Combining Ability and Types of Gene Action in Yellow Maize (*Zea mays* L.)

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Abstract:

Twenty six yellow maize inbred lines were topcrossed with three testers, i.e. inbred line Gm-1002, inbred line Gm-1021 and SC-155 at Mallawy Agric. Res. Station to produce 78 topcrosses. The crosses were evaluated at two locations, Gemmeiza (Gm) and Mallawy (Mall) Agric. Res. Stations in 2005 season.. In 2006 season two experiments were carried out at Gemmeiza and Mallawy Agric. Res. Station to evaluate 52 single crosses, 26 three way crosses (TWC) and three check hybrids, namely; SC-155, SC Pioneer-3084 and TWC-352 for days to 50% silking, ear length, no. of rows/ear, no. of kernels/row, 100-kernel weight and grain yield/plot . Combined analysis over the two locations revealed that the mean squares due to crosses, lines, testers and line x tester were significant or highly significant for the studied traits, except testers and line x tester for no. of rows/ear. The interactions of crosses, lines and testers x location were significant or highly significant for the studied traits, except the crosses x location for no. of rows/ear, lines x location for grain yield (Kg/plot) and tester x location for no. of rows/ear and 100-kernel weight. Mean squares due to lines x testers x location interaction were highly significant for ear length and no. of kernels/row.

The combined data showed that variance magnitude due to σ^2 GCA-L was higher than σ^2 GCA-T for all studied traits, except grain yield (Kg/plot), indicating that most of the total GCA variance was due to lines. The ratio σ^2_A/σ^2_D was less than unity for no. of kernels/row and grain yield/plot, indicating that the dominance gene action played an important role in the inheritance of these traits. On the other side, the ratio σ^2_A/σ^2_D was more than unity for days to 50% silking, ear length and 100-kernel weight.

For grain yield per plot, the combined data revealed that six single crosses (L-13, 9, 14 and L-1 x Gm-1021) and (L-8 and L-9 x Gm-1002) outyielded the best check hybrid SC-3084 by 23.47, 21.64, 19.75, 14.50, 13.66 and 9.45%, respectively. The best 3-way crosses were L-1, 20, 3, 7, 22 and L-25 x SC-155. These 3-way crosses out yielded the check hybrid TWC-352 by 43.10

36.19, 34.05, 32.14, 28.57 and 28.33%, respectively. The best GCA effects were inbred lines no. 1, 10, 13, 14 and 16 for days to 50% silking; lines no. 1, 3, 7and 11for ear length; lines no.8, 10, 14, 17, 20 and 24 for no. of rows/ear; lines no.7 and 23 For no. of kernels/row; lines no. 6, 7, 11 and 12 For 100-kernel weight. With respect to grain yield/plot, seven inbred lines (no.1, 9, 3, 7, 8, 20 and 13) over locations had positive and significant GCA effects.

The best SCA effects were 4, 5, 1, 4 and 1 topcrosses for earliness, ear length, no. of rows per ear, no. of kernels per row and 100 kernel weight Regarding grain yield/plot based on the combined data, the highest SCA estimates were detected from the topcrosses (line-13 x Gm-1021), (line-14 x Gm-1021), (line-8 x Gm-1002), (line-15 x Gm-1002), (line-25 x SC-155), (line-19 x Gm-1021), (line-1 x SC-155), (line-20 x SC-155) and (line-21 x Gm-1002).

Introduction

Maize (*Zea mays* L.) is one of the three most important cereal crops in the world together with wheat and rice. It is utilized as food for human consumption as well as feed for livestock and poultry, either as green fodder and silage or as a main component (grain) of dry feed. In addition, it is used as row materials for several industries such as starch, fructose and corn oil. Several types of hybrids are possible in maize; however the most common ones used for commercial production are derived from inbred lines. The top cross procedures suggested by Davis (1927) was used to evaluate the combining ability of inbred lines to determine the usefulness of the lines for hybrid development. Line x tester analysis is an extension of this method in which several testers are used (Kempthorne 1957). Line x testers analysis provides information about general and specific combining ability of parents and at the same time it is helpful in estimating various typed of gene action (Singh and Chaudhary 1985). Rojas & Sprague (1952) compared estimates of the variances of GCA and SCA for yield and their interaction with locations and years. They stressed that the variance of SCA includes not only the non-additive deviations due to dominance and epistasis but also a considerable portion of the genotype x environment interaction. The concepts of GCA and SCA became useful for characterization of inbred lines in crosses and often have been included in the description of an inbred line (Hallauer & Miranda Filho 1988). The main objectives of this study were to (1) identify the best inbred lines and crosses (2) Determine the different types of gene action involved in manifestation of grain yield and other agronomic traits.

Materials and Methods

This study was carried out during the summer seasons of 2005 and 2006 at Gemmeiza and

Mallawy Agric. Res. Stations, to study the general and specific combining ability for 26 inbred lines derived from two sources (i.e. Tuxpeno USA and population-45), which were obtained from National Maize Research Program (NMRP), Field Crops Research Institute, Agric. Res. Centre (ARC). In 2005 season topcrosses were formed in three isolated blocks for 26 inbred lines using three testers i.e. Gemmeiza-1002 (Gm-1002), Gemmeiza-1021 (Gm-1021) and Single cross-155 (Gm-1002 x Gm-1021) at Mallawy Agric. Res. Station, ARC. Two experiments were carried out at Gemmeiza and Mallawy Agric. Res. Station on May 27th and 22nd ,2006, respectively, to evaluate 52 single crosses and 26 three way crosses (TWC) with three check hybrids, namely; SC-155, SC Pioneer-3084 and TWC-352 in a randomized complete block design (RCBD) with three replications. Experimental plot size was one row, six meters long and 70 cm apart and 25 cm between hills within a row (4.2m^2). The studied characters were days to 50 % silking, ear length (cm), no. of rows/ear, no. of kernels/row, 100-kernel weight (g) and grain yield/plot (Kg) adjusted to 15.5% moisture content. Data collected from topcrosses were subjected to an ordinary analysis of variance of RCBD to test the significance of differences among genotypes, separately for each location and over the two locations. Bartlett test was used to

test the homogeneity of error variance. When differences among topcrosses were found to be significant, line x tester analysis according to Kempthorne (1957) was practiced for each location and their combined to estimate the general and specific combining abilities of the tested lines and testers.

Results and Discussion
Analysis of Variance.

Analysis of variance of all studied traits for 52 single crosses and 26 three way crosses at the two locations and the combined are presented in Table 1. Significant or highly significant differences were existed among crosses as well as lines for all studied traits. Significant or highly significant differences were also existed among testers for all studied traits, except no. of rows/ear at Mallawy. Line x tester interactions were significant or highly significant for all studied traits at the two locations, except, ear length and 100-kernel weight at Mallawy and no. of rows/ear at both locations.

Combined analysis over the two locations of 78 topcrosses for the studied traits are presented in Table 1. Results showed highly significant differences between the two locations for these traits. Mean squares due to lines, testers and crosses were significant or highly significant for the studied traits, except testers for no. of rows/ear. Mean squares due to line x tester interaction were highly significant for the studied traits, except no of rows/ear, in-

dicating that the lines differed in their order of performance in crosses with each of the testers. Similar results were obtained by Castellanos *et al.* (1998), Soliman and Sadek (1999), Soliman (2000), Venugopal *et al.* (2002), Amer *et al.* (2003), Abd El-Moula *et al.* (2004) Mean squares due to crosses x Location interaction were significant or highly significant for the studied traits, except no. of rows/per ear. Mean squares due to lines x location were significant or highly significant for the studied traits, except grain yield (Kg/ plot). Mean squares due to tester x location interactions were significant or highly significant for ear length, no. of rows/per ear and 100-kernel weight, while they were insignificant for days to 50% silking, no. of kernels/row and grain yield (Kg/plot). These results are in good agreement with those obtained by Soliman *et al.* (1995), they reported significant interactions of line x location and tester x location for ear length and other studied traits. Shehata *et al.* (1997) found highly significant mean squares interaction of line x location, tester x location and line x tester x location for all attributes except tester x location for number of rows/ear. Mean squares due to lines x testers x location interaction were highly significant for ear length and no. of kernels/row, while they were insignificant for days to 50% silking, no. of rows/ear, 100-kernel weight and grain yield (Kg/plot). These re-

sults are in good agreement with those obtained by Shehata *et al.* (2001) they found that the interaction of line x tester x location was insignificant for ear diameter and no. of rows/ ear. Mahmoud and Abd El-Azeem (2004) found that the interaction of line x tester x location was highly significant for grain yield.

Variance components and types of gene action.

The estimates of general combining ability variances for lines (σ^2GCA-L) and testers (σ^2GCA-T) in addition to specific combining ability variance (σ^2SCA) and types of gene action at Gemmeiza and Mallawy locations are presented in Table 2. The results showed that the variance of σ^2 GCA-L was higher than σ^2 GCA-T for all studied traits at the two locations, except grain yield/plot (Kg/plot) at Mallawy. The magnitude of σ^2 SCA was larger than that obtained for σ^2 GCA (average) for all studied traits, except no. of rows/ear at Gemmeiza and 100-kernel weight at Mallawy. The ratios of σ^2_A/σ^2_D were less than unity for all studied traits at the two locations, except no. of rows/ear at Mallawy, indicating that the dominance gene action plays an important role in inheritance of these traits.

For combined analysis, results in Table 3 showed that the variance of σ^2 GCA-L was higher than σ^2GCA-T for all studied traits except grain yield (Kg/plot), indicating that most of GCA variance was due to lines.

The variance of σ^2GCA (average) exceeded that of σ^2SCA for no. of rows/ear. On the other side, the σ^2SCA was grater than σ^2GCA (average) for days to 50% silking, ear length, no. of kernels/row, 100-kernel weight and grain yield (Kg/ plot). The results in Table 3 also showed that the ratio of σ^2_A/σ^2_D was less than unity for no. of kernels/row and grain yield/plot (0.715 and 0.793, respectively), indicating that the dominance gene action played an important role in the inheritance of these traits. On the other side, the ratio of σ^2_A/σ^2_D was more than unity for days to 50% silking, ear length and 100-kernel weight (1.151, 1.514 and 1.230, respectively), indicating that the additive gene action played an important role in the inheritance of these traits. Similar results were obtained by Motawei *et al.* (2005) who found that the non-additive genetic variance was more important in the expression of grain yield and number of kernels/row. Bujak *et al.* (2006) found that ear length and number of rows per ear were mostly determined by additive gene action. Jayakumar and Sundaram (2007) reported that the specific combining ability variances were higher than the general combining ability variances for days to 50% silking, number of grains/row, grain weight and grain yield. Abd El-Maksoud *et al.* (2003), Almanie *et al.* (2006), Todkar and Naval (2006) and Dar *et al.* (2007) reported similar results.

The interaction of σ^2GCA-L x E was larger than σ^2 GCA-T x E for all studied traits, except ear length and grain yield (Kg plot^{-1}), indicating that σ^2GCA-L was more affected by environment.

Furthermore, the magnitude of σ^2 SCA x E interaction was higher than σ^2GCA (average) x E interaction for all studied traits, except no. of rows/ear. These finding indicated that the non-additive type of gene action was more affected than the additive type of gene action by environment. These results are in a good agreement with those obtained by Sadek *et al* (2000), Soliman *et al.* (2001), Abd El-Moula *et al.* (2004) and Amer and El-Shenawy (2007). They found that the magnitude of σ^2 SCA x E interaction was higher than that of σ^2GCA x E interaction.

Mean performance

Mean performance of 78 topcrosses and 3 checks for days to 50% silking, ear length and no. of rows/ear at Gemmeiza, Mallawy and the combined are presented in Table 4. Based on the combined performance, there were 32 single crosses significantly earlier than the earliest check hybrid SC-155. The earliest four single crosses were line-1 x Gm-1002, line-15 x Gm-1002, line-23 x Gm-1021 and line-14 x Gm-1002 and their 50% of silking dates were 54.2, 54.7, 54.7 and 54.8 days, respectively. On the other side, all 3-way crosses were significantly earlier than the check hybrids TWC-352 and SC-3084.

For ear length there were 9, 3 and 11 single crosses significantly surpassed the check hybrid SC-155 at Gemmeiza, Mallawy and their combined.

It may be noticed that the crosses of line-1, 3, 10 and 11 x Gm-1021 exhibited a similar performance at the two locations and their combined, which may be attributed to their broader adaptability in comparison to the other genotypes. Concerning 3-way crosses there were 7, 2 and 14 crosses had significant ear length more than the check hybrid TWC-352. Therefore; these crosses can serve as a source for improved lines with desirable alleles for ear length.

For no. of rows/ear at Gemmeiza, the best single cross was line-20 x Gm-1021 followed by line-17 x Gm-1021, while at Mallawy the best single crosses were line-22 x Gm-1021 and line-17 x Gm-1002. Combined mean performance showed that 12 of 52 single crosses significantly surpassed the best check hybrid for no. of rows/ear (SC-155). The best crosses were line-20 x Gm-1021, lin-20 x Gm-1002 and line-17 x Gm-1021. Regarding the 3-way crosses, the line-20, 14 and 17 x SC-155 had the highest no. of rows/ear at Gemmeiza, while the 3-way crosses ; line-9, 14, 17 and 26 x SC-155 had the highest no. of rows/ear at Mallawy. Based on combined performance there were three crosses (line-20, 14 and 17 x SC-155) significantly surpassed the check hybrid TWC-352.

Means performance for no. of kernels/row, 100-kernel weight and grain yield (kg/plot) are shown in Table 5. Data showed that there were 15 and 10 single crosses exhibited significant no. of kernels/row than the check hybrid SC-155 at Gemmeiza and Mallawy, respectively. Regarding to the combined performance, 17 single crosses significantly surpassed the check hybrid SC-155. The crosses line-25 x Gm-1021, line-7 x Gm-1002, line-6 x Gm-1021 and line-2 x Gm-1021 had the highest no. of kernels/row. For the 3-way crosses, 14 and 4 crosses significantly surpassed the check hybrid TWC-352 at Gemmeiza and Mallawy, respectively. Concerning the combined performance, fourteen 3-way crosses significantly surpassed the check hybrid TWC-352. The best crosses were line-23 and 7 x SC-155 with values of 47.0 and 46.0, respectively. It is clear that the 3-way cross line-23 x SC-155 surpassed the best check hybrid SC-3084.

For 100-kernel weight there were 2 and 7 single crosses exhibited significant comparing with the check hybrid SC-155, respectively. For combined performance, 10 of 52 single crosses significantly surpassed the check hybrid SC-155 (the best check). The best two crosses were line-11 x Gm-1002 and line-6 x Gm-1021. Concerning the 3-way crosses, four crosses (line-11, 12, 7 and 22 X SC-155) significantly surpassed the check hybrid TWC-352 at each location and their combined. These 3-way crosses also significantly exceeded the check hybrids SC-155 and SC-3084 and can serve as a source for new improved lines with desirable alleles for heavy kernel weight

EL-Hifny et. al. 2010

EL-Hifny et. al. 2010

Regarding to grain yield/plot, at Gemmeiza, four single crosses (line-13 x Gm-1021), (line-14 x Gm-1021), (line-8 x Gm-1002) and (line-9 x Gm-1021) significantly outyielded the check hybrid SC-155 kg/plot. One of them (line-13 x Gm-1021) also significantly outyielded the check hybrid SC-3084. At Mallawy, two single crosses (line-13 x Gm-1021) and (line-9 x Gm-1021) significantly outyielded the two check hybrids SC-155 and SC-3084. Based on combined data, six single crosses (line-13, 9, 14 and 1 x Gm-1021) and (line-8 and 9 x Gm-1002) significantly outyielded the best check hybrid SC-3084 by 23.47, 21.64, 19.75, 14.50, 13.66 and 9.45%, respectively. Concerning the 3-way crosses, at Gemmeiza, four crosses (line-1, 3, 20 and 22 x SC-155) significantly outyielded the check hybrid TWC-352. At Mallawy, nine 3-way crosses significantly outyielded the check hybrid TWC-352. The best crosses were line-7, 1, 25, 17 and 20 x SC-155 which accounted 5.74, 5.67, 5.51, 5.46 and 5.45 kg plot^{-1}, respectively. The combined results of the 3-way crosses showed that 16 crosses significantly outyielded the check hybrid TWC-352. The best 3-way crosses were line-1, 20, 3, 7, 22 and 25 x SC-155. These 3-way crosses outyielded the check hybrid TWC-352 by 43.10, 36.19, 34.05, 32.14, 28.57 and 28.33%, respectively. These 3-way crosses also significantly surpassed the two check hybrids SC-3084 and SC-155. Similar results were obtained by Worku *et al.* (1996) they found that the best cross outyielded the check hybrids BH-140 and Beletech by 25.3 and 51.9%, respectively. Generally, the best 10 crosses, namely; (line-1 x Gm-1021), (line-9 x Gm-1021), (line-8 x Gm-1002), (line-13 x Gm1021), (line-1 x SC-155), (line-7 x SC-155), (line-13 x SC-155), (line-20 x SC-155), (line-22 x SC-155) and (line-25 x SC-155), which outyielded the checks over the two locations for yield/plot.

General Combining Ability Effects (GCA).

Estimates of general combining ability effects at the two locations and their combined for 26 inbred lines and 3 testers for grain yield and the other studied traits are presented in Table 6. For days to 50% silking, results indicated that the GCA effects of inbred lines No. 15, 16 and 23 were negative and significant or highly significant at Mallawy, Gemmeiza and their combined. These inbred lines were considered the best combiners for earliness. The combined GCA of testers Gm-1002 and SC-155 were negative and had highly significant GCA effects, but with the tester Gm-1021 it was positive and highly significant, indicating that the two testers; Gm-1002 and SC-155 were good combiners for earliness, while Gm-1021 was good combiner for the lateness.

For ear length, eight inbred lines (No. 1, 3, 7 and 11,) had positive and significant or highly

significant GCA effects at Gemmeiza, Mallawy and their combined, indicating that they have favorable genes and are good combiners for ear length. For testers, the inbred line Gm-1021 had positive and highly significant at the two locations and their combined, while the tester inbred line Gm-1002 had negative and highly significant GCA effects at Gemmeiza and over the two locations, but it was insignificantly negative at Mallawy. The tester Gm-1021 was considered as a good combiner for ear length.

For no. of rows/ear, the results showed that four inbred lines (No. 14, 17 and 20) possessed positive and significant or highly significant GCA estimates at the two locations and their combined. In these respect, these three inbred lines may have favorable genes and are considered as good combiners for number of rows/ear. Results indicated that the tester inbred line Gm-1002 had positive GCA effects at Mallawy as well as the combined over locations. On the other hand, the GCA effects of the tester Gm-1021 were negative at the two locations and their combined. The GCA of the testers SC-155 was positive and significant at Gemmeiza.

For no. of kernels/row data in Table 6 showed that two inbred lines; No.7 and 23 had positive and significant or highly significant GCA estimates at

Gemmeiza, Mallawy and their combined, indicating that theses lines could be considered as good combiners for developing hybrids with high no. of kernels/row. The tester-inbred line Gm-1021 had positive and highly significant, while the other tester SC-155 possessed positive but insignificant GCA effects, whereas, the GCA effects of the inbred line tester Gm-1002 were negative and highly significant. This is true at Gemmeiza and Mallawy as well as their combined. These results indicated that the tester inbred line Gm-1021 could be considered as the best combiner for no. of kernels/row.

For no. of kernels/row data in Table 6 showed that two inbred lines; No.7 and 23 had positive and significant or highly significant GCA estimates at Gemmeiza, Mallawy and their combined, indicating that theses lines could be considered as good combiners for developing hybrids with high no. of kernels/row. The tester-inbred line Gm-1021 had positive and highly significant, while the other tester SC-155 possessed positive but insignificant GCA effects, whereas, the GCA effects of the inbred line tester Gm-1002 were negative and highly significant. This is true at Gemmeiza and Mallawy as well as their combined. These results indicated that the tester inbred line Gm-1021 could be considered as the best combiner for no. of kernels/row

EL-Hifny et. al. 2010

For 100-kernel weight, the inbred lines No.6, 7, 11 and 12 had positive and significant or highly significant GCA effects at the two locations and their combined and were considered as the best combiners for heavy kernel weight. The results showed that the tester inbred line Gm-1002 had positive and significant effects only at Mallawy. The tester inbred line Gm-1021 had positive and significant GCA effects only at Gemmeiza. There were no stable trends for GCA effects of the testers at different locations and their combined. It might be due to the role of environmental conditions.

For grain yield/plot, seven inbred lines (No.1, 9, 3, 8, 13, 7 and 20) at Gemmeiza had positive and significant GCA effects. On the other side, four inbred lines (No.9, 3, 1 and 20) at Mallawy had positive and significant GCA effects. The combined estimates showed that seven inbred lines (No.1, 9, 3, 7, 8, 20 and 13) possessed positive and significant GCA effects. These lines were considered as good combiners for yield over all locations. The inbred lines No.1, 3, 9 and 20 had positive and significant GCA effects at the two locations and their combined, indicating that they have favorable genes and are the best combiners for grain yield. The tester inbred line Gm-1002 had negative and significant GCA effects, while the tester Gm-1021 was positive and highly significant at Gemmeiza and over combined locations and the tester SC-155 had positive and highly significant at Mallawy and their combined. These results indicated that the testers, inbred line Gm-1021and SC-155 could be considered as good combiners for grain yield.

Specific combining ability effects (SCA).

Estimates of specific combining ability effects (SCA) for days to 50% silking (Table 7) showed that the topcross (line-20 x Gm-1021), and had negative SCA effects at Gemmeiza, Mallawy and its combined.

Concerning the SCA effects for ear length (Table 7), the topcrosses line-19 x Gm-1002, line-14 x SC-155, line-24 x Gm-1002, line-8 x Gm-1002, line-3 x Gm-1021, line-4 x SC-155, line-6 x Gm-1021 and line-5 x Gm-1021 had positive and significant SCA effects at Gemmeiza. At Mallawy, the best topcrosses were line-15 x Gm-1021, line-7 x SC-155, line-6 x Gm-1002, line-4 x Gm-1021 and line-24 x SC-155 which had insignificant positive SCA effects values. The combined SCA effects of the topcrosses line-19 x Gm-1002, line-14 x SC-155, line-3 x Gm-1021, line-5 x Gm-1021 and line-20 x Gm-1002 were positive and significant. These crosses were considered as good combinations for this trait.

EL-Hifny et. al. 2010

EL-Hifny et. al. 2010

Respect to no. of rows/ear (Table 7), SCA effects of the topcrosses; (line-17 x Gm-1021) and (line-14 x SC-155) had positive and significant effects at Gemmeiza. At Mallawy, the topcrosses; (line-1 x Gm-1021), (line-9 x SC-155) and (line-22 x Gm-1021) exhibited positive and significant SCA effects. In their combined, the SCA effect was positive and significant for the top cross (line-9 x SC-155).

For no. of kernels/row, data in Table 8 showed that, eight topcrosses (line-24 x Gm-1002), (line-11 x SC-155), (line-19 x Gm-1002), (line-8 x Gm-1002), (line-5 x Gm-1021), (line-1 x Gm-1021), (line-4 x SC-155) and (line-25 x Gm-1021) had positive and significant or highly significant at Gemmeiza. At Mallawy, the topcrosses (line-11 x Gm-1021), (line-23 x SC-155), (line-7 x SC-155), (line-26 x Gm-1002), (line-25 x Gm-1021) and (line-14 x Gm-1021) exhibited positive and significant or highly significant SCA estimates. The combined data showed that the best topcrosses, which had positive and highly significant SCA effects were (line-25 x Gm-1021), (line-24 x Gm-1002), (line-23 x SC-155) and (line-19 x Gm-1002). These crosses may be considered as the best combinations for no. of kernels/row.

Regarding 100-kernel weight (Table 8), SCA effects were positive and significant for the topcrosses line-7, 21, and 22 x SC-155 for 100-kernel weight at Gemmeiza. At Mallawy, the

crosses (line-24 x SC-155) and (line-2 x Gm-1002) had positive and significant SCA effects. Moreover, from their combined the topcross (line-23 x SC-155) only had positive and significant SCA effect.

Regarding 100-kernel weight (Table 8), SCA effects were positive and significant for the topcrosses line-7, 21, and 22 x SC-155 for 100-kernel weight at Gemmeiza. At Mallawy, the crosses (line-24 x SC-155) and (line-2 x Gm-1002) had positive and significant SCA effects. Moreover, from their combined the topcross (line-23 x SC-155) only had positive and significant SCA effect.

Estimates of SCA effects for grain yield/plot (Table 8) showed that, the topcrosses (line-8, 15 and 21 x Gm-1002), (line-13, 14, and 19 x Gm-1021) and (line-1, 20 and 25 x SC-155) had the highest positive values of SCA effects at Gemmeiza. At Mallawy, the topcrosses (line-13 and 24 x Gm-1021) had positive and significant SCA effects.

Based on the combined data, the topcrosses (line-13 x Gm-1021), (line-14 x Gm-1021), (line-8 x Gm-1002), (line-15 x Gm-1002), (line-25 x SC-155), (line-19 x Gm-1021), (line-1 x SC-155), (line-20 x SC-155) and (line-21 x Gm-1002) possessed the highest SCA estimates of 0.71, 0.64, 0.60, 0.55, 0.52, 0.51, 0.48, 0.44 and 0.42 values, respectively. It is clear that the topcross (line-13 x Gm-1021) had positive and significant SCA

estimate at the two locations and their combined data, which may be attributed to its broader adaptability compared to other genotypes.

Most of our results are in agreement with those obtained by Worku *et al.* (1996), Soliman and Sadek (1999). They found positive and significant GCA effects for inbred lines and significant SCA effects for the crosses for grain yield. Bujak *et al.* (2006) found significant general combining ability effects (GCA) for plant height, ear length, number of rows per ear, and number of kernels per ear. Specific combining ability effects were significant for number of kernels per ear. GCA effects for testers were also significant in the case of ear length, number of rows per ear and seed weight per ear.

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القدرة على التآلف وطرز الفعل الجينى فى الذرة الشامية الصفراء

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تم إجراء التهجين القمى بين 26 سلالة مرباة داخليا مع ثلاث كشافات وهى السلالة النقية جميزة 1002 والسلالة النقية جميزة 1021 والهجين الفردى 155 فى محطة البحوث الزراعية بملوى فى موسم 2005 للحصول على 78 هجين قمى. تم تقيم 52 هجين فردى و 26 هجين ثلاثى مع ثلاثة هجن مقارنة هجين فردى 155 وهجين فردى بيونير 3084 والهجين الثلاثى 352 فى محطتي البحوث الزراعية بالجميزة وملوي لصفات عدد الأيام حتى ظهور 50% من الحراير و طول الكوز وعدد الصفوف فى الكوز وعدد الحبوب فى الصف ووزن 100 حبة ومحصول القطعة. اظهر تحليل التباين المشترك أن متوسطات مربعات الاختلافات كانت معنوية أو عالية المعنوية فى الهجن والسلالات والكشافات ما عدا صفة عدد الصفوف فى الكوز بالنسبة للكشافات والتفاعل بين السلالات والكشافات. كذلك أظهرت التفاعلات بين كلا من الهجن والسلالات والكشافات مع المواقع اختلافات معنوية أو عالية المعنوية فى الصفات المدروسة ما عدا صفة عدد الصفوف فى الكوز بالنسبة للهجن فى المواقع ومحصول القطعة بالنسبة للسلالات فى المواقع وعدد الصفوف فى الكوز ووزن-100 حبة بالنسبة للكشافات فى المواقع. اظهر التفاعل بين السلالات والكشافات والمواقع اختلافات عالية المعنوية لصفات طول الكوز وعدد الحبوب فى الصف.

اظهر التحليل المشترك لمكونات التباين أن القدرة العامة على الائتلاف للسلالات كان اكبر التباين الناتج عن اختلاف الكشافات بالنسبة لكل الصفات المدروسة ماعدا محصول القطعة. وهذا يشير إلى أن معظم تباين القدرة العامة للائتلاف ناتج عن السلالات. كانت النسبة بين التباين المضيف والسيادى اقل من الوحدة فى صفات عدد الحبوب فى الصف ومحصول القطعة. تشير هذه النتائج إلى أن الفعل الجينى السيادى يتحكم فى توريث تلك الصفات. ومن ناحية أخرى كانت النسبة بين التباين المضيف والسيادى اكبر من الوحدة بالنسبة لصفات عدد الأيام حتى ظهور 50% من الحراير وطول الكوز ووزن-100 حبة مما يشير إلى أن هذه الصفات يتحكم فى توريثها فعل الجين المضيف. بالنسبة لمتوسط محصول القطعة فقد اظهر التحليل المشترك أن هناك 6 هجن فردية (السلالة 13و9و14و1 * جميزة 1021) و (السلالة 9و8*جميزة1002) تفوقوا معنويا عن هجين المقارنة بيونير 3084 بمقدار 23.47و 21.64و 19.75و 14.50و 13.66و 9.45% على الترتيب. أما أفضل الهجن الثلاثية فكانت (السلالة 1و20و3و7و22و25*الهجين الفردى 155). تفوقت هذه الهجن عن الهجين الثلاثى بمقدار 43.10و 36.19 و34.05و 32.14و 28.57و 28.33 على الترتيب.

بالنسبة إلى تأثيرات القدرة العامة على التالف كانت السلالات 1و10و13و14و16 أفضل السلالات بالنسبة لصفة التبكير أما السلالات

1و3و7و11 كانت أفضل السلالات بالنسبة لصفة طول الكوز. كانت السلالات 8و10و14و17و20و24 بالنسبة لعدد الصفوف فى الكوز بينما كانت السلالات 6و7و11و12 أفضل السلالات بالنسبة لصفة وزن 100-حبة. أما بالنسبة للمحصول فكانت السلالات رقم 1و9و3و7و8و20و13 من أفضل السلالات على مستوى الموقعين حيث أعطت قدرة عامة موجبة ومعنوية. إما بالنسبة لتأثيرات القدرة الخاصة على التالف فانه كانت هناك 4و5و1و4 هجن ذات قيمة عالية ومعنوية بالنسبة لصفات التبكير و طول الكوز و عدد الصفوف فى الكوز وعدد الحبوب فى الصف ووزن-100 حبة على التوالى.أما بالنسبة لصفة المحصول فإن أفضل قيمة تم الحصول عليها من الهجن القمية (السلالة 13*جميزة 1002) و (السلالة 14* جميز 1021) و (السلالة 8* جميزة 1002) و (السلالة 15* جميزة 1002) و (السلالة 25* الهجين الفردى 155) و (السلالة 19* جميزة 1021) و (السلالة 1 * الهجين الفردى 155) و (السلالة 20* الهجين الفردى 155) و (السلالة 21* جميزة 1002).