49	-0.06	-1.67 *	1.74 *
10	0.39	0.52	-0.91	-1.85 *	1.47	0.38	-0.73	0.99	-0.26
11	0.83	-0.03	-0.80	-1.07	0.24	0.83	-0.12	0.11	0.01
12	1.83	-0.37	-1.47	2.59 **	-0.76	-1.84 *	2.21 **	-0.56	-1.65 *
13	0.39	0.86	-1.24	1.59	-1.09	-0.51	0.99	-0.12	-0.87
14	1.94	-1.26	-0.69	1.59	-1.09	-0.51	1.77 *	-1.17	-0.60
15	-0.61	2.86 **	-2.24 *	-1.41	2.58 **	-1.17	-1.01	2.72 **	-1.71 *
16	1.39	-0.48	-0.91	0.93	-1.42	0.49	1.16	-0.95	-0.21
17	0.72	1.19	-1.91	1.26	0.91	-2.17 *	0.99	1.05	-2.04 **
18	0.06	-1.81	1.76	1.37	-0.98	-0.39	0.71	-1.39 *	0.68
19	1.50	-1.70	0.20	-1.29	-0.31	1.61	0.10	-1.01	0.90
20	-1.61	0.86	0.76	-0.74	-0.09	0.83	-1.18	0.38	0.79
L.S.D. (gi) 5%	2.06			1.79			1.37		
1%	2.71			2.35			1.80		
L.S.D. (gi-gj) 5%	2.92			2.53			1.93		
1%	3.83			3.33			2.54		

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

Cont.

Traits / Lines	Plant height								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	-6.52	7.77	-1.25	4.41	-7.25 *	2.84	-1.05	0.26	0.80
2	0.03	4.66	-4.69	-0.47	16.19 **	-15.72 **	-0.22	10.43 **	-10.20 **
3	-10.30 *	13.33 **	-3.03	-9.36 **	7.97 *	1.39	-9.83 **	10.65 **	-0.82
4	-4.63	18.66 **	-14.03 **	5.53	1.19	-6.72	0.45	9.93 **	-10.37 **
5	0.48	-0.56	0.09	-0.47	-6.14	6.62	0.00	-3.35	3.35
6	2.48	1.77	-4.25	-14.14 **	9.53 **	4.62	-5.83 *	5.65 *	0.18
7	-3.86	-3.56	7.42	1.86	-5.47	3.62	-1.00	-4.52	5.52 *
8	11.59 **	-3.12	-8.47 *	-0.47	-1.47	1.95	5.56 *	-2.30	-3.26
9	5.26	-13.79 **	8.53 *	20.86 **	-25.81 **	4.95	13.06 **	-19.80 **	6.74 *
10	-21.41 **	11.88 **	9.53 *	-25.48 **	19.86 **	5.62	-23.44 **	15.87 **	7.57 **
11	-9.63 *	-1.68	11.31 **	-9.36 **	4.97	4.39	-9.50 **	1.65	7.85 **
12	-10.41 *	12.21 **	-1.80	-4.14	5.53	-1.38	-7.28 **	8.87 **	-1.59
13	-9.52 *	7.10	2.42	-12.20 **	8.80 *	3.39	-10.86 **	7.95 **	2.91
14	22.03 **	-8.34 *	-13.69 **	18.53 **	-0.14	-18.38 **	20.28 **	-4.24	-16.04 **
15	-0.63	-16.01 **	16.64 **	-9.70 **	-4.36	14.06 **	-5.17	-10.19 **	15.35 **
16	7.14	-14.23 **	7.09	5.75	-9.25 **	3.51	6.45 *	-11.74 **	5.30
17	12.59 **	-14.45 **	1.86	8.08 *	-5.25	-2.83	10.33 **	-9.85 **	-0.48
18	-3.86	-0.73	4.59	-5.59	-6.59	12.17 **	-4.72	-3.66	8.38 **
19	18.70 **	-1.34	-17.36 **	19.97 **	-0.36	-19.61 **	19.33 **	-0.85	-18.48 **
20	0.48	0.44	-0.91	6.41	-1.92	-4.49	3.45	-0.74	-2.70
L.S.D. (gi) 5%	8.31			6.93			5.41		
1%	10.93			9.10			7.11		
L.S.D. (gi-gj) 5%	11.76			9.79			7.65		
1%	15.45			12.87			10.06		

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

Cont.

Lines \ Traits	Ear height								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	-0.90	2.10	-1.20	3.20	-4.63	1.43	1.15	-1.26	0.11
2	0.54	1.55	-2.09	-3.91	8.93	-5.02	-1.68	5.24	-3.55
3	6.88	11.55 **	-18.42 **	3.65	6.15	-9.79 *	5.26	8.85 **	-14.11 **
4	-7.24 *	10.77 **	-3.53	-0.35	1.81	-1.46	-3.79	6.29 *	-2.50
5	-5.57	-2.23	7.80 *	-0.46	-2.30	2.76	-3.02	-2.26	5.28
6	-3.12	-0.12	3.25	-4.35	1.81	2.54	-3.74	0.85	2.89
7	-5.46	-0.12	5.58	6.65	-2.85	-3.79	0.59	-1.49	0.89
8	7.54 *	-3.79	-3.75	0.76	-1.74	0.98	4.15	-2.76	-1.39
9	1.54	-5.45	3.91	-2.13	-6.63	8.76	-0.29	-6.04 *	6.34 *
10	-6.90	3.77	3.13	-4.35	4.15	0.21	-5.63	3.96	1.67
11	-1.79	-0.79	2.58	-11.80 *	5.37	6.43	-6.79 *	2.29	4.50
12	-2.35	3.99	-1.64	-0.24	-3.08	3.32	-1.29	0.46	0.84
13	-2.46	7.21 *	-4.75	-3.07	2.09	0.98	-2.77	4.65	-1.89
14	9.32 **	-1.34	-7.98 *	12.98 **	2.48	-15.46 **	11.15 **	0.57	-11.72 **
15	1.54	-9.79 **	8.25 *	-3.02	-5.85	8.87	-0.74	-7.82 **	8.56 **
16	4.99	-11.01 **	6.02	2.54	-9.30 *	6.76	3.76	-10.15 **	6.39 *
17	7.76 *	-8.90 *	1.13	11.43 *	-8.08	-3.35	9.59 **	-8.49 **	-1.11
18	-5.41	1.52	3.89	-8.35	7.81	0.54	-6.88 *	4.67	2.21
19	2.99	-0.68	-2.31	1.98	1.81	-3.79	2.48	0.57	-3.05
20	-1.90	1.77	0.13	-1.13	2.04	-0.91	-1.52	1.90	-0.39
L.S.D. (gi) 5%	6.93			9.29			5.79		
1%	9.10			12.21			7.61		
L.S.D. (gi-gj) 5%	9.80			13.13			8.19		
1%	12.88			17.26			10.77		

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

Cont.

Lines \ Traits	Leaf area of upper ear								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	-15.48	-2.00	17.48	37.38	-47.05 *	9.67	10.95	-24.53	13.58
2	-23.06	51.14 **	-28.07	-0.10	48.11 *	-48.01 *	-11.58	49.62 **	-38.04 **
3	27.05	0.59	-27.64	2.84	-12.66	9.82	14.94	-6.03	-8.91
4	-10.84	37.70 *	-26.86	49.34 *	-23.91	-25.43	19.25	6.90	-26.14
5	15.93	19.98	-35.91	29.88	-16.02	-13.86	22.90	1.98	-24.89
6	41.75 *	-29.76	-11.99	22.11	3.22	-25.33	31.93 *	-13.27	-18.66
7	11.50	28.93	-40.43 *	-1.66	-30.28	31.93	4.92	-0.67	-4.25
8	32.48	4.21	-36.69 *	45.20 *	-29.19	-16.01	38.84 **	-12.49	-26.35 *
9	43.28 *	-36.21	-7.07	-37.42	-23.74	61.17 **	2.93	-29.98 *	27.05 *
10	-64.16 **	34.59	29.58	-103.56 **	89.54 **	14.02	-83.86 **	62.06 **	21.80
11	-16.12	-14.22	30.34	-18.70	37.61	-18.91	-17.41	11.69	5.72
12	-2.57	67.45 **	-64.88 **	30.71	43.68 *	-74.39 **	14.07	55.57 **	-69.63 **
13	16.29	-14.11	-2.17	21.38	-10.67	-10.71	18.83	-12.39	-6.44
14	-20.40	21.73	-1.33	29.61	31.42	-61.03 **	4.61	26.57 *	-31.18 *
15	-31.39	-30.18	61.57 **	-50.23 **	-28.13	78.36 **	-40.81 **	-29.15 *	69.97 **
16	-24.95	-87.41 **	112.36 **	5.43	8.81	-14.23	-9.76	-39.30 **	49.06 **
17	0.05	0.59	-0.64	15.92	-67.38 **	51.46 **	7.98	-33.39 *	25.41
18	-25.90	-8.28	34.18	-56.58 **	-19.45	76.03 **	-41.24 **	-13.86	55.11 **
19	-27.29	20.92	6.36	-15.29	22.24	-6.95	-21.29	21.58	-0.29
20	73.85 **	-65.67 **	-8.18	-6.24	23.87	-17.63	33.81 *	-20.90	-12.90
L.S.D. (gi) 5%	36.29			37.64			26.14		
1%	47.70			49.47			34.36		
L.S.D. (gi-gj) 5%	51.33			53.23			36.97		
1%	67.46			69.96			48.59		

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

Cont.

Lines \ Traits	Ear husk								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	0.13	-0.68	0.55	0.41	-0.24	-0.16	0.27	-0.46	0.19
2	-0.31	-0.13	0.44	-0.15	0.20	-0.05	-0.23	0.04	0.19
3	0.36	-0.79 *	0.44	0.18	-0.47	0.28	0.27	-0.63 *	0.36
4	-0.64	0.54	0.11	-0.04	-0.02	0.06	-0.34	0.26	0.08
5	0.13	-0.02	-0.12	-0.15	0.20	-0.05	-0.01	0.09	-0.08
6	-0.87 *	0.32	0.55	-0.59	0.09	0.51	-0.73 **	0.20	0.53
7	-0.20	-0.02	0.22	-0.04	-0.02	0.06	-0.12	-0.02	0.14
8	-0.09	-0.24	0.33	-0.15	-0.13	0.28	-0.12	-0.19	0.31
9	1.02 *	-0.46	-0.56	0.18	-0.13	-0.05	0.60 *	-0.30	-0.31
10	0.02	0.21	-0.23	-0.04	0.31	-0.27	-0.01	0.26	-0.25
11	-0.53	0.32	0.22	-0.48	0.20	0.28	-0.51	0.26	0.25
12	-0.20	0.32	-0.12	-0.15	-0.13	0.28	-0.18	0.09	0.08
13	0.13	-0.02	-0.12	0.29	0.31	-0.61	0.21	0.15	-0.36
14	0.13	0.32	-0.45	-0.37	0.31	0.06	-0.12	0.31	-0.19
15	-0.31	0.21	0.11	0.07	0.42	-0.49	-0.12	0.31	-0.19
16	-0.09	0.09	-0.01	0.18	-0.13	-0.05	0.05	-0.02	-0.03
17	-0.09	0.43	-0.34	-0.37	0.31	0.06	-0.23	0.37	-0.14
18	0.69	-0.13	-0.56	0.41	-0.58	0.17	0.55 *	-0.35	-0.19
19	0.58	0.43	-1.01 *	0.52	0.20	-0.72	0.55 *	0.31	-0.86 **
20	0.13	-0.68	0.55	0.29	-0.69	0.39	0.21	-0.69 *	0.47
L.S.D. (gi) 5%	0.78			0.75			0.54		
1%	1.03			0.98			0.71		
L.S.D. (gi-gj) 5%	1.11			1.06			0.77		
1%	1.46			1.39			1.01		

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

Cont.

Lines \ Traits	Ear length								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	0.38	-0.32	-0.06	0.04	0.11	-0.15	0.21	-0.11	-0.10
2	-0.03	0.30	-0.27	-1.36	0.61	0.75	-0.70	0.45	0.24
3	-0.13	2.03 **	-1.90 **	0.25	2.29 **	-2.54 **	0.06	2.16 **	-2.22 **
4	-1.02	0.84	0.18	-1.52 *	0.74	0.78	-1.27 *	0.79	0.48
5	-0.40	1.40 *	-1.00	1.29	-0.05	-1.24	0.44	0.68	-1.12 *
6	0.45	-0.54	0.09	0.10	-0.97	0.87	0.28	-0.76	0.48
7	-0.12	-0.46	0.58	0.39	-0.28	-0.11	0.13	-0.37	0.24
8	-0.82	0.54	0.28	0.45	0.15	-0.61	-0.18	0.35	-0.16
9	0.22	-0.58	0.36	1.51 *	-1.39	-0.12	0.86	-0.98 *	0.12
10	-1.71 *	0.09	1.62 *	-1.24	0.67	0.57	-1.47 **	0.38	1.10 *
11	0.10	0.27	-0.37	-1.57 *	0.27	1.30	-0.73	0.27	0.47
12	0.74	-0.89	0.14	0.13	0.60	-0.73	0.44	-0.14	-0.29
13	0.05	-0.34	0.29	0.50	-1.13	0.64	0.28	-0.74	0.46
14	1.41 *	-0.32	-1.09	0.64	-0.92	0.28	1.03 *	-0.62	-0.40
15	-0.86	0.41	0.44	-1.16	0.91	0.25	-1.01 *	0.66	0.35
16	0.40	-0.30	-0.10	0.89	-0.81	-0.07	0.64	-0.56	-0.09
17	1.00	-1.07	0.07	0.51	0.11	-0.62	0.75	-0.48	-0.28
18	-1.12	0.28	0.84	0.80	-1.94 **	1.14	-0.16	-0.83	0.99 *
19	1.13	-0.27	-0.87	0.38	-0.46	0.08	0.75	-0.36	-0.39
20	0.34	-1.09	0.74	-1.04	1.50 *	-0.46	-0.35	0.20	0.14
L.S.D. (gi) 5%	1.35			1.41			0.98		
1%	1.78			1.86			1.29		
L.S.D. (gi-gj) 5%	1.92			2.00			1.38		
1%	2.52			2.63			1.82		

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

Cont.

Traits / Lines	Ear diameter								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	0.10	-0.12	0.03	0.00	-0.05	0.05	0.05	-0.09	0.04
2	0.04	-0.21	0.17	-0.06	0.12	-0.05	-0.01	-0.05	0.06
3	0.01	-0.11	0.11	-0.08	0.01	0.07	-0.03	-0.05	0.09
4	-0.23	0.15	0.07	-0.06	0.12	-0.05	-0.15	0.14	0.01
5	-0.09	0.15	-0.06	-0.07	-0.05	0.11	-0.08	0.05	0.03
6	-0.18	0.13	0.05	-0.27	0.02	0.25	-0.22 *	0.07	0.15
7	0.14	-0.01	-0.13	0.21	0.06	-0.28	0.18	0.02	-0.20
8	-0.09	-0.01	0.11	0.28	-0.04	-0.24	0.09	-0.03	-0.07
9	-0.03	-0.11	0.14	-0.05	-0.07	0.12	-0.04	-0.09	0.13
10	0.05	0.13	-0.18	-0.22	0.13	0.09	-0.09	0.13	-0.05
11	0.08	0.03	-0.12	-0.04	-0.06	0.10	0.02	-0.01	-0.01
12	-0.18	0.13	0.05	0.01	0.30	-0.31	-0.08	0.21 *	-0.13
13	0.02	0.06	-0.08	0.11	-0.07	-0.04	0.07	0.00	-0.06
14	-0.01	0.10	-0.08	-0.06	0.12	-0.05	-0.04	0.11	-0.07
15	0.07	-0.08	0.01	-0.03	0.09	-0.05	0.02	0.00	-0.02
16	0.16	-0.02	-0.14	0.18	-0.10	-0.08	0.17	-0.06	-0.11
17	0.20	-0.22	0.03	-0.02	-0.20	0.22	0.09	-0.21 *	0.13
18	-0.09	0.05	0.04	0.19	-0.46 **	0.27	0.05	-0.20	0.15
19	-0.05	0.00	0.05	-0.05	0.00	0.06	-0.05	0.00	0.05
20	0.10	-0.02	-0.07	0.04	0.15	-0.19	0.07	0.06	-0.13
L.S.D. (gi) 5%	0.27			0.31			0.21		
1%	0.36			0.41			0.27		
L.S.D. (gi-gj) 5%	0.39			0.44			0.29		
1%	0.51			0.58			0.39		

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

Cont.

Traits / Lines	Number of rows/ ear								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	-0.15	0.72	-0.56	-0.17	-0.37	0.54	-0.16	0.18	-0.01
2	0.08	0.29	-0.36	-0.09	-0.39	0.48	-0.01	-0.05	0.06
3	-0.01	-0.70	0.71	0.22	-0.78 *	0.56	0.11	-0.74 *	0.64 *
4	0.66	-0.07	-0.59	-0.19	1.28 **	-1.09 **	0.23	0.60 *	-0.84 **
5	-0.37	0.77	-0.41	-0.02	-0.22	0.25	-0.19	0.28	-0.08
6	-0.71	0.96 *	-0.25	-1.51 **	0.39	1.13 **	-1.11 **	0.68 *	0.44
7	0.30	-0.56	0.26	-0.40	0.17	0.24	-0.05	-0.20	0.25
8	0.03	-0.29	0.26	0.49	0.05	-0.54	0.26	-0.12	-0.14
9	0.10	0.57	-0.68	-0.38	0.35	0.03	-0.14	0.46	-0.33
10	-0.98 *	-0.07	1.05 *	-0.41	-0.15	0.56	-0.70 *	-0.11	0.80 **
11	-0.24	0.73	-0.49	0.01	-0.02	0.01	-0.12	0.35	-0.24
12	0.09	-0.90 *	0.81	0.38	-0.22	-0.15	0.23	-0.56	0.33
13	0.93 *	-0.06	-0.88	0.81 *	-0.12	-0.69	0.87 **	-0.09	-0.78 **
14	0.96 *	-0.07	-0.89	-0.20	0.27	-0.06	0.38	0.10	-0.48
15	0.01	-0.35	0.34	-0.03	-0.27	0.30	-0.01	-0.31	0.32
16	0.02	-0.07	0.05	-0.01	0.19	-0.17	0.01	0.06	-0.06
17	0.47	-0.79	0.32	0.31	-0.12	-0.19	0.39	-0.46	0.07
18	-0.58	-0.17	0.75	0.70	0.40	-1.10 **	0.06	0.11	-0.18
19	-0.24	0.23	0.01	0.30	0.00	-0.30	0.03	0.11	-0.14
20	-0.38	-0.17	0.55	0.23	-0.43	0.20	-0.07	-0.30	0.37
L.S.D. (gi) 5%		0.89			0.75			0.58	
1%		1.17			0.98			0.77	
L.S.D. (gi-gj) 5%		1.26			1.06			0.82	
1%		1.66			1.39			1.08	

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

Cont.

Traits / Lines	Number of kernels/ row								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	1.09	0.22	-1.32	-1.05	1.08	-0.02	0.02	0.65	-0.67
2	0.51	-1.09	0.57	0.04	0.56	-0.60	0.28	-0.26	-0.02
3	-1.64	-0.58	2.22	0.37	0.67	-1.03	-0.64	0.04	0.59
4	-1.69	0.25	1.44	-1.66	-0.37	2.03	-1.67	-0.06	1.74
5	1.63	2.42	-4.05 *	2.85	-0.89	-1.96	2.24 *	0.77	-3.00 **
6	0.29	0.89	-1.18	0.68	-3.69 *	3.01	0.49	-1.40	0.91
7	-0.05	-0.92	0.97	1.09	-0.18	-0.91	0.52	-0.55	0.03
8	0.51	0.01	-0.53	1.61	-0.89	-0.72	1.06	-0.44	-0.63
9	-2.00	0.70	1.29	-0.59	-2.26	2.84	-1.29	-0.78	2.07
10	1.46	1.19	-2.65	-0.43	0.53	-0.10	0.51	0.86	-1.38
11	0.28	0.78	-1.06	-1.39	2.61	-1.22	-0.55	1.69	-1.14
12	-0.67	1.02	-0.35	-2.05	0.54	1.51	-1.36	0.78	0.58
13	-1.03	1.30	-0.27	1.33	-0.25	-1.08	0.15	0.53	-0.68
14	1.90	-1.10	-0.81	-1.32	0.01	1.31	0.29	-0.54	0.25
15	-3.95 *	2.45	1.50	-2.53	3.26 *	-0.73	-3.24 **	2.86 *	0.38
16	4.20 *	-7.96 **	3.76 *	1.56	-1.21	-0.35	2.88 *	-4.59 **	1.71
17	1.18	-1.75	0.57	0.78	0.08	-0.86	0.98	-0.84	-0.14
18	-0.25	0.55	-0.30	3.63 *	-2.05	-1.58	1.69	-0.75	-0.94
19	-1.77	0.89	0.88	-0.40	-1.37	1.77	-1.09	-0.24	1.32
20	-0.02	0.71	-0.70	-2.52	3.81 *	-1.29	-1.27	2.26 *	-0.99
L.S.D. (gi) 5%	3.27			3.04			2.23		
1%	4.30			4.00			2.94		
L.S.D. (gi-gj) 5%	4.63			4.30			3.16		
1%	6.08			5.65			4.15		

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

Cont.

Lines \ Traits	100-kernel weight								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	4.34 **	-1.62	-2.72 **	2.59 **	-0.54	-2.06 *	3.47 **	-1.08	-2.39 **
2	2.23 **	-1.40	-0.83	-2.85 **	4.35 **	-1.50	-0.31	1.48 *	-1.17
3	0.90	-3.07 **	2.17 **	-5.41 **	3.46 **	1.94	-2.25 **	0.20	2.06 **
4	-0.10	-0.73	0.83	-0.74	-0.54	1.28	-0.42	-0.64	1.06
5	-0.21	1.49	-1.28	-0.74	-1.21	1.94	-0.48	0.14	0.33
6	-3.88 **	1.49	2.39 **	0.82	-1.98 *	1.17	-1.53 *	-0.25	1.78 **
7	3.46 **	-1.84 *	-1.61	5.37 **	-0.76	-4.61 **	4.41 **	-1.30 *	-3.11 **
8	0.90	0.27	-1.17	4.37 **	-3.43 **	-0.94	2.64 **	-1.58 *	-1.06
9	-2.21 **	2.16 *	0.06	2.71 **	-2.76 **	0.06	0.25	-0.30	0.06
10	-2.21 **	-0.18	2.39 **	-4.74 **	1.79	2.94 **	-3.48 **	0.81	2.67 **
11	0.01	-0.62	0.61	-3.63 **	0.24	3.39 **	-1.81 **	-0.19	2.00 **
12	2.23 **	-0.40	-1.83 *	6.93 **	-0.54	-6.39 **	4.58 **	-0.47	-4.11 **
13	-2.54 **	3.82 **	-1.28	-4.41 **	-2.87 **	7.28 **	-3.48 **	0.47	3.00 **
14	0.68	-0.62	-0.06	1.71	0.57	-2.28 *	1.19	-0.02	-1.17
15	-0.99	3.04 **	-2.06 *	-3.96 **	5.24 **	-1.28	-2.48 **	4.14 **	-1.67 *
16	0.90	-0.40	-0.50	2.59 **	-1.87	-0.72	1.75 **	-1.14	-0.61
17	3.01 **	-1.96 *	-1.06	0.71	-4.43 **	3.72 **	1.86 **	-3.19 **	1.33 *
18	-1.43	1.27	0.17	5.26 **	-0.21	-5.06 **	1.91 **	0.53	-2.44 **
19	-1.43	-0.40	1.83 *	-4.07 **	-0.54	4.61 **	-2.75 **	-0.47	3.22 **
20	-3.66 **	-0.29	3.94 **	-2.52 *	6.02 **	-3.50 **	-3.09 **	2.86 **	0.22
L.S.D. (gi) 5%	1.65			1.96			1.28		
1%	2.16			2.57			1.68		
L.S.D. (gi-gj) 5%	2.33			2.77			1.81		
1%	3.06			3.64			2.38		

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

Cont.

Lines \ Traits	Ear weight /plant								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	-1.81	-8.33**	10.14**	6.81**	-5.51**	-1.31	2.50*	-6.92**	4.42**
2	9.82**	-16.86**	7.04**	-19.50**	6.45**	13.05**	-4.84**	-5.21**	10.05**
3	-2.05	-1.30	3.34	-13.03**	22.08**	-9.05**	-7.54**	10.39**	-2.85*
4	-5.09**	14.36**	-9.27**	-26.04**	23.51**	2.54	-15.57**	18.93**	-3.36**
5	-14.91**	38.07**	-23.16**	3.33	0.48	-3.82*	-5.79**	19.28**	-13.49**
6	-14.91**	29.60**	-14.69**	-4.43*	-25.05**	29.48**	-9.67**	2.28	7.40**
7	23.02**	-20.53**	-2.49	20.19**	-3.43	-16.76**	21.60**	-11.98**	-9.63**
8	-17.40**	-3.68*	21.09**	24.59**	-8.39**	-16.19**	3.59**	-6.04**	2.45
9	6.66**	-8.55**	1.89	-6.86**	-25.51**	32.36**	-0.10	-17.03**	17.12**
10	-18.70**	11.15**	7.55**	-29.69**	19.83**	9.86**	-24.20**	15.49**	8.71**
11	-5.87**	-0.35	6.22**	-21.69**	2.33	19.36**	-13.78**	0.99	12.79**
12	-15.08**	28.14**	-13.06**	-5.41**	30.61**	-25.19**	-10.25**	29.37**	-19.13**
13	24.73**	0.52	-25.25**	27.43**	-17.42**	-10.02**	26.08**	-8.45**	-17.63**
14	-9.43**	17.86**	-8.43**	12.64**	-10.87**	-1.77	1.61	3.49**	-5.10**
15	-4.31*	-20.23**	24.54**	-9.97**	12.88**	-2.92	-7.14**	-3.67**	10.81**
16	4.37*	-22.14**	17.77**	18.77**	-18.22**	-0.55	11.57**	-20.18**	8.61**
17	36.44**	-44.34**	7.90**	4.77*	-9.12**	4.35*	20.60**	-26.73**	6.12**
18	-26.83**	10.56**	16.27**	43.19**	-13.83**	-29.36**	8.18**	-1.63	-6.55**
19	28.13**	-8.68**	-19.45**	-10.32**	-1.27	11.59**	8.90**	-4.98**	-3.93**
20	3.22	4.74**	-7.96**	-14.78**	20.44**	-5.66**	-5.78**	12.59**	-6.81**
L.S.D. (gi) 5%	3.41			3.63			2.49		
1%	4.48			4.78			3.27		
L.S.D. (gi-gj) 5%	4.82			5.14			3.52		
1%	6.33			6.75			4.63		

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

Cont.

Traits / Lines	Shelling %								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop	L (100)	Elhosary 101	Gem pop
1	-0.76	1.38	-0.62	0.97	0.04	-1.01	0.10	0.71	-0.82
2	-0.66	-0.19	0.85	0.66	-1.40	0.74	0.00	-0.79	0.80
3	1.29	-0.41	-0.88	4.87 *	-4.17	-0.70	3.08 *	-2.29	-0.79
4	-2.02	0.03	1.99	0.24	-1.21	0.97	-0.89	-0.59	1.48
5	1.12	-1.65	0.53	-0.12	0.44	-0.32	0.50	-0.61	0.11
6	0.01	-1.16	1.15	-0.14	-2.00	2.15	-0.07	-1.58	1.65
7	-1.16	-0.55	1.71	0.23	-1.08	0.85	-0.46	-0.82	1.28
8	3.04	-3.28	0.24	0.66	3.26	-3.92	1.85	-0.01	-1.84
9	-1.65	0.78	0.87	-7.92 **	11.30 **	-3.38	-4.79 **	6.04 **	-1.25
10	1.31	-0.25	-1.06	0.44	0.15	-0.59	0.88	-0.05	-0.82
11	0.01	0.19	-0.20	0.65	-0.19	-0.46	0.33	0.00	-0.33
12	-2.71	2.59	0.12	-2.08	1.05	1.03	-2.39	1.82	0.57
13	-0.09	0.05	0.04	-3.96	-4.71 *	8.67 **	-2.02	-2.33	4.35 **
14	0.85	-0.29	-0.56	1.46	-0.17	-1.29	1.16	-0.23	-0.92
15	-0.37	-2.03	2.40	2.53	-2.58	0.06	1.08	-2.31	1.23
16	-0.43	1.63	-1.21	0.96	-1.74	0.78	0.27	-0.05	-0.22
17	1.19	-1.28	0.09	2.15	-3.30	1.15	1.67	-2.29	0.62
18	2.28	-1.37	-0.91	-3.41	8.63 **	-5.21 *	-0.57	3.63 *	-3.06 *
19	-1.10	4.93 **	-3.83 *	1.70	-1.16	-0.54	0.30	1.89	-2.18
20	-0.14	0.89	-0.74	0.12	-1.14	1.02	-0.01	-0.12	0.14
L.S.D. (gi) 5%	3.58			4.71			2.96		
1%	4.71			6.19			3.89		
L.S.D. (gi-gj) 5%	5.07			6.66			4.18		
1%	6.66			8.75			5.50		

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

Cont.

Traits / Lines	Grain yield								
	Early sowing date			Late sowing date			combiend		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
1	-2.72	-4.97	7.69 *	6.99	-4.25	-2.74	2.13	-4.61	2.48
2	6.76 *	-13.96 **	7.21 *	-15.34 **	3.75	11.59 **	-4.29	-5.10 *	9.40 **
3	0.26	-1.76	1.51	-3.62	11.84 **	-8.22 *	-1.68	5.04 *	-3.36
4	-7.76 *	12.29 **	-4.54	-21.66 **	18.58 **	3.08	-14.71 **	15.44 **	-0.73
5	-10.23 **	28.18 **	-17.95 **	2.01	1.44	-3.45	-4.11	14.81 **	-10.70 **
6	-12.06 **	22.09 **	-10.04 **	-4.58	-22.71 **	27.29 **	-8.32 **	-0.31	8.63 **
7	17.36 **	-18.19 **	0.84	17.48 **	-4.16	-13.32 **	17.42 **	-11.18 **	-6.24 *
8	-8.42 *	-8.74 *	17.16 **	20.90 **	-2.90	-18.00 **	6.24 *	-5.82 *	-0.42
9	2.70	-5.75	3.05	-15.01 **	-7.25 *	22.26 **	-6.16 *	-6.50 **	12.65 **
10	-12.99 **	8.83 *	4.16	-24.07 **	16.93 **	7.14 *	-18.53 **	12.88 **	5.65 *
11	-4.91	0.04	4.87	-17.13 **	2.13	15.00 **	-11.02 **	1.09	9.94 **
12	-17.14 **	28.24 **	-11.09 **	-7.99 *	27.98 **	-19.99 **	-12.57 **	28.11 **	-15.54 **
13	20.54 **	0.69	-21.24 **	17.20 **	-20.37 **	3.17	18.87 **	-9.84 **	-9.04 **
14	-6.19	14.06 **	-7.87 *	12.04 **	-9.02 *	-3.02	2.93	2.52	-5.45 *
15	-4.41	-19.76 **	24.17 **	-4.92	7.24 *	-2.32	-4.67	-6.26 *	10.93 **
16	3.01	-15.67 **	12.66 **	16.43 **	-16.80 **	0.37	9.72 **	-16.24 **	6.51 **
17	32.08 **	-38.54 **	6.46	6.43	-11.47 **	5.04	19.26 **	-25.00 **	5.75 *
18	-19.39 **	6.83 *	12.56 **	33.37 **	-4.20	-29.17 **	6.99 **	1.31	-8.30 **
19	21.23 **	0.65	-21.88 **	-6.41	-2.08	8.49 *	7.41 **	-0.71	-6.70 **
20	2.29	5.44	-7.73 *	-12.12 **	15.31 **	-3.19	-4.92 *	10.37 **	-5.46 *
L.S.D. (gi) 5%	6.72			7.08			4.88		
1%	8.83			9.30			6.41		
L.S.D. (gi-gj) 5%	9.50			10.01			6.90		
1%	12.49			13.15			9.07		

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

4.4. Heterosis:

Heterosis for grain yield/ plant was computed for individual top crosses as the percentage increase of hybrid performance relative to T.W. G 352, S.C. Pioneer 3080 and S.C. G 155 at early, late sowing date and the combined over them (Table8).

Eight, fourty one and twenty top crosses expressed significant and positive heterotic effects in early, late sowing dates as well as the combined analysis relative to T.W. G 352. However, most desirable heterotic effects were detected for the top crosses T_1xL_{13}, T_1xL_{17}, T_2xL_5, T_2xL_{10}, T_2xL_{12} and T_3xL_{10} at both sowing dates and the combined analysis. The useful heterotic effects relative to T.W. G 352 ranged from -31.8 to 17.42, -11.63 to 65.32 and -17.12 to 30.62% at early, late sowing dates and the combined over them, respectively.

Regarding useful heterotic effects relative to S.C G 155, zero, fifty eight and nineteen top crosses exhibited significant and positive values for grain yield/ plant at early, late sowing dates as well as the combined analysis, respectively. Eight top crosses at early sowing dates did not differ significant compared S.C. G 155. However, the best heterotic effects were obtained for the top crosses T_1xL_7, T_1xL_{13}, T_1xL_{17}, T_2xL_4, T_2xL_5, T_2xL_{10} and T_2xL_{12} in the combined data. The useful heterotic effects relative to S.C. G 155 ranged from -39.37 to 4.38, -11.29 to 106.82, and -17.49 to 30.03% at early, late sowing dates and the combined analysis, respectively.

Regarding useful heterotic effects relative to S.C. Pioneer 3080 Zero, twenty six and three top crosses exhibited significant and positive values for grain yield/ plant at early, late sowing date as well as the combined analysis, respectively. Also, five, twelve and eight top crosses did not differ significant compared S.C. Pioneer 3080 in the same order. Insignificant useful heterotic effects in these top crosses revealed that a hybrid program based on these materials may be useful for testing under different location and years. However, the best useful heterotic effects were obtained for the top crosses T_1xL_{13}, T_1xL_{17} and T_2xL_{12} in the combined data. The heterotic effects relative to S.C. Pioneer 3080 ranged from -41.09 to 1.42, -39.22 to 41.69 % and -28.62 to 12.49% at early, late sowing dates as well as the combined analysis. Hence, it could be concluded that the previous top crosses offer possibility for improving grain yield in maize. Many investigates reported useful heterosis for yield in maize **Shehata *et al.* (1997), Mahmoud *et al.* (2001), Amer *et al.* (2002), Mosa *et al.* (2004) and Abd El-Moula (2005).**

Table(8): Heterosis for grain yield realtive to T.W. 352 at first and second sowing date as well as combined analysis.

Traits / Lines	Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
	-16.71 **	-15.50 **	-9.88 **	52.80 **	26.66 **	29.97 **	9.00 **	0.10	4.86
2	-12.62 **	-23.39 **	-12.26 **	-6.48	0.88	11.19 *	-10.35 **	-14.41 **	-3.58
3	-25.31 **	-23.95 **	-24.43 **	44.11 **	47.46 **	26.95 **	0.37	2.47	-5.42
4	-9.99 **	5.69	-7.83 *	10.09	40.80 **	25.33 **	-2.56	18.67 **	4.44
5	-13.83 **	13.75 **	-18.76 **	39.84 **	25.48 **	21.72 **	6.02 *	18.09 **	-3.79
6	-17.55 **	7.26 *	-16.17 **	27.28 **	-6.48	50.41 **	-0.97	2.18	8.46 **
7	5.38	-15.00 **	-5.25	44.40 **	6.77	-1.69	19.82 **	-6.95 *	-3.94
8	-14.18 **	-11.72 **	2.49	55.56 **	15.54 **	0.52	11.62 **	-1.63	1.76
9	-14.05 **	-16.86 **	-13.75 **	6.41	1.25	35.49 **	-6.48 *	-10.16 **	4.47
10	-2.03	14.79 **	9.17 **	-2.36	29.20 **	20.03 **	-2.15	20.12 **	13.18 **
11	-20.06 **	-14.18 **	-13.64 **	20.40 **	27.95 **	43.81 **	-5.09	1.40	7.61 **
12	-20.62 **	11.48 **	-16.62 **	33.14 **	59.13 **	7.81	-0.74	29.11 **	-7.59 **
13	10.25 **	0.04	-16.77 **	65.32 **	10.09	37.74 **	30.62 **	3.76	3.39
14	1.62	17.42 **	0.61	28.13 **	-8.87	-0.59	11.43 **	7.70 **	0.16
15	-19.39 **	-26.68 **	-0.78	34.02 **	33.73 **	24.82 **	0.37	-4.33	8.69 **
16	-10.70 **	-20.15 **	-4.37	38.81 **	-11.63 *	8.98	7.61 **	-17.00 **	0.57
17	11.33 **	-31.80 **	-5.21	41.38 **	7.88	27.76 **	22.45 **	-17.12 **	6.99 *
18	-22.18 **	-2.51	-1.38	52.06 **	-3.17	-29.09 **	5.28	-2.75	-11.63 **
19	3.11	-7.57 *	-24.77 **	32.29 **	23.34 **	36.67 **	13.91 **	3.87	-2.04
20	-10.25 **	-5.53	-16.67 **	13.77 *	30.34 **	11.56 *	-1.36	7.74 **	-6.22 *

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

Table( ): Heterosis for grain yield realtive to S.C G 155 at first and second sowing date as well as combined analysis.

Traits / Lines	Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
	-25.96**	-24.88**	-19.89**	91.16**	58.45**	62.60**	8.52**	-0.35	4.39
2	-22.33**	-31.90**	-22.00**	17.00*	26.21**	39.11**	-10.75**	-14.79**	-4.01
3	-33.61**	-32.40**	-32.82**	80.29**	84.48**	58.82**	-0.08	2.01	-5.84*
4	-19.98**	-6.05*	-18.06**	37.72**	76.14**	56.79**	-3.00	18.14**	3.97
5	-23.41**	1.11	-27.79**	74.94**	56.98**	52.28**	5.55	17.56**	-4.22
6	-26.71**	-4.65	-25.48**	59.24**	17.00*	88.16**	-1.41	1.72	7.97**
7	-6.32*	-24.44**	-15.78**	80.65**	33.58**	22.98**	19.28**	-7.36*	-4.37
8	-23.71**	-21.52**	-8.90**	94.61**	44.54**	25.75**	11.12**	-2.07	1.30
9	-23.60**	-26.10**	-23.33**	33.12**	26.67**	69.51**	-6.90*	-10.56**	4.00
10	-12.91**	2.04	-2.96	22.16**	61.63**	50.16**	-2.59	19.58**	12.68**
11	-28.94**	-23.71**	-23.23**	50.62**	60.06**	79.92**	-5.52	0.95	7.13*
12	-29.44**	-0.90	-25.88**	66.56**	99.08**	34.87**	-1.18	28.53**	-8.00**
13	-2.00	-11.07**	-26.02**	106.82**	37.72**	72.32**	30.03**	3.29	2.93
14	-9.67**	4.38	-10.57**	60.29**	14.00*	24.37**	10.93**	7.21*	-0.28
15	-28.34**	-34.82**	-11.80**	67.66**	67.30**	56.15**	-0.08	-4.76	8.20**
16	-20.62**	-29.02**	-14.99**	73.65**	10.55	36.34**	7.13*	-17.37**	0.12
17	-1.04	-39.37**	-15.74**	76.88**	34.96**	59.83**	21.90**	-17.49**	6.51*
18	-30.82**	-13.34**	-12.34**	90.23**	21.14**	-11.29	4.81	-3.19	-12.03**
19	-8.34**	-17.83**	-33.13**	65.50**	54.31**	70.98**	13.40**	3.40	-2.48
20	-20.22**	-16.03**	-25.92**	42.33**	63.06**	39.57**	-1.80	7.25*	-6.64*

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

Table( ): Heterosis for grain yield realtive to S.C 3080 at first and second sowing date as well as combined analysis.

Lines \ Traits	Early sowing date			Late sowing date			Combined		
	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop	L (100)	Elhosary 101	Gem. pop
	-28.06 **	-27.02 **	-22.16 **	30.96 **	8.55	11.39 *	-6.12 *	-13.79 **	-9.69 **
2	-24.53 **	-33.83 **	-24.22 **	-19.85 **	-13.54 **	-4.70	-22.79 **	-26.29 **	-16.96 **
3	-35.49 **	-34.32 **	-34.73 **	23.51 **	26.38 **	8.80	-13.56 **	-11.75 **	-18.55 **
4	-22.26 **	-8.72 **	-20.39 **	-5.65	20.67 **	7.42	-16.08 **	2.21	-10.05 **
5	-25.58 **	-1.76	-29.84 **	19.85 **	7.54	4.32	-8.69 **	1.70	-17.14 **
6	-28.79 **	-7.36 **	-27.60 **	9.09	-19.85 **	28.91 **	-14.71 **	-12.00 **	-6.59 **
7	-8.98 **	-26.59 **	-18.17 **	23.76 **	-8.49	-15.75 **	3.19	-19.86 **	-17.27 **
8	-25.88 **	-23.75 **	-11.48 **	33.32 **	-0.98	-13.85 **	-3.87	-15.28 **	-12.36 **
9	-25.77 **	-28.19 **	-25.50 **	-8.80	-13.22 **	16.12 **	-19.46 **	-22.63 **	-10.03 **
10	-15.38 **	-0.86	-5.71 *	-16.31 **	10.73 *	2.87	-15.73 **	3.45	-2.52
11	-30.96 **	-25.88 **	-25.41 **	3.19	9.66 *	23.26 **	-18.26 **	-12.67 **	-7.32 **
12	-31.44 **	-3.72	-27.99 **	14.11 **	36.38 **	-7.60	-14.51 **	11.19 **	-20.41 **
13	-4.78	-13.59 **	-28.12 **	41.69 **	-5.65	18.05 **	12.49 **	-10.64 **	-10.96 **
14	-12.23 **	1.42	-13.11 **	9.81 *	-21.90 **	-14.80 **	-4.04	-7.25 **	-13.74 **
15	-30.38 **	-36.67 **	-14.30 **	14.86 **	14.61 **	6.97	-13.56 **	-17.61 **	-6.39 **
16	-22.87 **	-31.03 **	-17.40 **	18.96 **	-24.27 **	-6.60	-7.32 **	-28.52 **	-13.38 **
17	-3.85	-41.09 **	-18.13 **	21.17 **	-7.54	9.50	5.45 *	-28.62 **	-7.86 **
18	-32.79 **	-15.80 **	-14.82 **	30.33 **	-17.01 **	-39.22 **	-9.33 **	-16.25 **	-23.89 **
19	-10.94 **	-20.16 **	-35.03 **	13.38 **	5.71	17.13 **	-1.90	-10.55 **	-15.64 **
20	-22.48 **	-18.41 **	-28.02 **	-2.49	11.71 *	-4.39	-15.05 **	-7.21 **	-19.24 **

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

SUMMARY

SUMMARY

The main objectives of the present work were to evaluate inbred lines of maize through Line x tester analysis.

The experimental work of this study was carried out at the Experiment Research Station of Moshtohor, Benha University, Qalyubiya Governorate, Egypt during the two successive seasons 2006 and 2007.

A total of twenty (*Zea mays* L.) yellow inbred lines were used to establish the experiment materials for several characters among inbred lines under study. These lines were selected on bases of yielding ability and other desirable plant aspects. The plant materials were selected with a wide range of diversity for several traits. Three testers of yellow maize were used in this investigation to make all possible line x tester crosses. The three testers used in this study were chosen to represent wide difference in relation to the tested lines. i.e. (Gem. Pop.) representing broad genetic base, single cross (Elhosary 101) representing approximately narrow genetic base and the inbred line 100 representing narrow genetic base. Three check varieties were used in this investigation their names are single cross Giza 155, S. C. Pioneer 3080 and three way cross Giza 352.

In the first summer season 2006 seeds of the twenty inbred lines and three testers were split sown on 25th May, 30th May and 8th June to avoid differences in flowering time and to secure enough hybrid seed. All possible top crosses combinations were made between the twenty inbred lines and three testers by hand method giving a total of 60 top crosses.

Each top cross was constituted by collecting pollen from 40-50 protected tassels, representing the tester, then top crossing into protected silks of 15 plants, representing the inbred lines by hand pollinating.

In the second summer, season 2007 two adjacent experiments were conducted on two sowing dates. i.e. 15[th] June and 4[th] July. In each experiment the 60 top crosses as well as the three check hybrids (S.C. G.155,S.C Pioneer 3080 and T.W.C. G.352) were grown in a randomized complete block design with three replications.

Recorded data were days to 50% tasseling (tasseling date), days to 50% silking (silking date), maturity date, plant height (cm), ear height (cm), leaf area of upper ear (cm^2), ear husk, ear length (cm), ear diameter (cm), number of rows/ear, number of kernel/row, weight of 100-kernel (g), ear weight/ plant, grain yield per plant (g) adjusted at 15.5 % moisture content and shelling percentage was computed as 100 x (grain weight /ear weight). Line x tester analysis was used according to kempthorne (1957).

The results of the present study could be summarized as follows:

A) Analysis of variance

Sowing dates mean squares were significant for all traits except number of rows/ ear, number of kernels/ row and shelling percentage.

Crosses mean squares were significant for all the studied traits at both sowing dates as well as the combined analysis except ear diameter at early sowing date.Significant crosses x sowing date mean squares were obtained for all traits except ear height, ear husk, and ear diameter.

Lines mean squares were significant for all traits at early and late sowing dates as well as the combined over them.Significant lines x sowing date mean squares were detected for all traits except tasseling date, ear height, ear husk, ear diameter and shelling%.

Significant mean squares due to testers were obtained for all traits in both sowing dates as well as the combined analysis except maturity date at both sowing dates as well as the combined analysis; tasseling date, silking date, leaf area of upper ear, ear diameter, number of kernels/ row at early sowing, and ear length at early sowing date and the combined analysis. In addition, lines mean squares were much higher than those of testers for most studied traits. Such results revealed that lines contributed much more to the total variation as compared to testers. Therefore, the total GCA variance was due to inbred lines(GCA variance) for most traits.

The interaction between tester x sowing date mean squares were significant for silking date, leaf area of upper ear, ear length, ear diameter, no. of kernels/ row, ear weight/ plant, 100-kernel weight and grain yield/ plant.

Significant line x tester mean squares were detected for all traits except ear diameter at both sowing dates as well as the combined analysis; ear husk, number of rows/ ear and number of kernels/ row at late sowing date and shelling percentage at early sowing date. Significant interaction between line x tester x sowing date mean squares were obtained for tasseling and silking dates, plant height, leaf area of upper ear, no. of rows/ ear, 100-kernel weight, shelling percentage, ear weight/ plant and grain yield/ plant.

B) Mean performance:

The top cross T_1xL_1 at early sowing date had earlier than the best check variety S.C. Pioneer 3080. While, the top crosses T_3xL_{14}, T_1xL_1 and T_3xL_{16} gave the lowest mean values compared with other genotypes at late sowing date. The top crosses T_1xL_1, T_1xL_{13} and T_3xL_{14} gave the lowest mean values for tasseling date at the combined data.

For silking date, the top crosses T_1xL_1, T_1xL_{13}, T_2xL_{12} and T_3xL_{10} gave the lowest mean values for this trait at the combined data.

Regarding maturity date, the top crosses T_1xL_1, T_1xL_6, T_2xL_7, T_2xL_9, T_2xL_{10}, T_2xL_{18}, T_3xL_6, T_3xL_{10} and L_3xL_{12} expressed the lowest significant values of maturity date and it were the earliest among the studied top crosses at the combined analysis. For number of rows/ ear, the top crosses T_2xL_5 at early sowing date; T_2xL_4, T_3xL_5 and T_3xL_6 at late sowing date; T_1xL_{13}, T_2xL_5 and T_3xL_5 at the combined analysis exhibited significant higher than the best check hybrid. For number of kernels/row, with the exception of crosses T_1xL_3, T_2xL_{11}, T_2xL_{20}, T_3xL_6, T_3xL_9 and T_3xL_{12} at late sowing dates, none of top crosses surpassed the best check hybrids in early, late sowing dates as well as the combined analysis. For 100-kernel weight, the top crosses T_1xL_1, T_1xL_3, T_1xL_{12}, T_3xL_3 and T_3xL_{10} at early sowing date, T_1xL_{12}, T_2xL_3, T_2xL_{15}, T_3xL_3, T_3xL_{13} and T_3xL_{19} at late sowing date and T_1xL_1,T_1xL_7, T_1xL_{12}, T_2xL_3, T_2xL_{15}, T_3xL_3 and T_3xL_{19} at the combined analysis exhibited significantly higher than the best check hybrid S.C. G 155. For shelling percentage, none of the studied top crosses significantly exceeded that of the best of check hybrid. For grain yield/ plant, the highest mean values were recorded by S.C. Pioneer 3080 at early sowing date but without significant superiority over those of hybrids T_1xL_{13}, T_1xL_{17}, T_2xL_5, T_2xL_{10}, T_2xL_{12} and T_2xL_{14}. While, twenty six and three top crosses exhibited significantly higher than the best check hybrid S.C. Pioneer 3080 at late sowing date and the combined analysis, respectively. However, the best top crosses were T_1xL_{13}, T_1xL_{17} and T_2xL_{12} at the combined data.

C) Combining ability:

Results indicated that σ^2 SCA was more important than σ^2 GCA for all studied traits in both sowing dates as well as the combined analysis except tasseling date and number of rows/ ear in the combined analysis and ear diameter at early sowing date and ear husk at late sowing date σ^2 GCA= σ^2 SCA revealing that additive and non additive gene effects was similar for controling this trait .

The magnitude of the interaction between specific combining ability and sowing dates was much higher than that of interaction between general combining and sowing dates for all traits except ear height, ear husk and number of rows/ ear.

C) 1. General Combining ability effect

Testers:

The tester T_1 (L 100) exhibited significant desirable ($\hat{g}_i$) effects for plant and ear heights and 100-Kernel weight at early and late sowing dates as well as the combined data; ear diameter, ear weight/plant and grain yield/plant at late sowing date and the combined data, and ear length at late sowing date.

The parental tester S.C. (Elhosary 101) expressed significant positive ($\hat{g}_i$) effects for leaf area of upper ear and shelling percentage at late sowing date and the combined data and ear husk at early sowing date and the combined data; ear weight, grain yield/ plant and 100-Kernel weight at early sowing date, Also, it gave significant positive (undesirable) ($\hat{g}_i$) effects at late sowing date and the combined data for tasseling date and late sowing date for silking date. However, it gave insignificant ($\hat{g}_i$) effects for other cases.

Parental tester (Gem. pop.) expressed significant desirable ($\hat{g}_i$) effects for number of rows/ ear in both sowing dates and the combined data; and leaf area of upper ear at late sowing date; tasseling date and silking date at late sowing date and the combined data. Also, it gave significant undesirable or insignificant ($\hat{g}_i$) effects for other cases.

Inbred lines:

The parental inbred lines L_1 and L_{13} exhibited the highest ($\hat{g}_i$) effects for tasseling and silking dates in both sowing dates as well as the combined data. Moreover, both inbred lines L_1 and L_{13} were the best combiners for both traits together. For maturity date, the parental inbred lines L_6 and L_{10} seemed to be the best combiners for earliness in both sowing dates as well as the combined analysis. For number of rows/ ear the lines L_5, L_6 and L_{13} were the best combiners inbred lines in both sowing dates as well as the combined data.

For no. of Kernels/ row, the best general combiners which had significant and positive ($\hat{g}_i$) effects were the parental inbred lines L_{11} and L_{12} in both sowing dates and the combined over them. The most desirable ($\hat{g}_i$) effects for 100-kernel weight this trait were detected for the parental inbred lines L_3 followed by L_{19} in both sowing dates and the combined data. The most desirable combiners for ear and grain yields/ plant were the inbred lines L_5 and L_{13} in both sowing dates and the combined analysis.

C) 2. Specific combining ability effects:

For tasseling date the most desirable SCA effects were obtained for the top crosses T_1xL_1,T_2xL_{15} and T_2xL_{19} at early sowing date; T_1xL_7, T_1xL_{19}, T_2xL_3, T_2xL_{12}, T_3xL_2, T_3xL_{10}, T_3xL_{14} and T_3xL_{16} at late sowing date , and T_1xL_1, T_2xL_3, T_2xL_{19}, T_3xL_{10} and T_3xL_{14} at The combined analysis. Regarding to silking date, the most desirable SCA effects for this trait were obtained for the top crosses T_1xL_1 at early sowing date; T_2xL_3 and T_2xL_{12} at late sowing date and the combined analysis. For maturity date, the top crosses T_1xL_1 at early,late sowing date and the combined analysis; T_3xL_{15} at early sowing date and the top cross T_3xL_{17} at late sowing date and the combined analysis had the most desirable $\hat{S}_{ij}$ effects for this trait. For number of rows/ ear, the top crosses T_1xL_{13}, T_1xL_{14}, T_2xL_6 and T_3xL_{10} at early sowing date; T_1xL_{13}, $T_2x\ L_4$ and T_3xL_6 at late sowing date and T_1xL_{13}, T_2xL_4, T_2xL_6, T_3xL_3 and T_3xL_{10} at the combined analysis had the most desirable $\hat{S}_{ij}$ effects for this trait. Regarding number of kernels/ row, the top crosses T_1xL_{16} and T_3xL_{16} at early sowing; T_1xL_{18}, T_2xL_{15} and T_2xL_{20} at late sowing date; and T_1xL_{16}, T_2xL_{15} and T_2xL_{20} at the combined analysis exhibited significantly positive $\hat{S}_{ij}$ effects for this trait.The most desirable $\hat{S}_{ij}$ effects for 100-kernel weight were obtaind for the top crosses T_1xL_1, T_1xL_{12} and T_1xL_{12} at early, late sowing dates as well as the combined data, respectively. Concerning ear weight, the most desirable $\hat{S}_{ij}$ effects were recorded for the top crosses T_1xL_{17} and T_2xL_5 at early sowing date; T_1xL_{18}, T_2xL_{12} and T_3xL_9 at late sowing date; T_1xL_{13} and T_2xL_{12} at the combined analysis. For grain yield/ plant, the best $\hat{S}_{ij}$ effects were obtained from top crosses T_1xL_{17}, T_2xL_5, T_2xL_{12} and T_3xL_{15} at early sowing date;T_1xL_{18},T_2xL_{12} and T_3xL_6 at late sowing date; T_2xL_{12} and T_1xL_{17} at the combined analysis.

D) Useful heterosis:

Regarding useful heterotic effects relative to S.C G 155, zero, fifty eight and nineteen top crosses exhibited significant and positive values for grain yield/ plant at early, late sowing dates as well as the combined analysis, respectively. The eight top crosses at early sowing dates did not differ significant compared S.C. G 155. However, the best heterotic effects were obtained for the top crosses T_1xL_7, T_1xL_{13}, T_1xL_{17}, T_2xL_4, T_2xL_5, T_2xL_{10} and T_2xL_{12} in the combined data.The useful heterotic effects relative to S.C. G 155 ranged from -39.37 to 4.38, -11.29 to 106.82, and -17.49 to 30.03% at early, late sowing date and the combined analysis, respectively.

Regarding useful heterotic effects relative to S.C. Pioneer 3080 Zero, twenty six and three top crosses exhibited significant and positive values for grain yield/ plant at early, late sowing date as well as the combined analysis, respectively. However, the best useful heterotic effects were obtained for the top crosses T_1xL_{13}, T_1xL_{17} and T_2xL_{12} in the combined data. The heterotic effects relative to S.C. Pioneer 3080 ranged from -41.09 to 1.42, -39.22 to 41.69% and -28.62 to 12.49% at early, late sowing date as well as the combined analysis.

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ARABIC SUMMARY

الملخص العربى

أجريت هذه الدراسة بهدف تقييم مجموعة من سلالات الذرة الشامية الصفراء و قد أجريت هذه الدراسة فى محطة البحوث و التجارب الزراعية بمشتهر – جامعة بنها خلال موسمى الزراعة ٢٠٠٦, ٢٠٠٧.

اشتملت هذه الدراسة على عشرون سلالة صفراء متباعدة وراثيا و مستنبطة لقدرتها الإنتاجية العالية و صفاتها الأخرى المرغوبة.

استخدمت لهذه الدراسة ثلاثة كشافات من الذرة الصفراء هى (عشيرة- جميزة) ذات قاعدة وراثية عريضة و هجين فردى (El-Hosary 101) و السلالة النقية (L_{100}) ذات قاعدة وراثية ضيقة و استخدمت ثلاثة هجن للمقارنة هى (هجين فردى جيزة ١٥٥, هجين فردى بيونير ٣٠٨٠ و هجين ثلاثى ٣٥٢).

وفى موسم ٢٠٠٦ تم زراعة العشرين سلالة والثلاثة كشافات فى ثلاثة مواعيد للزراعة للتغلب على الاختلافات فى مواعيد التزهيرو الحصول على كمية حبوب كافية و تم إجراء كل التهجينات الممكنة بينهما و الحصول على ٦٠ هجين قمى و فى موسم صيف ٢٠٠٧ تم تقييم جميع الهجن القمية و عددها ٦٠ هجينا بالإضافة إلى ثلاثة هجن للمقارنة فى ميعادين للزراعة ١٥ يونيو، ٤ يوليه باستخدام تصميم قطاعات كاملة العشوائية فى ثلاثة مكررات.

وكانت الصفات تحت الدراسة هى:-

عدد الأيام من الزراعة حتى ظهور ٥٠% من النورة المذكرة و المؤنثة, عدد الأيام من الزراعة حتى النضج, ارتفاع النبات, ارتفاع الكوز, مساحة ورقة الكوز العلوى, طول أغلفة الكوز, طول الكوز, قطر الكوز, عدد صفوف الكوز,

عدد حبوب الصف, وزن ١٠٠ حبة, وزن الكوز و الحبوب للنبات، النسبة المئوية للتفريط.

و قد أجرى التحليل الإحصائى طبقا لطريقة كمبثورن عام ١٩٥٧ و يمكن تلخيص أهم النتائج فيما يلى:

ا) تحليل التباين.

١- كان التباين الراجع إلى مواعيد الزراعة معنوى لكل الصفات ماعدا عدد صفوف الكوز, عدد حبوب الصف و النسبة المئوية للتفريط.

٢- كان التباين الراجع إلى الهجن معنوى لكل الصفات فى ميعادى الزراعة و كذلك التحليل التجميعى بينهما ما عدا صفة قطر الكوز فى الميعاد المبكر للزراعة.

٣- كان التباين الراجع إلى تفاعل الهجن × مواعيد الزراعة معنوى لكل الصفات ماعدا ارتفاع الكوز و طول أغلفة الكوز و قطر الكوز.

٤- كان التباين الراجع إلى السلالات معنويا لكل الصفات فى ميعادى الزراعة و كذلك التحليل التجميعى بينهم.

٥- كان التباين الراجع إلى السلالات x مواعيد الزراعة معنويا لكل الصفات ماعدا صفة ميعاد طرد النورة المذكرة و ارتفاع الكوز و طول أغلفة الكوز و قطر الكوز و النسبة المئوية للتفريط.

٦- كان التباين الراجع إلى الكشافات معنويا لكل الصفات فى ميعادى الزراعة و كذلك التحليل التجميعى لهما ما عدا ميعاد النضج فى كل من ميعادى الزراعة و التحليل التجميعى. وميعاد طرد النورة المذكرة و المؤنثة و مساحة ورقة الكوز و قطر الكوز و عدد الحبوب فى الصف فى الميعاد المبكر و طول الكوز فى الميعاد المبكر و التحليل التجميعى. بالإضافة إلى ذلك كان التباين

الراجع إلى السلالات عالى عن التباين الراجع إلى الكشافات لكل الصفات المدروسة. لذلك كان التباين الكلى للقدرة العامة على التآلف راجعا إلى تباين القدرة العامة على التآلف للسلالات.

٧- كان التفاعل بين الكشافات x السلالات معنويا لكل الصفات تحت الدراسة عدا قطر الكوز فى ميعادى الزراعة و التحليل المشترك, طول أغلفة الكوز, عدد صفوف الكوز و عدد الحبوب فى الصف فى الميعاد المتأخر و نسبة التفريط فى الميعاد المبكر. بينما كان التفاعل بين السلالات x الكشافات x مواعيد الزراعة معنوي بالصفات ميعاد طرد النورة المذكرة و المؤنثة, ارتفاع النبات, مساحة ورقة الكوز, عدد صفوف الكوز, وزن ١٠٠ حبة والنسبة المئوية للتفريط ووزن الكوز و الحبوب للنبات.

ب) متوسط الأداء

١- كان الهجين القمى T_1xL_1 ابكر الهجن مقارنة بالهجين الفردى بيونير ٣٠٨٠ فى ميعاد طرد النورة المذكرة فى الميعاد المبكر بينما أظهرت الهجن القمية T_1xL_1, T_3xL_{16}, T_3xL_{14} فروق معنوية عن الهجن الأخرى فى الميعاد المتأخر و كان افضل الهجن القمية فى التحليل التجميعى هى T_1xL_1, T_1xL_{13}, T_3xL_{14} لصفة ميعاد طرد النورة المذكرة

٢- أظهرت الهجن القمية T_1xL_1, T_1xL_{13}, T_2xL_{12}, T_3xL_{10} فروق معنوية لصفة ميعاد طرد النورة المؤنثة فى التحليل التجميعى.

٣- كانت الهجن القمية $T_1x L_1$,$T_1x L_6$,$T_2 x L_7$,$T_2 xL_9$, $T_2 x L_{10}$, $T_2 x L_{18}$,T_3xL_6, T_3xL_{10} , $T_3 x L_{12}$ أفضل الهجن بالنسبة لصفة ميعاد النضج فى التحليل التجميعى .

٤- أظهرت الهجن القميــة T_3xL_{18} , T_3xL_{11} , T_2 x L_{11}, T_2 x L_3 , T_1xL_{14} فى التحليل التجميعى فروق معنوية عالية مقارنة بأفضل هجين فردى للمقارنة بيونير ٣٠٨٠ وذلك بالنسبة لصفة طول الكوز .

٥- لم تظهر أى من الهجن القمية فروق معنوية مقارنة بهجن المقارنة فــى كــلا الميعادين وأيضا التحليل التجميعى لهما وذلك لصفة قطر الكوز .

٦- أظهرت الهجن القمية T_2 x L_5 فــى الميعــاد المبكــر , T_3xL_5 , T_2xL_4 T_3xL_6فى الميعاد المتــأخر ، T_3xL_5 , T_2xL_5 , T_1xL_{13} فــى التحليــل التجميعى فروق معنوية عالية عن افضل هجين للمقارنة لصفة عدد صــفوف الكوز .

٧- أظهرت الهجن القميــة T_3 x L_9, T_3 x L_6 , T_2xL_{20}. T_2 x L_{11} , T_1xL_3 T_3xL_{12}, فى الميعاد المتأخر أفضل قيمة بالنسبة لصفة عدد حبوب /الــصف ولم يتفوق أى هجين قمى على هجن المقارنة.

٨- بالنسبة لصفة وزن المائة حبة أظهرت الهجن القمية, T_1xL_{12} , T_1xL_3 , T_3 x L_{10}, T_3 xL_3,T_1 x L_1 فى الميعاد المبكر ، T_2 , T_2xL_3 , T_1 x L_{12}, x L_{15},T_3xL_3 , T_3xL_{13} , T_3xL_{19} فى الميعاد المتأخر T_1 x L_1, T_1xL_7, T_1x L_{12} , T_2 x L_{15},T_2 x L_3 , T_3xL_3 , T_3x L_{19} فى التحليل التجميعــى فروق معنوية عن أفضل هجين مقارنة لهذه الصفة (هجين فردى جيزة ١٥٥).

٩- أعطى الهجين الفردى بيونير ٣٠٨٠ اعلى قيمة لمحصول النبات الفردى فــى الميعاد المبكر بدون تفوق معنوى عن الهجن القمية T_1xL_{13}, T_1x L_{17} , T_2x L_{12}, T_2xL_{10}, T_2xL_5 بينما اعطت ستة و عشرون و ثلاث هجن قمية زيادة معنوية فى المحصول عن افضل هجن المقارنة هجين فردى بيــونير ٣٠٨٠ فى الميعاد المتأخر و التحليل المشترك على التوالى. و كانت الثلاثــة هجــن

المبشرة و المتفوقة هى $T_2 \times L_{12}$ ، $T_1 \times L_{17}$ ، $T_1 \times L_{13}$ فى التحليل المشترك.

جـ - القدرة على التآلف :-

- أوضحت النتائج أن القدرة الخاصة على التآلف كانت أكثر أهمية من القدرة العامة وذلك بالنسبة لكل الصفات فى ميعادى الزراعة وأيضا التحليل التجميعى لهما ما عدا صفة ميعاد طرد النورة المذكرة وعدد صفوف الكوز فى التحليل التجميعى وكذلك صفة قطر الكوز فى الميعاد المبكر .
- كان قيمة التفاعل بين القدرة الخاصة على التآلف × مواعيد الزراعة أعلى من تفاعل القدرة العامة على التآلف × مواعيد الزراعة بالنسبة لكل الصفات ما عدا ارتفاع الكوز ، طول أغلفة الكوز ، وعدد صفوف الكوز .

ج) ١- القدرة العامة على التآلف :-

- الكشافات

- أعطى الكشاف T_1 (السلالة ١٠٠) تأثيرات معنوية للقدرة العامة على التآلف لصفة ارتفاع النبات ، ارتفاع الكوز ، وزن ١٠٠ حبة فى كلا الميعادين وكذلك التحليل التجميعى لهما و صفة قطر الكوز ، وزن الكوز للنبات ، ومحصول الحبوب للنبات فى الميعاد المتأخر والتحليل التجميعى وصفة طول الكوز فى الميعاد المتأخر.
- أعطى الكشاف الهجين الفردى تأثيرات موجبة ومعنوية للقدرة العامة على التآلف لصفات مساحة ورقة الكوز ، النسبة المئوية للتفريط فى الميعاد المتأخر والتحليل التجميعى و صفة طول أغلفة الكوز للميعاد المبكر والتحليل التجميعى ووزن الكوز ومحصول الحبوب للنبات ووزن ١٠٠ حبة فى الميعاد المبكر . وأيضا أعطى تأثيرات موجبة ومعنوية (غير مرغوبة) للقدرة العامة على

التآلف بالميعاد المتأخر والتحليل التجميعى لصفة ميعاد طرد النورة المذكرة وفى الميعاد المتأخر لصفة ميعاد خروج النورة المؤنثة .

- أعطى الكشاف (عشيرة- جميزه) تأثيرات موجبة ومعنوية للقدرة العامة على التآلف لصفة عدد صفوف الكوز فى كلا ميعادين الزراعة والتحليل التجميعى لهما و صفة مساحة ورقة الكوز فى الميعاد المتأخر وصفة ميعاد خروج النورة المذكرة والمؤنثة فى الميعاد المتأخر وكذلك التحليل التجميعى لهما .

- **السلالات**

- أظهرت السلالتان L_{13} ، L_1 تأثيرات سالبة وعالية المعنوية للقدرة العامة على التآلف لصفة عدد الأيام حتى ظهور ٥٠ % من النورة المذكرة والمؤنثة فى كلا الميعادين وأيضا التحليل التجميعى لهما .

- أظهرت السلالتان L_{10}, L_6 تأثيرات سالبة وعالية المعنوية للقدرة العامة على التآلف لصفة ميعاد النضج فى كلا الميعادين وأيضا التحليل التجميعى لهما .

- أظهرت السلالة L_{11} فى كلا ميعادين الزراعة وأيضا التحليل التجميعى لهما تأثيرات موجبة ومعنوية للقدرة العامة على التآلف لصفة طول الكوز . بينما أعطت السلالة L_{19} تأثيرات موجبة ومعنوية للقدرة العامة على التآلف لصفة قطر الكوز فى كلا ميعادين الزراعة وأيضا التحليل التجميعى لهما .

- أظهرت السلالات L_5, L_6, L_{13} تأثيرات موجبة ومعنوية للقدرة العامة على التآلف لصفة عدد صفوف الكوز فى كلا ميعادين الزراعة وأيضا التحليل التجميعى لهما .

- أظهرت السلالة L_{11} يليها L_{12} فى كلا ميعادين الزراعة وأيضا التحليل التجميعى لهما تأثيرات موجبة ومعنوية للقدرة العامة على التآلف بالنسبة لصفة عدد حبوب الصف .

- بالنسبة لصفة وزن المائة حبة أظهرت السلالة L_3 يليهاوL_{19} فى كــلا ميعــادى الزراعة وأيضا التحليل التجميعى أفضل تأثيرات للقدرة العامة علــى التــآلف لهذه الصفة .

- أظهرت السلالتان L_{13}، L_5 أفضل تأثيرات للقدرة على التــآلف لــصفتين وزن الكوز ومحصول الحبوب للنبات فى كلا ميعادين الزراعــة وأيــضا التحليــل التجميعى لهما .

جــ) ٢- القدرة الخاصة على التآلف :-

- أمكن الحصول على أفضل تأثيرات للقدرة الخاصة على التآلف بالنــسبة لــصفة عدد الأيام حتى ظهور ٥٠% من النورة المذكرة فى الهجــن القميــة التاليــة $T_1xL_{19}, T_2xL_3, T_2xL_{12},$ فى الميعاد المبكر $T_1xL_1, T_2x\ L_{15}, T_2xL_{19}$ $T_1xL_1, T_2xL_3,$ و فى الميعاد المتأخر $T_3xL_2, T_3xL_{10}, T_3xL_{14}, T_3xL_{16}$ $T_2xL_{19}, T_3xL_{10}, T_3xL_{14}$ فى التحليل التجميعى. كما أمكن الحصول على افضل تأثيرات للقدرة الخاصة على التآلف لصفة عدد الأيام حتى ظهور ٥٠% من النورات المؤنثة فى الهجن التالية T_1xL_1 فى الميعــاد المبكــر، $T_2xL_3,$ T_2xL_{12} فى الميعاد المتأخر و أيضا التحليل التجميعى لهما.

- أمكن الحصول على تأثيرات للقدرة الخاصة على التآلف بالنــسبة لــصفة ميعــاد النضج فى الهجن التالية $T_1\ x\ L_1$ فى الميعاد المبكر و المتــأخر و كــذلك التحليل المشترك، $T_1xL_1,\ T_3xL_{15}$ فى الميعاد المبكر و الهجين T_3xL_{17} فى الميعاد المتأخر و أيضا فى التحليل التجميعى لكلا الميعادين.

- بالنسبة لصفة عدد صفوف الكوز أعطت الهجن القمية التالية أفــضل تــأثيرات للقدرة الخاصة علــى التــآلف $T_1xL_{13}, T_1xL_{14}, T_2xL_6, T_3xL_{10}$ فــى الميعاد المبكر ; $T_1xL_{13}, T_2xL_4, T_3xL_6$ فى الميعاد المتأخر ; $T_1xL_{13},$ $T_2xL_4, T_2xL_6, T_3\ xL_3, T_3\ xL_{10}$ فى التحليل التجميعى .

- أمكن الحصول على أفضل تأثيرات للقدرة الخاصة على التـآلف لـصفة عـدد حبوب الصف فى الهجن القمية التالية T_1xL_{16} , T_3 xL_{16} فى الميعاد المبكر ; T_2xL_{20} , T_2xL_{15} , T_1x L_{13} فى الميعاد المتــأخر ; T_1 x L_5 ,T_1xL_{16} , T_2xL_{15} , T_2 x L_{20} فى التحليل التجميعى لكلا الميعادين .

- بالنسبة لصفة وزن المائة حبة أظهرت الهجن القمية T_1xL_{12}, T_1xL_{12}, T_1xL_1 تأثيرات موجبة للقدرة الخاصة على التآلف فى الميعاد المبكـر و المتـأخر و كذلك فى التحليل المشترك فلى التوالى.

- أمكن الحصول على أفضل تأثيرات للقدرة الخاصة علـى التـآلف لـصفة وزن الكوز للنبات فى الهجن القمية التالية

T_1xL_{17}, T_2xL_5 فى الميعاد المبكر; T_1xL_{18} , T_2xL_{12} , T_3 xL_9 فى الميعـاد المتأخر ; T_1xL_{18} , T_2 x L_{12} فى التحليل التجميعى .

- أمكن الحصول على أفضل تأثيرات للقدرة الخاصة على التآلف لصفة محـصول الحبوب للنبات فى الهجن القمية التالية T_1xL_{17} , T_2xL_5 , T_2xL_{12} , T_3 x L_{15} فى الميعاد المبكر ;

T_1 x L_{18} ,T_2 xL_{12} , T_3 x L_6 فى الميعاد المتأخر T_2 x L_{12} , T_1 x L_{17} ; فى التحليل التجميعى لهما .

د) قوة الهجين :-

- أمكن الحصول على أعلى قوة هجين مرغوبة لمحصول الحبوب للنبات بالنـسبة للهجين الفردى جيزة ١٥٥ فى الهجن القمية التالية

T_1xL_7 , T_1xL_{13} , T_1x L_{17} , T_2xL_4 , T_2x L_5 , T_2 X L_{10} , T_2xL_{12} فـى التحليل التجميعى .

- تراوحت قوة الهجين بالنسبة للهجين الفردى جيزة ١٥٥ من -٣٩,٣٧ إلى ٤,٣٨ , -١١,٢٩ إلى ١٠٦,٨٢ , -١٧,٤٩ إلى ٣٠,٠٣% فى كلا من الميعادين المبكر والمتأخر وكذلك التحليل التجميعى بينهما على الترتيب .
- أمكن الحصول على أعلى قوة هجين مرغوبة لمحصول الحبوب للنبات بالنسبة للهجين الفردى بيونير ٣٠٨٠ فى الهجن القمية التالية T_1xL_{13} , T_1xL_{17}, T_2xL_{12} فى التحليل التجميعى .
- تراوحت قوة الهجين بالنسبة للهجين الفردى بيونير ٣٠٨٠ بين - ٤١,٠٩ إلى ١,٤٢, -٣٩,٢٢ إلى ٤١,٦٩ , -٢٨,٦٢ إلى ١٢,٤٩ % فى كلا الميعادين المبكر والمتأخر والتحليل التجميعى بينهما على الترتيب .

التحليل الوراثى لبعض الهجن القمية للذرة الشامية

رسالة علمية مقدمة من

محمد رضا محمود عبد النبى إسماعيل

بكالوريوس علوم زراعية (محاصيل)- جامعة الزقازيق - فرع بنها ٢٠٠٤

للحصول على درجة

الماجستير فى العلوم الزراعية

محاصيل (تربية محاصيل)

و قد تمت مناقشة الرسالة و الموافقة عليها

اللجنة

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تاريخ المناقشة : ٢٠٠٨/٤/١٣

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الماجستير فى العلوم الزراعية

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التحليل الوراثى لبعض الهجن القمية للذرة الشامية

رسالة علمية مقدمة من

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للحصول على درجة

الماجستير فى العلوم الزراعية

محاصيل (تربية محاصيل)

من

قسم المحاصيل

كلية الزراعة

جامعة بنها

٢٠٠٨